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Analyzing Barriers to the Adoption of Websites and Mobile Applications in Libya: A Mixed-Methods Study on E-Services, Trust, and Digital Transformation

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ABSTRACT
Libya presents a paradox in the domain of digital transformation: despite a relatively high internet penetration rate of approximately 88.4% in 2024 [1]. the country continues to face significant barriers to the effective adoption of websites and mobile applications. This paper investigates the key obstacles hindering digital engagement in Libya, including inadequate infrastructure, low internet speed and reliability, limited electronic payment systems, lack of trust in online services, digital illiteracy, and cultural considerations such as compliance with Islamic principles. A mixed-methods study design was adopted, combining quantitative data from a survey of 482 respondents with qualitative insights from interviews with twelve business managers. Quantitative analysis was conducted using statistical tools, while qualitative data were processed through natural language processing (NLP) techniques using NLTK and spaCy. Results indicate that while internet connectivity is widespread, actual use of e-services remains hindered by systemic inefficiencies and social barriers. The study contributes to the literature by presenting a holistic view of Libya's digital ecosystem, highlighting both barriers and opportunities. Recommendations include short-term measures such as strengthening infrastructure and digital literacy programs, and long-term strategies such as legislative reforms, AI adoption, and the establishment of a national digital transformation authority.

KEYWORDS: Libya; digital transformation; websites; mobile applications; barriers; e-services; electronic banking; trust; infrastructure.

1. INTRODUCTION

1.1 Background

Digital technologies have emerged as essential enablers of socioeconomic development in the 21st century. Across the globe, countries are leveraging the internet, mobile applications, and e-services to enhance governance, streamline commerce, and promote social inclusion. In developed economies, e-commerce and digital banking have transformed the way individuals and institutions interact, enabling

faster transactions, greater transparency, and improved efficiency [2]. In contrast, many developing nations face challenges that restrict their ability to fully integrate into the digital economy.

Libya provides a compelling case of such disparities. On one hand, internet penetration is relatively high, with approximately 6.13 million users reported in 2024, representing about 88.4% of the population [1]. Mobile connections exceed 12 million, indicating that smartphones are widely used. However, on the other hand, actual utilization of websites and mobile applications for e-services such as banking, government transactions, and e-commerce remains extremely limited. According to the State Department's 2024 Investment Climate Statement, Libya has initiated a Banking Modernization Program that includes electronic payment reforms, yet adoption rates remain low. Internet infrastructure is weak compared to international benchmarks, with median mobile internet speeds of 14.48 Mbps and fixed broadband speeds of 8.86 Mbps [3]. These figures highlight the gap between access and effective utilization.

1.2 Problem Statement

Despite widespread internet connectivity, Libya struggles with translating digital access into functional usage of websites and applications. Key barriers include:

- Poor infrastructure and unreliable connectivity.
- Weak financial inclusion and limited electronic payment systems.
- Lack of trust in online platforms, exacerbated by cybersecurity concerns.
- Digital illiteracy and inadequate training.
- Cultural and religious considerations, including the need for Sharia-compliant services.

These barriers restrict Libya's ability to capitalize on the opportunities presented by the digital revolution, leaving it behind regional peers such as Tunisia and Egypt, which have advanced significantly in e-government and e-commerce adoption [4]. The paradox of "high connectivity but low usage" remains a central issue that requires urgent scholarly and policy attention.

1.3 Objectives of the Study

The study aims to:

1. Identify the primary barriers hindering the adoption of websites and mobile applications in Libya.
2. Examine user and business perspectives on digital engagement.
3. Explore cultural and regulatory dimensions affecting e-services adoption.
4. Propose short-term and long-term strategies to overcome these barriers.

1.4 Significance of the Study

This study is significant in multiple respects:

- **Academic contribution:** It fills a gap in the literature on Libya's digital readiness, combining quantitative and qualitative insights into a unified framework.
- **Practical relevance:** Findings will assist policymakers, banks, telecom companies, and entrepreneurs in designing interventions to accelerate digital adoption.
- **Regional context:** By comparing Libya's digital barriers to those in neighboring countries, the study situates the Libyan case within broader regional development trajectories.
- **Societal impact:** Addressing these barriers is essential for enhancing citizen access to financial services, education, healthcare, and governance, thereby improving overall quality of life.

1.5 Future Opportunities

While barriers persist, opportunities for digital development in Libya are considerable. High smartphone penetration and strong youth demographics provide a fertile environment for innovation. The growing global reliance on artificial intelligence (AI) and digital platforms offers Libya a chance to leapfrog stages of development by adopting emerging technologies. With appropriate investments in infrastructure, policies, and digital literacy, Libya could transform itself into a regional hub for digital services.

2. LITERATURE REVIEW

2.1 Digital Transformation and Barriers in Developing Countries

Digital transformation has become a cornerstone of global economic and social progress. In many developing countries, however, barriers such as inadequate infrastructure, low digital literacy, and weak regulatory environments limit the effectiveness of digital adoption [5]. These barriers not only slow down the implementation of e-government services but also undermine public trust in online systems [6].

The digital divide, often measured not only in terms of access but also in terms of skills and quality of use, is particularly pronounced in countries where infrastructure gaps persist. For example, while many African nations have achieved significant mobile penetration, actual use of digital financial services remains low due to challenges in cybersecurity and lack of interoperability between systems [7].

2.2 Libya's Digital Context

Libya presents a paradoxical situation: internet penetration is among the highest in North Africa, yet actual use of digital services is lagging. DataReportal [3] reports median internet speeds of 14.48 Mbps for mobile and 8.86 Mbps for fixed broadband, both below regional averages. According to Freedom House [1], while nearly 88% of Libyans have internet access, restrictive regulatory frameworks, outdated

infrastructure, and political instability limit the effective use of websites and mobile apps.

The lack of reliable electronic payment systems further complicates adoption. Although the Central Bank of Libya has introduced modernization efforts, such as expanding foreign exchange operations and electronic payment platforms, adoption remains minimal [8]. Moreover, logistical challenges, such as underdeveloped delivery services and postal systems, undermine the growth of e-commerce platforms.

2.3 Trust, Security, and Cultural Barriers

Trust in online systems remains low in Libya, largely due to concerns about fraud, data privacy, and cybercrime. This is consistent with findings from other developing nations, where weak cybersecurity frameworks discourage users from engaging with e-services [4]. In Libya, cultural and religious norms also play a role, as consumers often demand services that align with Islamic principles, such as Sharia-compliant financial products [9].

The lack of transparency and reliability in online platforms exacerbates these concerns. In neighboring Tunisia and Egypt, regulatory reforms and investment in secure platforms have fostered greater trust, leading to higher adoption rates of e-government and e-commerce services.

2.4 Digital Literacy and Human Capital

Digital literacy represents another major barrier. A significant portion of the Libyan population lacks the technical skills necessary to navigate websites and mobile applications effectively. digital literacy is not limited to basic access but also includes the ability to critically evaluate, communicate, and transact online [10]. Without comprehensive training programs, Libya risks widening its digital divide despite high connectivity.

2.5 Comparative Regional Insights

A comparative perspective underscores Libya's lag in digital adoption. For example:

- **Tunisia** has advanced in e-government, offering online platforms for taxation, education, and healthcare.
- **Egypt** has developed a growing fintech ecosystem, supported by central bank initiatives and startup accelerators.
- **Algeria** has invested in national broadband infrastructure, albeit with regulatory challenges.

Libya, however, has not yet leveraged its connectivity into meaningful service adoption. This comparative gap highlights the urgency of interventions.

2.6 Gaps in the Literature

The literature reveals several gaps:

1. A lack of empirical studies that combine both user and business perspectives on digital adoption in Libya.

2. Insufficient exploration of cultural and religious factors in shaping digital engagement.
3. Limited integration of quantitative and qualitative findings into a conceptual framework tailored to Libya's context.

This study seeks to address these gaps by adopting a mixed-methods approach to capture a holistic understanding of the barriers and opportunities.

3. METHODOLOGY

3.1 Study Design

This study employed a sequential explanatory mixed-methods design, combining quantitative surveys with qualitative interviews. This design allows for statistical generalization from the survey data and deeper contextual understanding from the interviews [11].

3.2 Quantitative Phase: Survey

- Sample size: 482 respondents from different regions in Libya.
- Sampling technique: Stratified random sampling to ensure representation across age, gender, and education levels.
- Data collection: Online survey administered via Google Forms.
- Survey instrument: Questions focused on frequency of website and app usage, perceived barriers (infrastructure, payment systems, trust, cultural fit), and satisfaction levels.
- Analysis: Descriptive statistics and inferential tests were conducted using the AI-powered statistical platform *Julius.ai*.

3.3 Qualitative Phase: Interviews

- Participants: 12 managers from companies engaged in e-services (e-commerce, digital banking, telecom).
- Sampling: Purposive sampling to target businesses actively involved in digital platforms.
- Data collection: Semi-structured interviews conducted via Zoom or phone.
- Interview themes: Organizational barriers, regulatory issues, cultural concerns, and future expectations.
- Analysis: Interview transcripts were analyzed using Natural Language Processing (NLP) tools (NLTK and spaCy). Topic modeling and thematic coding identified recurring patterns such as "trust," "payment difficulties," and "logistics gaps."

3.4 Integration of Findings

A joint display table was used to integrate survey results with interview themes. This approach highlights where quantitative trends aligned with qualitative insights (e.g., both users and managers cited weak payment systems as a barrier).

3.5 Ethical Considerations

All participants provided informed consent. Data confidentiality was maintained by anonymizing responses. The study adhered to international study ethics standards, ensuring that no sensitive information was disclosed.

4. RESULT AND DISCUSSION

4.1 Quantitative Findings

The survey revealed important trends regarding the use of websites and mobile applications in Libya:

- Frequency of Use: Only 27% of respondents reported daily use of e-services, while 49% used them occasionally, and 24% rarely or never.
- Key Barriers Identified:
  - Infrastructure problems (71%).
  - Lack of trust in online platforms (64%).
  - Limited electronic payment options (59%).
  - Digital illiteracy (42%).
  - Cultural/religious concerns (28%).

Table 1. Frequency of Website and App Usage by Respondents

Usage Frequency	Percentage
Daily	27%
Occasionally	49%
Rarely/Never	24%

These figures confirm the paradox of widespread internet access but limited effective adoption of e-services.

4.2 Qualitative Findings

Analysis of interviews with business managers highlighted several recurring themes:

1. Payment Systems: Nearly all businesses expressed frustration with the absence of reliable, interoperable electronic payment systems.
2. Trust and Security: Managers emphasized that consumer reluctance to share financial information online undermines business growth.

3. Logistical Barriers: Companies identified the lack of an efficient postal and delivery system as a major obstacle to e-commerce.
4. Cultural Concerns: Businesses acknowledged the importance of Sharia-compliant systems to build user trust.
5. AI and Innovation Gaps: Managers reported limited adoption of advanced digital tools, with little government support for innovation.

4.3 Integration of Quantitative and Qualitative Findings

The mixed-methods integration reveals alignment between user and business perspectives. Both groups consistently identified payment systems, infrastructure weaknesses, and trust deficits as major barriers. While users highlighted digital illiteracy, businesses focused more on regulatory and logistical issues. This indicates that digital adoption challenges are systemic, spanning both supply and demand sides.

Table 2. Integrated Findings from Users and Businesses

Theme	Users (Survey)	Businesses (Interviews)
Infrastructure	High concern	High concern
Payment Systems	High concern	High concern
Trust & Security	High concern	High concern
Digital Literacy	Moderate	Low
Cultural/Religious	Moderate	Moderate
Logistics	Low	High concern

4.4 Discussion in Regional and International Context

Compared to Tunisia and Egypt, Libya is significantly behind in implementing secure e-payment systems and e-government services. For instance, Egypt's fintech ecosystem has grown rapidly with government support, while Tunisia's online platforms provide citizens with efficient digital access [2]. Libya's lag is not due to lack of connectivity but to systemic failures in trust, regulation, and infrastructure.

From a global perspective, UNCTAD [4] stresses that digital economies cannot thrive without reliable payment systems, strong cyber laws, and logistics support. Libya's experience echoes these findings, highlighting the need for comprehensive reforms rather than piecemeal interventions.

4.5 Conceptual Framework

Based on the findings, a conceptual framework has been developed to illustrate the relationship between barriers and adoption of e-services.

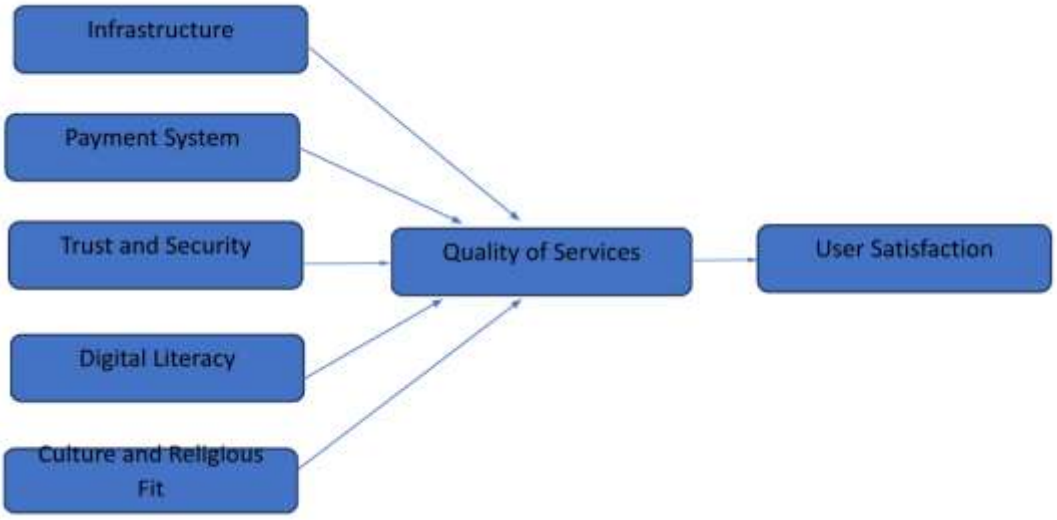

Figure 1. Conceptual Framework

In aggregate form (Figure 1) showed the framework emphasizes that quality e-services are contingent upon the integration of infrastructure, payments, trust, literacy, and cultural compatibility. Improving these dimensions collectively will drive adoption and satisfaction.

5. CONCLUSION AND RECCOMMENDATIONS

5.1 Conclusion

This study examined the barriers hindering the adoption of websites and mobile applications in Libya, using a mixed-methods approach that integrated both user and business perspectives. Findings highlight systemic issues in infrastructure, payment systems, trust, digital literacy, and cultural considerations. Despite high internet penetration, actual adoption of e-services remains limited, reflecting the paradox of access without effective use.

5.2 Recommendations

Short-Term Recommendations

1. Infrastructure upgrades: Immediate improvements in internet reliability and speed, including investment in mobile networks and fiber optics.
2. Digital literacy programs: Launch nationwide training initiatives targeting youth, women, and rural populations.
3. Basic electronic payment systems: Strengthen the role of the Central Bank in expanding interoperable e-payment platforms.

4. Trust-building campaigns: Government and private sector should collaborate on awareness programs to improve confidence in online transactions.

Long-Term Recommendations

1. Comprehensive regulatory framework: Establish laws governing data protection, cybersecurity, and e-transactions.
2. National Digital Authority: Create an independent body to oversee digital transformation strategies.
3. Integration of AI and advanced tools: Encourage adoption of AI to improve efficiency in banking, logistics, and governance.
4. Cultural and religious alignment: Develop Sharia-compliant e-services to build trust among conservative consumers.
5. Regional collaboration: Partner with neighboring countries to share best practices and harmonize digital standards.

6. LIMITATIONS AND FUTURE STUDY

This study is limited by its reliance on cross-sectional data, which captures conditions at a single point in time. Future study could employ longitudinal designs to track changes in adoption over time. Additionally, the qualitative sample was limited to twelve companies; larger samples could yield deeper insights. Comparative studies with other countries in North Africa or the Middle East could also enhance understanding of Libya's unique challenges and opportunities.

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