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**HAJJ MANAGEMENT MODELS:
A COMPREHENSIVE REVIEW AND FUTURE RESEARCH
AGENDA USING SCOPUS AI ANALYTICS**

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Abstract:

The management of the hajj pilgrimage presents one of the most complex logistical and organizational challenges in the world, involving millions of pilgrims in a confined geographical area within a limited timeframe. Despite numerous technological and managerial innovations such as RFID-enabled tracking, e-Hajj systems, AI-based crowd management and blockchain-supported healthcare logistics. These current practices remain fragmented and lack a comprehensive framework that integrates operational efficiency with the spiritual, cultural and social dimensions of the pilgrimage. Addressing this gap, the aim of this study is to provide a comprehensive review of hajj management models and propose directions for future research that align technological integration with Islamic perspectives and sustainable practices. Using Scopus AI Analytics, the review synthesizes evidence through a systematic exploration of academic literature, including summaries, expanded summaries, concept mapping, topic expert identification and emerging theme analysis. The findings highlight four consistent research trajectories: (i) technological integration through AI, IoT and machine learning for predictive crowd and health management; (ii) supply chain frameworks adapted for resource allocation and service delivery; (iii) Islamic perspectives emphasizing Maqasid al-Syariah, financial stewardship and conflict resolution; and (iv) holistic models that incorporate pilgrim well-being, education and inclusivity. These insights suggest that while significant progress has been made in addressing operational challenges, future research should focus on developing integrative frameworks that unify technology, governance and spirituality. The study contributes both theoretically by situating hajj management within interdisciplinary management discourse and practically by offering policymakers, hajj authorities and service providers actionable guidance for safer, more efficient and spiritually enriching pilgrim experiences.

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Hajj Management Models, Maqasid Al-Syariah and Islamic Governance, Pilgrimage Logistics, Technological Integration, Supply Chain Management in Hajj



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Introduction

The hajj pilgrimage represents one of the largest annual religious gatherings in the world, attracting more than two million pilgrims from across the globe. Managing such a massive and diverse congregation poses immense logistical, organizational and safety challenges that extend beyond traditional religious administration into the domains of crowd control, healthcare, environmental sustainability and digital innovation (Owaidah et al., 2019). Over the years, Saudi Arabia and other stakeholders have sought to develop innovative models and frameworks to ensure the safety, efficiency and spiritual integrity of the pilgrimage. These efforts range from physical infrastructure expansion to the incorporation of emerging technologies, reflecting the complex interplay between religious obligations, human mobility and modern governance (Elgammal & Alhothali, 2021). While various technological and managerial solutions have been proposed, the growing scale of hajj highlights persisting vulnerabilities. Studies have explored simulation models to predict crowd flows (Owaidah et al., 2019), big data frameworks (Felemban et al., 2020) and smart street designs for real-time communication (Abi Sen et al., 2021). More recent innovations include machine learning-based approaches for crowd forecasting (Alzahrani & Algethami, 2025), RFID-enabled monitoring systems (Rmili et al., 2025), blockchain-enabled medical supply chain systems (Albalwy, 2025) and AI-driven intelligent frameworks for crowd management (Alafif et al., 2025).

However, despite these advancements the literature remains fragmented with models often developed in isolation, lacking a unifying framework that integrates multiple perspectives such as safety, sustainability, healthcare and pilgrim experience. This fragmented landscape indicates a critical research gap. Although existing studies have made significant contributions to operational efficiency through technological solutions such as AI-based crowd control, RFID tracking and digital health systems, most of these models are developed in isolation and remain largely technocratic in orientation. Current reviews tend to focus either on logistical performance or technological innovation, with limited integration of Islamic normative principles such as Maqasid al-Syariah, ethical governance and pilgrim well-being. As a result, there is a lack of comprehensive reviews that systematically map how operational, technological and Islamic value-based perspectives intersect within hajj management models (Abdullah Haidar & Siti Annisa Satifa, 2023; Alhajaji et al., 2025; AlJahdali et al., 2024; Alshamrani et al., 2024; Alsulaiman & Rentner, 2024; Yezli et al., 2024).

Accordingly, the aim of this paper is to provide a comprehensive review of hajj management models with a focus on analyzing existing research contributions, constructing a concept map to visualize the interconnections between models, identifying topic experts and uncovering emerging themes within this evolving field. By systematically synthesizing the literature, this study not only clarifies the current state of knowledge but also proposes a future research agenda to guide scholars and practitioners in addressing unresolved challenges. The contribution of this paper is threefold. First, it consolidates diverse strands of scholarship on hajj management models into a coherent body of knowledge. Second, it identifies research gaps and thematic trends, thereby offering a roadmap for future investigation. Third, it provides practical implications for policymakers, religious authorities and technology developers seeking to design safer, more efficient and sustainable pilgrimage management systems.

Research Methodology

This study employed a comprehensive review approach using Scopus AI Analytics, which was accessed on 19th August 2025 to provide a comprehensive exploration of scholarly contributions on hajj management models. The review was designed to achieve the study's primary aim: to synthesize existing research on hajj management models, construct a concept map to visualize the interconnections between models, identify key topic experts and uncover emerging themes. Through this process, the study not only clarifies the current research landscape but also proposes a future research agenda to guide scholars and practitioners in addressing unresolved challenges.

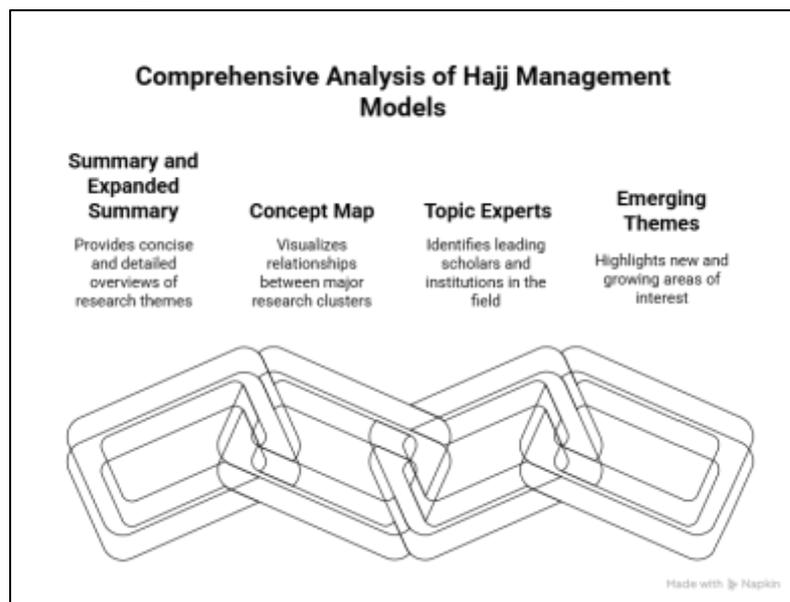
To ensure comprehensive coverage, a structured search string was developed, combining keywords relevant to the context of pilgrimage management and technological innovation. The search query used in Scopus was: ("Hajj" OR "pilgrimage" OR "Islamic pilgrimage") AND ("management" OR "organization" OR "administration" OR "coordination") AND ("model" OR "framework" OR "system" OR "approach") AND ("logistics" OR "planning" OR "operations" OR "strategy") AND ("crowd control" OR "safety" OR "risk management" OR "resource allocation") AND ("technology" OR "innovation" OR "digital" OR "data"). This query was designed to capture studies focusing on hajj and related Islamic pilgrimage contexts, while incorporating themes of management models, organizational frameworks, logistics, safety and technological integration. The search was limited to peer-reviewed journal articles, conference proceedings and book chapters indexed in Scopus to ensure academic rigor.

Scopus AI provided multiple analytical layers, including Summary, Expanded Summary, Concept Map, Topic Experts and Emerging Themes, which were systematically analyzed (Refer to Figure 1):

- i) Summary and Expanded Summary - These tools generated concise overviews and detailed explanations of the research field. The summary highlighted dominant research themes, such as crowd management, healthcare logistics and digital innovation in pilgrimage contexts (Alzahrani & Algethami, 2025; Owaidah et al., 2019). The expanded summary allowed deeper insights into methodological diversity across studies, including simulation models, machine learning approaches, blockchain applications and sustainability frameworks (Abi Sen et al., 2021; Albalwy, 2025).

- ii) **Concept Map** - A concept map was constructed to visualize the relationships between major clusters of research. Key nodes included crowd control and safety, technological integration (AI, IoT, blockchain, big data), sustainability initiatives and pilgrim services management. This map provided an analytical framework to understand how disparate models are interlinked and where gaps in integration remain (Elgammal & Alhothali, 2021).
- iii) **Topic Experts** - Scopus AI identified leading scholars and institutions publishing in this area. Among the most cited contributors were researchers specializing in crowd simulation (Owaidah et al., 2019), digital transformation in pilgrimage (Shah, 2024) and healthcare logistics (Albalwy, 2025). These experts provide an anchor for mapping intellectual influence within the field.
- iv) **Emerging Themes** - The analysis revealed emerging themes around green pilgrimage management, blockchain-enabled medical supply systems and AI-driven intelligent frameworks for risk prevention (Alafif et al., 2025). In addition, sustainability and environmental stewardship were identified as growing areas of interest, reflecting alignment with global green innovation frameworks (Elgammal & Alhothali, 2021).

Figure 1: Four Core Elements of Scopus AI



Source: Scopus

The methodology integrates Scopus AI’s bibliometric and conceptual mapping functions with a qualitative synthesis of findings. By examining both quantitative trends (publication growth, citation patterns, co-authorship networks) and qualitative themes (models, frameworks, gaps) this study develops a multidimensional understanding of hajj management models. The systematic approach ensures that the review not only categorizes existing models but also contextualizes them within broader domains of crowd management, technological innovation and sustainable religious tourism.

To mitigate potential AI-generated bias, the analytical outputs produced by Scopus AI, including summaries, emerging themes and concept maps, were manually cross-checked against the original source articles. The validity of the identified themes was further ensured through iterative comparison with the abstracts and core findings of highly cited and influential studies within the dataset.

Results And Discussion

The Scopus AI analysis generated valuable insights into the research landscape of hajj management models through multiple analytical dimensions, namely the summary and expanded summary, concept map, topic experts and emerging themes. Collectively, these outputs provide a holistic understanding of the field, highlighting both the maturity of existing scholarships and the direction in which they are evolving.

Although this review spans multiple domains such as logistics, technology, governance and Islamic perspectives, these dimensions are analysed through a unifying lens of hajj management models. The interdisciplinary scope is therefore not intended to be exhaustive but integrative, highlighting how these domains converge within a single complex management system.

Summary and Expanded Summary

The analysis of the summary and expanded summary generated through Scopus AI revealed that research on hajj management models has largely revolved around four interconnected dimensions: addressing persistent challenges, identifying emerging trends, capturing stakeholder perceptions and leveraging technological advancements. These findings demonstrate how the field has evolved from primarily focusing on crowd control and risk mitigation to encompassing broader concerns of sustainability, governance and innovation.

A recurrent theme across the literature is the management of overcrowding, congestion and safety hazards, which continue to be critical issues despite decades of infrastructural investment (Owaidah et al., 2019). Traditional approaches to crowd management, which often relied on manual coordination and reactive measures, have proven insufficient in preventing stampedes and minimizing risks in high-density settings. To address this, new strategies such as the integration of social media platforms (Alsulaiman, 2024) and digital smart streets equipped with wireless sensors and fog nodes (Abi Sen et al., 2021) have been proposed to enhance real-time monitoring and communication. These advancements signify a shift from reactive to proactive models of crowd management though challenges remain in large-scale implementation and coordination across stakeholders.

Emerging research highlights a transition toward technologically enabled and collaborative management models. One notable trend is the growing emphasis on RFID technology, which provides granular tracking of pilgrim movement and enables predictive modelling for congestion hotspots (Abdoh, 2025). Additionally, collaborative knowledge networks have been identified as a mechanism for improving service quality through collective learning and innovation, suggesting that effective hajj management is not solely dependent on technology but also on inter-organizational coordination and shared expertise (Mohammed et al., 2024). These developments illustrate the increasing recognition that hajj management requires integrated frameworks combining human, institutional and technological capacities.

The expanded summary also highlighted the role of stakeholder perceptions in shaping the direction of hajj management. For many Muslim-majority countries particularly Indonesia, hajj management is not only a logistical undertaking but also a matter of religious legitimacy and political accountability (Makrum, 2020). Supply chain management practices have been shown to improve efficiency and transparency in pilgrim services, aligning governance with the expectations of both pilgrims and policymakers (Makrum, 2020). Moreover, legislative oversight such as in Indonesia reflects how pilgrimage organization is increasingly embedded in national political discourse (Purkon, 2021). These findings underscore the importance of considering governance and cultural politics alongside technological innovation when evaluating hajj management models.

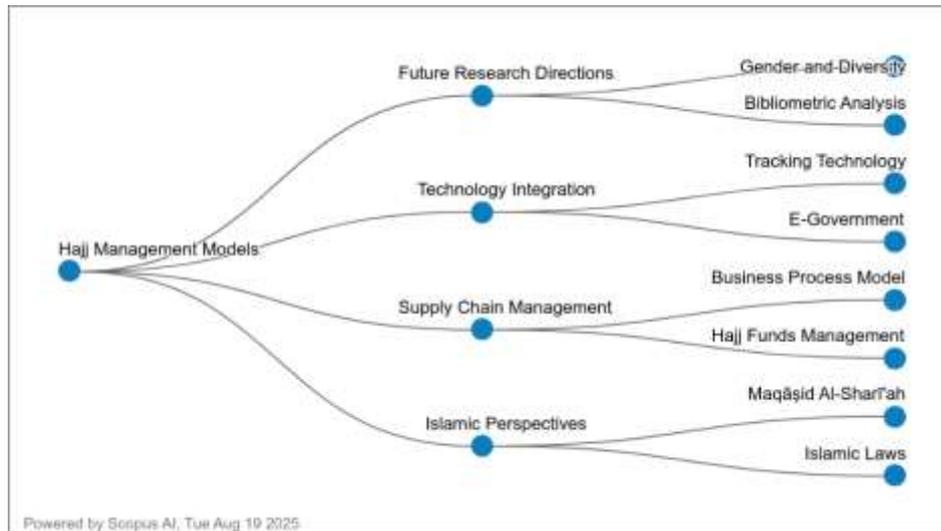
The most significant area of growth, however, lies in the adoption of advanced technologies. The literature points to artificial intelligence (AI), Internet of Things (IoT) applications and integrated communication systems as central to improving service quality and ensuring safety (Binsawad & Albahar, 2022). AI-driven analytics enable predictive modelling of crowd behavior, IoT applications facilitate seamless information sharing and smart infrastructure supports real-time decision-making. Importantly, the integration of digital smart streets with social media apps provides a responsive ecosystem where alerts can be quickly disseminated and acted upon (Abi Sen et al., 2021). Together, these innovations demonstrate a paradigm shift towards data-driven and anticipatory management models, which not only address immediate risks but also enhance pilgrims' overall experience.

Taken together, the summary and expanded summary reveal a research field in transition. While the enduring challenge of crowd safety remains central, the scholarly discourse is increasingly characterized by technological innovation, inter-organizational collaboration and attention to political and cultural dynamics. This indicates that hajj management models are evolving from narrowly defined operational frameworks into multi-dimensional systems that integrate safety, efficiency, governance and sustainability. Nevertheless, gaps persist in the integration of these models into a unified framework, suggesting the need for future research to focus on synthesizing disparate approaches into holistic, scalable solutions.

Concept Map

The concept map generated by Scopus AI highlights four main clusters in the literature on hajj management models: i) Future Research Directions, ii) Technology Integration, iii) Supply Chain Management and iv) Islamic Perspectives (Refer to Figure 2). Future research points to themes such as gender and diversity and bibliometric analysis, while technology integration emphasizes tracking systems and e-government for efficiency and safety. Supply chain management focuses on business processes and funds management, ensuring accountability and resource optimization. Meanwhile, Islamic perspectives including Maqasid al-Syariah and Islamic law stress the importance of aligning management practices with spiritual and ethical values. Collectively, the map illustrates the interdisciplinary nature of hajj management scholarship, bridging operational, technological, financial and religious dimensions.

Figure 2: Concept Map of Hajj Management Models



Source: Scopus

Review of Hajj Management Models

The review of academic contributions on hajj management models reveals that scholarship has primarily focused on discrete systems and innovations aimed at improving efficiency, safety and service quality rather than developing a single comprehensive model. One of the earliest proposals emphasized strategic information systems planning (SISP) for RFID implementation, which provided guidelines for effective deployment, data sharing and scenario planning in hajj management (Abdoh, 2025). This model highlights the importance of technological infrastructure in tracking pilgrim movement and ensuring accountability, yet it also underscores the challenges of aligning system design with the complex realities of multi-stakeholder coordination during hajj.

A second notable development lies in the financial and insurance domain, where scholars have proposed hybrid models for managing Hajj travel insurance and funds, combining elements of mudharabah and wakalah contracts to ensure fairness and transparency. These models aim to optimize fund management through strategic asset allocation in Islamic financial instruments (Masruroh et al., 2023). This approach integrates financial planning with risk mitigation through benefits such as coverage for critical illness and death compensation, reflecting the increasing recognition of economic preparedness as a dimension of *istita'ah* (capability) in hajj. By optimizing financial resource allocation, this model contributes not only to individual pilgrim welfare but also to institutional efficiency in managing hajj funds. However, the literature indicates limited exploration of how such financial models interact with broader governance frameworks or technological systems, leaving room for integrative approaches.

Finally, the literature also reflects attempts to frame hajj management within service quality paradigms, emphasizing the need for frameworks that address the experiences of diverse stakeholders (Alshaibi et al., 2023). A systematic literature review identified gaps in adapting tourism service models to the unique context of pilgrimage, calling for frameworks that balance efficiency with the spiritual and cultural dimensions of hajj. This underscores an important research agenda: the development of holistic models that integrate technological, financial,

logistical and experiential aspects of hajj management while remaining aligned with Islamic values. Future research should therefore move beyond fragmented models toward comprehensive frameworks that synthesize these domains, incorporating cross-disciplinary insights and advancing sustainable, inclusive and resilient pilgrimage management systems.

Relationship Between Hajj Management Models and Future Research Directions

The review of hajj management models indicates that scholarship has progressively moved beyond short-term operational improvements toward exploring future-oriented models that balance technological innovation, community empowerment and spiritual enrichment. One notable example is the utilization of hajj dormitories as star-rated hotels, which not only addresses accommodation challenges but also empowers local communities and contributes to the national economy (Sirna et al., 2024). This model demonstrates how hajj management can be linked to socio-economic development goals, suggesting future research should expand the scope of hajj studies to include broader societal impacts such as job creation, tourism development and local empowerment. At the same time, technology-driven solutions continue to dominate future research agendas. The strategic information systems planning (SISP) model for RFID implementation offers a structured pathway for integrating tracking technology into hajj management, ensuring transparency, accountability and real-time monitoring of pilgrim movements (Abdoh, 2025). While current models highlight technical feasibility, future research must assess the scalability of RFID systems in complex environments such as Mina and Arafat, as well as their interoperability with other digital platforms, including immigration and financial systems. These directions reflect a growing need for comprehensive frameworks that align advanced technologies with governance structures.

The future of crowd management research is equally critical, given the recurring risks of congestion and stampedes. Innovative models such as digital smart streets equipped with LED-light screens, control algorithms and wireless sensors provide promising avenues for proactive monitoring and rapid response during emergencies (Abi Sen et al., 2021). However, research has yet to fully investigate the integration of these systems with predictive analytics, artificial intelligence (AI) and Internet of Things (IoT) platforms. Future agendas should therefore focus on developing intelligent crowd management ecosystems that combine physical infrastructure with digital foresight to ensure safety and efficiency in mass pilgrimages.

Beyond logistics and safety, scholars have also proposed comprehensive hajj models that encompass educational, religious and emergency guidance functions. Such models envision integrated databases for pilgrim tracking, multilingual educational platforms and portable emergency systems. This holistic approach highlights the potential of hajj management to provide not only logistical efficiency but also religious and cultural benefits, fostering Muslim unity and cooperation worldwide. Future research directions in this domain should explore the design and implementation of multi-layered systems that address spiritual education, cultural inclusivity and crisis preparedness in a unified framework. Taken together, these studies reveal that future research directions in hajj management models must move beyond isolated solutions toward integrative and multi-dimensional frameworks. This includes linking infrastructure models with socio-economic empowerment, embedding technological solutions into larger governance ecosystems, advancing AI-driven crowd management and expanding educational and spiritual dimensions of hajj administration. Such comprehensive agendas will not only ensure safer and more efficient pilgrimage management but also align with the principles of Maqasid al-Syariah by promoting the welfare, safety and unity of the Muslim ummah.

Relationship Between Hajj Management Models and Technology Integration

The integration of technology within hajj management models represents a crucial shift from manual, paper-based practices to digital and automated systems designed to enhance efficiency, transparency and safety. Among the earliest advancements in this domain is the proposal of a Strategic Information Systems Planning (SISP) model for RFID implementation, which provides a structured approach for preparing hajj authorities and organizations to adopt RFID technologies (Abdoh, 2025). This model addresses practical implementation issues, including data-sharing mechanisms and scenario planning, reflecting the necessity of a strategic framework to accommodate the complexity of hajj operations. The emphasis on RFID highlights a growing recognition of how real-time tracking technologies can optimize pilgrim monitoring and ensure accountability across different stages of the pilgrimage.

Building on this foundation, more comprehensive models of technology integration have emerged, such as the e-Hajj system implemented in Indonesia. This system integrates multiple electronic platforms, including e-KTP (electronic identity cards), SISKOHAT (Hajj Integrated Computerized System), immigration, banking and ministry-level databases (Afriani et al., 2020). By employing Unified Modelling Language (UML), the e-Hajj system creates a standardized process model that connects disparate stakeholders under one digital framework. This not only streamlines administrative processes but also reduces redundancies, enhances coordination and improves data accuracy, thereby contributing to a more seamless pilgrimage experience.

The relationship between these models illustrates a continuum of technological integration within hajj management. On one end, targeted solutions like RFID focus on specific aspects of operational control, such as tracking pilgrim flows. On the other end, holistic platforms like e-Hajj aim to unify administrative, financial, and logistical processes under a comprehensive digital ecosystem. Together, they demonstrate how technological innovation is gradually transforming hajj management from isolated interventions to integrated systems. Future research should therefore examine how these distinct approaches can be merged into hybrid frameworks that balance real-time monitoring with systemic governance. Despite these advancements, challenges remain in achieving interoperability across platforms and ensuring equitable access for pilgrims from diverse backgrounds. For example, while RFID and e-Hajj systems provide technical efficiency, questions persist about cybersecurity, data privacy and the digital divide among pilgrims, particularly those from rural or underdeveloped regions. Moreover, the integration of advanced technologies requires substantial investment, regulatory oversight and capacity-building among hajj institutions. Addressing these challenges will require cross-disciplinary research that incorporates insights from information systems, governance and religious studies.

Looking forward, the future research agenda for technology integration in hajj management should focus on developing scalable and secure digital ecosystems that align technological innovation with the spiritual and cultural values of the pilgrimage. This includes exploring the potential of artificial intelligence for predictive crowd management, blockchain for secure financial transactions and mobile platforms for real-time communication and guidance. By embedding these innovations into comprehensive hajj management models, future systems can ensure safety, efficiency and inclusivity while upholding the spiritual sanctity of the pilgrimage.

Relationship Between Hajj Management Models and Supply Chain Management

The relationship between hajj management models and supply chain management (SCM) is increasingly relevant given the scale, complexity and critical nature of resource allocation during the pilgrimage. The hajj involves the movement of millions of pilgrims across multiple locations within a short timeframe, requiring efficient coordination of logistics, procurement and distribution. Traditional supply chain management (SCM) models have evolved to address modern challenges and strategies. Recent research highlights the shift from conventional approaches to more advanced concepts like sustainable SCM and SCM 4.0 (Hariharasudan et al., 2021). When applied to hajj, this model offers a framework to align strategic objectives, such as safety and efficiency, with operational practices including food distribution, transportation and accommodation management. The Supply Chain Operations Reference (SCOR) model is widely recognized for standardizing supply chain processes into five core activities: plan, source, make, deliver and return (Nahason et al., 2024; Prasetyaningsih et al., 2020). Applied to hajj management, the SCOR model could be instrumental in structuring pilgrim services planning pilgrim flows, sourcing supplies such as food and water, delivering healthcare and transport services and ensuring responsive systems for emergencies and waste management. Similarly, the House of Collaborative Partnership (HCP) model emphasizes collaboration and integration across supply chain partners (Patel et.al., 2022). In the hajj context, this implies stronger cooperation between government agencies, Tabung Haji, private service providers and local communities to enhance transparency and coordination.

A more comprehensive approach is offered in the Handbook of Global Supply Chain Management, which highlights practical guidelines for effective SCM implementation through integration of strategy, structure and process (Baisya, 2024). When applied to hajj management, this perspective highlights the importance of coordinating multiple stakeholders across countries, since pilgrims come from diverse regions worldwide, together with local Saudi authorities who oversee operations on the ground. Such a global-to-local SCM perspective is critical for anticipating challenges in procurement, ensuring timely distribution of supplies and mitigating risks during mass gatherings. The adaptation of SCM models to hajj management also highlights significant challenges that warrant future research. Unlike corporate supply chains, hajj logistics must incorporate religious obligations, cultural diversity and extreme seasonal demand. This requires customizing existing models to integrate ethical and religious considerations, particularly those tied to *istita'ah* (capability) and the welfare of pilgrims. Moreover, disruptions such as health crises (e.g., pandemics) or crowd surges necessitate resilient SCM frameworks capable of adapting rapidly to dynamic conditions. Future research should therefore focus on developing hybrid SCM models tailored to pilgrimage contexts, blending efficiency-driven corporate practices with values of inclusivity, sustainability and safety.

In summary, while existing SCM models such as the Harburger, SCOR, CLP and comprehensive global frameworks were not originally designed for religious mass gatherings, they provide robust foundations for reimagining hajj management models. Their adaptation requires contextualization to account for unique challenges of hajj, including cultural sensitivity, extreme temporal concentration of demand and the integration of technology for real-time monitoring. Future research should prioritize developing hajj-specific SCM frameworks that integrate logistical efficiency with religious, social and environmental dimensions, thereby contributing to a more resilient and holistic management of one of the world's largest annual human gatherings.

Relationship Between Hajj Management Models and Islamic Perspectives

Within management theory, Maqasid al-Syariah may be conceptualized as a value-based governance framework that informs organizational decision-making, performance evaluation and policy design. In the context of hajj management, the protection of life (*ḥifẓ al-nafs*) aligns directly with safety-oriented crowd management and healthcare logistics, while the protection of wealth (*ḥifẓ al-māl*) underpins transparent financial governance and sustainable fund management practices.

The relationship between hajj management models and Islamic perspectives is fundamental because the administration of hajj cannot be separated from the religious, ethical and spiritual values embedded in Islam. Unlike purely technical or logistical approaches, Islamic perspectives emphasize the role of Maqasid al-Syariah (objectives of Islamic law), *maslahah* (public interest) and principles of justice and accountability in shaping management decisions. Recent scholarship highlights the significance of managing hajj funds and institutional governance through a Maqasid al-Syariah lens, ensuring that resources are utilized not only for operational efficiency but also for the broader benefit of society (Samsudin et al., 2023). This integration of Islamic values into financial and managerial models underscores that effective hajj management must align with both religious obligations and social responsibilities.

One important dimension of Islamic perspectives in hajj management is the recognition of its spiritual centrality in the lives of Muslims worldwide. As highlighted by Makrum (2020), the role of supply chain management (SCM) in hajj is more than a logistical necessity. It is a religiously significant process that must safeguard the sanctity of pilgrimage. From this perspective, SCM practices act as mediating mechanisms to ensure that the delivery of food, healthcare, transportation and accommodation does not only meet efficiency standards but also reflects the Islamic values of service, fairness and compassion. This illustrates how Islamic perspectives transform operational models into value-based systems where technology and logistics are not ends in themselves but means to uphold the spiritual integrity of hajj. Another strand of research explores Islamic approaches to conflict management, which are highly relevant in the human resource management of hajj operations. Abdul Cader (2017) emphasizes that Islamic conflict resolution draws on values such as cooperation (*ta'awun*), patience (*sabr*) and maintaining good assumptions (*husn al-zann*). Applied to hajj management, these principles could guide decision-making in resolving disputes among stakeholders, volunteers, or even pilgrims. In mass gatherings where cultural and linguistic diversity often lead to misunderstandings, integrating Islamic principles of conflict management into organizational models could enhance cooperation, reduce tension and create a more harmonious environment for pilgrims.

Financial stewardship is another area where Islamic perspectives intersect with hajj management models. A recent comparative fiqh study by Aripin (2025) examined the investment of Indonesian hajj funds in domestic infrastructure projects, arguing that such investments are permissible under Islamic law if they serve both economic and spiritual *maslahah*. This approach reflects an Islamic model of proactive resource management, where hajj funds are not merely preserved but strategically invested to generate benefits for the wider Muslim community. The recognition of dual objectives, namely economic sustainability and religious accountability, indicates the need for future models that integrate Islamic financial jurisprudence with modern governance frameworks.

Taken together, these insights suggest that future research on hajj management models must pay closer attention to Islamic perspectives as integral rather than supplementary dimensions. This includes embedding Maqasid al-Syariah in financial governance, integrating Islamic principles of conflict resolution into organizational behaviour and aligning logistical operations with values of fairness and compassion. By bridging operational models with Islamic ethics, future hajj management frameworks can become more holistic, ensuring that they are not only efficient and technologically advanced but also spiritually grounded and socially responsible.

Topic Experts

The identification of key topic experts provides valuable insight into the scholarly contributions shaping the field of hajj management models. Among these, Mazin M. Alshamrani emerges as an important figure, particularly for his work on the stress and fatigue experienced by pilgrims. His research leverages wearable remote sensing systems to collect real-time physiological and behavioural data from pilgrims, enabling an evidence-based understanding of the physical and emotional challenges encountered during hajj. This integration of technology with human experience underscores Alshamrani's role in advancing data-driven management approaches that go beyond logistics, focusing instead on the well-being of pilgrims as a central component of hajj management (Alshamrani, 2022).

Similarly, Anas A. Khan stands out for his pioneering work at the intersection of healthcare innovations and mass gathering management. His publications demonstrate how artificial intelligence (AI) can be deployed to strengthen clinical services, optimize resource allocation and enhance health security during large-scale events such as hajj. By applying AI to predict health risks, streamline patient flow and support decision-making, Khan provides forward-thinking contributions that address the unique healthcare challenges of mass religious gatherings (Khan et al., 2021). His expertise ensures that hajj management models increasingly incorporate health-centered strategies, reflecting the critical role of public health in ensuring both safety and spiritual fulfilment during the pilgrimage.

The contributions of Tarik K. Alafif align closely with Alshamrani's research trajectory, focusing on the use of wearable remote sensing systems to monitor stress and fatigue among pilgrims. By analyzing biometric data, Alafif provides a comprehensive picture of the physical demands imposed by the pilgrimage, which can inform strategies for rest, recovery and crowd flow management (Alafif et al., 2023). His work reinforces the significance of integrating human-centric data into hajj management models, ensuring that pilgrims' physiological and psychological conditions are factored into planning and operations. This research direction enhances the sustainability of hajj management by centering the human experience alongside technological innovation.

The convergence of expertise among these scholars demonstrates a growing emphasis on technology-enabled, health-focused and human-centered hajj management models. While Alshamrani and Alafif provide critical insights into pilgrim stress, fatigue and resilience, Khan extends this discourse into the realm of AI-driven healthcare innovation, emphasizing preparedness and response to health emergencies. Together, their work highlights a paradigm shift from purely logistical management toward integrated systems that balance operational efficiency with health, safety and well-being. This interdisciplinary perspective is crucial for developing future-ready hajj management frameworks.

Looking forward, the insights of these experts suggest clear future research agendas. These include scaling wearable sensing technologies for larger pilgrim populations, integrating AI-powered predictive analytics into real-time management systems and embedding healthcare innovation into comprehensive hajj management models. Additionally, there is a need for collaborative research networks that link technology developers, healthcare providers and religious authorities to co-create holistic models. By leveraging the expertise of Alshamrani, Khan and Alafif, future studies can build robust frameworks that ensure the safe, sustainable and spiritually enriching performance of hajj for millions of pilgrims worldwide.

Emerging Themes

The consistent theme of technological integration in hajj management demonstrates a clear and ongoing trajectory in the scholarly literature, reflecting the critical role of innovation in addressing the complexities of one of the world's largest religious gatherings. Researchers consistently highlight the potential of artificial intelligence (AI), Internet of Things (IoT) and machine learning as transformative tools to improve efficiency, coordination and safety across all aspects of the pilgrimage. The sustained presence of these themes in the literature underscores a growing recognition that traditional approaches to hajj management are insufficient to cope with the scale of modern challenges, particularly those related to overcrowding, transportation and healthcare delivery (Alzaharani & Algethami, 2025).

One of the most prominent applications of technological integration lies in crowd management, where AI-driven predictive models have shown significant promise. By employing machine learning algorithms and neural networks, researchers have been able to forecast abnormal crowd behaviors, identify risks of congestion and generate real-time alerts to mitigate stampedes or bottlenecks (Alzaharani & Algethami, 2025). These predictive models represent a paradigm shift from reactive crowd control strategies to proactive prevention, where risks are anticipated and addressed before they escalate into crises. Such approaches not only safeguard pilgrims' physical safety but also enhance their spiritual experience by reducing anxiety and uncertainty during the pilgrimage.

Beyond crowd control, IoT-enabled systems are emerging as essential tools for logistical coordination in hajj management. Smart devices, wireless sensors and real-time communication platforms allow for dynamic monitoring of transportation routes, accommodation capacities and service delivery systems. Studies suggest that these technologies can significantly improve coordination across multiple stakeholders, enabling seamless management of pilgrim flows and resources (Abi Sen et al., 2021). In particular, the development of smart street designs and connected infrastructure has shown potential in facilitating efficient movement and communication during peak rituals, aligning operational management with safety imperatives.

Healthcare services have also benefited from technological integration, particularly using AI and digital platforms. AI-assisted triage systems and predictive analytics can optimize resource allocation in medical facilities, anticipate potential health crises and improve overall emergency preparedness (Khan et al., 2021). The integration of blockchain-enabled systems further enhances transparency and accountability in the medical supply chain, ensuring that critical resources are available when needed (Albalwy, 2025). Together, these innovations highlight how digital transformation is not only improving operational efficiency but also reinforcing resilience in healthcare delivery during mass gatherings.

Taken collectively, the emerging theme of technological integration in hajj management reveals a comprehensive and interdisciplinary approach to future models. By combining AI for predictive crowd safety, IoT for logistical coordination and digital innovations in healthcare, researchers are paving the way toward holistic, technology-driven frameworks. However, challenges remain in scaling these systems, ensuring interoperability and addressing ethical concerns such as data privacy and equitable access. Future research should therefore focus on integrating these technologies into unified, sustainable hajj management models, validating their effectiveness in real-world contexts and aligning their implementation with Islamic values of welfare (maslahah) and justice.

Conclusion

This review has synthesized the existing body of knowledge on hajj management models, drawing upon diverse themes including technological integration, supply chain management, Islamic perspectives, healthcare innovations and pilgrim well-being. The key findings indicate that while numerous models have been developed to address specific challenges such as RFID-enabled tracking, e-Hajj systems, AI-driven crowd management, blockchain-enabled healthcare logistics and mobile service unit simulations. There remains a lack of a unified, comprehensive framework that integrates these disparate approaches. Emerging themes highlight a growing reliance on advanced technologies (AI, IoT, blockchain, machine learning), the importance of Islamic governance principles such as Maqasid al-Syariah and maslahah and the relevance of supply chain management models to ensure efficiency, safety and transparency in hajj operations.

The theoretical implications of this study lie in extending the discourse on hajj management beyond operational or logistical concerns to embrace interdisciplinary frameworks. By bridging management theories such as supply chain operations reference (SCOR), service quality models and Islamic jurisprudence-based governance, this study emphasizes the potential for developing a hybrid conceptual framework that situates hajj management at the intersection of religious values, technological innovation and organizational science. Such a framework enriches both Islamic management theory and broader discussions of mass gathering management, positioning hajj as a unique but globally relevant case study.

From a practical perspective, the findings underscore the urgent need for policymakers, religious authorities and hajj organizers to embrace integrative models that harness the strengths of digital transformation while remaining grounded in ethical and spiritual considerations. Practical implications include the adoption of AI-driven predictive systems for crowd safety, the integration of IoT-enabled platforms for real-time coordination and the application of blockchain for healthcare and financial transparency. Additionally, embedding Islamic conflict resolution principles into organizational culture can enhance stakeholder collaboration, while supply chain management models can improve resource allocation and service delivery. Together, these practices promise not only operational efficiency but also a more spiritually meaningful and safe pilgrimage experience. Nevertheless, this review acknowledges several limitations. First, the literature analysed remains fragmented, with many studies focusing on niche technological solutions without assessing their integration into broader systems. Second, empirical studies evaluating these models in real-world hajj contexts are limited, raising questions about scalability, feasibility and cultural acceptance. Third, much of the scholarship is concentrated in specific geographical contexts (Saudi Arabia and Indonesia), suggesting that perspectives from other Muslim-majority countries remain

underexplored. These limitations point to the need for more comprehensive, comparative and contextually sensitive studies.

Looking ahead, this study identifies several directions for future research. Scholars should prioritize developing integrative hajj management frameworks that consolidate technological, logistical, financial and religious dimensions into a unified model. Longitudinal and empirical research is needed to test the effectiveness of AI, IoT and blockchain systems in actual pilgrimage settings, particularly in terms of scalability and inclusivity. Furthermore, future studies should explore the role of sustainability and green innovation in hajj management, aligning with global environmental goals. Finally, greater attention should be given to the pilgrim experience, incorporating psychosocial well-being, cultural diversity and gender inclusivity into management models. By addressing these gaps, future research can contribute to a holistic and resilient system of hajj management that ensures safety, efficiency and spiritual fulfilment for millions of Muslims worldwide.

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