"Business Intelligence adoption in Jordanian e-banking: Unveiling key drivers and challenges"

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BUSINESS INTELLIGENCE ADOPTION IN JORDANIAN E-BANKING: UNVEILING KEY DRIVERS AND CHALLENGES

Abstract

The study examines decisive elements affecting Business Intelligence (BI) acceptance within e-banking operations in Jordan by analyzing how IT infrastructure, data analytics competency, cybersecurity preparedness, and regulatory alignment impact the process. A series of questions were asked to 374 staff members from IT departments and compliance teams, as well as data analysis divisions representing Islamic and commercial banks in Amman, Jordan. The research period spanned from March to July 2024, while SEM was the analysis method. The study found that IT infrastructure ($\beta = 0.38$, $p < 0.001$) and data analytics capability ($\beta = 0.45$, $p < 0.001$), along with cybersecurity ($\beta = 0.41$, $p < 0.001$), positively influence BI adoption. The impact of regulatory compliance failed to reach statistical significance with a coefficient of 0.22 ($p = 0.07$). The success of BI implementation in Jordanian banks relies mainly on technology hardware capabilities, together with internal company resources, yet strict regulations pose obstacles unless they support a bank's mission. The business solutions identified through this research will help banking leaders and software developers, together with government officials, to improve data-driven decision systems in Jordan's financial market.

Keywords	business intelligence, e-banking, IT infrastructure, data analytics, cyber security, regulatory compliance, digital transformation
JEL Classification	M15, G21, O33, L86

INTRODUCTION

The transformation of digital banking now leads to worldwide changes in financial operations that advance both operational efficiency and customer satisfaction, together with improved institutional services. Business Intelligence (BI) systems emerged as fundamental business tools that help banks perform data processing to develop better decision systems and tailored banking solutions. The Jordanian market contains various obstacles that limit local organizations from adopting Business Intelligence solutions despite the substantial financial benefits they provide.

Jordanian banks face various challenges when deploying BI tools due to their developing IT structures and minimal analytic abilities and higher security threats, and stringent regulatory rules. The installation barriers obstruct operational BI technology fusion and decrease organizations' ability to discover fraudulent activities and deliver quality customer support at the expense of slowing digital transformation across credit facilities. The existing research about BI adoption in banking has produced global insights, but fails to demonstrate conclusively the combination of technical and regulatory factors affecting e-banking in Jordan.

The main research objective focuses on analyzing four essential elements, which include information technology infrastructure alongside data analytics competence and cybersecurity preparedness, and regulatory adherence to evaluate Business Intelligence system utilization throughout Jordanian e-banking institutions. This study examines the dynamic relationship between organizational framework and regulatory mechanisms to contribute to research-based knowledge about BI adoption in digital banking sectors.

1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

BI systems have a great significance in enhancing e-banking operations, particularly by enabling better decision making, better fraud detection, and better service quality. BI is a necessary tool used by modern banking institutions that helps them to process large-scale data and extract insights from it, and feed the insights to support strategic planning. Nevertheless, there are a few hurdles to overcome when it comes to implementing BI technologies in emerging economies, for instance, in Jordan, and these pertain to IT infrastructure, data analytics capabilities, cybersecurity preparedness, and regulatory compliance. The first has a comprehensive review of the literature on constructs and factors influencing the adoption of BI in e-banking.

The implementation of an effective BI system starts with the fact that it is based on an IT infrastructure that collects, stores, processes, and integrates data within all digital banking operations. Banks can run cloud-based analytics tools, integrate artificial intelligence, and have access to real-time data to ease decision-making (Jaradat et al., 2024; Bany Mohammad et al., 2022; Al-Muhrami et al., 2021) in their robust technological infrastructure. However, on the other hand, challenges in IT infrastructure, such as outdated hardware, slow connectivity, or integration issues, can hinder BI performance (ALzoubi et al., 2023). In accordance with empirical research, organizations with high levels of infrastructure deliver better BI system efficiency and better data governance (Spoorthi et al., 2024; Ali et al., 2024; Ali & AlSondos, 2020).

Data analytics capability is an organization's capacity to convert, read, and derive value from large sets of structured and unstructured data. Overall, analytics use within e-banking has to be effective in detecting fraud, profiling customers, assessing risk, and personalizing services (Kalyani & Gupta, 2023; Cele & Kwenda, 2025; Yuan, et al., 2025). To train the model and generate predictive insight, advanced BI powered by AI tools need to be suitably strong in analytical capabilities (Găbudeanu et al., 2021). Jordan is identified as one of the countries that have faced common barriers such as inadequate analytics frameworks, weak data governance, and a lack of technical expertise to successfully implement BI (Kannagi et al., 2023).

BI integration in digital banking environments exposes them to risk of exposure in the form of unauthorized access, data breach, and fraud. Customers' data must be kept secure through cybersecurity readiness to ensure compliance with privacy regulations (Egerson et al., 2024). Encryption, multi factor authentication, and AI powered threat detection within security frameworks provide consumers with additional trust as well as improving the integrity of the BI system (Wang et al., 2024). The financial institutions with poor cybersecurity protocols rarely adopt BI tools because of the high danger of reputation and monetary damage.

Financial regulations, data protection laws, anti-money laundering protocols, and central banking authority requirements, at a minimum in terms of reporting, are encompassed in the makeup of regulatory compliance. Even as regulations encourage trust and standardization, they could also result in operational burdens that are likely to make it difficult for BI systems to be deployed (Balasubramanian et al., 2024; Farayola, 2024). To innovate in digital banking, strict compliance obligations are frequently mentioned as an impediment to digital banking innovation (Alzubi et al., 2025; Shittu et al., 2024; Mahmoud & Othman, 2024; Oladeinde et al., 2023) in the Jordanian context. However, an appropriate regulatory environ-

ment in place can stimulate the adoption of BI because it reveals uncertain elements, and policies and practices that can ease the adoption. Therefore, the hypotheses are formulated as follows:

H1: *IT infrastructure positively influences Business Intelligence adoption in Jordanian e-banking.*

H2: *Data analytics capability positively influences Business Intelligence adoption in Jordanian e-banking.*

H3: *Cybersecurity positively influences Business Intelligence adoption in Jordanian e-banking.*

H4: *Regulatory compliance positively influences Business Intelligence adoption in Jordanian e-banking.*

2. RESEARCH METHODOLOGY

This study was of a quantitative type that used a cross-sectional survey to investigate factors associated with Business Intelligence (BI) adoption in banks that utilize e-banking in Jordan. The study aimed to investigate the adequacy of the IT risk management system in the Jordanian banking and financial institutions, and consider the IT environment as a target population, which includes IT managers, compliance officers, risk analysts, and data scientists working in commercial banks and financial institutions in Jordan. These individuals either are currently using BI technologies, or plan to, or are assisting in planning or implementing BI systems. Data were collected from March to July 2024, in Amman, Jordan, as the majority of the Jordanian banks' head offices and all the digital transformation (DX) teams of the Jordanian banks are based there. A stratified random sampling technique was used to get a balanced representation across the department and job functions relevant to BI integration. The questionnaires were distributed through email, as well as online survey platforms, a total of 461, and 374 completed responses were received, reaching a response rate of 81.1%. The minimum sample for Structural Equation Modeling (SEM) is 200-300, and this sample size is much higher than the minimum.

The measurement scales in use were adapted from the previous literature; this was done by developing the survey instrument. The methodology was divided into two main sections, with the first collecting demographic information and the second consisting of four study constructs, including IT infrastructure, data analytics capability, cybersecurity, and regulatory compliance, measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Bany Mohammad et al. (2022) adapted the measurement items for IT infrastructure from Jaradat et al. (2024). Information capability items for data analytics were sourced from the work by Cele and Kwenda (2025), Kalyani and Gupta (2023), and Farooq et al. (2024). Cybersecurity items in the scale were based on Wang et al. (2024), AL-Dosari et al. (2024), and Kineber et al. (2023), whereas regulatory compliance items were based on Balasubramanian and Sundararajan (2024), Oladeinde et al. (2023), and Gupta et al. (2020). All items were reviewed by subject matter experts to ensure they were clear, contextual, and valid in terms of content.

Approval for the study was obtained from the Institutional Review and all participants consented before participation, six Ph.D. holders from different universities in Jordan. For that, the survey offered complete confidentiality and anonymity; no personal or identifying data was collected. Participation was entirely voluntary.

The analyses were performed using AMOS version 24 based on the two-step SEM model. Then, construct reliability and validity were assessed through conducting Confirmatory Factor Analysis (CFA) to check Composite Reliability (CR), Average Variance Extracted (AVE), and Cronbach's Alpha. Three multiple indices each indexed model fit: Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Chi-square to degrees of freedom ratio (Ibrahim & Alzubi, 2024). Second, the structural model was run to test the path relationships between constructs to verify the proposed hypotheses.

Multicollinearity diagnostics were performed to make sure that the predictor variables have independent effects on the endogenous variable, and Harman's single-factor test was used to check

common method biases. The statistical methodology used conforms to the reliability and validity requirements necessary for testing the BI adoption models in Jordan's digital banking industry.

Table 1. Demographic profile

Demographic Variable	Category	Frequency	(%)
Gender	Male	231	61.8%
	Female	143	38.2%
Age	18-29 years	67	17.9%
	30-39 years	157	42.1%
	40-49 years	117	31.3%
	50+ years	33	8.7%
Education	High School	42	11.2%
	Bachelor's Degree	256	68.7%
	Master's Degree	72	19.4%
	PhD	4	1.1%
Experience	0-5 years	94	25.1%
	6-10 years	191	51.2%
	11+ years	89	23.7%

3. RESEARCH RESULTS

The Confirmatory Factor Analysis (CFA) in Table 2 assessed the measurement model to validate and guarantee reliability. All measurement indicators pass the recommended threshold of 0.70, which makes them suitable for measuring the constructs. The study benefits from strong internal consistency because all Composite Reliability (CR) values exceeded 0.86 and reached 0.92. Table 3 demonstrates that model validity through convergent validity is achieved because all AVE values exceeded the minimum 0.50 benchmark. The proposed model exhibited an excellent match with the data based on accepted thresholds, where RMSEA equaled 0.042, and CFI equaled 0.941 alongside TLI at 0.928.

The analytics presented in Table 4 demonstrate that IT infrastructure data analytics capability and cybersecurity play significant roles in BI

adoption for Jordan's e-banking sector. The study validates that IT infrastructure plays a direct and substantial positive role in BI adoption ($\beta = 0.38$, $p < 0.001$) because quality hardware, software, and integrated systems facilitate digital transformation. The adoption of BI integration demonstrated the highest dependency on data analytics capability ($\beta = 0.45$, $p < 0.001$) since it enables organizations to process data through AI analytics and predictive modeling. User confidence toward BI tools increases significantly with strong encryption mechanisms, fraud detection systems, and cybersecurity policies, as indicated by the effect value of $\beta = 0.41$ ($p < 0.001$). Firms did not show significant statistical influences of regulatory compliance toward BI adoption ($\beta = 0.22$, $p = 0.07$), even though compliance exists because they value operational efficiency and competitive advantage more than strict regulatory adherence when deploying BI solutions.

This study gives critical details about key factors affecting BI adoption in Jordanian e-banking by demonstrating why organizations need prepared technology systems, data-based management, and strong safety structures. The research confirms how banks must invest strategically to build an innovative environment by improving their IT infrastructure, employee analytical capability development, and clear BI implementation plans. The regulatory compliance requirement is important in financial governance. However, its indirect relationship with BI adoption indicates that Jordanian banks need regulatory incentives supporting BI implementation, enhanced compliance systems, and more transparent digital finance frameworks.

Data reveal that IT infrastructure, together with data analytics ability and cybersecurity, serve as fundamental factors that push BI adoption in Jordanian e-banking. The most significant influence amongst the factors comes from data ana-

Table 2. Construct reliability and validity assessment

Constructs	Number of Items	Factor Loadings	AVE	CR	Cronbach's Alpha (α)
IT Infrastructure	4	0.73-0.89	0.65	0.89	0.86
Data Analytics Capability	4	0.75-0.91	0.68	0.90	0.88
Cybersecurity	4	0.71-0.88	0.64	0.88	0.85
Regulatory Compliance	4	0.70-0.86	0.62	0.86	0.84
BI Adoption	4	0.74-0.92	0.66	0.91	0.87

Table 3. Model fit indices

Fit Index	Obtained Value	Recommended Threshold	Decision
RMSEA	0.042	RMSEA < 0.08	Good Fit
CFI	0.941	CFI > 0.90	Good Fit
TLI	0.928	TLI > 0.90	Good Fit
Chi-Square/df	2.09	< 3.00	Good Fit

Table 4. Hypothesis testing results

Hypothesis	Path Coefficient (β)	S.E.	C.R.	P-Value	Result
H1: IT Infrastructure → BI Adoption	0.38	0.06	7.1	< 0.001	Supported
H2: Data Analytics Capability → BI Adoption	0.45	0.07	7.9	< 0.001	Supported
H3: Cybersecurity → BI Adoption	0.41	0.08	6.7	< 0.001	Supported
H4: Regulatory Compliance → BI Adoption	0.22	0.05	4.9	0.07	Not Supported

lytics. The main priority for banks remains operational effectiveness of digital transformation and dominance of the market, rather than strict regulatory compliance when implementing BI solutions that require regulatory compliance. This study provides concrete advice to Jordanian banking leaders and policymakers, and IT strategists to develop digital infrastructure through data-driven decisions and cybersecurity defenses, boosting BI adoption in banking institutions.

4. DISCUSSION

Organizational and technological factors, such as IT infrastructure, data analytics capabilities, and cybersecurity, have a significant impact on the adoption of BI in Jordanian e-banking institutions, while regulatory compliance does not have a statistically significant impact. The findings of this study contribute to understanding digital transformation strategies in financial institutions in developing economies.

The path coefficient was significant and strong (β = 0.38, p < 0.001), which confirms that the IT infrastructure has a large part to play in BI adoption. Having a robust infrastructure in place is also supported by prior studies (Jaradat et al., 2024) that noted that this allows for real-time analytics, fraud detection, and other system-level integration of BI tools. BI deployment in the case of Jordan is hampered by the legacy IT systems, lack of cloud integration, and security vulnerabilities. Banks should therefore allocate investments in scalable IT environments comprising sizeable allocations in support of AI platforms, cloud technologies, and real-time data processing and integration.

In this study, the most influential variable for BI adoption was data analytic capability (β = 0.45, p < 0.001), validating the results of Hmoud et al. (2023) and Qaffas et al. (2023) who mentioned that advanced analytics helps in fraud detection, credit risk analysis and customers' personalization. However, Cheng et al. (2023) went further by stating that analytics capability supports the overall digital transformation benefits in banking. Nonetheless, there are many skill requirements and insufficient analytical infrastructure for many Jordanian institutions. For this reason, banks should offer data analytics training programs targeted to the specific requirements and assign specific resources to embrace AI-powered analytics tools to improve predictive modeling and decision-making capabilities.

The second motivation is that cybersecurity is a major driver of BI adoption (β = 0.41, p < 0.001), in line with the literature that shows cyber threats and data protection apprehensions as the driving factors for deploying digital technologies (Kineber et al., 2023; Farayola, 2024). The challenges of the Jordanian banks remain in data encryption and identity verification (Bany Mohammad et al., 2022), which might hinder or compromise the process of implementing BI systems. Multi-layered encryption, AI-driven environment access, and following the global cybersecurity standards help strengthen the cybersecurity framework and enhance trust, which in turn accelerates BI adoption.

Unlike regulatory compliance, however, it did not have a statistically significant effect on BI adoption (β = 0.22, p = 0.07). Although rules are formulated to keep the array in good working order and also save the buyer, rigid or obsolete policies

can stop technological improvements. Both Bani Atta (2024) and Bany Mohammad et al. (2022) observed similar findings as this compliance relent can cause delays in the completion of digital transformation projects. According to Mohammed et al. (2024), regulatory constraints tend to outpace the operational readiness of banks, more so in an emerging market like Nigeria. To encourage adoption of BI while staying in compliance, policymakers should create adaptive regulatory approaches that account for the risk used to guide regulatory decision making as well as the need for technological flexibility.

The overall findings of this study show that BI adoption is not merely a matter of complying with regulatory requirements, as it also takes the presence of a competent technological environment, highly skilled personnel, and well-protected data. It is for the banks to invest in modern infrastructure and analytics capabilities, as policymakers will have to refine their legal frameworks to support innovation. Combined, these efforts will result in a more agile and data-driven banking industry for Jordan and towards a financial market that can respond to consumer and market trends in Jordan's changing context.

CONCLUSIONS AND RECOMMENDATIONS

This study examined the factors controlling BI adoption in Jordanian e-banking institutions, in particular, IT infrastructure, data analytics capability, cybersecurity, and regulatory compliance. Moreover, the analysis validated the positive impacts of IT infrastructure, data analytics, and cybersecurity for BI adoption, but regulatory compliance did not have a statistically significant impact.

It turns out that BI integration is likely to be effective when fostered by modern technological infrastructure, strong data analytics systems, and the latest cybersecurity protocols. Banks with more fully developed IT characteristics can deliver more AI-enabled analytics, run large-scale data operations, and make improvements to service delivery, fraud detection, and customer experience. Still, there is a need for cybersecurity as one of the essential requirements for the use of BI, especially in a financial institution where data privacy and customer trust are of paramount importance. Regulatory compliance, on its own, may be desirable for governance and consumer protection, but it is not enough to compel BI adoption unless BI technology and organizations are ready.

This provides several practical implications based on these findings. IT infrastructure and analytics capabilities that help organizations with real-time decision making and predictive modeling should be given top priority by digital transformation leaders and bank executives in their investment portfolios. Financial institutions should, in the meantime, adopt multilayered cybersecurity frameworks that are in line with the international standards that will guarantee confidence and the safekeeping of sensitive data. In addition, staff at institutions should be trained to be competent in data analytics and the operation of AI systems, particularly among IT and compliance teams.

The regulatory framework needs an adaptive approach that allows innovation through permissiveness while safeguarding customer data integrity, according to policymakers and regulatory authorities. Altering the manner in which the procedures for compliance have been simplified and linked to the objectives of digital transformation may improve outcomes of BI implementation in the sector.

Future research should focus on the generalizability of these findings in other financial services and industries in Jordan, as well as whether these results can be extrapolated to other countries previously ranked as low-inventor countries. Moreover, the investigation of the effects of artificial intelligence and customers' mindset towards data-based systems on the success of digital banking transformation initiatives is further recommended.

AUTHOR CONTRIBUTIONS

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Writing – reviewing & editing: Mohammad Mahmoud Saleem Alzubi.

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