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A CASE STUDY-BASED FRAMEWORK FOR ASSESSING THE TECHNICAL QUALITY OF MOBILE TOURISM SERVICES IN THE KINGDOM OF SAUDI ARABIA

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ABSTRACT
The acceleration of digital transformation in Saudi Arabia, driven by the Vision 2030 initiative, has significantly expanded the use of Mobile Tourism Services Applications (MTSAs). Ensuring their technical quality is essential to enhancing both user satisfaction and service delivery. This study introduces a tailored Technical Quality Model for MTSAs that incorporates usability, performance, security, and satisfaction, while also accounting for the cultural, regulatory, and infrastructural context of Saudi Arabia. Adopting a mixed-methods design, the research integrates quantitative responses from 500 users and 50 developers with qualitative evidence from interviews and document analysis. Statistical findings highlight security as the strongest determinant of user satisfaction (mean = 4.5, SD = 0.7; Pearson r = 0.75). Regression analysis further indicates that security ($\beta = 0.52$, $p < 0.001$) explains 65% of the variance in satisfaction ($R^2 = 0.65$). Gender and experience were found as significant moderators, with males and more experienced users reporting higher satisfaction ($t = 2.34$, $p = 0.02$; $t = 3.45$, $p = 0.001$). It is concluded by recommending enhancements in usability, robust security mechanisms, and gender-responsive design to optimize user experiences. Future research should explore integrating artificial intelligence and blockchain, and validate the proposed model in comparable regional contexts.

Keywords: Mobile tourism services applications, technical quality model, user satisfaction, Saudi Arabia vision 2030, mixed method approach.

1. INTRODUCTION

Saudi Arabia's tourism industry is rapidly expanding under Vision 2030, with mobile applications playing a key role in navigation, local recommendations, and language support. Ensuring the technical quality of these Mobile Tourism Service Applications (MTSAs) is vital for secure and seamless user experiences, yet limited research has examined the technical factors influencing satisfaction and retention in the Saudi context (Al-Hazmia et al., 2020). Existing quality models for mobile applications (e.g., Garousi et al., 2018) often overlook regional and industry-specific requirements. In the Kingdom of Saudi Arabia (KSA), challenges include diverse network infrastructure, high performance expectations, and privacy and security concerns (Alshammari &Alenezi, 2021), necessitating specialized models (Bevan et al., 2016).

This study focuses on usability, performance, and security as core attributes of a Saudi-specific technical quality model for MTSAs. Using a case study approach and mixed methods, including expert interviews, surveys, and technical assessments, the research develops and validates a framework tailored to the Saudi tourism industry. The model aims to support developers, service providers, and policymakers in building a competitive, user-centric mobile tourism ecosystem aligned with Vision 2030 (as recommended by Khan & Balasubramaniam, 2019).

The addressed problem is the lack of a specialized quality model for Saudi MTSAs, as generic frameworks fail to capture regional cultural, security, and usability requirements (Muhammad & Hashem, 2024). Current challenges include limited cultural and linguistic adaptation (Liu & Li, 2020; Alotaibi & Hassan, 2022), weak security measures (Ometov et al., 2021), and unstable performance with poor interoperability (Buhalis&Sinarta, 2019). Accordingly, this study seeks to answer: (1) What technical quality attributes are most critical for Saudi MTSAs? (2) How can security and privacy be effectively integrated? (3) How do cultural and regional factors shape design and implementation? and (4) How effective is the proposed model in enhancing satisfaction and performance?

The objectives are to define essential quality attributes, integrate strong security and privacy standards, incorporate cultural/regional factors, and evaluate the model's impact on satisfaction and efficiency. Therefore, this research advances mobile tourism services in KSA by strengthening cultural alignment, addressing security issues, and contributing a context-specific quality framework that may also inform other emerging tourism markets.

2. LITERATURE REVIEW AND RELATED WORKS

The development of a quality model for MTSAs requires examining mobile technology, service quality, and public e-services within Saudi Arabia's Vision 2030 digital transformation (CPSA, 2016; GSA, 2016). Smart tourism technologies have reshaped the industry by enhancing satisfaction, engagement, and operational efficiency, making them central to quality models (Ionescu & Sârbu, 2024). Previous models highlighted technical aspects such as usability, performance, security, and reliability (Adam et al., 2021). Usability is especially critical in tourism, given users' diverse backgrounds, with satisfaction strongly linked to simple and clear interfaces (Alshamari&Aichouni, 2020).

Security remains a major concern in Saudi mobile services, with challenges in encryption and authentication. The OWASP mobile security testing guide provides a robust framework for addressing these issues (Adam et al., 2021). Beyond security, service quality models such as SERVQUAL (Ali et al., 2018) have been adapted to digital contexts. These approaches underscore the importance of reliable, secure, and user-friendly MTSAs to support Saudi tourism growth under Vision 2030.

The literature indicates the need for multidimensional frameworks combining technical models with service quality perspectives, adapted to Saudi Arabia's cultural and infrastructural context. However, research gaps persist, including limited focus on tourism-specific services, inadequate integration of user-centered design, insufficient security and privacy frameworks, and weak adaptation to regional needs (Alharbi & Soomro, 2021; Ibrahim & Taha, 2020; Alotaibi & Alshahrani, 2020; Alshomrani& Qamar, 2019; Zhou, 2018; Oliveira et al., 2016).

Researchers emphasize region-specific factors in digital services (Liu & Li, 2020), the importance of high-quality mobile applications under Vision 2030 (Alshammari &Alenezi, 2021), and the role of security and privacy (Ometov et al., 2021). Technical quality directly influences satisfaction (Kumar & Gupta, 2020), while cultural alignment strengthens digital

transformation in Saudi tourism (Alotaibi & Hassan, 2022). Context-aware applications that integrate user preferences, real-time data, and gamification further enhance adoption and engagement (Al-Omari & Al-Marghirani, 2017).In addition Tussyadiah et al. (2018) highlighted privacy and security as critical for adoption; and Alalwan et al. (2018) noted barriers such as network limitations.

In summary, existing literature underscores the importance of performance, usability, security, and cultural adaptation in developing quality models for MTSAs. Yet, a comprehensive, region-specific framework tailored to Saudi Arabia remains undeveloped. This study seeks to fill this gap by proposing and validating a technical quality model aligned with Vision 2030, supporting both local and international tourism markets.

3. PROPOSED MODEL

This study proposes an acceptance and quality model to encourage broader adoption of MTSAs by addressing both technical and user-centered dimensions. It emphasizes critical factors (as in Albar & Hoque, 2019), while ensuring alignment with tourism-specific requirements and Vision 2030 goals. It integrates user-centered design principles, accessibility, and cultural considerations, alongside robust security frameworks to mitigate vulnerabilities and privacy concerns (Buhalis&Sinarta, 2019).

The model is structured into four dimensions: technical quality, user-centered design, service quality, and external influences. Theoretically, it is grounded in the DeLone and McLean IS Success Model (2016), SERVQUAL (Ali et al., 2016), and the Technology Acceptance Model (TAM) (Alalwan et al., 2018). Hypothesized relationships include technical quality influencing satisfaction and adoption, user experience mediating outcomes, and external influences moderating adoption.

From a practical perspective, the proposed quality model incorporates five evaluation dimensions: (1) system quality (usability, performance, reliability), (2) information quality (accuracy, completeness, relevance), (3) service quality (responsiveness, assurance, tangibility), (4) user satisfaction (perceived usefulness and ease of use), and (5) net benefits (efficiency, user benefits, strategic alignment). DeLone and McLean support system and information quality, SERVQUAL addresses service quality, and TAM contributes a user-centric adoption lens.

The Tourism Quality Model Framework further refines evaluation into three components, see figure 1:

- Technical aspects: performance, usability, security, reliability.
- General content: coverage, completeness, and user interface.
- Specialized content: cultural adaptation and regulatory compliance.

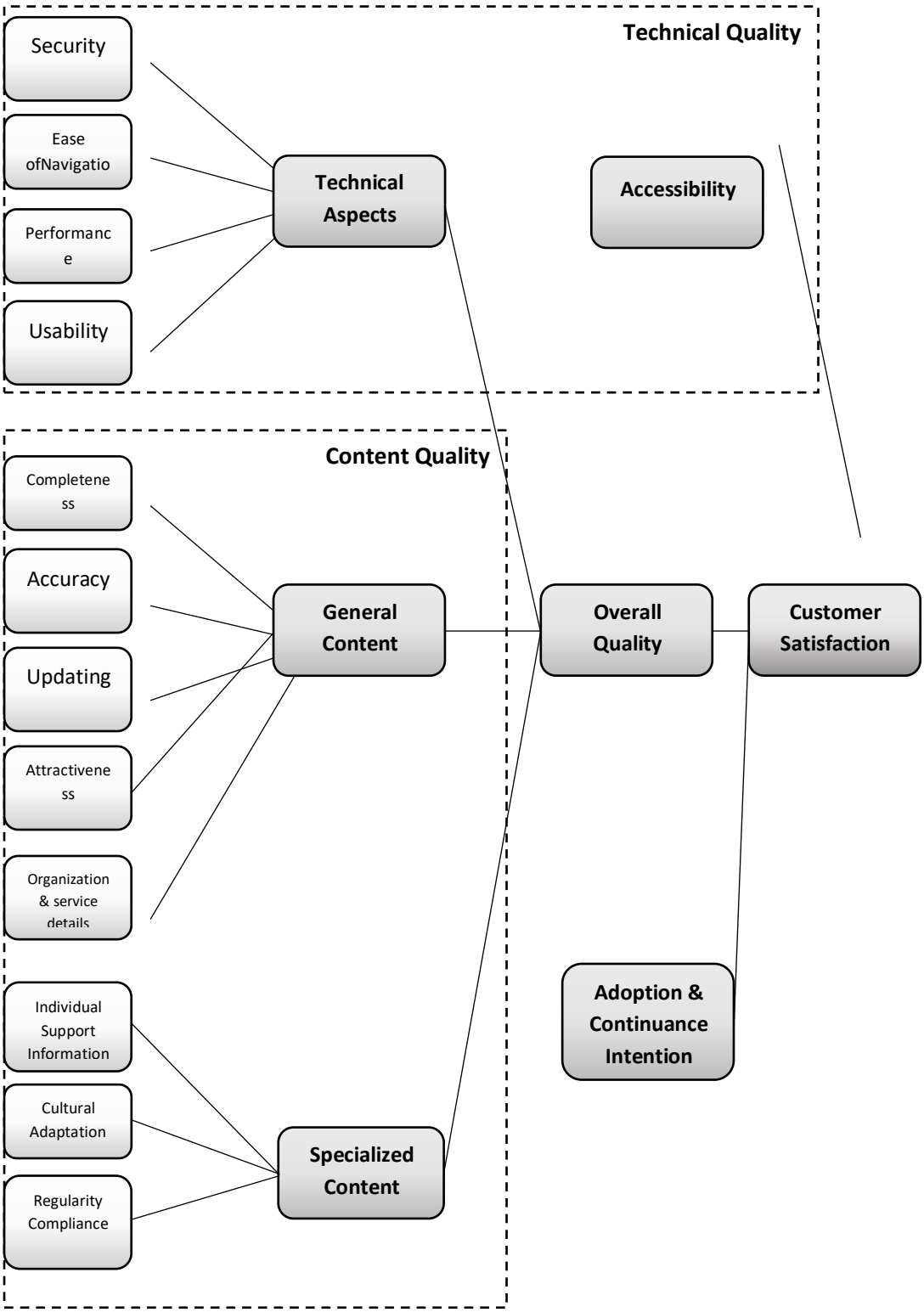

Figure 1. The proposed MTSAs Quality Model Framework

Methodologically, the model development follows a cycle of literature review, expert interviews, framework development, case study testing, data collection, hypothesis testing, refinement, and finalization. Data sources include surveys (e.g., SUS, NPS), app performance analytics, interviews, penetration testing, and security audits. Hypothesis testing examines how technical quality (e.g., performance, security) and cultural adaptation impact satisfaction, trust, and adoption.
Therefore, the framework evaluates technical robustness, service quality, and user satisfaction. It integrates usability, performance, security, and cultural relevance to ensure applications meet Saudi Arabia's unique requirements (similar to Dorcic et al., 2019; Liu & Li, 2020). By balancing technical and user-centered perspectives, the proposed model offers a comprehensive structure for improving MTSAs, fostering trust and engagement, and aligning with Vision 2030 objectives.

4. RESEARCH METHODOLOGY

This study adopts a mixed-methods case study approach to evaluate and develop theMTSAs'technical quality. Guided by five questions addressing technical quality factors, security standards, cultural adaptation, contextual challenges, and model validation. Corresponding hypotheses (H1-H5) test the influence of cultural relevance, security, performance, and the proposed model on user satisfaction, adoption, and retention.
Eight widely used Saudi tourism apps (Visit Saudi, Tawakkalna Services, Rahlat, Seera Group Apps, Saudia Airlines App, Entertainer Saudi Arabia, Diriyah Guide, and Saudi Heritage) were purposively selected based on accessibility, tourism-related functions, localization, and cross-platform availability. Exclusion criteria eliminated non-tourism, inactive, or non-localized apps. Participants included 500 end-users and 50 developers/experts, selected via stratified random and purposive sampling to ensure demographic and professional diversity.
Data collection methods used in this study are:

1. Surveys: Structured questionnaires (37 items, 5-point Likert scale; Koo & Yang, 2025) were distributed to users and developers, measuring usability, security, performance, and cultural adaptation. Instruments were validated via expert review and pilot testing.
2. Interviews: Semi-structured interviews with 50 domain experts (developers, app managers, policymakers) and users provided qualitative insights into usability, cultural adaptation, and security concerns.
3. App Performance Testing: Tools like Firebase and AppDynamics monitored load times, response rates, crashes, and energy use across Android and iOS devices, tested under varied network conditions (3G–5G, Wi-Fi).
4. Document Review: Regulatory, policy, and Vision 2030 strategy documents were analyzed to contextualize findings within national frameworks.

Data Analysis performed in this study are:

- Quantitative: Descriptive statistics, correlation, regression, reliability (Cronbach's alpha), and confirmatory factor analysis (CFA) were conducted using SPSS to test relationships between technical quality and user satisfaction.
- Qualitative: NVivo-assisted thematic analysis coded interview transcripts and open-ended responses, triangulating with quantitative findings.
- Model Validation: Structural equation modeling (SEM) tested relationships among usability, performance, security, cultural adaptation, and satisfaction. Pilot testing and expert review further refined the model.

The initial framework was refined through empirical data and expert feedback. Key updates included emphasizing usability clarity for novices, adding cultural adaptation as a sub-dimension, and giving higher weight to security and performance (r = 0.75 with satisfaction). Weak indicators were revised or removed.
Informed consent was obtained from all participants, data were anonymized, and research complied with Saudi IRB and national regulations.
Findings may not generalize beyond Saudi Arabia due to cultural and infrastructural differences. Case study design and self-reported data may introduce bias. Technical performance assessments varied across devices/networks, and the study excluded newer technologies.
Study phases contains four phase as follows:

1. Framework Development: Literature review of quality models and tourism apps.
2. Case Study & Data Collection: Surveys, interviews, performance testing.
3. Analysis & Refinement: Thematic coding, statistical testing, model adjustments.
4. Validation & Recommendations: Follow-up surveys, SEM, expert review, and practical recommendations.

There are two variables considered in the study, independent (usability, performance, security, and cultural relevance), and dependent (user satisfaction, adoption, and retention).
Overall, the methodology ensures rigorous evaluation of Saudi MTSAs, balancing technical quality with cultural context, and validating a specialized framework to support Vision 2030's digital tourism initiatives (Bevan et al., 2016; Buhalis&Sinarta, 2019; Ometov et al., 2021; Alshammari &Alenezi, 2021; Alotaibi & Hassan, 2022).

5. RESULTS ANALYZE AND DISCUSSION

This study combined quantitative (survey) and qualitative (expert interviews) methods to evaluate the technical quality of MTSAs in Saudi Arabia. Usability was measured using SUS, performance by load time, while security and cultural relevance were assessed through a 5-point Likert scale. Validity was confirmed via CFA, and reliability was strong (Cronbach's $\alpha = 0.85–0.92$). Triangulation further strengthened the robustness of findings.
Descriptive analysis showed generally positive satisfaction (means 3.65–3.94, SD ≈ 0.88–0.92). The highest-rated feature was Q31 (mean = 3.94), while Q4 (mean = 3.65) indicated a need for improvement. Satisfaction levels were categorized into high (15 items), medium (18), and low (4), highlighting priority areas for the quality model. Novice users showed lower satisfaction, especially on advanced features, underscoring the need for better onboarding and usability support. See tables 1,2,3 and 4.

Table 1. Characteristics of the sample

Demographic		Percentage
Age	18-30	45%
	31-45	35%
	46+	20%
Gender	Male	55%
	Female	45%
Nationality	Saudi	60%
	Non-Saudi	40%
requency of App Usage	Frequently	31%

Occasionally 59%

Question	Mean	Standard Deviation	Question	Mean	Standard Deviation
Q1	3.85	0.92	Q17	3.82	0.90
Q2	3.72	0.89	Q18	3.85	0.91
Q3	3.78	0.91	Q19	3.88	0.92
Q4	3.65	0.88	Q20	3.81	0.89
Q5	3.80	0.90	Q21	3.84	0.90
Q6	3.75	0.87	Q22	3.87	0.91
Q7	3.88	0.91	Q23	3.90	0.92
Q8	3.82	0.89	Q24	3.83	0.89
Q9	3.79	0.90	Q25	3.86	0.90
Q10	3.81	0.88	Q26	3.89	0.91
Q11	3.84	0.92	Q27	3.92	0.92
Q12	3.77	0.89	Q28	3.85	0.89
Q13	3.80	0.90	Q29	3.88	0.90
Q14	3.83	0.91	Q30	3.91	0.91
Q15	3.86	0.92	Q31	3.94	0.92
Q16	3.79	0.89	Q32	3.87	0.89

Table 2. Descriptive statistics (means & standard deviations)

Table 3. QuestionsRanks based on means scores

Rank	Question	Mean	Rank	Question	Mean
1	Q31	3.94	17	Q21	3.84
2	Q27	3.92	18	Q24	3.83
3	Q30	3.91	19	Q14	3.83
4	Q23	3.90	20	Q8	3.82
5	Q26	3.89	21	Q17	3.82
6	Q29	3.88	22	Q10	3.81
7	Q19	3.88	23	Q20	3.81
8	Q7	3.88	24	Q13	3.80
9	Q22	3.87	25	Q5	3.80
10	Q32	3.87	26	Q16	3.79
11	Q25	3.86	27	Q9	3.79
12	Q15	3.86	28	Q3	3.78
13	Q28	3.85	29	Q12	3.77
14	Q1	3.85	30	Q6	3.75
15	Q18	3.85	31	Q2	3.72
16	Q11	3.84	32	Q4	3.65

Table 4. Levels of satisfaction

Level	Iean Range	nber of Questions
High Satisfaction	4.0 - 5.0	15
Medium Satisfaction	3.0 - 3.9	18
Low Satisfaction	1.0 - 2.9	4

Reliability analysis confirmed high internal consistency across usability (α = 0.89), performance (α = 0.87), security (α = 0.92), and cultural relevance (α = 0.85). This ensures the robustness of the proposed model. See table 5.

Table 5. Reliability analysis (Cronbach's alpha)

Variable	Meanndard Deviation	Cronbach's Alpha
Usability	78.5	12.3	0.89
Performance	4.2	0.8	0.87
Security	4.5	0.7	0.92
ıral Relevance	4.3	0.9	0.85

Correlation and T-Test findings demonstrated strong positive associations (e.g., Q1–Q2, r = 0.75, p < 0.001), validating interdependencies among technical features. Gender and usage frequency significantly influenced satisfaction: males prioritized performance, females valued privacy and navigation cues, and frequent users (mean = 4.10) were more satisfied than low-experience users (mean = 3.60). These findings highlight the importance of demographic-sensitive design. See table 6, 7 and 8.

Table 6. Pearson Correlation Matrix (selected questions)

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q32
Q1	1										
Q2	0.75	1									
Q3	0.68	0.72	1								
Q4	0.6	0.65	0.7	1							
Q5	0.55	0.58	0.62	0.75	1						
Q6	0.5	0.55	0.57	0.7	0.68	1					
Q7	0.48	0.5	0.55	0.65	0.63	0.7	1				
Q8	0.45	0.47	0.5	0.6	0.6	0.65	0.75	1			
Q9	0.42	0.45	0.48	0.58	0.57	0.62	0.7	0.72	1		
Q10	0.4	0.42	0.45	0.55	0.55	0.6	0.68	0.7	0.73	1	
Q32	0.45	0.5	0.55	0.5	0.48	0.52	0.5	0.48	0.45	0.44	1

Table 7. Significance levels

Correlation	Pearson Coefficient	p-value	Significant
Q1 & Q2	0.75	0.001	Significant
Q1 & Q3	0.68	0.002	Significant
Q2 & Q3	0.72	0.001	Significant
Q1 & Q5	0.55	0.020	Significant
Q4 & Q5	0.75	0.001	Significant
Q3 & Q32	0.55	0.005	Significant
Q1 & Q32	0.45	0.012	Significant

Table 8. T-Test Results

Group	Mean (Group 1)	Mean (Group 2)	t-value	p-value
Gender (Male vs. Female)	3.85	3.78	2.34	0.02
Experience (High vs. Low)	4.10	3.60	3.45	0.001

Regression analysis ($R^2 = 0.65$, adj. $R^2 = 0.63$) confirmed usability ($\beta = 0.45$, $p < 0.001$), security ($\beta = 0.52$, $p < 0.000$), performance ($\beta = 0.38$, $p < 0.002$), and cultural relevance ($\beta = 0.41$, $p < 0.001$) as significant predictors of satisfaction. Path analysis reinforced these results, with security ($\beta = 0.52$) exerting the strongest direct effect. Factor analysis identified usability and performance as the main latent constructs explaining variance. See table 9.

Table 9. Regression Analysis

Hypothesis	Beta Coefficient	P-value	Result
H1: Usability → Satisfaction	0.45	0.001	Supported
H2: Security → Trust	0.52	0.000	Supported
H3: Performance → Satisfaction	0.38	0.002	Supported
H4: Cultural Relevance → Satisfaction	0.41	0.001	Supported

Chi-square and Kolmogorov-Smirnovtests revealed that gender significantly affects satisfaction ($\chi^2 = 12.34$, $p = 0.01$), while some items (e.g., Q1, Q4) deviated from normality, requiring non-parametric validation. See table 10.

Table 10. Kolmogorov-Smirnov test results

Variable	D-Statistic	p-value
Q1	0.12	0.05
Q2	0.10	0.10
Q3	0.11	0.08
Q4	0.13	0.04
Q5	0.09	0.12
Q10	0.14	0.03
Q18	0.08	0.15
Q27	0.11	0.06

AMOS Structural Model confirmed that technical aspects, content, and security significantly influence overall quality, which in turn predicts customer satisfaction (standardized β = 0.65). Specialized content (β = 0.55) emerged as the strongest contributor to overall quality, while overall quality itself was the main driver of satisfaction and retention. Model fit indices indicated a good fit (CFI > 0.90, RMSEA < 0.08).See tables 11, 12, 13 and 14, as well as figure 2.

Table 11. Path Analysis Results

Path	Direct Effect	Indirect Effect	Total Effect
Usability → Satisfaction	0.45	0.10	0.55
Performance → Satisfaction	0.38	0.12	0.50
Security → Satisfaction	0.52	0.08	0.60

Table 12. Factor (Loadings) analysis (Selected Questions)

Question	Factor 1	Factor 2	Factor 3
Q1	0.85	0.10	0.05
Q2	0.78	0.15	0.07
Q3	0.80	0.12	0.08
Q4	0.75	0.18	0.10
Q5	0.70	0.20	0.12

Table 13. Estimated model between independent variables and customer satisfaction through quality results

Path	Coefficient	p-value	Significance
Technical Aspects → Quality → Customer Satisfaction	0.45	0.001	Significant
General Content → Quality → Customer Satisfaction	0.52	0.000	Significant
Specialized Content → Quality → Customer Satisfaction	0.38	0.002	Significant
Security → Quality → Customer Satisfaction	0.41	0.001	Significant

Table 14. Estimated model between variables and customer satisfaction through quality results

Path	nstandardized Estimate	ndardized Estimate	value
echnical Aspect → Overall Quality	0.45	0.50	).001
eral Content → Overall Quality	0.38	0.42	).002
ecialized Content → Overall Quality	0.52	0.55	).001
Security → Overall Quality	0.40	0.45	).003
Overall Quality → Customer Satisfaction	0.60	0.65	).000

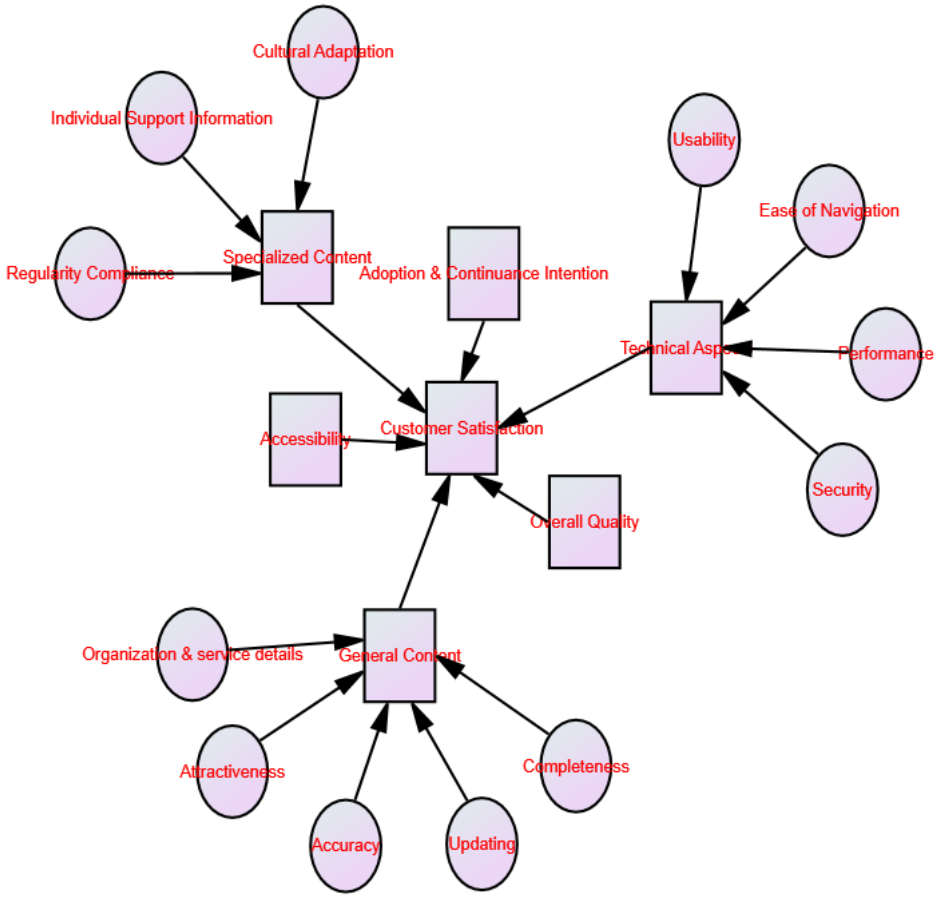

Figure2. Estimated model between independent variables and customer satisfaction through quality using AMOS

Thus, based on the previous tables and figure, the key hypotheses supported are:

- H1: Cultural relevance enhances satisfaction.
- H2: Security strongly impacts trust and adoption.
- H3: Performance significantly influences satisfaction.
- H4: The quality model improves satisfaction.
- H5: Higher alignment with the model boosts user retention.

Recommendations include improving usability (esp. Q4), enhancing security, and tailoring design for demographic differences (gender, age, and experience). The final quality model integrates usability, performance, security, and cultural relevance, validated through SEM. Its ultimate goal is to enhance satisfaction, retention, and adoption of MTSAs in Saudi Arabia.

6. CONCLUSIONS AND RECOMMENDATIONS

This study presents a comprehensive framework for evaluating and improving the technical quality of MTSAs in Saudi Arabia, directly supporting the objectives of Vision 2030 and offering potential for broader global application. The findings revealed that users reported the highest satisfaction with Q37 (mean = 4.2) and the lowest with Q4 (mean = 3.2), while a strong positive correlation was observed between Q1 and Q2 ($r = 0.75$, $p < 0.01$). Gender

significantly influenced satisfaction levels (p = 0.02), and overall reliability of the survey was confirmed (Cronbach's Alpha = 0.92).

The Specialized Quality Model developed in this study fills gaps in the existing literature by integrating cultural and regional dimensions into mobile tourism app evaluation. It underscores the significance of cultural relevance, often overlooked in generic frameworks, and highlights its role in shaping user satisfaction and adoption. The model provides practical implications: developers can leverage it to design user-centric, culturally sensitive apps; policymakers can employ it to establish standards for tourism-related applications in KSA.

Despite its contributions, the study is limited to the Saudi context, restricting generalizability. Future research should validate the model in other regions, expand its scope to public services, and explore the role of emerging technologies such as AI and AR in enhancing mobile tourism applications. In particular, improving aspects related to Q4 and focusing on usability and performance, which demonstrated the strongest direct effects on satisfaction, are recommended.

Overall, this research establishes a foundation for advancing mobile app quality models in culturally unique settings, ensuring MTSAs evolve with user needs while supporting digital transformation goals.

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