A DATA-DRIVEN FRAMEWORK FOR ASSESSING GOVERNMENT READINESS FOR PRIVATE BLOCKCHAIN ADOPTION

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ABSTRACT

The transformative potential of private, permissioned blockchains for public service delivery is widely recognized, offering significant improvements in data integrity, transparency, and process efficiency through decentralized and unchangeable ledgers. Despite this appeal, a notable gap exists in the literature regarding a structured, data-driven framework to systematically assess government readiness for blockchain adoption. The absence of such a diagnostic tool often leads to ad-hoc, trial-and-error implementations that frequently fail to scale or integrate effectively with existing systems. This study addresses this gap by proposing and empirically validating a comprehensive, multi-dimensional framework for assessing government readiness. The methodology involved the design of a conceptual model, the development of a functional prototype, and its subsequent quantitative validation through a survey of domain experts. The findings demonstrate the framework's effectiveness in providing an integrated analysis of the technical, organizational, and environmental factors crucial for successful blockchain adoption. This research contributes to theoretical knowledge by operationalizing readiness constructs and also offers a practical, evidence-based diagnostic tool for policymakers and public managers to inform investment decisions and mitigate adoption risks.

Keywords: Permissioned Blockchain; Government; Readiness Assessment; Functional Prototype; Data-driven Framework

1.0 INTRODUCTION

Blockchain is a secure, decentralised, distributed ledger for recording transactions among various entities. Although it has become strongly associated in the public domain with cryptocurrencies such as Bitcoin, in the public sector, its most promising applications lie in private, permissioned blockchains[1]. Unlike public blockchains, which allow anyone to participate, private networks restrict access to approved organisations such as government departments or trusted partners[2]. This selective visibility generates a controlled environment that aligns with the privacy, regulatory, and governance requirements of the public sector[1], [3]. While this may not deliver the full transparency of public blockchains, it provides governments with a middle ground: a way to leverage the immutability and cryptographic security of blockchain while maintaining oversight and control.

The potential appeal of blockchain in the public sector stems from its ability to address several long-standing challenges. First, it enhances data integrity by ensuring that records such as land titles, licenses, or identity documents cannot be altered once entered into the chain. Second, it fosters transparency by creating a shared, single source of truth across multiple stakeholders[4]. This “common ledger” enables near real-time monitoring of government operations, such as procurement or financial aid distribution, which in turn reduces opportunities for fraud and corruption. Finally, blockchain has the capacity to improve efficiency by automating inter-organisational workflows through smart contracts[5]. These self-executing protocols streamline processes that would otherwise require extensive manual checks or third-party intermediaries, thereby lowering costs and making services more accessible to citizens.

Beyond efficiency and security, blockchain has the potential to strengthen trust between governments and citizens, a relationship often weakened by perceptions of corruption or inefficiency[6]. By ensuring that every transaction or decision is permanently recorded and verifiable, governments can enhance accountability and demonstrate a commitment to fairness. In social welfare programs, for instance, blockchain could provide evidence that benefits are reaching intended recipients without diversion or manipulation. Likewise, blockchain-enabled voting systems could contribute to more secure, transparent, and trustworthy electoral processes, helping restore public confidence in democratic institutions while protecting voter privacy[7].

Furthermore, blockchain adoption offers opportunities for innovation in governance and service delivery[8]. By enabling secure, real-time data sharing across agencies, blockchain can help dismantle bureaucratic silos and promote more integrated decision-making. This can lead to greater agility in policy implementation, such as the rapid disbursement of disaster relief or the simplification of cross-border trade procedures. In the longer term, blockchain may also support new models of collaboration between government, the private sector, and civil society, paving the way for more participatory and responsive governance[9]. Thus, rather than being viewed solely as a technological upgrade, blockchain can be understood as a transformative tool with the potential to reshape the relationship between governments and citizens in the digital era.

1.1 Problem Statement

Although there is a growing consensus regarding the transformative role of private, permissioned blockchains in public services, a significant and unaddressed gap exists in the systematic assessment of government readiness for this technology[8]. While the literature is rich with theoretical discussions of blockchain's benefits, it lacks a methodical, data-driven framework for public organizations to assess their preparedness[10]. This absence often leads to trial-and-error approaches, which are financially and operationally inefficient. Consequently, many blockchain pilot projects fail to scale, are not properly integrated with existing systems, or are abandoned due to unanticipated institutional and organizational challenges [11].

This suboptimal technology transfer is rooted in the fact that a comprehensive evaluation paradigm is missing, which often causes decision-makers to overlook critical elements. For instance, an agency may possess robust technical resources, including a skilled IT team and the necessary hardware infrastructure, yet may face a critical lack of clear regulatory guidance or, more importantly, the political backing to move forward with a technology that fundamentally alters established processes[11], [12]. The absence of a legal framework for smart contracts or data ownership can create an insurmountable barrier. Conversely, a department with strong leadership buy-in and a clear mandate from above may fail because its employees are not digitally literate enough to adapt, or because the underlying departmental culture is deeply resistant to the type of radical process change that blockchain implementation requires[13].

The diverse interdependencies of these factors, from technological maturity to leadership vision and cultural openness highlight that single-factor analyses are woefully insufficient. An integrated, multi-dimensional approach is necessary to understand the full landscape of readiness[14]. Thus, the fundamental research problem is that, without a holistic model that accounts for these intertwined technical, organizational, and environmental aspects, government leaders lack the informed decision support needed to make strategic, risk-mitigated investments and avoid costly project failures[15].

1.2 Research Question

To address this critical gap, this study is designed to answer a series of fundamental research questions that underpin the development of a structured readiness framework.

RQ1: What are the key technical, organizational, and environmental determinants of government preparedness for deploying blockchain in public services?
This question moves beyond anecdotal evidence by seeking to identify and operationalize the specific factors that collectively influence an agency's readiness. It aims to develop a comprehensive, multi-dimensional model that accounts for everything from an agency's existing IT infrastructure and cybersecurity capabilities to its leadership's strategic vision and the regulatory clarity of its operational environment.

RQ2: To what extent do readiness levels for blockchain adoption vary among government agencies, considering disparities in technological capabilities, leadership support, and regulatory conditions?
This question delves into the practical application of the proposed framework. By investigating the variance in readiness across different agencies, this research can highlight common strengths and weaknesses, reveal critical bottlenecks, and provide a context-specific asset of considerations. Cumulatively, the answers to these questions will form the basis for a holistic and actionable blueprint, designed to help decision-makers increase the likelihood of successful blockchain adoption for the public sector.

1.3 Contribution

This paper enhances the literature by proposing and testing a framework for measuring the state of readiness of governments for blockchain adoption in the public sector[16]. Previous research has derived some possible advantages and identified individual aspects that drive adoption of the technology[17], but no comprehensive multi-dimensional framework that includes technical, organizational, and environmental factors has been presented. Filling this gap allows the study to contribute both to theoretical understanding by operationalizing readiness aspects[18] and to a practical diagnostic tool for policymakers and public managers to assess the feasibility of adoption. Hence, the research crosses the stage of conceptual debates and takes academic discussion and managerial decision-making in the field of digital governance one step further[19].

2.0 LITERATURE REVIEW

This literature review synthesizes key findings from 34 relevant studies, as shown in Appendix A, to critically examine the current state of research on blockchain readiness and adoption, with a particular focus on its application within the public sector. The review highlights seminal contributions, common methodologies, and persistent challenges, which help identify significant research gaps based on a systematic literature review (SLR) of existing academic research. A key insight from this review is the necessity for developing frameworks that guide public sector blockchain adoption, focusing on a more holistic set of factors than just the technology itself.

2.1 The Emergence of Multi-Dimensional Adoption Frameworks

The literature reveals a developing but complex understanding of blockchain technology's adoption and readiness across various sectors. In this section, we address RQ1: What are the key technical, organizational, and environmental determinants of government preparedness for deploying blockchain in public services? A prominent theme is the emergence of adoption frameworks designed to move beyond the technical specifics of the technology itself. Several studies, including those by [20][21], empirically validate the Technology-Organization-Environment (TOE) framework. The TOE framework posits that three key contexts influence a firm's decision to adopt and implement a technological innovation: Technological Context (the attributes of the technology itself, such as complexity and compatibility with existing systems), Organizational Context (the internal resources and characteristics of the firm, including top management support and organizational structure), and Environmental Context (the external factors, such as regulatory clarity, competitive pressure, and government policy). These studies demonstrate that factors like top management support, regulatory clarity, and competitive pressure are as critical as technical compatibility for adoption readiness in sectors ranging from the Malaysian software industry to emerging supply chains[20][22].

This holistic view is further refined by[23], who introduce the PIMT (Process, Institutional, Markets, Technology) framework. This model integrates institutional and market factors, arguing that a narrow, technology-centric perspective is insufficient, particularly for public sector implementations. The PIMT framework emphasizes that processes must be redesigned, institutional buy-in secured, market conditions understood, and the technology itself must be a viable fit. This multi-dimensional approach highlights the need to consider not only an organization's internal capabilities but also the external forces and established institutional norms that govern public service delivery[17].

2.2 Blockchain Applications and Challenges in the Public Sector

In the public sector, a key application focus is leveraging blockchain for enhanced transparency, accountability, and citizen trust in e-government services[24] [25]. Specific use cases discussed in the literature include digital identity ([26], where immutable records could provide a secure and verifiable means of identification, and cross-departmental data sharing [27], where a distributed ledger could streamline information exchange between disparate government agencies. Parallel to this, the literature on supply chain management (SCM) highlights blockchain's potential to improve traceability and performance in industries like pharmaceuticals and agriculture [28], offering a glimpse into the potential for similar benefits in public logistics and procurement.

However, despite these promising applications, a critical review of this body of work reveals several significant tensions and contradictions that challenge the straightforward implementation of blockchain in government. A key contradiction lies between the optimistic rhetoric and the practical realities of implementation. As noted by[29], many of the purported benefits are often exaggerated in conceptual papers, and adoption is frequently driven by technological hype rather than a clear strategic need or problem-driven approach. The practical realities of implementation often involve unforeseen challenges, such as high energy consumption for public blockchains, scalability issues when dealing with large volumes of citizen data, and the significant cost and complexity of integrating a new system with legacy IT infrastructure[30].

Furthermore, there is a fundamental conflict between blockchain's decentralized nature and the ingrained need for centralized authority and oversight in many government and industrial applications [28]. Public administrations are built on a hierarchical, accountable model where a single entity is responsible for data and decisions. Blockchain, by its nature, distributes this authority, which can create ambiguity regarding legal responsibility, data governance, and liability in the event of an error or security breach. The immutable nature of blockchain also clashes directly with modern data protection regulations like GDPR's (General Data Protection Regulation) "right to be forgotten," a legal and ethical challenge that remains largely unresolved [26], [31].

2.3 Decision Tree for Blockchain Adoption

The literature also presents valuable decision-making models to determine the suitability of blockchain for specific use cases. The decision tree outlines the process of determining whether blockchain technology is necessary and what type is best suited for specific use cases. In the context of the public sector, this decision-making model is crucial for identifying when and how to implement a private blockchain solution. For instance, when multiple participants are required to update data, and the data needs to be kept private, a private blockchain offers a controlled environment where only authorized participants can access and modify the blockchain[32]. This is particularly relevant in the public sector, where sensitive information, such as citizen data or governmental transactions, needs to remain secure and confidential.

Additionally, if the database is vulnerable to attacks or censorship, the model suggests that blockchain could provide a more secure, redundant system with distributed copies to prevent data loss or unauthorized alterations[32]. Furthermore, if participants do not trust each other but still require a decentralized system, a permissioned blockchain can be used. This type of blockchain ensures that only trusted entities can update the data while maintaining transparency and integrity [33]. Such solutions can enhance efficiency, security, and accountability in government operations, making blockchain a powerful tool for the public sector.

2.4 Comparison with Other Adoption and Change Models

The Prioritization Model is a systematic framework that organizations use to assess readiness and prioritize initiatives or projects based on their potential impact, strategic alignment, resource availability, and organizational capacity[34]. However, this model is not the only approach to decision-making and project management. Below is a comparison of the Prioritization Model with three other related models, the ADKAR Model, the McKinsey 7S Framework, and the Technology Acceptance Model (TAM)[35].

The Prioritization Model is a strategic tool that helps organizations assess their readiness to adopt and implement new initiatives, particularly focusing on factors such as strategic alignment, organizational capacity, IT infrastructure, and cultural readiness. By evaluating these readiness areas, the model enables organizations to prioritize initiatives that are most aligned with their strategic goals and ensure that necessary resources and infrastructure are available[18]. This model is particularly useful when organizations need to prioritize several projects, such as the adoption of new technologies like blockchain, and ensures that the selected initiatives are most likely to succeed based on their preparedness for implementation.

In comparison, the ADKAR Model, developed by Prosci, is primarily used for managing organizational change at the individual level. The model's five components Awareness, Desire, Knowledge, Ability, and Reinforcement focus on the individual’s transition through the change process[35]. While the Prioritization Model assesses the overall readiness of the organization to implement changes or technologies, ADKAR is concerned with how individuals within the organization respond to and adopt those changes. The Prioritization Model focuses more on evaluating organizational factors such as IT readiness, resource availability, and strategic fit, while ADKAR is geared toward understanding and facilitating individual change. This distinction makes ADKAR more suitable for driving personal change, while the Prioritization Model helps with evaluating which initiatives to prioritize within the organization.

The McKinsey 7S Framework offers another perspective on organizational change, focusing on aligning seven internal elements, which are Strategy, Structure, Systems, Shared Values, Skills, Style, and Staff, to achieve organizational effectiveness[35]. While the Prioritization Model is specifically designed to evaluate readiness for adopting new initiatives, the McKinsey 7S Framework takes a broader approach to ensuring that the organization’s internal components work harmoniously together. The 7S Framework doesn’t focus directly on prioritizing projects but instead aims to align the organizational structure with the overall strategy and goals. In contrast, the Prioritization Model evaluates specific readiness factors like IT infrastructure and cultural fit to determine which projects should be prioritized for implementation[34].

Finally, the Technology Acceptance Model (TAM), developed by Davis (1989)[36], is focused on predicting how individuals will accept and use new technologies based on two primary factors: perceived ease of use and perceived usefulness. TAM has been widely applied to understand individual user acceptance in the context of new technology adoption. While the Prioritization Model is concerned with organizational readiness, TAM evaluates individual-level factors influencing technology adoption. The Prioritization Model looks at the overall readiness for a new initiative within the organization, whereas TAM focuses on understanding user perceptions and behaviors, which are critical when the initiative involves technology adoption at the individual level.

In conclusion, while each model serves a distinct purpose, they all offer valuable insights into the decision-making process regarding change management and technology adoption. The Prioritization Model is best suited for organizations that need to evaluate their readiness to implement large-scale initiatives and prioritize them based on several organizational factors[37]. ADKAR is more effective for guiding individual readiness for change, while the McKinsey 7S Framework focuses on aligning organizational elements to achieve strategic goals. Finally, TAM is particularly useful for predicting individual acceptance of technology, especially when organizations are considering new technological tools.

2.5 Literature Review Synthesis

The three papers [38], [39], and [40] tackle blockchain adoption from fundamentally different yet complementary angles. Despite valuable contributions by [38], [39] and [40], significant gaps persist in the current blockchain adoption research for government and healthcare sectors, particularly in the context of private, permissioned blockchain networks[38] proposed a robust technical architecture for private blockchain deployment in government services but did not address organizational readiness, policy integration, or governance evolution.

Meanwhile, [39] developed a detailed readiness assessment model focused on healthcare sector blockchain adoption, yet their framework stops short of linking readiness evaluation to technical deployment strategies or dynamic governance models. [40] provided valuable empirical insights from a private blockchain pilot in the Dubai Economic Department, highlighting operational challenges such as skills shortages, governance immaturity, and underutilization, yet without proposing a sustainable, scalable roadmap for managing blockchain ecosystems over time.

Thus, although each paper contributes significantly within its domain, technical architecture [38], readiness assessment [39], and empirical policy insights [40], there remains no comprehensive model that integrates eligibility assessment, technical deployment, governance adaptation, and long-term operational sustainability within private blockchain environments for government institutions.

Therefore, the researcher proposes to develop the Blockchain Adoption Eligibility and Readiness Assessment Framework (B-TAERA), which is fully logical, justified, and directly addresses the gaps identified across the three anchor studies. [38] contribute a strong blockchain technical architecture tailored for government services, yet lack an integrated consideration of institutional readiness; thus, B-TAERA must bridge this gap by connecting technical deployment to strategic organizational assessments. [39] offer a detailed readiness model for blockchain adoption, but fall short of translating readiness evaluations into practical technical implementation pathways. Accordingly, B-TAERA will extend readiness into operational deployment roadmaps. While [40] reveals significant empirical challenges during blockchain implementation, especially concerning governance flexibility, system scalability, and sustainability.

Consequently, B-TAERA must embed mechanisms for dynamic governance evolution and long-term platform management suited to private blockchain environments. On top of that, B-TAERA also aims to create an actionable, lifecycle-based model ensuring that private blockchain adoption in the government sector is not only technologically robust but also organizationally viable, sustainably governed, and operationally resilient. This development is essential to guide public sector agencies toward secure, efficient, and scalable blockchain-enabled transformations with minimized risk and maximized institutional value. Table 1 shows the summary of the literature review synthesis discussed above.

2.6 Research Gaps and the Need for a New Framework

These contradictions and challenges point to a significant gap in the research, which is currently dominated by conceptual papers and reviews. The literature consistently calls for more empirical studies, real-world case implementations, and longitudinal research to move beyond theoretical claims and validate the technology's effectiveness in practice[41]. Another identified gap is the lack of a standardized, unified framework for evaluating blockchain performance, with papers like [42] and [43] highlighting an over-reliance on unrealistic simulations and a lack of practical, measurable metrics for success. Lastly, the limited generalizability of many studies, which are often confined to single countries or sectors, underscores the need for broader, comparative research to understand how diverse contexts influence blockchain adoption [44].

Ultimately, while the literature establishes a strong theoretical foundation, a significant gap remains in the absence of a practical and robust framework for assessing blockchain adoption eligibility and readiness in a specific, high-stakes sector like government[45]. The researcher, therefore, will move toward filling this gap by developing a practical framework (B-TAERA) for assessing blockchain adoption in government agencies, building on the multi-dimensional approaches of previous models while directly addressing the critical challenges and contextual needs identified in this review.

3.0 METHODOLOGY

The research methodology of this study is grounded in a Design Science Research (DSR) approach[44], which is particularly suitable for creating and evaluating artifacts (in this case, the B-TAERA framework) that solve a practical problem. This approach is iterative and aims to produce a solution while also generating new knowledge. The overall research process is divided into two distinct phases: Phase I, focused on the conceptual design and development of the framework and prototype; and Phase II, which involves the empirical validation of the framework.

Table 1: Summary Of Literature Review Synthesis

Dimension	[38]	[39]	[40]	Identified Gap
Focus	Private blockchain architecture for government services (Hyperledger Fabric)	Readiness model for blockchain adoption in healthcare	Private blockchain pilot deployment in Dubai Economic Department	No integrated model for private blockchain adoption in government spanning readiness, deployment, and governance
Strength	Comprehensive technical architecture and detailed blockchain design	Readiness assessment across organizational, technical, and policy dimensions	Empirical insights from pilot deployment in a government setting	Missing connection between organizational readiness and technical deployment; no long-term sustainability or governance evolution
Weakness	Does not address organizational readiness or governance evolution	Focuses on readiness but lacks translation to operational deployment	Identifies governance immaturity and underutilization but no sustainability roadmap	Lack of integration of readiness, governance, and long-term sustainability in private blockchain adoption
Governance Aspect	Focus on technical architecture, minimal discussion on governance	Recognizes policy importance but no explicit governance model	Governance immaturity identified but no dynamic governance solution	Need for dynamic governance models in private blockchain ecosystems
Sustainability & Scalability	Limited focus on scalability or long-term platform management	Does not address sustainability in technical implementation	Issues like underutilization and scalability challenges	Lack of a sustainability roadmap and scalability plan for private blockchain in government
Technology Integration	Focused on Hyperledger Fabric, no direct connection to organizational readiness	Platform-agnostic, but no deployment architecture	Discusses Hyperledger, Corda, Ethereum but fragmented approach	Need for a framework that integrates technical deployment with organizational readiness, scalability, and governance

3.1 Proposed Blockchain Framework and Prototype Development

The foundation of this study is the Blockchain Technology Adoption Requirement, Eligibility & Readiness Assessment (B-TAERA) Model. This conceptual framework, as shown in Fig. 1 is a novel, two-part model designed to provide a systematic and data-driven approach for government agencies considering blockchain adoption.

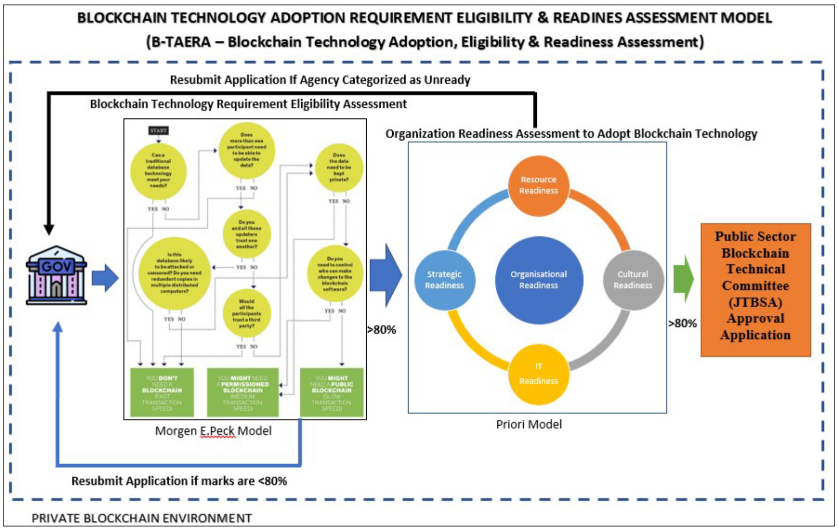

Fig. 1: Conceptual Framework

The conceptual diagram presented above outlines a structured process for assessing the eligibility and readiness of organizations, particularly within the public sector, for adopting blockchain technology. The Blockchain Technology Adoption Requirement Eligibility & Readiness Assessment Model (B-TAERA) is divided into two main stages: the Blockchain Technology Requirement Eligibility Assessment and the Organizational Readiness Assessment (Peck, 2023). The first stage, the Blockchain Technology Requirement Eligibility Assessment, uses a decision-making flow to evaluate whether an organization meets the fundamental criteria for adopting blockchain technology.

Key decision points in this phase involve assessing if a traditional database can meet the department's needs, if multiple participants need to access shared data, and if data privacy and security are major concerns [32]. If the answers suggest that blockchain may not be needed, the department is advised that blockchain is unnecessary. If it’s needed, they might require a permissioned blockchain or a private blockchain solution. The Morgen E. Peck Model is referenced to guide these assessments, which helps organizations understand if blockchain is suitable for their operational needs.

The next step in the process is resubmission, particularly if the department is categorized as "Unready", based on the eligibility assessment. If an agency scores below 80% in eligibility, they are encouraged to improve their processes and resubmit the application. Agencies that score above 80% progress to the Organizational Readiness Assessment, which evaluates the department's internal preparedness across four critical dimensions: Strategic Readiness, Organizational Readiness, IT Readiness, and Cultural Readiness[46]. These dimensions assess how well blockchain adoption aligns with the department's goals, its internal capacity to handle change, the existing IT infrastructure’s support for blockchain, and the organization’s willingness to embrace new technologies. The Prioritization Model is utilized to evaluate these four areas and ensure the department is ready for blockchain integration.

Once the Organizational Readiness Assessment is completed, the next step involves submitting an Approval Application for particular Blockchain Technology-based project paper together with the assessment’s statement of results accordingly to the Public Sector Blockchain Technical Committee (JTBSA), who will review the department’s preparedness for full blockchain adoption within the public sector. If the application meets the necessary criteria, the department is approved to move forward with blockchain technology adoption. If an agency's eligibility score is still below the required threshold, they are encouraged to resubmit the application after making the necessary improvements.

The process is designed to be iterative, ensuring that departments are fully prepared for blockchain adoption before moving to implementation. The model uses the Morgen E. Peck Model and Prior Model to assess the readiness of the organization from a strategic, organizational, IT, and cultural perspective, ensuring that every department is ready for the change before blockchain is adopted.

The first part of the model is the Blockchain Technology Requirement Eligibility Assessment. This component is represented as a decision tree, which guides potential adopters through a series of key questions to determine if blockchain is a suitable solution for a given problem. It is designed to filter out inappropriate use cases early in the process. This decision tree specifically evaluates a use case based on questions derived from established blockchain suitability criteria, such as whether multiple parties need to update data, if privacy is a requirement, if a centralized database is vulnerable to attack, and if trust is a concern among participants [47]. This initial assessment helps to determine if the use case is a good candidate for a private, permissioned blockchain environment.

A dichotomous scale is a closed-ended question format offering only two possible responses, typically "Yes" or "No." This makes it a simple, quick, and efficient method for gathering decisive data [48]. It is especially suitable for binary decision-making contexts, such as "go/no-go" or "adopt/reject" evaluations, where clarity and speed are critical. In technological assessments, particularly when evaluating the suitability of blockchain systems over conventional databases, dichotomous items serve as diagnostic indicators, helping to identify specific technical or organizational requirements. Each question in such a framework is purposefully constructed to represent a criterion that must be fulfilled to justify the adoption of blockchain technology, making the dichotomous scale both practical and analytically robust in decision-support environments.

To ensure the internal consistency of the blockchain suitability questionnaire, the Kuder-Richardson Formula 20 (KR-20) was employed. This statistical method is specifically designed for instruments with dichotomous items (e.g., Yes/No responses), making it more appropriate than other reliability indices like Cronbach's alpha, which assumes continuous or Likert-type data[49].

The Kuder-Richardson Formula 20 (KR-20) was first published in 1937 by George Frederic Kuder and Mary Wilkinson Richardson. The formula is used to measure the internal consistency reliability of a test, questionnaire, or inventory where items are scored dichotomously (e.g., true/false, yes/no)[49].

Internal consistency reliability refers to the degree to which all items in a test or questionnaire measure the same underlying concept or construct. It assesses how well the items "hang together" as a group, meaning whether they are consistent in evaluating the same trait. For example, if a questionnaire is designed to measure blockchain suitability, internal consistency reliability tells whether all the individual Yes/No items are effectively contributing to that specific goal. If some questions measure unrelated concepts, the overall reliability would be low.

The second part of the model is the Organization Readiness Assessment to Adopt Blockchain Technology. This component is a multi-dimensional assessment tool that evaluates the internal and external readiness of a public sector organization. It is based on a priori model that assesses several key dimensions:

- Strategic Readiness: The alignment of blockchain adoption with the organization's overarching strategic goals and mission.
- Resource Readiness: The availability of necessary financial, human, and technological resources.
- Cultural Readiness: The organization's openness to change and its willingness to embrace new processes.
- IT Readiness: The existing IT infrastructure's capability to support a blockchain solution.

The framework proposes that an organization must achieve a threshold of readiness (e.g., scoring above 80% in the assessment) to be considered eligible for blockchain adoption. If the organization does not meet this threshold, the framework recommends that they resubmit their application once the necessary readiness improvements have been made.

To operationalize this framework and prepare for validation, a prototype was designed and developed. The prototype is a functional representation of the B-TAERA model, providing a practical tool to test and demonstrate its utility. The development process is detailed in the following subsections.

3.2 Prototype Development and Implementation

The prototype was developed to function as a web-based application, allowing users to interact with the framework's assessment tools and see how their readiness scores are calculated.

3.2.1 Development Tools

The prototype was built using a combination of specialized and common development tools to create a realistic, functional environment.

- GETH: Geth (Go-Ethereum) was used to set up and manage a private, permissioned blockchain[50]. It provides the command-line interface and tools necessary for creating a private network, configuring nodes, and deploying smart contracts. Its role was to simulate the decentralized ledger environment that a government agency would use.
- Smart Contracts: The core logic of the readiness assessment model and data storage was encoded in smart contracts using the Solidity programming language[51]. These contracts define the rules for how data is handled and how scores are calculated, ensuring immutability and transparency in the assessment process.
- Web 3.0: The front-end interface and user interaction were built using Web 3.0 technologies. This allowed for the creation of a decentralized application (dApp) that directly interacts with the smart contracts on the private Geth blockchain, providing a user-friendly and secure interface for the readiness assessment.

3.2.2 Implementation Details

The prototype implementation followed a structured approach to ensure the accurate representation of the B-TAERA framework.

- Prototype Use Case Diagram: A Use Case Diagram was developed to visually map out the interactions between the users (e.g., government officials, technical staff) and the system. This diagram clarified the functional requirements, such as taking a readiness assessment, viewing the results, and submitting the application for approval.

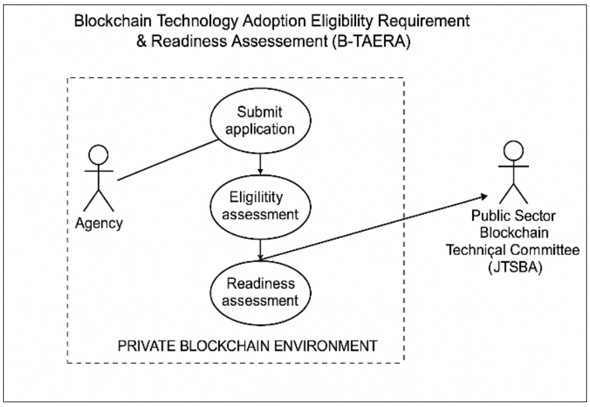

Fig. 2: B-TAERA Use Case Diagram

- Prototype Implementation: The prototype was implemented as a simple web application that allowed a user to input data corresponding to the readiness criteria of the B-TAERA model. The application then used the Web 3.0 library to send this data to the deployed smart contracts, which calculated the readiness score. The final result was displayed on the front-end, indicating whether the agency met the required threshold for adoption.

3.3 Expert Validation and Weightage Determination

The conceptual and structural validity of the B-TAERA framework was empirically tested through a focused and rigorous expert validation process. This validation was critical for ensuring that the model's constructs and components were relevant, comprehensive, and accurately reflected the realities of public sector blockchain adoption.

The validation was conducted using a Focus Group Discussion (FGD) methodology[52]. This approach was chosen to facilitate a rich, collaborative discussion among participants, allowing for real-time feedback and a deeper understanding of their perspectives. A total of six subject matter experts were carefully selected to participate in three distinct sessions. The selection criteria for the experts were stringent, requiring them to have at least five years of experience within a government ministry, thereby ensuring a deep and practical understanding of public sector operations and challenges.

For the first part of the model, the internal consistency reliability of the instrument was assessed using the Kuder-Richardson Formula 20 (KR-20)[49], which is appropriate for dichotomously scored items. The analysis yielded a KR-20 coefficient of 0.9782, indicating excellent reliability. This suggests a high degree of internal consistency among the items, with minimal measurement error and strong inter-item correlation. According to standards in educational and psychological testing, a coefficient above 0.90 reflects highly reliable measures.

According to established research standards, a coefficient above 0.90 is considered very high, indicating, that the questionnaire items consistently measure the same underlying construct specifically, the suitability for blockchain adoption. This high level of reliability suggests that the items are highly cohesive, reflecting a common underlying trait across ministries, and that respondents are interpreting and answering the questions in a consistent manner. As such, the instrument demonstrates strong reliability and is well-suited for further analysis, policy formulation, or diagnostic applications in the context of blockchain assessment within the government sector. The high KR-20 value enhances confidence in the results and reduces the immediate need for item revision. The complete step-by-step KR-20 formula apllication to determine the internal consistency reliability is shown as in Appendix B.

For the second part of the model, the FGD sessions were structured to progressively validate the framework. In the first session, the experts were introduced to the theoretical underpinnings and the conceptual diagram of the B-TAERA model. The discussion focused on the logical flow of the decision tree and the relevance of the four readiness dimensions (Strategic, Resource, Cultural, and IT Readiness)[14]. Feedback from this session led to minor refinements in terminology and the clarity of the diagram. Subsequent sessions discussed into the operationalization of the framework's constructs and the practical application of the prototype. The experts' collective input provided crucial insights that were integrated into the final design, strengthening the model's validity and practical utility.

A critical component of this validation process was the determination of weightage for each question within the assessment. This process was undertaken to ensure that the final readiness score was not just a simple average but a nuanced reflection of the relative importance of each factor in the public sector context. The weightage was determined through a structured expert consensus process[52], involving the five experienced professionals who served as the Heads of the Information Technology Unit in their respective government departments (Departments A, B, C, D, and E). This is a form of purposive or expert sampling. Each expert was provided with a list of 23 questions, categorized under the four domains of the B-TAERA model. They were asked to independently assign scores to each question based on a set of pre-defined criteria that captured the real-world complexities of government technology adoption. The criteria were:

- Practical Relevance: How directly the question contributes to a reliable readiness assessment.
- Strategic Importance: The long-term impact on organizational transformation.
- Operational Risk and Feasibility: The level of risk associated with the factor and its potential to impede implementation.
- Implementation Complexity: The cognitive and resource demand required to address the factor.
- Experience-Based Judgement: The experts' personal, firsthand understanding of the public administration environment.

After the individual scoring was complete, the scores for each question were averaged across all five experts. This average score provided an initial consensus view of the importance of each question. Finally, these average scores were normalized to ensure that the final weight distribution across all 23 questions summed to 100% using the score matrix computation method as attached in Appendix C. This normalization process created a balanced and proportional weighting system that was both theoretically grounded and practically informed by the experiences of senior government IT professionals. This meticulous approach enhances the B-TAERA framework's credibility, reliability, and relevance for real-world blockchain readiness assessments in the public sector.

3.4 Data Preparation and Analysis

The quantitative data collected from the expert validation process were prepared and analyzed to empirically validate the B-TAERA framework[53]. The data, which included the experts' scores and judgments, was processed using IBM SPSS and python code. The data cleaning process involved several key steps to ensure the accuracy and reliability of the dataset.

- Data Entry and Inspection: The scores assigned by the experts were manually entered into the SPSS software. A thorough inspection was then conducted to check for any data entry errors, such as out-of-range values or inconsistent responses.
- Missing Value Analysis: The dataset was checked for any missing values. Since the expert validation was conducted in a structured, in-person manner, there were no missing data points, ensuring a complete and valid dataset.
- Outlier Detection: Univariate and multivariate outlier detection methods were employed to identify any data points that were significantly different from the rest of the dataset. No major outliers were detected, confirming the consistency of the experts' scores.

Once the data were prepared, it was ready for the quantitative analysis steps to assess the framework's validity.

3.4.1 Common Method Variance (CMV)

In this study, common method variance (CMV) was assessed using Harman’s single-factor test, which evaluates whether a single factor accounts for the majority of the variance in the dataset[54]. The analysis revealed that the first factor explained 41.66% of the total variance, which is below the commonly accepted 50% threshold used to indicate serious CMV concerns as in Table 2 and plotted in Fig. 3. The analysis was done with Python code as shown in Fig. 4 and the variance output in Fig. 5. According to methodological guidelines, when the variance explained by the first factor is less than 50%, the risk of CMV bias is considered minimal [55]. Therefore, the results suggest that CMV is not a major threat to the validity of findings in this study. Since no single factor accounted for more than half of the total variance, CMV is unlikely to threaten the validity of this study. This outcome supports the robustness of the findings, indicating that the observed relationships among variables are not primarily driven by measurement bias.

Table 2. Results of Harman's Single-Factor Test (Top 10 Factors)

Factor	Variance Explained (%)	Cumulative Variance (%)
Factor 1	41.66	41.66
Factor 2	10.63	52.29
Factor 3	8.14	60.43
Factor 4	6.24	66.67
Factor 5	5.30	71.97
Factor 6	4.83	76.80
Factor 7	4.07	80.87
Factor 8	3.32	84.19
Factor 9	2.68	86.87
Factor 10	2.20	89.07

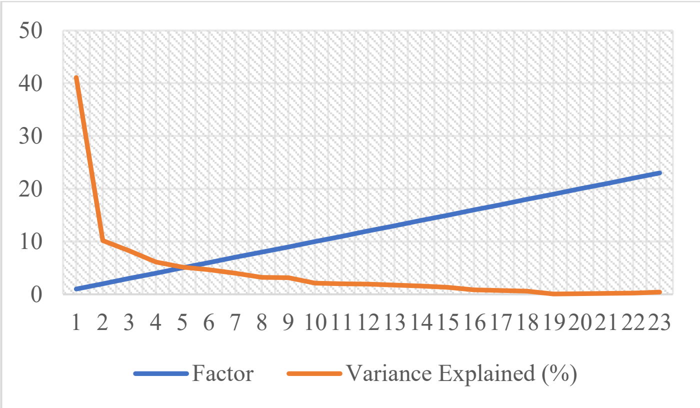

Fig. 3: Results of Harman's Single-Factor Test

```
Variance explained by first factor: 41.66%
Factor 1: 41.66%
Factor 2: 10.63%
Factor 3: 8.14%
Factor 4: 6.24%
Factor 5: 5.30%
Factor 6: 4.83%
Factor 7: 4.07%
Factor 8: 3.32%
Factor 9: 2.68%
Factor 10: 2.20%
Factor 11: 2.10%
Factor 12: 1.83%
Factor 13: 1.67%
Factor 14: 1.37%
Factor 15: 0.97%
Factor 16: 0.79%
Factor 17: 0.07%
Factor 18: 0.13%
Factor 19: 0.18%
Factor 20: 0.30%
Factor 21: 0.60%
Factor 22: 0.44%
Factor 23: 0.51%
```

Fig. 4: Harman's single-factor Test Code

```
import pandas as pd
import numpy as np

# Step 1: Recreate your dataset (23 items, 32 cases)
data = {
"Strategic_Q1": [4,2,5,3,5,4,2,1,5,3,2,4,1,2,4,3,3,5,3,2,1,3,4,1,3,1,2,2,3,2,1,4],
"Strategic_Q2": [5,5,4,5,4,4,1,3,3,3,2,5,3,3,3,4,4,1,1,2,2,1,3,4,5,3,2,2,3,3,3,4],
"Strategic_Q3": [5,4,5,5,4,3,3,2,2,3,2,3,2,1,2,2,2,2,2,1,1,5,4,3,2,2,2,1,1,1,1,2],
"Strategic_Q4": [5,5,4,5,4,3,3,2,2,2,3,3,2,4,1,1,1,5,1,2,1,4,5,2,2,2,1,3,2,2,2,3],
"Strategic_Q5": [4,5,5,5,5,4,1,3,3,3,2,2,4,4,2,3,3,1,3,1,2,3,5,5,1,1,1,3,2,3,1,5],
"Strategic_Q6": [4,5,4,3,5,5,2,4,4,3,1,2,2,2,2,4,5,5,5,1,2,3,3,2,5,2,2,2,3,2,2,3],
"Org_Q1": [5,4,4,4,5,5,2,3,3,1,2,4,1,1,2,3,2,3,4,3,1,2,3,3,3,1,2,3,2,3,2,5],
"Org_Q2": [5,3,5,3,5,5,1,3,3,2,2,4,2,2,2,3,2,3,1,1,2,5,5,5,3,2,2,2,3,1,1,3],
"Org_Q3": [5,5,3,5,5,4,2,2,1,4,4,5,3,3,3,4,1,2,5,5,5,5,5,4,3,3,2,3,2,2,2,2],
"Org_Q4": [5,5,2,4,5,3,2,2,1,2,2,2,2,3,3,2,1,2,2,2,2,4,5,2,3,1,3,3,2,1,2,3],
"Org_Q5": [5,5,3,3,5,4,5,5,1,5,2,3,3,3,3,2,1,2,5,2,3,1,5,3,2,2,1,3,3,2,2,3],
"IT_Q1": [4,3,4,4,5,5,3,1,3,3,2,2,1,1,1,2,3,3,5,5,5,4,3,3,3,1,2,3,2,3,2,3],
"IT_Q2": [4,5,5,5,4,4,2,5,5,3,3,3,3,3,3,1,3,1,2,1,5,2,2,2,3,1,2,2,3,2,2,3],
"IT_Q3": [4,4,3,4,5,5,3,4,2,3,1,3,3,3,3,2,2,2,5,5,5,1,3,3,2,3,2,2,2,3,3,4],
"IT_Q4": [4,4,3,4,5,4,2,2,1,3,3,4,3,3,3,2,2,2,2,2,2,3,3,3,2,5,3,2,3,2,2,3],
"IT_Q5": [5,4,4,4,5,5,3,2,1,2,3,2,5,5,5,3,1,3,1,1,1,3,3,3,2,2,3,2,2,3,2,2],
"IT_Q6": [4,3,4,4,5,5,3,4,2,1,3,2,3,3,3,4,1,3,2,2,2,2,4,5,1,2,4,3,2,3,2,3],
"Cultural_Q1": [4,5,5,5,5,5,3,4,3,1,5,2,3,2,2,2,3,3,4,5,3,5,1,3,5,4,3,2,2,2,2,2],
"Cultural_Q2": [4,4,4,5,4,5,3,3,3,3,3,1,3,3,3,2,2,1,4,3,1,4,3,3,4,2,1,2,3,2,2,3],
"Cultural_Q3": [5,5,5,5,5,5,2,3,2,2,1,3,1,1,1,1,4,2,2,3,2,2,3,3,2,1,2,1,3,2,2,2],
"Cultural_Q4": [4,4,4,5,5,5,1,2,3,3,1,2,1,2,2,3,2,2,5,5,5,2,3,3,3,2,2,2,3,2,2,3],
"Cultural_Q5": [4,5,5,5,5,5,4,2,3,1,1,2,1,1,1,3,2,1,1,1,2,2,3,4,2,1,2,1,2,2,2,2],
"Cultural_Q6": [4,5,5,4,5,5,1,4,2,1,3,3,1,1,1,1,1,3,2,2,3,3,4,5,1,1,3,3,2,3,3,4]
}

df = pd.DataFrame(data)

# Step 2: Standardize the data
X = (df - df.mean()) / df.std()

# Step 3: Compute correlation matrix
corr_matrix = np.corrcoef(X.T)

# Step 4: Eigen decomposition
eigenvalues, eigenvectors = np.linalg.eig(corr_matrix)

# Step 5: Variance explained
explained_variance = eigenvalues / sum(eigenvalues)

# Step 6: Print results
print("Variance explained by first factor: {:.2f}%".format(explained_variance[0]
* 100))

# Optional: Print all factors
```

Fig. 5: Variance Output

3.5 Findings from Quantitative Analysis

Two sets of assessment was done in quantitative anlaysis. The first is the assessment for the eligibility requirement analysis and followed by readiness assessment analysis.

3.5.1 Eligibility Requirements Assessment Analysis

The analysis of the eligibility assessment data reveals significant variability in the performance of ministries, indicating a clear divide in their eligibility. The mean total score was 4.97 out of a possible 8, or approximately 62%, which is notably low. However, the median score of 7.5 suggests that half of the ministries scored at or above this level. This discrepancy between the mean and median, combined with a high standard deviation of 3.63, points to a bimodal distribution of scores. This pattern indicates that ministries are not clustered around a single average level of eligibility; instead, they are split into two distinct groups, a highly prepared cohort and a largely unprepared one. Fig. 6 illustrates the total scores by the 32 ministries Head of Information Technology Department. The response data table is attached in Appendix E.

An analysis of the pass rates for individual questions provides further insight into the specific strengths and weaknesses of the ministries. Questions Q2, Q5, and Q8 exhibited the highest pass rate at 68.75%, demonstrating that the majority of ministries were able to meet these specific requirements. Conversely, Q7 had the lowest pass rate at 50%, identifying it as the most challenging or least commonly met eligibility requirement.

The remaining questions, Q1 and Q6 (59.38%), Q4 (56.25%), and Q3 (65.63%), show a moderate level of compliance. The low pass rate for Q7 highlights a critical area for focused improvement and potential policy intervention to address the specific obstacles preventing ministries from meeting this requirement. Overall, the data points to a dual reality, which is a segment of ministries that are highly prepared(eligible) and a segment that is lagging, with specific requirements presenting consistent challenges for the unprepared group. This analysis underscores the necessity for tailored support strategies to address the varying needs of each group effectively.

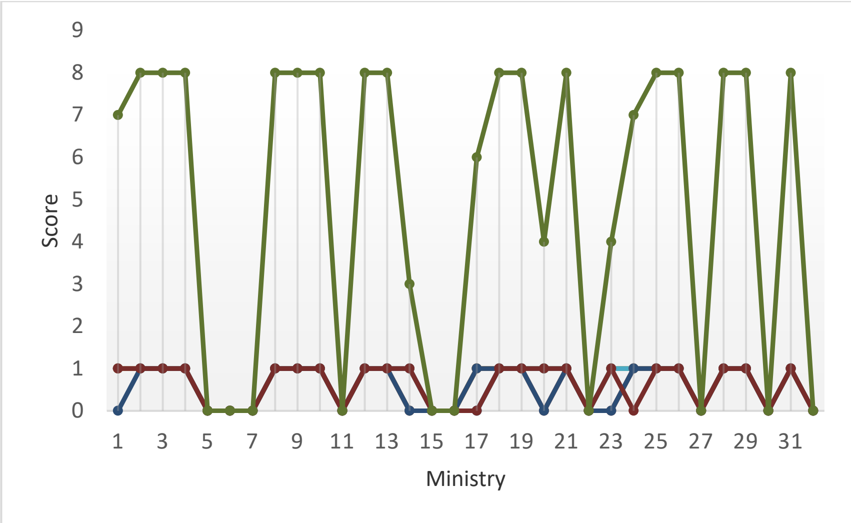

Fig. 6: Total Scores by Ministry

The majority of ministries participated fully in the assessment, with several achieving the maximum score of 8. These high-scoring ministries demonstrated complete engagement, having answered all eight questions positively. A few ministries showed partial engagement, reflected by total scores ranging from 3 to 7, indicating inconsistent participation.

In contrast, Fig. 7, focuses specifically on ministries that recorded a total score of zero. This graph highlights ten ministries specifically Ministries 5, 6, 7, 11, 15, 16, 22, 27, 30, and 32 that answered zero to all questions, showing no engagement at all. These ministries consistently gave null responses, resulting in a flat line at the bottom of the graph.

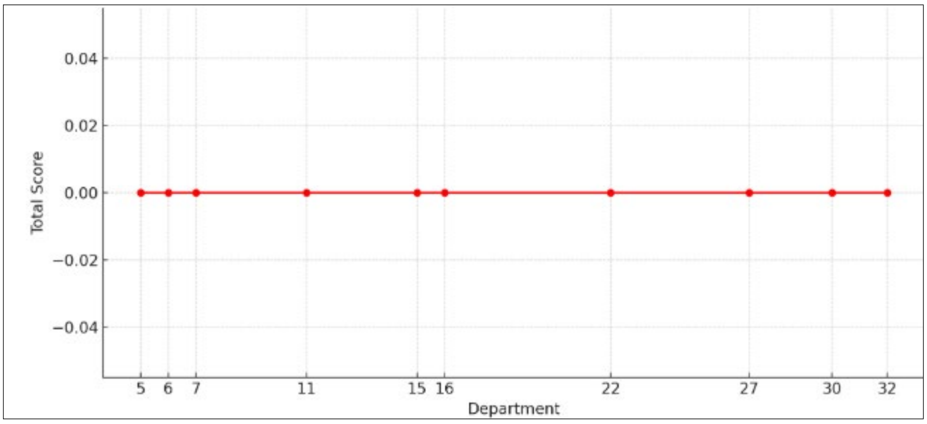

Fig. 7: Zero Total Scores

3.5.2 Regression Analysis

The regression analysis of the data shows a perfect and direct linear relationship between the total assessment score and the scores for each individual question (Q1 through Q8). The model has an R-squared value of 1.00, indicating that the individual question scores account for 100% of the variance in the total score. This is a very straightforward finding. The total score is simply the sum of the scores from the eight questions, with each question contributing equally. There are no other hidden factors or complex relationships influencing the final score. In this case, regression analysis serves to confirm the direct mathematical composition of the 'Total' column from the scores of the individual questions.

In a typical regression analysis, we fit a line to the data points to predict a dependent variable based on one or more independent variables[56]. The R-squared value measures how well that line fits the data, with 1.00 indicating a perfect fit. It's calculated using the following formula:

$$R^2 = 1 - \frac{\text{Sum of Squared Residuals (SSR)}}{\text{Total Sum of Squares (SST)}} \quad (1)$$

- The Sum of Squared Residuals (SSR) measures the total error of the model's predictions. It's the sum of the squared differences between the actual data points and the values predicted by the model.
- The Total Sum of Squares (SST) measures the total variance in the dependent variable.

In this data, the dependent variable (Total) is not an independently measured value but is the exact sum of all the independent variables (Q1 through Q8). Because the total score is a direct, linear combination of the question scores, the regression model can predict it perfectly with zero error. This means the Sum of Squared Residuals (SSR) is equal to zero. When you substitute zero into the R-squared formula, you get:

$$R^2 = 1 - \frac{0}{\text{SST}} = 1 - 0 = 1 \quad (2)$$

Therefore, the R-squared value is exactly 1.00 because the model's prediction perfectly matches every actual data point, as the dependent variable is a direct sum of the independent variables. This a perfect causal relationship, which explains why the model's R-squared value is precisely 1.00.

3.5.3 Readiness Assessment Analysis

The analysis of the readiness assessment data reveals data on whether a particular ministry is prepared in four spectra of readiness i.e. Strategic, Organization, Information Technology(IT), and Cultural. This addresses ~~the~~ RQ2: To what extent do readiness levels for blockchain adoption vary among government agencies, considering disparities in technological capabilities, leadership support, and regulatory conditions? ~~where~~ The data provides a clear look at how ready ~~are~~ different ministries are to adopt blockchain technology. The complete respond data table is attached in Appendix F.

The descriptive analysis of the readiness data indicates a moderate but varied level of blockchain preparedness across the ministries. The average score for all readiness categories Strategic, Organizational, IT, and Cultural floats around 2.90 out of 5. This suggests that while ministries are not fully prepared, they have made some progress. The median scores are very close to the mean, which indicates a fairly balanced distribution without being heavily skewed by extreme outliers. However, the wide range between the minimum score of 1.33 and the maximum of 4.83 highlights a significant disparity in readiness among each ministry. While the average shows a general trend, it obscures the fact that some ministries are highly prepared, while others have made little to no progress in their blockchain readiness. This suggests a need for tailored support rather than a one-size-fits-all approach. Table 3 shows the mean, median, standard deviation, ~~the~~ minimum and maximum scores.

Table 3: Mean, Median, Standard Deviation, Minimum, Maximum

Category	Mean	Median	Standard Deviation	Minimum	Maximum
Strategic	2.92	2.83	0.87	1.33	4.83
Organizational	2.89	2.8	0.77	1.6	4.4
IT	2.88	2.83	0.75	1.5	4.5
Cultural	2.87	2.67	0.86	1.5	4.83
Overall Readiness	2.9	2.83	0.74	1.75	4.58

The most striking finding from this comparison is how little variation there is across the four readiness categories. The mean scores for all categories are tightly clustered between 2.87 and 2.92. This suggests a balanced state of moderate readiness across the ministries, with no single category standing out as a major strength or a major weakness.

- Strongest Area (by a narrow margin): Strategic Readiness has the highest average score of 2.92. This indicates that ministries generally have a good handle on the "what" and "why" of blockchain adoption, understanding its benefits and having a high-level plan.
- Weakest Area: Cultural Readiness has the lowest average score of 2.87. While the difference is small, this suggests that the human element, employee mindset, willingness to change, and acceptance of new processes is the most challenging aspect of blockchain adoption. This is a common challenge for new technology adoption and often requires the most time and effort to address.

The minimal difference between the IT Readiness and Organizational Readiness scores also suggests that the ministries' technological infrastructure and their internal structures are developing at a similar level. The comparative analysis reveals that while ministries have a solid strategic foundation for blockchain adoption, they are not significantly more or less ready in any one area.

3.6 Findings from Qualitative Analysis

Qualitative analysis is performed to interpret the numerical findings, providing substantive insights into the underlying factors that either facilitate or impede blockchain adoption[52]. The findings of this analysis are intended to serve as a robust, evidence-based framework for policymakers and organizational leaders, informing the development of targeted interventions and strategic roadmaps to enhance blockchain integration within the public sector.

By comparing the average scores across the readiness categories, a gap analysis reveals the key areas of strength and weakness. While all scores are clustered around a moderate level of readiness (approximately 2.90 out of 5), a notable gap exists between Strategic Readiness (2.92) and Cultural Readiness (2.87).

This finding suggests a crucial disconnect: ministries are generally good at the high-level planning and understanding the strategic benefits of blockchain, but they struggle with the human and cultural side of implementation. The gap highlights that a well-defined strategy is insufficient if the organization's culture and employees are not prepared to adapt to the new technology.

Deeper exploration into each category's scores provides specific insights into potential barriers to blockchain adoption. The highest average score in Strategic Readiness (2.92) suggests that ministries have successfully identified the core value propositions of blockchain, such as increased security and efficiency, and have likely established high-level roadmaps for adoption.

In contrast, the average score for IT Readiness (2.88) points to potential challenges with technical infrastructure, suggesting a need to address issues like legacy system integration and data compatibility for a decentralized ledger. The score for Organizational Readiness (2.89) indicates a need for new governance structures and clearer decision-making processes to effectively manage resources and oversee projects.

Most critically, the lowest score in Cultural Readiness (2.87) highlights a significant qualitative barrier, a lack of employee buy-in, and resistance to change. Without addressing these human factors, even the most robust strategies and IT systems will likely face internal friction, slowing down successful adoption.

3.6.1 Latent Constructs and Reliability

The FGD sessions provided strong qualitative evidence that the questions and their grouping under the four latent constructs of Strategic Readiness, Organizational Readiness, IT Readiness, and Cultural Readiness are valid and relevant to the public sector context. The experts' consensus-based scoring and commentary during the three sessions confirmed the theoretical a priori structure of the framework[52].

Each construct was judged to be a distinct and meaningful dimension of readiness, and the questions associated with each were deemed to be a consistent and reliable measure of that dimension's readiness level. This expert consensus, rather than a statistical measure, serves as the primary evidence of the framework's reliability and internal consistency.

3.6.2 Assessment of the Model

The B-TAERA model as a whole was assessed for its overall fit and practicality based on the expert validation process. The experts unanimously affirmed the model’s logical coherence and its potential to be a valuable decision-support tool for public sector blockchain adoption. The qualitative assessment confirmed that the model’s two-part structure, first, a go/no-go eligibility check, followed by a multi-dimensional readiness assessment is both a logical and a practical approach for navigating the complexities of government-wide technology implementation.

The experts found the model’s conceptual design to be comprehensive, arguing that it captures the full range of factors from technical to human resources and addresses a critical need in a field that lacks standardized diagnostic instruments. Their feedback underscored that the framework’s strength lies in its ability to provide a holistic and integrated view of readiness, which is essential for mitigating the high risks associated with public sector technology projects.

4.0 DISCUSSION

The results of the unrotated factor analysis indicated that the first factor explained 41.66% of the total variance. While this is less than the 50% threshold often cited as a strong indicator of significant CMV, it suggests that some degree of common method bias may be present in the dataset. This finding is a limitation of the study and is an important consideration when interpreting the results. However, because the CMV is not severe (i.e., less than 50%), the framework's validity is not entirely compromised. The CMV result underscores the importance of interpreting the findings with caution and highlights the need for future research to employ alternative data collection methods to mitigate this risk.

The most critical finding is the bimodal distribution of the total readiness scores. The stark contrast between the high median score (7.5) and the low mean score (4.97) indicates that readiness is not a uniform progression across all ministries. This suggests that agencies are not moving in a single, cohesive group but are instead forming two distinct cohorts: a highly prepared group that has likely invested heavily in the necessary strategic and technical components, and a second group that is largely unprepared and has yet to meet even the most fundamental requirements. This "readiness divide" has significant implications for policy and support, as a one-size-fits-all approach would be inefficient. Instead, interventions should be tailored to meet the specific needs of each group, providing foundational assistance to lagging agencies while supporting the advanced cohort in piloting and scaling their initiatives.

Furthermore, the analysis revealed a remarkably balanced state of moderate readiness across the four dimensions. The mean scores for Strategic (2.92), Organizational (2.89), IT (2.88), and Cultural (2.87) readiness were tightly clustered. This lack of a clear-cut strength or weakness suggests a cautious approach to blockchain adoption. Rather than fully committing to one area, ministries appear to have made small, incremental progress across all fronts. This moderate, balanced readiness may reflect an exploratory phase where agencies are aware of blockchain's potential but are not yet fully invested in the comprehensive strategic, technological, and cultural changes required for successful implementation. The slightly lower score in Cultural Readiness is particularly telling, suggesting that despite moderate progress in strategy and technology, the human element, including employee resistance and a lack of a shared vision, remains the most significant bottleneck for successful adoption.

5.0 LIMITATION AND RECOMMENDATION

The analysis, while insightful, is subject to certain limitations that must be acknowledged. Firstly, the data lacks key demographic information, such as ministry size, budget, or specific sector. Including these variables in future surveys would allow for a more nuanced comparative analysis, revealing whether disparities in readiness are correlated with organizational scale or financial resources. This would move the analysis from a general comparison of ministries to a more targeted examination of specific groups.

Secondly, the quantitative nature of the data, which relies on a Likert-type scale, provides limited insight into the "why" behind the scores. Future research could benefit from a mixed-methods approach, combining quantitative data with qualitative interviews or open-ended questions. This would allow for a deeper understanding of the specific challenges and success stories of ministries in their own words, providing a richer context for the numerical findings.

Looking forward, the findings from this study provide a strong foundation for future research. A longitudinal study could track readiness over time to measure the effectiveness of new policies or interventions. This would enable researchers to determine if and how specific initiatives influence readiness. Additionally, a more comprehensive survey could explore new variables, such as the specific types of technologies in use, the number of employees with blockchain training, and the perceived level of leadership support. Ultimately, the insights from this analysis can guide policymakers in developing a robust and evidence-based framework for enhancing blockchain integration within the public sector.

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