Influence of Data Analytics on The National Security Strategy Formulation Process in Kenya

by

Kodheck Z achary Makori, Martine Odhiambo Oleche and James Kimuyu

Abstract

This study investigates the application of data analytics techniques in the formulation process of National Security Strategies (NSS) in Kenya, examining its influence and strategies for enhancement. The research is grounded in open systems theory (OST), which conceptualizes the NSS formulation process as a dynamic system interacting with its environment. The study used a descriptive research design to collect primary data through close-ended questionnaires from key stakeholders in Kenya's national security organs and agencies. The data analysis, employing both descriptive and inferential statistics, revealed a significant positive correlation between data analytics and the NSS process. Key findings indicate that despite this positive correlation, the utilization of data analytics is minimal due to limited proficiency among personnel and inadequate formal training. Integrating data analytics into the NSS process enhances environmental scanning, real-time monitoring of security threats, technological advancements, and socio-political dynamics. Challenges identified include a lack of skilled professionals, insufficient data infrastructure, and poor inter-ministerial collaboration. Recommendations to overcome these challenges include government incentives, regulatory clarity, the establishment of Data Analytics Centers of Excellence, investments in modern data infrastructure, comprehensive training initiatives, awareness campaigns, and partnerships with academia and industry. The study concludes that integrating data analytics into Kenya's NSS formulation process is essential for improving the effectiveness and responsiveness of national security strategies to address evolving security challenges. This integration demands adaptive policies, informed decision-making, and a paradigm shift in NSS formulation to leverage data analytics capabilities fully.

Keywords: *Security, strategy, data, analytics, threats*

Introduction to the Study

The formulation of effective national security strategies has grown increasingly complex in today's

dynamic environment, marked by diverse threats and exponential data growth (Ogundipe, 2024). Policymakers and security agencies must leverage advanced analytical techniques to extract actionable insights from vast datasets. Data analytics has emerged as a powerful tool, processing large volumes of structured and unstructured data to identify patterns, trends, and predictive models that inform decision-making. Integrating data analytics into the National Security Strategy (NSS) formulation presents opportunities and challenges in Kenya. While data analytics can enhance situational awareness, threat detection, and proactive response planning, its adoption requires addressing organizational, technological, and human resource factors.

This study examines the current state of data analytics integration in Kenya's NSS formulation process to identify factors influencing its successful adoption. The hypothesis suggests a significant relationship between variables like data analytics infrastructure, personnel proficiency, techniques, and strategies, and the effectiveness of the NSS process. By exploring these relationships, the study provides insights and recommendations to policymakers and security agencies on enhancing data analytics integration, ultimately contributing to more responsive and informed national security strategies (Hadžić, 2020). The introduction outlines the research context, emphasizing the importance of data analytics in national security strategy formulation and the associated opportunities and challenges while presenting the guiding research hypothesis.

Background to the Study

Developing effective National Security Strategies (NSS) is a complex and challenging task, especially in today's dynamic environment with diverse threats and the exponential growth of data from multiple sources (Long & Zhang, 2024). Traditional data collection and analysis methods have led to incomplete and ineffective strategies. However, data analytics has emerged as a powerful tool for processing big data enhancing the collection, collation, and analysis of massive unstructured data. This shift towards data analytics is driven by its ability to scale, operate quickly, handle complexity, and adapt to evolving requirements. Integrating data analytics into the NSS process can be understood through the lens of open system theory (OST), which views the NSS as a dynamic entity engaged in continuous interaction with its environment (Fang et al., 2021). Data analytics techniques, combining statistical techniques, machine learning algorithms, artificial intelligence, and automation, provide a superior alternative to traditional data collection and analysis methods. They extract meaningful information from large datasets, enabling countries to develop data-driven strategies responsive to emerging threats and security challenges. In Kenya,

this study seeks to investigate approaches to enhance the integration of data analytics into the NSS formulation process from an architectural perspective. By focusing on the architectural aspects of this integration, the study aims to identify structural and procedural challenges that hinder effective integration and propose solutions to overcome these challenges.

Statement of the Problem

In the era of big data, nation-states face the challenge of formulating responsive strategies informed by real-time, relevant, and contextualized data. This requires comprehensive situational analysis and advanced techniques for collecting, analyzing, and interpreting data to uncover patterns and predict trends. However, Kenya's national security agencies struggle to integrate data analytics effectively into their strategy formulation processes. Traditional methods have produced deficient, ambiguous, and unresponsive strategies inadequate for contemporary security challenges (Hatcheret al., 2022). The massive volume, velocity, variety, and veracity of big data further complicate this integration, as traditional techniques are insufficient. Limited technological infrastructure, a shortage of skilled personnel in data analytics, and inadequate data governance frameworks also hinder progress. Additionally, privacy and ethical concerns, such as potential misuse, bias, and lack of transparency, require careful consideration and robust regulation. Addressing these challenges is crucial for Kenya to develop data-driven, proactive national security strategies to counter evolving threats effectively.

Study Objective

This study aims to critically assess the adoption and integration of data analytics techniques in the National Security Strategies (NSS) formulation process in Kenya, aiming to identify strategies and approaches that can enhance their effective utilization. This involves examining the current state of data analytics adoption within Kenya's NSS framework, evaluating its impact on strategic decision-making processes, and proposing recommendations to optimize its use for developing responsive and well-informed security strategies that address evolving threats and challenges.

Empirical Literature Review

Data Analytics and National Security Strategy Formulation Process: Global Perspectives

The formulation of National Security Strategies (NSS) has traditionally relied on human intelligence and conventional surveillance methods. However, the rise of digital technologies and data analytics has introduced a paradigm shift, enabling the processing of large datasets quickly

and efficiently. This literature review examines the role of data analytics in NSS formulation, focusing on global, regional, East African, and Kenyan contexts.

Globally, data analytics has significantly influenced NSS formulation. The Congressional Research Service (2020) highlights the role of AI in U.S. national security, noting its capabilities in intelligence gathering, cyber operations, and command control. AI facilitates more efficient data analysis, improving target recognition and decision-making capabilities. Similarly, Chi (2017) emphasizes that Australia's adoption of big data analytics has enhanced its national security community's ability to organize and analyze large datasets, identifying potential threats proactively.

In another study, Van Puyvelde et al. (2017) explore how big data influences decision-making processes within U.S. national security. The study found that data analytics technologies, including machine learning, enable national security strategists to detect fraudulent activities and potential threats, creating a more robust NSS. The European Defence Agency (2022) has leveraged AI and data analytics to improve situational awareness and decision-making within the European Union (EU). Integrating these technologies into the NSS formulation process helps address modern threats more effectively.

Countries like Australia and Singapore have made significant strides in the Asia-Pacific region. Australia's Integrated Command and Control (IC2) program utilizes data analytics to enhance national security, while Singapore's Data Science and Artificial Intelligence Program (DSAI) improves situational awareness and decision-making capabilities (Department of Defence, Australia, 2021).

Integrating data analytics into national security strategies is becoming increasingly important in Africa, but it faces significant challenges. South Africa, for instance, has initiated the Data Science for Impact and Decision Enhancement (DSIDE) program to leverage data analytics for national security, disaster management, and policy development (DSIDE, 2022). This program uses data-driven insights to improve decision-making processes and predict potential security threats.

Additionally, Nigeria has started incorporating data analytics to address security challenges such as terrorism and cybercrime. A study by Akinyemi and Siyanbola (2018) discusses using big data analytics to enhance intelligence gathering and threat prediction in Nigeria's fight against Boko

Haram. The study highlights the potential of data analytics to provide timely and actionable intelligence, although infrastructure and expertise remain significant barriers. East Africa has gradually integrated data analytics into national security strategies.

In Kenya, data analytics in NSS formulation is still emerging. Njoroge (2020) argues that rapid technological changes in Kenya have created an environment for evolving national security gaps. Integrating data analytics is necessary to enhance analytical capabilities and extract insights and predictive patterns crucial for responsive NSS. A study by Moses et al. (2018) in Kenya revealed initiatives to integrate data from diverse sources to build a predictive security landscape, focusing on cyberattacks and terrorism. Similarly, Akello (2020) found that AI applications are becoming significant in Kenya, impacting various sectors, including national security.

Wambua (2020) highlighted the need for the Kenyan government to reevaluate the role of social media in NSS formulation due to its rapid growth. The study emphasized the importance of incorporating data analytics to effectively manage social media's implications on national security. A study by Saura et al. (2022) notes that Kenya faces significant challenges in adopting AI and data analytics, such as insufficient regulatory capacity and a lack of STEM courses promoting AI knowledge. This shortage of expertise hampers the successful implementation of AI-driven strategies in national security. Despite these challenges, Kenya is making progress. Moses et al. (2018) report ongoing projects aimed at leveraging data analytics tools to predict and manage security threats. These initiatives reflect a growing recognition of the importance of data analytics in enhancing national security.

Challenges and Limitations in Data Analytics Adoption

While data analytics holds promise for enhancing national security strategy formulation, several challenges impede its effective adoption and implementation. Chief among these is ensuring data quality and integrity. Incomplete, inconsistent, or inaccurate data can yield flawed insights and decisions (Van Puyvelde et al., 2019), particularly when integrating data from diverse sources with varying formats and standards. Without robust data governance frameworks and quality assurance mechanisms, the accuracy and reliability of data-driven insights are compromised, undermining the effectiveness of national security strategies.

Effective data analytics hinges on robust infrastructure, encompassing high-performance computing resources, storage capabilities, and advanced software tools. However, many organizations, especially in developing nations, lack the technical infrastructure and expertise to effectively utilise data analytics (Mikalef et al., 2021). This deficiency impedes adoption and implementation of data analytics solutions for national security strategy formulation, resulting in capability disparities between nations and hindering global security efforts. Moreover, successful data analytics initiatives rely on a skilled workforce proficient in advanced analytical techniques, result interpretation, and insight translation into actionable strategies. However, there is a global shortage of data scientists, analysts, and professionals with expertise in data analytics and related fields (Wilson, 2018). Bridging this skill gap through training and education presents a formidable challenge, requiring substantial investments in human resource development and specialized educational programs.

Integrating data analytics into national security raises ethical and legal concerns regarding privacy, civil liberties, and potential data misuse (Bormida, 2021). Organizations must navigate complex regulatory landscapes and develop robust governance frameworks to ensure ethical data use while safeguarding individual rights. Failure to address these concerns risks eroding public trust and legitimacy, leading to legal and reputational consequences.

Moreover, national security operations often require secrecy, yet data analytics, particularly advanced algorithms, can introduce opacity in decision-making (Moses & De Koker, 2018). Striking a balance between secrecy and transparency is crucial for maintaining public trust and accountability while protecting sensitive information.

These challenges highlight the multifaceted nature of data analytics adoption in national security strategy formulation. Addressing them requires a holistic approach involving technological advancements, capacity building, regulatory frameworks, and ethical considerations. Collaborative efforts among nations and stakeholders are crucial to harnessing the full potential of data analytics to enhance global security capabilities.

Theoretical Model

The integration of data analytics into the NSS formulation process can be explained through the lens of open systems theory (OST). OST views organizations as dynamic entities constantly

interacting with their environment, exchanging information and resources. The NSS formulation process operates as an open system within a complex environment influenced by security threats and technological advancements. Data analytics is crucial in processing external information, enabling the NSS process to adapt to changing circumstances (Benson, 2024).

The NSS process can improve its ability to collect, process, and analyze data from various sources by employing data analytics techniques. This aligns with OST principles, emphasizing environmental scanning and real-time data analysis for informed decision-making. Integrating data analytics fosters a feedback loop where insights inform strategy refinement, facilitating continuous adaptation and improvement—a core tenet of OST, which views organizations as dynamic systems responding to environmental changes.

Study Methodology

The study employed a descriptive research design to analyze data analytics integration practices within Kenya's National Security System (NSS) framework (Mutonyi & Sirera, 2020). The target population consisted of stakeholders involved in NSS formulation across ministries and agencies in Kenya, with a sample of 60 participants selected using stratified random sampling. Data were collected through a close-ended questionnaire covering aspects like familiarity with data analytics, training, utilization of techniques, organizational structure, challenges, and strategies for integration. The analysis involved descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics, including regression analysis, to explore relationships between factors and NSS formulation effectiveness.

Findings of the Study

Structure of Data Analytics Function in Ministries/Agencies

The study emphasizes the critical role of organizational structure and placement of data analytics functions within ministries and agencies for effective data-driven National Security Strategy (NSS) formulation (Chatterji & Mukkai, 2024). It highlights that 91.6% of respondents place data analytics within IT departments, indicating a heavy reliance on existing IT infrastructures for data initiatives, which suggests recognition of the technical expertise needed for data management and analysis.

However, concerns arise regarding aligning data analytics with the specific needs of NSS formulation. While IT departments possess technical skills, NSS formulation requires understanding geopolitical dynamics and strategic considerations beyond IT functions. The study shows limited dedicated data analytics personnel or units supporting NSS formulation, with only 4.2% reporting part-time staff and an equal proportion integrating data analytics within the NSS unit. This highlights a potential disconnect between technical capabilities and strategic NSS objectives.

The predominant placement of data analytics functions within IT departments raises questions about strategic alignment in national security strategy formulation. While IT expertise is valuable, effective integration of data analytics may require a more interdisciplinary approach, combining technical proficiency with deep domain knowledge and strategic understanding.

Ministries and agencies can address this disconnect by reconsidering their organizational structures and establishing dedicated data analytics teams or units. These specialized units can collaborate closely with NSS formulation teams, translating complex data insights into actionable intelligence tailored to national security strategy development. Additionally, fostering cross-functional collaboration and breaking down silos between IT departments, strategic planning units, and domain experts can facilitate seamless integration of data analytics into NSS formulation processes. By promoting interdisciplinary teamwork and knowledge-sharing, organizations can enhance the effectiveness of data-driven approaches in developing robust national security strategies.

Table 1 summarizes the structure of the data analytics function within Ministries/Agencies, presenting the frequency and percentage distribution across six categories. The findings reveal that many respondents (91.6%) indicated that the IT department's data analytics function is housed, suggesting a predominant reliance on existing IT infrastructures for data analytics initiatives. Additionally, a small percentage of respondents (4.2%) reported having part-time staff dedicated to data analytics, while an equal proportion (4.2%) stated that data analytics is an integral part of the NSS unit.

Table 1

Summary of Data Analytics Function in Ministries/Agencies

Variable	Observations	Percent (%)	Cumulative Percent (%)
Fully Pledged Department	0	0	0
Has Full-Time Staff	0	0	0
Has Part-time Staff	2	4.2	4.2
Integrated All Levels	0	0	4.2
Integral Part of NSS Unit	2	4.2	8.4
Part of the IT Department	44	91.6	100.0
Total	**48**	**100.0**	

Source: Research Data, (2024)

Familiarity with Data Analytics

The study's findings reveal a concerning lack of familiarity with data analytics among the respondents, highlighting a significant knowledge gap that could hinder the effective integration of data-driven approaches into national security strategy formulation processes. Specifically, a substantial 20.8% of respondents reported being "very unfamiliar" with data analytics, while an additional 25% acknowledged unfamiliarity with the subject matter. While a notable 31.3% claimed some level of familiarity and 14.6% indicated being "somewhat familiar," the overall picture suggests that most employees within the National Security Council lack the requisite knowledge, skills, and expertise in data analytics techniques and applications.

Table 2: ***Familiarity with Data Analytics***

Variable	*Observations*	*Percent*	*Cumulative Percent*
Very Unfamiliar	10	20.8	20.8
Unfamiliar	12	25.0	45.8
Somehow	15	31.3	77.1
Familiar	7	14.6	91.7
Very Familiar	4	8.3	100.0
Total	**48**	**100.0**	**100.0**

Formal Training in Data Analytics

Table 3 presents the respondents' level of data analytics training, revealing a significant disparity in formal education. The majority (83.3%) lack formal training, while only 12.5% and 4.2% have diploma and degree-level training, respectively. Notably, no respondents possess postgraduate qualifications in data analytics. This substantial gap in structured training among the participants underscores potential barriers to effectively integrating data analytics techniques into the National Security Strategy (NSS) formulation process, as the absence of formal education may hinder the optimal utilization of these critical tools and methodologies.

Table 3: Level of Data Analytics Training

Variable	Observations	Percent	Cumulative Percent
Diploma	6	12.5	12.5
Degree	2	4.2	16.7
Post graduate	0	0	16.7
No Training	40	83.3	100.0
Total	**48**	**100.0**	**100.0**

Source: Research Data, (2024)

Utilization of Data Analytics Techniques in NSS Formulation

The National Security Strategy (NSS) formulation process utilizes diverse data analytics techniques and tools to address the complex challenges of statistical analysis within its framework. Tableau emerges as the most widely employed data visualization tool, while Power BI and Ggplot2 also find significant use. SPSS dominates statistical analysis, accounting for over a third of NSS tasks. Data management and graphics techniques play a vital role, being utilized in more than 37% of NSS activities. SQL proves indispensable for data manipulation and analysis, with machine learning tools like Scikit-Learn and TensorFlow contributing to a substantial portion of NSS tasks. Text analytics and natural language processing tools also find notable applications alongside the prevalent use of cloud platforms such as Amazon AWS, Microsoft Azure, and Google Cloud Platform. This multifaceted toolkit underscores the importance of leveraging diverse and complementary approaches to effectively navigate the intricacies of data analytics within the NSS framework.

Table 4: Utilization of Data Analytics Techniques in NSS Formulation

Data Analytics Techniques	1	2	3	4	5	Mean	SD
Data Visualization Tools							
Tableau	55%	40%	5%	0%	0%	3.61	.982
Power BI	30%	45%	10%	5%	0%	3.88	1.515
Ggplot2	65%	20%	10%	5%	5%	3.48	1.479
Statistical Analysis							
SPSS	10%	15%	10%	45%	0%	3.60	1.49
Statistical Analysis System (SAS)	20%	30%	27.5%	35%	0%	3.41	1.49
Data Management & Graphics	7.5%	10%	35%	27.5%	20%	3.77	1.51
Data Manipulation and Analysis							
Excel	5%	5%	10%	30%	50%	3.49	1.49
Structured Query Language	35%	20%	25%	10%	10%	3.92	1.52
Apache Spark	45%	25%	15%	15%	0%	3.33	1.02
Machine Learning Tools							
Scikit-Learn	7.5%	15%	22.5%	35%	40%	3.36	.35
TensorFlow	10%	12.5%	20%	27.5%	42.5%	3.36	.45
Text Analytics & Natural Language							
Natural Language Toolkit	70%	15%	10%	5%	0%	3.24	.56
Text Blob	60%	20%	15%	5%	0%	3.26	1.35
Cloud Platforms							
Amazon AWS	35%	25%	30%	10%	0%	3.40	1.41
Microsoft Azure	65%	10%	10%	15%	0%	3.48	1.45
Google Cloud Platform	50%	20%	25%	5%	0%	1.37	1.20
Data Pre-Processing							
Open Refine	65%	15%	10%	15%	10%	2.38	0.98
Trifacta	45%	30%	15%	10%	0%	2.61	1.41
Web Analytics							
Google Analytics	50%	25%	25%	0%	0%	2.84	1.25
Adobe Analytics	50%	17.5%	27.5%	0%	0%	2.61	.67

Source: Research Data, (2024)

Levels of Investment and Challenges Faced in Implementation

The study reveals varying levels of awareness regarding data analytics among ministries and agencies. While some show moderate to high awareness, indicating a solid understanding, others display low or no awareness, suggesting potential gaps that may require targeted interventions or educational initiatives to improve overall comprehension. Implementation of data analytics faces challenges, including data quality, lack of skilled personnel, privacy/security concerns, constrained budgets, insufficient top management support, and difficulties in data integration. Investment in data analytics varies, with a quarter reporting high investment, a third indicating moderate investment, and over a quarter acknowledging low investment. These findings emphasize the importance of addressing awareness gaps, overcoming implementation challenges, and optimizing investment to utilize data analytics within surveyed entities fully.

Table 5: Levels of Investment and Challenges Faced in Implementation

Aspect	Percentage
Awareness Levels	
Completely Unaware	12.4%
Partially Aware	27.1%
Moderately Aware	29.1%
Very Aware	21.0%
Fully Knowledgeable	10.4%
Challenges Faced in Implementation	
Data Quality	60.7%
Lack of Skilled Staff	48.4%
Data Privacy and Security	45.3%
Level of Investment	
High Level	25.5%
Moderate Level	34.5%
Low Level	28.6%

Adoption of Data Analytics in Ministries/Agencies

The study evaluates the integration of data analytics in governmental bodies' operations and decision-making processes. It reveals a concerning situation, with 22.5% of respondents indicating no adoption of data analytics. The remaining respondents reported either timely or moderate

adoption, with 17.5% indicating excessive adoption and 17.5% indicating fully integrated adoption. The findings highlight the need for improved data analytics integration in national security strategy formulation.

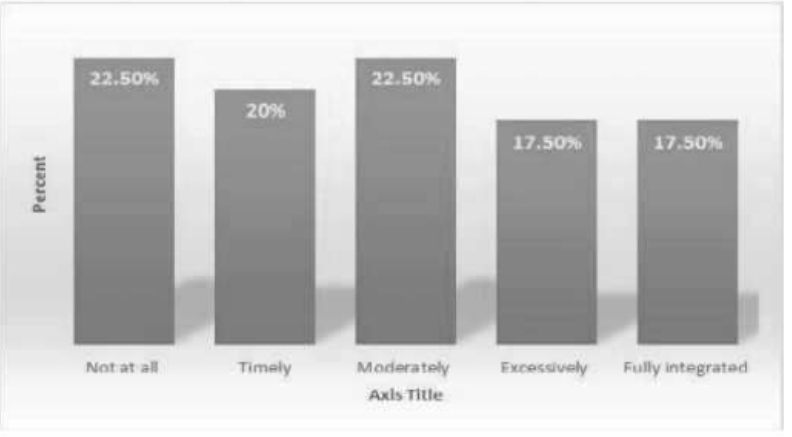

Figure 1: *Adoption of Data Analytics in Ministries/Agencies*

Source: Research Data, (2024)

Programs to Enhance Personal Data Analytics Skills

The study delves into evaluating programs designed to enhance personal data analytics skills within Ministries/Agencies, aiming to shed light on the availability and efficacy of training initiatives to bolster individual competencies in this crucial domain. By analyzing the frequency and distribution of respondents' perceptions regarding these programs, the research seeks to illuminate the organizational endeavours undertaken to cultivate and nurture data analytics capabilities among personnel in formulating national security strategies.

Figure 2 presents a comprehensive overview of the distribution of programs focused on enhancing personal data analytics skills within Ministries/Agencies, showcasing the frequency and percentage distribution across five distinct categories. The findings reveal that a substantial portion of respondents reported limited (22.5%) or moderate (25%) training initiatives, while an equivalent percentage indicated the presence of extensive training programs.

Furthermore, a smaller proportion of respondents noted the complete absence of training (20.0%), and only 10.0% highlighted the existence of continuous training programs. These results underscore the diverse landscape of efforts to improve data analytics skills among personnel involved in national security strategy formulation, emphasizing the need for more comprehensiveand sustained training initiatives to foster data-driven capabilities within Ministries/Agencies and ensure the effective utilization of data analytics in this critical domain.

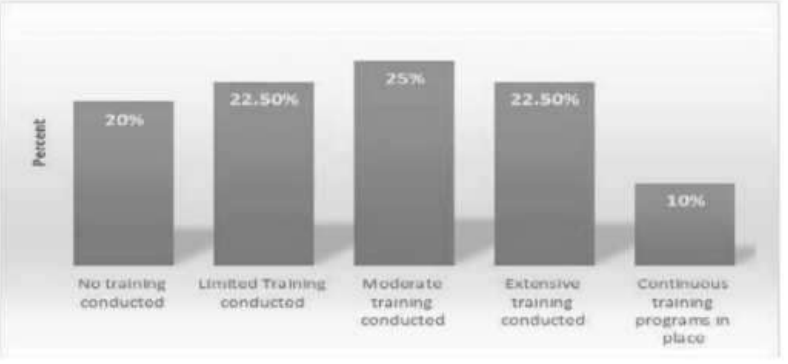

Figure 2: ***Programs to Enhance Personal Data Analytics Skills***

Source: Research Data, (2024)

NSS Formulation and Data Analytics Integration Enhancement Approaches

The researcher explores strategies to improve the integration of National Security Strategy (NSS) formulation with data analytics. They identify challenges data analytics faces in the effective formulation process within ministries/agencies. The study ranked various strategies, with the highest perceived effectiveness being the availability of skilled data analytics professionals. The establishment of Data Analytics Centres of Excellence was also effective. However, the training of employees in data analytics was found to be moderately effective.

Table 6: *NSS Formulation and Data Analytics Integration*

Variable/Data Analytics Strategies	1	2	3	4	5	Mean	SD
Incentives for Data Analytics Adoption	5%	8%	17%	25%	45%	3.85	1.47
Regulations for Data Sharing and Integration	7%	13%	20%	27%	33%	3.90	1.53
Establishment of Data Analytics Centres	8%	12%	18%	23%	38%	4.10	1.62
Dev't of Data Infrastructure and Technology	0%	15%	23%	28%	23%	3.75	1.49
Skilled Training of employees on Data Analytics	13%	17%	22%	25%	23%	3.55	1.48
Awareness Campaigns within Gov't	12%	18%	20%	22%	28%	3.70	1.38
Increased Investment in Data Infrastructure	8%	13%	17%	30%	32%	4.00	1.61
Collaboration between Industry-Academic	10%	15%	18%	27%	30%	3.80	1.56
Availability of Data Analytics Skilled Professionals	7%	10%	15%	33%	35%	4.15	1.62
Affordability of Data Analytics Tools/Technologies	12%	20%	25%	28%	15%	3.75	1.44

Source: Research Data, (2024).

Regression Analysis

Regression techniques were used to analyze the relationship between the independent variable (Source of Data, Order of Preference, Data Analytic Techniques, Data Analytic Strategies and Order of Preference) and the dependent variable (Formulation of Effectiveness NSS). The hypothesis guided this section; there is no significant relationship between the independent variables (Data analytics techniques, personnel data analytics proficiency, data analytics aspects, data analytics challenges, data analytics strategies) and the dependent variable (Effective NSS Formulation Process).

Table 7: *Model Summary*

Model	R	R Squared	Adjusted R Squared	Std. Error of Estimate
	.764[a]	.757	.574	.759

A. Predictors (Constant): DATA ANALYTICS TECHNIQUES, PERSONNEL DATA ANALYTICS PROFICIENCY, DATA ANALYTICS ASPECTS, DATA ANALYTICS STRATEGIES AND DATA ANALYTICS CHALLENGES

Source: Research Data, (2024)

The Model Summary table (Table 8) reveals crucial insights into the regression model's performance regarding the effectiveness of the NSS (National Statistical System) formulation process. With an impressive R-value of 0.764a, signifying a strong positive correlation between the predictors and the dependent variable, the analysis suggests a robust relationship between the included variables such as data analytics infrastructure, personnel data analytics proficiency, techniques, strategies, and aspects, and the effectiveness of NSS formulation.

Moreover, the R Square value of 0.757 indicates that approximately 75.7% of the variability in the effectiveness of the NSS formulation process can be accounted for by the predictors considered in the model. This substantial proportion underscores the significance of the selected predictors in explaining the variance observed in the dependent variable. These findings imply that the chosen regression model provides a compelling framework for understanding and predicting the factors influencing the effectiveness of the NSS formulation process, thus offering valuable insights for enhancing statistical processes and decision-making within the system.

Table 8: ***ANOVA***[a]

Model	Sum of Squares	DF	Mean Square	F	Sig.
Residual	179.985	4	44.996		
Regression	228.600	43	6.712	14.920	0.000
Total	308.585	47			
Dependent Variable: Effectiveness Formulation Process of NSS					
Predictors (Constant): Data Analytics Techniques, Personnel Data Analytics Proficiency, Data Analytics Aspects, Data Analytics Strategies & Data Analytics Challenges.					

Source: Research Data, (2024)

Hypothesis Testing

Null hypothesis (H0): There is no significant relationship between the predictors (Data Analytics Infrastructure, Personnel Data Analytics Proficiency, Data Analytics Techniques, Data Analytics Strategies, and Data Analytics Aspects) and the dependent variable (Formulation of Effectiveness NSS).

Alternative hypothesis (H1): There is a significant relationship between the predictors (Data Analytics Infrastructure, Personnel Data Analytics Proficiency, Data Analytics Techniques, Data Analytics Strategies, and Data Analytics Aspects) and the dependent variable (Formulation of Effectiveness NSS).

Based on the ANOVA table, the F-statistic is 14.920 with a corresponding significance level (Sig.) of 0.000. Since the significance level (0.000) is less than the conventional threshold of 0.05, we reject the null hypothesis, indicating a statistically significant relationship between the predictors (Data Analytics Infrastructure, Personnel Data Analytics Proficiency, Data Analytics Techniques, Data Analytics Strategies, and Data Analytics Aspects) and the dependent variable (Formulation of Effectiveness NSS). Furthermore, the F-statistic value of 14.920 suggests that the included predictors collectively explain variation in the dependent variable, underscoring their meaningful impact on the formulation of effectiveness within the National Statistical System (NSS).

Table 9: ***Coefficients***[a]

Variable Parameter (Aspect)	Coeff (β)	R-Squared	Std. Error	t	p
Data Analytics Techniques	1.481	0.244	0.248	5.97	0.036
Personnel Data Analytics Proficiency	.859	0.403	0.243	3.53	0.048
Data Analytics Aspects	0.614	0.698	0.194	3.16	0.024
Data Analytics Strategies	1.170	0.646	0.210	5.57	0.036
Data Analytics Challenges	-0.497	0.854	0.205	-2.42	0.027
Constant ($QQQQ_{0000}$) = **1.387**; Number of Observations 48					

Source: Research Data, (2024)

The Regression Model presented as: $YYYY = QQQQ_{000} + QQQQ_{111}XXXX_{111} + QQQQ_{222}XXXX_{222} + QQQQ_{333}XXXX_{333} + QQQQ_{444}XXXX_{444} + QQQQ_{555}XXXX_{555}$.....(i)

Y = 551.979 + 232.546 x **Data Analytics Techniques** + 133.389 x **Personnel Data Analytics Proficiency** + 533.230 x **Data Analytics Aspects** + 544.143 x Data **Analytics Challenges** - 987.079 x **Data Analytics Strategies**.....(ii)

Table 10 displays the unstandardized coefficients (B) alongside their respective significance levels (Sig.), offering crucial insights into the relationships between independent variables and the effectiveness of the NSS (National Statistical System) formulation process.

Data Analytics Techniques (B = 232.546, Sig. = .008). The coefficient for Data Analytics Techniques indicates that for every unit increase in the utilization of data analytics techniques, there is an associated increase of 232.546 units in the effectiveness of the NSS formulation process. The significance level of .008 suggests that this relationship is statistically significant at the 0.05 level, emphasizing the importance of incorporating diverse data analytics techniques to enhance NSS formulation.

Data Analytics Aspects (B = 133.389, Sig. = .002). The coefficient for Data Analytics Aspects signifies that each unit increase in the consideration of various aspects related to data analytics leads to a corresponding increase of 133.389 units in the effectiveness of NSS formulation. With a significance level of .002, this relationship is statistically significant at 0.05, underscoring the significance of comprehensively addressing different aspects within the NSS formulation process.

Data Analytics Challenges (B = 533.230, Sig. = .006). The coefficient for Data Analytics Challenges suggests that for every unit increase in addressing challenges related to data analytics, there is an associated increase of 533.230 units in the effectiveness of NSS formulation. With a significance level of .006, this relationship is statistically significant at 0.05, highlighting the importance of identifying and mitigating challenges to optimize NSS formulation outcomes.

Data Analytics Strategies (B = 554.143, Sig. = .013). The coefficient for Data Analytics Strategies indicates that each unit increase in the implementation of strategies related to data analytics results in a corresponding increase of 554.143 units in the effectiveness of NSS formulation. While this relationship is statistically significant at the 0.05 level, as indicated by a significance level of .013, it is essential to note the relatively higher p-value, suggesting a slightly weaker significance level than other variables.

Personnel Data Analytics Proficiency (B = 551.976, Sig. = .003). The coefficient for Personnel Data Analytics Proficiency implies that for every unit increase in the proficiency of personnel in data analytics, there is a corresponding increase of 551.976 units in the effectiveness of NSS formulation. This relationship is statistically significant at the 0.05 level, with a significance level of .003, underscoring the importance of personnel expertise in driving effective NSS formulation processes.

Constant (B = 987-.079, Sig. = .007). The constant term represents the intercept of the regression equation. In this case, it suggests that when all independent variables are held at zero, the estimated effectiveness of the NSS formulation process is 987-.079. With a significance level of .007, this constant term is statistically significant at 0.05, indicating its relevance in the regression model.

These coefficients and their associated significance levels provide valuable insights into the relative importance and statistical significance of different factors influencing the effectiveness of NSS formulation, guiding policymakers and practitioners in optimizing data analytics practices within the NSS framework.

Discussion and Summary of the Key Findings

The current research builds upon previous studies on data analytics adoption in governmental organizations for national security strategy formulation, expanding insights into key challenges like data quality, staffing, and security concerns (Muiga, 2019; Njoroge, 2020). It quantifies the frequency of these obstacles within ministries and agencies, offering specific percentages for a nuanced understanding of implementation challenges. These findings enable policymakers to tailor interventions and allocate resources more effectively to address identified gaps and needs. Regarding awareness levels and investment trends in data analytics, this study confirms prior literature findings of diverse awareness and investment levels across organizational contexts (Maj, 2020; Moses & De Koker, 2018). However, it provides a more detailed analysis of awareness and investment distribution within government organizations. This specificity enables decision-makers to develop targeted strategies that address unique requirements within surveyed ministries and agencies.

On data analytics adoption, the study's findings of mixed adoption levels align with previous research, indicating that while some organizations fully embrace data analytics, others lag due to barriers (Heale & Twycross, 2018; Cabrera-Sánchez & Villarejo-Ramos, 2020). The analysis underscores a significant gap in complete data analytics integration into governmental processes, emphasizing the need for immediate action to bridge this divide.

Furthermore, examining data analytics roles within ministries and agencies resonates with prior research, highlighting the critical role of organizational structure in data analytics adoption (Akello, 2020; Cristea, 2020). By revealing the distribution of data analytics functions across departments and units, the study provides insights into organizational dynamics, identifying areas where structural adjustments and capacity-building initiatives could enhance data analytics integration into national security strategy formulation processes.

Summary of the Key Findings

The study reveals that governmental bodies' organizational structure and data analytics capacity are crucial for effective adoption in National Security Strategy (NSS) formulation. Many organizations house data analytics within IT departments, relying on existing infrastructure, but often lack a dedicated department, highlighting potential organizational gaps. There is also a significant knowledge gap among employees, indicating a need for increased training to enhance data analytics proficiency, which is linked to more effective national security strategies.

Most respondents reported a lack of formal data analytics training, showing a gap in utilising these techniques in NSS processes. This underscores the necessity for structured training programs to equip personnel with the necessary skills. The research also shows disparities in adopting various data analytics techniques, suggesting a need for a balanced approach to utilize available tools fully. The regression model indicates that employing diverse techniques is important for effective NSS formulation.

Investment and challenges in implementing data analytics within governmental organizations vary. Key challenges include data quality, lack of skilled staff, privacy concerns, limited budgets, insufficient top management support, and data integration issues. These factors highlight the need for strategic interventions.

The adoption of data analytics varies across ministries and agencies, emphasizing the importance of better integration into government processes for effective NSS formulation. Organizational factors such as structure, culture, and leadership significantly influence the success of data analytics adoption.

The research underscores the integration of data analytics into governmental organizations for NSS formulation. It emphasizes the need to address organizational structure, capacity, and training, promote diverse techniques, and overcome implementation challenges. Regression analysis highlights these factors' significance, offering guidance for policymakers to optimize data analytics and improve decision-making in national security strategy.

Prioritizing initiatives to enhance organizational structures and capacity-building and address challenges is crucial for effective data analytics integration that bolsters national security efforts. The study emphasizes investing in capacity-building initiatives to enhance personnel skills, as proficiency in data analytics correlates with the effectiveness of national security strategies. The survey reveals a significant gap in formal data analytics training among respondents, indicating the underutilization of data analytics techniques in NSS formulation processes.

Recommendations for Future Research or Practice

To advance data analytics in National Security Strategy (NSS) formulation, future research should focus on longitudinal studies tracking its adoption within governmental organizations over time. This can reveal trends and the effectiveness of interventions. Comparative studies across different countries or regions can highlight the influence of cultural, political, and socio-economic factors on data analytics adoption and its impact on NSS.

In-depth qualitative research is also needed to explore the factors influencing data analytics adoption. Methods like interviews, focus groups, and case studies can uncover organizational dynamics, challenges, and success factors that quantitative analysis may miss. These insights can provide a more comprehensive understanding of the interplay between organizational culture, structure, and data analytics adoption.

Governmental organizations should invest in robust data analytics infrastructure, including technology, tools, and human resources, to handle large data volumes while ensuring security and privacy. Enhancing personnel proficiency through targeted training programs and continuous learning initiatives is also crucial for fostering a data-driven culture and improving evidence-based decision-making.

Furthermore, greater collaboration between governmental agencies, academic institutions, and industry partners is needed to share best practices and resources. Collaborative initiatives can facilitate knowledge exchange, capacity-building, and the development of innovative solutions, accelerating the adoption and integration of data analytics in NSS formulation.

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