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IMPACT OF DIGITAL PLATFORM USABILITY AND SMART SERVICE QUALITY ON PILGRIM SATISFACTION IN MAKKAH: A STUDY OF THE NUSUK PLATFORM

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Abstract

Guided by the ambitious objectives of Saudi Vision 2030, this study explores how digital infrastructure influences the pilgrim experience in Makkah, focusing specifically on the Nusuk platform. As Saudi Arabia transitions toward a "Smart Tourism" ecosystem, understanding the interplay between technical usability and service quality has become essential for ensuring spiritual and logistical success. This research adopted a quantitative approach, analyzing responses from 161 pilgrims. Initial testing confirmed the high reliability of the research instrument, with Cronbach's Alpha scores for Digital Platform Usability (DPU), Smart Service Quality (SSQ), and Pilgrim Satisfaction (PS) all exceeding the .80 threshold. The resulting regression model proved to be statistically significant ($F=46.262$, $p<.001$), successfully explaining 37.1% of the variance in overall satisfaction levels. The data analysis supported two primary hypotheses: H1: Digital Platform Usability exerts a significant positive influence on Pilgrim Satisfaction ($\beta=.400$, $p<.001$). H2: Smart Service Quality contributes significantly and positively to Pilgrim Satisfaction ($\beta=.376$, $p<.001$). The findings suggest that while advanced "smart" features are vital, the ease with which a pilgrim can navigate the digital interface remains the most critical driver of their contentment. These results provide a clear roadmap for the Ministry of Hajj and Umrah: to reach the target of 30 million annual visitors, digital platforms must prioritize a frictionless user experience alongside technological innovation.

Keywords: Nusuk Platform, Digital Platform Usability, Smart Service Quality, Pilgrim Satisfaction, Saudi Vision 2030.

Introduction

The pilgrimage to Makkah, encompassing both the Hajj and the year-round Umrah, is far more than a logistical challenge (Khan, A. A., & Khan, M. 2010).); it is one of the most profound spiritual undertakings on Earth. For the Kingdom of Saudi Arabia, managing these sacred sites is both a sovereign duty and the emotional heart of Saudi Vision 2030. This national blueprint isn't just about economic shifts; it's an ambitious promise to transform the pilgrim experience, aiming to welcome 30 million Umrah visitors annually by the end of the decade (Ul Haq, et al. 2020). To make a scale of this magnitude possible, the Kingdom is moving away from traditional paperwork and into a Smart Tourism ecosystem where technology acts as the primary bridge between the pilgrim and their spiritual goals.

At the center of this digital rebirth is the Nusuk platform. Launched as an official, unified gateway, Nusuk serves as a one-stop-shop designed to remove the friction from the journey. It pulls together a fragmented array of services, everything from e-visas and high-speed Haramain Railway bookings to the critical reservation of time slots for prayer in the Rawdah, into a single, intuitive interface (Hidayat et al.2021). The goal is simple yet profound: to ensure that the "Guests of Allah" can navigate their logistics with ease, allowing them to focus entirely on their worship. However, as we rely more on this digital backbone, two factors emerge as the real gatekeepers of success: Digital Platform Usability and Smart Service Quality. Usability is the measure of how easily a global population, representing over 180 nationalities, can actually use the app. When you consider that these pilgrims bring vastly different levels of digital literacy and speak dozens of languages, the platform's current support for 7 core languages becomes a vital lifeline. Alongside this, Smart Service Quality represents the intelligence behind the screen, the AI-powered identity checks, secure e-wallets, and personalized logistics that make a modern pilgrimage feel both safe and tailored (Alam, et al, 2015).

The core problem, however, lies in the potential tech-gap. There is a delicate balance between a system's technical brilliance and a human being's experience under pressure (Ahmed, M. et al, 2014). While Saudi Arabia has deployed cutting-edge tools like the Wakeb system for real-time crowd monitoring and GPS-guided navigation, these tools are only as effective as the pilgrim's ability to use them. If a 10-step registration sequence feels like a hurdle rather than help, or if the system lags during a high-stress moment in the Holy Sites, the primary mission of enhancing pilgrim satisfaction is at risk.

Current academic literature has a noticeable blind spot here. While there are plenty of studies on general e-government apps or standard tourism (Alam, A. et al. 2016), very few look at the unique intersection of usability and service quality in the high-stakes, deeply emotional context of Makkah. Most research looks at the big-picture goals of Vision 2030, but it often misses the micro-interactions, the moments where a pilgrim's satisfaction is decided by a few taps on a screen. This study aims to bridge that gap. Theoretically, it takes the "Smart Tourism" framework and applies it to a world of faith, exploring how silicon and software can mediate a spiritual experience. Practically, it offers the Saudi Ministry of Hajj and Umrah a data-driven mirror. By understanding exactly how usability and service quality move the needle on satisfaction, developers can refine Nusuk to be more than just a tool, it can be a companion. Ultimately, this work supports a mission far greater than logistics: ensuring that every pilgrim can complete their rituals with the comfort, safety, and spiritual focus they deserve.

Literature Review

The transition toward a smart pilgrimage in Makkah is driven by the integration of advanced digital systems aimed at managing millions of visitors efficiently. This literature review explores the theoretical and empirical foundations of the core variables: Digital Platform Usability, Smart Service Quality, and Pilgrim Satisfaction, followed by the development of the research hypotheses.

1. Digital Platform Usability (DPU)

Digital platform usability refers to the extent to which a system can be used by specific users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context (Ahmad et al. 2021). In the realm of smart pilgrimage, usability is synonymous with the functionality of the Nusuk platform. Recent studies highlight that a seamless digital experience is the primary driver for beneficiaries to engage positively with government platforms. For a platform like Nusuk, usability encompasses a 10, step AI-powered registration process and multilingual support (currently in 7 languages) to accommodate a global demographic. Literature suggests that high-threshold or complex content management systems often lead to user disengagement; therefore, a low-threshold design that allows for autonomous updates and easy navigation is essential for platforms serving non-specialist users like pilgrims.

2. Smart Service Quality (SSQ)

Smart Service Quality extends beyond traditional service metrics to include the integration of Industry 4.0 technologies, such as Artificial Intelligence (AI), the Internet of Things (IoT), and big data, to enhance service delivery. In Makkah, smart service quality is characterized by Smart Hajj initiatives, including AI-powered crowd intelligence, biometric verification at entry points, and wearable smart bands for real-time health and location monitoring (Shah, 2024). Research indicates that for religious tourism, service quality is determined by five dimensions: tangibility, responsiveness, empathy, assurance, and reliability. In a digital context, Smart quality is specifically measured by the system's ability to provide real-time updates, AI-driven chatbots for religious inquiries, and automated logistics that reduce the physical and mental burden on the pilgrim.

3. Pilgrim Satisfaction (PS)

Pilgrim Satisfaction is defined as a positive psychological response and an emotional state formed after the completion of the pilgrimage experience (Albahar et al. 2023). Traditionally, satisfaction in Makkah was rooted in spiritual fulfillment and the attainment of religious goals. However, contemporary literature argues that the modern pilgrim has also become a customer, who evaluates satisfaction based on logistical preparation, service excellence, and digital engagement. Satisfaction is now increasingly mediated by Smart Technologies, where the quality of digital interaction determines the overall perception of the journey. High satisfaction levels are critical for the Saudi Vision 2030, as they directly correlate with positive word-of-mouth and the long-term competitiveness of Makkah as a global religious destination.

4. Hypotheses Development

The Relationship Between Digital Platform Usability and Pilgrim Satisfaction

The literature consistently demonstrates a noteworthy positive correlation between usability and user satisfaction in digital platforms. In the context of e-government services, platforms that offer easy-to-navigate options and updated information significantly increase the likelihood of user satisfaction (Tsatsani et al. 2024). When pilgrims can easily navigate the Nusuk app to book permits or manage travel packages without technical friction, their overall experience is enhanced.

- **H_1:** Digital Platform Usability (DPU) has a positive and significant impact on Pilgrim Satisfaction (PS).

The Relationship Between Smart Service Quality and Pilgrim Satisfaction

Empirical evidence suggests that superior service quality is essential for building trust and fostering loyalty in the tourism industry (Cheunkamon et al. 2022). Smart technologies enable "personalized, immersive, and sustainable" travel experiences that meet the evolving expectations of modern travelers. In Makkah, the implementation of Smart Hajj tools, such as AI algorithms that prevent overcrowding and digital e-wallets that ensure secure transactions, contributes to a safer and more responsive service environment. Studies have confirmed that enhancing service quality is a critical element that fundamentally influences user satisfaction in high-pressure service environments.

- **H_2:** Smart Service Quality (SSQ) has a positive and significant impact on Pilgrim Satisfaction (PS).

Theoretical Underpinning

The theoretical foundation of this study is primarily anchored in the DeLone and McLean (D&M) Information Systems (IS) Success Model, complemented by the Expectancy Disconfirmation Theory (EDT). These theories provide a robust framework for understanding how the technical and service-oriented attributes of the Nusuk platform influence the psychological and logistical outcomes for pilgrims.

1. DeLone and McLean Information Systems Success Model

The D&M IS Success Model is one of the most widely recognized frameworks for evaluating the effectiveness of digital systems (Saba et al. 2025). In the context of the Nusuk platform, the model posits that the success of an information system is a multidimensional construct determined by several interrelated factors:

- System Quality (Digital Platform Usability): In this research, the variable of Digital Platform Usability (DPU) aligns with the D&M dimension of "System Quality." It focuses on the technical performance of the app, including its ease of use, navigation, and reliability. According to the model, when a system is highly usable, it directly leads to increased user satisfaction.
- Service Quality (Smart Service Quality): The study's focus on Smart Service Quality (SSQ) is represented by the "Service Quality" dimension of the D&M model. This refers to the support and responsiveness provided by the system, such as AI-driven assistance, real-time updates, and secure payment processing. The model suggests that high service quality is a prerequisite for generating positive user responses.
- User Satisfaction (Pilgrim Satisfaction): Within the D&M framework, "User Satisfaction" is the critical bridge between the system's performance and the ultimate benefits realized by the user. This study treats Pilgrim Satisfaction (PS) as the primary outcome, reflecting the pilgrim's emotional and practical evaluation of the digitalized journey.

2. Expectancy Disconfirmation Theory (EDT)

While the D&M model defines the technical and service inputs, the Expectancy Disconfirmation Theory (EDT) explains the cognitive process behind Pilgrim Satisfaction (Albahar et al 2023). Developed by Oliver (1980), EDT suggests that satisfaction is a result of a comparison between a user's initial expectations and the actual performance of the service (Cho, 2017).

In the context of Makkah's digital transformation:

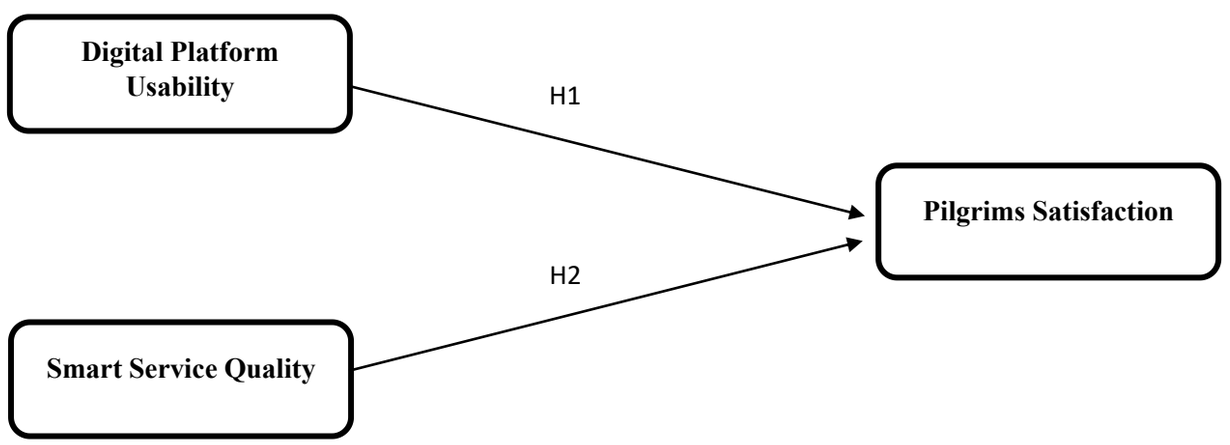
- Pilgrims arrive with high expectations shaped by the global reputation of Saudi Vision 2030 and the promise of a Smart Hajj.
- The perceived performance is determined by their actual interaction with the Nusuk platform (its usability and service quality).
- Satisfaction occurs through positive disconfirmation when the ease of booking permits and the efficiency of AI-powered services meet or exceed the pilgrim's expectations.

3. Synthesis: The Study Framework

By integrating these two theories, this research establishes a comprehensive lens through which to analyze the Nusuk platform. The D&M IS Success Model identifies the specific technological drivers (DPU and SSQ) that constitute the Smart environment of Makkah. Simultaneously, EDT provides the psychological basis for measuring how these drivers culminate in Pilgrim Satisfaction.

Together, these theories explain the study's central premise: that a usable and high-quality digital platform is not merely a technical tool, but a strategic asset that fulfills the spiritual and logistical expectations of the guests of Allah, thereby supporting the overarching goals of Saudi Vision 2030.

Research Framework



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Methodology

The methodology employed in this study is designed to empirically investigate the relationship between digital infrastructure and the pilgrim experience in Makkah. It follows a quantitative, descriptive, and analytical approach to ensure the findings are robust and generalizable to the target population.

1. Research Design

This study utilizes quantitative research design with a cross-sectional survey method to collect data from pilgrims who have used the Nusuk platform. A deductive approach is applied, where hypotheses derived from existing Smart Tourism and E-Service Quality literature are tested using primary data. The research framework focuses on measuring the impact of two independent variables, Digital Platform Usability (DPU) and Smart Service Quality (SSQ), on the dependent variable, Pilgrim Satisfaction (PS).

2. Population and Sampling

The target population consists of international pilgrims in Makkah who utilized digital platforms for their religious journey.

- **Sampling Technique:** A simple random sampling method was employed to ensure that every pilgrim using the Nusuk application had an equal opportunity to participate, thereby reducing selection bias.
- **Sample Size:** The study gathered data from 161 valid responses. This sample size is consistent with similar digital transformation studies in the region, which often utilize sample sizes ranging from 100 to 155 participants for structural or regression-based analysis.

3. Data Collection Instrument

The primary data collection tool was a structured electronic questionnaire distributed via digital channels. The instrument was divided into four sections:

1. **Demographics:** Age, nationality, and frequency of pilgrimage.
2. **Digital Platform Usability (9 items):** Adapted from Nielsen's usability heuristics and the USE questionnaire, focusing on ease of use, navigation, and learnability.
3. **Smart Service Quality (9 items):** Based on the SERVQUAL model and Smart Tourism, scales, measuring responsiveness, AI-driven personalization, and reliability.
4. **Pilgrim Satisfaction (9 items):** Measuring overall contentment with the digitalized journey and willingness to recommend the platform.

4. Data Analysis Procedures

Statistical analysis was conducted using SPSS. The analysis proceeded in three phases:

- **Reliability Analysis:** Cronbach's Alpha was calculated to ensure the internal consistency of the scales.
- **Correlation Analysis:** Pearson Correlation was used to identify the strength and direction of the relationships between variables.
- **Regression Analysis:** Multiple linear regression was performed to determine the predictive power of DPU and SSQ on Pilgrim Satisfaction.

Reliability Analysis:

Reliability was measured using Cronbach's Alpha to ensure that the internal consistency of the research instrument was adequate for each variable.

Digital Platform Usability		Smart Service Quality		Pilgrim Satisfaction	
Cronbach's Alpha	N of Items	Cronbach's Alpha	N of Items	Cronbach's Alpha	N of Items
.809	09	.817	09	.853	09

All variables exceeded the recommended threshold of 0.70, indicating that the scales are highly reliable and the items are internally consistent. Pilgrim Satisfaction showed the highest reliability at .853

Descriptive Statistics:

Descriptive statistics provide an overview of the central tendency and dispersion of the responses collected from the 161 participants.

	N	Minimum	Maximum	Mean	Std. Deviation
DPU	161	31.00	49.00	37.3375	3.00709
SSQ	161	31.00	49.00	37.5093	2.87254
PS	161	32.00	59.00	41.9130	3.50248

The Mean scores indicate a generally positive perception of the Nusuk platform. Pilgrim Satisfaction holds the highest mean score (41.91), suggesting that users are largely satisfied with the overall experience. The relatively low Standard Deviations suggest that the responses are closely clustered around the mean, indicating a high level of agreement among pilgrims.

Correlation Analysis:

Pearson Correlation was used to determine the strength and direction of the relationships between the independent variables (DPU, SSQ) and the dependent variable (PS).

		DPU	SSQ	PS
DPU	Pearson Correlation	1	.230**	.487**
SSQ	Pearson Correlation	.230**	1	.467**
PS	Pearson Correlation	.487**	.467**	1

**. Correlation is significant at the 0.01 level (2-tailed).

There is a moderate positive and statistically significant correlation between Digital Platform Usability and Pilgrim Satisfaction ($r = .487$, $p < .01$). Similarly, Smart Service Quality shows a significant positive correlation with Satisfaction ($r = .467$, $p < .01$). These results provide initial support for the research hypotheses.

Regression Analysis:

Multiple linear regression was conducted to assess how much of the variance in Pilgrim Satisfaction can be explained by Usability and Service Quality.

Model Summary:

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.609[a]	.371	.363	2.80466	.371	46.262	2	157	.000

a. Predictors: (Constant), SSQ, DPU

The model yielded an R Square of .371, which means that 37.1% of the variance in Pilgrim Satisfaction is explained by the combination of Digital Platform Usability and Smart Service Quality.

ANOVA[a]:

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	727.798	2	363.899	46.262	.000[b]
	Residual	1234.977	157	7.866		
	Total	1962.775	159			

a. Dependent Variable: PS

b. Predictors: (Constant), SSQ, DPU

The ANOVA table shows an F-value of 46.262 with a significance level of .000. This confirms that the regression model is statistically significant and a good fit for the data.

Coefficients[a]:

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	7.202	3.621		1.989	.048
	DPU	.468	.076	.400	6.156	.000
	SSQ	.459	.079	.376	5.779	.000

a. Dependent Variable: PS

Hypothesis 1 (H_1) Supported: Digital Platform Usability has a significant positive impact on Satisfaction (B = .468, p < .001). For every 1-unit increase in usability, satisfaction increases by .468 units.

Hypothesis 2 (H_2) Supported: Smart Service Quality also has a significant positive impact on Satisfaction (B = .459, p < .001).

Both variables are crucial, but Digital Platform Usability has a slightly higher relative impact (β = .400) compared to Smart Service Quality (β = .376) in determining the satisfaction of pilgrims in Makkah.

Discussion and Conclusion

The results of this study provide empirical evidence regarding the critical role of digital infrastructure in the pilgrim experience, specifically within the context of the Nusuk platform. This section discusses the findings in relation to the Saudi Vision 2030 and offers strategic recommendations for the Ministry of Hajj and Umrah.

1. Discussion of Findings

The statistical analysis confirms that both Digital Platform Usability (DPU) and Smart Service Quality (SSQ) are significant predictors of Pilgrim Satisfaction (PS).

- **The Dominance of Usability:** The findings indicate that DPU (beta = .400) has a slightly stronger relative impact on satisfaction than SSQ (beta = .376). This suggests that while advanced smart, features are essential, the user's ability to navigate the interface effectively is the primary driver of a positive experience. This aligns with the one-stop-shop, philosophy of Nusuk, which aims to simplify a complex, multi-step logistical journey into a user-friendly digital path.
- **The Role of Smart Services:** The significant impact of SSQ highlights that pilgrim value the integration of AI-powered document verification, real-time updates via systems like "Wakeb," and secure e-wallets. These features directly address the logistical challenges of high-density religious tourism, transforming the pilgrimage into a more personalized and secure experience.
- **Strategic Alignment with Vision 2030:** The model's ability to explain 37.1% of the variance in satisfaction underscores that digital transformation is not merely a technical upgrade but a fundamental component of Saudi Arabia’s goal to host 30 million Umrah pilgrims annually. By enhancing these digital touchpoints, the Kingdom directly improves the global competitiveness of its religious tourism sector.

2. Conclusion

This research concludes that the digitalization of the pilgrim journey via the Nusuk platform is a highly effective strategy for increasing satisfaction. The study successfully validated that high internal reliability and positive correlations exist between digital usability, service quality, and the emotional and logistical contentment of pilgrims. As Makkah continues its transition toward a Smart City model, the digital interface will remain the primary bridge between the Kingdom's hospitality and the global Muslim community.

3. Recommendations

Based on the results, the following recommendations are proposed for the Saudi Ministry of Hajj and Umrah and digital developers:

- **Prioritize Interface Simplification:** Given that usability is the strongest predictor, developers should continue to streamline the 10-step registration process to reduce cognitive load, especially for elderly or less tech-savvy pilgrims.
- **Expand Multilingual Capabilities:** While the platform currently supports 7 languages, expanding to more regional dialects and offering AI-driven real-time translation for customer support could further bridge the usability gap for a diverse global population.
- **Enhance Real-Time AI Feedback:** To improve Smart Service Quality, further integrate AI to provide predictive crowd management alerts, allowing pilgrims to choose the least crowded times for rituals like the Tawaf or visiting the Rawdah.
- **Strengthen Data Security Communication:** To maintain high satisfaction, the platform should clearly communicate its data protection protocols, ensuring pilgrims feel confident using the integrated digital e-wallet for all financial transactions.

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Appendix 1

Research Questionnaire

Scale: 1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

1.1 **Section A: Digital Platform Usability (DPU)**

No.	Statement	1	2	3	4	5
1	The Nusuk app interface is easy to navigate.					
2	I can quickly find the information I need on the platform.					
3	The registration and permit-booking process is simple and straightforward.					
4	The app's design is visually appealing and well organized.					
5	I did not require manual or external assistance to learn how to use the app.					
6	The app functions properly without frequent technical errors or crashes.					
7	The multilingual support (including my native language) is effective.					
8	The platform's buttons and icons are clear and easy to understand.					
9	It is easy to correct mistakes (such as entering incorrect data) within the app.					

1.2 **Section B: Smart Service Quality (SSQ)**

No.	Statement	1	2	3	4	5
1	The app provides real-time updates regarding my permits and bookings.					
2	The AI-based document verification process is fast and efficient.					
3	The digital e-wallet offers a secure method for making payments.					
4	The platform provides personalized service packages that meet my needs.					
5	The system delivers accurate information about crowd density and optimal visiting times.					
6	The digital customer service (such as the chatbot) responds promptly to my inquiries.					
7	The app integrates effectively with other services, such as transportation (Haramain Rail).					
8	I feel that my personal data is safe and secure on the Nusuk platform.					
9	The smart features of the app significantly reduced my physical waiting time.					

1.3 **Section C: Pilgrim Satisfaction (PS)**

No.	Statement	1	2	3	4	5
1	Overall, I am highly satisfied with the digital experience provided by Nusuk.					
2	The platform made my pilgrimage journey smoother and more seamless.					
3	I am satisfied with the quality of smart services available in Makkah.					
4	Using the digital platform enhanced my overall pilgrimage experience.					
5	The digital tools allowed me to focus more on my spiritual rituals.					
6	I would recommend the Nusuk platform to other pilgrims.					
7	The platform met my expectations of a smart and modern pilgrimage experience.					
8	I prefer using this digital platform over traditional methods.					
9	I am satisfied with the efficiency of the Saudi Ministry's digital transformation.					