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Research Article

An Integrated TOE–TAM Framework for the Adoption of Decentralized E-Government in Iraqi Higher Education: A Conceptual Model

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Abstract

Public institutions have come to treat electronic government (e-government) as a central means of providing services more efficiently, transparently, and accessibly. Adoption within Iraq's higher education sector, however, is held back by centralized decision-making, underdeveloped information and communication technology (ICT) infrastructure, unclear regulatory frameworks, and limited institutional autonomy. The Technology-Organization-Environment (TOE) framework and the Technology Acceptance Model (TAM) have each served widely to explain technology adoption, yet the two are seldom joined; no validated model so far shows how institutional readiness and the perceptions of individual users together shape e-government use in a fragile, post-conflict governance setting such as Iraq. An integrated TOE–TAM conceptual framework for the adoption of decentralized e-government systems in Iraqi public universities is developed and given theoretical justification in this paper. Eight constructs are put forward across three dimensions: technological (IT skills, technical support, technological infrastructure), environmental (rules and regulations, awareness, culture), and governmental (trust in government, quality of information). For every construct, the supporting literature is reviewed and a matching hypothesis is formulated that links the construct to the use of e-government in higher education. The eight-hypothesis model that results gives a theoretically grounded, context-sensitive lens on digital governance reform in Iraq and in comparable post-conflict, decentralizing states; the model also lays the conceptual foundation for the empirical validation reported in a companion study. In closing, the theoretical contribution of the framework is discussed, together with its implications for policymakers who seek to design more effective strategies of ICT governance and decentralization in higher education.

Keywords: e-government; decentralization; higher education; Technology-Organization-Environment (TOE); Technology Acceptance Model (TAM); Iraq

1. Introduction

During the past two decades, e-government has appeared worldwide as a transformative means of modernizing public institutions, in which information and communication technologies become part of the daily work of government so that service efficiency, transparency, and stakeholder engagement improve [1]. Many developed nations have built e-government strategies deep into their governance structures; developing and post-conflict countries, by contrast, still meet persistent political, institutional, and technological obstacles that slow implementation [2]. Iraq is an acute example of these challenges, above all in its higher education sector, in which administrative centralization meets constrained digital infrastructure.

For the most part, Iraqi public universities still work under centralized, bureaucratic models of governance that place decision-making authority at the level of the Ministry of Higher Education and

Scientific Research; individual institutions are thus left with little autonomy to design or run their own initiatives of digital transformation [3].

Administrative decentralization has been promised repeatedly by the government, but the policy intention has not yet been translated in any meaningful way into practice in higher education [4]. Inadequate ICT infrastructure, limited technical capacity among staff, low trust in digital platforms run by the government, and cultural resistance to technological change still confront the universities; all of the factors restrict the effective use of e-government services [5], [6].

Much research on e-government adoption has relied either on the Technology Acceptance Model (TAM), with its emphasis on the perceived usefulness and perceived ease of use experienced by individual users [7], or on the Technology-Organization-Environment (TOE) framework, which accounts for adoption through the technological, organizational, and environmental readiness of an organization [8]. The two theoretical traditions are usually applied separately. In fragile governance settings such as Iraq, however, where weak institutional structures meet considerable public skepticism toward digital services, neither institutional readiness nor individual perception can fully explain adoption behaviour by itself; a more integrated explanatory approach is needed [9].

Although a considerable volume of e-government research on Iraq has appeared in recent years, most existing studies stay descriptive or treat isolated dimensions of adoption; relatively little work has joined TOE and TAM in one empirically testable model fitted to the context of higher education [10]. The gap is addressed here through the development and theoretical justification of an integrated TOE–TAM conceptual framework that explains the use of decentralized e-government systems in Iraqi public universities. Eight constructs, grouped into technological, environmental, and governmental dimensions, are identified in the framework, and eight matching hypotheses are put forward. The rest of the paper is arranged as follows: e-government concepts and practice in higher education are reviewed in Section 2; decentralization in public administration and higher education is discussed in Section 3; the evolution and status of e-government in Iraq and Iraqi higher education are examined in Section 4; the theoretical foundations of TOE and TAM are presented in Section 5; the proposed integrated framework and its hypotheses are developed in Section 6; the implications of the framework are discussed in Section 7; and Section 8 concludes.

2. E-Government: Concepts, Goals, and Practice in Higher Education

Broadly, e-government denotes the use of ICT, above all internet-based platforms, by public sector institutions to provide information and services to citizens, businesses, and internal stakeholders with greater efficiency and transparency [11]. Beyond mere digitization of existing processes, e-government is more and more seen as a vehicle for wider transformation of the public sector, through which institutions reshape how they communicate, take decisions, and account for their performance [1].

Among the main goals usually attributed to e-government initiatives are faster and more accessible service delivery, lower bureaucratic overhead, greater transparency and accountability, and stronger stakeholder trust in public institutions. Effective implementation of e-government has been associated with lower administrative costs, more accurate data, greater responsiveness to stakeholder needs, and a wider portfolio of accessible public services [11]. The benefits depend, however, on adequate technological readiness and on supportive institutional and regulatory conditions; national contexts do not uniformly provide such conditions.

Frequent barriers to the implementation of e-government are insufficient ICT infrastructure, limited digital literacy among providers and users alike, weak legal and regulatory frameworks, concerns over cybersecurity and data privacy, and, in many developing contexts, low institutional trust [5]. The barriers tend to reinforce one another; a lack of regulatory clarity can hold back investment in infrastructure, while low digital literacy can weaken confidence in newly deployed systems.

In higher education in particular, e-government, frequently implemented through integrated campus management or administrative information systems, supports functions that extend from admissions and registration to human resource management, financial administration, and research reporting. Universities that adopt the systems successfully typically report gains in efficiency in administrative workload, better data-driven decision-making, and easier access to services for academic and administrative staff alike. In developing and post-conflict states, however, higher education institutions often trail behind national e-government strategies because of scarce resources, fragmented governance, and limited technical capacity [6].

3. Decentralization and Higher Education Governance

Decentralization, meaning the transfer of administrative authority and responsibility for decisions from central government bodies to lower-level or institutional units, is widely seen as a way of improving the responsiveness, efficiency, and contextual relevance of public administration [12]. Once local units hold greater autonomy over resource allocation and service design, decentralization is expected to let institutions fit their operations more closely to local needs instead of relying on uniform directives imposed centrally.

For higher education, decentralization can mean that individual universities receive greater autonomy over curricular, financial, technological, and administrative decisions, among them the authority to design and run their own initiatives of digital transformation. Evidence from comparisons with other national contexts suggests that greater institutional autonomy often goes together with more effective, contextually adapted use of digital administrative systems [13]. Where decision-making stays centralized, by contrast, institutions may lack the incentive to adopt e-government tools and adapt them to their particular operational contexts; the practical capacity to do so may be lacking as well.

Administrative decentralization has been publicly embraced by the Iraqi government as a goal of national policy, yet the commitment has so far not been put effectively into practice in the higher education sector [4]. Universities seldom have the power to start or run digital transformation on their own; policy decisions on e-government systems are instead usually imposed at the central level, in particular by the Ministry of Higher Education and Scientific Research. The centralization restricts the ability of institutions to fit e-government services to their particular operational needs and holds back the pace and depth of digital adoption across the sector.

4. E-Government in Iraq and Iraqi Higher Education

Since the early 2000s, the development of e-government in Iraq has been uneven, shaped jointly by priorities of post-conflict reconstruction, political instability, and limited public investment in ICT infrastructure [10]. National strategies for digital governance have been set out at various points, but implementation has generally fallen behind the stated policy ambitions; core applications are concentrated in a few ministries and services instead of being spread widely across the public sector [14].

The e-government path of Iraq differs from that of more stable developing economies in several structural respects. Among them are the legacy of prolonged conflict and its effect on institutional capacity, a strongly centralized culture of decision-making that restricts local experimentation, ICT infrastructure that is underdeveloped and inconsistently maintained, and a regulatory environment that has failed to keep pace with technological change [15]. Public trust in government institutions, their digital services included, also stays comparatively low; years of institutional instability have left the low trust as a legacy [9].

In Iraqi higher education in particular, the adoption of e-government could modernize processes for admissions, registration, examinations, and human resources, cut paper-based bureaucracy, and make

academic administration more transparent. Resource constraints and a shortage of trained IT personnel, including the departure of qualified technical staff from the public higher education system, complicate the realization of these benefits, however [5], [16]. Technological readiness and administrative capacity differ considerably among universities across the country; progress is therefore uneven even among institutions that operate under the same national policy framework.

Coordinated investment in ICT infrastructure, sustained capacity-building for administrative and academic staff, clearer regulatory guidance, and, critically, a genuine devolution of decision-making authority to individual institutions will likely be needed to address the challenges. Without such a shift, e-government initiatives in Iraqi higher education run the risk of staying mandated by central authorities yet under-utilized at the local level.

5. Theoretical Foundations

5.1 The Technology-Organization-Environment (TOE) Framework

Tornatzky and Fleischer [8] built the TOE framework to explain why organizations adopt technology, using three contextual dimensions; the technological context covers internal and external technologies relevant to the organization, current practices and available infrastructure among them; the organizational context covers firm size, structure, and resources; and the environmental context covers the regulatory, competitive, and social surroundings in which the organization works. Information systems research has drawn on TOE extensively, studies of institution-level e-government adoption included, because readiness factors beyond the control of any single user fall within its scope [17]. Here, the TOE framework is adapted to capture how technological, environmental, and governmental conditions shape the use of decentralized e-government in Iraqi higher education institutions; the governmental conditions are a context-specific adaptation of the organizational dimension, reflecting the central role of government policy and institutional trust in the Iraqi setting.

5.2 The Technology Acceptance Model (TAM)

TAM, which Davis [7] developed, accounts for individual technology-adoption behaviour through two central beliefs; the first is perceived usefulness, the degree to which a person believes that a system will improve their performance, and the second is perceived ease of use, the degree to which a person believes that using the system will involve no effort. Across public sector, higher education, and developing-country contexts, TAM has shown strong and consistent predictive power for user acceptance [18]. The inclusion of TAM in the present framework answers a core dimension of the research problem; engagement with and uptake of e-government systems among individual institutional users remain limited, which readiness factors at the institutional level cannot fully explain by themselves.

5.3 Rationale for an Integrated Framework

Complementary but distinct levels of explanation are covered by TOE and TAM; institutional and contextual readiness falls within TOE, whereas individual user perception and behavioural response fall within TAM. In prior e-government research, the two models have usually been applied separately, at the risk of leaving out either the institutional conditions that enable or constrain adoption or the individual perceptions that finally decide system use. With the two traditions combined, the present framework can capture both dimensions at once: whether the institutional environment, technological, environmental, and governmental, favours e-government use, and whether individual users see the resulting systems as useful and usable. The integration matters particularly in fragile governance contexts such as Iraq, in which institutional weaknesses and individual scepticism are likely to interact and to shape actual usage behaviour jointly.

6. Proposed Integrated Framework

On the theoretical foundations set out above, an integrated framework of eight constructs in three dimensions is proposed: technological factors (IT skills, technical support, technological infrastructure), environmental factors (rules and regulations, awareness, culture), and governmental factors (trust in government, quality of information). A direct, positive influence on the use of decentralized e-government systems in Iraqi higher education institutions, the dependent construct of the model, is hypothesized for each construct. A schematic of the proposed framework is given in Figure 1, and the same eight hypotheses are summarized in table form in Table 1.

Figure 1. Proposed integrated TOE-TAM framework

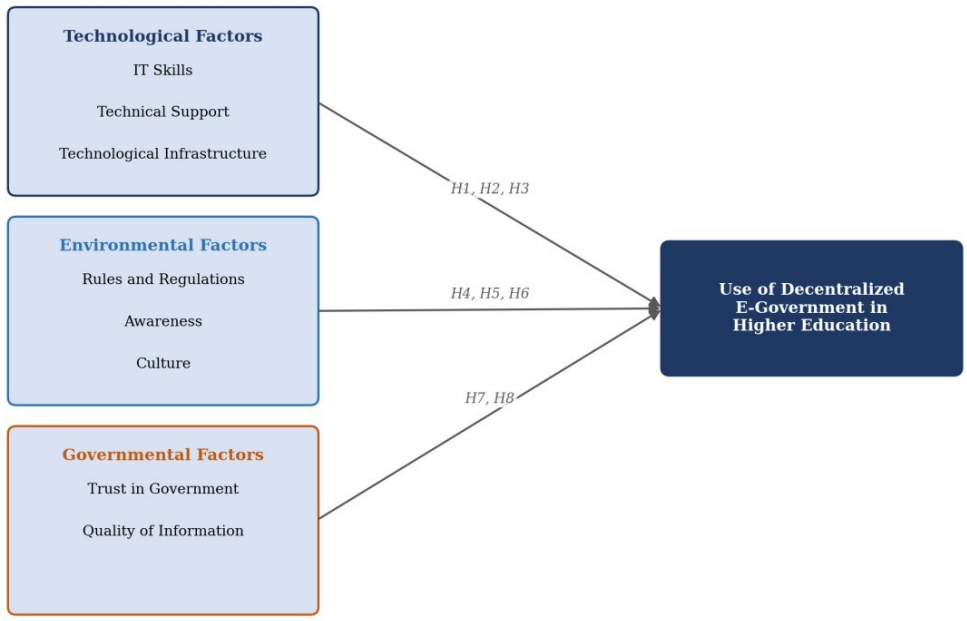


Figure 1. Proposed integrated TOE–TAM framework: three dimensions of institutional and individual readiness, each linked to the use of decentralized e-government in higher education.

Table 1. Constructs, dimensions, and hypotheses of the proposed integrated TOE–TAM framework

Dimension	Construct	Hyp.	Hypothesized relationship
Technological	IT Skills	H1	IT skills → Use of e-government (+)
	Technical Support	H2	Technical support → Use of e-government (+)
	Technological Infrastructure	H3	Technological infrastructure → Use of e-government (+)
Environmental	Rules and Regulations	H4	Rules and regulations → Use of e-government (+)
	Awareness	H5	Awareness → Use of e-government (+)
	Culture	H6	Culture → Use of e-government (+)
Governmental	Trust in Government	H7	Trust in government → Use of e-government (+)
	Quality of Information	H8	Quality of information → Use of e-government (+)

6.1 Technological Factors

IT skills denote the technical competence that institutional staff need in order to implement, manage, and use e-government platforms effectively, covering general digital literacy as well as specialized technical expertise. Capacity constraints in Iraqi public universities, among them limited investment in technical training and vulnerability to the attrition of skilled staff, are often named as obstacles to effective implementation of e-government. On this reasoning, the framework proposes:

H1: *IT skills have a significant and positive effect on the use of e-government in Iraqi higher education.*

The systems, protocols, and personnel needed for assistance and troubleshooting on e-government platforms make up technical support, with help-desk services, system maintenance, and mechanisms for data backup and integration among them. By keeping service disruption low and building user confidence in digital platforms, reliable technical support lowers resistance to system use. Accordingly:

H2: *Technical support has a significant and positive effect on the use of e-government in Iraqi higher education.*

Technological infrastructure denotes the availability, quality, and reliability of the hardware, network connectivity, and system architecture on which e-government platforms rest. In settings with constrained resources, such as the public university system of Iraq, uneven infrastructure quality is often named as a binding constraint on the delivery of digital services. Accordingly:

H3: *Technological infrastructure has a significant and positive effect on the use of e-government in Iraqi higher education.*

6.2 Environmental Factors

Rules and regulations denote the clarity, consistency, and enforceability of the legal and policy frameworks under which e-government is implemented, with data protection, institutional accountability, and procedural standards included. Clear regulatory frameworks are widely seen as a precondition for institutions to feel confident in adopting new digital systems.

Accordingly:

H4: *Rules and regulations have a significant and positive effect on the use of e-government in Iraqi higher education.*

Awareness denotes how far institutional staff understand the purpose, availability, and benefits of e-government services. Underutilization or misapplication of digital services that are otherwise available has been linked to limited awareness; the importance of communication and training initiatives follows from the link. Accordingly:

H5: *Awareness has a significant and positive effect on the use of e-government in Iraqi higher education.*

The shared values, beliefs, and attitudes in an institution that shape its receptiveness to technological change, including institutional and wider national orientations toward digital transformation, make up cultural factors. Accordingly:

H6: *Culture has a significant and positive effect on the use of e-government in Iraqi higher education.*

6.3 Governmental Factors

Trust in government expresses how institutional staff perceive the credibility, integrity, and reliability of government-run digital platforms and of the bodies that operate them. Particularly where

institutional credibility has been contested historically, trust is regarded as a key behavioural driver of the acceptance of public digital services [17]. Accordingly:

H7: *Trust in government has a significant and positive effect on the use of e-government in Iraqi higher education.*

Quality of information denotes the accuracy, relevance, timeliness, and clarity of the information that e-government platforms deliver. Consistent engagement is more likely with systems that users perceive as supplying reliable, useful information. Accordingly:

H8: *Quality of information has a significant and positive effect on the use of e-government in Iraqi higher education.*

7. Discussion and Implications

By joining two well-established but historically separate theoretical traditions, the integrated framework proposed here extends the existing knowledge on information systems and digital governance. Institutional readiness and individual user perception are treated by the framework as complementary dimensions of one adoption process rather than as competing explanations of e-government use. A more holistic lens thus becomes available for the study of digital governance in fragile or post-conflict environments, in which both dimensions plausibly matter and neither can be assumed away.

Eight concrete levers across technological, environmental, and governmental dimensions, by which e-government adoption in higher education might be strengthened, are brought to the attention of policymakers and university administrators. According to the framework, interventions limited to infrastructure investment, for example, are unlikely to succeed without parallel efforts to build institutional trust, clarify regulatory frameworks, and raise staff awareness. Sustained adoption is more likely to follow from a multi-dimensional intervention strategy that addresses several constructs at once than from any single-factor approach.

Being a conceptual contribution, the framework presented here needs empirical testing so that the relative strength and statistical significance of each proposed relationship can be established. That validation is carried out by a companion study; the study draws on survey data gathered from academic and administrative staff across five Iraqi public universities and analysed with structural equation modelling [19]. Specifically, the contribution of the present paper lies in the theoretical development and justification of the model that such empirical work then tests.

8. Conclusion

An integrated TOE–TAM conceptual framework that explains the use of decentralized e-government systems in Iraqi higher education institutions has been developed in this paper. Prompted by the persistent gap between the decentralization ambitions declared by Iraq and the realities of centralized, under-resourced digital governance in its public universities, the framework joins readiness factors at the institutional level (technological, environmental, and governmental) with user perception at the individual level, arranged into eight constructs and eight matching hypotheses. On the theoretical side, the framework contributes by uniting two seldom-combined traditions of technology-adoption research; on the practical side, policymakers gain a structured, multi-dimensional basis for designing reforms in decentralization and ICT governance. Future work, the empirical validation summarized in the companion study included, should keep testing, refining, and extending the framework across different types of institutions and national contexts, with comparative work in other post-conflict or transitional governance settings among them.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

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