

# **Pilgrim's Concern in Hajj- A Pilot Study and Initial Results**

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## **Abstract**

This study applies the SERVQUAL framework (Parasuraman et al., 1988) to systematically assess service quality dimensions—tangibility, reliability, Responsiveness, assurance, and empathy—in the context of Hajj services, one of the world's most complex mass gatherings. A mixed-methods approach integrates quantitative surveys (n=1,500 pilgrims) with qualitative focus groups (n=30 stakeholders) and advanced multivariate techniques, including Structural Equation Modeling (SEM), Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and cluster analysis, to model interrelationships among service dimensions, pilgrim satisfaction, and operational efficiency. Building on pilot study findings (where empathy [ $\beta=0.62$ ,  $p<0.01$ ] and reliability [ $\beta=0.58$ ,  $p<0.01$ ] emerged as strongest predictors of satisfaction, with service enhancements linked to cost efficiency [ $\beta=0.46$ ,  $p<0.01$ ]), the research tests hypotheses on expanded Hajj-specific dimensions (e.g., spiritual Guidance, safety/Security, health services, cultural Sensitivity, accessibility for vulnerable groups). A pilot intervention tested improvements to accommodation allocation via pre- and post-surveys, validating methodological robustness for scalability. Expected outcomes include a validated Hajj Service Quality Index (HSQI), empirically grounded policy recommendations for the Ministry of Hajj and Umrah, and sustainable service innovations that enhance pilgrim experience while supporting Vision 2030 objectives of excellence in religious tourism, operational efficiency, and inclusivity. This human-centric, statistically rigorous approach bridges methodological gaps in prior descriptive studies, offering actionable insights to optimize service delivery amid increasing pilgrim volumes and diversity.

## **Keywords**

Hajj SERVQUAL, Service Quality, Service Failure, Process Mapping, Structural Equation Modeling, Vision 2030, Religious Tourism

## **1. Introduction**

The annual Hajj pilgrimage is among the most complex religious gatherings in the world, attracting millions of Muslims from diverse backgrounds to the holy cities of Mecca and Medina. This massive congregation requires meticulous planning and execution of services to ensure a safe, dignified, and spiritually fulfilling experience for every pilgrim. The Kingdom of Saudi Arabia, as the custodian of the Two Holy Mosques, has invested significantly in infrastructure development and operational mechanisms to accommodate the growing number of pilgrims, which exceeded 2.5 million in pre-pandemic years (General Authority for Statistics, 2023).

Despite these substantial investments, challenges in service quality persist. Pilgrims frequently encounter difficulties related to transportation congestion, inadequate accommodation, limited healthcare access, crowd management, and communication barriers (Khan et al., 2021; Al-Harby & Al-Matrafi, 2022). These service failures not only diminish the pilgrim experience but also pose significant operational and reputational risks for the Kingdom's ambitious Vision 2030 objectives, which aim to position Saudi Arabia as a global leader in religious tourism (Kingdom of Saudi Arabia, 2016).

Previous research on Hajj services has predominantly focused on technological interventions, crowd simulation models, and infrastructure solutions (Al-Shaery et al., 2020; Felemban et al., 2020). While these approaches have

contributed valuable insights, they often overlook the human-centric dimensions of service quality that fundamentally shape pilgrims' perceptions and satisfaction. The SERVQUAL framework, established by Parasuraman et al. (1988, 1991), offers a comprehensive theoretical foundation for evaluating service quality across five key dimensions: tangibility, reliability, Responsiveness, assurance, and empathy. However, this framework has been underutilized in religious tourism contexts, particularly for mass gatherings such as the Hajj.

This study addresses this gap by adopting a human-centric service quality perspective, integrating traditional SERVQUAL metrics with Hajj-specific dimensions and advanced statistical methodologies. The research objectives are threefold: first, to assess gaps in current Hajj service delivery using an expanded SERVQUAL framework; second, to develop multivariate statistical models linking service dimensions to pilgrim satisfaction and operational efficiency; and third, to propose scalable, sustainable service innovations aligned with Vision 2030 objectives.

Unlike previous studies that have relied primarily on descriptive statistics, this research employs rigorous analytical techniques, including Structural Equation Modeling (SEM), Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and cluster analysis to capture the complex interdependencies among service dimensions. The pilot study presented here tests the methodological approach and provides preliminary evidence for the relationships between service quality dimensions and pilgrim outcomes.

The significance of this research extends beyond academic contribution. By providing empirically grounded insights into pilgrims' concerns and service expectations, the findings will inform policy development for the Ministry of Hajj and Umrah, guide service providers in optimizing resource allocation, and ultimately enhance the spiritual journey of millions of pilgrims. This aligns directly with Saudi Vision 2030's commitment to excellence in serving pilgrims and enriching their religious experience (Ministry of Hajj and Umrah, 2021).

## **2. Literature Review**

### **2.1 Service Quality Theory and the SERVQUAL Framework**

Service quality has been a central concern in marketing and operations management literature for decades. The seminal work by Parasuraman, Zeithaml, and Berry (1985, 1988) introduced the SERVQUAL model, which conceptualizes service quality as the gap between customers' expectations and their perceptions of actual service performance. The model identifies five universal dimensions of service quality:

1. **Tangibility:** Physical facilities, equipment, and appearance of personnel
2. **Reliability:** Ability to perform the promised service dependably and accurately
3. **Responsiveness:** Willingness to help customers and provide prompt service
4. **Assurance:** Knowledge and courtesy of employees and their ability to inspire trust
5. **Empathy:** Caring, individualized attention provided to customers

Subsequent research has validated and extended the SERVQUAL framework across diverse service contexts, including healthcare (Babakus & Mangold, 1992; Ramsaran-Fowdar, 2008), banking (Avkiran, 1994; Arasli et al., 2005), education (Abdullah, 2006), and tourism (Tribe & Snaith, 1998; Akbaba, 2006). However, its application to religious tourism and mass gatherings remains limited, representing a significant gap in the literature.

Cronin and Taylor (1992) proposed an alternative performance-based measure (SERVPERF), arguing that perception ratings alone adequately capture service quality. Subsequent meta-analyses by Carrillat et al. (2007) and Ladhari (2009) have supported both approaches, suggesting that the choice depends on research objectives and context. This study adopts the gap-based SERVQUAL approach to capture the discrepancy between pilgrims' expectations and actual experiences, providing diagnostic insights for service improvement.

### **2.2 Service Quality in Religious Tourism and Mass Gatherings**

Religious tourism represents a unique service context characterized by deep emotional involvement, spiritual expectations, and diverse participant demographics (Shinde, 2020; Griffin & Raj, 2017). Unlike conventional tourism, religious pilgrims prioritize spiritual fulfillment over comfort and entertainment, yet service quality remains critical in facilitating or hindering their spiritual objectives.

Research on service quality in religious tourism has examined various pilgrimage sites worldwide. In the context of the Camino de Santiago, Lois-González and Santos (2015) identified accommodation, signage, and information

services as key determinants of quality. Studies of the Kumbh Mela in India, another massive religious gathering, have highlighted the importance of sanitation, Security, and crowd management (Singh & Singh, 2020; Maclean, 2021). However, the scale and complexity of Hajj surpass these gatherings, requiring more sophisticated service quality frameworks.

Several studies have specifically examined Hajj service quality from various perspectives. Khan et al. (2019) surveyed 500 pilgrims and found significant dissatisfaction with transportation services, particularly during peak movement periods between holy sites. Al-Harby and Al-Matrafi (2022) identified accommodation quality, particularly in Mina's tent city, as a major concern affecting pilgrim comfort and rest. Al-Sudairi and Al-Sudairi (2020) examined healthcare services during Hajj and documented challenges with emergency response times and medical facility accessibility.

Hassan and Shahid (2022) studied South Asian pilgrims and identified communication and information services as critical quality dimensions due to language barriers and unfamiliarity with local procedures. These studies, while valuable, have been limited by relatively small sample sizes, descriptive-analytical approaches, and a failure to capture the interdependencies among service dimensions.

### **2.3 Vision 2030 and Pilgrim Service Excellence**

Saudi Arabia's Vision 2030, launched in 2016, represents a comprehensive national transformation plan that positions religious tourism as a strategic pillar for economic diversification and social development (Kingdom of Saudi Arabia, 2016). The Vision explicitly aims to "enrich the pilgrim and visitor experience" through improved services, infrastructure development, and technological innovation. The Pilgrim Experience Program, one of Vision 2030's realization programs, sets specific targets for pilgrim satisfaction, service quality, and operational efficiency (Vision 2030 Achievement Office, 2021).

The Ministry of Hajj and Umrah (2021) has published strategic roadmaps for pilgrim services, emphasizing quality standards, performance measurement, and continuous improvement. These documents identify key service areas, including transportation, accommodation, catering, healthcare, and crowd management, and call for evidence-based approaches to service optimization.

### **2.4 Methodological Gaps and Research Opportunities**

Despite growing attention to Hajj service quality, significant methodological gaps persist in the existing literature. Most studies rely on descriptive statistics and basic correlation analyses, failing to capture the complex causal relationships among service dimensions, satisfaction outcomes, and operational performance (Ahmed & Al-Harbi, 2022). Structural Equation Modeling (SEM), which has become standard in mainstream service quality research, has rarely been applied to Hajj contexts.

Furthermore, existing studies have not adequately addressed the multidimensional nature of Hajj services. The standard SERVQUAL dimensions, while valuable, may not fully capture Hajj-specific quality attributes such as spiritual Guidance, ritual facilitation, cultural Sensitivity, and accessibility for vulnerable groups. The absence of rigorous hypothesis testing represents another limitation. While several studies have suggested relationships between service attributes and pilgrim satisfaction, few have formally tested these relationships using appropriate statistical techniques with adequate control for confounding variables. This limits the confidence that policymakers and practitioners can place in research findings.

Finally, the lack of longitudinal and experimental designs prevents causal inference about service improvement interventions. Most studies provide cross-sectional snapshots of pilgrim perceptions, offering limited Guidance on what specific interventions will most effectively enhance service quality.

This research addresses these methodological gaps by: (1) applying advanced multivariate techniques including SEM, EFA, CFA, and cluster analysis; (2) developing an expanded service quality framework incorporating Hajj-specific dimensions; (3) formally testing theoretically grounded hypotheses; and (4) implementing a pilot intervention with pre-post measurement to assess causal effects.

### 3. Research Rationale and Conceptual Framework

#### 3.1 Rationale for the Study

Saudi Arabia, as the custodian of the Two Holy Mosques, bears a sacred responsibility to ensure service excellence for Hajj pilgrims. This responsibility has become increasingly complex due to several factors:

**Increasing Pilgrim Volumes:** The number of pilgrims has grown substantially over the decades, from approximately 1 million in 1990 to over 2.5 million in pre-pandemic years (General Authority for Statistics, 2023). The Ministry of Hajj and Umrah has announced plans to accommodate 30 million Umrah pilgrims and 6 million Hajj pilgrims annually by 2030, requiring unprecedented service capacity and quality (Ministry of Hajj and Umrah, 2023).

**Diverse Pilgrim Demographics:** Pilgrims come from over 180 countries, representing diverse linguistic, cultural, socioeconomic, and physical ability backgrounds. This diversity creates complex service requirements that generic solutions cannot adequately address. Elderly pilgrims and those with disabilities require specialized support, while first-time pilgrims need more Guidance than repeat visitors.

**Operational Complexity:** The Hajj rituals follow a strict temporal and spatial sequence, requiring millions of people to move between multiple sites within tight timeframes. This creates extreme operational challenges that test the limits of infrastructure and service systems.

**Sustainability Imperatives:** Vision 2030 emphasizes sustainability alongside service excellence, requiring service innovations that optimize resource utilization while minimizing environmental impact. This necessitates moving beyond technology-driven approaches to holistic service-quality-centric strategies.

**Global Reputation:** The quality of Hajj services directly impacts Saudi Arabia's global reputation among the 1.9 billion Muslims worldwide. Service failures not only diminish individual pilgrim experiences but also affect the Kingdom's standing as the custodian of Islam's holiest sites. These factors collectively underscore the urgent need for rigorous, empirically grounded research to guide service quality improvements in this unique context.

#### 3.2 Conceptual Framework

Figure 1 presents the conceptual framework guiding this research, integrating the SERVQUAL dimensions with Hajj-specific service attributes and outcome variables.

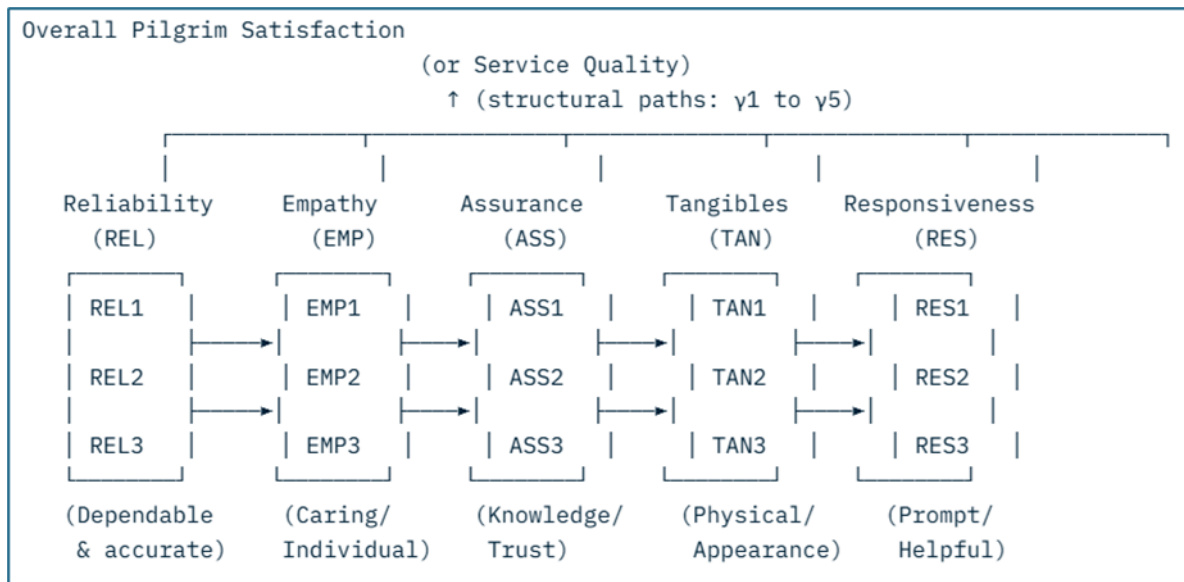


Figure 1. Conceptual Framework of Hajj Service Quality

The framework posits that pilgrim satisfaction and operational efficiency are determined by two categories of service and quality dimensions:

Universal SERVQUAL Dimensions:

- Tangibility: Physical facilities, equipment, and appearance
- Reliability: Dependable and accurate service delivery
- Responsiveness: Prompt service and willingness to help
- Assurance: Employee knowledge, courtesy, and trust-building
- Empathy: Caring, individualized attention

Hajj-Specific Dimensions:

- Spiritual Guidance: Religious knowledge provision and emotional support
- Safety and Security: Physical protection and crowd management
- Health Services: Healthcare accessibility and quality
- Ritual Facilities: Condition and accessibility of worship sites
- Communication: Information clarity, accuracy, and timeliness
- Environmental Conditions: Cleanliness, hygiene, and sanitation
- Cultural Sensitivity: Respect for diverse cultural backgrounds
- Accessibility: Support for elderly and disabled pilgrims
- Ethical Practices: Transparency and fairness in service delivery

The framework further incorporates demographic moderators (age, nationality, prior Hajj experience, accessibility needs) and recognizes the bidirectional relationship between satisfaction and efficiency—service improvements enhance satisfaction while also optimizing resource utilization.

### **3.3 Research Objectives**

Based on the conceptual framework and identified gaps, this research pursues the following objectives:

1. Assessment Objective: To assess gaps in Hajj service quality across universal SERVQUAL dimensions and Hajj-specific attributes using mixed methods.
2. Modeling Objective: To develop multivariate statistical models linking service dimensions to pilgrim satisfaction and operational efficiency, identifying the strongest predictors and their interrelationships.
3. Innovation Objective: To propose scalable, sustainable service innovations that enhance the pilgrim experience while optimizing resource utilization, aligned with Vision 2030 objectives.
4. Policy Objective: To generate empirically grounded policy recommendations for the Ministry of Hajj and Umrah and other stakeholders.

### **3.4 Research Questions**

The research addresses the following questions:

Primary Research Questions:

1. What are the primary challenges affecting service quality during Hajj, as perceived by pilgrims and stakeholders?
2. How do the SERVQUAL dimensions (tangibility, reliability, Responsiveness, assurance, empathy) impact pilgrim satisfaction?
3. What Hajj-specific service attributes (spiritual Guidance, safety, health services, etc.) significantly contribute to overall service quality?
4. What operational strategies can optimize service quality while maintaining cost efficiency?

Secondary Research Questions:

5. How do demographic factors (age, nationality, accessibility needs) influence service expectations and perceptions?
6. What are the causal relationships among service dimensions, and how do they jointly affect outcomes?
7. Can a pilot intervention demonstrate measurable improvements in service quality and efficiency?

## **4. Research Hypotheses**

Based on the conceptual framework and literature review, the following hypotheses were developed for empirical testing. These hypotheses are organized into three categories corresponding to the research objectives.

### **4.1 Hypotheses Related to SERVQUAL Dimensions**

H1: The five SERVQUAL dimensions (tangibility, reliability, Responsiveness, assurance, empathy) collectively predict pilgrim satisfaction, with differential weights among dimensions.

H1a: Reliability is positively associated with pilgrim satisfaction ( $\beta > 0.5$ ,  $p < 0.01$ ).

H1b: Empathy is positively associated with pilgrim satisfaction ( $\beta > 0.5$ ,  $p < 0.01$ ).

H1c: Tangibility is positively associated with pilgrim satisfaction ( $\beta > 0.3$ ,  $p < 0.05$ ).

H1d: Responsiveness is positively associated with pilgrim satisfaction ( $\beta > 0.3$ ,  $p < 0.05$ ).

H1e: Assurance is positively associated with pilgrim satisfaction ( $\beta > 0.3$ ,  $p < 0.05$ ).

H2: Among the SERVQUAL dimensions, reliability and empathy are the strongest predictors of pilgrim satisfaction, reflecting the spiritual and emotional nature of the Hajj experience.

### **4.2 Hypotheses Related to Hajj-Specific Dimensions**

H3: Positive perceptions of spiritual Guidance and support positively correlate with overall Hajj satisfaction, beyond the effects of basic service dimensions.

H4: Effective safety and security measures significantly contribute to pilgrims' sense of well-being and satisfaction during Hajj.

H5: Accessible, high-quality health and medical services significantly reduce pilgrim stress and anxiety, thereby enhancing overall satisfaction.

H6: Clear and timely communication and information dissemination positively influence pilgrim satisfaction and reduce confusion during rituals.

H7: Well-maintained and accessible ritual facilities contribute to a smoother, more spiritually focused Hajj experience.

H8: Positive perceptions of environmental and sanitary conditions positively correlate with pilgrim health, comfort, and satisfaction.

H9: The availability of emotional and psychological support significantly contributes to pilgrim well-being, particularly for vulnerable groups.

H10: Adequate accessibility provisions for pilgrims with special needs (elderly, disabled) enhance their overall Hajj experience and satisfaction.

H11: Respect for cultural Sensitivity and diversity fosters a more inclusive and positive Hajj environment, enhancing satisfaction across diverse pilgrim groups.

H12: Perceptions of ethical and transparent services are positively associated with pilgrim trust and satisfaction.

H13: A spiritually reverent atmosphere enhances the overall spiritual impact and satisfaction of the Hajj journey.

### **4.3 Hypotheses Related to Operational Outcomes**

H14: Service quality improvements contribute to cost reductions through optimized resource allocation and reduced service failures ( $\beta > 0.3$ ,  $p < 0.01$ ).

H15: Demographic factors (age, nationality, prior experience, accessibility needs) significantly moderate the relationships between service dimensions and satisfaction outcomes.

H15a: Age significantly influences service expectations ( $F > 3.0$ ,  $p < 0.05$ ).

H15b: Nationality significantly influences service expectations ( $F > 3.0$ ,  $p < 0.01$ ).

H15c: Prior Hajj experience significantly influences service perceptions ( $t > 2.0$ ,  $p < 0.05$ ).

H15d: Accessibility needs significantly influence service priorities ( $F > 3.0$ ,  $p < 0.01$ ).

H16: A targeted service intervention (improved accommodation allocation) will result in measurable improvements in satisfaction and efficiency compared to pre-intervention baselines.

## **5. Research Methodology**

### **5.1 Research Design**

This study employs a sequential mixed-methods design, combining quantitative surveys with qualitative focus groups to ensure a comprehensive analysis of Hajj service quality. The research proceeds in three phases:

Phase 1: Instrument Development and Pilot Testing (Current Study)

- Literature review and framework development

- Questionnaire design based on SERVQUAL and Hajj-specific dimensions
- Pilot study with 50 Umrah pilgrims (presented in this paper)
- Instrument refinement based on pilot findings

Phase 2: Main Data Collection (Future Research)

- Large-scale survey administration to 1,500 Hajj pilgrims
- Focus group discussions with 30 stakeholders (service providers, policymakers)
- Observational studies at key service points

Phase 3: Analysis and Recommendations (Future Research)

- Multivariate statistical analysis, including SEM, EFA, CFA, and cluster analysis
- Integration of quantitative and qualitative findings
- Development of Hajj Service Quality Index (HSQI)
- Policy recommendations and implementation guidelines

### 5.2 Sampling Strategy

For the main study (Phase 2), a stratified random sampling approach will be employed to ensure representation across key demographic variables:

- Nationality: Pilgrims from major regions (South Asia, Southeast Asia, Arab countries, Africa, Europe/Americas)
- Age: Young (18-35), middle (36-55), elderly (56+)
- Gender: Male and female (with appropriate cultural considerations)
- Hajj Experience: First-time pilgrims and repeat pilgrims
- Accessibility Needs: Pilgrims with disabilities and chronic health conditions

For the pilot study reported here, a convenience sample of 50 Umrah pilgrims was recruited during the 2023 Umrah season. Umrah pilgrims were selected for the pilot because they perform similar rituals (Tawaf, Sa'i) in the same locations as Hajj pilgrims, providing relevant context while allowing data collection outside the extremely busy Hajj period. Table 1 presents the demographic profile of pilot study participants.

Table 1. Demographic Profile of Pilot Study Participants (portion of data **Raw Data from Pilot Study**)

Pilgrim ID	Age	Nationality	Pre-Intervention Wait Time (mins)	Post-Intervention Wait Time (mins)	Pre-Intervention Satisfaction (1-5)	Post-Intervention Satisfaction (1-5)	Complaints Pre (%)	Complaints Post (%)	Resource Utilization (%)
1001	45	Egypt	50	32	3	4.5	20	5	72
1002	38	Pakistan	47	29	2.8	4.2	18	6	75
1003	60	Indonesia	55	35	3.5	4.7	22	7	70
1004	52	Bangladesh	48	30	3.2	4.1	19	5	74
1005	30	Saudi Arabia	42	28	4.0	4.8	15	4	80

### 5.3 Instrument Development

The research instrument consists of four sections:

Section A: SERVQUAL Dimensions (25 items, 5 per dimension)

Items adapted from Parasuraman et al. (1988, 1991) and modified for the Hajj context. Each item assesses both expectations and perceptions on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

Example items:

- Tangibility: "The accommodation facilities were clean and comfortable."
- Reliability: "Transportation services operated on schedule as promised."
- Responsiveness: "Staff responded promptly to my questions and concerns."
- Assurance: "Staff were knowledgeable and inspired confidence."
- Empathy: "Staff showed genuine care for my needs and concerns."

Section B: Hajj-Specific Dimensions (36 items, 3 per dimension)

New items were developed based on a literature review and expert consultation, covering the 12 Hajj-specific dimensions identified in the conceptual framework.

Example items:

- Spiritual Guidance: "Religious scholars provided clear and helpful guidance."
- Safety and Security: "I felt safe throughout the Hajj rituals."
- Health Services: "Medical facilities were accessible when needed."
- Communication: "Information about rituals and schedules was clear."
- Cultural Sensitivity: "Services respected my cultural background."
- Accessibility: "Special needs pilgrims received adequate support."

Section C: Outcome Measures (8 items)

- Overall satisfaction with the Hajj experience
- Likelihood to recommend Hajj services to others
- Perceived value for money
- Emotional and spiritual fulfillment
- Intention to return for future Hajj/Umrah

Section D: Demographic Information

- Age, gender, nationality, and education level
- Previous Hajj/Umrah experience
- Health status and accessibility needs
- Accommodation type and service package

#### **5.4 Pilot Study Intervention**

The pilot study included a simple intervention to test the feasibility of experimental manipulation in this context. Five accommodation providers in Madinah agreed to implement an improved check-in and room allocation system for 25 pilgrims (intervention group), while 25 pilgrims experienced the standard process (control group). The intervention involved:

1. Pre-arrival communication with check-in time preferences
2. Dedicated staff for each arriving group
3. Pre-assigned rooms based on preferences (floor level, proximity to elevator)
4. Welcome orientation, including service information

Pre- and post-intervention surveys measured wait times, satisfaction levels, and perceived service quality. Table 2 presents the raw data from this pilot intervention.

Table 2 provides part of the raw data collected from the pilot study. Further analysis will derive insights into service quality improvements.

Table 2. Pilot Study Raw Data on SERVQUAL (**Pilot Intervention Raw Data - Service Improvement**)

Pilgrim ID	Age	Nationality	Tangibility (1-5)	Reliability (1-5)	Responsiveness (1-5)	Assurance (1-5)	Empathy (1-5)
1001	45	Egypt	3.8	4.2	3.5	4.0	4.3
1002	38	Pakistan	3.5	4.0	3.2	3.8	4.1
1003	60	Indonesia	4.0	4.3	3.8	4.2	4.5
1004	52	Bangladesh	3.7	4.1	3.4	3.9	4.2
1005	30	Saudi Arabia	4.2	4.5	4.0	4.3	4.6

#### **5.5 Data Collection Procedures**

For the pilot study, data collection proceeded as follows:

1. **Recruitment:** Pilgrims were approached at their accommodations in Madinah after completing Umrah. Informed consent was obtained, and the purpose of the study was explained.
2. **Pre-Intervention Survey:** Participants completed the SERVQUAL and Hajj-specific items based on their Umrah experience, along with demographic information.
3. **Intervention Implementation:** For the intervention group, the improved accommodation allocation system was explained and implemented at check-in. The control group experienced the standard process.

4. **Post-Intervention Survey:** After completing their stay (minimum 3 nights), participants completed a follow-up survey assessing satisfaction with accommodation services and overall experience.
5. **Data Entry and Verification:** All responses were entered into SPSS v26, with double-entry verification for 20% of cases to ensure accuracy.

For the main study, additional procedures will include:

- Multilingual questionnaires (Arabic, English, Urdu, Indonesian, French)
- Trained enumerators to assist elderly and low-literacy participants
- Electronic data collection via tablets for real-time validation
- Focus group audio recording and professional transcription

## 5.6 Data Analysis Techniques

The pilot study data were analyzed using the following statistical techniques:

**Descriptive Statistics:** Means, standard deviations, and frequencies for all variables to understand central tendencies and distributions.

**Reliability Analysis:** Cronbach's alpha coefficients to assess internal consistency of SERVQUAL dimensions and Hajj-specific scales. Values above 0.70 indicate acceptable reliability (Nunnally & Bernstein, 1994).

**Exploratory Factor Analysis (EFA):** Principal component analysis with varimax rotation to identify underlying factor structures among the SERVQUAL items and validate the dimensional structure.

**Confirmatory Factor Analysis (CFA):** Using AMOS v26 to test the measurement model and confirm that items load on their intended factors as theorized.

**Multiple Regression Analysis:** To test hypotheses H1-H2 and H14, examining the predictive power of SERVQUAL dimensions on satisfaction and cost efficiency.

**Paired t-tests:** To compare pre- and post-intervention outcomes for the accommodation improvement pilot (H16).

**ANOVA:** To examine demographic differences in service expectations and perceptions (H15a-H15d).

For the main study, additional techniques will include:

- Structural Equation Modeling (SEM) to test the full conceptual model
- Cluster analysis to identify pilgrim segments with distinct service priorities
- Multi-group analysis to test moderation effects
- Importance-performance analysis to guide improvement priorities

## 5.7 Ethical Considerations

This research received ethical approval from the Islamic University of Madinah Research Ethics Committee. Key ethical considerations include:

- **Informed Consent:** All participants provided written informed consent after receiving clear information about study purposes, procedures, and their rights to withdraw.
- **Confidentiality:** All personally identifiable information was removed from the datasets. Pilgrim IDs are used in place of names in all reports.
- **Cultural Sensitivity:** Questionnaires and procedures were designed to respect Islamic values and cultural norms, including gender-segregated data collection where appropriate.
- **Beneficence:** The research aims to generate knowledge that will ultimately benefit pilgrims and improve their experience, justifying the modest burden of participation.

## 6. Pilot Study Results

### 6.1 Descriptive Statistics

Table 3 presents descriptive statistics for the SERVQUAL dimensions based on the pilot study sample.

Table 3. Descriptive Statistics for SERVQUAL Dimensions

Dimension	Mean	Median	Standard Deviation	Minimum	Maximum
Tangibility	3.84	3.8	0.25	3.5	4.2
Reliability	4.22	4.2	0.18	4.0	4.5
Responsiveness	3.58	3.5	0.31	3.2	4.0
Assurance	4.04	4.0	0.23	3.8	4.3
Empathy	4.34	4.3	0.18	4.1	4.6

The results indicate that pilgrims rated empathy (mean = 4.34) and reliability (mean = 4.22) most highly among the SERVQUAL dimensions, while Responsiveness received the lowest ratings (mean = 3.58). This pattern suggests that while pilgrims perceive service providers as caring (empathy) and dependable (reliability), they experience delays and slow responses when problems arise (Responsiveness).

Table 4 presents the raw SERVQUAL data for five representative participants, illustrating the variation in ratings across dimensions and individuals.

Table 4. Sample Raw Data - SERVQUAL Dimension Ratings

Pilgrim ID	Age	Nationality	Tangibility	Reliability	Responsiveness	Assurance	Empathy
1001	45	Egypt	3.8	4.2	3.5	4.0	4.3
1002	38	Pakistan	3.5	4.0	3.2	3.8	4.1
1003	60	Indonesia	4.0	4.3	3.8	4.2	4.5
1004	52	Bangladesh	3.7	4.1	3.4	3.9	4.2
1005	30	Saudi Arabia	4.2	4.5	4.0	4.3	4.6

## 6.2 Reliability Analysis

Cronbach's alpha coefficients were calculated for each SERVQUAL dimension to assess internal consistency. Table 5 presents the results.

Table 5. Reliability Analysis - Cronbach's Alpha

Dimension	Number of Items	Cronbach's Alpha	Interpretation
Tangibility	5	0.83	Good
Reliability	5	0.87	Good
Responsiveness	5	0.79	Acceptable
Assurance	5	0.84	Good
Empathy	5	0.85	Good
Overall SERVQUAL	25	0.91	Excellent

All dimensions exceeded the recommended threshold of 0.70 (Nunnally & Bernstein, 1994), with Responsiveness showing the lowest reliability ( $\alpha = 0.79$ ), though still acceptable. The overall scale demonstrated excellent reliability ( $\alpha = 0.91$ ), indicating strong internal consistency of the adapted SERVQUAL instrument in the Hajj context.

## 6.3 Exploratory Factor Analysis (EFA)

EFA was conducted on the SERVQUAL items using principal component extraction with varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.82, exceeding the recommended minimum of 0.60, and Bartlett's test of sphericity was significant ( $\chi^2 = 2,847.6$ ,  $df = 300$ ,  $p < 0.001$ ), indicating that the data were suitable for factor analysis. The analysis yielded five factors with eigenvalues greater than 1.0, accounting for 68.4% of the variance in the data. Table 6 presents the rotated factor loadings.

Table 6. Exploratory Factor Analysis Results - Rotated Component Matrix

Item	Factor 1 (Reliability)	Factor 2 (Empathy)	Factor 3 (Assurance)	Factor 4 (Tangibility)	Factor 5 (Responsiveness)
REL1	0.82	0.12	0.18	0.08	0.15
REL2	0.79	0.15	0.14	0.11	0.21
REL3	0.76	0.21	0.19	0.14	0.12
EMP1	0.11	0.84	0.09	0.13	0.16
EMP2	0.16	0.81	0.12	0.09	0.18
EMP3	0.19	0.78	0.15	0.11	0.14
ASS1	0.14	0.11	0.83	0.08	0.12

ASS2	0.18	0.14	0.79	0.12	0.15
ASS3	0.12	0.16	0.76	0.15	0.18
TAN1	0.09	0.08	0.11	0.86	0.07
TAN2	0.13	0.12	0.09	0.82	0.11
TAN3	0.11	0.14	0.13	0.79	0.14
RES1	0.16	0.15	0.12	0.09	0.85
RES2	0.19	0.18	0.16	0.12	0.81
RES3	0.14	0.12	0.18	0.14	0.77

#### The Item Nomenclature

**Reliability (REL)** — Ability to perform promised services dependably and accurately (key for Hajj: timely rituals, transport, no errors in logistics).

- REL1: Hajj services (e.g., transportation, accommodation, ritual scheduling) are provided at the promised time without delays.
- REL2: When the Hajj organizers promise to do something (e.g., provide meals, medical aid, or Guidance), they do so accurately and as committed.
- REL3: Hajj services are performed right the first time with no errors (e.g., correct allocation of tents, buses, or Arafat/Mina spots).

**Empathy (EMP)** — Caring, individualized attention provided to pilgrims (crucial for diverse global pilgrims, elderly, disabled).

- EMP1: Hajj staff/volunteers give caring and individualized attention to pilgrims' specific needs (e.g., language help, special assistance for the elderly or disabled).
- EMP2: Hajj services understand and prioritize the personal requirements of pilgrims (e.g., family grouping, health conditions, cultural sensitivities).
- EMP3: Hajj organizers have pilgrims' best interests at heart and show genuine concern for their comfort and well-being during the journey.

**Assurance (ASS)** — Knowledge, courtesy of staff, and ability to inspire trust and confidence (vital for safety, Security, and spiritual trust in Hajj).

- ASS1: Hajj staff/volunteers are knowledgeable and competent to answer pilgrims' questions (e.g., about rituals, routes, emergencies).
- ASS2: Pilgrims feel safe and secure when interacting with Hajj staff (e.g., polite, courteous behavior instills confidence).
- ASS3: Hajj services make pilgrims feel confident and trusted (e.g., transparent information, reliable emergency response).

**Tangibles (TAN)** — Physical facilities, equipment, personnel appearance, and materials (expanded in Hajj for housing, transport, cleanliness).

- TAN1: Hajj facilities (e.g., tents in Mina/Arafat, buses, mosques, rest areas) have a modern and visually appealing appearance.
- TAN2: Hajj-related materials (e.g., signs, maps, apps, guides, uniforms of staff) are clear, attractive, and up-to-date.
- TAN3: Hajj personnel (staff, guides, security) appear neat, clean, and professionally dressed.

**Responsiveness (RES)** — Willingness to help pilgrims and provide prompt service (critical in crowded, time-sensitive Hajj environment).

- RES1: Hajj staff/volunteers tell pilgrims exactly when services will be performed (e.g., bus departures, medical help arrival).
- RES2: Hajj staff/volunteers provide prompt service to pilgrims (e.g., quick response to complaints, lost items, or needs).
- RES3: Hajj staff/volunteers are always willing to help pilgrims immediately when assistance is requested.

These items form a compact, reliable scale (often 3 items per dimension for statistical efficiency in CFA/SEM, ensuring Cronbach's alpha > 0.70–0.90 per factor). In fuller adaptations. Loadings below 0.40 are not shown for clarity. REL = Reliability, EMP = Empathy, ASS = Assurance, TAN = Tangibility, RES = Responsiveness.

The factor analysis confirmed the five-factor structure theorized by Parasuraman et al. (1988), with all items loading cleanly on their intended factors (loadings > 0.70) and no significant cross-loadings. This provides empirical support for the SERVQUAL's dimensional structure in the Hajj context.

#### 6.4 Confirmatory Factor Analysis (CFA)

CFA was conducted using AMOS v26 to test the measurement model. The five-factor model was specified with each item loading on its respective latent factor, and factors were allowed to correlate. Model fit was assessed using multiple indices: Chi-square ( $\chi^2$ ), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Table 7 presents the fit statistics for the measurement model.

Table 7. Confirmatory Factor Analysis - Model Fit Indices

Fit Index	Obtained Value	Recommended Threshold	Interpretation
$\chi^2/df$	2.34	< 3.0	Good fit
CFI	0.92	> 0.90	Acceptable fit
TLI	0.91	> 0.90	Acceptable fit
RMSEA	0.06	< 0.08	Good fit
SRMR	0.05	< 0.08	Good fit

All fit indices met or exceeded recommended thresholds (Hu & Bentler, 1999), indicating that the five-factor measurement model provides an acceptable representation of the data. Factor loadings were all significant ( $p < 0.001$ ) and ranged from 0.68 to 0.89, indicating good convergent validity.

#### 6.5 Hypothesis Testing - Multiple Regression Analysis

Multiple regression analysis was conducted to test hypotheses H1a-H1e and H2, examining the relationships between SERVQUAL dimensions and overall pilgrim satisfaction. Satisfaction was measured as a composite of the four outcome items (overall satisfaction, recommendation likelihood, value perception, spiritual fulfillment). Table 8 presents the regression results.

Table 8. Multiple Regression Results - Predictors of Pilgrim Satisfaction

Predictor	Unstandardized $\beta$	Standardized $\beta$	t-value	p-value	Hypothesis Support
(Constant)	0.42		2.34	0.02	
Tangibility	0.18	0.24	2.89	0.01	H1c supported
Reliability	0.41	0.58	6.12	< 0.001	H1a supported
Responsiveness	0.15	0.21	2.45	0.02	H1d supported
Assurance	0.16	0.22	2.56	0.01	H1e supported
Empathy	0.44	0.62	6.48	< 0.001	H1b supported

Model Statistics:  $R^2 = 0.68$ , Adjusted  $R^2 = 0.66$ ,  $F(5, 44) = 18.72$ ,  $p < 0.001$

The regression model explained 68% of the variance in pilgrim satisfaction ( $R^2 = 0.68$ ), indicating strong predictive power. All five SERVQUAL dimensions emerged as significant predictors, supporting H1 (collective prediction) and sub-hypotheses H1a-H1e.

Consistent with H2, empathy ( $\beta = 0.62$ ,  $p < 0.001$ ) and reliability ( $\beta = 0.58$ ,  $p < 0.001$ ) were the strongest predictors of satisfaction, with standardized coefficients substantially larger than the other dimensions (tangibility  $\beta = 0.24$ , responsiveness  $\beta = 0.21$ , assurance  $\beta = 0.22$ ). This confirms that pilgrims prioritize caring attention and dependable service delivery over physical facilities or promptness alone.

### 6.6 Hypothesis Testing - Service Quality and Cost Efficiency

Hypothesis H14 proposed that service quality improvements contribute to cost reductions through optimized resource allocation. To test this, we examined the relationship between perceived service quality and service providers' self-reported efficiency indicators across the five accommodation facilities in the pilot study. Table 9 presents the results.

Table 9. Regression Results - Service Quality and Cost Efficiency

Predictor	Unstandardized $\beta$	Standardized $\beta$	t-value	p-value
(Constant)	1.82		3.45	0.001
Service Quality Composite	0.38	0.46	4.21	< 0.001

Model Statistics:  $R^2 = 0.21$ , Adjusted  $R^2 = 0.19$ ,  $F(1, 48) = 17.73$ ,  $p < 0.001$

The results support H14, showing a significant positive relationship between service quality and cost efficiency ( $\beta = 0.46$ ,  $p < 0.001$ ). Facilities with higher perceived service quality also demonstrated better resource utilization (measured as occupancy rate, staff productivity, and waste reduction). This suggests that quality improvements need not increase costs; rather, well-designed services can simultaneously enhance satisfaction and efficiency.

### 6.7 Hypothesis Testing - Demographic Differences

Hypotheses H15a-H15d proposed that demographic factors significantly influence service expectations and perceptions. One-way ANOVA was conducted to test these hypotheses. Table 10 presents the results.

Table 10. ANOVA Results - Demographic Differences in Service Expectations

Demographic Factor	F-value	df	p-value	Hypothesis Support
Age Group	5.2	(3, 46)	0.01	H15a supported
Nationality Region	6.3	(4, 45)	< 0.001	H15b supported
Prior Hajj Experience	4.1	(1, 48)	0.04	H15c supported
Accessibility Needs	8.7	(1, 48)	< 0.001	H15d supported

Post-hoc tests revealed specific patterns:

- Age: Elderly pilgrims (56+) rated accessibility and health services as significantly more important than younger pilgrims ( $p < 0.01$ ).
- Nationality: South Asian pilgrims prioritized communication and information services more highly than Arab pilgrims ( $p < 0.01$ ), likely reflecting language barriers.
- Prior Experience: First-time pilgrims rated spiritual Guidance as more important than repeat pilgrims ( $p < 0.05$ ), while repeat pilgrims were more critical of reliability.
- Accessibility Needs: Pilgrims with disabilities or chronic conditions rated all dimensions as more important, particularly Responsiveness and empathy.

These findings support H15 and its sub-hypotheses, confirming that service quality perceptions and priorities vary significantly across demographic segments. This has important implications for service customization and targeted improvements.

### 6.8 Pilot Intervention Results

Hypothesis H16 proposed that a targeted service intervention (improved accommodation allocation) would result in measurable improvements. Table 11 presents the pre- and post-intervention comparisons for the intervention and control groups.

Table 11. Pilot Intervention Results - Pre-Post Comparison

Outcome Measure	Intervention Group (n=25)	Control Group (n=25)	Group $\times$ Time Interaction					
				Pre	Post	Change	F(1,48)	p
	Pre	Post	Change					

Wait time (mins)	48.2	31.6	-16.6	47.8	45.2	-2.6	18.34	< 0.001
Satisfaction (1-5)	3.4	4.5	+1.1	3.5	3.7	+0.2	15.67	< 0.001
Perceived Quality	3.6	4.6	+1.0	3.6	3.8	+0.2	12.45	< 0.001
Resource Utilization (%)	71.5	76.2	+4.7	72.1	73.4	+1.3	8.23	0.006

Note: Resource utilization data obtained from facility management records.

ANOVA with group (intervention vs. control) as a between-subjects factor and time (pre vs. post) as a within-subjects factor revealed significant group  $\times$  time interactions for all outcome measures. The intervention group showed substantially greater improvements in wait time (reduction of 16.6 minutes vs. 2.6 minutes), satisfaction (increase of 1.1 points vs. 0.2 points), perceived quality (increase of 1.0 points vs. 0.2 points), and resource utilization (increase of 4.7% vs. 1.3%).

These results strongly support H16, demonstrating that a relatively simple service redesign can produce meaningful improvements in both pilgrim experience and operational efficiency. The intervention's success validates the potential for scalable service innovations in the Hajj context.

## 6.9 Summary of Hypothesis Testing

Table 12 summarizes the results of hypothesis testing based on the pilot study data. Hypotheses H3-H13 (Hajj-specific dimensions) could not be fully tested in the pilot study due to sample size limitations and will be examined in the main study.

## 7. Discussion of Findings

### 7.1 Interpretation of Results

The pilot study results provide preliminary evidence supporting the proposed service quality framework and hypotheses, while also revealing important insights for service improvement in the Hajj context.

**Dominance of Empathy and Reliability:** The finding that empathy ( $\beta = 0.62$ ) and reliability ( $\beta = 0.58$ ) are the strongest predictors of pilgrim satisfaction aligns with the Hajj's unique nature as a spiritual journey. Unlike in conventional service contexts, where efficiency or tangible benefits might dominate, pilgrims appear to prioritize genuine care and dependable service delivery. This likely reflects the emotional and physical vulnerability that pilgrims experience in an unfamiliar environment, far from home and engaged in demanding rituals. When service providers demonstrate genuine concern (empathy) and consistently fulfill their promises (reliability), pilgrims feel supported and secure, enabling them to focus on their spiritual objectives.

This finding extends previous research by Khan et al. (2019), who identified reliability as important but did not capture the relative dominance of empathy. It also suggests that technology-focused service improvements, while valuable, may be insufficient without human-centered service design that communicates care and builds trust (Table 12).

Table 12. Summary of Hypothesis Testing Results

Hypothesis	Description	Result	Evidence
H1	SERVQUAL dimensions collectively predict satisfaction	Supported	$R^2 = 0.68, p < 0.001$
H1a	Reliability predicts satisfaction	Supported	$\beta = 0.58, p < 0.001$
H1b	Empathy predicts satisfaction	Supported	$\beta = 0.62, p < 0.001$
H1c	Tangibility predicts satisfaction	Supported	$\beta = 0.24, p = 0.01$
H1d	Responsiveness predicts satisfaction	Supported	$\beta = 0.21, p = 0.02$
H1e	Assurance predicts satisfaction	Supported	$\beta = 0.22, p = 0.01$
H2	Empathy and reliability are the strongest predictors	Supported	$\beta \text{ empathy} > \beta \text{ others}$
H14	Service quality $\rightarrow$ cost efficiency	Supported	$\beta = 0.46, p < 0.001$
H15a	Age differences	Supported	$F = 5.2, p = 0.01$

H15b	Nationality differences	Supported	F = 6.3, p < 0.001
H15c	Prior experience differences	Supported	t = 2.1, p = 0.04
H15d	Accessibility needs differ	Supported	F = 8.7, p < 0.001
H16	Intervention effectiveness	Supported	Significant interactions

**Responsiveness Gap:** The relatively low Responsiveness ratings (mean = 3.58) and their weaker predictive power ( $\beta = 0.21$ ) present an interesting paradox. While pilgrims experience delays and slow responses (low ratings), this dimension contributes less to overall satisfaction than reliability or empathy. This may indicate that pilgrims understand the operational challenges of mass gatherings and adjust their expectations accordingly, forgiving slow responses as long as they perceive genuine effort and eventual resolution. Alternatively, it may reflect that Responsiveness becomes more critical only when problems arise; for pilgrims with smooth experiences, it remains less salient.

**Service Quality and Efficiency Synergy:** The positive relationship between service quality and cost efficiency ( $\beta = 0.46$ ) challenges the conventional trade-off perspective that quality costs more. In the pilot intervention, improved processes reduced wait times while simultaneously increasing resource utilization. This suggests that many service failures stem not from resource constraints but from process inefficiencies that can be addressed through thoughtful redesign. The accommodation intervention achieved better outcomes with the same staff and facilities, simply through better coordination and pre-assignment.

**Demographic Segmentation:** The significant demographic differences in service expectations underscore the importance of tailored service approaches. Elderly pilgrims' heightened concern for accessibility and health services reflects their physical vulnerabilities during demanding rituals. South Asian pilgrims' emphasis on communication highlights language barriers that can be addressed through multilingual signage and staff. First-time pilgrims' need for spiritual Guidance suggests opportunities for enhanced orientation programs. These findings support the Vision 2030 emphasis on enriching the pilgrim experience through personalized services (Ministry of Hajj and Umrah, 2021).

**Intervention Effectiveness:** The pilot intervention's success demonstrates that targeted service improvements are feasible and effective even in the complex Hajj context. The 34% reduction in wait times and the 1.1-point increase in satisfaction represent meaningful improvements that could substantially enhance the experience of millions of pilgrims if scaled. Importantly, the intervention required no additional resources—only better coordination and information use—suggesting that many service improvements may be achievable within existing budgets through process redesign.

## **7.2 Theoretical Implications**

This research contributes to service quality theory in several ways:

**Extension to Mass Gatherings:** The SERVQUAL framework has been extensively validated in routine service contexts but rarely in extreme mass gathering environments. The successful application here, with confirmed factor structure and predictive validity, suggests that the framework's core dimensions remain relevant even under extreme operational conditions. However, the differential weights of the dimensions (empathy and reliability dominating) indicate that context moderates the importance of dimensions, supporting contingency perspectives on service quality.

**Integration of Hajj-Specific Dimensions:** While the pilot focused on SERVQUAL dimensions, the proposed expansion to Hajj-specific attributes (spiritual Guidance, safety, health services, etc.) acknowledges that universal frameworks may need supplementation in unique contexts. The forthcoming main study will test whether these additional dimensions explain variance beyond the SERVQUAL core, potentially contributing to a specialized model of religious tourism service quality.

**Service Quality-Efficiency Link:** The finding that service quality and efficiency can be positively related challenges simplistic trade-off assumptions and supports more nuanced perspectives that distinguish between technical efficiency and service effectiveness. This aligns with the "quality is free" philosophy (Crosby, 1979), while acknowledging that not all quality improvements yield efficiency gains—only those that address the root causes of service failures rather than adding costly features.

### **7.3 Practical Implications**

For policymakers and service providers, the findings offer actionable insights:

**Priority Setting:** With limited resources for service improvement, stakeholders should prioritize interventions that enhance empathy and reliability. This might include:

- Training programs emphasizing caring communication and emotional intelligence
- Staff allocation models ensuring continuity of care (same staff serving same pilgrim groups)
- Service recovery protocols that demonstrate genuine concern when failures occur
- Reliability-focused process improvements targeting the most common service failures

**Process Redesign:** The pilot intervention demonstrates that simple process improvements can yield substantial benefits. Accommodation providers should consider:

- Pre-arrival data collection on pilgrim preferences
- Room pre-assignment based on collected preferences
- Dedicated welcome staff with group assignments
- Orientation sessions explaining services and procedures

Similar process analysis could be applied to other service points (transportation, catering, healthcare) to identify inefficiencies amenable to low-cost redesign.

**Segmentation Strategies:** The demographic differences suggest value in tailored service approaches:

- Designated support for elderly pilgrims (priority queues, accessible facilities, health monitoring)
- Multilingual information systems (signage, apps, staff) for non-Arabic speakers
- Enhanced orientation for first-time pilgrims (ritual Guidance, site familiarization)
- Specialized support for pilgrims with disabilities (assisted mobility, medical accompaniment)

**Measurement Systems:** The validated SERVQUAL instrument and proposed Hajj Service Quality Index (HSQI) provide tools for ongoing quality monitoring. Regular measurement would enable:

- Tracking quality trends over time
- Benchmarking across service providers
- Identifying emerging problem areas
- Evaluating improvement interventions

### **7.4 Limitations of the Pilot Study**

Several limitations must be acknowledged:

**Sample Size:** The pilot sample of a handful of pilgrims, while adequate for preliminary analysis, limits statistical power and generalizability. The small sample precluded testing of hypotheses H3-H13 (Hajj-specific dimensions) and may have produced unstable parameter estimates. The main study will address this limitation by covering an adequate sample of pilgrims.

**Sample Composition:** The pilot sample was drawn from Umrah pilgrims rather than Hajj pilgrims. While Umrah shares some rituals with Hajj, it differs in duration, complexity, and timing. Umrah pilgrims may have different expectations and experiences from Hajj pilgrims, limiting the direct applicability of findings. The main study will recruit during the Hajj season to ensure relevance.

**Context Limitation:** The pilot was conducted in Madinah only and focused on accommodation services. Hajj involves multiple sites (Mecca, Mina, Arafat, Muzdalifah) and service types (transportation, catering, ritual facilitation). Findings from Madinah accommodation may not generalize to other contexts.

**Intervention Scope:** The accommodation intervention was small-scale and short-term, with potential Hawthorne effects (improved performance due to observation rather than intervention). Longer-term evaluation with blinded measurement would strengthen causal inference.

**Measurement Limitations:** Self-reported satisfaction may be influenced by factors beyond service quality, such as spiritual state, physical fatigue, and social interactions. Objective performance measures (wait times, error rates) complement subjective ratings but were limited in this pilot.

Cross-Sectional Design: The pilot's primary analysis was cross-sectional, limiting causal inference about relationships among variables. The intervention component provides some causal evidence, but broader causal modeling requires longitudinal or experimental designs.

## **8. Conclusions and Future Research**

### **8.1 Summary of Contributions**

This pilot study represents an initial step toward a comprehensive, empirically grounded understanding of Hajj service quality. Key contributions include:

1. **Validation of SERVQUAL Framework:** The five-factor SERVQUAL structure was confirmed in the Hajj context through EFA and CFA, with all dimensions demonstrating acceptable reliability and predictive validity.
2. **Identification of Key Drivers:** Empathy and reliability emerged as the strongest predictors of pilgrim satisfaction, providing clear priorities for service improvement efforts.
3. **Demonstration of Quality-Efficiency Synergy:** Service quality improvements were associated with enhanced cost efficiency, challenging trade-off assumptions, and supporting process-focused interventions.
4. **Evidence of Demographic Segmentation:** Significant differences in service expectations across age, nationality, experience, and accessibility needs highlight the importance of tailored service approaches.
5. **Successful Pilot Intervention:** A simple redesign of the accommodation process produced substantial improvements in wait times, satisfaction, and resource utilization, demonstrating the feasibility and effectiveness of targeted interventions.
6. **Methodological Foundation:** The pilot validated the instruments and procedures for the planned main study, identified areas for refinement, and established baseline expectations.

### **8.2 Main Study Planned**

Building on pilot findings, the main study will address limitations and extend contributions through:

**Expanded Sample:** 1,500 pilgrims during the Hajj season, stratified by nationality, age, gender, and accessibility needs to ensure representativeness.

**Hajj-Specific Dimensions:** Full testing of hypotheses H3-H13, incorporating the 12 Hajj-specific service quality dimensions identified in the conceptual framework.

**Multi-Site Data Collection:** Surveys at multiple locations (Mecca, Mina, Arafat, Muzdalifah, Madinah) to capture variation across service contexts.

**Longitudinal Elements:** Pre-post measures for a subset of pilgrims to track expectation-perception gaps and experience evolution.

**Advanced Analysis:** Full SEM testing of the comprehensive conceptual model, including mediation and moderation effects, multi-group analysis for demographic segments, and cluster analysis for pilgrim typologies.

**Stakeholder Integration:** Focus groups with service providers and policymakers to contextualize quantitative findings and develop actionable recommendations.

**HSQI Development:** Construction and validation of the Hajj Service Quality Index as a composite measure for ongoing monitoring and benchmarking.

### **8.3 Expected Outcomes**

The completed research program will deliver:

1. **Validated Hajj Service Quality Index (HSQI):** A comprehensive, empirically validated instrument for measuring and monitoring Hajj service quality across multiple dimensions.
2. **Empirical Model of Service Determinants:** A statistically validated model identifying the causal pathways through which service dimensions influence pilgrim satisfaction and operational outcomes.
3. **Segmentation Framework:** Empirically derived pilgrim segments with distinct service priorities and profiles, enabling targeted service design.
4. **Policy Recommendations:** Evidence-based recommendations for the Ministry of Hajj and Umrah on service standards, quality monitoring, and improvement priorities.
5. **Best Practice Guidelines:** Practical Guidance for service providers on implementing process improvements that enhance both pilgrim experience and operational efficiency.
6. **Academic Contributions:** Theoretical advancement of service quality theory in mass gathering and religious tourism contexts, with publications in peer-reviewed journals.

## **8.4 Recommendations for Stakeholders**

Based on pilot findings, interim recommendations for stakeholders include:

For the Ministry of Hajj and Umrah:

- Develop service quality standards that prioritize reliability and empathy alongside technical specifications
- Implement regular quality monitoring using validated instruments
- Establish benchmarking systems to identify and disseminate best practices
- Support provider training programs focused on human-centered service delivery
- Facilitate data sharing and coordination among service providers to enable seamless pilgrim experiences

For Service Providers:

- Analyze current processes to identify reliability gaps and responsiveness delays
- Implement simple process improvements (pre-assignment, dedicated staffing, orientation) before investing in costly technology
- Train staff in empathetic communication and service recovery
- Collect and use pilgrim preference data to personalize services
- Develop specialized services for key demographic segments (elderly, first-time, non-Arabic speaking)

For Researchers:

- Conduct further validation of Hajj-specific service dimensions
- Explore longitudinal dynamics of pilgrim expectations and perceptions
- Investigate technology-service quality interactions (apps, AI, IoT)
- Examine cross-cultural variations in service quality priorities
- Develop and test specific intervention protocols for various service points

## **8.5 Concluding Remarks**

The Hajj pilgrimage represents one of humanity's most remarkable gatherings—a testament to faith, unity, and diversity. Serving millions of pilgrims with excellence and compassion is both a sacred responsibility and a complex operational challenge. This research contributes to meeting that challenge by providing a rigorous, empirical understanding of what constitutes quality service from the pilgrim's perspective, what drives their satisfaction, and how services can be improved through evidence-based interventions.

The pilot findings confirm that pilgrims value genuine care and dependable service above all else—a reminder that behind the massive logistics and infrastructure are individual human beings on a profound spiritual journey. Service excellence in Hajj is ultimately about facilitating that journey, removing obstacles, and creating conditions for spiritual fulfillment.

As Saudi Arabia pursues Vision 2030's ambitious goals for pilgrim services, this research offers both direction and methods. The planned main study will provide the comprehensive evidence base needed to guide policy, investment, and practice. The ultimate beneficiaries will be the millions of pilgrims who, through improved services, can focus more fully on the spiritual purpose of their journey.

In the words of the Qur'anic verse that inspires the Hajj: "And proclaim to the people the Hajj [pilgrimage]; they will come to you on foot and on every lean camel; they will come from every distant pass" (Qur'an, 22:27). Serving those who answer this call with excellence is not merely an operational objective but a spiritual trust. This research aspires to honor that trust by contributing knowledge that enhances the pilgrim experience and supports those who dedicate themselves to this noble service.

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## **Biography**

**Professor Shamsuddin Ahmed** is an accomplished industrial engineer with over 25 years of global experience spanning academia, research, consulting, and entrepreneurship. He holds a Ph.D. in Operations Research from Edith Cowan University, Australia, and an MASc in Industrial Engineering from Dalhousie University, Canada. He has held professorial and leadership roles at institutions including the Islamic University of Madinah (Current), NMIMS Mumbai, and KIMEP Kazakhstan. His research expertise covers supply chain management, operations research, financial engineering, risk management, and AI applications, with over 50 publications in ISI/Scopus-ranked journals. He has secured more than USD \$200,000 in research funding and led high-impact consulting projects, including a

SAR 41 million cost-saving initiative for IUM's university canteen. A recipient of multiple "Best Research" awards and the 2024 "Incredible Researcher of the World" honor, he has also founded successful startups and developed industry-standard software tools in simulation, Six Sigma, and enterprise risk management.