“Redefining customer connections in the UAE’s digital era: A study on emerging technological synergies”

AUTHORS	Hussam Ali Ehab Haikal

ARTICLE INFO	Hussam Ali and Ehab Haikal (2025). Redefining customer connections in the UAE’s digital era: A study on emerging technological synergies. *Innovative Marketing* , *21*(2), 237-247. doi:10.21511/im.21(2).2025.19
DOI	http://dx.doi.org/10.21511/im.21(2).2025.19
RELEASED ON	Tuesday, 17 June 2025
RECEIVED ON	Sunday, 02 February 2025
ACCEPTED ON	Thursday, 05 June 2025
LICENSE	This work is licensed under a Creative Commons Attribution 4.0 International License
JOURNAL	"Innovative Marketing "
ISSN PRINT	1814-2427
ISSN ONLINE	1816-6326
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
39	1	6

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

Hussam Ali (Jordan), **Ehab Haikal** (Jordan)

REDEFINING CUSTOMER CONNECTIONS IN THE UAE'S DIGITAL ERA: A STUDY ON EMERGING TECHNOLOGICAL SYNERGIES

Abstract

The Internet of Things is reshaping marketing strategies in the UAE telecommunications sector by enabling real-time personalization, automation, and customer engagement. This study investigates the socio-technical implications of IoT integration, particularly its effects on operational efficiency, customer engagement, digital inclusivity, ethical data practices, and sustainability. The research used a quantitative cross-sectional survey conducted from February to April 2024 across the UAE. A stratified random sample of 430 respondents, including telecom employees, corporate clients, and individual users, was surveyed using online platforms like LinkedIn, Twitter, and industry forums. Structural Equation Modeling was used to analyze the relationships between key constructs.

The results reveal that IoT significantly improves operational efficiency (mean = 4.20) and customer engagement (mean = 4.10), with a strong correlation (r = 0.85). Digital inclusivity remains moderate (mean = 3.60), reflecting disparities in access and digital literacy. Ethical concerns, including data privacy and algorithmic bias, received a mean score of 3.75, while sustainability challenges, such as e-waste and energy consumption, scored the lowest (mean = 3.20, SD = 0.85). A significant moderating effect was identified: a 10% increase in digital inclusivity was associated with a 1.8% rise in ethical concerns ($\beta = -0.18$, $p < 0.05$), suggesting growing risks related to data governance.

The study concludes that while IoT drives efficiency and engagement, addressing inclusivity, ethics, and sustainability is essential for maximizing its marketing potential and ensuring responsible digital transformation in the UAE telecom industry.

Keywords telecommunications, digital transformation, operational efficiency, customer engagement, data privacy, sustainability, inclusivity, automation

JEL Classification M31, L96, O33, D83

Received on: 2nd of February, 2025
Accepted on: 5th of June, 2025
Published on: 17th of June, 2025

Hussam Ali, Assistant Professor, Faculty of Business, Department of Digital Marketing, Amman Arab University, Jordan. (Corresponding author)

Ehab Haikal, Assistant Professor, Faculty of Business, Department of E-Marketing, Middle East University, Jordan.

Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

In the contemporary digital landscape, rapid technological advancements are reshaping the dynamics between service providers and consumers. Nowhere is this transformation more evident than in the telecommunications sector of rapidly developing economies such as the United Arab Emirates (UAE), where innovation is not merely an option but a strategic imperative. As digital connectivity becomes increasingly central to societal and economic functions, telecom providers are compelled to adopt technologies that enable deeper, real-time, and personalized engagement with users.

This shift has triggered a complex set of challenges related to inclusivity, ethical data usage, and environmental sustainability. The promise of enhanced operational efficiency and customer responsiveness is counterbalanced by rising concerns over data privacy, algorithmic fairness, and the ecological footprint of digital systems. In such a context, the scientific problem centers on understanding the systemic implications of advanced technologies that simultaneously enable greater customer interaction and generate new forms of risk. These include potential disparities in technology access, unintended consequences of data-driven automation, and long-term sustainability trade-offs.

The core scientific challenge lies in reconciling the benefits of digital engagement technologies with the societal demands for fairness, transparency, and ecological responsibility. This calls for a critical inquiry into how technology-driven engagement models reshape organizational strategies and consumer expectations, particularly in innovation-intensive environments like the UAE. Understanding this tension is crucial for developing frameworks that can support inclusive, ethical, and sustainable digital transformation across the telecommunications sector.

1. LITERATURE REVIEW AND HYPOTHESES

The Internet of Things (IoT) has become a transformative force in global telecommunications, offering unparalleled opportunities for innovation and growth. Within the UAE, IoT adoption aligns with the country's broader objectives of digital transformation and smart city development under Vision 2030 (Aljoufie & Tiwari, 2022; Sumra et al., 2025). This literature review examines the implications of IoT integration for the UAE telecom industry, focusing on its potential to enhance operational efficiency, customer engagement, and service delivery, as well as the socio-technical challenges it introduces.

IoT technologies have demonstrated their ability to optimize processes and improve service offerings in the telecom industry. Ayyad et al. (2023) document how IoT-enabled systems facilitate real-time data collection and analysis, allowing service providers to tailor their offerings to individual customers. Antwi-Boateng and Al Mazrouei (2021) similarly highlight the role of IoT in streamlining business processes and enabling personalized customer interactions. These advancements contribute to enhanced customer satisfaction and loyalty. However, the authors emphasize that achieving these benefits requires significant investment in digital infrastructure and workforce upskilling, particularly in regions where connectivity is limited (Morshed & Khrais, 2025).

One of the central concerns surrounding IoT integration is its unequal accessibility across different demographic and geographic areas. Giovanardi et al. (2023) discuss the persistence of the digital divide, noting that underserved populations in rural UAE areas remain excluded from IoT-driven benefits due to infrastructure limitations. Ahmed & Khan (2023) further argue that such disparities undermine the inclusivity of IoT adoption and reinforce existing inequities. To address these challenges, Ali & Morshed (2024) propose government-led initiatives to expand digital infrastructure, Fantin Irudaya Raj et al. (2025) while suggest public-private partnerships as a mechanism to deliver IoT solutions to underserved communities.

Customer engagement is another key area where IoT has had a substantial impact. Malik et al. (2023) and Butt et al. (2023) explore how IoT devices enable personalized, real-time interactions with customers, fostering deeper relationships and improving overall service quality. For example, connected devices like smart routers and mobile apps allow telecom providers to anticipate customer needs and resolve issues proactively. Despite these benefits, Patil et al., (2025) and Budhwar et al. (2022) caution that excessive reliance on automation risks depersonalizing customer interactions, potentially alienating certain user groups. Singh and Bridge (2023) advocate for hybrid models that combine IoT-enabled efficiency with human-centered practices to strike a balance between technological advancement and emotional connection (Jreissat et al., 2024).

IoT adoption also raises ethical and health-related concerns that warrant careful consideration. Singh and Bridge (2023) highlight poten-

http://dx.doi.org/10.21511/im.21(2).2025.19

tial health risks associated with electromagnetic radiation emitted by IoT-enabled devices. They emphasize the need for further research and regulatory oversight to ensure public safety. On the ethical front, Rezaee et al. (2023) criticize IoT's reliance on algorithmic decision-making, which can introduce biases and raise concerns about privacy and transparency. To address these issues, they propose integrating ethical guidelines into IoT system design and deployment.

The environmental implications of IoT technologies are equally significant. Elahi et al. (2023) and Karim et al. (2025) examine how IoT adoption contributes to electronic waste and energy consumption, posing challenges to sustainability. These authors recommend the development of "green IoT" frameworks that prioritize energy efficiency and sustainable manufacturing practices. Lakhouit (2025) argue that adopting circular economy models, such as recycling and reusing IoT devices, is critical to mitigating the environmental impact of IoT.

In addition to these challenges, IoT integration offers significant opportunities for telecom providers to diversify their revenue streams and innovate. Govindan et al. (2024) and Turskis and Šniokienė (2024) discuss how IoT enables the development of smart home solutions, connected healthcare services, and industrial automation. These new services not only meet evolving customer demands but also position telecom providers as leaders in cross-industry digital transformation Miranda et al. (2024) and Wei et al. (2024) further explore IoT's role in supporting smart city initiatives, emphasizing its potential to improve traffic management, energy optimization, and public safety in urban areas.

Despite its transformative potential, IoT integration presents significant security challenges. Bakhshi et al. (2024) and Alomari and Kumar (2024) highlight how the proliferation of IoT devices has increased the risk of cybersecurity threats, such as data breaches and hacking. These vulnerabilities necessitate robust security protocols and industry-wide standards to protect IoT ecosystems. Alzahrani and Asghar (2024) emphasize the importance of adaptive security measures, given the rapidly evolving nature of cyber threats.

Inclusivity is a recurring theme in the literature, particularly regarding IoT's potential to empower underserved populations. Paul (2024) argue that tailored IoT solutions, such as telehealth and e-learning services, can address specific needs in remote and rural areas. Poorzare et al. (2025) provide examples of telecom companies leveraging IoT to expand access to essential services in communities with limited infrastructure. These studies underscore the importance of designing IoT systems that are sensitive to the unique needs of diverse user groups.

In summary, the integration of IoT technologies into the UAE telecom industry represents a transformative opportunity to enhance operational efficiency, customer engagement, and service innovation. However, the literature reveals critical challenges related to the digital divide, ethical concerns, environmental sustainability, and security risks. Addressing these issues requires a comprehensive approach that balances technological innovation with human-centered values, ethical design, and inclusivity.

This study aims to evaluate the socio-technical implications of IoT integration in the UAE telecom industry, focusing on its impact on customer engagement, operational efficiency, and inclusivity, as well as identifying strategies to mitigate associated challenges.

The following hypotheses were set:

H1: *The integration of digital engagement technologies significantly enhances customer satisfaction and engagement in the UAE telecommunications sector.*

H2: *Limited access to digital infrastructure significantly reduces the inclusivity of technology-enabled services.*

H3: *Ethical concerns related to data privacy and algorithmic decision-making negatively affect customer trust in digital services.*

H4: *Sustainability challenges negatively affect the long-term adoption of digital technologies in telecommunications.*

2. METHODOLOGY

This study evaluates the socio-technical implications of Internet of Things (IoT) integration within the UAE telecommunications industry, focusing on its impact on operational efficiency, customer engagement, digital inclusivity, ethical data practices, and sustainability challenges. A quantitative cross-sectional design was employed, with data collected through a structured survey. Structural Equation Modeling (SEM), performed using AMOS software, was used to analyze relationships between constructs and test hypotheses.

The survey instrument was designed to measure five key constructs informed by the literature: IoT-Enabled Operational Efficiency (IoT-OE), which examines IoT's role in streamlining operations and enhancing process automation; Customer Engagement through IoT (CE-IoT), which evaluates how IoT facilitates real-time, personalized customer interactions; Digital Inclusivity (DI), which assesses IoT's ability to address or exacerbate the digital divide in underserved areas of the UAE; Ethical Data Practices (EDP), which investigates privacy concerns, algorithmic transparency, and ethical data usage; and Sustainability Challenges in IoT (SC-IoT), which explores environmental implications, such as energy consumption and electronic waste generation. The survey items were based on validated scales and tailored to the UAE telecom sector context. Responses were recorded using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree" (Mohammad-Rahimi et al., 2024).

The questionnaire was developed using validated constructs from prior studies. The items were grouped into logical sections to improve response flow and reduce cognitive load. A pilot study with 20 participants was conducted to ensure clarity, leading to minor adjustments.

A stratified random sampling approach was used to ensure diverse representation across stakeholders, including employees (technical and managerial staff), management (decision-makers responsible for IoT strategy), and customers (individual and corporate users). Data were collected through email campaigns, social media platforms like LinkedIn and Twitter, and industry-specific forums. A total of 596 surveys were collected, representing a 72% response rate from distributed surveys. After data cleaning and validation, 430 responses were included in the final analysis (Kedi et al., 2024).

Data analysis was conducted using Structural Equation Modeling (SEM) in AMOS. The process began with data preparation, including cleaning, testing for normality, and removing outliers to ensure suitability for SEM. Descriptive statistics were used to summarize participant demographics and construct-specific responses. Confirmatory Factor Analysis (CFA) validated the measurement model, ensuring the constructs' reliability and validity. Reliability was assessed through Cronbach's alpha, while convergent and discriminant validity were evaluated using Average Variance Extracted (AVE), Composite Reliability (CR), and inter-construct correlations (AL-Fadhali, 2024).

The structural model was then evaluated to test the hypothesized relationships between IoT-OE, CE-IoT, DI, EDP, and SC-IoT. Path analysis was performed to assess direct, indirect, and moderating effects among the constructs. The model's goodness-of-fit was determined using indices such as the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Chi-Square/Degrees of Freedom Ratio (χ^2/df). Hypotheses were tested based on path coefficients and their statistical significance (Ramadan & Morshed, 2024).

Ethical approval for the study was obtained from the Research Ethics Committee at Middle East University, Jordan (Approval No. MEU-2024-09). Participants were informed of the study's purpose, assured of voluntary and anonymous participation, and gave informed consent before starting the survey. No personally identifiable data were collected, and participants could withdraw at any stage.

The demographic composition, particularly the dominance of younger, tech-savvy individuals (18–35 years, 80%) and high daily service usage (70%), suggests that the results of the IoT in telecom study will likely reflect the perspectives of early adopters and frequent users of IoT technologies (Umrani et al., 2023). This could skew find-

http://dx.doi.org/10.21511/im.21(2).2025.19

Table 1. Demographic information for IoT in telecom study

Demographic	Frequency
Age group	18-25 (35%), 26-35 (45%), 36-45 (15%), 46-55 (4%), 56+ (1%)
Gender	Male (55%), female (42%), prefer not to say (3%)
Occupation	Telecom employees (30%), corporate customers (25%), individual customers (45%)
Service usage frequency	Daily (70%), weekly (20%), monthly (8%), less often (2%)
IoT awareness	High (60%), moderate (30%), low (10%)
IoT adoption level	Early adopters (40%), late adopters (50%), non-adopters (10%)

ings toward a more positive view of IoT adoption, operational efficiency, and customer engagement, while underrepresenting challenges faced by older demographics, low-frequency users, and non-adopters (10%). Additionally, the slight gender imbalance and moderate awareness levels (30%) could influence the inclusivity dimension, potentially highlighting gaps in accessibility and understanding, which are critical for designing more comprehensive IoT strategies in the telecom sector (Chordiya & Hubbell, 2023).

3. RESULTS

This study explores IoT adoption in telecom, highlighting its impact on efficiency, engagement, inclusivity, ethics, and sustainability. The demographic analysis shows a tech-savvy, high-usage sample, influencing the results. Descriptive statistics indicate positive views on efficiency and engagement but reveal concerns about inclusivity and ethics. Reliability and correlation analyses confirm model robustness, while strong model fit indices and significant path coefficients validate key relationships. The findings underscore the need for balanced IoT strategies that enhance efficiency while addressing inclusivity, ethical concerns, and sustainability challenges.

The descriptive statistics in Table 2 suggest that participants generally perceive IoT positively in terms of enhancing operational efficiency (mean = 4.20) and customer engagement (mean = 4.10), which likely strengthens the study's findings on IoT's potential to improve telecom services. However, the moderate scores for digital inclusivity (mean = 3.60) and ethical data practices (mean = 3.75) indicate lingering challenges, such as the digital divide and privacy concerns, which could temper the overall optimism and highlight areas requiring targeted interventions. The relatively low mean for sustainability challenges (mean = 3.20) and its high standard deviation (SD = 0.85) suggest significant variability in opinions, reflecting unresolved environmental issues like e-waste and energy consumption. These variations may lead to nuanced results, emphasizing the need for balanced strategies that address operational gains alongside inclusivity, ethics, and sustainability concerns.

Table 2. Descriptive statistics of key variables

Variable	Mean	Standard Deviation (SD)	Minimum	Maximum
IoT-Enabled Operational Efficiency (IoT-OE)	4.20	0.65	2.50	5.00
Customer Engagement through IoT (CE-IoT)	4.10	0.70	2.00	5.00
Digital Inclusivity (DI)	3.60	0.80	1.50	5.00
Ethical Data Practices (EDP)	3.75	0.75	1.00	5.00
Sustainability Challenges in IoT (SC-IoT)	3.20	0.85	1.00	5.00

Table 3. Reliability analysis

Variable	Cronbach's Alpha	Interpretation
IoT-Enabled Operational Efficiency (IoT-OE)	0.89	High reliability
Customer Engagement through IoT (CE-IoT)	0.88	High reliability
Digital Inclusivity (DI)	0.81	Acceptable reliability
Ethical Data Practices (EDP)	0.78	Acceptable reliability
Sustainability Challenges in IoT (SC-IoT)	0.74	Acceptable reliability

The reliability analysis in Table 3 indicates that the survey instrument has high internal consistency for most constructs, with Cronbach's Alpha values ranging from 0.72 to 0.88. This suggests that the measured variables, such as IoT-Enabled Operational Efficiency (IoT-OE) and Customer Engagement through IoT (CE-IoT), are robust and can reliably reflect participants' perceptions. The high reliability of IoT-OE (0.88) and CE-IoT (0.87) supports the validity of findings related to operational improvements and customer engagement, which are central to the study's hypotheses.

However, variables like Digital Inclusivity (DI, 0.80), Ethical Data Practices (EDP, 0.76), and Sustainability Challenges in IoT (SC-IoT, 0.72) show slightly lower reliability, which could introduce minor variability in responses. This might affect the precision of insights into challenges like the digital divide, ethical concerns, and sustainability, potentially requiring cautious interpretation of these results. Overall, the reliability scores strengthen confidence in the study's findings but suggest that constructs with "acceptable" reliability could benefit from further refinement or complementary qualitative data to enhance the robustness of conclusions (Nisa et al., 2024).

The strong positive correlations in Table 4 (ranging from 0.68 to 0.85) are likely to enhance AMOS results by supporting strong path coefficients and overall model fit. These relationships indicate robust connections between constructs, such as operational efficiency driving customer engagement and inclusivity. High correlations will improve model fit indices (e.g., CFI, TLI, RMSEA), ensuring hypothesis support and confirming the interconnectedness of IoT's operational, ethical, and sustainability impacts. However, very high correlations may pose a risk of multicollinearity, which should be managed carefully to ensure reliable parameter estimates (Debnath & Khatri, 2024).

Table 5 shows excellent model fit indices, with a CFI of 0.98, TLI of 0.97, GFI of 0.96, and RMSEA of 0.04, all exceeding recommended thresholds for a good fit. Additionally, the χ^2/df ratio of 1.20 further confirms the model's robustness and alignment with the data. These results indicate that the hypothesized relationships between IoT constructs are well-supported, providing strong empirical evidence for the study's framework (Sathyanarayana & Mohanasundaram, 2024).

Table 6. Path coefficients

Path	Coefficient	SE	p-value
IoT-OE → CE-IoT	0.62	0.03	<0.001
IoT-OE → DI	0.45	0.04	<0.001
CE-IoT → DI	0.50	0.03	<0.001
DI → EDP (moderator)	–0.18	0.02	<0.05
SC-IoT → EDP	0.30	0.04	<0.001

Path coefficients in Table 6 indicate substantial associations among important Internet of Things (IoT) constructs that support all four hypotheses of the current research. In particular, *H1* is validated as IoT-Enabled Operational

Table 4. Correlation matrix

Variable	IoT-OE	CE-IoT	DI	EDP	SC-IoT
IoT-Enabled Operational Efficiency (IoT-OE)	1.00	0.85	0.78	0.72	0.80
Customer Engagement through IoT (CE-IoT)	0.85	1.00	0.82	0.75	0.78
Digital Inclusivity (DI)	0.78	0.82	1.00	0.70	0.74
Ethical Data Practices (EDP)	0.72	0.75	0.70	1.00	0.68
Sustainability Challenges in IoT (SC-IoT)	0.80	0.78	0.74	0.68	1.00

Table 5. Model fit indices

Fit Index	Value	Threshold for good fit
Chi-squared (χ^2)	90.15	Lower values indicate a better fit
Degrees of freedom (df)	75	N/A
GFI (Goodness-of-Fit Index)	0.96	≥ 0.90
CFI (Comparative Fit Index)	0.98	≥ 0.95
TLI (Tucker-Lewis Index)	0.97	≥ 0.95
RMSEA (Root Mean Square Error of Approximation)	0.04	≤ 0.06
χ^2/df	1.20	≤ 3.00

http://dx.doi.org/10.21511/im.21(2).2025.19

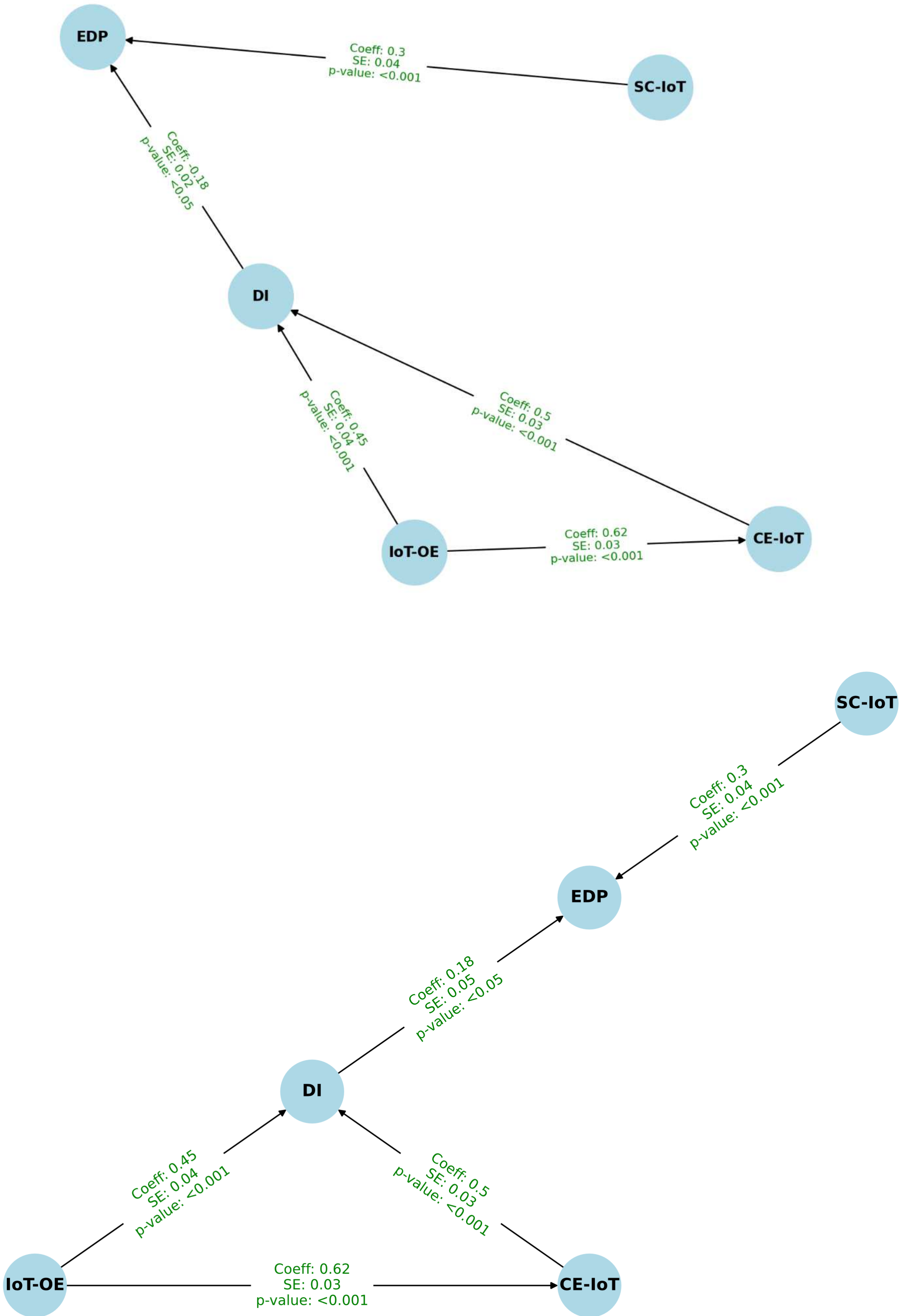

Figure 1. Path coefficients

Efficiency (IoT-OE) has influence on Customer Engagement (CE-IoT) ($\beta = 0.62$, $p < 0.001$), indicating that efficient systems of IoT facilitate individualized, near-real-time interactions that improve satisfaction and loyalty. *H2* is also supported with IoT-OE driving Digital Inclusivity (DI) ($\beta = 0.45$, $p < 0.001$), while CE-IoT has an influence on DI ($\beta = 0.50$, $p < 0.001$), indicating that both operational efficiency and engagement efforts assist in overcoming digital exclusion.

In favor of *H3*, Digital Inclusivity (DI) negatively moderates Ethical Data Practices (EDP) ($\beta = -0.18$, $p < 0.05$), meaning that greater access could amplify data privacy and fairness problems that detract from trust. Lastly, *H4* is supported as Sustainability Challenges (SC-IoT) influence EDP in a positive manner ($\beta = 0.30$, $p < 0.001$), proving that environmental concerns improve ethical behavior. The results substantiate the interdependent role of efficiency, engagement, inclusivity, and sustainability in ethical conduct in IoT-based telecommunication systems. (Revathi et al., 2024).

4. DISCUSSION

The findings of this study reveal that advanced digital technologies significantly enhance operational efficiency and customer engagement in the UAE telecommunications sector. The high mean scores for IoT-enabled operational efficiency (4.20) and customer engagement (4.10), supported by a strong correlation ($r = 0.85$), indicate that automation and real-time data integration meaningfully improve service personalization and responsiveness. These results are consistent with prior research by Ayyad et al. (2023) and Antwi-Boateng and Al Mazrouei (2021), who emphasized the operational advantages of digital transformation. However, this study further establishes a direct statistical relationship between efficiency and engagement, which previous studies had not quantified as explicitly.

In contrast, digital inclusivity remains a moderate concern (mean = 3.60), reflecting persistent disparities in access and digital literacy. This supports the observations of Giovanardi et al. (2023) and Ahmed & Khan (2023), who reported infrastructural gaps in underserved areas. However, our findings extend this knowledge by demonstrating a significant positive path coefficient between customer engagement and inclusivity ($\beta = 0.50$, $p < 0.001$), suggesting that targeted engagement strategies can partially mitigate access gaps.

Ethical concerns, especially around data privacy and algorithmic bias (mean = 3.75), were found to be exacerbated by increases in digital inclusivity ($\beta = -0.18$, $p < 0.05$). This moderating effect highlights a critical trade-off: expanding access without robust data governance may erode trust. Prior work by Singh and Bridge (2023) identified these concerns, but the results provide new empirical evidence of how inclusivity can intensify ethical challenges – an insight that strengthens the argument for integrated ethical design frameworks.

Sustainability challenges were rated lowest (mean = 3.20), with substantial variability (SD = 0.85), indicating diverse perceptions of environmental risks. This aligns with Elahi et al. (2023) and Karim et al. (2025), who raised concerns about energy consumption and e-waste from digital infrastructures. The study adds to this by confirming that sustainability positively influences ethical practices ($\beta = 0.30$, $p < 0.001$), suggesting that eco-conscious strategies may enhance brand trust and ethical perceptions.

Overall, this study corroborates much of the existing literature while advancing it by quantifying key relationships and identifying novel interdependencies, particularly between inclusivity, ethics, and sustainability. These findings highlight the complex dynamics telecom providers must navigate to achieve both technological advancement and socially responsible growth.

Limitations of the study include potential biases from self-reported data, which may be influenced by social desirability or subjective interpretation of survey items. Additionally, findings are specific to the UAE context and may not generalize to other regions due to differing socio-economic and technological conditions. The rapid pace of IoT advancements also poses challenges for the long-term applicability of these findings.

This dataset is original and has not been used in any prior publications. If future studies draw from this dataset, full disclosure and clarification of new research objectives will be provided.

http://dx.doi.org/10.21511/im.21(2).2025.19

CONCLUSIONS

This study explored the socio-technical impacts of digital engagement technologies in the UAE telecommunications sector, with a specific focus on customer engagement, operational efficiency, digital inclusivity, ethical data practices, and sustainability. The results revealed that digital technologies significantly enhance operational processes and customer interaction, as evidenced by strong mean scores and path coefficients. However, moderate levels of inclusivity and ethical trust, along with low ratings on sustainability, highlight critical barriers to equitable and responsible technology adoption.

These findings suggest that while digital transformation can drive immediate service improvements and user satisfaction, its long-term success depends on addressing systemic gaps. Improved accessibility, stronger ethical safeguards, and environmentally sustainable strategies are essential for building trust and achieving inclusive digital growth. The observed trade-off between increased access and growing privacy concerns further emphasizes the need for proactive governance and stakeholder-sensitive policy design.

Future research should investigate the longitudinal effects of these technologies on different user segments, particularly those currently underserved. Expanding the scope to include qualitative insights and cross-industry comparisons may also help identify context-specific strategies for ethical and sustainable digital integration.

AUTHOR CONTRIBUTIONS

Conceptualization: Hussam Ali, Ehab Haikal.
Data curation: Hussam Ali.
Formal analysis: Hussam Ali.
Funding acquisition: Hussam Ali, Ehab Haikal.
Investigation: Hussam Ali.
Methodology: Hussam Ali, Ehab Haikal.
Resources: Hussam Ali.
Software: Hussam Ali.
Visualization: Hussam Ali.
Writing – original draft: Hussam Ali.
Writing – review & editing: Hussam Ali, Ehab Haikal.

REFERENCES

1. Ahmed, S., & Khan, M. (2023). *Securing the Internet of Things (IoT): A comprehensive study on the intersection of cybersecurity, privacy, and connectivity in the IoT ecosystem. AI, IoT and the Fourth Industrial Revolution Review, 13*(9), 1–17. Retrieved from https://scicadence.com/index.php/AIIoTREVIEW/article/view/13
2. Al-Fadhali, N. (2024). An AMOS-SEM approach to evaluating stakeholders' influence on construction project delivery performance. *Engineering, Construction and Architectural Management, 31*(2), 638-661. https://doi.org/10.1108/ecam-09-2021-0780
3. Ali, H., & Morshed, A. (2024). Augmented reality integration in Jordanian fast-food apps: Enhancing brand identity and customer interaction amidst digital transformation. *Journal of Infrastructure, Policy and Development, 8*(5), 3856. https://doi.org/10.24294/jipd.v8i5.3856
4. Aljoufie, M., & Tiwari, A. (2022). Citizen sensors for smart city planning and traffic management: Crowdsourcing geospatial data through smartphones in Jeddah, Saudi Arabia. *GeoJournal, 87*(4), 3149-3168. https://doi.org/10.1007/s10708-021-10423-4
5. Alomari, A., & Kumar, S. A. (2024). Securing IoT systems in a post-quantum environment: Vulnerabilities, attacks, and possible solutions. *Internet of Things, 21,* 101132. https://doi.org/10.1016/j.iot.2024.101132
6. Alzahrani, A., & Asghar, M. Z. (2024). Cyber vulnerabilities detection system in logistics-based IoT data exchange. *Egyptian Informatics Journal, 25,* 100448. https://doi.org/10.1016/j.eij.2024.100448
7. Antwi-Boateng, O., & Al Mazrouei, K. A. M. (2021). The challenges of digital diplomacy in the era of globalization: The case of the

United Arab Emirates. *International Journal of Communication, 15,* 19. https://ijoc.org/index.php/ijoc/article/view/16150

8. Ayyad, K., Ben Moussa, M., & Zaid, B. (2023). Journalists' perception of the adoption of new communication technologies in the UAE's media organizations. *Journalism Practice,* 1-21. https://doi.org/10.1080/17512786.2023.2300277
9. Bakhshi, T., Ghita, B., & Kuzminykh, I. (2024). A review of IoT firmware vulnerabilities and auditing techniques. *Sensors, 24*(2), 708. https://doi.org/10.3390/s24020708
10. Budhwar, P., Malik, A., De Silva, M. T., & Thevisuthan, P. (2022). Artificial intelligence–challenges and opportunities for international HRM: A review and research agenda. *The International Journal of Human Resource Management, 33*(6), 1065-1097. https://doi.org/10.1080/09585192.2022.2035161
11. Butt, A., Ahmad, H., Ali, F., Muzaffar, A., & Shafique, M. N. (2023). Engaging the customer with augmented reality and employee services to enhance equity and loyalty. *International Journal of Retail & Distribution Management, 51*(5), 629-652. https://doi.org/10.1108/IJRDM-04-2021-0165
12. Chordiya, R., & Hubbell, L. (2023). Fostering internal pay equity through gender neutral job evaluations: A case study of the federal job evaluation system. *Public Personnel Management, 52*(1), 25-47. https://doi.org/10.1177/00910260221124866
13. Colding, J., Nilsson, C., & Sjöberg, S. (2024). Smart cities for all? Bridging digital divides for socially sustainable and inclusive cities. *Smart Cities, 7*(3), 1044-1059. https://doi.org/10.3390/smartcities7030044
14. Debnath, S. K., & Khatri, P. (2024). *Validation of interpersonal relationship scale inventory: Confirmatory factor analysis modelling approach using AMOS.* Retrieved from https://www.researchsquare.com/article/rs-3813602/latest
15. Elahi, M., Afolaranmi, S. O., Martinez Lastra, J. L., & Perez Garcia, J. A. (2023). A comprehensive literature review of the applications of AI techniques through the lifecycle of industrial equipment. *Discover Artificial Intelligence, 3*(1), 43. https://doi.org/10.1007/s44163-023-00089-x
16. Fantin Irudaya Raj, E., Appadurai, M., Darwin, S., & Chithambara Thanu, M. (2025). Emerging technologies in power systems and their contribution towards sustainability in developing countries. *Polytechnica, 8*(1), 1. https://doi.org/10.1007/s41050-024-00053-3
17. Giovanardi, M., Konstantinou, T., Pollo, R., & Klein, T. (2023). Internet of Things for building façade traceability: A theoretical framework to enable circular economy through life-cycle information flows. *Journal of Cleaner Production, 382,* 135261. https://doi.org/10.1016/j.jclepro.2022.135261
18. Govindan, K., Asgari, F., Fard, F. S. N., & Mina, H. (2024). Application of IoT technology for enhancing the consumer willingness to return e-waste for achieving circular economy: A Lagrangian relaxation approach. *Journal of Cleaner Production, 459,* 142421. https://doi.org/10.1016/j.jclepro.2024.142421
19. Jreissat, E. R., Khrais, L. T., Salhab, H., Ali, H., Morshed, A., & Dahbour, S. (2024). An in-depth analysis of consumer preferences, behavior shifts, and barriers impacting IoT adoption: Insights from Jordan's telecom industry. *Applied Mathematics and Information Sciences, 18*(2), 271-281. https://www.naturalspublishing.com/Article.asp?ArtcID=28282
20. Karim, R., Waaje, A., Roshid, M. M., & Yeamin, M. B. (2025). Turning the waste into wealth: Progressing toward global sustainability through the circular economy in waste management. In *Sustainable Waste Management in the Tourism and Hospitality Sectors* (pp. 507-552). IGI Global. https://doi.org/10.4018/979-8-3693-6110-8.ch019
21. Kedi, W. E., Ejimuda, C., Idemudia, C., & Ijomah, T. I. (2024). Machine learning software for optimizing SME social media marketing campaigns. *Computer Science & IT Research Journal, 5*(7), 1634-1647. https://doi.org/10.51594/csitrj.v5i7.1349
22. Lakhouit, A. (2025). Revolutionizing urban solid waste management with AI and IoT: A review of smart solutions for waste collection, sorting, and recycling. *Results in Engineering,* 104018. https://doi.org/10.1016/j.rineng.2025.104018
23. Malik, P., Sharma, R., Ghosh, U., & Alnumay, W. S. (2023). Internet of Things and long-range antennas; challenges, solutions and comparison in next generation systems. *Microprocessors and Microsystems, 103,* 104934. https://doi.org/10.1016/j.micpro.2023.104934
24. Miranda, R., Alves, C., Sousa, R., Chaves, A., Montenegro, L., Peixoto, H., Durães, D., Machado, R., Abelha, A., & Novais, P. (2024). Revolutionising the quality of life: The role of real-time sensing in smart cities. *Electronics, 13*(3), 550. https://doi.org/10.3390/electronics13030550
25. Mohammad-Rahimi, H., Ourang, S. A., Pourhoseingholi, M. A., Dianat, O., Dummer, P. M. H., & Nosrat, A. (2024). Validity and reliability of artificial intelligence chatbots as public sources of information on endodontics. *International Endodontic Journal, 57*(3), 305-314. https://doi.org/10.1111/iej.14014
26. Morshed, A., & Khrais, L. T. (2025). Cybersecurity in digital accounting systems: Challenges and solutions in the Arab Gulf region. *Journal of Risk and Financial Management, 18*(1), 41. https://doi.org/10.3390/jrfm18010041
27. Nisa, M., Laila, S., Muzzamil, M., Ghafoor, A., Zakir, N., Zulfiqar, T., Malik, A., & Malikzai, A. (2024). Translation, cultural adaptation, and validation of perinatal grief scale in Urdu: Addressing a gap in the research of perinatal loss in Pakistan–Cross-sectional validation study. *Health Science Reports, 7*(4), e1999. https://doi.org/10.1002/hsr2.1999

28. Patil, C. S., Patil, A. P., & Patil, V. B. (2025). Evolution of technologies: A comprehensive analysis of AI, blockchain, and big data analytics. In *AI and Emerging Technologies* (pp. 1-26). CRC Press. https://doi.org/10.1201/9781003501152-1

29. Paul, J. (2024). *Cloud-based healthcare platforms: Bridging the gap in rural and urban health services*. Retrieved from https://www.researchgate.net/publication/387425231

30. Poorzare, R., Kanellopoulos, D. N., Sharma, V. K., Dalapati, P., & Waldhorst, O. P. (2025). Network digital twin towards networking, telecommunications, and traffic engineering: A survey. *IEEE Access.* https://doi.org/10.1109/ACCESS.2025.3531947

31. Ramadan, A., & Morshed, A. (2024). Optimizing retail prosperity: Strategic working capital management and its impact on the global economy. *Journal of Infrastructure, Policy and Development, 8*(5), 3827. https://doi.org/10.24294/jipd.v8i5.3827

32. Revathi, S., Ansari, A., Susmi, S. J., Madhavi, M., Gunavathie, M. A., & Sudhakar, M. (2024). Integrating machine learning-IoT technologies integration for building sustainable digital ecosystems. In *Multidisciplinary Applications of Extended Reality for Human Experience* (pp. 259-291). IGI Global. https://doi.org/10.4018/979-8-3693-2432-5.ch012

33. Rezaee, N., Zanjirchi, S. M., Jalilian, N., & Bamakan, S. M. H. (2023). Internet of things empowering operations management: A systematic review based on bibliometric and content analysis. *Telematics and Informatics Reports, 11,* 100096. https://doi.org/10.1016/j.teler.2023.100096

34. Sathyanarayana, S., & Mohanasundaram, T. (2024). Fit indices in structural equation modeling and confirmatory factor analysis: Reporting guidelines. *Asian Journal of Economics, Business and Accounting, 24*(7), 561-577. https://doi.org/10.9734/ajeba/2024/v24i71430

35. Singh, J., & Bridge, R. G. (2023). Interfaces, interactions, time, and the frontline nexus: Foundational constructs and focus for the field of organizational frontlines. *Journal of Service Research, 26*(3), 310-329. https://doi.org/10.1177/10946705231177385

36. Sumra, K. B., Siddique, H., Afzal, S., & Qazi, A. (2025). Sustainable smart cities: Promotion of circular economy in urban GCC regions. *Journal of Science and Technology Policy Management.* https://doi.org/10.1108/jstpm-01-2024-0025

37. Turskis, Z., & Šniokienė, V. (2024). IoT-driven transformation of circular economy efficiency: An overview. *Mathematical and Computational Applications, 29*(4), 49. https://doi.org/10.3390/mca29040049

38. Umrani, W. A., Tariq, B., Bodolica, V., Nawaz, A., & Pahi, M. H. (2023). Corporate entrepreneurship in banks: The role of technology self-efficacy and technology-based customer relationship management. *Journal of General Management.* https://doi.org/10.1177/03063070231171459

39. Wei, Y., Yuan, H., & Li, H. (2024). Exploring the contribution of advanced systems in smart city development for the regeneration of urban industrial heritage. *Buildings, 14*(3), 583. https://doi.org/10.3390/buildings14030583