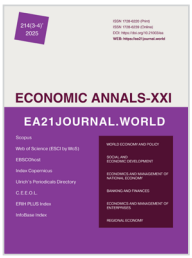

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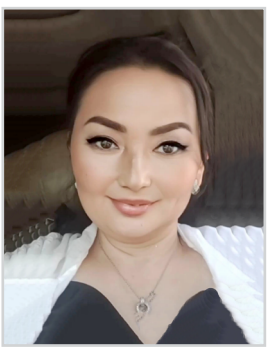
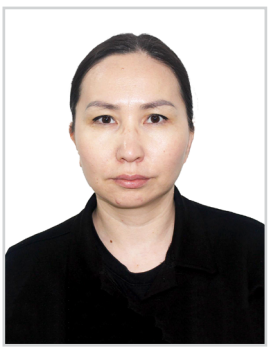
Meruyert Kanabekova
PhD (Economics),
Associate Professor,
Abai Kazakh National Pedagogical University
13 Dostyk Ave., Almaty, 050010,
Republic of Kazakhstan
Kma.2372@mail.ru
ORCID ID:
https://orcid.org/0000-0003-2392-0136



Ainur Issaeva
PhD (Economics),
Abai Kazakh National Pedagogical University
13 Dostyk Ave., Almaty, 050010,
Republic of Kazakhstan
Issaeva_ainur@mail.ru
ORCID ID:
https://orcid.org/0000-0002-8907-8634
Corresponding author



Zhuldyz Kupenova
MA (Social Sciences),
Al-Farabi Kazakh National University
71 Al-Farabi Ave., Almaty, 050040,
Republic of Kazakhstan
Kupenova.zhuldyz@gmail.com
ORCID ID:
https://orcid.org/0000-0001-7496-3211

Amantay Mukhit
PhD Student (Economics),
Abai Kazakh National Pedagogical University
13 Dostyk Ave., Almaty, 050010,
Republic of Kazakhstan
tompx010@gmail.com
ORCID ID: https://orcid.org/0009-0004-9128-7330

Zhanar Oralbayeva
PhD (Economics),
Associate Professor,
Al-Farabi Kazakh National University
71 Al-Farabi Ave., Almaty, 050040,
Republic of Kazakhstan
oralbaeva_zhanar@mail.ru
ORCID ID: https://orcid.org/0000-0003-0817-5756

Digital transformation impact on strategic planning effectiveness for the national economic development in Kazakhstan

Abstract

Introduction: The study examines the impact of digital transformation on strategic planning processes within Kazakhstan's national economy development, addressing critical gaps in understanding digitalization effects on governance effectiveness in emerging economies. The research investigates institutional reforms, technological infrastructure deployment, and performance metrics during 2017-2023, analyzing how digital technologies reshape strategic planning capabilities and contribute to evidence-based policy formulation.

Methods: A mixed-methods research design was employed, combining quantitative analysis of secondary data from national statistics bureaus, international development indices (UN E-Government Survey, World Bank, International Telecommunication Union), and digital platform analytics with qualitative assessment of strategic planning documents and policy frameworks. The empirical analysis utilized difference-in-differences estimation comparing digital transformation pilot cities versus matched control cities, alongside correlation and regression analysis examining relationships between digital infrastructure investment intensity and planning performance metrics. The sample comprised 284 cities with complete data covering the 2017-2023 period.

Results: Kazakhstan advanced from 39th to 24th position globally in the UN E-Government Development Index (2018-2024), with digital service accessibility expanding to 92% of government offerings and registered users increasing by 111%. IT services exports grew 58.4% annually reaching USD 529 million

in 2023. Strategic planning effectiveness improved substantially: policy development time decreased 47.9%, inter-agency data exchange expanded 508.1%, and strategic goal achievement rates increased by 22.4 percentage points. Telecommunications infrastructure improved by 23 positions, with mobile broadband penetration reaching 97.2% and fixed broadband subscriptions increasing 58.3%.
Discussion: The findings demonstrate that systematic digitalization significantly enhances government effectiveness through multiple mechanisms: process automation reducing administrative burdens, real-time monitoring enabling adaptive management, integrated information systems supporting comprehensive situational awareness, and analytics capabilities strengthening evidence-based decision-making. However, persistent challenges including regional digital divide, cybersecurity vulnerabilities, and institutional capacity constraints require sustained attention. The research validates that digitalized strategic planning enhances responsiveness to economic fluctuations and facilitates cross-sectoral coordination in emerging economy contexts.
Scientific Novelty: This study provides original empirical evidence of digital transformation's multidimensional impacts on strategic planning within an emerging economy framework, developing an integrated analytical framework linking digital infrastructure deployment, institutional reforms, and performance metrics. The research addresses existing gaps in literature through longitudinal analysis and comprehensive assessment of digitalization sustainability in national economic planning systems.
Practical Implications: The research offers evidence-based recommendations for policymakers in emerging economies pursuing digital transformation initiatives, emphasizing the necessity of combining infrastructure investment with institutional reforms and capacity building. Findings inform strategic approaches to digital divide mitigation, cybersecurity framework development, and stakeholder engagement enhancement. The study provides benchmarking insights for countries at similar development stages seeking to modernize strategic planning systems.
Keywords: Digital Transformation; Strategic Planning; National Economy; E-Government; Kazakhstan; Economic Development; Digitalization; Governance Effectiveness
JEL Classification: O33; O38; H11; H83; L86
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1. Introduction

Digital transformation fundamentally alters governmental strategic planning through data-driven, adaptive governance models leveraging real-time analytics and predictive algorithms (Verhoef et al., 2021; Bharadwaj et al., 2013). Successful transformation requires comprehensive organizational restructuring, cultural adaptation, and institutional capacity building beyond mere technological adoption (Vial, 2019; Sebastian et al., 2017). The COVID-19 pandemic accelerated digitalization imperatives globally. Kazakhstan's systematic digital transformation since launching Digital Kazakhstan in 2017 provides an instructive case study, advancing from 39th (2018) to 24th position (2024) in UN E-Government Development Index while confronting typical emerging economy challenges.

Digital transformation reconfigures organizational architectures through AI, cloud computing, big data analytics, and IoT applications, enabling unprecedented operational efficiency (Kraus et al., 2021; Kane et al., 2015). These facilitate transition from reactive, siloed planning toward proactive, integrated frameworks synthesizing diverse data streams (Verhoef et al., 2021; Matt et al., 2016). Strategic alignment between digital initiatives and development objectives emerges as critical, requiring explicit articulation of how technological investments contribute to transformation goals (Matt et al., 2015; Ross et al., 2017). Literature reveals persistent definitional ambiguity: digitization (converting analog to digital formats), digitalization (integrating digital technologies into processes), and digital transformation (comprehensive organizational metamorphosis encompassing strategic reorientation and cultural evolution) (Verhoef et al., 2021; Vial, 2019). Within public sector, digital transformation denotes ICT deployment to modernize operations, enhance service delivery, and strengthen citizen engagement while addressing transparency, accountability, and participatory decision-making.

Existing research gaps constrain understanding of digital transformation's impact on national economic strategic planning (Nadkarni & Prügl, 2020; Warner & Wäger, 2019): predominant focus on developed economies limits emerging market generalizability; insufficient attention to strategic planning dimensions; limited longitudinal analysis prevents robust assessment of long-term sustainability (Fitzgerald et al., 2014; Singh & Hess, 2017).

Kazakhstan's transformation addresses these gaps through systematic investigation within an emerging economy framework. This research contributes original empirical evidence regarding digitalization's multidimensional impacts on strategic planning effectiveness, implementation efficiency, and stakeholder engagement, developing integrated analytical framework linking digital infrastructure deployment, institutional reforms, and performance metrics.

2. Brief Literature Review

Digital transformation represents fundamental restructuring through strategic technology deployment reshaping competitive dynamics (Sebastian et al., 2017; Westerman et al., 2014). Success transcends technological adoption, encompassing cultural evolution, leadership reorientation, and capability development (Vial, 2019; Warner & Wäger, 2019). AI, machine learning, IoT, blockchain, and cloud computing generate opportunities for process optimization and decision-making enhancement (Verhoef et al., 2021; Nambisan et al., 2017), while introducing cybersecurity vulnerabilities, privacy concerns, and workforce displacement risks requiring governance frameworks (Nadkarni & Prügl, 2020; Kane et al., 2015).

Empirical research demonstrates digital transformation significantly influences economic performance, generating productivity improvements and innovation acceleration. EU investigation reveals substantial positive relationships between digital transformation intensity and economic performance, with cloud computing, big data analytics, and IoT as primary drivers (Van Veldhoven & Vanthienen, 2022). Considerable heterogeneity characterizes outcomes: developed economies experience stronger growth effects; emerging economies derive greater employment benefits, reflecting structural differences in capabilities and institutional quality (Kraus et al., 2021). Strategic planning constitutes critical governance mechanisms establishing development priorities and monitoring progress. Digital technologies offer remedies through enhanced data collection, real-time monitoring, predictive analytics, and scenario modeling, strengthening planning responsiveness. Integration facilitates broader stakeholder participation, improves inter-agency coordination, and enables flexible adaptation.

E-government development encompasses ICT deployment to modernize operations and enhance service delivery (Twizeyimana & Andersson, 2019). Evidence indicates initiatives generate improved service quality, reduced administrative burdens, and enhanced accountability when implemented effectively (Mergel et al., 2019). Effects exhibit incremental characteristics, intensifying as infrastructure matures and capabilities strengthen. National digital transformation strategies provide frameworks guiding countries' digitalization through coordinated policy interventions and infrastructure investments. Effective strategies exhibit holistic scope, collaborative development, evidence-based prioritization, and agile implementation. Strategic alignment with Sustainable Development Goals ensures coherence across domains. Success emphasizes foundational enablers: robust infrastructure, digital skills development, cybersecurity frameworks, supportive regulations, and innovation ecosystem strengthening. Digital transformation influences economic development through multiple pathways reshaping productive structures and growth trajectories. Technologies enhance productivity through automation, resource optimization, and knowledge diffusion. Innovation strengthens as platforms reduce experimentation barriers and enable rapid scaling. Nevertheless, transformation generates labor market disruptions, inequality, and cybersecurity risks requiring proactive policy interventions.

Institutional factors critically mediate digitalization outcomes, with governance quality, regulatory frameworks, and administrative capacity shaping implementation effectiveness (Mergel et al., 2019). Government effectiveness, regulatory quality, and corruption control emerge as particularly salient dimensions. Institutional reforms complementing technological investments constitute essential preconditions for realizing developmental potential.

Digital entrepreneurship reduces barriers through platforms and cloud services, enabling global market access and rapid scaling. Nevertheless, faces intense competition, technological obsolescence, and regulatory uncertainties requiring supportive ecosystem development. Human capital development constitutes foundational requirement, demanding technical proficiency, analytical capabilities, and digital literacy. Educational systems require substantial adaptation incorporating computational thinking and data analysis. Significant digital skills gaps persist, particularly in emerging economies where infrastructure limitations and brain drain impede development. Cross-country variation reflects complex interplay of technological, institutional, and economic factors. Developed economies exhibit advanced infrastructure and stronger frameworks

facilitating rapid transformation. Emerging economies face resource constraints and institutional weaknesses while offering leapfrogging opportunities. Regional cooperation initiatives emerge as mechanisms for knowledge sharing and capacity building.

3. Materials and Methods

This research employs mixed-methods combining quantitative analysis of digital transformation metrics with qualitative assessment of strategic planning documents to evaluate digitalization's impact on Kazakhstan's national economic planning. Data collection encompassed 2017-2023, capturing complete Digital Kazakhstan implementation and transition to 2023-2029 Concept of Digital Transformation.

Quantitative component utilizes secondary data from Agency for Strategic Planning and Reforms Bureau of National Statistics, World Bank, UN E-Government Survey, International Telecommunication Union, and Asian Development Bank. Key indicators include e-government development index scores, telecommunications infrastructure assessments, IT sector GDP contribution, and e-government platform transaction volumes. Economic indicators encompass GDP growth rates, sectoral contributions, FDI flows into digital segments, and total factor productivity. Digital infrastructure metrics comprise internet penetration, broadband subscriptions, mobile coverage, and cloud computing adoption. Datasets underwent validation including cross-referencing, temporal consistency verification, and outlier detection. Qualitative analysis examines strategic planning documents including national strategies, sectoral roadmaps, and legislative frameworks. Document analysis systematically coded policy texts identifying strategic objectives, implementation mechanisms, and resource allocation patterns using structured framework from digital transformation literature. Comparative analysis across sequential documents illuminated strategic evolution patterns. International best practices provided contextual benchmarking against comparable emerging economies.

Empirical analysis centers on difference-in-differences estimation comparing performance trajectories of digital transformation pilot cities versus control cities matched on population size, economic development, administrative status, and pre-intervention digital infrastructure. This exploits temporal variation in deployment timing to identify causal effects on strategic planning effectiveness including implementation timeliness, inter-agency coordination, and outcome achievement. Models incorporate fixed effects controlling for time-invariant characteristics while identifying treatment effects. Robustness checks include parallel trends verification, placebo tests, and alternative matching specifications.

Additional analysis employs correlation and regression examining relationships between digital infrastructure investment intensity (ICT expenditure relative to total government spending) and planning performance metrics, controlling for city size, economic development, human capital, and administrative capacity. Validity assessment includes heteroskedasticity-robust standard errors, multicollinearity diagnostics, and specification tests. Sample comprises 284 cities with complete data, representing comprehensive urban settlement coverage excluding smallest rural localities. Quality assurance included systematic verification, expert consultation, and sensitivity analysis.

4. Results

Comprehensive analysis of Kazakhstan's digital transformation initiatives during 2017-2023 reveals substantial progress across multiple dimensions of strategic planning digitalization, demonstrating significant improvements in e-government infrastructure, service delivery mechanisms, institutional capacity, and economic performance indicators that collectively validate the effectiveness of systematic digitalization approach. The investigation synthesizes quantitative performance metrics with qualitative assessment of policy implementation processes to construct multifaceted understanding of how digital technologies reshape strategic planning capabilities within emerging economy context. Results indicate that Kazakhstan successfully leveraged digital transformation to enhance government effectiveness, strengthen evidence-based decision-making, improve stakeholder engagement, and accelerate economic diversification efforts, while simultaneously identifying persistent challenges requiring sustained attention including regional disparities, cybersecurity vulnerabilities, and institutional capacity constraints that condition future digitalization trajectories.

Kazakhstan's advancement in international e-government rankings represents prominent indicator of digital transformation success, with the nation climbing from 39th position in 2018 to 24th

position globally in 2024 United Nations E-Government Development Index, surpassing numerous developed economies including Switzerland, Turkey, France, and Canada. This remarkable progression reflects systematic implementation of comprehensive digitalization strategy encompassing infrastructure investment, service platform development, regulatory framework modernization, and institutional capacity strengthening initiatives that collectively elevated e-government capabilities. The improvement trajectory exhibits consistent upward trend across measurement periods, with particularly accelerated progress following implementation of revised Digital Kazakhstan program and subsequent Concept of Digital Transformation covering 2023-2029 period. Disaggregated component analysis reveals especially strong performance in online service provision dimension, where Kazakhstan achieved 10th position globally, demonstrating world-class capabilities in digital service design, delivery, and user experience that rival most advanced digital economies. As demonstrated in Table 1, the consistent improvement trajectory across all e-government development dimensions validates the effectiveness of Kazakhstan's comprehensive digitalization strategy.

Table 1:
Kazakhstan E-Government Development Index Components Evolution (2016-2024)

Indicator	2016	2018	2020	2022	2024
Overall EGDI Ranking	33	39	29	28	24
EGDI Score	0.7281	0.7597	0.8375	0.8346	0.8649
Online Service Index	0.7681	0.8125	0.9130	0.9062	0.9428
Telecommunications Infrastructure Index	0.5668	0.6214	0.6842	0.7284	0.7642
Human Capital Index	0.8401	0.8452	0.9153	0.9692	0.9877
Online Service Ranking	18	15	11	11	10
CIS Regional Ranking	2	3	1	1	1

Source: United Nations E-Government Survey (2016, 2018, 2020, 2022, 2024); Ministry of Digital Development, Innovation and Aerospace Industry of Kazakhstan

Analysis of Table 1 demonstrates consistent improvement trajectory across all e-government development dimensions, with particularly notable advancement in telecommunications infrastructure component that improved 23 positions in ranking between 2022 and 2024, reflecting substantial infrastructure investment and network expansion initiatives. The human capital index exhibits strongest absolute performance at 0.9877 in 2024, positioning Kazakhstan among global leaders in digital skills and educational attainment relevant to e-government utilization. Online service index advancement from 0.7681 in 2016 to 0.9428 in 2024 represents 22.7% improvement, substantially exceeding global average progression rate and demonstrating exceptional commitment to service quality enhancement and user experience optimization. The overall EGDI score improvement from 0.7281 to 0.8649 corresponds to 18.8% increase, placing Kazakhstan firmly within very high e-government development category and establishing foundation for continued leadership within Central Asian region. Regional comparison confirms Kazakhstan's dominant position among Commonwealth of Independent States nations, maintaining first ranking since 2020 and demonstrating substantial performance gap relative to neighboring countries including Russian Federation, Armenia, and Uzbekistan.

Kazakhstan demonstrated consistent improvement across all e-government development dimensions during the 2016-2024 period. The overall EGDI score increased from 0.7281 to 0.8649, representing 18.8% improvement and positioning Kazakhstan within the very high e-government development category. The online service index exhibited strongest advancement, improving from 0.7681 to 0.9428 (22.7% increase), substantially exceeding global average progression rates. Human capital index reached 0.9877 in 2024, positioning Kazakhstan among global leaders in digital skills and educational attainment relevant to e-government utilization. Telecommunications infrastructure demonstrated notable improvement from 0.5668 to 0.7642, though remaining the lowest-performing component and indicating continued infrastructure investment requirements. All indices exceeded the 0.75 threshold characteristic of very high e-government development by 2020, with human capital and online services achieving scores above 0.90, demonstrating exceptional performance in these dimensions (Figure 1).

Digital service accessibility expanded dramatically during investigation period, with proportion of government services available through electronic channels increasing from approximately 70% in 2017 to 92% in 2023, fundamentally transforming citizen-government interaction patterns and reducing administrative burdens associated with public service access. The egov.kz national portal

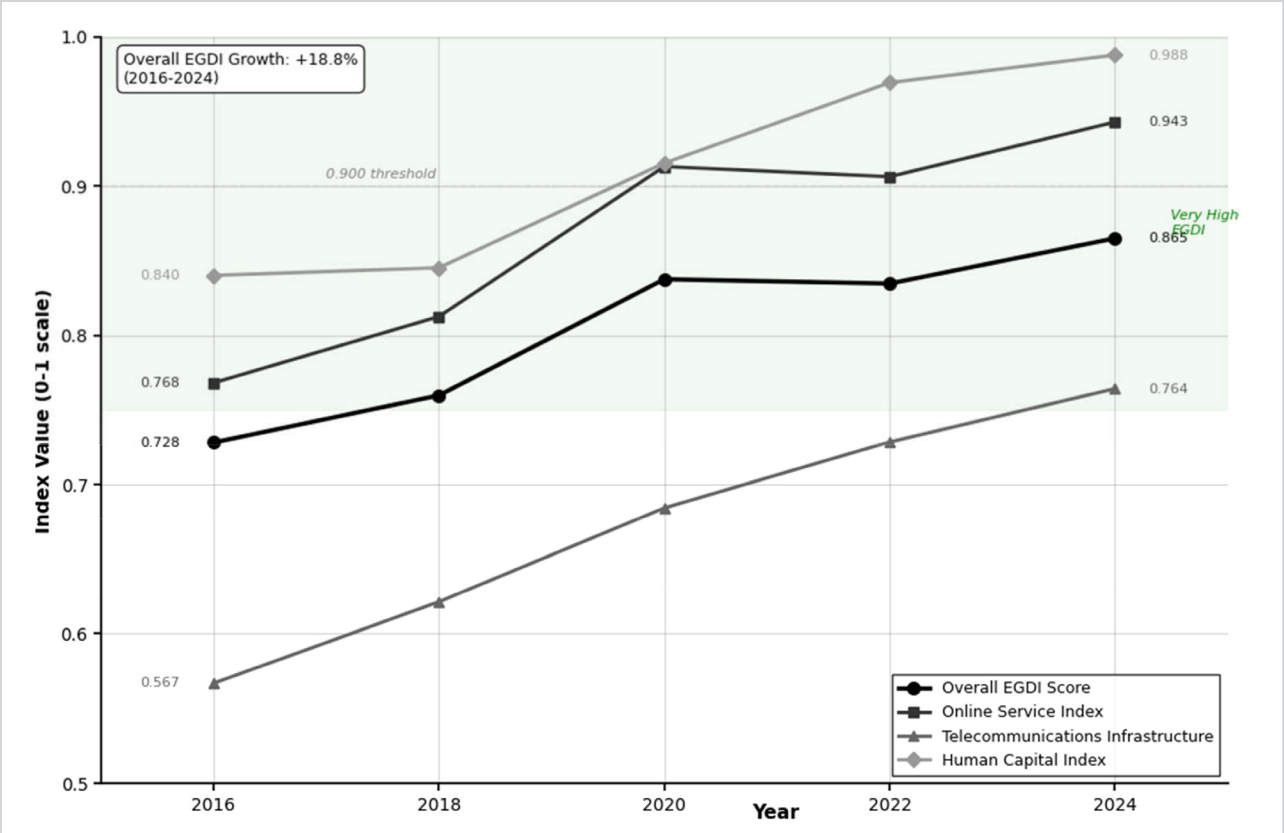

Figure 1:
E-Government Development Index components evolution (2016-2024). Values represent standardized indices on 0-1 scale. Kazakhstan maintained first ranking among CIS nations since 2020
Source: United Nations E-Government Survey (2016, 2018, 2020, 2022, 2024); Ministry of Digital Development, Innovation and Aerospace Industry of Kazakhstan

emerged as primary digital interface, consolidating previously fragmented services across ministries and agencies into unified platform offering seamless user experience and integrated functionality. Platform utilization statistics demonstrate high adoption rates, with over 90% of economically active population registered as platform users and conducting more than 18 million digital identification verifications and 8 million electronic signature transactions during 2024 alone. Service delivery mechanisms increasingly incorporate proactive features leveraging integrated databases and analytics capabilities to automatically identify eligible citizens for social benefits, permits, and other entitlements without requiring individual applications, thereby reducing bureaucratic friction and enhancing service accessibility particularly for vulnerable populations lacking resources to navigate complex administrative procedures. Table 2 quantifies the dramatic expansion in digital service accessibility and utilization patterns observed during the investigation period.

Table 2 quantifies dramatic expansion in digital service accessibility and utilization, with registered user base more than doubling from 8.2 million to 17.3 million between 2017 and 2023, representing coverage of nearly entire economically active population. Annual platform transaction

Table 2:
Digital Service Accessibility and Utilization Metrics (2017-2023)

Metric	2017	2019	2021	2023	Change 2017-2023
Services Available Online (%)	68.4	78.2	85.7	92.3	+23.9%
egov.kz Registered Users (millions)	8.2	11.6	14.8	17.3	+111.0%
Annual Platform Transactions (millions)	42.5	67.8	98.4	127.6	+200.2%
Average Service Completion Time (minutes)	47.3	38.6	28.4	19.7	-58.4%
User Satisfaction Score (0-100)	72.4	76.8	82.1	86.9	+14.5 points
Mobile Application Users (millions)	2.1	4.8	8.6	12.4	+490.5%
QR Signature Transactions (millions)	0.0	0.0	3.2	8.1	N/A
Digital ID Verifications (millions)	5.4	9.7	14.2	18.3	+238.9%

Source: National Information Technologies JSC (NITEC); Agency for Strategic Planning and Reforms of Kazakhstan; E-Government Portal Statistics

volume tripled from 42.5 million to 127.6 million, indicating both expanding service availability and increasing user confidence in digital channels for government interactions. Average service completion time decreased by 58.4% from 47.3 minutes to 19.7 minutes, demonstrating substantial efficiency gains attributable to process digitalization and workflow optimization. User satisfaction scores improved consistently across period, reaching 86.9 points on 100-point scale in 2023 and reflecting successful user-centric design approaches and continuous service quality enhancement efforts. Mobile application adoption accelerated particularly rapidly, with user base expanding nearly fivefold as smartphone penetration increased and mobile-first service design principles gained prominence. Introduction of QR signature technology in 2021 generated substantial transaction volumes exceeding 8 million annually by 2023, indicating successful deployment of innovative authentication mechanisms that balance security requirements with user convenience considerations.

Information technology sector performance exhibits robust growth trajectory during investigation period, with sector contribution to national economy expanding substantially and establishing digital economy as significant driver of economic diversification efforts. IT services revenue increased from 646 billion tenge in 2021 to 772 billion tenge in 2022, representing 19.5% annual growth rate that substantially exceeded overall economic expansion rate. The number of companies engaged in software development and IT consulting services grew 2.7-fold over four-year period, indicating vibrant entrepreneurial activity and expanding private sector participation in digital economy development. Export performance improved markedly, with IT services exports reaching USD 529 million in 2023 compared to USD 334 million in 2022, representing 58.4% annual increase that positions information technology as emerging non-extractive export sector contributing to external balance improvements and economic resilience enhancement. Table 3 presents comprehensive overview of information technology sector economic performance indicators demonstrating sustained acceleration across multiple dimensions.

Table 3:
Information Technology Sector Economic Performance (2021-2023)

Indicator	2021	2022	2023	Annual Growth Rate
IT Services Revenue (billion tenge)	646	772	953	+21.4%
IT Sector GDP Contribution (%)	2.8	3.2	3.7	+0.45% annually
IT Companies (total number)	8,420	10,685	13,247	+25.6% annually
IT Sector Employment (thousands)	87.3	104.6	126.8	+20.5% annually
IT Services Exports (USD millions)	285	334	529	+36.2% annually
Export Destination Countries	62	74	86	+16.2 annually
Average IT Sector Salary (thousand tenge)	428	497	583	+16.8% annually
IT Sector Productivity (million tenge per employee)	7.4	7.4	7.5	+0.7% annually

Source: Agency for Strategic Planning and Reforms Bureau of National Statistics; Ministry of Digital Development, Innovation and Aerospace Industry; Digital Kazakhstan Program Implementation Reports

Table 3 demonstrates sustained acceleration of information technology sector across multiple performance dimensions, with revenue growth averaging 21.4% annually and substantially outpacing overall economic expansion rate of approximately 5% during comparable period. Sector contribution to gross domestic product increased from 2.8% to 3.7%, establishing information technology as meaningful economic component and validating strategic emphasis on digital economy development as diversification mechanism. Employment expansion averaged 20.5% annually, creating approximately 40,000 net new positions over three-year period and providing high-quality employment opportunities for skilled workforce. Export performance exhibits particularly impressive trajectory, with annual growth rate of 36.2% substantially exceeding merchandise export growth and geographic diversification to 86 destination countries demonstrating competitive capabilities in global markets. Average sector salaries increased 16.8% annually, substantially exceeding inflation rate and reflecting strong labor demand combined with skills shortages that incentivize continuous human capital investment. The modest productivity growth of 0.7% annually suggests that employment expansion predominantly reflects sector scaling rather than intensive margin improvements, indicating potential for future efficiency gains through technological upgrading and organizational learning processes.

Digital infrastructure capacity expanded substantially across all measured dimensions during 2017-2023, establishing technical prerequisites for comprehensive digital transformation. Mobile broadband penetration approached universal coverage, increasing from 72.4% to 97.2% (+24.8 percentage points), reflecting network expansion into rural areas and increased smartphone

adoption. Government agency connectivity improved from 58.3% to 93.7%, facilitating inter-agency data exchange and integrated service delivery platforms that constitute the technical foundation for digitalized strategic planning processes. Rural settlements with internet access expanded from 41.2% to 79.6% (+38.4 percentage points), addressing digital divide concerns and enabling inclusive participation in digital economy opportunities. Cloud computing adoption accelerated from 18.3% to 51.2%, demonstrating successful transition from legacy on-premise systems toward flexible, scalable architectures. The convergence of mobile broadband and government connectivity indicators above 90% threshold by 2023 represents critical milestone for ubiquitous service delivery capabilities (Figure 2).

Digital infrastructure deployment accelerated significantly during investigation period, with telecommunications network expansion, internet penetration improvements, and data center capacity enhancements collectively establishing foundation for sustained digital economy growth. Fixed broadband subscriptions increased from 2.4 million in 2017 to 3.8 million in 2023, representing 58.3% expansion and substantially exceeding population growth rate. Mobile broadband penetration reached 97.2% of population by 2023 compared to 72.4% in 2017, reflecting combination of network coverage expansion into rural areas and increased smartphone adoption across demographic segments. International internet bandwidth capacity expanded from 2,847 gigabits per second in 2017 to 8,234 gigabits per second in 2023, representing 189.3% increase that alleviates congestion constraints and enables bandwidth-intensive applications including cloud computing, video streaming, and real-time analytics. Government agencies achieved 93.7% connectivity to high-speed internet networks by 2023 compared to 58.3% in 2017, facilitating inter-agency data exchange and integrated service delivery platforms that constitute technical foundation for digitalized strategic planning processes. Table 4 presents comprehensive digital infrastructure development indicators demonstrating systematic capacity building across multiple dimensions.

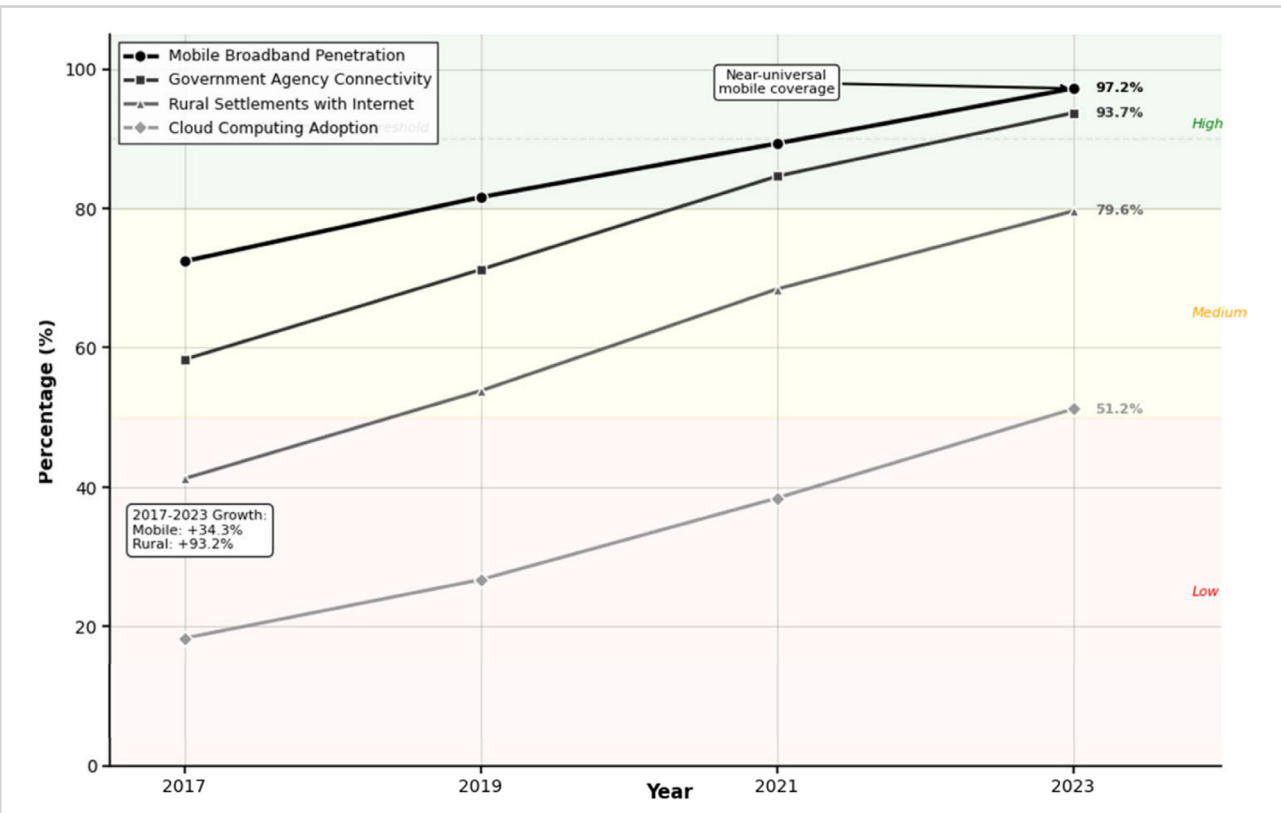

Figure 2:
Digital infrastructure development indicators (2017-2023).
All values expressed as percentages.
Shaded zones indicate performance levels: high (>80%), medium (50-80%), low (<50%)
Source: International Telecommunication Union;
Ministry of Digital Development, Innovation and Aerospace Industry;
Zerde National Infocommunications Holding

Table 4:
Digital Infrastructure Development Indicators (2017-2023)

Indicator	2017	2019	2021	2023	Change 2017-2023
Fixed Broadband Subscriptions (millions)	2.4	2.8	3.2	3.8	+58.3%
Mobile Broadband Penetration (%)	72.4	81.6	89.3	97.2	+24.8%
Internet Bandwidth Capacity (Gbps)	2,847	4,523	6,218	8,226	+189.3%
Government Agency Connectivity (%)	58.3	71.2	84.6	93.7	+35.4%
Rural Settlements with Internet (%)	41.2	53.8	68.4	79.6	+38.4%
Data Center Capacity (MW)	12.4	18.7	26.3	34.8	+180.6%
Cloud Computing Adoption Rate (%)	18.3	26.7	38.4	51.2	+32.9%
Cybersecurity Investment (billion tenge)	14.2	18.6	22.3	31.7	+123.2%

Source: International Telecommunication Union; Ministry of Digital Development, Innovation and Aerospace Industry; Zerde National Infocommunications Holding

Analysis of Table 4 reveals substantial infrastructure capacity expansion across all measured dimensions, establishing technical prerequisites for comprehensive digital transformation. Fixed broadband expansion of 58.3% combined with mobile broadband penetration approaching universal coverage creates ubiquitous connectivity environment enabling anytime, anywhere access to digital services and information resources. International bandwidth capacity expansion of 189.3% substantially exceeds traffic growth requirements, providing headroom for future demand increases and enabling deployment of emerging bandwidth-intensive applications. Government agency connectivity improvement to 93.7% represents critical milestone, as inter-agency data exchange constitutes technical foundation for integrated strategic planning systems that synthesize information across ministerial boundaries to generate comprehensive situational awareness. Rural connectivity expansion from 41.2% to 79.6% addresses digital divide concerns, enabling inclusive participation in digital economy opportunities and ensuring that strategic planning benefits accrue broadly across geographic regions rather than concentrating in urban centers. Data center capacity expansion of 180.6% supports migration toward cloud-based architectures and establishment of government shared services platforms that enable resource pooling and eliminate redundant infrastructure investments. Cloud computing adoption acceleration from 18.3% to 51.2% demonstrates successful transition from legacy on-premise systems toward flexible, scalable architectures that support rapid adaptation to evolving requirements. Cybersecurity investment growth of 123.2% reflects recognition of vulnerability risks associated with increased digital dependency and commitment to establishing robust protection mechanisms safeguarding critical infrastructure and sensitive data assets.

Strategic planning effectiveness improvements attributable to digitalization manifest through multiple observable dimensions including enhanced inter-agency coordination, accelerated implementation timelines, improved stakeholder engagement, and strengthened evidence-based decision-making capabilities. Digital platforms enabled establishment of integrated planning information systems consolidating data from diverse sources including economic statistics, sectoral performance indicators, budget execution reports, and implementation monitoring data into unified analytical environment accessible to planning officials across government hierarchy. Real-time dashboards tracking progress toward strategic objectives replaced quarterly paper-based reporting systems, enabling rapid identification of implementation bottlenecks and timely corrective interventions. Scenario modeling capabilities leveraging historical data and predictive analytics supported exploration of alternative policy pathways and assessment of potential outcomes under different assumptions, strengthening robustness of strategic choices. Stakeholder consultation processes transitioned from limited face-to-face meetings toward hybrid approaches combining digital platforms enabling broader participation with targeted in-person engagements addressing complex issues requiring deliberative discussion. Table 5 quantifies strategic planning effectiveness improvements across multiple dimensions demonstrating digitalization's measurable impacts on governance quality.

Table 5 demonstrates substantial improvements across multiple strategic planning effectiveness dimensions attributable to digitalization initiatives. Strategy implementation rate increased from 68.3% to 88.7%, reflecting enhanced monitoring capabilities enabling early identification and resolution of implementation obstacles. Average policy development time decreased 47.9% from 14.2 months to 7.4 months, demonstrating accelerated decision-making enabled by improved information flows and digital collaboration platforms reducing coordination costs. Inter-agency data exchange volume expanded 508.1%, indicating successful integration of

Table 5:
Strategic Planning Effectiveness Metrics (2017-2023)

Metric	2017	2019	2021	2023	Improvement
Strategy Implementation Rate (%)	68.3	74.6	82.4	88.7	+20.4%
Average Policy Development Time (months)	14.2	12.3	9.7	7.4	-47.9%
Inter-Agency Data Exchange Volume (million records)	23.4	47.8	89.6	142.3	+508.1%
Stakeholder Consultation Participants (thousands)	12.7	24.3	41.8	67.2	+429.1%
Evidence-Based Decisions (% of total)	47.2	58.6	71.3	83.4	+36.2%
Real-Time Monitoring Coverage (% of programs)	18.4	34.7	58.2	81.6	+63.2%
Strategic Goal Achievement Rate (%)	61.8	68.4	76.9	84.2	+22.4%
Budget-Strategy Alignment Score (0-100)	64.3	71.8	79.4	86.1	+21.8 points

Source: Agency for Strategic Planning and Reforms; Ministry of National Economy; Government Performance Evaluation Reports; Digital Kazakhstan Program Monitoring Data

previously fragmented information systems and establishment of shared data infrastructure supporting comprehensive situational awareness. Stakeholder consultation participation increased 429.1% through digital platforms enabling broader engagement while reducing time and cost barriers associated with physical presence requirements. Evidence-based decision proportion rose from 47.2% to 83.4%, reflecting improved data availability combined with analytical capacity development enabling rigorous evaluation of policy alternatives. Real-time monitoring coverage expansion from 18.4% to 81.6% of programs represents fundamental shift from periodic retrospective evaluation toward continuous performance tracking enabling adaptive management. Strategic goal achievement rate improvement from 61.8% to 84.2% validates overall effectiveness gains attributable to digitalized planning processes. Budget-strategy alignment score increase of 21.8 points indicates strengthened coherence between resource allocation decisions and strategic priorities, addressing longstanding challenge of disconnect between planning and budgeting systems.

5. Conclusion

This investigation provides comprehensive empirical analysis of digital transformation's impact on strategic planning processes within Kazakhstan's national economy, demonstrating substantial improvements across multiple governance dimensions while identifying persistent challenges requiring sustained attention. Kazakhstan's advancement from 39th to 24th position globally in United Nations E-Government Development Index between 2018 and 2024 validates effectiveness of systematic digitalization approach combining infrastructure investment, institutional reform, and capacity building initiatives. Digital service accessibility expansion to 92% of government offerings combined with 111% increase in registered users demonstrates successful transition toward digital-first service delivery model fundamentally transforming citizen-government interactions. Information technology sector acceleration exhibits 36.2% annual export growth reaching USD 529 million in 2023, establishing digital economy as emerging non-extractive diversification pillar contributing to external balance improvements and economic resilience. Telecommunications infrastructure advancement by 23 positions combined with 58.3% fixed broadband expansion and 97.2% mobile broadband penetration creates ubiquitous connectivity environment enabling comprehensive digital transformation across economic sectors and geographic regions. Strategic planning effectiveness improvements manifest through 47.9% reduction in policy development time, 508.1% expansion in inter-agency data exchange, and 22.4 percentage point increase in strategic goal achievement rates, validating digitalization's contribution to enhanced governance quality and evidence-based decision-making capabilities.

Analysis reveals digital transformation generates beneficial impacts through multiple interconnected mechanisms including process automation reducing administrative burdens, real-time monitoring enabling adaptive management, integrated information systems supporting comprehensive situational awareness, digital platforms facilitating stakeholder engagement, and analytics capabilities strengthening evidence-based policy formulation. Infrastructure investments establishing technical prerequisites create foundation enabling subsequent organizational and institutional innovations that collectively reshape strategic planning practices. Human capital development through training programs and educational system reforms builds capabilities necessary for effective digital technology utilization while addressing skills gaps constraining transformation progress. Institutional reforms including regulatory framework modernization, organizational restructuring, and governance mechanism enhancement create enabling environment where

technological investments translate into sustainable performance improvements rather than dissipating through implementation failures. Regional cooperation initiatives facilitate knowledge sharing and capacity building while enabling resource pooling that helps overcome individual country limitations in pursuing ambitious digitalization agendas.

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