Unleashing Public Sector Innovation: Exploring the Impact of Big Data Analytics and Value-Driven Capabilities on Digital Governance

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Abstract. Big data analytics (BDA) is fast revolutionizing circular economy being driven by the avalanche of data. In public governance, harnessing the value-driven opportunities of BDA has been challenging studied to improve resource allocation, decision-making, and openness and accountability but, with little attention in existing literature. Through the lens of the task technology fit theory, this study examines how big data analytics and value-driven capabilities improve public sector digital governance innovation and performance. The study leveraged PLS-SEM and collected data from 310 staff of public sectors institutions in Ghana. The study found that, task complexities, value-driven capabilities, data quality, organizational support and analytical literacy have significant impact on public sector innovation. this relationship is not however moderated by digital governance maturity. Moreover, public sector innovation was found to influence digital governance performance. The study underscores how data-driven innovations could be leveraged to improve service delivery and citizen participation in digital governance. This study outlines best practices for public sector organizations to effectively utilize big data, enhancing decision-making and governance, and fostering trust and performance in the digital era.

Keywords. Public sector innovation, big data, analytics, digital governance, task technology fit
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1. Introduction

Big data analytics (BDA) and artificial intelligence (AI) have emerged as transformative tools in reshaping public governance, enabling governments to analyze large, diverse datasets, uncover actionable insights, and optimize public service delivery. These technologies have the potential to address pressing societal challenges, enhance transparency, and foster citizen-centric governance models (Cingolani, McBride, & Hammerschmid, 2022; Curry et al., 2021). Initiatives like the European Data Space exemplify this promise by creating unified frameworks for data sharing and analysis, with an estimated economic contribution of €2.5 trillion annually by 2030, including benefits for public administration (European Commission, 2022). Similarly, in Kenya, integrating AI into healthcare has improved resource allocation and reduced maternal mortality rates by 15% over five years, showcasing the measurable impact of BDA on governance and service delivery (Agolla, 2015).

At its core, BDA involves collecting, processing, and analyzing vast datasets to identify patterns, correlations, and actionable insights (Mach-Król & Hadasik, 2021). In public governance, this enables predictive analytics for urban planning, disaster response optimization, and enhanced citizen engagement (Urs, Nisioi, & Roja, 2023). However, the successful implementation of BDA requires more than technical integration. It demands alignment with organizational and contextual factors, including value-driven capabilities, data quality, and analytics literacy—all essential for ensuring that technology adoption aligns with ethical, transparent, and citizen-centric principles. For instance, the Netherlands successfully combined participatory governance models with BDA, increasing public trust in municipal services by 25% over three years (Mariani & Mortati, 2024). Furthermore, organizational support and task complexities play a pivotal role in determining whether BDA tools are effectively utilized to address governance challenges.

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Despite its potential, the public sector in most developing economies faces several challenges in adopting BDA effectively. Fragmented data infrastructures, insufficient technical expertise, and concerns over data privacy are significant barriers (Gupta et al., 2023; Egala & Afful-Dadzie, 2022). For example, over 60% of public sector organizations in the EU identify interoperability issues as a major obstacle to achieving data-driven innovation (European Commission, 2022). This is even dire in most developing economies where the issues go beyond interoperability to low literacy on BDA (Shah, 2019). This raises ethical concerns, including algorithmic bias and risks of mass surveillance, further complicate the adoption of BDA, threatening public trust and accountability. In contrast, the private sector has demonstrated considerable success in leveraging BDA to drive innovation and efficiency, leaving public institutions at risk of falling behind due to bureaucratic inertia and insufficient digital governance maturity (Dorasamy, 2021).

Existing research highlights the transformative potential of BDA in enhancing public governance. Gupta et al. (2023) for instance, emphasizes its role in promoting sustainability, while Palumbo et al. (2023) examine how open innovation frameworks can modernize public services. Urs et al. (2023) underscore the importance of leadership in fostering digital transformation, and Bwalya (2018) explores the role of e-government initiatives in developing economies. However, these studies often focus on isolated technical frameworks or case studies, leaving significant gaps in understanding the interplay between BDA and key variables such as task complexities, data quality, organizational support, and analytics literacy. Additionally, the moderating role of digital governance maturity, a critical factor influencing the success of technology adoption remains underexplored.

To address these gaps, this study synthesizes big data analytics with value-driven capabilities to investigate how they enhance public sector innovation by fostering efficiency, improving decision-making, and aligning governance with societal values. The research explores the mechanisms through which BDA drives innovation, emphasizing the importance of task complexities, data quality, and organizational support in enabling meaningful outcomes. Additionally, it examines how digital governance maturity moderates these relationships, enhancing public sector innovation and governance performance.

The objectives of this study are twofold: (1) to investigate how big data analytics capabilities influence public sector innovation and (2) to analyze the impact of value-driven capabilities, data quality, and organizational support on ethical and effective governance. By addressing these objectives, this research aims to bridge critical gaps in theory and practice, providing actionable recommendations for policymakers and practitioners. The study seeks to propose a holistic framework that integrates these elements to foster transparency, efficiency, and citizen-centric solutions. Ultimately, the convergence of big data analytics and value-driven governance represents a transformative opportunity for the public sector to achieve sustainable innovation. However, addressing systemic challenges, such as fragmented infrastructure, data privacy concerns, and insufficient digital governance maturity, remains critical. By advancing the understanding of these interactions, this study contributes to the ongoing discourse on digital transformation, offering a roadmap for fostering equitable and impactful public sector innovation particularly in developing economies.

2. Conceptual foundation and hypothesis formulation

2.1 Task technology fit theory

The Task-Technology Fit Theory (TTFT) provides a theoretical foundation for evaluating the alignment between technology, task requirements, and user capabilities. According to TTFT, the effectiveness of a technology depends on how well it supports the specific tasks it is intended to enhance (Goodhue & Thompson, 1995). The theory posits that when a technology is appropriately tailored to address the complexities, interdependencies, and requirements of tasks, it leads to improved performance outcomes (Abelsen et al., 2021). A strong task-technology fit ensures that the capabilities of the technology align with organizational goals and individual competencies, resulting in enhanced innovation and efficiency (Isaac et al., 2019).

In the context of public governance, the integration of big data analytics capabilities and value-driven frameworks has the potential to transform decision-making processes, enhance transparency, and foster citizen-centric governance. TTFT provides a robust framework to analyze the interplay between task complexities, data quality, organizational support, and analytics literacy in influencing the adoption and effectiveness of big data analytics (BDA) technologies (Abelsen et al., 2021). Furthermore, the maturity of digital governance systems acts as a moderating factor, influencing how these variables contribute to public sector innovation and digital governance performance.

This study leverages TTFT to explore how public sector organizations can harness BDA tools to meet complex governance challenges while ensuring alignment with ethical and societal values. The theory guides the investigation of how task characteristics, organizational factors, and technological readiness interact to drive innovation and improve governance outcomes. By integrating TTFT into the analysis, this research emphasizes the importance of aligning technical capabilities with organizational and societal priorities for achieving sustainable innovation.

2.2 Big data analytics task complexities effect on public sector innovation

Big data analytics, characterized by the 5Vs (volume, variety, velocity, veracity, and value), presents unique analytical challenges due to its scale, diversity, and dynamic nature (Sreenivasan, 2017). Task complexity examines the regulatory, stakeholder and technical challenges confounding big data. These inherent complexities can act as catalyst for innovation, particularly in the public sector, where data-driven insights can transform service delivery, policymaking, and citizen engagement. For instance, when governance tasks involve high complexity, such as managing large, heterogeneous datasets, navigating regulatory constraints, or addressing multi-stakeholder demands, traditional methods may prove inadequate, creating a misfit that necessitates innovative solutions (Abelsen et al., 2021). Gupta et al. (2023) contends that, BDA capabilities help bridge this gap by enabling advanced data processing, predictive insights, and real-time decision-making, thus improving task-technology alignment. However, excessive complexity without sufficient organizational support or analytics literacy can hinder innovation. Effectively managing and analyzing these complexities is crucial for implementing transformative initiatives such as smart city solutions, advanced healthcare systems, and adaptive environmental policies (Kuru,2020). Existing studies underscore the importance of data-driven decision-making in enhancing transparency and accountability within public administration (Alexopoulos & Janssen, 2020; Bibri, 2020). The ability to leverage BDA effectively is significantly influenced by task complexities coupled with low digital infrastructure, data governance frameworks, and skilled personnel. This influence of BDA complexities is supported by research emphasizing organizational context and digital transformation as key enablers of public sector innovation (Gil-Garcia et al., 2020). Studies also highlight the importance of digital governance frameworks for effective data utilization and public sector innovation (Janssen et al., 2020; Chhetri et al., 2021). Following these discussions, we hypothesize that:

H1: Big data analytics task complexities will significantly influence public sector innovation.

2.2 Big data analytics capabilities effect on public sector innovation

BDA capabilities, encompassing the technical infrastructure, analytical skills, and organizational processes necessary to effectively handle complex datasets, are crucial drivers of innovation, particularly within the public sector (Janssen et al., 2020). It measures the technical capabilities and assesses the predictive decision-making capabilities of big data. These capabilities enable organizations to understand citizen needs, identify emerging trends, and develop solutions to complex challenges. Existing research highlights the imperative of robust data governance and management practices in cultivating innovation and agility within public sector organizations (Janssen et al., 2020). Moreover, a data-driven culture and effective leadership are essential for harnessing the potential of BDA to drive organizational transformation and innovation in the public sector (Arshad et al., 2024). However, the ability of public sector organizations to effectively leverage BDA capabilities is significantly influenced by their existing digital infrastructure, data governance frameworks, and overall digital maturity (Waqar & Paracha, 2024). Organizations with more mature digital governance structures, characterized by robust data management practices, skilled personnel, and clear data strategies, are better positioned to harness the full potential of BDA for innovation. This moderating role of digital maturity is supported by research emphasizing the importance of organizational context and digital transformation in public sector innovation (Ndou, 2020). Extant research further underscores the significance of robust data governance frameworks in facilitating responsible AI implementation within the public sector, a critical component of contemporary digital governance (Leslie et al., 2021). Following these discussions, we hypothesize that:

H2: Big data analytics capabilities will significantly influence public sector innovation;

H2a: Digital governance maturity will moderate between big data capabilities and public sector innovation.

2.3 Effect of value-driven capabilities on public sector innovation

Value-driven capabilities in BDA represent the organizational capacity to ethically and transparently align technological applications with societal priorities, ensuring data-driven initiatives benefit citizens and communities (Mittelstadt et al., 2016). This ethical and societal alignment is crucial for translating raw data into public value and driving meaningful public sector innovation. Specifically, BDA value-driven capabilities influence public sector innovation by enabling organizations to derive actionable insights, align analytical efforts with strategic goals, and measure outcomes. Existing research underscores the significance of responsible data use and ethical considerations in optimizing the benefits of data-driven initiatives for citizens (Hagendorff, 2020). Moreover, robust data governance frameworks and effective management practices are essential for unlocking the value of data in the public sector (Brous & Janssen, 2020). By integrating stakeholder engagement and focusing on outcomes that align with societal goals, public sector organizations can leverage these value-driven capabilities to drive sustainable innovation and better serve their communities. Following these discussions, we hypothesize that:

H3: Big data analytic value-driven capabilities will significantly influence public sector innovation.

2.4 Effect of big data quality on public sector innovation

Data quality, encompassing dimensions like accuracy, completeness, consistency, and timeliness, is foundational

for effective data utilization and informed public sector decision-making (Egala & Afful-Dadzie, 2022). Thus, measuring the intrinsic and assessing the contextual accuracy, consistency, security and relevance of the public data. In the context of big data, these core dimensions are amplified, necessitating considerations of believability, interpretability, and accessibility (Batini et al., 2016). High-quality big data is pivotal for driving public sector innovation by providing reliable and actionable insights that inform policy decisions, resource allocation, and service delivery. Conversely, poor data quality undermines these efforts, leading to flawed insights and ineffective policies. Existing research underscores the critical role of data quality in various facets of public sector operations. Robust data quality management frameworks are essential for effective data utilization and innovation in public organizations, particularly in open government data initiatives, where high-quality data is paramount for fostering citizen trust (Kalampokis et al., 2020). The increasing reliance on real-time data in public services, such as smart city applications, further highlights the imperative of timely and accurate data for effective service delivery (Bibri, 2020). Moreover, extant studies emphasize the importance of effective data management practices, including rigorous data quality control, for informing data-driven decision-making and public service delivery (Janssen et al., 2020; Zuiderveen Borgesius et al., 2020). Following these discussions, we hypothesize that:

H4: Big data quality will significantly influence public sector innovation

2.5 Effect of organizational support on public sector innovation

Organizational support, encompassing leadership advocacy, resource allocation (financial, technological, and human), and a collaborative culture, is fundamental for public sector innovation, especially given complex societal challenges (Amabile & Pratt, 2016). This supportive environment fosters experimentation, risk-taking, and knowledge sharing, all of which are crucial for driving innovation within public organizations. While pioneering research investigated the general relationship between organizational support and various organizational outcomes, including innovation (Anderson et al., 2014), recent studies have narrowed their focus to examine the specific roles of leadership and organizational culture in cultivating digital innovation within public sector organizations (Nadkarni & Prügl, 2021; Kraus et al., 2022). Notably, the efficacy of organizational support in driving digital innovation is substantially augmented by the maturity of digital governance frameworks. Mature digital governance, characterized by strategic alignment, robust data management, and active citizen engagement, provides the necessary framework for effectively channelling organizational resources toward innovation (Udoh, 2024). The maturity of digital governance frameworks facilitates alignment with public needs, enhances transparency, and cultivates a data-driven culture, thereby ensuring that organizational support yields meaningful outcomes. This moderating role of digital governance maturity is corroborated by extant research, which underscores the significance of organizational context and digital transformation in driving public sector innovation (Ndou, 2020). Furthermore, existing studies highlight the importance of developing digital skills and capabilities within public sector organizations to facilitate successful digital transformation and innovation (Janssen et al., 2020). Following these discussions, we hypothesize that:

H5: Organizational support will significantly influence public sector innovations

H5a: Digital governance maturity will moderate between organizational support and public sector innovation

2.6 Effect of analytics literacy on public sector innovation

Analytics literacy, entails the ability to effectively interpret, analyze, and communicate data insights using analytical tools, is increasingly crucial for data-driven decision-making and innovation (Chen et al., 2012). Analytics literacy empowers individuals to transform raw data into actionable knowledge. Analytics literacy is a critical driver of public sector innovation, enabling data-informed solutions. While earlier work provided valuable perspectives (Magakwe, 2025.; Mpofu & Chasokela,2025), existing research emphasizes the specific skills and competencies required for effective data utilization and digital transformation within the public sector. For example, Janssen et al. (2020) highlight the importance of data literacy and skills development for public sector employees. Zuiderveen Borgesius et al. (2020) added that, effective data governance frameworks are essential for realizing the benefits of analytics literacy and data-driven innovation. The relationship between analytics literacy and innovation is significantly influenced by digital governance maturity. Mature digital governance, with robust infrastructure, strategic policies, effective leadership, and seamless data integration, amplifies the impact of analytics literacy by providing necessary support systems. This moderating role is supported by existing research emphasizing the importance of organizational context and digital transformation in public sector innovation (Mergel et al., 2019). Leslie et al. (2021) also found the role of data governance in supporting responsible AI implementation and data-driven decision-making within public sector organizations, further underscoring the importance of this moderating factor. Hence, we hypothesize that:

H6: Analytics literacy will significantly influence public sector innovation

H6a: Digital governance maturity will moderate between analytics literacy and public sector innovation

2.7 Public sector innovation on Digital governance performance

Public sector innovation, defined as the development and implementation of new or significantly improved processes, services, policies, organizational structures, or technologies aimed at enhancing public value and addressing societal challenges (Osborne & Brown, 2011). In this study, public sector innovation is operationalized by measuring frequency and impact of new digital initiatives in governance. Public sector innovation is crucial for improved public sector performance and effective governance. This innovation can range from incremental improvements to radical transformations, all aimed at enhancing public value. Public sector innovation plays a pivotal role in shaping digital governance performance by leveraging transformative approaches and technologies to achieve efficiency, transparency, and responsiveness, ultimately improving citizen services and engagement. Extant research underscores the pivotal role of digital transformation in driving public sector innovation and enhancing governance outcomes. Recent studies, for instance, demonstrate the transformative impact of digital technologies and data-driven approaches on public service delivery and governance (Janssen et al., 2020). Moreover, open government data initiatives, a key manifestation of public sector innovation, are recognized for their profound influence on enhancing transparency, accountability, and citizen engagement, which are fundamental tenets of effective digital governance (Zuiderveen Borgesius et al., 2020). Notably, recent research highlights the imperative of robust data governance frameworks for facilitating public sector innovation and effective digital governance (Janssen et al., 2020; Alexopoulos & Janssen, 2020). Thus, the study hypothesizes that:

H7: Public sector innovation will significantly influence digital governance performance.

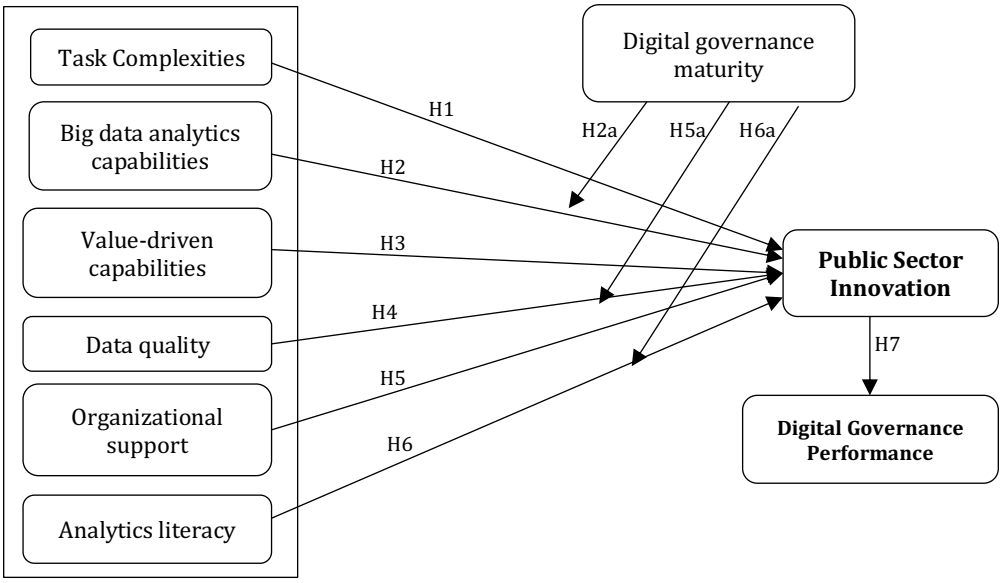

Fig. 1: Conceptual Model of the Research

3. Research Methodology

To adequately measure the determinant of BDA capabilities among public institutions in Ghana, this study employs a quantitative methodology. A questionnaire was developed based on an extensive literature review guided by the conceptual framework in Fig. 1. The first part of the questionnaire gathered demographic information, while the second section posed a series of questions on the determinants of BDA, based on a five-point Likert scale between 1-5 (1=Strongly Disagree - 5=Strongly Agree). To ensure question validity, a pre-test was conducted with sixty (60) respondents, and all questions received favourable results. After the pre-test, participants were purposively sampled using a non-probability sampling approach to ensure that the right respondents were selected from various public institutions in Ghana (Pace, 2021). Participants were selected based on their primary responsibility being data-driven and their appreciable knowledge of data mining. Again, respondents must be innovative-oriented and hold strong opinion about digital transformation. This selection criterion ensured consistency in the responses, justifying the use of purposive sampling aimed at getting results from proactive adopters. Ghana over the past decades have initiated a number of digital initiatives including the open Ghana initiative, national big data initiative, right to information act, and digital acceleration project. Other public sector innovation tools such as e-government system, Ghana digital address systems, e-procurement systems among others, are geared towards streamlining government data collection, processing, sharing and support decision-making across different public sector ministries, agencies and departments. The questionnaire was designed using Google Forms, an online survey tool, and was distributed to participants through a snowballing method between March and October 2024. A total of 310 valid responses were received for analysis.

The Statistical Package for Social Sciences (SPSS) and SmartPLS software were used for the descriptive and partial-

least quare structural modeling (PLS-SEM) analysis respectively. Recent studies have shown that Partial Least Squares Structural Equation Modeling (PLS-SEM) enhances construct variance and endogeneity compared to covariant-based SEM (Egala et al., 2022; Hair et al., 2019). Furthermore, PLS-SEM has been proven to be effective for its predictive relevance capabilities in the model.

The research adhered to all ethical standards, such as confidentiality, informed consent, and disclosing the study's implications to the respondents before answering to the questionnaire. The objective of the study was made clear, and the respondent's private information was kept private. This was done to ensure that all ethical protocols are ensured.

4. Results

4.1 Key findings

As presented in Tab. 1, the respondents comprised 56.5% males and 43.5% females. Majority, 53.9% of the respondents were aged 25 to 40. Relative to the respondent's educational qualification, majority (36.4%), diploma holders followed by bachelor's degree (33.9%) and (28.7%) master's holders. Participants were drawn from departments including Administration (31,6%), budget and planning (25.5%), statistics and IT (20.3%) and finance (19.7%).

Table 1: Demographic Variables of Respondents

Category	Variables	Frequency (N=310)	Percentage (%)
Gender	Male	175	56.5
	Female	135	43.5
Age	18-24	48	15.5
	25-40	167	53.9
	41-60	95	30.6
level of education	Diploma	130	36.4
	Bachelor	105	33.9
	Masters	72	28.7
	Doctorate	3	1.00
Department	Budget and planning	79	25.5
	Procurement	9	2.9
	Administration	98	31.6
	Finance	61	19.7
	Statistics and IT	63	20.3

4.2 Measurement model assessment

As per Hair et al. (2019), it is recommended to have indicator loadings of 0.708 or higher to ensure item reliability. Based on this criterion, variables BC2, OS1 and AL1 were excluded as they did not meet the minimum acceptable threshold. After removing these variables, the data was re-run and the factor loadings resulting from the PLS algorithm are presented in Table 2 and corresponding Fig. 2.

Tab. 2 Construct reliability and factor loadings

Construct/Indicator	Cronbach's Alpha	Composite Reliability	Ave. var. extr. (AVE)	Factor Loadings
PI: *Public Sector innovation*	0.882	0.914	0.679	
PI1: Our organization frequently introduces new digital governance initiatives.				0.809
PI2: We continuously explore innovative ways to improve public service delivery.				0.840
PI3: Our agency encourages experimentation with new digital solutions.				0.812
PI4: We adopt emerging technologies to enhance governance processes.				0.849
PI5: Our organization rewards employees for innovative ideas in digital governance.				0.810
OS*: Organizational Support*	0.856	0.902	0.697	
OS1: Top management actively supports the adoption of BDA.				0.831
OS2: Our agency allocates sufficient resources for digital governance innovation.				0.831
OS3: Employees receive training to enhance digital governance competencies.				0.836

OS4: There is a clear strategy for integrating BDA into governance.				0.839
***AL:** Analytics literacy*	0.839	0.892	0.675	
AL2: Employees in our organization understand how to interpret Big Data insights.				0.842
AL3: Decision-makers use data analytics to guide governance strategies.				0.928
AL4: Our agency has skilled personnel to manage BDA tools.				0.810
***DQ:** Data quality*	0.824	0.876	0.587	
DQ1: The data used in our governance processes are accurate and reliable.				0.748
DQ2: Our agency ensures timely updates of datasets for decision-making.				0.772
DQ3: We have mechanisms to verify the consistency of governance data.				0.757
DQ4: Data privacy and security measures are strictly enforced.				0.767
DQ5: Our Big Data sources are relevant to public sector needs.				0.780
***DP:** Digital governance performance*	0.866	0.903	0.651	
DP1: Digital governance tools improve service delivery efficiency.				0.806
DP2: Citizens are more satisfied with our digital public services.				0.846
DP3: Our agency reduces operational costs through digital governance.				0.805
DP4: Decision-making processes are faster due to data-driven insights.				0.826
DP5: Transparency and accountability in governance have increased.				0.745
***VC:** Value- driven capabilities*	0.819	0.873	0.579	
VC1: Our organization prioritizes citizen-centric values in digital governance.				0.759
VC2: Ethical considerations guide our use of BD in public services.				0.798
VC3: We align digital governance strategies with societal needs.				0.745
VC4: Stakeholder feedback is incorporated into governance innovations.				0.718
VC5: Our agency balances efficiency with equity in digital service delivery.				0.779
***BC:** Big Data Analytics capabilities*	0.767	0.848	0.584	
BC1: Our organization has the infrastructure to process large datasets.				0.792
BC3: We use predictive analytics to improve governance decisions.				0.700
BC4: Real-time data analytics enhance our responsiveness to public needs.				0.819
BC5: Advanced analytics tools (AI, machine learning) are leveraged in governance.				0.738
***TC:** Task Complexities*	0.825	0.876	0.586	
TC1: The governance challenges we face require sophisticated data analysis.				0.706
TC2: Multiple stakeholders increase the complexity of decision-making.				0.778
TC3: Regulatory constraints complicate digital governance implementation.				0.816
TC4: Rapid technological changes demand continuous adaptation.				0.805
TC5: Data integration from diverse sources is a challenge for our agency.				0.714

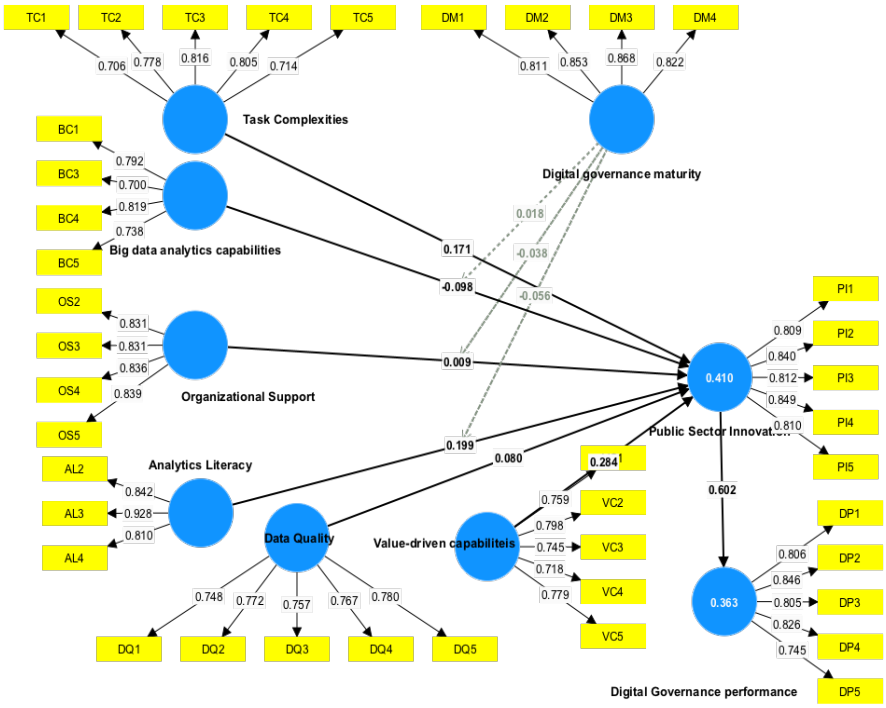

Fig. 2: Factor loadings

To ascertain the reliability of the constructs, Hair et al. (2019) recommend that composite reliability (CR) values between 0.60 and 0.70 are acceptable, 0.70 and 0.90 are good and values exceeding 0.95 are problematic since they cause a decline in the reliability of the model (Henseler et al., 2009). As shown in Tab. 2 all CR values were within the threshold indicating good reliability among constructs. The Average Variance Extracted (AVE) was also used to measure the convergent validity (CV) across all the items specific measured construct. CV is the degree to which separate items reflecting a concept converge or meet when compared to items measuring a distinct construct (Hair et al., 2019). The AVE's cut-off value is 0.50, which indicates that 50% of the construct's explanation of item variability is acceptable for CV (Hair et al., 2019). The AVE values derived for this study were above the 0.50 threshold indicating a satisfactory convergent validity.

Relative to the discriminant validity, the study adopts the Heterotrait-Monotrait ratio (HTMT) criterion given the weaknesses in the Fornell-Larcker criterion (Henseler et al., 2015), for its ineffectiveness in accounting for the uniqueness between the indicators. Tab. 3 presents the HTMT values between constructs which was within the acceptable range. The study adopts Henseler et al. (2015) recommended 0.85 threshold which suggest that, construct with this threshold are conceptually distinct.

Tab. 3 Discriminant validity with Heterotrait-Monotrait Ratio (HTMT)

Construct	1	2	3	4	5	6	7
BDA Capabilities							
Organizational support	0.479						
Analytics Literacy	0.281	0.15					
Data quality	0.576	0.753	0.098				
Digital governance performance	0.690	0.357	0.180	0.459			
Value- driven capabilities	0.606	0.589	0.096	0.829	0.591		
Big data analytics capabilities	0.486	0.497	0.192	0.762	0.340	0.812	
Task complexities	0.495	0.450	0.180	0.646	0.284	0.677	0.931

4.3 Structural model assessment

The next step was to access the inner structure of the model to determine the presence of collinearity with the predictor variables. When two or more formative indicators with the same values are inserted in the same block of indicators, collinearity occurs (Sarstedt et al., 2020). High degrees of collinearity impact on the formative indicator's statistical significance and weight estimate. It is thus, recommended that, the variance inflation factor (VIF) is kept low not above 5 (Hair et al., 2012). In this study, no collinearity problem existed since all VIF values.

The study finally tested the relationship among constructs using the PLS-SEM bootstrapping algorithm. This study

used the *t-statistic* values to measure the effect of the independent and mediating variables on the dependent variable relying on the recommended 1.65 threshold based on the 95% confidence interval (Hair et al., 2019). From the Ta. 4, six hypotheses (*H1, H3, H4, H5, H6 and H7*) out of the seven were supported.

Tab. 4 PLS-SEM Path Coefficients and hypotheses

	Hypothesis Relationship	**Std Beta**	**Std Error**	**T_Stat.**	**Interpretation**
H1	Task complexities -> Public sector innovation	0.205	0.126	1.693**	Supported
H2	Big data analytics capabilities -> Public sector innovation	-0.042	0.101	0.557	Not supported
H3	Value-driven capabilities -> Public sector innovation	0.28	0.083	3.415**	Supported
H4	Data quality -> Public sector innovation	0.123	0.07	1.732**	Supported
H5	Organizational support -> Public sector innovation	0.125	0.07	1.721**	Supported
H6	Analytics literacy -> Public sector innovation	0.214	0.046	4.664**	Supported
H7	Public sector innovation -> Digital governance performance	0.607	0.064	9.393**	Supported
Variables		*Coefficient of determination (R^2)*			*Adjusted R^2*
Public sector innovation		0.382			0.369
Digital governance performance		0.367			0.365

*Note: t denotes two-tailed statistics at **05 significant level*

To demonstrate the predictive capability of the model, an assessment of the structural model's path coefficient significance was performed to determine the goodness of fit (GOF) (Jung & Park, 2018). The commonly used criterion for this purpose is the determination coefficient (R^2), which gauges the exploratory power of the model (Hair et al., 2019). The range of R^2 values is from 0 to 1, with higher values indicating a greater level of explanatory power. R^2 values of 0.25, 0.50, and 0.75 are typically considered to be weak, moderate, and substantial, respectively (Hair et al., 2019). As shown in Table 3, the R^2 values were above 0.30, indicating a substantial model fit.

4.4 Moderation analysis

A moderation analysis was conducted to determine the moderating effect of digital governance maturity on the connection between the big data analytics capability, organizational support and analytics literacy, and public sector innovation. This was to find out how digital governance maturity affect the attainment public sector innovation. Using the t-value of 1.65 (Hair et al., 2019) as the benchmark, the result is shown in Tab. 5.

Tab. 5. Moderating Analysis result

Relationship	**Original Sample (O)**	**t- values**	**P Values**
IT*CO -> BDA	-0.048	0.595	0.552
IT*DS -> BDA	-0.08	1.135	0.257
IT*TI -> BDA	0.036	0.435	0.663

5. Discussion and implications

The results revealed that task complexity, value-driven capabilities, data quality, organizational support, and analytics literacy are the key factors influencing public sector innovations within the Ghanaian public sector. This finding aligns with prior research, including studies by (Egala & Afful-Dadzie, 2022; Yusif, 2017), which highlight the growing recognition of BDA capabilities as pivotal in enhancing decision-making, improving operational efficiency, and optimizing service delivery in public sector organizations.

The study identified that public sector innovation is significantly influenced by task complexity, value-driven capabilities, data quality, organizational support, and analytics literacy, validating hypotheses H1, H3, H4, H5 and H6. Instructively, H7 was also supported validating the proposition that, while the later antecedents lead to innovations in the public sector, it has a significant impact the performance of digital governance. These findings align with prior research by Joshi et al. (2021) and Didas (2023), which similarly highlighted these factors as key determinants of BDA adoption. Furthermore, Waqar and Paracha (2024) submit that BDA serve as a crucial enabler, offering public sector organizations the ability to strategically leverage data resources to enhance both academic and administrative task quality. Given these insights, it is recommended to increase investments in data analytics and business intelligence tools to strengthen decision-making processes. Additionally, this study underscores the importance of advancing the value of BDA to enhance decision-making and comprehensively assess the adoption and performance of digital governance in Ghana's public sector.

The findings indicate a significant relationship between value-driven capabilities (H3), data quality (H4), organizational support (H5), and analytics literacy (H6) in the context of technology characteristics. This suggests that public sector innovation's ability to provide organizational support, foster analytics literacy, improve data quality, and facilitate value-driven capabilities plays a critical role in determining the extent to which organizations adopt and effectively utilize such innovations (Lee et al., 2024).

In line with the guided theory, Larosiliere and Carter (2016), note that, the integration of ICTs within organizations significantly influences task operations. The study emphasize that the technological aspects of a task enable individuals within an organization to interact, collaborate, and participate more effectively in organizational activities. These insights highlight the importance of aligning technological characteristics with organizational needs to maximize the impact of public sector innovation (Arunde et al., 2019).

The findings of this study highlight that public sector innovation provides institutions with an efficient and effective platform for mining and utilizing data to enhance performance. Additionally, the technological characteristics of such innovations support seamless data access for users and allow for customization to achieve desired outcomes. Yoo and Kim (2019) observed that technology adoption increases when the alignment between the nature of the work and the technology is strong. Furthermore, the collection, storage, and utilization of big data require significant attention, emphasizing analytics literacy as a critical component of public sector innovation (Saggi & Jain, 2018). Supporting this, Solangi et al. (2018) identified data analytics literacy as one of the most crucial issues concerning data utilization. The study also underscores the importance of data security, revealing its significant influence on the successful adoption and implementation of public sector innovation.

However, the study revealed that BDA capability was not the most suitable fit for public sector innovation in Ghana. This finding contrasts with the conclusions of Brock and Khan (2017), who emphasized that BDA capabilities play a crucial role in facilitating the implementation of technology. This contradiction suggests that the effectiveness of BDA capabilities may vary depending on contextual factors, such as the specific technological, organizational, and environmental conditions within a region or sector.

The study found that digital governance maturity had no moderating effect on organizational support, analytics literacy, and Big Data Analytics (BDA) capabilities concerning the utilization of public sector innovation. This finding contradicts previous research, such as Wu et al. (2019), which highlighted that IT architecture appropriateness significantly influences the adoption and viability of IT implementation in organizations. Wu et al. (2019) argued that the alignment of IT architecture facilitates smoother technology adoption, leading to enhanced organizational efficiency. Similarly, Chege et al. (2020) emphasized that a well-structured IT architecture supports the integration of new technologies, improving operational efficiency. Tam and Oliveira (2016) further established that technology infrastructure has a substantial impact on task performance. Despite these contradictions, the study acknowledges the ongoing concerns surrounding analytics literacy in the context of data privacy and security. As Siddiqa et al. (2016) highlighted, safeguarding data integrity through secure computational tools and effective distributed storage systems is a critical element of public sector innovation. While this study's findings suggest that public sector innovation and organizational support require minimal reliance on digital governance maturity for performance enhancement, it reinforces the importance of preserving institutional data integrity as a foundational aspect of innovation. Robust data security measures remain essential to ensure the successful adoption and utilization of public sector innovation.

Empirically, this study provides valuable insight into how task-technology and value-driven characteristics influence the implementation of public sector innovation and their consequences on digital governance performance. Drawing on Przegalinska et al. (2025) introduction of task complexities and big data analytics capabilities, we extend the TTF framework to account for the evolving nature of BDA within public institutions. Notably, this research is among the first to examine public sector innovation from a developing country's perspective, addressing a gap in existing literature that has largely focused on developed contexts. In Ghana, for instance, organizations face unique challenges in acquiring both the technical and human resources essential for successful innovation.

To bridge this gap, we synthesize factors such as big data analytics and value-driven capabilities, analytical literacy and digital governance maturity and into the TTF model, recognizing that public sector innovation hinges not only on technological considerations but also on business processes and value propositions. While previous studies have predominantly emphasized technical variables, this work responds to calls for a deeper investigation into the "dependent side" of the TTF model namely, productivity and performance, which our findings affirm as key outcomes of innovation adoption. Although our moderating analyses did not yield significant results, the importance of providing robust IT infrastructure remains evident.

This study also underscores that simply investing in public sector innovation does not automatically lead to positive outcomes. For employees with non-routine tasks, selecting the right ICTs can indeed boost productivity, but achieving the desired impact requires more than just equipment provision. Organizations must also align users'

culture and work practices with their core business processes to fully capitalize on these investments.

Moreover, public sector innovation initiatives should be adaptable to the specific activities and organizational practices of the public sector and other public entities. Overreliance on ICT tools without considering tasks, hierarchies, and decision-making processes can diminish potential value. Consequently, a supportive policy environment that encourages staff and other stakeholders to embrace and effectively use public sector innovation is crucial. This includes granting staff appropriate access to IT infrastructure for collaborative work and instituting ICT policies (e.g., database use policy, internet use policy) to safeguard user information. Lastly, government-led educational and ICT policies can further ensure the protection and security of information, thus fostering a more conducive environment for public sector innovation.

6. Conclusions and limitations

The objectives of the study were to examine the nature of BDA, investigate the factors that influence BDA fit in task-oriented activities, and assess the impact of BDA on Public sector in Ghana. Drawing on the TTF, the study employs and exploratory approach and collected data from 310 public sectors workers in Ghana. The study uses PLS-SEM analysis to analyse the data. The findings revealed that innovations in the public sector are driven by factors such as task complexity, value-driven capabilities, data quality, organizational support, and analytics literacy as key antecedents of BDA use in public sector of Ghana. Unfortunately, the proposition that, big data analytics capabilities influence public sector innovations was not support. The study also found that, public sector innovations through BDA contribute significantly to their digital governance performance in Ghana. The study presents several implications for theory and practice as technology keeps changing the public sectors landscape in Ghana yet, fraught with several challenges in its adoption, use and implementation.

The research was limited by the context in which it was studied and the adopted methodology. While this presents a practical case for a developing economy, future research can leverage other methodologies to explore other geographical context for a broader understanding of the digital governance and how BDA transforms public governance. Again, a comparative analysis could also enhance the generalizability of the future studies. Theoretically, other theories may also be leveraged to explore similar phenomenon.

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