

Modeling the Acceptance of Waqf Blockchain Ecosystem among Millennial Alumni of Public Universities in Malaysia: A Conceptual Framework

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ABSTRACT

Purpose: This study aims to propose a conceptual framework for the acceptance of a blockchain-based waqf management system (“Waqf blockchain”) among millennial alumni of public universities in Malaysia. The framework employs the Unified Theory of Acceptance and Use of Technology (UTAUT) with four exogenous latent variables which are Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC), extended with a domain specific construct, Smart Contract (SC), and a moderating variable, Voluntariness of Use (VoU), acting on the relationship between the exogenous constructs and Behavioural Intention (BI) to adopt Waqf blockchain.

Theoretical framework: Waqf, as an Islamic endowment institution, continues to be constrained in Malaysian public universities by low efficiency, transparency and accountability in fund management. Blockchain technology, through its immutable and decentralised ledger and self-executing smart contracts, has been advanced in the literature as a mechanism to restore trust and accountability in waqf administration (Anshari et al., 2020a; Mohaiyadin et al., 2021, 2022). Building on the original UTAUT model of Venkatesh et al. (2003), which identifies performance expectancy, effort expectancy, social influence and facilitating conditions as determinants of behavioural intention, this study extends the model by embedding Smart Contract as a fifth, domain-specific predictor and repositioning Voluntariness of Use one of UTAUT’s original moderators as the sole moderating variable, following the same logic used by prior UTAUT extensions that substitute a single theoretically salient moderator for the original four (e.g., religiosity in Soomro, 2019).

Design/methodology/approach: Consistent with a positivist research paradigm, this study adopts a deductive, quantitative, cross-sectional survey design. The unit of analysis is the individual millennial alumnus (born 1981–1996) of a Malaysian public university, residing or working in the urban Central Region (Selangor, Kuala Lumpur, Putrajaya, Negeri Sembilan). A multistage cluster sampling technique geographical clustering, institutional clustering and individual selection is proposed to obtain a representative sample, with a targeted final sample of 600 respondents for the field study, preceded by a pilot study of 100–150 respondents to refine the ten-point Likert-scale survey instrument.

Findings: As a conceptual paper, this study does not report empirical results. It instead proposes nine hypotheses: five direct-effect hypotheses (H1–H5) linking PE, EE, SI, FC and SC to BI, and four moderation hypotheses (H6–H9) in which Voluntariness of Use is proposed to moderate the relationships between SC, PE, EE and SI, respectively, and BI. The proposed model is intended to be validated using Structural Equation Modelling (SEM) via AMOS, following exploratory factor analysis, reliability analysis and confirmatory factor analysis of the measurement model.

Research, Practical & Social implications: The proposed framework offers university administrators, State Islamic Religious Councils (SIRC) and waqf and endowment (WAE) units an evidence-based basis for designing Waqf blockchain platforms that respond to users’ performance, effort, social and infrastructural expectations, while treating the perceived voluntariness of adoption as a factor that can strengthen or weaken these relationships. Socially, the framework supports Malaysia’s policy agenda under the Malaysia Education

Blueprint 2015–2025 and the UniTP Purple Book to diversify university income through waqf, by clarifying the behavioural drivers of alumni participation in a digitalised waqf ecosystem.

Originality/value: While UTAUT has been widely applied to fintech, mobile banking and, more recently, waqf-blockchain adoption (e.g., Mokthar et al., 2023), very few studies combine a domain-specific Smart Contract construct with Voluntariness of Use as a moderator in the context of institutional (university-based) waqf. This study addresses that gap by proposing an integrated, testable conceptual model tailored to the millennial alumni segment of Malaysian public universities – a population identified in the literature as digitally literate, socially conscious and central to future university income diversification.

Keywords: Waqf Blockchain; Waqf blockchain; Smart Contract; Voluntariness of Use; UTAUT; Public Universities; Conceptual Framework.

INTRODUCTION

Waqf, an enduring Islamic philanthropic institution, has historically played a pivotal role in promoting social welfare and economic stability within Muslim societies, including the funding of educational institutions, healthcare and community development (Daud et al., 2022; Hasan et al., 2015). In Malaysia, public universities are significant beneficiaries and administrators of waqf funds, using them to support research, infrastructure and scholarships (Mujani et al., 2017). Despite this potential, waqf management in Malaysian public universities continues to suffer from a low level of efficiency, transparency and accountability, thereby reducing the realisation of waqf's full potential (Mohsin & Muneeza, 2018; Usman & Ab Rahman, 2023).

Blockchain technology, with its inherent features of transparency, immutability and decentralisation, has emerged as a promising solution for modernising waqf management. The integration of blockchain into waqf administration, or “Waqf blockchain”, offers a robust framework for collecting, distributing and monitoring waqf funds while attracting greater public participation (Ahmad et al., 2023; Zulkifli et al., 2022). Within this framework, smart contracts self-executing digital agreements coded on blockchain infrastructure have been proposed as a mechanism to automate fund disbursement according to donor intent (niyyah), thereby reducing bureaucratic delay and mismanagement (Anshari et al., 2020a, 2020b).

Notwithstanding this potential, adoption of blockchain technology in waqf management among Malaysian public universities remains limited, constrained by technological resistance, low awareness and insufficient regulatory support (Johan et al., 2016). Understanding the behavioural intention of stakeholders particularly millennial alumni, who are digitally literate, values-driven and central to institutional fundraising strategies (Hasbullah et al., 2024; Salleh, 2019) is therefore crucial to the successful implementation of Waqf blockchain. This paper responds to this need by proposing a conceptual framework, grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), that explains the behavioural intention to adopt Waqf blockchain and the moderating role of voluntariness of use.

LITERATURE REVIEW

This section synthesises existing knowledge relevant to the adoption of Waqf blockchain and introduces the theoretical framework guiding this study. It is organised into seven strands: (i) waqf management and its persistent challenges; (ii) blockchain technology in Islamic finance; (iii) smart contracts as a domain-specific enabler; (iv) blockchain application in waqf governance; (v) the higher education and income-generation context in Malaysia; (vi) millennial alumni as the study population; and (vii) technology adoption models concluding in UTAUT, from which the study's hypotheses are derived.

Waqf Management: Historical Role and Persistent Challenges

Waqf, derived from the Arabic root *waqafa* (to stop, contain or preserve), refers to a perpetual charitable endowment in Islamic law in which an asset is dedicated permanently for religious, educational or philanthropic purposes while only its benefits or revenues are utilised (Anshari et al., 2020a). Classical scholarship distinguishes *waqf khayri* (public/charitable waqf), *waqf ahli* (family waqf) and *waqf mushtarak* (a combination of both), with endowed assets historically including land, buildings, cash (*waqf naqdi*) and, in contemporary practice, intellectual property. Over the centuries, waqf institutions financed mosques, schools (*madrakah*), hospitals (*bimaristan*) and water distribution, making waqf one of the most durable instruments of Islamic social finance (Anshari et al., 2020a).

Despite this legacy, the modern waqf institution is constrained by fragmented governance structures, a lack of standardised data and documentation, insufficient public awareness, and inadequate transparency and accountability mechanisms (Anshari et al., 2020a; Kahf, 2003). Existing studies document outdated management practices, weak record-keeping and, in some jurisdictions, corruption (Cizacka, 1998; Mohamed et al., 2019), while legal authority over waqf in Malaysia is fragmented across multiple State Islamic Religious Councils (SIRC), producing inconsistent governance models and bureaucratic delay (Kamaruddin, 2021).

Within Malaysian public universities specifically, waqf has been positioned as a key mechanism for income diversification under the Malaysia Education Blueprint 2015–2025 (Higher Education) and the University Transformation Programme (UniTP) Purple Book, with institutions such as UKM, USIM, UPM and UTM establishing dedicated waqf funds to finance infrastructure, healthcare centres and student support services, often in collaboration with SIRCs (Hussin et al., 2017). Nonetheless, implementation continues to be hampered by limited awareness and readiness among university leadership, legal ambiguity regarding waqf in higher-education law, and limited staff capacity to manage waqf assets in accordance with Shariah principles (Hussin et al., 2017; Johan et al., 2016). A study focused specifically on Malaysian public universities found that institutions must seek SIRC approval to act as waqf administrators, and that inconsistent reporting, limited disclosure and disjointed collection–distribution processes undermine efficiency, contribute to public scepticism and weaken the sustainability of educational waqf initiatives (Mohaiyadin et al., 2021).

Blockchain Technology in Islamic Finance

Blockchain is a distributed ledger technology (DLT) that records transactions across multiple nodes in a secure, transparent and immutable manner, such that data cannot be altered without network consensus (Anshari et al., 2020b). Its integration with Islamic finance aligns naturally with Shariah principles of transparency and accountability, and has been studied in relation to zakat, halal supply chains and crowdfunding, although research specifically addressing waqf remains comparatively scarce (Aloui et al., 2021; Abdullah et al., 2022; Yaacob et al., 2021).

For waqf institutions, which often suffer from weak transparency, inadequate public disclosure and inefficient audit practices, blockchain offers real-time tracking of waqf flows, transparent reporting to stakeholders and permanent, tamper-evident storage of donor intentions and contract terms, thereby upholding the Islamic principles of accountability (*amanah*), trust (*thiqah*) and integrity (*istiqamah*) (Anshari et al., 2020b). Complementary work has proposed blockchain-based cash-waqf models to finance Islamic religious schools, in which donations are collected through a digital platform and managed by robo-advisers for Shariah-compliant investment before smart contracts release funds directly to verified beneficiaries, with all transaction records stored on a public ledger for traceability (Abd Razak et al., 2020). Within Malaysian public universities specifically, blockchain has been proposed to address administrative errors, weak governance in fund distribution, limited stakeholder involvement and fragmented systems, by enabling automated data authentication, minimising manual errors in receipt issuance, and allowing donors and regulators (SIRC) to view transaction histories transparently (Mohaiyadin et al., 2022).

Nonetheless, adoption of blockchain in Islamic finance faces regulatory uncertainty, technical complexity and the need for Shariah scholars' consensus on its permissibility, alongside unresolved debate over the Shariah status of certain digital-asset elements embedded in some blockchain platforms (Dahdal et al., 2021; Aysan et al., 2023). These challenges underline the importance of examining not only the technical feasibility of blockchain but also the behavioural intention of the human stakeholders who must ultimately adopt it – the focus of the present study.

Smart Contract as a Domain-Specific Construct

Smart contracts, first conceptualised by Szabo (1996), are self-executing programs coded on blockchain infrastructure in which contractual terms are written directly into code and automatically enforced once pre-specified conditions are met, without reliance on intermediaries (Anshari et al., 2020a; Peters & Panayi, 2015, as cited in Abd Razak et al., 2020). Within waqf, smart contracts have been proposed as a mechanism to execute donor intent (*niyyah*) precisely – for example, disbursing a fixed scholarship amount annually once recipient eligibility is verified through integrated data checks – thereby reducing administrative delay, eliminating ambiguity (*gharar*) in disbursement, and minimising the risk of mismanagement or human error (Anshari et al., 2020b; Abd Razak et al., 2020).

Empirical and conceptual work on university-based waqf suggests that, while not yet widely implemented, smart contracts could standardise the issuance of digital waqf receipts, regulate the timing of fund release and create digital triggers based on institutional needs or pre-set conditions, all validated and enforced without human intervention – a function expected to prevent malpractice and enhance stakeholder confidence (Mohaiyadin et al., 2022). At the level of university financial autonomy more broadly, smart contracts have been linked to improved governance, performance

tracking and transparency in university waqf institutions, helping to attract external funding and build stakeholder trust (Salleh et al., 2023), and to enabling real-time authentication of fund flows under systems such as Waqf blockchain (Mohamed et al., 2020). Because these capabilities are specific to blockchain-based waqf platforms rather than a generic system attribute captured by the original UTAUT constructs, this study incorporates Smart Contract (SC) as a fifth, domain-specific exogenous construct, consistent with prior UTAUT extensions that add context-specific predictors to the base model (e.g., Alghushairy et al., 2023; Prati, 2024).

Technology Adoption Models and UTAUT

Technology adoption models explain how individuals decide to accept, use or reject technological innovations, drawing on constructs such as perceived usefulness, ease of use and social norms (Taherdoost, 2018). The Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), synthesises eight earlier models including the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB) and Diffusion of Innovation Theory (DOI) into four core determinants of behavioural intention and use: Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions, moderated in the original formulation by gender, age, experience and voluntariness of use.

UTAUT has been extensively applied to blockchain adoption research across sectors, including SMEs (Smith et al., 2025), banking (Abu Afifa et al., 2022), supply chain management (Khan et al., 2023), real estate (Atayah et al., 2024) and, specifically, waqf blockchain adoption among endowers in Malaysia (Mokthar et al., 2023). However, limited research has applied UTAUT to Islamic blockchain technologies in an institutional, university-based waqf setting, and the role of voluntariness of use as a moderator in this specific context remains largely unexplored.

Millennial Alumni as the Study Population

The selection of millennial alumni (born 1981–1996) as the target respondents for waqf–blockchain research is grounded in their digital fluency, philanthropic potential and alignment with institutional financing reforms. As Malaysian public universities increasingly rely on alumni as a donor base for waqf and endowment initiatives, millennials now the dominant workforce segment are positioned as long-term contributors to such funds (Hasbullah et al., 2024). Their familiarity with digital banking, mobile applications and financial technology increases the likelihood that they will embrace blockchain platforms that promise transparency and accountability, with FinTech acceptance among younger donors typically shaped by performance expectancy, ease of use and system trust qualities that a decentralised, immutable ledger is well positioned to satisfy (Sani et al., 2022).

This technological readiness is compounded by millennials' social consciousness: this cohort is more likely than previous generations to support causes demonstrating transparency, ethical governance and impact, with trust and accountability identified as key determinants of donor behaviour in Islamic charitable institutions (Kamaruddin et al., 2021). As both former beneficiaries of the public university system and potential future donors, millennial alumni represent a form of reciprocal giving whose engagement is directly aligned with national policy frameworks that advocate alumni participation in institutional fundraising (Salleh, 2019). Their behavioural intentions toward Islamic FinTech more broadly have also been shown to be strongly influenced by perceptions of trustworthiness and transparency (Abdul-Rahim et al., 2022; Samad et al., 2022) the precise concerns that blockchain-based waqf platforms are designed to resolve which justifies their selection as the unit of analysis for this study.

Hypothesis Development

The first set of hypotheses in this study concerns the direct relationships between the five exogenous constructs and behavioural intention to adopt Waqf blockchain. Performance expectancy is expected to shape intention because alumni who believe that a blockchain based waqf platform will genuinely improve fund transparency, disbursement speed and Shariah compliance are more likely to want to use it, a pattern consistently reported in prior fintech and mobile banking studies (Alkhowaiter, 2020; Kumar & Anjaly, 2017). Effort expectancy follows a similar logic: a system perceived as complicated or technically demanding discourages adoption regardless of its benefits, so ease of use is proposed as a second direct predictor (Baabdullah et al., 2019a). Social influence captures the pressure or encouragement alumni feel from peers, family, religious leaders and university administrators, all of whom can normalise or discourage engagement with a new Islamic finance technology (Soomro, 2019). Facilitating conditions reflect the practical infrastructure, internet access, technical support and institutional readiness, that alumni believe will be available to them, and smart contract, as the domain specific construct, captures how much trust alumni place in the platform's ability to execute waqf disbursement automatically and accurately according to donor intent (Anshari et al., 2020b; Abd Razak et al., 2020).

The second set of hypotheses positions voluntariness of use as a moderator rather than an independent predictor, following the logic embedded in the original UTAUT model but narrowing its scope to a single, theoretically relevant moderator instead of the original four demographic ones. Because participation in Waqf blockchain is inherently optional for alumni, unlike, say, a workplace system that employees are required to use, the perceived freedom to choose is expected to strengthen the effect that smart contract, performance expectancy, effort expectancy and social influence each have on behavioural intention. This expectation is grounded in a meta-analysis of over seventy studies confirming that voluntariness significantly amplifies the influence of usefulness and ease of use perceptions on intention (Wu et al., 2009), and it is extended here to smart contract on the reasoning that trust in an automated, self-executing feature becomes even more consequential when the user is not obligated to engage with it. Facilitating conditions is deliberately left outside the moderation structure, since in the original UTAUT specification this construct operates primarily on actual use behaviour rather than intention, and the framework preserves that distinction until the field study can test it empirically.

Definition for each constructs:

Performance Expectancy (PE): the degree to which an individual believes that using Waqf blockchain will improve waqf management outcomes, including Shariah compliance, transaction efficiency and trust (Venkatesh et al., 2003). Prior studies confirm PE as a strong predictor of behavioural intention across mobile payment and fintech contexts (Alkhowaiter, 2020; Kumar et al., 2017).

H1: Performance expectancy provides a positive and significant effect on the behavioural intention to use Islamic Blockchain (Waqf blockchain).

Effort Expectancy (EE): the degree of ease associated with using Waqf blockchain (Venkatesh et al., 2003). When a system is perceived as intuitive and requiring minimal effort, behavioural intention to adopt it increases (Baabdullah et al., 2019a).

H2: Effort expectancy provides a positive and significant effect on the behavioural intention to use Islamic Blockchain (Waqf blockchain).

Social Influence (SI): the extent to which an individual perceives that important others family, peers, community leaders or university administration believe he or she should use Waqf blockchain (Venkatesh et al., 2003; Soomro, 2019).

H3: Social influence provides a positive and significant effect on the behavioural intention to use Islamic Blockchain (Waqf blockchain).

Facilitating Conditions (FC): the perceived organisational and technical infrastructure internet access, technical support, regulatory frameworks that supports Waqf blockchain use (Venkatesh et al., 2003; Ahmad et al., 2021).

H4: Facilitating conditions provide a positive and significant effect on the behavioural intention to use Islamic Blockchain (Waqf blockchain).

Smart Contract (SC): the perceived reliability, transparency and automation benefits of smart contracts embedded in Waqf blockchain (Anshari et al., 2020a, 2020b). When individuals perceive that smart contracts improve transactional efficiency and reduce fraud, behavioural intention to adopt the underlying blockchain platform increases (Alghushairy et al., 2023; Prati, 2024).

H5: Smart Contract has a positive and significant effect on the behavioural intention to use Islamic Blockchain (Waqf blockchain).

Voluntariness of Use (VoU) as Moderator: In the Unified Theory of Acceptance and Use of Technology (UTAUT) framework, voluntariness of use is defined as the degree to which individuals perceive their adoption of a technology as non-mandatory (Venkatesh et al., 2003 a). This construct serves as a moderating variable, influencing the strength of the relationships between core determinants such as performance expectancy, effort expectancy, and social influence and behavioral intention to use a technology. In contexts where technology adoption is voluntary, these relationships may differ compared to environments where usage is mandatory.

Applying this to the adoption of Islamic blockchain solutions like Waqf blockchain, voluntariness of use becomes particularly relevant. For instance, when individuals choose to engage with Waqf blockchain of their own choice, the impact of perceived usefulness (performance expectancy) and ease of use (effort expectancy) on their intention to adopt

the technology may be more pronounced. Similarly, the influence of social factors such as recommendations from peers or community leaders (social influence) could vary depending on whether the adoption is perceived as voluntary or obligatory.

Empirical studies have explored these moderating effects. For instance, research by (Alghushairy et al., 2023) examined the adoption of smart contracts in business organizations and highlighted the significance of voluntariness in moderating the relationship between performance expectancy and behavioral intention. Their findings suggest that when users feel they have a choice in adopting the technology, their perceptions of its usefulness have a stronger influence on their intention to use it.

Applying this to the fintech context, particularly with blockchain-based smart contracts, it's plausible that voluntariness of use could similarly moderate the relationship between smart contract functionality and behavioral intention. When users perceive the adoption of smart contracts as voluntary, their positive perceptions of the technology's functionality such as automation, transparency, and security may more strongly influence their intention to adopt it.

A meta-analysis of 71 studies found that environment-based voluntariness significantly moderates the effects of ease of use and usefulness on behavioral intention to use technology (Wu et al., 2009). In electricity markets, smart contracts based on voluntary participation can lead to activities improvements, meaning some parties benefit without harming others. This supports the idea that voluntariness can enhance smart contract acceptance and efficiency (Brandstätt et al., 2011). In a smart payment system, voluntariness of use moderated behavioral intention, suggesting that forced use may reduce perceived usefulness or engagement (Surja, 2023). Although not about smart contracts specifically, this meta-analysis confirms that voluntariness moderates the effects of perceived usefulness and ease of use on behavioral intention to adopt technology. This supports the idea that voluntariness likely plays a similar role in smart contract systems (Wu et al., 2009).

H6: Voluntariness of use positively moderates the relationship between Smart Contract and behavioural intention to use Islamic Blockchain (Waqf blockchain).

H7: Voluntariness of use positively moderates the relationship between performance expectancy and behavioural intention to use Islamic Blockchain (Waqf blockchain).

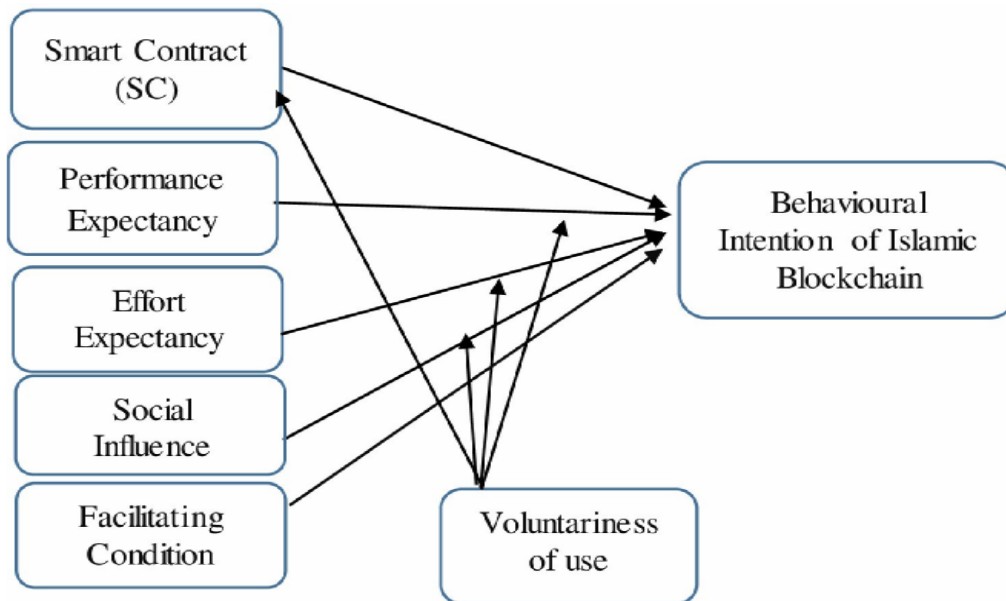
H8: Voluntariness of use positively moderates the relationship between effort expectancy and behavioural intention to use Islamic Blockchain (Waqf blockchain).

H9: Voluntariness of use positively moderates the relationship between social influence and behavioural intention to use Islamic Blockchain (Waqf blockchain).

Proposed Conceptual Framework

Bringing the nine hypotheses together, the proposed framework places performance expectancy, effort expectancy, social influence, facilitating conditions and smart contract as exogenous constructs feeding directly into behavioural intention to adopt Waqf blockchain, while voluntariness of use sits alongside the model as a moderator acting specifically on the paths from smart contract, performance expectancy, effort expectancy and social influence to intention. Behavioural intention is treated as the single endogenous construct of interest at this conceptual stage, consistent with UTAUT's own emphasis on intention as the strongest proximal predictor of eventual use. Visually, the model would be drawn with five arrows converging on behavioural intention from the exogenous constructs, four of which pass through or are intersected by the voluntariness of use moderator, and one, facilitating conditions, which remains a direct and unmoderated path.

This structure is intended to do two things at once: explain how much of alumni's willingness to adopt Waqf blockchain can be attributed to conventional technology acceptance factors, and isolate the incremental contribution of a feature that is unique to blockchain based waqf platforms, namely the smart contract. Because the framework has not yet been tested empirically, it is presented here as a set of testable relationships rather than a confirmed model, with the expectation that Structural Equation Modelling will later be used to estimate the strength and significance of each path and each moderation effect. The framework is deliberately kept parsimonious, five predictors and one moderator, so that it remains practical to test with a single field survey while still capturing what the literature suggests are the most theoretically important drivers of adoption in this specific context.



Integrating the discussion above, the study proposes that Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Smart Contract act as exogenous constructs with a direct path to Behavioural Intention (BI) to adopt Waqf blockchain, while Voluntariness of Use moderates the relationships between PE, EE, SI and SC and BI (H6–H9). Facilitating Conditions is modelled as a direct, non-moderated predictor, consistent with the original UTAUT specification. Behavioural Intention is positioned as the key dependent construct to be tested via path analysis in Structural Equation Modelling (SEM), while the moderation hypotheses are tested via multi-group Confirmatory Factor Analysis (CFA).

MATERIAL AND METHODOLOGY

Consistent with (Alam, Hu & Barua, 2018), positivism focuses on testing hypotheses derived from an existing theory and understanding individual behaviour through observable, quantifiable phenomena. This study therefore adopts a positivist paradigm and a deductive approach: a conceptual framework and specific hypotheses are formulated from the pre-existing UTAUT theory and are intended to be subjected to rigorous empirical testing (Saunders et al., 2019). This choice also reflects the practical reality that UTAUT has already been validated across many technology contexts, including several blockchain and Islamic fintech studies, which gives the researcher a reasonably solid foundation from which to adapt constructs and measurement items rather than starting from scratch.

Methodologically, the study is quantitative in nature and will proceed in two broad stages once fieldwork begins. The first stage is a pilot study intended to refine the survey instrument and check that the adapted items behave as expected among a smaller group of respondents, and the second is the full field study, in which the finalised instrument is distributed to the target sample of millennial alumni. Data collected from both stages will be analysed using standard techniques appropriate to survey based, theory testing research, including reliability and factor analysis at the pilot stage and Structural Equation Modelling at the field study stage, with the overall aim of establishing whether the proposed relationships hold up under empirical scrutiny.

Research Design

A quantitative, cross-sectional survey design is proposed. Cross-sectional designs are relatively efficient and cost-effective compared with longitudinal designs (Levin, 2006; Setia, 2016). A cross sectional survey design has been selected for this study, meaning that data will be collected from respondents at a single point in time rather than tracked over multiple periods. This choice suits the current stage of Waqf blockchain's development in Malaysia, since the technology is still largely conceptual or in early pilot phases at most public universities, so the immediate research priority is to capture a clear snapshot of how millennial alumni currently perceive and feel about the idea of adopting such a system, rather than to observe how those perceptions might change over time. Cross sectional designs are also comparatively efficient in terms of cost and time, which matters for a doctoral level study operating within a fixed research timeline (Levin, 2006; Setia, 2016).

Within this cross sectional design, the study will rely on a structured, self administered online questionnaire as the primary data collection tool, distributed through official alumni networks and associations of the participating public universities. An online format is appropriate given that the target respondents, millennial alumni, are digitally active and geographically dispersed across the Central Region, and it allows the researcher to reach a larger and more representative pool of respondents than a paper based or in person approach would realistically permit. The design also anticipates a two phase rollout, a smaller pilot administration to check the instrument's clarity and psychometric properties, followed by the main field administration once any necessary adjustments have been made. This design is considered appropriate for quantifying millennial alumni's intention to adopt Waqf blockchain at the current stage of blockchain maturity in Malaysian higher education.

Unit of Analysis

The unit of analysis is the individual millennial alumnus of a Malaysian public university (born 1981–1996, approximately 25–40 years of age at the time of the study), who resides or is employed in the urban Central Region of Malaysia and possesses the digital literacy required to engage with a blockchain-based waqf platform (Ali et al., 2022).

Population and Sampling

The target population comprises alumni of Malaysia's 20 public universities, accessed through official alumni associations and networks. Given the geographic dispersion of this population and the absence of a single consolidated national alumni database, a Multistage Cluster Sampling technique is proposed: (i) first-stage geographical clustering, selecting the Central Region (Selangor, Kuala Lumpur, Putrajaya, Negeri Sembilan) on account of its highest concentration of internet users and tertiary-educated professionals (DOSM, 2024; MCMC, 2023); (ii) second-stage institutional clustering of public universities within the region; and (iii) third-stage individual random selection of alumni from institutional or alumni-association records.

Based on the recommendation to add 10–30 percent to the calculated minimum sample size to compensate for non-response and incomplete submissions (Israel, 1992), and consistent with prior SEM-based waqf and Islamic fintech studies using similar constructs (Awang, 2015; Hair et al., 2019), a target sample size of 600 valid responses is proposed for the main field study, preceded by a pilot study of 100–150 respondents to conduct Exploratory Factor Analysis (EFA) and reliability testing of the measurement items.

RESULTS AND DISCUSSION

As this is a conceptual paper, no primary data have yet been collected; the “results” discussed here are the theoretical and instrumental outputs of the framework-building process rather than empirical findings. The proposed model integrates five direct-effect hypotheses (H1–H5) and four moderation hypotheses (H6–H9) into a single structural model to be estimated via Covariance-Based Structural Equation Modelling (CB-SEM) using AMOS, consistent with the theory-testing objective of this study (Hair et al., 2021).

The inclusion of Smart Contract as a domain-specific fifth predictor is expected to explain incremental variance in Behavioural Intention beyond the four original UTAUT constructs, reflecting the centrality of automated, tamper-resistant fund disbursement to waqf donors' and administrators' trust. The repositioning of Voluntariness of Use as the sole moderator in place of UTAUT's original four moderators (gender, age, experience, voluntariness) follows precedent in prior UTAUT extensions for specific religious or philanthropic technologies, where a single theoretically salient moderator is prioritised over demographic moderators of secondary relevance to the phenomenon under study (Soomro, 2019; Tran & Nguyen, 2021).

Two testable propositions follow from the framework. First, because adoption of Waqf blockchain by alumni is inherently non-mandatory unlike, for example, an employer-mandated system voluntariness is expected to strengthen rather than weaken the hypothesised relationships, consistent with findings that perceived choice amplifies the influence of usefulness and ease-of-use perceptions on intention (Wu et al., 2009). Second, because Facilitating Conditions in the original UTAUT model act primarily on actual use rather than intention, this study retains FC as a direct, unmoderated predictor of Behavioural Intention, reserving empirical confirmation of this path for the subsequent field study.

Practically, the framework suggests that Waqf blockchain developers and university waqf and endowment (WAE) units should prioritise (i) demonstrable performance gains in transparency and disbursement speed, (ii) an intuitive, low-effort user interface, (iii) endorsement from trusted social referents such as alumni networks and religious authorities, (iv)

adequate technical infrastructure and support, and (v) visibly reliable and auditable smart contract mechanisms while communicating the voluntary nature of adoption to strengthen, rather than dilute, users' behavioural intention.

CONCLUSION

This paper has proposed a conceptual framework for the acceptance of a blockchain-based waqf ecosystem (Waqf blockchain) among millennial alumni of Malaysian public universities, extending the Unified Theory of Acceptance and Use of Technology (UTAUT) with a domain-specific Smart Contract construct and repositioning Voluntariness of Use as the study's sole moderating variable. Nine hypotheses (H1–H9) were developed from the literature to be tested via path analysis and multi-group confirmatory factor analysis within a Structural Equation Modelling framework.

The framework contributes to the limited body of literature examining blockchain adoption in institutional, university-based waqf settings, and to the broader literature on UTAUT extensions for Islamic social finance technologies. For university administrators, State Islamic Religious Councils and policymakers under the Malaysia Education Blueprint 2015–2025 and the UniTP Purple Book, the framework offers a structured, theory-grounded basis for designing and promoting Waqf blockchain platforms that resonate with the behavioural drivers of the millennial alumni segment.

As a conceptual study, this paper is limited to the proposal and justification of the framework and does not report empirical results; the sample is further limited, by design, to urban millennial alumni of the Central Region, which may constrain generalisability to other regions, generations or institutions. Future research should proceed to pilot testing, exploratory and confirmatory factor analysis, and full-scale SEM estimation of the proposed model, and should consider refining the Voluntariness of Use items to capture Islamic Muamalat-specific understandings of choice and obligation, so as to obtain a more precise estimate of its moderating effect.

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