Macrothink Institute™

International Journal of Social Science Research
ISSN 2327-5510
2025, Vol. 13, No. 3

Organisational Culture as a Mediator of 5G Implementation Success at Abu Dhabi National Oil Company

Mohamed Ali Suwaid Saeed Alshamsi
Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia, Malaysia

Norliana Sarpin (Corresponding author)
Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia, Malaysia
E-mail: norliana@uthm.edu.my

Received: August 23, 2025 Accepted: Nov. 2, 2025 Published: Nov. 11, 2025
doi:10.5296/ijssr.v13i3.23331 URL: https://doi.org/10.5296/ijssr.v13i3.23331

Abstract

As digital transformation accelerates across industries, the successful implementation of emerging technologies increasingly depends on underlying organisational culture. This study examines the mediating role of Organisational Culture in the relationship between Higher-Order Critical Success Factors and the successful implementation of 5G technology (S5G) within the Abu Dhabi National Oil Company (ADNOC). A theoretical framework was developed from existing literature, positioning OC as a mediating construct between influential factors and 5G implementation success. The framework was empirically validated using data from 382 ADNOC employees via a structured questionnaire. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed in SmartPLS to assess the measurement and structural models. The measurement model demonstrated adequate construct reliability, convergent validity, and discriminant validity using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The structural model indicated strong explanatory power, with R^2 values of 0.580 for OC and 0.629 for S5G. Bootstrapping analysis confirmed the significance of all hypothesised relationships. Notably, the indirect effect of CSFs on S5G through OC was significant ($p = 0.002$), confirming that OC partially mediates this relationship. Predictive relevance was supported by Q^2 values exceeding threshold levels, based on blindfolding procedures using Cross-Validated Communality (CCVC) and Cross-Validated Redundancy (CCVR). The validated framework provides practical guidance for decision-makers at ADNOC and similar organisations, enabling them to diagnose internal cultural readiness, align leadership strategies, and prioritise high-impact success factors for effective 5G integration across supply chain operations. These findings underscore the critical role of organisational culture in enabling digital transformation and offer strategic insights for large-scale enterprise technology adoption.

Keywords: 5G Implementation, Organisational Culture, Adoption Success Factors

1. Introduction

The implementation of fifth-generation (5G) technology represents a significant milestone in digital transformation across industries, enabling ultra-fast connectivity, low latency, and real-time data exchange. Numerous studies have investigated the technological achievements and performance benefits of 5G. For instance, Dangi et al. (2021) highlight high-speed, ubiquitous internet capabilities powered by innovations such as beamforming and massive MIMO. Patil et al. (2012) explore the evolution of 5G beyond 4G, focusing on standardisation and technological challenges. Similarly, Adebusola et al. (2020) examine the progression of wireless communication, underscoring enhancements in speed, capacity, and latency, while Gohil et al. (2013) emphasise the integration of multiple wireless technologies for consumer-centric outcomes. Shukurillaevich et al. (2019) further discuss the transition from 1G to 4G and recent research advances in 5G, and Pierucci (2015) investigates Quality of Experience (QoE) optimisation through neural network techniques. In the context of smart cities, El-Shorbagy (2021) highlights 5G's potential to improve urban design and connectivity.

While the technological enablers of 5G are well-documented, successful implementation extends beyond infrastructure, it is also shaped by the internal dynamics of adopting organisations. Organisational culture plays a mediating role in how advanced technologies like 5G are perceived, adopted, and embedded into daily operations. Walter (2021) notes that flexible, agile cultures are more receptive to digital transformation, and Shen (2019) emphasises the role of visionary leadership in supporting such transitions. A culture that fosters continuous learning, open communication, collaboration, and adaptability accelerates innovation and enhances organisational readiness. Javaid et al. (2024) argue that forward-thinking leadership and customer-centric practices are essential to effective 5G adoption.

From a functional perspective, 5G offers immense benefits, including high-speed connectivity for real-time data applications such as predictive maintenance, smart sensors, and automated systems (Oughton & Frias, 2018). Enhanced network efficiency also contributes to service reliability and congestion management, even in remote and high-demand environments (Prasad, Hossain, & Bhargava, 2017). Khan et al. (2019) illustrate how 5G supports critical services in emergency response, utilities, and logistics, while Ahmad et al. (2024) highlight its broader contribution to economic growth and job creation.

Despite these benefits, several barriers to implementation remain. Technical challenges such as mmWave spectrum utilisation, infrastructure limitations, and policy constraints are well-documented (Taheribakhsh et al., 2020). Moreover, Peraković et al. (2020) recommend aligning 5G implementation with Industry 4.0 principles to enhance automation and ecosystem collaboration. Ionescu et al. (2021) emphasise the importance of economic preparedness in adopting 5G, while Rao and Prasad (2018) stress its relevance to urban infrastructure and IoT development. Sah, Bindle, and Gulati (2022) focus on performance dimensions such as ultra-reliable low latency communication (URLLC), massive machine-type communications (mMTC), and enhanced mobile broadband (eMBB). In addition, Marabissi et al. (2018) provide empirical insights into the socio-economic impacts of 5G from smart city field trials.

The oil and gas sector, particularly companies like the Abu Dhabi National Oil Company (ADNOC), faces unique challenges in adopting 5G. Studies have shown that supply chains in this sector are vulnerable to disruptions due to regulatory complexity, fluctuating market dynamics, and logistical inefficiencies. Al-Jadir (2021) highlights 5G's role in enhancing upstream and downstream processes through real-time data, predictive maintenance, and automation. Dolgui and Ivanov (2022) point out that 5G supports supply chain resilience by improving visibility, scenario planning, and control mechanisms. Ericsson (2023) further notes that robust data management and sustainable practices made possible by 5G help reduce carbon footprints and improve compliance with safety standards.

Specific to ADNOC, studies reveal persistent issues in procurement processes, stakeholder coordination, and technology adoption. AlQubaisi, Emran, and Sam (2022) identify bottlenecks such as supply delays, inefficient workers, and outdated procurement methods. Mohamed (2023) notes a lack of supply chain visibility, limited stakeholder engagement, and resistance to technological change. Addressing these barriers requires not only advanced infrastructure but also a strong organisational culture that values innovation, collaboration, and continuous improvement.

Despite extensive literature on 5G enablers and technical implementation, there remains a gap in understanding how organisational culture mediates the relationship between implementation factors and 5G success particularly in complex, resource-intensive environments like ADNOC. This study aims to fill that gap by investigating the mediating role of organisational culture in the adoption of 5G technologies within ADNOC's supply chain. By establishing a framework, the study seeks to explain how organisational culture mediates the relationship between key influential factors and the successful implementation of 5G technology.

2. Literature Review

This section presents a review of existing literature pertinent to the study titled Organisational Culture as a Mediator of 5G Implementation Success at Abu Dhabi National Oil Company (ADNOC). The review is organized around three thematic areas: (1) influential factors affecting the implementation of 5G technology, (2) key attributes that define successful 5G deployment, and (3) the mediating role of organisational culture in facilitating 5G adoption. Together, these themes form the conceptual foundation for examining how internal organisational dynamics and external operational factors collectively influence the effectiveness of 5G implementation within a complex, innovation-led organisation such as ADNOC.

2.1 Influential Factors (Enablers) on Successful 5G Implementation

The implementation of 5G in supply chain management is shaped by a multi-dimensional set of influential factors encompassing technological, economic, operational, organizational, and regulatory domains. These factors operate synergistically rather than independently, collectively determining the extent to which 5G applications can be successfully planned, deployed, and sustained in increasingly complex logistics environments.

Technological readiness is foundational, with critical enablers including spectrum availability, infrastructure development, system integration, and network compatibility. Adequate and regulated radio frequency spectrum—particularly in mid-band and millimeter-wave ranges—ensures reliable, high-speed communication and broad device connectivity (Gavrilovska et al., 2016; Banda et al., 2022). However, many supply chains are still underpinned by fragmented or legacy IT systems, which necessitates the development of middleware and standardized protocols for seamless integration (Shah et al., 2020; Mustafa et al., 2015). Supporting infrastructure such as dense small cell deployments, edge computing, and data centers further enables real-time analytics and ultra-reliable low-latency communications (Gundall et al., 2018; Iannacci & Poor, 2022). Effective data management systems, equipped with AI and machine learning capabilities, are essential to analyze the large volumes of real-time data generated, enhancing visibility and forecasting across the supply chain (Neway, 2024; Otlyvanska et al., 2023).

From an economic perspective, the financial burden of 5G deployment remains a significant barrier, especially considering costs related to spectrum acquisition, infrastructure upgrades, and rural deployment (Lee & Yu, 2022; PEDRON & MAFFEZZOLI, 2018). Ensuring a positive return on investment is critical for stakeholders, particularly in developing contexts where investment risk is higher (Olofsgård & Göransson, 2022). To mitigate this, government-led incentives, infrastructure-sharing models, and flexible service pricing tailored to industry-specific applications have been proposed (Jassim et al., 2024; Borgaonkar & Jaatun, 2019).

Operational factors include workforce preparedness, supply chain reconfiguration, and organizational readiness. A skilled workforce is essential for managing 5G-enabled tools and processes, requiring continuous training in IoT, AI, and cybersecurity domains (Gundall et al., 2018; Mustafa et al., 2015). Simultaneously, the restructuring of logistics workflows is necessary to leverage 5G's capabilities in real-time automation, adaptive logistics, and predictive analytics (Neway, 2024). Security concerns must also be addressed, as 5G networks expand the cyberattack surface. Multi-layered security measures ranging from zero-trust frameworks to EDR solutions are essential to protect sensitive supply chain data and foster trust in digital infrastructure (Borgaonkar & Jaatun, 2019; Iannacci & Poor, 2022).

Organizational culture plays a mediating role in how 5G technologies are perceived and adopted internally. Cultures that emphasize innovation, adaptability, and open communication are more likely to succeed in deploying advanced technologies (Otlyvanska et al., 2023). Conversely, rigid or siloed cultures may resist technological change, hindering adoption and effectiveness. Leadership engagement, employee empowerment, and transparent communication are crucial for creating a supportive environment for 5G transformation (Neway, 2024).

Finally, the regulatory environment serves as a macro-level enabler or constraint. Successful

5G deployment depends on coherent policies governing spectrum allocation, data privacy, cybersecurity, and network neutrality (Basaure & Finley, 2019; Lee & Yu, 2022). Regulatory clarity reduces legal uncertainties for suppliers and investors. Additionally, cross-sector collaboration involving regulators, industry stakeholders, and academia can promote standardization and align national priorities with global innovation trends (Pateromichelakis et al., 2018; Shah et al., 2020; PEDRON & MAFFEZZOLI, 2018).

2.2 Successful Attributes of 5G Implementation

There are various attributes that represent successful 5G implementation in the supply chain of the oil and gas industry. First, improved connectivity and speed: the successful rollout of 5G networks has transformed connectivity by providing unprecedented speeds and ultra-low latency. This innovation enables high-demand applications like real-time data monitoring, predictive maintenance, and IoT device management, resulting in enhanced operational efficiency and new commercial opportunities (Gavrilovska et al., 2016; Mustafa et al., 2015; Gundall et al., 2018).

Second, improved network efficiency: 5G networks have demonstrated greater efficiency in managing data traffic and network resources. This has led to more reliable and consistent service, reducing congestion and enhancing overall network performance, even in remote and densely populated oil and gas operation sites (Pateromichelakis et al., 2018; Shah et al., 2020; Banda et al., 2022).

Third, enhanced emergency response, transportation, and utilities: 5G has significantly improved these areas within the supply chain. High-speed connectivity and real-time data exchange have enhanced safety measures, enabled smarter infrastructure management, and streamlined the delivery of critical services such as remote monitoring and automated logistics (Otlyvanska et al., 2023; Borgaonkar & Jaatun, 2019; Iannacci & Poor, 2022).

Finally, the deployment of 5G technology has encouraged innovation and economic growth within the oil and gas industry by creating new markets and job opportunities. Advancements in connectivity, data processing, and analytics have opened avenues for technological innovations and more efficient supply chain processes (Neway, 2024; Lee & Yu, 2022; Olofsgård & Göransson, 2022).

2.3 Organisational Culture for Successful 5G implementation

Assessing ADNOC’s readiness to adopt 5G technology requires an in-depth understanding of several interrelated organizational dimensions, primarily centered on organizational culture, leadership, technical capabilities, and ICT infrastructure. Organisational culture—comprising the shared values, beliefs, attitudes, systems, and norms within an institution—fundamentally shapes employee behaviour, innovation potential, and adaptability to technological change (Otlyvanska et al., 2023; CEO Weekly, 2024). Culture manifests in various forms, clan, adhocracy, market, and hierarchy where each influencing the organization’s readiness for transformation. In the context of knowledge-driven environments like ADNOC, organisational culture is driven by principles of competence, commitment, contribution, and character, alongside six pillars: leadership, values, empowerment, development, growth, and communication (Neway, 2024).

Leadership support is a vital catalyst for cultivating a culture that embraces innovation and technological adoption. Evidence from both public and private sectors, including logistics and transport industries, underscores that servant leadership and transformational leadership styles contribute positively to organisational commitment and cultural maturity, both of which are necessary for seamless 5G integration (Shah et al., 2020; Lee & Yu, 2022; Otlyvanska et al., 2023). A well-aligned leadership vision helps bridge resistance to change, builds trust among employees, and promotes collaborative decision-making processes—conditions critical for 5G implementation success.

The influence of organizational culture extends to the ability to harness 5G capabilities in areas such as remote working, real-time data processing, intelligent automation, and high-quality virtual collaboration. Cultures that support decentralization, trust, and remote work arrangements are more likely to benefit from enhanced connectivity, improved employee satisfaction, and productivity (Olofsgård & Göransson, 2022; Borgaonkar & Jaatun, 2019). Furthermore, fostering a digital innovation mindset enables ADNOC to leverage 5G for business agility and improved supply chain visibility (Neway, 2024; Iannacci & Poor, 2022). Studies also suggest that the failure to align culture with technological innovation can lead to slow adoption and suboptimal outcomes (PEDRON & MAFFEZZOLI, 2018; Pateromichelakis et al., 2018). Therefore, a culture that embraces flexibility, learning, and customer centricity is essential to maximize the transformative potential of 5G. Agile organizational structures, effective project management, and inclusive stakeholder engagement are equally critical to support change and mitigate barriers during deployment. Ultimately, the success of 5G implementation in ADNOC hinges not only on technical infrastructure but also on an innovation-oriented culture empowered by strategic leadership, knowledge sharing, and continuous improvement (Gavrilovska et al., 2016; Gundall et al., 2018).

3. Establishing Theoretical Framework

A well-defined theoretical framework provides the foundation for research by bridging identified knowledge gaps with methodological direction (Zuber-Skerritt, Fletcher, Kearney 2015). This study constructs its framework to explore how organisational culture mediates the relationship between influential factors and the successful implementation of 5G technology within the Abu Dhabi National Oil Company (ADNOC). The framework is grounded in established theoretical perspectives namely, causal relationship theory and mediator theory that collectively articulate both direct and indirect pathways of influence.

Causal relationship theory posits that independent variables such as technological readiness, operational capabilities, economic viability, regulatory policies, and industry-specific dynamics can exert a direct influence on implementation outcomes (Peyrot, 1996; Mustafa et al., 2015; Gundall et al., 2018). In the context of 5G integration, these influential factors serve as enablers or constraints that shape deployment effectiveness and strategic alignment within supply chain operations (Banda et al., 2022; Gavrilovska et al., 2016).

However, mediator theory offers a more nuanced understanding by introducing a third variable, organisational culture that modifies the strength and direction of these causal relationships (Pardo & Román, 2013). Organisational culture encompasses the shared values, norms, and behavioural expectations that guide internal responses to technological change. A culture that fosters innovation, continuous learning, and adaptability can enhance the organisation's ability to translate enabling conditions into successful 5G outcomes (Neway, 2024; Otlyvanska et al., 2023).

Incorporating organisational culture as a mediating variable, the framework facilitates both theoretical and practical insights. It not only clarifies the mechanisms through which influential factors exert their effects but also informs the development of targeted interventions that can optimise technological transformation (Lee & Yu, 2022; Olofsgård & Göransson, 2022). Thus, the proposed framework provides a comprehensive lens through which to understand the interplay between organisational dynamics and technological advancement in the UAE oil and gas sector.

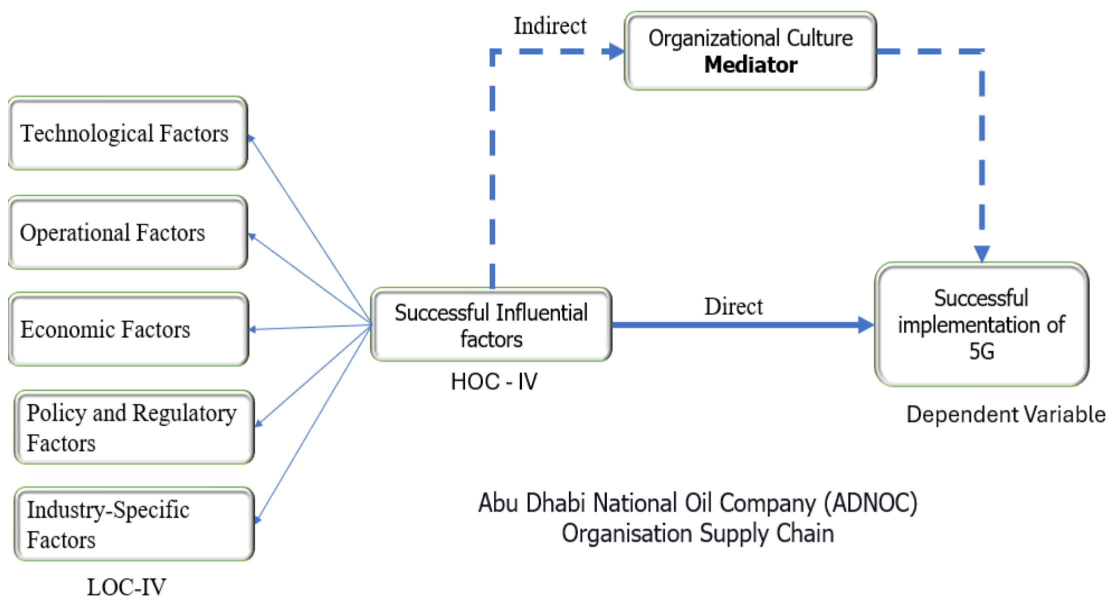

Figure 1. Theoretical Framework

As presented in Figure 1, the theoretical framework illustrates these relationships within ADNOC's organisational supply chain. It groups the independent variables into five lower-order constructs including technological, operational, economic, policy and regulatory, and industry-specific factors. These are collectively referred to as a higher-order construct representing successful influential factors. These factors influence 5G implementation success in two ways directly through their immediate impact and indirectly through the mediating role of organisational culture.

This model highlights that achieving successful 5G integration is not solely reliant on structural or external readiness but also significantly dependent on internal cultural dynamics. Organisational values, norms and practices can either enable or hinder technology adoption, making culture a central factor in realising the full potential of 5G innovations within the ADNOC context.

4. Modelling of Theoretical Framework

Before initiating the modelling process, data were collected through a structured questionnaire developed based on items derived from the conceptual framework. The instrument utilised a five-point Likert scale to assess respondents' levels of agreement with various statements representing the study constructs. The target population comprised employees of the Abu Dhabi National Oil Company (ADNOC) involved in the implementation of 5G applications, with an estimated total workforce of approximately 10,000, according to the Department of Human Resources. A sample of 382 participants was selected using a convenience non-probability sampling method, chosen for its practicality in accessing respondents who were available and willing to participate. The collected data were subsequently analysed using SmartPLS software to validate the proposed conceptual framework.

Following data collection, the modelling process was conducted using the SmartPLS software, which is well-suited for analysing complex structural equation models, especially with smaller sample sizes and non-normal data distributions. The analysis proceeded in two main stages: the assessment of the measurement model and the structural model.

4.1 Measurement Model Evaluation

The measurement model evaluation was conducted using the PLS Algorithm in SmartPLS to assess the psychometric properties of the constructs included in the study. This evaluation focuses on two primary dimensions: construct reliability and validity and discriminant validity. Construct reliability and validity examine whether the indicators consistently and accurately measure the latent constructs. This includes assessing internal consistency (using Cronbach's alpha and composite reliability) and convergent validity (using Average Variance Extracted, or AVE). Discriminant validity, on the other hand, determines the extent to which a construct is truly distinct from other constructs in the model, ensuring that there is no significant overlap among theoretically different concepts.

The measurement model demonstrated acceptable levels for all key metrics, affirming the robustness of the instrument used. Detailed results of the reliability, convergent validity, and discriminant validity are presented in the subsequent sections. A graphical representation of the full measurement model is illustrated in Figure 2, which visualizes the relationships between latent constructs and their observed indicators.

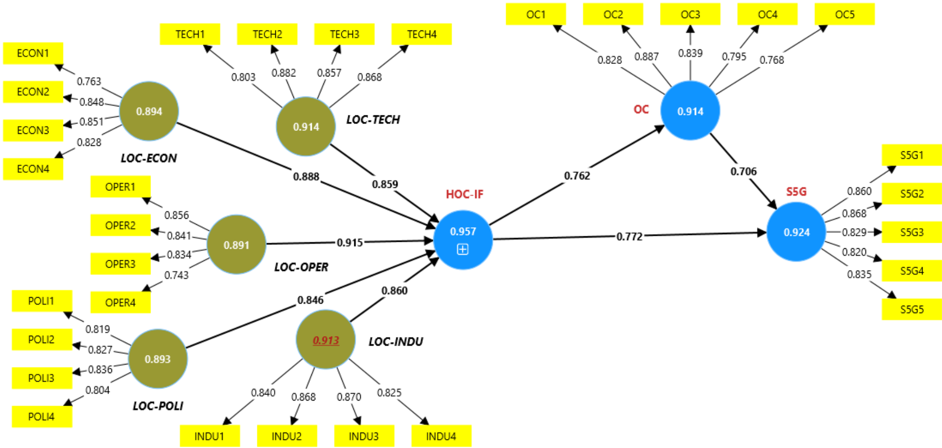

Figure 2. Model after conducting PLS Algorithm

4.1.1 Construct Reliability and Validity

Construct reliability and validity were evaluated following the execution of the PLS Algorithm in SmartPLS. Two key measures were used: composite reliability (CR) to assess internal consistency and Average Variance Extracted (AVE) to determine convergent validity. The results, as summarized in Table 1, indicate that all constructs exceeded the recommended threshold values for both CR and AVE, thus meeting established psychometric standards (Hair et al., 2017; Memon et al., 2021).

All constructs achieved Cronbach's alpha values ranging from 0.836 to 0.953, well above the minimum threshold of 0.70, indicating strong internal consistency and reliability of the measurement items (Hair et al., 2019). In terms of convergent validity, the AVE values for all constructs were greater than the required minimum of 0.50. This suggests that the constructs captured a substantial portion of the variance from their observed indicators (Sarstedt et al., 2020). Specifically, AVE values ranged from 0.530 for the higher-order construct Influential Factors (HOC-IF) to 0.727 for the lower-order construct Technology Factors (LOC-TECH).

Table 1. Results of Construct Reliability and validity

Constructs	Cronbach's alpha	Average variance extracted (AVE)
HOC-IF	0.953	0.530
LOC-ECON	0.841	0.678
LOC-INDU	0.873	0.724
LOC-OPER	0.836	0.672
LOC-POLI	0.839	0.675
LOC-TECH	0.875	0.727
OC	0.881	0.680
S5G	0.898	0.709

Overall, the findings confirm that the measurement model demonstrates high levels of reliability and convergent validity, ensuring that the latent constructs are measured accurately and consistently. This strengthens the foundation for subsequent structural model evaluation and hypothesis testing.

4.1.2 Discriminant Validity

Discriminant validity was evaluated using two widely recommended approaches: the Heterotrait-Monotrait (HTMT) ratio and the Fornell-Larcker criterion, both applied following the execution of the PLS Algorithm in SmartPLS (Henseler, Ringle, & Sarstedt, 2015; Hair et al., 2017). These techniques ensure that each construct in the model is empirically distinct from the others, which is essential for validating the structural relationships.

Table 2. Heterotrait-Monotrait (HTMT) ratio

	HOC-IF	**LOC-ECON**	**LOC-INDU**	**LOC-OPER**	**LOC-POLI**	**LOC-TECH**	**OC**	**S5G**
HOC-IF								
LOC-ECON	0.894							
LOC-INDU	0.835	0.789						
LOC-OPER	0.899	0.859	0.848					
LOC-POLI	0.879	0.773	0.785	0.723				
LOC-TECH	0.896	0.878	0.736	0.841	0.717			
OC	0.830	0.728	0.800	0.769	0.803	0.732		
S5G	0.829	0.751	0.898	0.779	0.729	0.663	0.792	

Table 2 displays the HTMT values for all constructs. Most values fall below the conservative threshold of 0.90, thereby confirming sufficient discriminant validity across constructs. A few values approach the threshold for example, the relationships between HOC-IF and LOC-ECON (0.894), HOC-IF and LOC-OPER (0.899), and S5G and LOC-INDU (0.898). These elevated values are justifiable given the conceptual proximity between the higher-order construct (HOC-IF) and its associated lower-order components (LOCs). Despite their closeness, all values remain within the acceptable range, affirming that each construct maintains distinct measurement properties (Memon et al., 2021; Sarstedt et al., 2020).

In line with best practices for higher-order construct modelling, only the higher-order construct (HOC-IF) and its external relations with Organisational Culture (OC) and Successful 5G Implementation (S5G) were retained for the Fornell-Larcker analysis (Hair et al., 2019). Table 3 confirms that the square roots of AVE values for all three constructs exceed their respective inter-construct correlations, thereby satisfying the Fornell-Larcker criterion.

Table 3. Fornell-Larcker criterion

	HOC-IF	OC	S5G
HOC-IF	0.762		
OC	0.728	0.824	
S5G	0.772	0.706	0.842

Despite a moderately high correlation between HOC-IF and S5G (0.772), the diagonal AVE values are consistently higher than off-diagonal correlations, confirming discriminant validity between all constructs. These findings reinforce the construct validity of the measurement model and support the empirical distinction between dimensions, particularly between the formative second-order construct (HOC-IF) and the endogenous outcome variables (OC and S5G) (Zeng et al., 2021; Aburumman et al., 2022).

4.2 Structural Model Evaluation

The structural model was evaluated using three core procedures within the SmartPLS environment: (1) the PLS Algorithm, which examines the model's explanatory power through R^2 and f^2 values; (2) the bootstrapping procedure, which tests the statistical significance of hypothesised paths via t-values and p-values; and (3) the blindfolding procedure, which assesses the model's predictive relevance using Q^2 values. These techniques collectively provide a comprehensive evaluation of the model's structural validity. The PLS Algorithm identifies how well the exogenous constructs explain the variance in the endogenous constructs (Hair et al., 2019). Bootstrapping offers robust estimates for hypothesis testing by generating empirical confidence intervals through resampling (Sarstedt et al., 2020). Blindfolding assesses the model's predictive capability, ensuring that it not only explains relationships but can also reliably predict future outcomes (Aburumman et al., 2022; Memon et al., 2021). These procedures confirm the strength, reliability, and predictive utility of the hypothesised structural relationships, thereby reinforcing the robustness and empirical soundness of the proposed research framework.

4.2.1 Explanatory Power

The explanatory power of the structural model was evaluated using two primary metrics: the coefficient of determination (R^2) and the effect size (f^2), both derived using the PLS Algorithm in SmartPLS. These indicators provide insights into the model's capability to explain and predict variance in the dependent constructs (Hair et al., 2019; Sarstedt et al., 2020).

The coefficient of determination (R^2) reflects the proportion of variance in each endogenous construct that can be attributed to its associated exogenous variables. According to established benchmarks, R^2 values of 0.25, 0.50, and 0.75 are interpreted as indicating weak, moderate, and substantial explanatory power, respectively (Hair Jr. et al., 2017; Memon et al., 2021). As presented in Table 4, the R^2 value for Organisational Culture (OC), the mediating construct, is 0.580, demonstrating a moderate level of explanatory strength. The dependent construct, Successful 5G Implementation (S5G), has an R^2 value of 0.629, which also indicates a moderately strong explanation of variance. These results confirm that the model offers acceptable explanatory capacity for both outcome variables.

Table 4. R-square values of the model

Endogenous constructs	R-square
Mediator - OC	0.580
Dependent variable - S5G	0.629

In addition to R^2, the model's explanatory utility was further evaluated using the effect size (f^2), which assesses the contribution of each exogenous construct to the R^2 value of a specific endogenous variable. The f^2 metric is calculated by observing the change in R^2 when an individual predictor is included versus when it is excluded from the model (Cohen, 1988). Threshold values of 0.02, 0.15, and 0.35 are commonly used to classify small, medium, and large effects, respectively (Hair et al., 2019; Aburumman et al., 2022).

Table 5 illustrates the f^2 values for each hypothesized path in the model. The effect size of HOC-IF (Higher-Order Construct of Influential Factors) on Organisational Culture (OC) is exceptionally strong, with an f^2 value of 1.381, which far exceeds the benchmark for a large effect. Similarly, HOC-IF → S5G demonstrates a large effect ($f^2 = 0.352$), whereas the effect of OC → S5G is smaller, with an f^2 value of 0.090. These findings suggest that HOC-IF is the most dominant predictor within the structural model, exerting a substantial influence on both OC and S5G, while OC contributes more modestly to the implementation success of 5G technologies.

Table 5. f-square values of the model

	f-square
HOC-IF -> OC	1.381
HOC-IF -> S5G	0.352
OC -> S5G	0.090

Overall, the R^2 and f^2 analyses collectively reinforce the model's explanatory robustness and the significant role of influential factors in driving both organizational culture and the successful implementation of 5G technologies in the targeted environment.

4.2.2 Hypothesis Testing

Following the validation of the measurement model, the structural model was evaluated to test the hypothesised relationships among the constructs. This was performed using the bootstrapping procedure with 5,000 resamples in SmartPLS, a method recommended for assessing the statistical significance of path coefficients in variance-based structural equation modelling (Hair et al., 2019; Sarstedt et al., 2020). The analysis yielded path coefficients along with associated t-values and p-values, which were used to determine the strength, direction, and statistical relevance of each hypothesised relationship (Henseler et al., 2015; Cohen, 1988).

Bootstrapping in PLS-SEM is widely recognized for its robustness in testing mediation and moderation effects, as well as for evaluating both direct and indirect relationships in complex models (Memon et al., 2021; Aburumman et al., 2022). By resampling the data repeatedly, the procedure enhances the accuracy of standard error estimations, thus improving the reliability of hypothesis testing results. This step was essential in establishing the validity of the proposed structural relationships within the model framework as Figure 3.

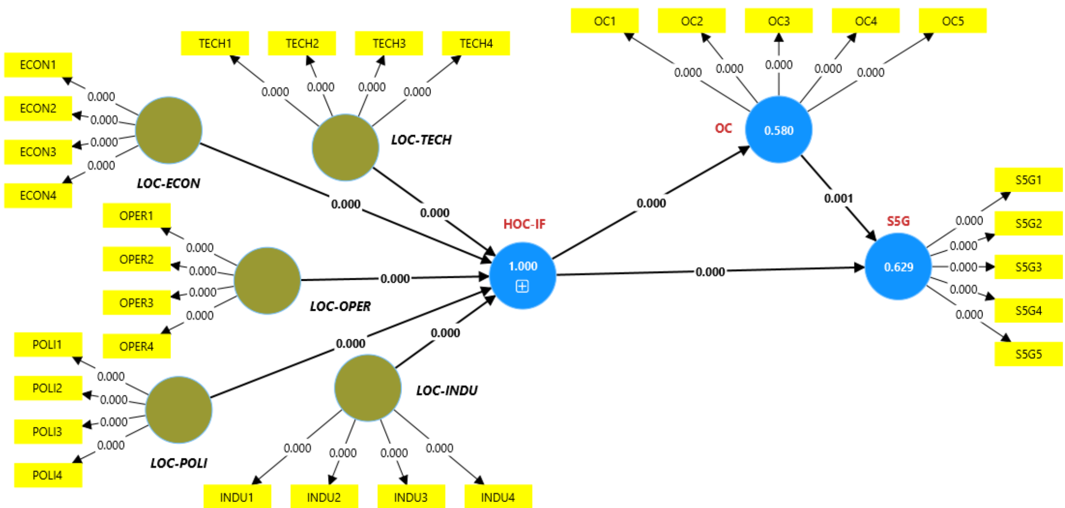

Figure 3. The model after bootstrapping procedure

The results of hypothesis testing from the bootstrapping procedure are presented in Table 6 for direct relationships and Table 6 for indirect relationships.

Table 6. Results of direct relationship

Direct relationship	Path strength	T statistics	P values
HOC-IF -> OC	0.762	17.117	0.000
HOC-IF -> S5G	0.558	6.801	0.000
OC -> S5G	0.282	3.238	0.001

Table 6 presents the direct effects assessed through the bootstrapping procedure in SmartPLS. The path from HOC-IF (Higher-Order Influential Factors) to Organizational Culture (OC) yielded a path coefficient of 0.762 with a t-value of 17.117 and p-value < 0.001, indicating a strong and statistically significant relationship. This suggests that the collective influence of technological, economic, operational, political, and industrial factors significantly shapes the internal culture of organizations during 5G implementation initiatives. Similarly, HOC-IF also demonstrated a significant and positive direct effect on Successful 5G Implementation (S5G) with a path coefficient of 0.558, a t-value of 6.801, and p-value < 0.001. This affirms that foundational infrastructural and contextual enablers directly influence the execution of 5G-related initiatives.

Finally, Organizational Culture (OC) was found to positively impact S5G (path coefficient = 0.282, t = 3.238, p = 0.001), supporting the hypothesis that internal cultural dynamics such as leadership, communication, and adaptability play a vital role in ensuring the success of advanced technological implementations. These relationships reinforce findings from past literature that highlight how external readiness factors must be internally supported by a conducive organizational environment for digital transformation efforts to succeed (Hair et al., 2019; Sarstedt et al., 2020; Zeng et al., 2021; Aburumman et al., 2022). The strength and significance of these paths indicate a well-specified model with practical implications for strategic 5G deployment planning in public and private sector organizations.

Table 7. Results of indirect relationship

Indirect relationship	**Original sample (O)**	**T statistics (|O/STDEV|)**	**P values**
HOC-IF -> OC -> S5G	0.214	3.066	0.002

As shown in Table 7, the indirect relationship between HOC-IF (Higher-Order Influential Factors) and Successful 5G Implementation (S5G), mediated by Organizational Culture (OC), was found to be statistically significant. The indirect effect has an original sample estimate of 0.214, a t-value of 3.066, and a p-value of 0.002, indicating that the mediation effect is both positive and significant at the 0.01 level. This result confirms that organizational culture acts as a partial mediator in the relationship between contextual enablers (technological, economic, operational, political, and industrial) and the successful implementation of 5G. It supports the notion that even when the external conditions are favorable, the presence of a strong and adaptive organizational culture is essential to fully realize the benefits of complex technological rollouts like 5G (Hair et al., 2019; Sarstedt et al., 2020; Aburumman et al., 2022).

The mediation path further aligns with previous empirical work emphasizing the importance of internal cultural readiness in mediating the success of strategic digital transformations (Zeng et al., 2021; Memon et al., 2021). Thus, for organizations to optimize the impact of influential external factors, they must cultivate values, leadership, communication, and adaptability conducive to innovation and technology absorption.

4.2.3 Predictive Relevance

Predictive relevance (Q^2) is assessed using the blindfolding procedure available in SmartPLS, a method designed to evaluate the model's capacity to accurately predict observed data points (Hair et al., 2019). Two forms of predictive relevance were employed: Cross-Validated Communality (CCVC) and Cross-Validated Redundancy (CCVR). CCVC determines how effectively the indicators of each construct can be predicted by their associated latent variable, while CCVR expands this scope by evaluating the structural model's ability to predict each construct's indicators, incorporating the effects of exogenous variables (Sarstedt et al., 2020; Aburumman et al., 2022). Figure 4 demonstrate the model after blindfolding procedure.

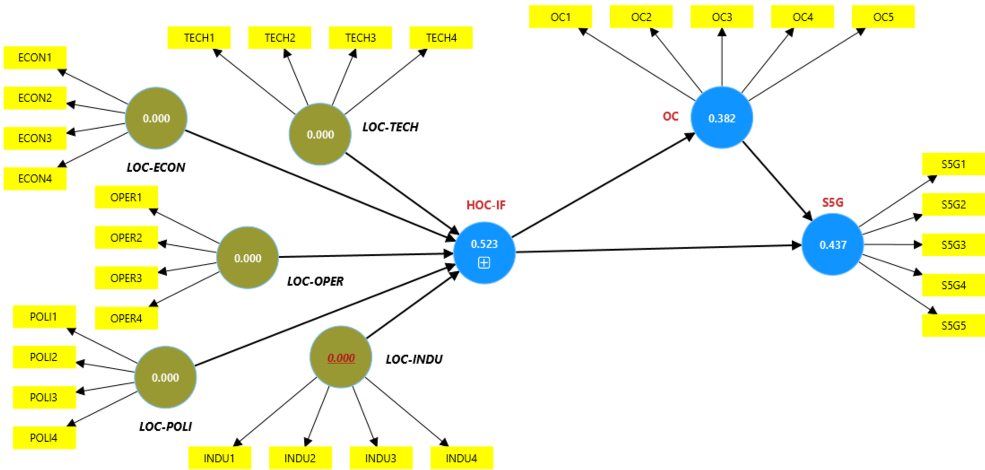

Figure 4. After Blindfolding procedure

The Cross-Validated Redundancy (CCVR) and Cross-Validated Communality (CCVC) values are extracted after the blindfolding procedure as in Tables 8 and 9.

Table 8. CCVR results

	SSO	SSE	Q^2 (=1-SSE/SSO)
HOC-IF	7960.000	3793.145	0.523
LOC-ECON	1592.000	1592.000	0.000
LOC-INDU	1592.000	1592.000	0.000
LOC-OPER	1592.000	1592.000	0.000
LOC-POLI	1592.000	1592.000	0.000
LOC-TECH	1592.000	1592.000	0.000
OC	1990.000	1229.102	0.382
S5G	1990.000	1120.626	0.437

Table 8 presents the Cross-Validated Redundancy (Q^2) values, obtained through the blindfolding procedure in SmartPLS, which is commonly used to evaluate the predictive relevance of structural models (Hair et al., 2019; Sarstedt et al., 2020). The Q^2 value is calculated using the formula $Q^2 = 1 - (SSE/SSO)$, where SSO denotes the sum of squared observations and SSE represents the sum of squared prediction errors (Aburumman et al., 2022).

The Q^2 values for HOC-IF (0.523), OC (0.382), and S5G (0.437) are all above zero, which aligns with the criterion that Q^2 values greater than zero indicate meaningful predictive relevance for endogenous constructs (Hair et al., 2017; Memon et al., 2021). Conversely, the lower-order constructs, LOC-ECON, LOC-INDU, LOC-OPER, LOC-POLI, and LOC-TECH, show Q^2 values of 0.000. This outcome is anticipated, as these constructs serve as formative components of the higher-order construct HOC-IF and are not modelled as dependent variables (Henseler et al., 2015). These findings confirm that the model possesses adequate predictive capability for its main outcome variables, consistent with best practices in PLS-SEM analysis (Zeng et al., 2021; Cohen, 1988).

Table 9. CCVC results

	SSO	SSE	Q^2 (=1-SSE/SSO)
HOC-IF	7960.000	4163.977	0.477
LOC-ECON	1592.000	863.271	0.458
LOC-INDU	1592.000	752.840	0.527
LOC-OPER	1592.000	879.891	0.447
LOC-POLI	1592.000	873.250	0.451
LOC-TECH	1592.000	738.564	0.536
OC	1990.000	971.930	0.512
S5G	1990.000	881.622	0.557

Table 9 presents the results of the Cross-Validated Communality (Q^2) values, which assess the predictive relevance of the measurement model using the blindfolding technique in SmartPLS (Hair et al., 2019; Memon et al., 2021). The Q^2 values are derived using the standard formula $Q^2 = 1 – (SSE / SSO)$, where SSO represents the sum of squared observations and SSE denotes the sum of squared prediction errors (Aburumman et al., 2022; Sarstedt et al., 2020).

All constructs reported Q^2 values significantly greater than zero, affirming that the model exhibits acceptable predictive relevance across both higher-order and lower-order constructs (Hair et al., 2017; Henseler et al., 2015). Among the results, S5G recorded the highest predictive relevance with a Q^2 value of 0.557, followed closely by LOC-TECH (0.536) and LOC-INDU (0.527). The higher-order construct HOC-IF also demonstrated strong predictive capability with a Q^2 of 0.477, while OC achieved a value of 0.512, further validating the predictive quality of the model. These findings indicate that the model is not only theoretically sound but also practically capable of predicting observed data patterns effectively, reinforcing its robustness and measurement reliability (Zeng et al., 2021; Cohen, 1988).

5. Conclusion

This study investigated the role of Organisational Culture (OC) as a mediator in the relationship between higher-order implementation factors (HOC-IF) and the success of 5G technology adoption (S5G) at the Abu Dhabi National Oil Company (ADNOC). The structural model was developed and tested using Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS based on data collected from relevant organisational stakeholders. The measurement model evaluation confirmed that all constructs demonstrated satisfactory construct reliability and validity, with Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) values exceeding recommended thresholds. Discriminant validity was also established through both the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio, ensuring that all constructs in the model are empirically distinct.

In the structural model, the results indicated strong explanatory power, with R^2 values of 0.580 for OC and 0.629 for S5G, suggesting that the model accounts for a substantial proportion of variance in these constructs. Hypothesis testing using the bootstrapping procedure with 5,000 resamples confirmed that all direct and indirect paths were statistically significant. Notably, the indirect path HOC-IF → OC → S5G was significant, with a t-value of 3.066 and p-value of 0.002, indicating that OC partially mediates the relationship between HOC-IF and S5G. Moreover, the model demonstrated strong predictive relevance, as evidenced by positive Q^2 values from blindfolding analysis in both Cross-Validated Redundancy (CCVR) and Cross-Validated Communality (CCVC) assessments. Constructs such as HOC-IF, OC, and S5G all showed Q^2 values above the threshold, reinforcing the model's predictive capability.

The findings emphasize the critical role of organisational culture in facilitating successful 5G implementation. The validated model provides both theoretical and practical insights, suggesting that enhancing internal cultural factors can significantly improve the effectiveness of technology integration efforts in large, innovation-driven organisations like ADNOC.

References

Aburumman, O. J., Omar, K., Al Shbail, M., & Aldoghan, M. (2022, March). *How to deal with the results of PLS-SEM* (pp. 1196–1206)? International conference on business and technology. Cham: Springer International Publishing.

Adebusola, J. A., Ariyo, A. A., Elisha, O. A., Olubunmi, A. M., & Julius, O. O. (2020, March). *An overview of 5G technology* (pp. 1–4). In 2020 international conference in mathematics, computer engineering and computer science (ICMCECS). IEEE.

Ahmad, A. A., Abubakar, U. B., Adunola, F. O., Jibril, A., & Amalo, K. A. (2025). Development of Adaptive Resource Allocation and Interference Mitigation for Spectrum

Sharing in D2D-Enabled 5G Heterogeneous Networks: A Case Study of Urban Microcell Environments. *ABUAD Journal of Engineering Research and Development* (AJERD), *8*(2), 52–65.

Al-Jadir, S. J. (2021, December). *The use of 5G technologies in the digital transformation of the Oil/Gas industry* (p. D041S125R002). Abu Dhabi International Petroleum Exhibition and Conference. SPE.

AlQubaisi, A. J., Emran, N. A., & Sam, M. F. M. (2022). A mediation role of sustainable supply chain in e-procurement of ADNOC the largest energy company in UAE. *Journal of Positive School Psychology*, *6*(3).

Anna-Theresa, W. (2021). Organizational agility: ill-defined and somewhat confusing? A systematic literature review and conceptualization. *Management Review Quarterly*, *71*(2), 343–391.

Banda, L., Mzyece, M., & Mekuria, F. (2022). 5G business models for mobile network operators; A survey. *Ieee Access*, *10*, 94851–94886.

Basaure, A., & Finley, B. (2019). *Urban 5G regulation: Local licensing versus coopetition*.

Borgaonkar, R., & Jaatun, M. G. (2019, September). *5G as an enabler for secure IoT in the smart grid* (pp. 1–7). In 2019 first international conference on societal automation (SA). IEEE.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates.

Dangi, R., Lalwani, P., Choudhary, G., You, I., & Pau, G. (2021). Study and investigation on 5G technology: A systematic review. *Sensors*, *22*(1), 26.

Dolgui, A., & Ivanov, D. (2022). 5G in digital supply chain and operations management: fostering flexibility, end-to-end connectivity and real-time visibility through internet-of-everything. *International Journal of Production Research*, *60*(2), 442–451.

El-Shorbagy, A. M. (2021). 5G Technology and the Future of Architecture. *Procedia Computer Science*, *182*, 121–131.

Gavrilovska, L., Rakovic, V., & Atanasovski, V. (2016). Visions towards 5G: Technical requirements and potential enablers. *Wireless Personal Communications*, *87*(3), 731–757.

Goyal, P., & Sahoo, A. K. (2019). A roadmap towards connected living: 5G mobile technology. *Int. J. Innov. Technol. Explor. Eng*, *9*(1), 1670–1685.

Gundall, M., Schneider, J., Schotten, H. D., Aleksy, M., Schulz, D., Franchi, N., … Grießbach, J. (2018, September). *5G as enabler for industrie 4.0 use cases: Challenges and concepts* (Vol. 1, pp. 1401–1408). In 2018 IEEE 23rd international conference on emerging technologies and factory automation (ETFA). IEEE.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24.

Hair Jr, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135.

Iannacci, J., & Poor, H. V. (2022). Review and perspectives of micro/nano technologies as key-enablers of 6G. *IEEE Access*, *10*, 55428–55458.

Ibrahim Mohamed, A. M. S. (2023). *The effect of transformational leadership on job satisfaction: the mediating role of knowledge management and organizational culture in adnoc refining company in UAE*. Doctoral dissertation, Universiti Tun Hussein Onn Malaysia.

Ionescu, C. A., Fülöp, M. T., Topor, D. I., Căpușneanu, S., Breaz, T. O., Stănescu, S. G., & Coman, M. D. (2021). The new era of business digitization through the implementation of 5G technology in Romania. *Sustainability*, *13*(23), 13401.

Jassim, M. M., Mosa, M. M., Okbi, Z. A. I., Abdullah, S. B., Taha, S. W., Migo, P., & Kondakova, S. (2024, October). *Cost-Effectiveness Analysis of IoT Deployment in 5G Networks* (pp. 493–502). 2024 36th Conference of Open Innovations Association (FRUCT). IEEE.

Javaid, M., Haleem, A., Singh, R. P., & Sinha, A. K. (n.d.). *Green Technologies and Sustainability*.

Khan, R., Kumar, P., Jayakody, D. N. K., & Liyanage, M. (2019). A survey on security and privacy of 5G technologies: Potential solutions, recent advancements, and future directions. *IEEE Communications Surveys & Tutorials*, *22*(1), 196–248.

Lee, C. K., & Yu, L. (2022). A multi-level perspective on 5G transition: The China case. *Technological Forecasting and Social Change*, *182*, 121812.

Marabissi, D., Mucchi, L., Fantacci, R., Spada, M. R., Massimiani, F., Fratini, A., … Fedele, L. (2018). A real case of implementation of the future 5G city. *Future Internet*, *11*(1), 4.

Memon, M. A., Ramayah, T., Cheah, J. H., Ting, H., Chuah, F., & Cham, T. H. (2021). PLS-SEM statistical programs: a review. *Journal of Applied Structural Equation Modeling*, *5*(1), 1–14.

Mustafa, H. A. U., Imran, M. A., Shakir, M. Z., Imran, A., & Tafazolli, R. (2015). Separation framework: An enabler for cooperative and D2D communication for future 5G networks. *IEEE Communications Surveys & Tutorials*, *18*(1), 419–445.

Neway, A. S. (2024). *Digital Supply Chain: Navigating the future operation*. Abegaz Sahilu Neway.

Olofsgård, M., & Göransson, P. (2022). *Key Success Factors for End-User Adoption of 5G Technology Within a Low-Middle Income Country: A case study in Malaysia*.

Otlyvanska, G., Connolly, N., Walsh, G., & Dooley, J. (2023, December). *Studying the Adoption of 5G and Future Networks for Social Inclusion: An Innovation Systems Transitions Perspective for Networks-as-a-Service* (pp. 137–149). In International Working Conference on Transfer and Diffusion of IT. Cham: Springer Nature Switzerland.

Oughton, E. J., & Frias, Z. (2018). The cost, coverage and rollout implications of 5G infrastructure in Britain. *Telecommunications Policy*, *42*(8), 636–652.

Pardo, A., & Román, M. (2013). Reflections on the Baron and Kenny model of statistical mediation. *Anales de psicologia*, *29*(2), 614–623.

Park, S. J., & Yi, Y. (2025). Re-evaluating prospect theory: A causal mediation approach to reference point, loss aversion, and diminishing sensitivity. *Journal of Hospitality and Tourism Management*, *62*, 135–147.

Pateromichelakis, E., Bulakci, O., Peng, C., Zhang, J., & Xia, Y. (2018). LAA as a key enabler in slice-aware 5G RAN: Challenges and opportunities. *IEEE Communications Standards Magazine*, *2*(1), 29–35.

Patil, G. R., & Wankhade, P. S. (2012). *5G wireless technology*.

Pedron, M., & Maffezzoli, F. A. (2018). *Estimating the socio-economic impact of 5G use cases: a conceptual framework*.

Peraković, D., Periša, M., Zorić, P., & Cvitić, I. (2020). Development and implementation possibilities of 5G in Industry 4.0. In *Design, Simulation, Manufacturing: The Innovation Exchange* (pp. 166–175). Cham: Springer International Publishing.

Peyrot, M. (1996). Causal analysis: Theory and application. *Journal of Pediatric Psychology*, *21*(1), 3–24.

Pierucci, L. (2015). The quality of experience perspective toward 5G technology. *IEEE Wireless Communications*, *22*(4), 10–16.

Prasad, K. S. V., Hossain, E., & Bhargava, V. K. (2017). Energy efficiency in massive MIMO-based 5G networks: Opportunities and challenges. *IEEE Wireless Communications*, *24*(3), 86–94.

Rao, S. K., & Prasad, R. (2018). Impact of 5G technologies on industry 4.0. *Wireless Personal Communications*, *100*(1), 145–159.

Sah, M. B., Bindle, A., & Gulati, T. (2022, September). *Analysis of different interference mitigation techniques based on bit error rate (BER) in 5G* (vol. 2, pp. 295–311). In International Conference on Innovative Computing and Communications: Proceedings of ICICC 2022. Singapore: Springer Nature Singapore.

Sarstedt, M., Hair Jr, J. F., Nitzl, C., Ringle, C. M., & Howard, M. C. (2020). Beyond a tandem analysis of SEM and PROCESS: Use of PLS-SEM for mediation analyses! *International Journal of Market Research*, *62*(3), 288–299.

Shah, S. P., Pattan, B. J., Gupta, N., Tangudu, N. D., & Chitturi, S. (2020, September). Service enabler layer for 5g verticals. In *2020 IEEE 3rd 5G World Forum* (5GWF) (pp. 269–274). IEEE.

Shen, F., Shi, H., & Yang, Y. (2021, August). *A comprehensive study of 5G and 6G networks* (pp. 321–326). In 2021 international conference on wireless communications and smart grid (ICWCSG). IEEE.

Shukurillaevich, U. B., Sattorivich, R. O., & Amrillojonovich, R. U. (2019, November). *5G technology evolution* (pp. 1–5). In 2019 International Conference on Information Science and Communications Technologies (ICISCT). IEEE.

Taheribakhsh, M., Jafari, A., Peiro, M. M., & Kazemifard, N. (2020, January). *5g implementation: Major issues and challenges* (pp. 1–5). In 2020 25th International Computer Conference, Computer Society of Iran (CSICC). IEEE.

Zeng, N., Liu, Y., Gong, P., Hertogh, M., & König, M. (2021). Do right PLS and do PLS right: A critical review of the application of PLS-SEM in construction management research. *Frontiers of Engineering Management*, *8*(3), 356–369.

Zuber-Skerritt, O., Fletcher, M., & Kearney, J. (2015). Conceptual framework. In *Professional learning in higher education and communities: Towards a new vision for action research* (pp. 1–37). London: Palgrave Macmillan UK.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).