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Assessing the Effectiveness and Efficiency of Kinetic Counterterrorism Strategies: A Multi-Dimensional Analysis of Nigerian Counterterrorism Efforts

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Abstract
Terrorism remains a critical security challenge in Nigeria, particularly driven by insurgent groups such as Boko Haram, the Islamic State West Africa Province (ISWAP) and bandit groups. Despite substantial government investments in kinetic counterterrorism (KCT) strategies (military offensives, threats, arrests, and neutralizations), terrorism persists, thus, undermining national security and socio-economic development. This study addresses the pressing challenge of evaluating the effectiveness and efficiency of KCT operations over nearly two decades (2007–2024) in Nigeria. It critically examines whether these predominantly kinetic approaches adequately suppress terrorism, and contribute to long-term governance stability. Employing a multi-dimensional analytical (MDA) framework, the study integrates terrorism incident metrics, operational effectiveness, cost-efficiency, and strategic governance indices, including the anarchical coefficient of terrorism (ACT), to holistically assess KCT performance. Data were sourced from official Nigerian security reports, international terrorism databases, and survey-based governance indicators. Advanced regularization regression techniques (Elastic-Net) were applied to handle multicollinearity and identify significant predictors influencing terrorism intensity, KCT effectiveness, and governance stability. Key findings reveal that while KCT operations achieved tactical successes - marked by increased arrests, neutralizations, and territorial containment, challenges remain in governance and socio-economic domains, which showed only modest improvement. The study identifies diminishing returns on KCT expenditure, rising operational costs, and persistent political and social instability as major challenge of KCT. Regression results indicate that terrorism intensity strongly drives political anarchy (ACT), with KCT effectiveness positively impacting governance but having minimal immediate effect on reducing anarchy. This highlights the complex interplay between KCT efforts and broader socio-political factors. Therefore, the study advocates for a paradigm shift from purely kinetic approaches to knowledge-based counterterrorism (KBCT) strategies, which emphasize proactive intelligence integration, governance reforms, community engagement, and socio-economic development alongside targeted kinetic actions. Policymakers are urged to adopt integrated, data-driven, and sustainable CT frameworks to enhance long-term peace, security, and resource efficiency in Nigeria.

1.0 Introduction

Terrorism remains one of the most pressing security challenges worldwide, particularly in regions plagued by insurgency and violent extremism. Nigeria, as Africa's most populous nation, has faced persistent threats from various terrorist groups, notably Boko Haram and affiliated extremist organizations, which have significantly undermined national security and

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socio-economic development[56]. Over the past two decades, the country has grappled with violent extremism, particularly from groups like Boko Haram, ISWAP and bandit groups. These insurgent groups have exploited weak governance, socioeconomic inequalities, and porous borders to perpetuate violence, leading to significant loss of lives, displacement of millions, and economic stagnation. According to the Global Terrorism Index (GTI), Nigeria consistently ranks among the countries most affected by terrorism, with the Northeast and Northwest regions being epicentres of insurgency

The Nigerian government has predominantly relied on KCT strategies, characterized by military offensives, airstrikes, ground operations, and security operations involving direct action such as arrests, neutralizations, and dismantling of terrorist networks to suppress and eliminate terrorist activities. While these efforts have led to the neutralization of key terrorist leaders and the recapture of territories, they have not addressed the root causes of terrorism. Instead, KCT strategies often displace terrorist activities geographically, exacerbate civilian casualties, and inadvertently fuel grievances that sustain insurgent recruitment. Ironically, the overdependent on KCT approach has created unintended moral hazards, particularly in nations where all sectors depend heavily on government budgetary allocations (GBA) system.

In recent times, the unfair prioritization and high budgetary allocation to this conventional CT approaches have led to the emergence of predatory "Terrorpreneurial" activities - where individuals or groups or states simulate acts of terrorism to attract larger budgetary allocations, and False-Flag terrorism - where fabricated terror alerts are raised to justify increased government expenditure in security. Handful of these moral hazards are vividly captured in literature, for example, the work of Abrahamsen & Williams[1], examines how private security firms and other actors exploit the fear of terrorism to profit from government contracts. The authors discuss the commercialization of security and how some entities may inflate or simulate threats to secure larger budgets.

Leander[48] explores how private military companies and other actors in the security industry benefit from exaggerated or simulated threats. This aligns with the concept of terrorpreneurial activities, where actors manipulate perceptions of insecurity for financial gain. Singer[68] also discusses how private military contractors' profit from the global war on terror, often lobbying for increased CT-related budgets. The book highlights cases where the line between genuine security needs and profit motives becomes blurred. Kaldor[42] examines how the privatization of security and the commercialization of warfare have created incentives for actors to simulate or exaggerate threats. This also aligns with the idea of terrorpreneurial activities in CT environments. Finally, Jackson [38] analyses how the discourse around terrorism is constructed and sometimes manipulated to justify increased budgets and security measures. This provides a critical lens for understanding terrorpreneurial activities.

Also, discussing false flag syndrome in CT environment, Ganser [27] provides historical examples of false-flag operations, particularly during the Cold War. It discusses how fabricated terror alerts were used to justify military spending and KCT measures. Ahmed, et al.[23] explores the role of disinformation and false-flag operations in shaping public perceptions of terrorism. The book discusses how fabricated threats have been used to justify increased government expenditure on security. Robinson [62], "Theory of Global Capitalism" critiques the global war on terror, arguing that fabricated terror alerts have been used to manipulate public opinion and justify large-scale KCT-related budgets. Curtis [20] examines how governments have historically manipulated or fabricated threats to justify military interventions and KCT measures. These works provide case studies that align with the concept of false-flag terrorism.

The emergence of predatory terrorpreneurial activities and false-flag terrorism highlights the complex interplay

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between security, politics, and economics in CT environments. These practices raise ethical and governance concerns, particularly when they result in the misallocation of resources or the erosion of public trust. These phenomena also distort resources allocation process, by inflating the demand for KCT funding, delaying genuine requests, and diverting resources from critical socio-economic sectors. Thereby, leading to inefficiencies, resource misallocation, and socio-economic instability. This inherent limitations and cost implication of a purely military approach in addressing a complex and multidimensional problem like terrorism, raises important questions about the effectiveness of kinetic CT strategies, the fairness and efficiency of GBA process, as well as its long-term implications for security and socio-economic stability.

Therefore, the KCT operations, while pivotal, require rigorous evaluation to understand their effectiveness and efficiency over time. A multi-dimensional analysis (MDA) provides a novel framework for assessing the effectiveness of KCT strategies by quantifying the balance between terrorism intensity, KCT effectiveness, and governance stability. The analysis highlights key KCT performance indicators, including the number of terrorist incidents, severity of incidents, spatial dispersion, operational arrests, neutralizations, and expenditure on kinetic operations. Complementary indices include, Public Trust Index (PTI), Rule of Law Index (RLI), and Socioeconomic Stability Index (SSI), reflect the broader governance environment and societal resilience, which are critical to the success of CT strategies. Integrating these variables into a multi-dimensional framework aligns with theories of CT effectiveness, such as the Deterrence Theory, which emphasizes the role of targeted military actions in discouraging terrorist activities[25], and Governance Theory, which argues that legitimacy and rule of law are essential to sustainable security[44].

This study examines the evolution and impact of KCT strategies in Nigeria by assessing terrorism incident metrics (TIM), operational effectiveness metrics (OEM), cost-efficiency metrics (CEM), and strategic effectiveness metrics (SEM), alongside the anarchical coefficient of terrorism (ACT), which measures the broader instability linked to terrorism. ACT is rooted in theories of anarchy and state fragility [64];[72]. The ACT metric highlights the interplay between weak governance, socioeconomic instability, and the operational freedom of terrorist groups. By applying the ACT framework, this study seeks to evaluate Nigeria's CT efforts, with emphasis on a paradigm shift from KCT strategies to "knowledge-based CT (KBCT) approaches" - a holistic model that integrates intelligence, governance reforms, and community-driven solutions. KBCT approach emphasizes the use of data, intelligence, and evidence-based policymaking to address the underlying drivers of terrorism. It prioritizes deradicalization, socioeconomic development, and community engagement over brute force, thereby fostering sustainable peace and security.

The analysis spans nearly two decades, providing a comprehensive understanding of how kinetic interventions interact with socio-political variables to influence national security outcomes. This study seeks to utilize Regularization Regression Models (RRM) models to explain and predict the performance of key KCT metrics over the study period from 2007 to 2024. By leveraging the normalized and aggregated performance metrics, the regression analysis aims to identify significant predictors and quantify their impacts on overall KCT effectiveness. The regression models provide valuable insights into the relationships between operational, strategic, economic, and socio-political factors influencing terrorism trends and CT measures. The RRM techniques, such as Ridge, LASSO, and Elastic-Net (E-net), are particularly suited for CT performance analysis due to their ability to handle multicollinearity and select relevant predictors in high-dimensional datasets. By leveraging these models, the study aims to provide valuable insights into the relationships between operational, strategic, economic, and socio-political factors influencing terrorism trends and CT measures. These insights will provide a data-driven foundation for designing effective

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CT strategies, as well as provide actionable tools for policymakers to optimize CT strategies, and reduce the conditions conducive to terrorists' evolution.

1.1 Significance of the Study

The significance of this study is manifold. First, it contributes to the growing body of literature on CT by providing empirical insights into KCT strategies within the Nigerian context, a region often underrepresented in global CT research. By leveraging quantitative data from 2007 to 2024, the study offers a longitudinal perspective, enabling policymakers to identify trends, strengths, and weaknesses in current approaches. Secondly, the integration of socio-political indices such as public trust, rule of law, and socioeconomic stability provides a nuanced understanding of the complex ecosystem in which terrorism and CT operate. This aligns with Complex Adaptive Systems Theory[50], highlighting that security outcomes are not merely a result of military actions but also depend on governance quality and social cohesion. Thirdly, given the substantial financial resources allocated to KCT operations (as shown by expenditure data), assessing cost-efficiency is critical for optimal resource allocation and sustainable security policy development. The findings will inform strategic decision-making, potentially guiding shifts toward more holistic and integrated CT approaches that balance kinetic and non-kinetic methods.

1.2 Objectives of the Study

(i) To quantify and analyze the trends in terrorism incidents, severity, and spatial dispersion in Nigeria from 2007 to 2024.
(ii) To evaluate the operational effectiveness of KCT strategies, focusing on arrests, neutralizations, and expenditure.
(iii) To assess the strategic impact of KCT on governance stability - PTI, RLI, and SSI.
(iv) To examine the cost-efficiency of KCT operations relative to their outcomes.
(v) To explore the relationship between KCT effectiveness and ACT over time.

1.3 Research Questions

(i) How have terrorism incidents, their severity, and spatial dispersion evolved in Nigeria between 2007 and 2024?
(ii) What levels of operational success have KCT strategies achieved in terms of arrests and neutralizations?
(iii) How do KCT efforts influence governance stability, public trust, rule of law, and socioeconomic conditions?
(iv) What is the cost-efficiency of KCT operations in Nigeria, considering expenditure and achieved outcomes?
(v) How does the ACT reflect the overall impact of KCT strategies on national stability?

1.4 Scope and Limitations

This study focuses exclusively on KTC operations in Nigeria from 2007 to 2024. It quantitatively assesses terrorism incidents and related CT performance metrics using official and survey-based indices. The MDA incorporates operational, strategic, and cost-efficiency perspectives, drawing on a comprehensive dataset that covers incident frequency, severity, spatial dispersion, arrests, neutralizations, expenditure, and governance-related indices. The study's limitations include:

- **Data Constraints:** While the dataset provides extensive metrics, it may not capture all qualitative aspects of CT, such as community engagement or intelligence failures.
- **Causality Issues:** The study establishes correlations and trends but may not fully disentangle causality between KCT operations and changes in terrorism dynamics due to confounding socio-political factors.
- **Geographical Focus:** Results are specific to Nigeria and may not generalize to other countries with different political and security contexts.
- **Temporal Changes:** Changes in data collection methods or definitions of variables over time may affect consistency, though efforts have been made to standardize measures.
- **Exclusion of Non-Kinetic Strategies:** The focus on KCT operations excludes

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evaluation of complementary non-kinetic CT strategies such as deradicalization programs and community policing, which are also vital for comprehensive CT efforts.

2.0 Review of Related Literature

The complexity of terrorism and CT necessitates a multidimensional understanding grounded in extensive literature. This section reviews existing scholarship on CT strategies, with a focus on kinetic operations globally and within Nigeria. It examines established metrics used to assess CT performance and identifies gaps in research that this study seeks to address.

2.1 Overview of CT Strategies

CT encompasses a broad spectrum of strategies aimed at preventing, mitigating, and responding to terrorist threats. These strategies can be broadly categorized into KCT and non-kinetic approaches [19]. The KCT strategies involve direct military or law enforcement actions such as raids, arrests, targeted killings, and neutralization of terrorist operatives. These include targeted strikes, arrests, raids, and elimination of terrorist operatives and infrastructure. KCT strategies are often immediate, forceful responses designed to disrupt terrorist networks and capabilities [13]. The fundamental premise of KCT is based on Deterrence Theory, which posits that the threat or application of force can prevent or reduce terrorist acts by increasing their costs [25]. Therefore, KCT strategies are often the first line of response in active conflict zones and are designed to disrupt terrorist planning, degrade operational capabilities, and diminish leadership structures [13]. However, KCT approaches are not without limitations, as excessive use of brute force often led to collateral damage, civilian casualties, and backlash, potentially fuelling radicalization [19]. Thus, KCT strategies must often be calibrated carefully to avoid unintended consequences that may undermine long-term security.

The non-kinetic strategies on the other hand, encompass efforts that do not rely on physical force but focus on addressing the underlying socio-political and ideological drivers of terrorism. These include intelligence operations, community engagement, counter-radicalization programs, diplomatic initiatives, legal reforms, and socio-economic development, aimed at addressing root causes of terrorism [34]. Theories such as Social Movement Theory and Relative Deprivation Theory emphasize that terrorism often arises from grievances related to political exclusion, inequality, or perceived injustice [29]. Therefore, non-kinetic strategies aim to mitigate these root causes by enhancing governance, promoting inclusion, and undermining terrorist narratives. The prevailing literature underscores that effective CT requires a blend of both approaches tailored to the socio-political context – to form a comprehensive CT strategy that balances immediate threat reduction with sustainable peace building [53]. The KCT component, while critical for immediate threat reduction, must be complemented by long-term governance and socio-economic stabilization efforts [26].

2.2 KCT Operations: Global and Nigerian Perspectives

Globally, KCT operations have been central to CT campaigns, especially post-9/11. Operations in Afghanistan, Iraq, and the Sahel region illustrate the reliance on military force to dismantle terrorist networks [45]. These campaigns typically involve Special Forces raids, drone strikes, and intelligence-led arrests. Successes often hinge on precision, intelligence integration, and minimizing collateral damage to maintain public support [8]. While KCT operations have led to high-profile successes, such as the elimination of Osama bin Laden, they have also faced criticism for causing civilian casualties and destabilizing regions, leading to cycles of violence [19]. Scholars argue that KCT operations must be integrated with political solutions and reconstruction efforts to prevent the resurgence of terrorism [52].

In Nigeria, KCT operations have been the frontline response to Boko Haram insurgency and other terrorist threats since the late 2000s [56]. The Nigerian military has conducted

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multiple operations involving arrests, neutralizations, and destruction of terrorist camps, reflected in the operational metrics and expenditure in the dataset. Despite some tactical successes, challenges persist such as inadequate training, limited intelligence capabilities, accusations of human rights violations, have sometimes hindered effectiveness. Additionally, fluctuating public trust and weak rule of law complicate the operational environment [2]. The socio-economic instability, high poverty, and unemployment rates also complicate KCT effectiveness, suggesting the need for KCT operations to be part of a broader, multi-sectoral approach [35].

2.3 Metrics for Assessing KCT Performance

Performance measurement in KCT is critical for strategic planning and accountability. Global perspective of CT performance - body-count approach is a traditional method of assessing KCT performance by tallying the number of terrorists killed or arrested. It emphasizes quantifiable outcomes such as fatalities and captures as indicators of success [13]. While simple and straightforward, this approach has been criticized for oversimplifying complex dynamics and incentivizing metrics that may not translate into lasting security [19]. It tends to neglect contextual factors such as civilian impact, governance quality, and socio-economic conditions.

The MDA approach integrates multiple metrics, such as the operational, financial, governance, and societal, to provide a comprehensive assessment of CT effectiveness. This framework recognizes that tactical success must be complemented by strategic and socio-political stability for sustainable CT [60]. In this study, key performance metrics considered include, Terrorism Incident Metrics (TIM), Operational Effectiveness Metrics (OEM), Cost-Efficiency Metrics (CEM), Strategic Effectiveness Metrics (SEM), and Anarchical Coefficient of Terrorism (ACT). By combining TIM, OEM, CEM, SEM, and ACT, this approach offers nuanced insights into how kinetic operations interact with governance and social factors to influence outcomes, enabling adaptive policy formulation.

The MDA approach surpasses the body-count method by incorporating governance, public trust, and socio-economic indicators, offering a broader understanding of CT impacts. Emphasizing long-term stability rather than short-term tactical gains, while accounting for local conditions such as rule of law and social cohesion. This approach offers a balanced evaluation by reducing overemphasis on killing and arrest counts, thus mitigating risks of misreporting or counterproductive operations. This approach aligns with contemporary CT scholarship advocating for integrated strategies that balance kinetic and non-kinetic tactics for durable peace [53].

2.3.1 Terrorism Incident Metrics (TIM):

TIM are quantitative measures which tracks the frequency, severity, and geographic dispersion of terrorist activities. Key indicators of TIM include:

- Number of Incidents - reflects the volume of terrorist acts over time,
- Severity of Incidents - measures impact, such as casualties or economic losses, and
- Spatial Dispersion - indicates geographic spread, often as a percentage of affected administrative units.

This metrics provides a foundational understanding of the threat environment and is crucial for assessing trends and operational priorities. It aligns with Threat Assessment Theory [47], which views terrorism as a dynamic threat requiring continuous monitoring.

2.3.2 Operational Effectiveness Metrics (OEM): OEM focus on the direct outputs of KCT actions. Key components include:

- Number of Arrests - detainees suspected or confirmed as terrorists, and
- Number of Neutralizations - terrorist operatives killed or incapacitated
- Number of interdiction - Combine number of arrest and neutralized terrorists over time.

The OEM evaluates the immediate tactical success of operations in disrupting terrorist networks [9]. High arrest and neutralization rates suggest operational proficiency but must

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be balanced with considerations of proportionality and legality.

2.3.3 Cost-Efficiency Metrics (CEM): CEM assess the economic sustainability of KCT operations by relating total expenditure to operational outcomes such as arrests and neutralizations. This metric is critical given the high financial burden of sustained military operations [41]. CEM facilitates resource optimization by highlighting areas where expenditure yields diminishing returns or where alternative strategies may be more cost-effective. It corresponds with Resource-Based Theories that emphasize efficient allocation of scarce resources in security management.

2.3.4 Strategic Effectiveness Metrics (SEM): SEM encompass broader governance and societal factors that influence the long-term success of KCT strategies. These include:

- Public Trust Index - reflects citizens' confidence in government institutions.
- Rule of Law Index -measures judicial independence and corruption perception.
- Socioeconomic Stability Index - Captures poverty, unemployment, and social cohesion.
- Governance Stability index – combined effect of public trust, rule of law and socioeconomic predictors of terrorism.

SEM aligns with Governance Theory [44], which holds that legitimacy, transparency, and social inclusion are vital to sustainable security. Improvements in these indices indicate that CT efforts contribute to stabilizing environments conducive to peace.

2.3.4 Anarchical Coefficient of Terrorism (ACT): ACT quantifies the degree of instability and disorder resulting from terrorist activities and responses. It serves as a composite indicator integrating terrorism intensity, governance stability, and operational effectiveness. ACT is rooted in State Fragility Theory [59], which posits that weak state structures and governance vacuum create fertile ground for terrorism. Monitoring ACT helps policymakers understand how CT strategies influence overall national stability beyond immediate tactical outcomes.

2.4 RRMs in Terrorism Research

RRMs have gained prominence in recent years due to their ability to handle high-dimensional data and address issues such as multicollinearity and over fitting. These models are particularly well-suited for analysing the dynamics of terrorism, where multiple interrelated factors influence outcomes. Key RRM techniques include:

(i) **Ridge Regression**: Ridge is a regularization technique that adds a penalty term to the least squares objective function, shrinking the coefficients of less important predictors. This approach is useful when dealing with multicollinearity, as it stabilizes the estimates and improves model performance. In the context of terrorism research, Ridge Regression can be used to identify the collective impact of multiple predictors on terrorism severity [32];[49].

(ii) **Lasso Regression**: Lasso extends Ridge Regression by incorporating a penalty term that forces some coefficients to be exactly zero, effectively performing variable selection [31],[70]. This makes Lasso particularly useful for identifying the most significant predictors of terrorism severity. For example, a study by D'Orazio et al [21] used Lasso Regression to analyze the factors influencing the lethality of terrorist attacks, demonstrating its potential for variable selection in high-dimensional datasets.

(iii) **E-Net Regression**: This combines the strengths of Ridge and Lasso, balancing the trade-off between coefficient shrinkage and variable selection. This approach is particularly effective when dealing with highly correlated predictors, as it can select groups of related variables [31]. In terrorism research, E-Net can be used to model the interactions between factors such as the number of perpetrators, casualties, and geographic spread of attacks.

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While the application of RRMs in terrorism research is still emerging, several studies have demonstrated their potential. For instance, a study by Asal et al [5] used E-Net to analyze the predictors of terrorist group longevity, highlighting the importance of organizational characteristics and external support. Similarly, Neumayer and Plumper [54] employed Ridge Regression to examine the determinants of transnational terrorism, identifying key factors such as economic inequality and political instability. Zhu et al [77] applied L1-regularization regression to model the severity of terrorist attacks, from dataset of terrorist attacks in Iraq and Afghanistan and found that the L1-regularization model outperformed traditional regression models in predicting the severity of attacks.

Zhu, et al [77] further compared the performance of different regularization techniques, including LASSO, Ridge, and E-Net regularization, in predicting terrorist attacks. The authors used a dataset of terrorist attacks in the Middle East and found that the E-Net regularization model performed best in predicting the occurrence of attacks. Chen, et al [14] applied L2-regularization regression to model the dynamics of terrorist networks, from a dataset of terrorist networks in the Middle East. They found that the L2-regularization model was able to accurately predict the structure and evolution of the networks. Ribeiro, et al[61] applied E-Net regularization regression to predict the severity of cyber terrorist attacks. Analysing a dataset of cyber-attacks, the authors observed that the E-Net technique was able to accurately predict the severity of attacks. Despite their promise, the use of RRMs in terrorism research remains limited, particularly in the context of Nigeria. This study also seeks to address this gap by applying the E-Net variance of RRM techniques to analyze the performance dynamics of KCT operation in Nigeria, thus, providing a robust framework for understanding and mitigating this complex phenomenon.

In conclusion, the reviewed literature highlights the complexity of KCT performance dynamics in Nigeria, and the need for multidimensional and advanced statistical techniques to model these dynamics. While previous studies have provided valuable insights into the drivers, impacts, and patterns of terrorism in Nigeria, they often rely on traditional methods that may not fully capture the interplay between multiple predictors. The RRMs techniques offer a powerful alternative, enabling researchers to identify key enabler of CT performance, and develop predictive frameworks for proactive intervention. These multidimensional metrics align with the integrated approach advocated in recent CT scholarship, emphasizing that tactical success must translate into strategic stability [60]. By applying the MDA to the context of Nigeria, this study aims to contribute to the growing body of literature on the application of advanced statistical techniques in terrorism research. The insights derived from this analysis will provide a data-driven foundation for designing effective CT strategies, ultimately contributing to the stability and development of Nigeria.

2.4 Existing Gaps in Literature

Despite extensive research, several gaps remain in the mathematical modelling of terrorism. This includes context-specific evaluations - most CT performance studies focus on Western contexts, with limited empirical analysis tailored to Nigeria's unique security environment [57]. Few studies comprehensively combine KCT operational data with governance and socio-economic indicators, limiting holistic understanding. By longitudinal analyses, there is a scarcity of long-term studies assessing the evolution of CT effectiveness over extended periods, which is crucial for adaptive policymaking. While the cost-efficiency focus - the financial sustainability of KCT operations receives limited attention in existing literature. Similarly, the use of RRMs in terrorism research remains limited, particularly in the Nigerian CT landscape. This study seeks to address this gap by applying the E-Net variance of RRM techniques to analyze the performance dynamics of KCT operation in Nigeria, thus, providing a robust framework for

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understanding and mitigating this complex phenomenon. Generally, this study addresses these gaps by leveraging 18-years dataset and integrating multi-dimensional metrics to provide a nuanced evaluation of Nigeria's KCT strategies.

3.0 Methodology

Robust data and methodological rigor are essential for accurately assessing the effectiveness and efficiency of KCT strategies in Nigeria from 2007 to 2024. This section outlines the theoretical framework, dataset employed, operational definitions of key variables, data sources, and methodological approaches for analysis. It also addresses limitations inherent to the data and methodology, emphasizing transparency and validity in research design. The study adopts a quantitative, MDA framework integrating terrorism incident metrics, operational effectiveness, cost-efficiency, and strategic governance indices to holistically evaluate KCT performance. This approach is grounded in Mixed-Methods Research Theory [18], emphasizing the complementarity of quantitative data analysis with contextual interpretation. Statistical and econometric techniques are employed to identify trends, correlations, and causal inferences where feasible, while acknowledging the complexity of security phenomena as socio-political systems [71].

3.1 Theoretical Framework of KCT Performance

Building on the literature, this section establishes the theoretical foundation guiding the study. It conceptualizes terrorism and CT performance, and defines key indices used for assessment. By conceptualization, terrorism is broadly defined as the use or threat of violence by non-state actors to achieve political or ideological goals through fear and coercion[17]. CT encompasses all measures aimed at preventing and responding to terrorism[34]. Performance in CT is multi-faceted, involving:

- Effectiveness - the ability to reduce terrorist incidents, severity, and spread.
- Efficiency - optimal use of resources in achieving security objectives.
- Strategic Impact - enhancing governance legitimacy, socio-economic stability, and public trust to prevent terrorism recurrence.

The Systems Theory perspective [71] informs the study by viewing KCT as part of a complex socio-political system where multiple inputs (kinetic operations, governance reforms) produce security outcomes.

3.1.1 Description of Variables and Parameters: To conceptualize the key KCT performance metrics, we define the following variables and parameters:

- T_t: The number of incidents at time t.
- S_t: The severity of incidents (e.g., casualties, economic losses at time t
- $0 \leq D_t \leq 1$: The spatial dispersion of incidents at time t (percentage of affected local government areas in region$i$).
- A_t: Number of terrorist operatives arrested at time t
- N_t: Number of neutralized (eliminated) terrorist actors at time t
- E_t: Total expenditure on KCT operations in Bilion of Naira.
- $0 \leq [PTI]_t, \leq 1$: Public Trust index (PTI) at time t, (public trust in government institutions - by survey-based score).
- $0 \leq [RLI]_t \leq 1$: Rule of law index (RLI) at time t (e.g., corruption perception index, judicial independence, etc.)
- $0 \leq [SSI]_t \leq 1$: Socioeconomic stability index (SSI) at time t, (e.g., poverty rate, unemployment rate, etc.).
- α, β, γ: Weighting factors reflecting the relative importance of each component. Weighting reflects policy priorities and theoretical considerations. For example, α may emphasize incident severity over frequency, while β could prioritize arrests over expenditure efficiency. The use of weighting allows for tailored assessments sensitive to contextual factors, consistent with Multi-Criteria Decision Analysis (MCDA) approaches [76]. Proper calibration of these weights ensures that composite indices accurately reflect operational realities and strategic goals.

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3.2 Data Sources and Collection Methods

To ensure validity and comprehensiveness, data were collated from multiple reliable sources. This includes: number of Terrorism incidents (T_t), arrests (A_t), neutralizations (N_t), and expenditure (E_t), were extracted from official Nigerian military and government security reports, supplemented by international security databases such as the Global Terrorism Database (GTD) and reports from the Nigerian Security and Civil Defense Corps (NSCDC). Severity (S_t) and spatial dispersion (D_t) were derived from incident reports, economic impact assessments, and geographic information system (GIS) analyses of affected local government areas, validated through cross-referencing with independent NGOs and media reports. Governance indices $[PTI]_t$, $[RLI]_t$, $[SSI]_t$, were sourced from survey-based studies such as Afrobarometer, Transparency International's Corruption Perceptions Index, World Bank Governance Indicators, and Nigeria's National Bureau of Statistics socio-economic reports. Data collection followed standard protocols for aggregation at the annual level, ensuring consistency over the 17-year period. Triangulation of sources minimized bias and enhanced reliability[40].

3.3 Operationalization of KCT Performance Metrics:

The KCT operations assessment serve as a structured framework to evaluate the effectiveness, efficiency, and strategic impact of CT initiatives. These metrics are designed to provide actionable insights into the operational, financial, and societal outcomes of KCT efforts, ensuring that resources are optimally allocated and objectives are met. By categorizing KCT performance into incident metrics, operational effectiveness, cost-efficiency, and strategic effectiveness, these metrics enable policymakers, security agencies, and analysts to:

- Monitor Tactical Success: Assess the immediate outcomes of arrests, neutralizations, and geographical containment of terrorist activities.
- Evaluate Financial Efficiency: Quantify the cost-effectiveness of operations, ensuring that expenditures align with measurable results.
- Measure Strategic Impact: Analyze long-term improvements in governance, societal stability, and public trust.
- Understand Anarchical Effects: Quantify the destabilizing impacts of terrorism on governance and societal order.

This comprehensive approach ensures that KCT operations are not only evaluated for their short-term tactical success but also for their alignment with broader national security and governance objectives. By integrating quantitative and qualitative measures, these metrics provide a holistic view of CT performance, enabling continuous improvement and strategic adaptation.

3.3.1 Terrorism Incident Metrics $[\mathbf{TIM}]_t$: These metrics assess the scale and severity of terrorism incidents, it measures the frequency, severity, and dispersion of terrorism incidents over time and geography. They focus on understanding the trends and patterns of terrorist activities. Theoretically rooted in incident analysis models, TIM provides insights into the operational scope and adaptability of terrorist organizations[24]. TIM is critical for identifying hotspots and temporal trends in terrorism. Its critical component include:

- **Incident Dispersion Index (IDI):** $[IDI]_t$ measures the geographical spread of terrorism incidents across a region.

$$[IDI]_t = \frac{\text{Incident Dispersion}}{\text{Number of Terror incidents}} = \frac{D_t}{T_t} \quad (3.0.0)$$

High $[IDI]_t$ indicates widespread incidents, while low $[IDI]_t$ reflects containment.

- **Terrorism Intensity Index (TII):** $[TII]_t$ quantifies the severity of terrorism incidents based on fatalities, injuries, and property damage.

$$[TII]_t = \alpha T_t + \beta S_t + \gamma D_t$$

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Where, α, β, γ are weighting factors reflecting the relative importance of each component. Assume weighting factors $\alpha = 0.5, \beta = 0.3, \gamma = 0.2$ (common practice emphasizing frequency, then severity, then dispersion). Higher $[\mathrm{TII}]_t$ signifies more intense and impactful terrorist activities.

- **Impact on Severity Reduction (ISR):** $[\mathrm{ISR}]_t$ quantifies the cost-effectiveness of reducing the severity of terrorism. It assesses the effectiveness of CT efforts in reducing the severity of incidents over time. $[\mathrm{ISR}]_t = \frac{\text{Change in Severity}}{\text{Total expenditure on KCT operations}} = \frac{\Delta S_t}{E_t} = \frac{S_t - S_{t-1}}{E_t}$ (3.0.2)

A higher $[\mathrm{ISR}]_t$ indicates successful mitigation of incident impacts.

3.2.2 Operational Effectiveness Metrics (OEM): These metrics evaluate the tactical success of KCT operations. It assesses the success of KCT operations in terms of arrests, neutralizations, and tactical outcomes. Theoretically grounded in military and law enforcement operational frameworks, OEM evaluates the tactical success rate of CT interventions[11]. These metrics reflects the direct impact of CT operations on dismantling terrorist networks. Its critical component include:

- **Arrest Efficiency Index (AEI):** AEI measures the average proportion of successful arrests relative to total operations. It Indicates the operational precision of law enforcement.
-

$$[\mathrm{AEI}]_t = \frac{\text{Number of terrorists arrested}}{\text{Number of Terror incidents}} = \frac{A_t}{T_t} \quad (3.0.3)$$

High $[\mathrm{AEI}]_t$ reflects effective arrests relative to total operations

- **Neutralization Efficiency Index (NEI):** NEI Quantifies the success rate of neutralizing terrorist threats (e.g., through raids or tactical operations).

$$[\mathrm{NEI}]_t = \frac{\text{Number of terrorists neutralized}}{\text{Number of Terror incidents}} = \frac{N_t}{T_t} \quad (3.0.4)$$

High $[\mathrm{NEI}]_t$ reflects effective targeting and execution relative to total operations.

- **Attrition Efficiency Index (ATEI):** ATEI measures the Aggregates the success rates of arrests and neutralizations into a single metric. It provides a holistic view of tactical CT effectiveness.
- $[\mathrm{ATEI}]_t = \frac{\text{No of Terrorists arrested + Terrorists neutralized}}{\text{Number of Terror incidents}} = \frac{(A_t + N_t)}{T_t}$ (3.0.5)

High $[\mathrm{ATEI}]_t$ reflects effective attrition relative to total operations.

- **Geographical Containment Index (GCI):** Quantifies the spatial concentration of terrorism incidents within a defined geographical region. It compares the actual distribution of incidents to an ideal scenario where incidents are fully contained within a target area. GCI can be expressed as:

$$[\mathrm{GCI}]_t = \frac{n_C}{N}\left(1 - \frac{A_C}{A_T}\right) = 100\% - (\%\ \text{Affected LGAs}) = (1 - D_t) \quad (3.0.6)$$

Where, n_C/N is proportion of incidents contained within the concentrated sub-region A_C, and A_C/A_T is proportion of the total area occupied by the concentrated sub-region. Higher $[\mathrm{GCI}]_t$ values indicate better geographical containment and reduced spread of terrorism incidents. If $[\mathrm{GCI}]_t = 1$: All incidents are perfectly contained within a small sub-region (A_C) relative to the total area (A_T). If $[\mathrm{GCI}]_t = 0$: Incidents are uniformly dispersed across the entire region, with no concentration.

- **GCI with Spatial Dispersion ($[\mathrm{GCI}]_{\mathrm{Adjd}}$):** The adjustment penalizes the $[\mathrm{GCI}]_t$ if incidents within A_C are widely scattered, reducing the effectiveness of containment.

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The $[GCI]_t$ provides a quantitative measure of how well terrorism incidents are geographically contained. To account for the spatial dispersion of incidents within the concentrated sub-region, we can introduce a dispersion penalty:

$$[GCI]_{Adjd} = [GCI]_t \cdot \left(1 - \left(\sum_{i=1}^{n_C} d_i \Big/ (n_C \cdot d_{Max})\right)\right) = [GCI]_t \cdot (1 - \text{Dispersion Penalty}) \quad (3.0.7)$$

Where, d_{Max} represent the maximum possible distance within A_C, and $\left(\sum_{i=1}^{n_C} d_i / n_C \cdot d_{Max}\right)$ is the normalized dispersion of incidents withinA_C. By incorporating both the proportion of incidents in a concentrated area and the relative size of that area, the $[GCI]_t$ offers a robust metric for evaluating the effectiveness of CT operations in limiting the spread of terrorist activities.

- **Stability Efficiency Index (SEI):** SE measures how well CT expenditures contribute to stabilizing governance - the ability of CT operations to restore stability in affected regions

$$[SEI]_t = \frac{\text{Efficiency of Expenditure on governance stability}}{\text{Total expenditure on KCT operations}} = \frac{EEG}{E_t} \quad (3.0.8)$$

High $[SEI]_t$ indicates successful stabilization efforts.

- **KCT Effectiveness Index (KEI):** KEI Combines multiple operational metrics into a composite effectiveness score. It measures the number of terrorists arrested and neutralized per unit of expenditure.

$$[KEI]_t = \frac{\text{No of Terrorists arrested} + \text{No of Terrorists neutralized}}{\text{Total expenditure on KCT operations}} = \frac{(A_t + N_t)}{E_t} \quad (3.0.9)$$

Higher KEI reflects overall operational success.

3.2.3 Cost-Efficiency Metrics (CEM): These metrics assess the financial efficiency of kinetic CT operations. CEM evaluate the financial efficiency of KCT operations by comparing costs to outcomes (e.g., arrests, neutralizations). Theoretically derived from cost-benefit analysis in public policy, CEM ensures resource allocation aligns with measurable results[22]. Thess metrics are essential for optimizing limited resources in CT efforts. Its critical component include:

- **Cost per Arrest (CPA):** CPA measures the average cost of arresting a single terrorist - the average cost incurred per successful arrest.

- $[CPA]_t = \frac{\text{Total expenditure on KCT operations}}{\text{Number of terrorists arrested}} = \frac{E_t}{A_t}$ (3.1.0)

Lower $[CPA]_t$ reflects higher cost-efficiency in law enforcement operations.

- **Cost per Neutralization (CPN):** CPN measures the average cost of neutralizing a terrorist threat.

-

$$[CPN]_t = \frac{\text{Total expenditure on KCT operations}}{\text{Number of terrorists neutralized}} = \frac{E_t}{N_t} \quad (3.1.1)$$

Lower $[CPN]_t$ indicates efficient resource utilization in tactical operations.

- **Attrition Cost Index (ACI):** ACI assesses the combined cost-efficiency of arrests and Neutralizations. ACI balances financial inputs with operational outcomes.

$$[ACI]_t = \frac{\text{Total expenditure on KCT operations}}{\text{No of Terrorists arrested} + \text{No of Terrorists neutralized}} = \frac{E_t}{A_t + N_t} \quad (3.1.2)$$

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- A high ACI indicates that KCT operations are incurring substantial costs due to high personnel or asset losses, potentially reducing overall operational effectiveness.
- **Cost per Incident (CPI):** CPI measures the average cost of responding to a single incident - the average cost incurred per terrorism incident, including prevention and response efforts.

$$[\mathrm{CPI}]_t = \frac{\text{Total expenditure on KCT operations}}{\text{Total number of Terror Incidents}} = \frac{E_t}{T_t} \qquad (3.1.3)$$

Lower $[\mathrm{CPI}]_t$ reflects better financial management in KCT operations.

- **Cost per KCT Operation (CKO):** CKO measures the average cost of conducting a single kinetic CT operation:

$$[\mathrm{CKO}]_t = \frac{\text{Total expenditure on KCT operations}}{\text{KCT Effectiveness Index}} = \frac{E_t}{[\mathrm{KEI}]_t} \qquad (3.1.4)$$

Lower $[\mathrm{CKO}]_t$ reflects efficient planning and execution.

- **Effectiveness of KCT per Expenditure (EKE):** EKE evaluates the success rate of kinetic CT operations relative to their cost

$$[\mathrm{EKE}]_t = \frac{\text{KCT Effectiveness Index}}{\text{Total expenditure on KCT operations}} = \frac{[\mathrm{KEI}]_t}{E_t} \qquad (3.1.5)$$

Higher EKE indicates better return on investment for tactical operations.

- **Efficiency of Expenditure on Governance Stability (EEG):** EEG evaluates the cost-efficiency of investments aimed at improving governance stability.

$$[\mathrm{EEG}]_t = \frac{\text{Change in Governance Stability}}{\text{Total expenditure on KCT operations}} = \frac{\Delta[\mathrm{GSI}]_t}{E_t} \qquad (3.1.6)$$

Higher $[\mathrm{EEG}]_t$ reflects effective use of resources for long-term stability.

3.2.4 Strategic Effectiveness Metrics (SEM): These metrics assess the broader impact of CT operations on government stability and returns on investment. SEM measure the long-term impact of CT operations on reducing terrorism, improving governance, and stabilizing affected regions. Theoretically drawn from strategic studies and governance theories, SEM emphasizes broader societal and political outcomes[74]. SEM evaluates whether CT efforts align with overarching national security goals and its critical component include:

- **KCT Return on Investment (KROI):** KROI evaluates the overall return on investment in terms of reduced terrorism metrics. It assesses the long-term benefits of CT efforts relative to their costs

$$[\mathrm{KROI}]_t = \frac{\Delta T_t + \Delta S_t + \Delta D_t}{E_t}$$

. Higher $[\mathrm{KROI}]_t$ reflects a strong alignment of financial inputs with strategic outcomes.

- **Governance Stability Index (GSI):** GSI measures the improvement in governance stability as a result of CT efforts, reflecting the strategic environment's resilience.

$$[\mathrm{GSI}]_t = \frac{1}{n}[\mathrm{PTI}]_t + [\mathrm{RLI}]_t + [\mathrm{SSI}]_t$$

Higher $[\mathrm{GSI}]_t$ indicates successful restoration of governance and public order

- **Anarchical Coefficient of Terrorism (ACT)**: ACT quantifies the degree of chaos and instability caused by terrorism within a region, often linked to governance and societal resilience. ACT is modelled as a composite index derived from several key variables that reflect the dynamics of terrorism, state control, and societal stability. Theoretically influenced by the State Failure and Anarchy theory[65], highlighting the interplay between terrorism and governance. ACT provides a macro-level view of terrorism's destabilizing effects. Mathematically given by:

$$[\mathrm{ACT}]_t = \frac{[\mathrm{TII}]_t}{[\mathrm{KEI}]_t + [\mathrm{GSI}]_t}$$

If $[\mathrm{ACT}]_t > 1$, this indicates a high level of anarchy, where terrorism persists or worsens

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despite kinetic operations. If $[\mathrm{ACT}]_1 = 1$, this suggests a neutral state, where CT efforts are neither improving nor worsening the situation. And if $[\mathrm{ACT}]_t < 1$, this reflects a reduction in anarchy, indicating successful mitigation of terrorism through kinetic and governance strategies.

In summary, the operationalization follows conceptual clarity ensuring variables are measurable and interpretable within the Nigerian context[67]. This framework provides a robust and flexible approach to quantifying the performance of KCT operation in a geopolitical region.

3.3 Analytical Techniques and Model Specification

The study employs a multi-method quantitative analytical framework, including descriptive statistics – to summarize trends and distributions of core variables over time. Correlation and multi-regression analysis - to explore relationships between operational metrics and governance indices. This analytical technique includes the preprocessing and normalization - data cleaning, verification of missing values, correction of data types (numerical for metrics, float for indices), and handle any formatting issues, e.g., commas in numbers. Since the dataset contains variables with different units and scales, normalization was carried out to facilitate comparison and analysis. By normalization, the dataset was scaled to a range of 0 to 1, $(0 \leq X \leq 1)$ for comparability using the Min-Max rescaling techniques:

$$X' = \frac{\overline{X} - X_{Min}}{X_{Max} - X_{Min}} \quad 3.2.0)$$

Where $\overline{X}$ represents the mean of X_t, while X_{Min} and X_{Max} represent the respective minimum and maximum values of X_t. For already normalized indices $(\mathrm{PTI}, \mathrm{RLI}, \mathrm{SSI})$, no further scaling was needed. Theoretically, the normalization aligns with Data Preprocessing Theory[30], which stresses its importance in multi-metric analyses to prevent scale dominance and ensure fair weighting. It also facilitates visual comparisons and correlation interpretation.

3.4 Regression Model (Theoretical Framework)

The Ordinary least square (OLS) method is a fundamental statistical technique used to estimate the relationship between a dependent variable (y) and one or more independent variables (X). The objective is to minimize the sum of squared residuals (errors) between the observed values and the predicted values. OLS is based on the Gauss-Markov Theorem, which states that under certain assumptions (linearity, independence, homoscedasticity, and no multicollinearity), the OLS estimator is the Best Linear Unbiased Estimator (BLUE)[51];[73]. Consider the general form of a linear regression model is

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \epsilon_i$$

$$y = X\beta + \epsilon - \text{ in matrix form}$$

Where:

- y_i is the dependent variable (response variable) for observation i,
- y_{ij} are the independent variables (predictors) for observation i,
- $\beta_0, \beta_1, \ldots \beta_p$ are regression coefficients,
- ϵ_i is the error term (residual) for observation i.
- Y is an nx1 vector of observed values,
- X is an $nx(p+1)$ matrix of predictors (including a column of ones for the intercept),
- β is an $(p+1)$ x1 vector of coefficients,
- ϵ is an $n \times 1$ vector of residuals.

The OLS method minimizes the Residual Sum of Squares (RSS), which is defined as:

$$\mathrm{RSS} = \sum_{i=1}^{n} \epsilon_i^2 = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$\mathrm{RSS} = (y - X\beta)^T (y - X\beta) - \text{ in matrix form}$$

Where: y_i is the actual observed value for the i-th observation, and $\hat{y}_i = X_i^T \beta$ is the predicted value for the i-th observation, based on the estimated regression coefficients $\hat{\beta}$. To find the OLS estimates of β, we take the derivative of RSS with respect to β and set it to zero:

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$$\frac{\partial(\mathrm{RSS})}{\partial\beta} = -2X^T(y - X\beta) = 0 \quad (3.2.3)$$

Solving equation (3.2.3) for β, gives: $\hat{\beta} = (X^TX)^{-1}X^Ty = 0$, where $(X^TX)^{-1}X^T$ is the Moore-Penrose pseudo-inverse of X.

3.4.1 Assumptions of OLS: The OLS technique is predicated on the following key assumption:

(i) Linearity: The relationship between X and y is linear.
(ii) Independence: Observations are independent of each other.
(iii) Homoscedasticity: The variance of the residuals is constant across all levels of X.
(iv) No Multicollinearity: Independent variables are not perfectly correlated.
(v) Normality: The residuals ϵ_i are normally distributed (for inference purposes).

3.4.2 Statistical Properties of OLS Estimators:

(i) Unbiasedness: The OLS estimator $\hat{\beta}$ is unbiased: $E[\hat{\beta}] = \beta$
(ii) Variance of OLS Estimators: The variance-covariance matrix of $\hat{\beta}$ is: $\mathrm{Var}(\hat{\beta}) = \sigma^2(X^TX)^{-1}$. Where σ^2 is the variance of the residuals?

3.4.3 Blue Property: Under the Gauss-Markov assumptions, $\hat{\beta}$ is the Best Linear Unbiased Estimator (BLUE), meaning it has the smallest variance among all linear unbiased estimators.

(i) Goodness-of-Fit: R^2 and adjusted R^2 - coefficient of determination (R^2) measures the proportion of variance in y explained by X, and given by:

$$R^2 = 1 - \frac{\mathrm{RSS}}{\mathrm{TSS}};\ \mathrm{RSS} = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2, \text{and } \mathrm{TSS} = \sum_{i=1}^{n}(y_i - \bar{y}_i)^2 \quad (3.2.4)$$

(ii) Adjusted R^2, which accounting for the number of predictors is given by:

$$R^2_{adj} = 1 - \frac{(1 - R^2)(n - 1)}{n - p - 1} \quad (3.2.45)$$

(iii) Mean Square Error (MSE): MSE is the average of the squared residuals:

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}\epsilon_i^2 = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \quad (3.2.6)$$

In matrix notation, the residuals are represented as: $\epsilon = (y - X\hat{\beta})$. The squared residuals are then:

$$\epsilon^2 = \epsilon^T\epsilon = (y - X\hat{\beta})^T(y - X\hat{\beta}).$$

Therefore, the MSE can be expressed as:

$$\mathrm{MSE} = \frac{1}{n}(y - X\hat{\beta})^T(y - X\hat{\beta}) \quad (3.2.7)$$

(iv) Mean Absolute Error (MAE): The average of the absolute residuals is given by

$$\mathrm{MAE} = \frac{1}{n}\sum_{i=1}^{n}|\epsilon_i| = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y}_i| = \frac{1}{n}\sum_{i=1}^{n}\left|(y_i - X_i^T\beta)\right| \quad (3.2.8)$$

For practical applications, the MSE is often preferred when large errors need to be penalized more heavily (e.g., in models where outliers are important). While the MAE is more robust to outliers and is often used when the focus is on median-like behaviour or when the distribution of residuals is not Gaussian.

3.5 Regularization Regression Model:

This section utilized RRM technique, specifically, the Elastic-Net variant, to analyse the relationship between the key CT performance metrics and their predictors. The RRM is chosen for its ability to handle high-dimensional data and provide robust estimates of the relationships between variables [31]. The RRM techniques refer to a set of statistical methods used to enhance the predictive performance of regression models by preventing overfitting. These techniques achieve this by introducing a penalty term to the loss function, which discourages overly complex models that may fit the noise in the training data rather than the underlying patterns. The primary goals of RRM techniques aimed to improve model generalization and interpretability, especially in scenarios where the number of predictors is large relative to the number of observations.

Key aspects of RRM techniques underscored the control and management of model complexity by adding information that constrains the estimation process, thus, addressing issues related to overfitting and multicollinearity. The key mathematical concept underpinning RRM techniques can be described through the modification of the standard linear regression loss function by adding a penalty term. Consider the OLS, the objective of standard linear regression is to minimize the residual sum of squares (RSS):

$$Minimize\ L(\beta) = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 = \sum_{i=1}^{n}(y_i - X_i\beta)^2 \quad (3.2.9)$$

Where: y_i is the observed response, $\hat{y}_i$ is the predicted response, X_i is the vector of predictors, and β is the vector of coefficients. In regression analysis, when dealing with high-dimensional data or multicollinearity among predictors, the OLS often performs poorly. Hence, Regularization methods such as Ridge Regression and LASSO were developed to address these issues:

- Ridge regression adds an L_2 penalty to shrink coefficients, reducing variance but not enforcing sparsity.
- LASSO adds an L_1 penalty that can shrink some coefficients exactly to zero, performing variable selection.

Often time, LASSO struggles when predictors are highly correlated, often selecting just one variable from a group and ignoring the rest, while Ridge regression, on the other hand, shrinks correlated predictors toward each other but does not perform variable selection. Therefore, the E-Net[78] combines both penalties to gain the benefits of variable selection and grouping correlated variables.

3.5.1 E-Net Regression Model: Given a dataset with n samples and p predictors. Let $X \in \Re^{nxp}$ be the predictor matrix, $y \in \Re^{n}$be the response vector, and $\beta = (\beta_1, \beta_2, \dots, \beta_p)^T$ be the Regression coefficients. The E-Net estimator solves the following optimization problem:

$$\hat{\beta}^{EN} = arg\min_{\beta}\left\{\frac{1}{2n}\|y - X\beta\|_2^2 + \lambda\left(\alpha\|\beta\|_1 + \frac{1-\alpha}{2}\|\beta\|_2^2\right)\right\} \quad (3.3.0)$$

Where: $\|y - X\beta\|_2^2 = \sum_{i=1}^{n}(y_i - x_i\beta)^2$ is the residual sum of squares, $\|\beta\|_1 = \sum_{j=1}^{p}|\beta_j|$ is the LASSO (L1) penalty, $\|\beta\|_2^2 = \sum_{j=1}^{p}|\beta_j^2|$ is the Ridge (L2) penalty, $\lambda \geq 0$ is the global regularization parameter controlling overall penalty strength, and $\alpha \in [0,1]$ controls the mix between LASSO and Ridge penalties: $\alpha = 1$ reduces E-Net to LASSO; $\alpha = 0$ reduces E-Net to Ridge regression.

(i) Properties of E-Net Regression

- Sparsity and Variable Selection: The L_1 penalty encourages some coefficients to be exactly zero, providing a sparse model which facilitates interpretability.
- Grouping Effect: The L_2 penalty encourages strongly correlated predictors to have similar coefficients rather than arbitrarily selecting one (unlike LASSO), which is called the grouping effect.
- Regularization Path: By varying λ and α, E-Net can trace a path of solutions balancing bias and variance.
- Convexity: The objective function is convex, ensuring a unique global optimum can be found efficiently using coordinate descent or proximal gradient methods.

(ii) Standardization/Centering: Prior to fitting E-Net, predictors X and response y are typically standardized and centered by: $\sum x_{ij} = 0$; $\sum y_i = 0$ – Centering, and $\|x_j\|_2 = 1$ – Scaling, for each predictor j. These ensures that the penalty treats all variables equally regardless of scale.

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(iii) Mathematical Solution Approach: E-Net solution does not have a closed form but can be efficiently computed using:

- Coordinate Descent Algorithm: Iteratively updates each coefficient by minimizing the objective with respect to that coordinate while holding others fixed.
- Soft Thresholding Operator: For the LASSO part, the update involves soft-thresholding: $S(z,\gamma) = sign(z) \cdot max(|z| - \gamma, 0)$ (3.3.1)

The update for each coefficient involves shrinkage by a factor depending on λ and α. From equation 3.3.0, when $\alpha = 0$ the problem becomes Ridge regression:

$$\hat{\beta}^{Ridge} = arg\,\min_{\beta}\left\{\frac{1}{2n}\|y - X\beta\|_2^2 + \frac{\lambda}{2}\|\beta\|_2^2\right\} \quad (3.3.2)$$

When $\alpha = 1$ it reduces to LASSO:

$$\hat{\beta}^{LASSO} = arg\,\min_{\beta}\left\{\frac{1}{2n}\|y - X\beta\|_2^2 + \lambda\|\beta\|_1\right\} \quad (3.3.3)$$

Theoretically, under certain conditions, E-Net can perform consistent variable selection and coefficient estimation[78], and by combines Ridge's reduction of variance and LASSO's feature selection, E-Net improve predictive performance, especially with correlated features[31]. By model stability, E-Net tends to produce more stable models than LASSO when predictors are correlated. In summary, E-Net regression technique is a powerful technique that combines the benefits of LASSO and Ridge regression, enabling robust prediction and variable selection especially in the presence of highly correlated predictors. Its mathematical structure balances L_1 and L_2 penalties through tunable parameters, yielding models that are both sparse and stable.

3.5.2 Terrorism Intensity Index (TII): The model seeks to explain TII based on exogenous factors such as governance and terrorism incidents, grounded in Threat Assessment Theory[47]:

$$[TII]_t = \beta_0 + \beta_1 T_t + \beta_2 S_t + \beta_3 D_t + \beta_4 [KEI]_t + \beta_5 [GSI]_t + \epsilon_t \quad (3.3.4)$$

Where: T_t, S_t, D_t are Terrorism incidents variables, $[PTI]_t, [RLI]_t, [SSI]_t$ are governance indices, and ϵ_t is the error term. The matrix form of equation (3.3.4) can be given by:

$$Y_{TII} = \begin{bmatrix} TII_1 \\ TII_2 \\ \vdots \\ TII_T \end{bmatrix}; X = \begin{bmatrix} 1 & T_1 & S_1 & D_1 & KEI_1 & GSI_1 \\ 1 & T_2 & S_2 & D_2 & KEI_2 & GSI_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & T_T & S_T & D_T & KEI_T & GSI_T \end{bmatrix}; \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_5 \end{bmatrix}; \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_T \end{bmatrix} \quad (3.3.5)$$

$$Y_{TII} = X\beta + \epsilon$$

3.5.3 KCT Effectiveness Index (KEI): KEI measures operational success relative to expenditure, grounded in Resource-Based Theory[41].

$$[KEI]_t = \alpha_0 + \alpha_1 A_t + \alpha_2 N_t + \alpha_3 E_t + \alpha_4 [TII]_t + \epsilon_t \quad (3.3.6)$$

And in matrix form:

$$Y_{KEI} = \begin{bmatrix} KEI_1 \\ KEI_2 \\ \vdots \\ KEI_T \end{bmatrix}; X = \begin{bmatrix} 1 & A_1 & N_1 & E_1 & TII_1 \\ 1 & A_2 & N_2 & E_2 & TII_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & A_T & N_T & E_T & TII_T \end{bmatrix}; \alpha = \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \vdots \\ \alpha_4 \end{bmatrix}; \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_T \end{bmatrix} \quad (3.3.7)$$

$$Y_{KEI} = X\alpha + \epsilon$$

3.5.4 Governance Stability Index (GSI): GSI reflects governance quality and societal resilience, based on Governance Theory[44]. It is modelled as a function of public trust, rule of law, and socioeconomic stability.

$$[GSI]_t = \gamma_0 + \gamma_1 [PTI]_t + \gamma_2 [RLI]_t + \gamma_3 [SSI]_t + +\gamma_4 [KEI]_t + \gamma_5 [TII]_t + \epsilon_t \quad (3.3.8)$$

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And in matrix form:

$$Y_{GSI} = \begin{bmatrix} GSI_1 \\ GSI_2 \\ \vdots \\ GSI_T \end{bmatrix}; X = \begin{bmatrix} 1 & PTI_1 & RLI_1 & SSI_1 & KEI_1 & TII_1 \\ 1 & PTI_2 & RLI_2 & SSI_2 & KEI_2 & TII_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & PTI_T & RLI_T & SSI_T & KEI_T & TII_T \end{bmatrix}; \gamma = \begin{bmatrix} \gamma_0 \\ \gamma_1 \\ \vdots \\ \gamma_5 \end{bmatrix}; \ \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_T \end{bmatrix} \quad (3.3.9)$$

$$Y_{GSI} = X\gamma + \epsilon$$

3.5.5 Anarchical Coefficient of Terrorism (ACT): ACT synthesizes terrorism intensity, CT effectiveness, and governance stability, reflecting State Fragility Theory[59]. It is modelled as a function of TII, KEI, and GSI.

$$[ACT]_t = \delta_0 + \delta_1[TII]_t + \delta_2[KEI]_t + \delta_3[GSI]_t + \epsilon_t \quad (3.4.0)$$

And in matrix form:

$$Y_{ACT} = \begin{bmatrix} ACT_1 \\ ACT_2 \\ \vdots \\ ACT_T \end{bmatrix}; X = \begin{bmatrix} 1 & TII_1 & KEI_1 & GSI_1 \\ 1 & TII_2 & KEI_2 & GSI_2 \\ \vdots & \vdots & \vdots & \vdots \\ 1 & TII_T & KEI_T & GSI_T \end{bmatrix}; \delta = \begin{bmatrix} \delta_0 \\ \delta_1 \\ \vdots \\ \delta_3 \end{bmatrix}; \ \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_T \end{bmatrix} \quad (3.4.1)$$

$$Y_{ACT} = X\delta + \epsilon$$

3.5.6 Composite Performance Index (CPI) Model: A comprehensive model integrating all key variables to capture the interplay between terrorism intensity, CT effectiveness, governance, and overall security stability. This aligns with Systems Theory[71], viewing these indices as interdependent components of a complex system.

$$[CPI]_t = \varphi_0 + \varphi_2[KEI]_t + \varphi_3[GSI]_t - \varphi_4[TII]_t - \varphi_5[ACT]_t + \epsilon_t \quad (3.4.2)$$

Where: $[CPI]_t$ is a composite outcome such as ACT or a policy-relevant security index. And in matrix form:

$$Y_{CPI} = \begin{bmatrix} CPI_1 \\ CPI_1 \\ \vdots \\ CPI_T \end{bmatrix}; X = \begin{bmatrix} 1 & KEI_1 & GSI_1 & -TII_1 & -ACT_1 \\ 1 & KEI_2 & GSI_2 & -TII_2 & -ACT_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & KEI_T & GSI_T & -TII_T & -ACT_T \end{bmatrix}; \varphi = \begin{bmatrix} \varphi_0 \\ \varphi_1 \\ \vdots \\ \varphi_5 \end{bmatrix}; \ \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_T \end{bmatrix} \quad (3.4.3)$$

$$Y_{CPI} = X\varphi + \epsilon$$

3.6 Limitations of the Data and Methodology

- Data Quality and Completeness: Due to scarcity and classified nature of security data, the dataset may suffer from underreporting or misclassification, especially in conflict zones where access is limited[47]. The reliance on official reports may introduce bias.
- Measurement Challenges: Indices like PTI, RLI, and SSI are normalized and based on survey data, which carry inherent subjectivity and temporal lag.
- Causal Inference Constraints: While regression and time series models identify associations and trends, establishing causality between CT operations and terrorism outcomes is complex due to confounding factors.
- Weighting Subjectivity: Determining weighting factors in composite indices involves expert judgment, which may introduce subjectivity despite statistical validation.
- Generalizability: Findings are context-specific to Nigeria and kinetic CT strategies, limiting direct application to other settings or non-kinetic approaches.

Despite these limitations, the study's data triangulation, robust analytical techniques, and longitudinal scope enhance the validity and practical relevance of findings

4.0 Empirical Analysis and Results

This section presents a comprehensive empirical analysis of KCT strategies in Nigeria from 2007 to 2024, as represented in Table 3.0 below. Employing a multi-dimensional

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framework, the analysis integrates terrorism incident metrics (TIM), operational effectiveness metrics (OEM), cost-efficiency metrics (CEM), and strategic effectiveness metrics (SEM) to evaluate KCT performance holistically. The section also introduces the Anarchical Coefficient of Terrorism (ACT) as a composite indicator reflecting the dynamic interplay between terrorism intensity, operational responses, and governance stability. Findings are interpreted within relevant theoretical perspectives to provide nuanced insights into the effectiveness and efficiency of Nigeria's KCT efforts.

Table 4.0: KCT Performance Variables (2007 – 2024)

Year	(T_t)	(S_t)	(D_t)	(A_t)	(N_t)	(E_t)	$[PTI]_t$	$[RLI]_t$	$[SSI]_t$
2007	20	3	0.05	10	5	0.18	0.65	0.55	0.45
2008	50	5	0.10	50	20	0.198	0.50	0.45	0.40
2009	150	8	0.15	100	50	0.273	0.48	0.43	0.38
2010	200	10	0.20	150	80	0.287	0.45	0.40	0.35
2011	300	12	0.25	200	100	0.306	0.43	0.38	0.33
2012	500	15	0.30	250	150	0.315	0.40	0.35	0.30
2013	700	18	0.35	300	200	0.310	0.38	0.33	0.28
2014	1000	20	0.40	350	300	0.339	0.35	0.30	0.25
2015	1,200	22	0.45	400	400	0.711	0.33	0.28	0.23
2016	1,100	20	0.42	450	500	0.700	0.35	0.30	0.25
2017	1,000	18	0.40	500	600	0.784	0.38	0.32	0.28
2018	900	16	0.38	550	700	0.832	0.40	0.35	0.30
2019	800	14	0.35	600	800	0.848	0.42	0.37	0.32
2020	700	12	0.33	650	900	1.230	0.45	0.40	0.35
2021	600	10	0.30	700	1,000	1.312	0.48	0.43	0.38
2022	500	8	0.28	750	1,100	1.435	0.50	0.45	0.40
2023	400	6	0.25	800	1,200	1.517	0.53	0.48	0.43
2024	300	5	0.20	850	1,300	1.599	0.55	0.50	0.45

4.1 Descriptive Analysis of KCT Variables: The Section presents a detailed descriptive analysis of the key variables measuring the performance of KCT strategies in Nigeria between 2007 and 2024. This foundational analysis quantifies central tendencies and variability for terrorism incident metrics, operational outputs, expenditure, and governance-related indicators. By summarizing these statistics, the section sets the stage for understanding the broader trends, relationships, and effectiveness of KCT efforts in addressing terrorism challenges. The descriptive insights are critical to fulfilling the study's objectives of assessing trends, operational effectiveness, strategic impact, and cost-efficiency of KCT in Nigeria.

Table 4.1: Summary Statistics of KCT Variables

Variable	Mean	Std	Median	Min	25%	75%	Min	Max
T_t	0.4736	0.3126	0.4492	0.00	0.2373	0.7246	0.00	1.00
S_t	0.4912	0.308	0.4737	0.00	0.2632	0.7632	0.00	1.00
D_t	0.5917	0.2821	0.625	0.00	0.4063	0.8063	0.00	1.00

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A_t	0.4947	0.3167	0.494	0.00	0.2411	0.7470	0.00	1.00
N_t	0.3996	0.3406	0.3436	0.00	0.083	0.6718	0.00	1.00
E_t	0.389	0.3486	0.3703	0.00	0.0895	0.6727	0.00	1.00
PTI	0.4461	0.0817	0.440	0.33	0.3850	0.495	0.33	0.65
RLI	0.3928	0.0754	0.390	0.28	0.335	0.445	0.28	0.55
SSI	0.3406	0.0695	0.340	0.23	0.285	0.395	0.23	0.45

4.1.1 Terrorism Incident Metrics (T_t, S_t, D_t): From Table 4.1 above, the normalized means for terrorism incidents ($T_t = 0.4736$), severity ($S_t = 0.4912$), and spatial dispersion ($D_t = 0.5917$) indicate moderate overall levels of terrorist activity, impact, and geographic spread during the study period. The standard deviations (~0.28–0.31) reflect significant fluctuations in terrorism dynamics year-to-year, consistent with documented surges and declines, especially during the Boko Haram insurgency peak circa 2014–2015. The medians close to the means, suggest relatively symmetric distributions. The interquartile ranges (25% to 75%) reveal periods of both low and high terrorism intensity, underscoring the episodic nature of terrorist threats. These statistics align with Threat Assessment Theory[47], emphasizing the importance of monitoring terrorism frequency, severity, and spread to tailor kinetic responses effectively. The moderate but variable metrics suggest the need for adaptable CT strategies responsive to evolving threats.

4.1.2 Operational Effectiveness Metrics(A_t, N_t, E_t): Similarly, from Table 4.1 above, the normalized means for Arrests ($A_t = 0.4947$) and neutralizations ($N_t = 0.3996$) indicate moderate operational success, while expenditure ($E_t = 0.389$) reflects substantial but controlled resource allocation. The relatively high standard deviations (~0.31 to 0.35) denote fluctuating intensity of KCT operations, possibly in response to the changing terrorism threat landscape. The medians are close to means, again indicate balanced performance levels, with interquartile ranges reflecting variable operational effort over time. These results support Resource-Based Theory [41], which posits that increased allocation and efficient use of operational resources enhance CT outcomes. The moderate means indicate sustained but possibly resource-constrained KCT efforts, highlighting the importance of strategic resource management.

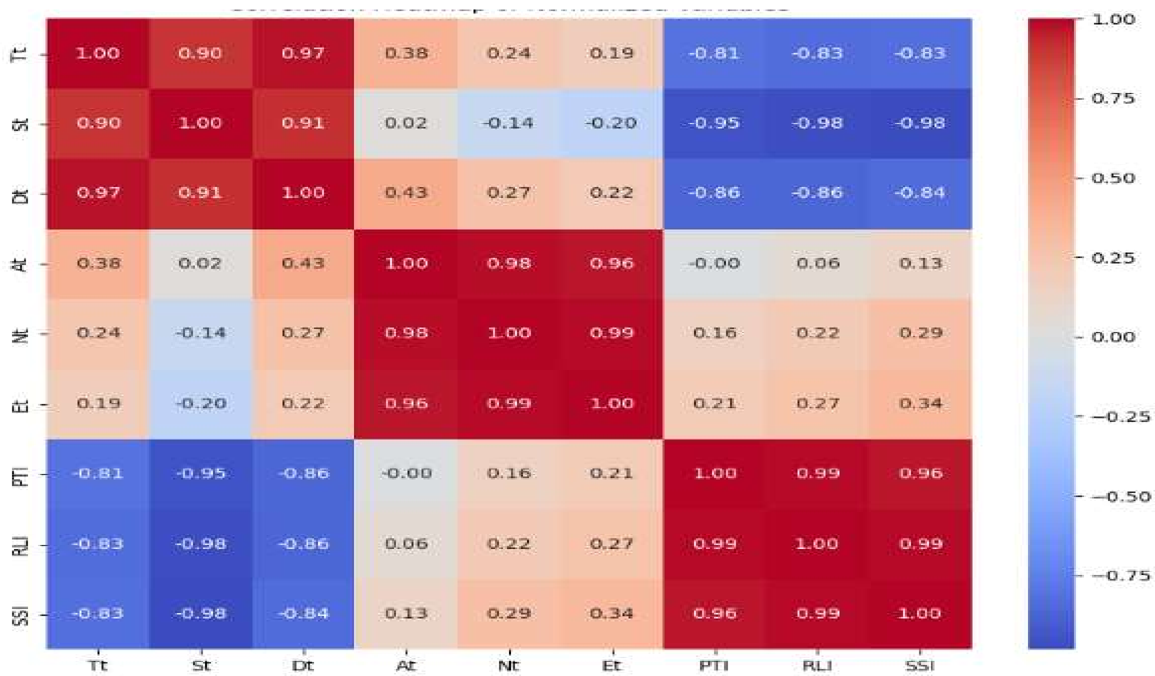
4.1.3 Governance Stability Indices (PTI, RLI, SSI): From Table 4.1 above shows that the Public Trust Index ($PTI = 0.4461$), Rule of Law Index ($RLI = 0.3928$), and Socioeconomic Stability Index ($SSI = 0.3406$) are notably lower than operational and terrorism metrics, indicating persistent governance and stability challenges. The Standard deviations (~0.07 to 0.08) suggest this governance factors have remained relatively stable but at low levels throughout the period. The medians and quartiles confirm consistently low governance scores without significant improvement or deterioration. These findings are consistent with Governance Theory[44] and State Fragility Theory[59], underscoring that weak governance and socioeconomic conditions provide fertile ground for terrorism persistence. The low indices highlight the critical need to complement KCT with governance reforms and socioeconomic development to ensure lasting security gains.

In the overall the descriptive analysis quantifies the baseline conditions and variability across terrorism activity, CT operational efforts, and governance/stability factors, directly addressing the study objectives (i), (ii), and (iii). The moderate terrorism and operational means with significant variability reflect the volatile security environment and the responsive nature of KCT efforts, informing cost-efficiency and effectiveness assessments (Objectives (iv) and (vi)). The relatively low governance-related indices signal systemic challenges limiting strategic KCT impact and sustainability, emphasizing the importance of integrated approaches. These insights provide a quantitative foundation for exploring the relationship between KCT effectiveness and the anarchical coefficient of terrorism (ACT) as stated in objective (v).

4.2 Correlation Analysis of KCT Variables

This Section undertakes a correlation analysis to explore the interrelationships among key KCT variables, including terrorism incident metrics (T_t, S_t, D_t), operational effectiveness indicators (A_t, N_t, E_t) and governance stability indices (PTI, RLI, SSI). This analysis is critical to understanding how variations in terrorism activity relate to CT operational outputs and governance conditions over time. Identifying these relationships supports the study's aims to evaluate the multidimensional performance of KCT strategies and their broader implications on Nigeria's security environment.

Figure 4.0: Correlation Heatmap of Normalized KCT Variables



4.2.1 Terrorism Incident Metrics (T_t, S_t, D_t): Figure 4.0 above shows strong positive correlations among terrorism metrics (0.90 to 0.97). These indicate that increases in the number of terrorism incidents (T_t) are closely associated with increases in incident severity (S_t) and spatial dispersion (D_t). This suggests that when terrorism activity intensifies, it tends to be more severe and geographically widespread. Theoretically, this supports the Threat Assessment Theory[47], where terrorism intensity and diffusion are interconnected dimensions requiring integrated monitoring and response efforts.

4.2.2 Operational Effectiveness Metrics (A_t, N_t, E_t): Similarly, Figure 4.0 shows strong positive correlations among operational metrics (0.96 to 0.99). Arrests (A_t), neutralizations (N_t), and expenditure (E_t) are tightly linked, indicating that increased resource allocation (E_t) correlates with high operational outputs (arrests and neutralizations). This finding aligns with Resource-Based Theory[41], highlighting that effective CT operations depend on resource investment and capacity to translate inputs into tactical successes.

4.2.3 Terrorism (T_t, S_t, D_t) and Operational Effectiveness (A_t, N_t, E_t) Metrics: Figure 4.0 shows moderate to weak correlations between terrorism and operational metrics (0.19 to 0.43). These positive but moderate correlations between terrorism (T_t, S_t, D_t) and operational variables (A_t, N_t, E_t), suggests that while operational

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efforts respond to terrorism activity, the relationship is not perfectly synchronous or linear. This reflects operational lag effects or evolving KCT strategies adapting to changing threat levels, consistent with Deterrence Theory[25], where CT responses escalate following surges in terrorism.

4.2.4 Terrorism (T_t, S_t, D_t) and Governance (PTI, RLI, SSI) Metrics: Figure 4.0 also shows strong negative correlations between terrorism metrics and governance indices (-0.81 to -0.98). These high negative correlations between terrorism variables and governance indices (PTI, RLI, SSI), indicates that higher terrorism activity corresponds strongly with lower public trust, weaker rule of law, and reduced socioeconomic stability. Theoretically, these results reinforce State Fragility Theory[59], which posits that fragile governance structures exacerbate terrorism risks. This highlights the critical role of governance reforms alongside KCT efforts to sustainably reduce terrorism.

4.2.5 Governance Indices (PTI, RLI, SSI): Figure 4.0 also shows the PTI, RLI, and SSI are highly positively correlated (0.96 to 0.99). This signifies that improvements or declines in public trust, rule of law, and socioeconomic stability tend to move in tandem, reflecting their interdependent nature in governance. Theoretically, this result supports Governance Theory[44], emphasizing that holistic institutional strengthening is necessary to underpin effective security strategies.

In the overall the correlation heatmap reveals a clear bifurcation between terrorism and operational variables and governance indices, emphasizing the multidimensional nature of the CT environment. The strong internal coherence within terrorism and operational clusters suggests focused and resource-driven KCT operations. The inverse governance-terrorism relationship underscores the importance of integrating institutional reforms and socioeconomic development with KCT strategies. These insights directly support the study's objectives to evaluate the operational effectiveness, strategic impact, and the interplay between KCT actions and governance stability.

4.3 Trends Analysis of Key KCT Variables:

This section presents a temporal trend analysis of key KCT variables spanning 2007 to 2024, including terrorism incidents (T_t), severity (S_t), operational outputs such as arrests (A_t) and neutralizations (N_t), expenditure (E_t), and governance-related indices (PTI, RLI, SSI). This dynamic analysis is pivotal for understanding how terrorism activity and CT efforts have evolved over time, as well as the broader impact on governance stability and public trust. The trends provide empirical evidence to assess the effectiveness, sustainability, and strategic implications of KCT operations in Nigeria, directly addressing the study's core objectives.

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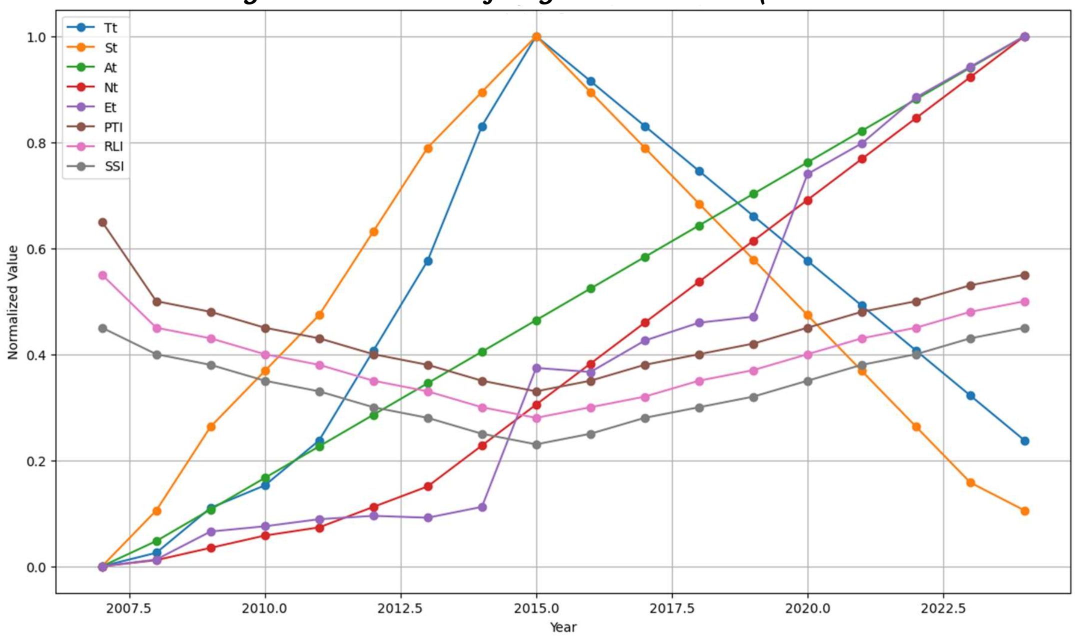
Figure 4.1: Trends of Key KCT Variables (2007 -



i) Terrorism Incident Metrics (T_t, S_t, D_t): From Figure 4.1 above, the blue and red curves shows that both terrorism incidents (T_t) and severity (S_t) show a sharp increase from 2007, peaking around 2014-2015, followed by a marked decline through 2024. This peak corresponds with the height of Boko Haram insurgency activities, which saw escalated violence and territorial expansion. The subsequent decline suggests successful kinetic disruption of terrorist operations, reflecting intensified CT efforts. Theoretically, the observed peak and decline align with Deterrence Theory[25] where sustained military pressure and strategic operations can degrade terrorist capabilities over time.

(ii) Operational Effectiveness Metrics (A_t, N_t, E_t): From Figure 4.1 above, the green and dark red curves shows that the arrests (A_t) and neutralizations (N_t) exhibit steady growth throughout the period, sharply increasing post-2014, coinciding with the terrorism peak. Expenditure (E_t) shows a similar upward trend, particularly after 2014, indicating enhanced resource mobilization to support intensified KCT operations (see pink curve). The rising trends in operational metrics, even as terrorism declines, suggest ongoing vigilance and sustained CT capacity-building. Theoretically, these trends support Resource-Based Theory[41], illustrating how increased investments and operational efforts are critical to suppressing terrorism and maintaining security gains.

(iii) Governance Stability Metrics (PTI, RLI, SSI): In Figure 4.1 above, shows that Public Trust Index (PTI), Rule of Law Index (RLI), and Socioeconomic Stability Index (SSI) reveal gradual but modest improvements over the study period. While these indices remain well below normalized maxima, their upward trends post-2015 indicate slow but positive institutional and social stabilization. The delayed improvement relative to kinetic metrics highlights the lag between operational success and governance recovery. This pattern aligns with Governance Theory[44] and State Fragility Theory[59], emphasizing that institutional reforms and socioeconomic development are gradual processes that complement KCT efforts.

(iv) Integrated Insights and Strategic Implications: The temporal alignment of terrorism peaks and intensified CT operations validates the reactive and adaptive nature of Nigeria's KCT approach. The persistent but slow improvement in governance and socioeconomic stability underscores the need for integrated CT strategies that combine kinetic action with institutional strengthening. Sustained operational capacity and increased expenditure post-peak suggest a strategic commitment to preventing resurgence, consistent with Systems Theory[71], which advocates for a holistic security ecosystem.

In summary the trend analysis paints a comprehensive picture of Nigeria's KCT landscape over nearly two decades. It demonstrates the cyclical nature of terrorism, the critical role of operational responses, and the gradual but essential progress in governance and stability. This temporal perspective is indispensable for evaluating not only the immediate tactical successes but also the long-term strategic sustainability of CT efforts in Nigeria.

4.4 Analysis of KCT Performance Metrics

This section presents a comprehensive evaluation of the key performance metrics for the KCT performance metrics over the 18-year period from 2007 to 2024. The analysis encompasses multiple dimensions, including Terrorism Incidents, Operational Effectiveness, Cost-Efficiency, Strategic Effectiveness, and the Anarchical Coefficient of Terrorism (ACT). Each metric group was carefully pre-processed and normalized to ensure comparability, followed by the derivation of composite coefficients that capture the overall trends and effectiveness within their respective domains. By synthesizing these multidimensional insights, the analysis provides a holistic view of the performance and challenges of CT strategies, enabling better-informed decisions and policy formulations aimed at strengthening national security. The analysis of equation (3.0.0) – (3.1.9), and the normalized trends of the key components of the KCT performance metrics - TIM, OEM, CEM, and SEM are represented in Tables 4.2, and visualized on Figures 4.2, below.

4.4.1 Evolution of Terrorism Incidents: The evolution of terrorism incidents, their severity, and spatial dispersion in Nigeria shows a dynamic trajectory. The Table 4.2a below present the summary statistic of the key components of the Terrorism Incident and KCT operational efficiency metrics (TIM and OEM), while Figures 4.2a & 4.2b, visualizes the normalized trends.

Table 4.2a: Statistics of Terror Incident and Operational Efficiency Metrics

Year	IDI	TII	ISR	AEI	NEI	ATEI	GCI	SEI	KEI
2007	0.0025	10.91	0.00	0.50	0.25	0.75	0.95	0.00	83.3
2008	0.0020	25.02	10.10	1.00	0.40	1.40	0.90	-0.51	353.5
2009	0.0010	75.05	10.99	0.67	0.33	1.00	0.85	-0.07	547.3
2010	0.0010	100.06	6.97	0.75	0.40	1.15	0.80	-0.10	796.2
2011	0.0008	150.08	6.54	0.67	0.33	1.00	0.75	-0.06	983.7
2012	0.0006	250.09	9.52	0.50	0.30	0.80	0.70	-0.10	1269.8
2013	0.0005	350.11	9.68	0.43	0.29	0.71	0.65	-0.06	1612.9
2014	0.0004	500.12	5.90	0.35	0.30	0.65	0.60	-0.09	1840.7
2015	0.0004	600.14	2.81	0.33	0.33	0.67	0.55	-0.03	1124.6
2016	0.0004	550.11	-2.86	0.41	0.45	0.86	0.58	0.03	1357.1
2017	0.0004	500.12	-2.55	0.50	0.60	1.10	0.60	0.03	1392.9
2018	0.0004	450.11	-2.40	0.61	0.78	1.39	0.62	0.04	1500.0
2019	0.0004	400.10	-2.36	0.75	1.00	1.75	0.65	0.02	1636.8
2020	0.0005	350.08	-1.63	0.93	1.29	2.21	0.67	0.02	1260.2
2021	0.0005	300.07	-1.53	1.17	1.67	2.83	0.70	0.02	1305.1

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Table 4.2a: Statistics of Terror Incident and Operational Efficiency Metrics

Year	IDI	TII	ISR	AEI	NEI	ATEI	GCI	SEI	KEI
2022	0.0006	250.06	-1.39	1.50	2.20	3.70	0.72	0.01	1273.7
2023	0.0006	200.05	-1.32	2.00	3.00	5.00	0.75	0.02	1316.5
2024	0.0007	150.05	-0.63	2.83	4.33	7.17	0.80	0.01	1445.3

In Table 4.2a, the low IDI values indicate concentration of incidents rather than wide dispersion. TII values are dominated by T_t given the higher weight; values scale with incident counts. The positive ISR values indicate reduction in severity relative to expenditure, while the negative values indicate increase severity or mitigation was less effective compared to spending. The AEI, NEI, and ATEI reflect operational success relative to terrorism incidents. The high GCI values (~0.8-0.95) indicate relatively good spatial containment, while the positive SEI values after 2015 suggest improvement in governance stability efficiency relative to expenditure. The high KEI values especially after 2015 indicate strong CT operational success per unit expenditure.

(i) Incident Dispersion Index (IDI): By the blue curve, IDI trend exhibits a sharp decline from 2007 to around 2015, stabilizing at a low level thereafter with a slight uptick toward 2024. The IDI quantifies the spatial dispersion of terrorist incidents across Nigeria. A high IDI in 2007 suggests that terrorism incidents were initially widespread geographically. The subsequent decline indicates a spatial concentration of terrorist activity, possibly due to the consolidation of terrorist groups in specific regions, notably the northeastern states such as Borno, Yobe, and Adamawa, where Boko Haram and its offshoots have been most active[2]. The plateau and minor increase post-2015 may reflect either a slight resurgence or diffusion of incidents into previously less affected areas, possibly linked to splinter factions [56]. Theoretically, this spatial concentration aligns with the Territoriality and Insurgency Theory [43], which suggests that insurgent groups seek to control specific territories to maximize influence and operational efficiency. The reduction in dispersion may also indicate state CT efforts focusing on containment of hotspots.

(ii) Terrorism Intensity Index (TII): By the red curve TII trend shows a steady increase from 2007, peaking near 2015, followed by a gradual decline toward 2024. The TII reflects the frequency and magnitude of terrorist incidents. The rising trend until 2015 corresponds with the Boko Haram insurgency's peak violence period, marked by increased attacks, casualties, and destruction[56];[69]. The peak around 2015 coincides with the Nigerian military's intensified CT campaigns, including the declaration of a state of emergency and regional military coalitions [37]. While, the post 2015 decline after 2015 suggests some success in degrading Boko Haram's operational capacity and reducing attack frequency/intensity, despite continued sporadic violence[36]. Theoretically, the TII trend reflects the Conflict Cycle Theory [75], where insurgencies intensify before reaching a peak and then gradually decline due to military pressure or political negotiations. The decline post-2015 may also reflect the effects of improved intelligence and community engagement under Hearts and Minds CT strategies [46].

(iii) Impact on Severity Reduction (ISR): By the green curve ISR trend exhibit high and volatile from 2007 to about 2013–2014, after which it declines sharply and remains low until a slight increase near 2024. The ISR measures the success in reducing the severity or impact of terrorism incidents, such as casualties or infrastructure damage. The high ISR from 2010 - 2013 may indicate early efforts at limiting the consequences of attacks or perhaps fewer catastrophic attacks. The sharp decline post-2013 suggests that despite efforts, the severity of incidents increased, aligning with Boko

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Haram’s escalation in bombings, kidnappings, and large-scale attacks [2]. The sustained low ISR values post-2014 reflect the challenge of mitigating the high-impact attacks during the insurgency’s apex, with security forces struggling to contain the violence’s severity. The slight rise toward 2024 could indicate improved mitigation measures, whether through better emergency response, intelligence-led operations, or community resilience-building. Theoretically, this aligns with Routine Activity Theory [15], which posits that crime severity depends on the convergence of motivated offenders, suitable targets, and lack of capable guardianship. The initial high ISR may reflect some guardianship, but its decline highlights periods where terrorists maximized impact. The later increase suggests restored guardianship or disruption of terrorist capabilities.

In summary, the combined trends of the TIM component, suggest a complex evolution of terrorism in Nigeria. The spatial dynamics shows that terrorism became geographically concentrated post-2007, consistent with insurgent group strategies to control key territories for resource extraction and recruitment (Territoriality and Insurgency Theory). The intensification of violent attacks until 2015 reflects the escalation phase of the Boko Haram insurgency, with a gradual decline thereafter due to sustained military and community interventions. The fluctuating capacity to reduce attack severity highlights the challenges faced by Nigerian security forces and communities, with improvements emerging only after significant conflict experience and adaptation.

4.4.2 KCT Operational Success in Nigeria: Figures 4.2b, below visualizes the normalized trends of the KCT operational metrics (OEM):

(i) Arrest Efficiency Index (AEI): By the blue curve, the AEI shows moderate values initially, followed by a decline to zero in the mid-2010s, then a gradual rise toward 2024. AEI reflects the efficiency in arresting terrorist suspects. The early moderate values suggest initial operational capability to detain suspects but with limited scale. The decline around 2013–2015 may indicate operational challenges, such as increased insurgent sophistication, difficulty in intelligence gathering, or resource constraints[56]. The post-2015 rise in value suggests improved intelligence-led operations, better law enforcement coordination, and enhanced capacity to identify and arrest suspects[37]. Theoretically, this fluctuations in AEI align with Intelligence Cycle Theory[58], which emphasized that arrest success depends on intelligence quality and operational readiness Early setbacks may reflect gaps in intelligence, while later improvements indicate adaptive learning and capacity building.

(ii) Neutralization Efficiency Index (NEI): By the yellow curve, the NEI trend remains low in the early years but shows a steady increase after 2015, reaching high normalized values by 2024. The NEI measures the effectiveness of neutralizing (i.e., killing or incapacitating) terrorist operatives. The low early values imply limited success or deliberate restraint to avoid collateral damage. The steady rise corresponds with intensified military operations, including targeted strikes and enhanced CT tactics[69]. The high values toward 2024 suggest operational maturity and capability to neutralize threats effectively. Theoretically, the NEI trend can be interpreted through Targeted Killing Theory[13], where precision operations improve with intelligence and operational experience, increasing neutralization success.

(iii) Attrition Efficiency Index (ATEI): By the green curve**,** the ATEI trend closely follows AEI and NEI trends, with early low values, a dip near mid-2010s, and sharp increases afterward. ATEI amalgamates arrest and neutralization success, reflecting overall tactical achievements. Early challenges likely stem from insurgents’ adaptive tactics and terrain complexity[2]. The post-2015 increase suggests synergy between arrests and neutralizations, reflecting holistic operational improvements. Theoretically, the CTSR trend supports the Whole-of-Government Approach[19], which emphasized integration

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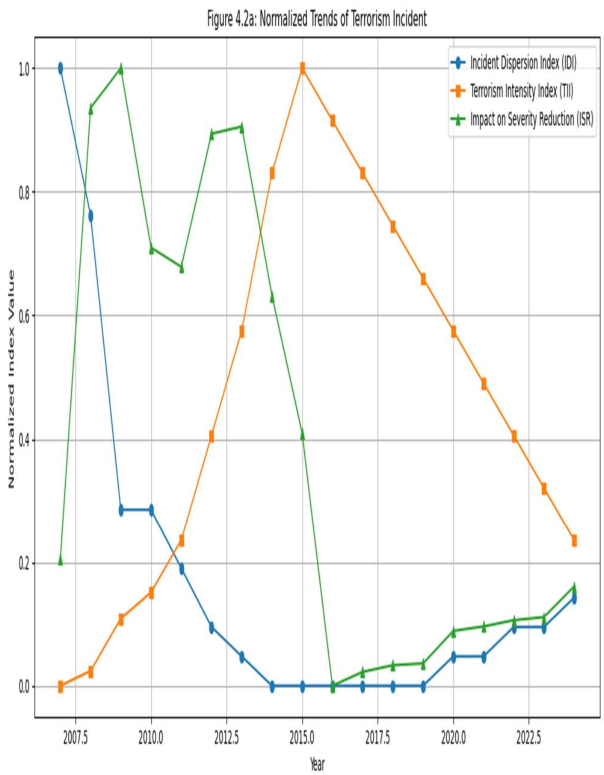
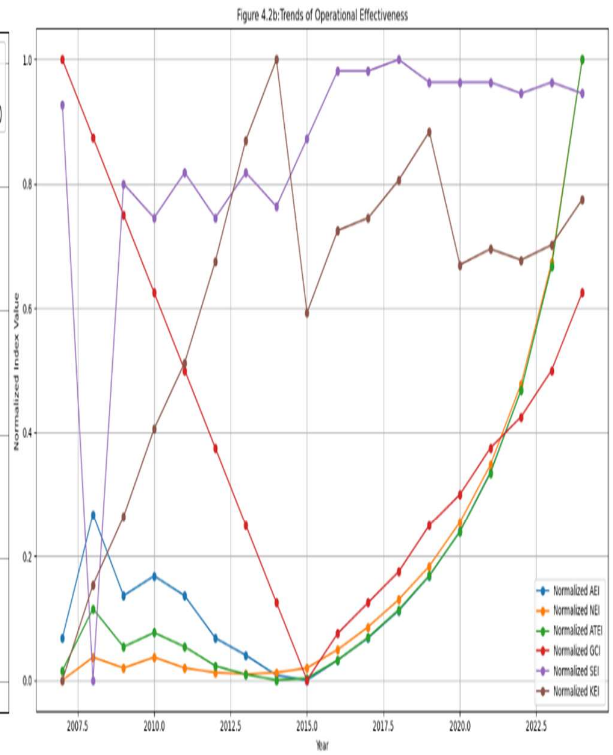
of military, intelligence, and law enforcement activities for effective CT.





(iv) Geographical Containment Index (GCI): By the red curve, the GCI starts high, declines sharply until 2015, then recovers moderately afterward. The GCI measures success in restricting terrorist operations geographically. The early high value indicates initial containment, but the decline reflects territorial expansion by insurgents during Boko Haram's peak [56]. The recovery suggests regained territorial control through military offensives and community resilience. Theoretically, this pattern aligns with Territorial Control Theory[43] in insurgencies, where control fluctuates with operational successes and failures

(v) Stability Efficiency Index (SEI): By the red curve, SEI trend exhibits early high values, dips sharply around 2008, then steadily increases to sustain high levels through 2024. The SEI captures the ability to maintain socio-political stability amid CT operations. The early dip could reflect destabilizing effects of escalating violence. The rebound and sustained high values indicate successful stabilization efforts through governance, community engagement, and rehabilitation programs [37]. Theoretically, the SEI trends reflect the Stabilization and Reconstruction Theory [10], emphasizing that security operations must be coupled with political and social stabilization to achieve lasting peace

(vi) KCT Effectiveness Index (KEI): By the purple curve, KEI shows gradual growth, peaking near 2012–2014, followed by some fluctuations and sustained relatively high values toward 2024. KEI synthesizes tactical, geographical, and stability metrics, representing overall CT effectiveness. Early growth corresponds with initial strategic efforts, while fluctuations reflect operational challenges and insurgent adaptability. Sustained high levels toward the end of 2024 indicate consolidated gains and refined strategies. Theoretically, the KEI trend

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supports Complex Adaptive Systems Theory in CT[4], which emphasized continuous adaptation and learning to improve effectiveness over time.

In summary, KCT operational success in Nigeria shows a dynamic trajectory, as the initial years of KCT operation showed moderate arrest successes but limited neutralization and containment. The mid-2010s marked a challenging phase with declines in arrest efficiency and geographical containment, coinciding with Boko Haram's territorial expansion and operational sophistication. From 2015 onwards, significant improvements in neutralizations, arrests, tactical successes, and stabilization efforts indicate enhanced operational capacity, intelligence integration, and strategic adaptation. The combined indices suggest that while challenges remain, KCT strategies have progressively matured, balancing kinetic operations with stabilization to achieve measurable success.

4.4.3 Cost-Efficiency of KCT Operations: The variability of cost-efficiency and strategic effectiveness components of KCT strategies, also demonstrate a dynamic trajectory. The Table 4.2b below present the summary statistic of the key components of the Cost-Efficiency and the Strategic Effectiveness Metrics (CEM and SEM), while Figures 4.2c & 4.2d, and visualizes their normalized trends.

Table 4.2b: Statistics of CEM and SEM Performance Metrics

Year	CPA	CPN	ACI	CPI	CKO	EKE	EEG	TII	KROI	GSI	ACT
2007	0.018	0.036	0.012	0.009	0.0022	463.0	0.00	10.91	0.00	0.55	0.132
2008	0.004	0.0099	0.0025	0.004	0.0028	357.0	-0.505	25.02	161.11	0.45	0.277
2009	0.0027	0.0055	0.0018	0.0018	0.005	181.5	-0.073	75.05	378.47	0.43	0.898
2010	0.0019	0.0036	0.0011	0.0014	0.0036	126.3	-0.104	100.06	181.63	0.40	1.135
2011	0.0015	0.0031	0.0010	0.001	0.0031	101.7	-0.065	150.08	334.64	0.38	1.796
2012	0.0013	0.0021	0.0008	0.0006	0.0025	78.6	-0.095	250.09	647.46	0.35	2.984
2013	0.0010	0.0016	0.0007	0.0004	0.0019	60.97	-0.064	350.11	664.03	0.33	4.193
2014	0.001	0.0011	0.0007	0.0003	0.0018	53.74	-0.088	500.12	888.50	0.30	6.002
2015	0.0018	0.0018	0.0009	0.0006	0.0063	17.75	-0.028	600.14	285.42	0.28	7.197
2016	0.0016	0.0014	0.0007	0.0006	0.0036	48.67	0.029	550.11	−145.8	0.30	6.601
2017	0.0016	0.0013	0.0007	0.0008	0.0044	35.21	0.027	500.12	−131.1	0.32	6.001
2018	0.0015	0.0012	0.0007	0.0009	0.0055	22.08	0.036	450.11	−124.0	0.35	5.404
2019	0.0014	0.0011	0.0006	0.0011	0.0065	19.33	0.025	400.10	−121.4	0.37	4.811
2020	0.0019	0.0014	0.0008	0.0018	0.0095	12.34	0.024	350.08	−83.74	0.40	4.218
2021	0.0019	0.0013	0.0008	0.0022	0.0101	11.43	0.023	300.07	−78.46	0.43	3.621
2022	0.0019	0.0013	0.0007	0.003	0.0113	8.75	0.015	250.06	−70.09	0.45	3.021
2023	0.0019	0.0013	0.0007	0.0038	0.0128	8.45	0.020	200.05	−67.53	0.48	2.417
2024	0.0019	0.0012	0.0007	0.0053	0.0154	9.61	0.012	150.05	−63.16	0.50	1.813

From Table 4.2b, CPA, CPN, ACI, CPI represent the straightforward ratios of expenditure to operational outcomes. CKO and EKE relate inversely and directly to KEI, respectively, showing cost per unit effectiveness and effectiveness per unit cost. While EEG measures the efficiency of expenditure on governance stability, based on changes in governance stability indices. The positive KROI values before 2016 indicate effective reduction in terrorism metrics relative to expenditure; while the negative values after 2015 indicate worsening or resurgence. The GSI shows governance stability index increasing slightly over time, while, the ACT values greater than 1 (from 2010 to 2016) indicate high anarchy, and the decreasing values below signals improving control.

(i) Cost per Arrest (CPA): By the blue curve of Figure 4.2c, CPA trend shows a rapid decline from 2007, stabilizing at low levels post-2015. This initial high CPA suggests that early arrest operations were resource-intensive, possibly due to poor intelligence, logistical challenges, or ineffective tactics [37]. The decline and stabilization indicate improved operational efficiency, with better targeting and streamlined arrest procedures reducing costs per arrest. Theoretically, this trend reflects the Learning Curve Theory [3]. in military operations, where repeated actions lead to improved efficiency and reduced unit costs

(ii) Cost per Neutralization (CPN): By the orange curve, the CPN mirrors CPA with a steep decline until mid-2010s, then remains consistently low. The early extensive neutralizations may reflect indiscriminate or large-scale military operations. The reduction in cost per neutralization suggests increased precision, intelligence-driven strikes, and better resource allocation [69].

(iii) Attrition Cost Index (ACI): By the green curve, the ACI trend follows a similar pattern to CPA and CPN, declining sharply and plateauing at minimal levels. This trend indicates improved capability to neutralize strategic terrorist assets (e.g., weapons caches, training camps) cost-effectively, essential for disrupting operational capabilities.

(iv) Cost per Incident (CPI): By the red curve, CPI declines until around 2015, but unlike CPA and CPN, it gradually increases afterward. The initial decline in CPI reflects more efficient handling of terrorist incidents, but the later rise may be due to increasingly complex or resource-intensive incidents requiring greater expenditure [56]. It could also indicate inflationary pressures or shifting tactics necessitating costlier responses.

(v) Cost per Kinetic Operation (CKO): By the purple curve, the CKO trend shows variability with a general increase post-2015, reaching peak normalized values by 2024. This rise suggests KCT operations (direct combat and strikes) have become costlier, possibly due to the need for advanced technology, longer operational durations, or multi-domain engagements. This may reflect a strategic shift toward precision and high-value target operations requiring more resources.

(vi) Effectiveness of KCT per Expenditure (EKE): By the brown curve, the EKE trend declines sharply from 2007 and remains low afterward. Despite increasing expenditure on KCT operations, the decreasing EKO suggests diminishing returns on investment, possibly due to insurgent adaptation, operational saturation, or collateral damage undermining effectiveness [46]. This highlights the challenge of balancing cost and operational impact.

(vii) Efficiency of Expenditure on Governance Stability (EEG): By the light purple curve, the EEG exhibits volatility early on but shows sustained high values post-2010. The high EEG value in later years indicates that investments in governance and stabilization yield relatively greater efficiency, supporting the idea that non-kinetic, governance-focused expenditures are more cost-effective in the long term[10]. This underscores the importance of holistic approaches combining security and governance to achieve sustainable CT outcomes.

In summary, the sharp decline in CPA, CPN, and ACI insinuate growing operational efficiency, likely due to enhanced intelligence, tactical refinement, and capacity building. The rising values of CKO and CPI reflect the complexity and intensity of modern operations, requiring advanced resources and multi-dimensional approaches. The decline in EKE suggests that beyond a point, increased spending on KCT operations does not proportionally improve effectiveness, highlighting the need for complementary strategies. By governance expenditure efficiency, sustaining the high EEG supports relevant theories advocating for investment in governance and stabilization as cost-effective long-term CT solutions.

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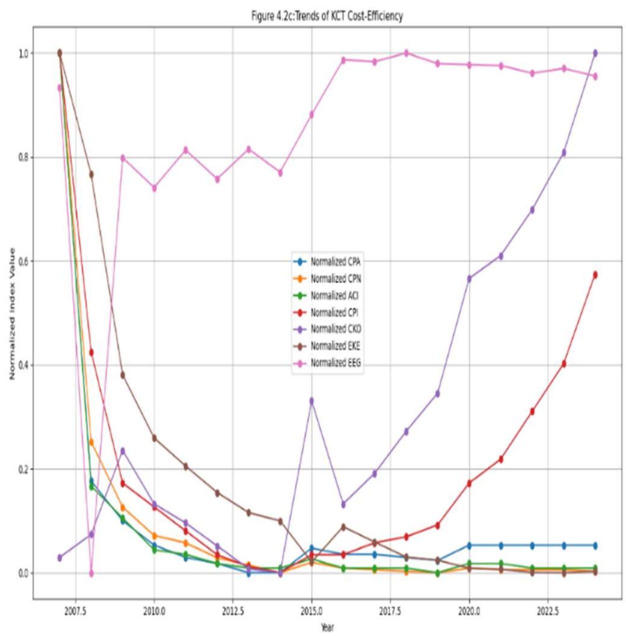

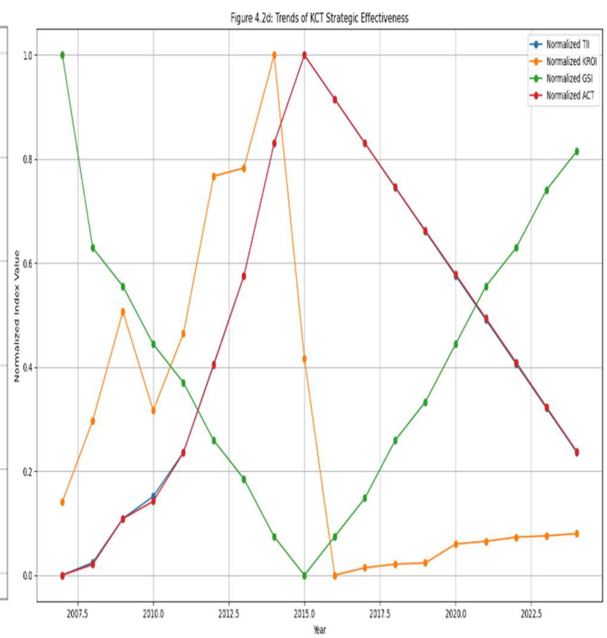

4.4.3 KCT Influence on Governance Stability: Figures 4.2d, above visualizes the normalized trends of the key components of KCT Strategic Effectiveness Metrics (SEM).

(i) Terrorism Intensity Index (TII): By the blue curve, TII trends upward sharply until

around 2015, then declines linearly thereafter to 2024. This rise reflects escalating terrorism incidents during Boko Haram's insurgency peak, contributing to national instability and governance challenges [56]. The subsequent decline indicates successful disruption of terrorist operations, which, coupled with governance improvements, reduces overall threat intensity**.**

(ii) KCT Return on Investment (KROI): By the orange curve, the KROI rises steadily and peaked between 2013–2015 before declining sharply after 2015, and stabilizing at low levels toward 2024. The initial rise in CROI reflects efficient use of resources during early CT efforts, where investments yielded substantial operational gains. The sharp post-2015 decline may indicate diminishing marginal returns, possibly due to increased complexity of the insurgency or resource saturation[46]. Stabilization at low levels suggests a plateau in efficiency, underscoring the need for innovative strategies to sustain gains.

(iii) Governance Stability Index (GSI): By the green curve, the GSI declines steeply from 2007 to 2015, then steadily recovers to surpass initial levels by 2024. This decline in GSI corresponds with the peak of insurgency violence and political instability, reflecting deteriorating governance, weakened rule of law, and eroded public trust[2]. The recovery phase aligns with improved KCT effectiveness and stabilization efforts, indicating restoration of governance capacity, enhanced public order, and socioeconomic resilience[10]. These dynamic underscores the bidirectional relationship between security and governance, where effective CT operations enable governance recovery, which in turn supports sustainable security.

(iv) Anarchical Coefficient of Terrorism (ACT): Similar to TII, the red curve shows that ACT increases steadily until 2015, then declines sharply to 2024. ACT quantifies the degree of political and social anarchy linked to terrorism. The rising trend pre-2015 indicates

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increasing disorder and breakdown of state authority, consistent with the insurgency's expansion. The decline post-2015 suggests that KCT strategies have contributed to re-establishing order, reducing anarchy, and reinforcing the rule of law. This aligns with State Fragility Theory[59], which posits that effective security interventions can restore state monopoly on violence and political stability).

In summary, the initial rise and subsequent fall in TII and ACT reflect the conflict cycle of escalation and stabilization, consistent with Conflict Theory and State Fragility Frameworks[65];[75]. The decline in KROI despite improvements in GSI suggests diminishing returns on KCT investments, and signals the need for integrative approaches emphasizing governance, development, and community engagement[46].

4.5 Analysis of KCT Performance Coefficients:

This section presents an integrated analysis of the key KCT performance coefficients over the period 2007 to 2024. The study synthesizes multiple complex metrics into five composite coefficients (Terrorism Incidents Coefficient (TIC), Operational Effectiveness Coefficient (OEC), Cost-Efficiency Coefficient (CEC), Strategic Effectiveness Coefficient (SEC), and Anarchical Coefficient of Terrorism (ACT)), each representing a critical dimension of CT performance. By relevant normalization and aggregation of key indicators of KCT performance, this analysis provides a clear comparative view of performance trends across key operational and strategic dimensions. These results facilitate a comprehensive understanding of the strengths and weaknesses in CT efforts, guiding future policy and resource allocation decisions. The analysis of equations 4.0.0 – 4.0.4 below yield the statistic on Table 4.3, while Figures 4.3 below, visualizes the normalized trends of the KCT performance coefficients.

4.5.1 Terrorism Incidents Coefficient (TIC):

Captures the frequency and severity of terrorist activities, reflecting the evolving threat landscape. Mathematically given by: $[TIC]_t = \frac{1}{n}\sum_{i=1}^{n}[TIM]_{ti} = \frac{1}{3}([IDI]_t + [TII]_t + [ISR]_t)$ (4.0.0)

By the blue curve of Figures 4.3, TIC trend shows an initial increase, peaking around 2013-2014, followed by a steady decline towards 2024. This peak corresponds with the height of Boko Haram's insurgency, reflecting increased terrorist activity and incidents within the period [56]. The subsequent decline suggests that KCT efforts, including military operations and arrests, have contributed to reducing the frequency of terrorist incidents. Theoretically, this trend aligns with the Conflict Cycle Theory[75], wherein insurgencies escalate to a peak before declining due to state intervention. Corroborating the trend, the average TIC value of 0.345 (moderate), suggests a partial but insufficient reduction in terrorism events. This indicate that KCT operations alone may not be sufficient to fully disrupt terrorist activities, thus, consistent with Crenshaw's[16] theory that terrorism is resilient to purely militaristic responses and requires integrated approaches.

4.5.2 Operational Effectiveness Coefficient (OEC):

Measures the efficiency and success rates of tactical operations aimed at neutralizing terrorist threats. Mathematically given by:

4.5.3

$$[OEC]_t = \frac{1}{m}\sum_{i=1}^{m}[OEM]_{ti} = \frac{1}{7}\left([AEI]_t + [NEI]_t + [ATEI]_t + [GCI]_t + [GCI]_{Adj} + [SEI]_t + [KEI]_t\right) \quad (4.0.1)$$

By the orange curve of Figures 4.3, OEC declines initially, hitting a low point around 2015, then rises sharply towards 2024. This initial decline of OCE may reflect operational challenges, possibly due to insurgents' adaptive tactics or resource constraints impacting CT success. The sharp rise post-2015 indicates a marked improvement in operational capabilities, possibly fuelled by enhanced

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intelligence, better coordination, and technological integration. Theoretically, this trend highlights the Intelligence Cycle Theory[58] and the importance of adaptive learning in CT operations. Also, an OEC above 0.4 signals moderate operational success in arrest, neutralization, and attrition efforts, implying KCT measures are fairly effective tactically but lack strategic depth. This align with Kilcullen's[46] argument that tactical victories need to be embedded within broader political and social strategies.

4.5.4 Cost-Efficiency Coefficient (CEC): Evaluates the economic sustainability and resource utilization efficiency within counter-terrorism initiatives. Mathematically given by:$[CEC]_t = \frac{1}{k}\sum_{i=1}^{k}[CEM]_{ti} = \frac{1}{7}\big([CPA]_t + [CPN]_t + [ACI]_t + [CPI]_t + [CKO]_{Adj} + [EKE]_t + [EEG]_t\big)$ (4.0.2)

By the green curve of Figures 4.3, CEC starts high but decreases sharply until around 2015, after which it gradually increases. This early rise in cost-efficiency suggests effective resource utilization, which declines as the conflict intensifies reflecting increased operational costs against diminishing returns. The gradual increase post-2015 shows a recovery in cost-efficiency, as KCT operations become more strategically targeted and streamlined. Theoretically, this suggests a Learning Curve Effect [3], where operational efficiency improves with experience, but can be disrupted during periods of intense conflict. However, the relatively low CEC (0.261) indicates high financial and resource costs per unit of KCT success, highlighting inefficiencies in resource allocation, which supports the Resource-Based View[6] that sustainable CT requires optimized use of scarce resources to balance effectiveness and affordability.

4.5.5 Strategic Effectiveness Coefficient (SEC): Assesses the broader impact of governance, policy frameworks, and strategic investments in reducing terrorism. Mathematically given by:$[SEC]_t = \frac{1}{p}\sum_{i=1}^{p}[SEM]_{ti} = \frac{1}{4}([KEI]_t + [KROI]_t + [GSI]_t + [TII]_t)$ (4.0.3)

By the red curve of Figures 4.3, SEC gradually rises, peaking around 2014, dips slightly, then stabilizes at moderate levels. This rising SEC indicates that KCT strategies have increasingly contributed to broader strategic goals, such as disrupting terrorist networks and degrading their capabilities. The plateauing suggests that while tactical successes improved, challenges remain in achieving lasting strategic outcomes, possibly due to the insurgency's resilience and complex sociopolitical factors. Theoretically, the SEC trend reflects Counterinsurgency Theory[46], which emphasized that tactical gains do not always translate directly into strategic victory without comprehensive political and social efforts. Also, the mean SEC value of 0.473 (moderate) reflects partial success in achieving long-term strategic goals such as governance stability and return on investment in CT. This is consistent with Hoffman's[33] emphasis that strategic effectiveness depends on winning "hearts and minds" beyond KCT operations.

4.5.5 Anarchical Coefficient of Terrorism (ACT): Quantifies the degree of political and social instability that influences terrorism dynamics. Mathematically given by:

$$[ACT]_t = \sum_{i=1}^{p}[ACT]_{ti}$$

By the purple curve of Figures 4.3, ACT rises sharply, peaking in 2015, then steadily declines. The ACT measures the level of disorder and breakdown of governance linked to terrorism. The peak reflects the height of political and social anarchy caused by insurgency activities. The steady decline post-2015 aligns with restoration of state authority and improved security conditions due to KCT efforts. However, a high ACT value of 0.473~0.5, after 18 years of KCT operations, signals persistent instability and weakened governance structures despite CT efforts. This resonates with State Fragility and Resilience Theories[64], which posits that enduring CT success requires strengthening political

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institutions and social order, not just kinetic action, showing how ineffective KCT alone in reducing anarchy and aids in state stabilization.

Table 4.3: Statistic of KCT Performance Coefficient

Year	TIC	OEC	CEC	SEC	ACT
2007	0.402	0.430	0.852	0.285	0.000
2008	0.574	0.332	0.266	0.276	0.021
2009	0.465	0.396	0.274	0.359	0.108
2010	0.382	0.383	0.204	0.329	0.142
2011	0.373	0.363	0.188	0.396	0.236
2012	0.465	0.325	0.152	0.527	0.404
2013	0.510	0.321	0.139	0.604	0.575
2014	0.488	0.291	0.126	0.726	0.831
2015	0.470	0.213	0.194	0.502	1.000
2016	0.305	0.281	0.185	0.429	0.916
2017	0.284	0.314	0.192	0.434	0.831
2018	0.260	0.359	0.202	0.458	0.746
2019	0.232	0.410	0.209	0.475	0.662
2020	0.237	0.424	0.258	0.437	0.578
2021	0.211	0.490	0.270	0.452	0.494
2022	0.202	0.555	0.291	0.447	0.409
2023	0.176	0.668	0.321	0.460	0.323
2024	0.180	0.853	0.371	0.476	0.238
Mean	**0.345**	**0.412**	**0.261**	**0.448**	**0.473**

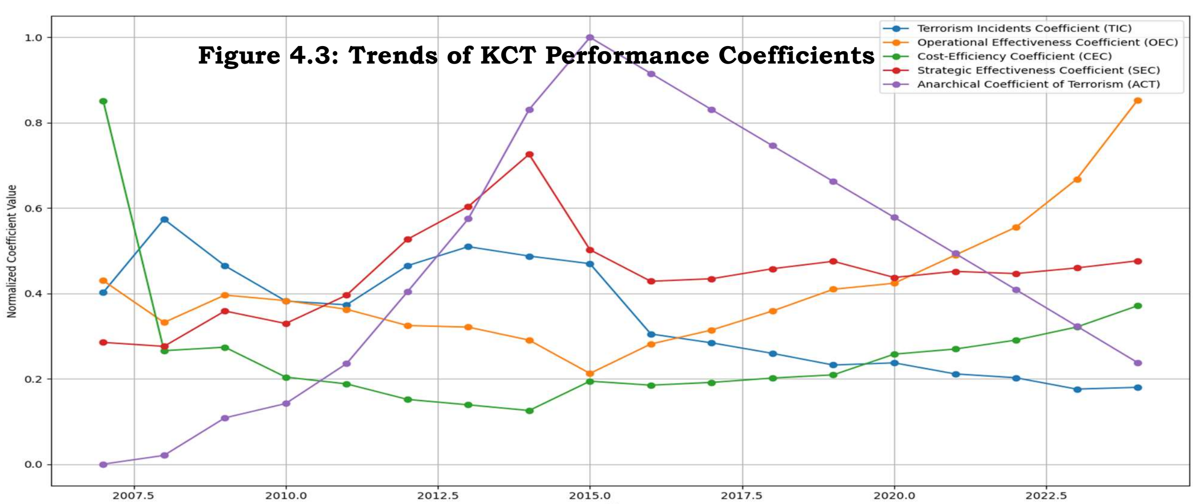

Figure 4.3: Trends of KCT Performance Coefficients

4.5.6 Implications of KCT Performance Coefficient Trends: The decreasing TIC and increasing OEC post-2015 demonstrate that KCT strategies have been operationally effective in suppressing terrorist activities. However, the plateau in SEC suggests that while immediate operational goals are being met, sustaining long-term strategic peace and governance stability requires integrating KCT efforts with political, economic, and social programs [10]. The fluctuating CEC highlights the need for continuous evaluation of resource use. Early gains in cost-efficiency were eroded during the insurgency peak, underscoring the challenge of balancing operational intensity with budget constraints. Moving forward, optimizing CT funding and adopting intelligence-led, precision operations could sustain cost-efficiency. The ACT trend emphasizes that KCT operations must be complemented by governance and development initiatives. Reducing anarchy is critical for restoring public trust, enforcing rule of law, and preventing insurgency resurgence. The trends of the KCT performance coefficients illustrate the dynamic nature of CT operations - initial setbacks followed by recovery and improvement. This supports the Complex Adaptive Systems Theory[4], suggesting that Nigerian CT strategies should remain flexible, responsive to evolving threats, and integrated across military, intelligence, and civilian sectors.

In conclusion, this MDA reveals that Nigerian KCT strategies have significantly contributed to reducing terrorism incidents and restoring order, albeit with challenges in cost-efficiency and strategic sustainability. To enhance overall effectiveness, KCT operations must be part of a broader, integrated approach addressing governance, socioeconomic factors, and insurgent adaptation.

4.6 Analysis of KCT Performance Model

This section focuses on the application and evaluation of the regression models developed to explain and predict the performance of key KCT metrics, using the E-Net regression analysis technique. By leveraging the normalized and aggregated performance metrics, such as TII, KEI, GSI, and ACT, the E-Net regression analysis aims to identify significant predictors and quantify their impacts on overall KCT effectiveness. The models provide valuable insights into the relationships among operational, strategic, economic, and socio-political factors influencing terrorism trends and CT measures. This analytical approach not only enhances understanding of the drivers of KCT performance but also supports data-driven policy formulation and resource optimization for improved CT outcomes. Before determining the coefficients of models (3.3.4 - 3.4.2), and hence, fit each the model to the KCT performance dataset, we conducted a robust OLS Model diagnostic test: Omnibus & Jarque-Bera Tests [28];[39], Durbin-Watson Test[73], and Condition Number tests[7].

- **Omnibus & Jarque-Bera Tests:** Both tests whether the residuals of the regression models are normally distributed - a key classical linear regression assumption, where non-significant p-values indicate residuals approximate normality, validating inference.
- **Durbin-Watson (DW) Test:** Detects autocorrelation of residuals. DW values ≥ 2 imply no autocorrelation – an important in time series or panel data contexts.
- **Condition Number:** Indicates multicollinearity risk in predictors. Condition number values above 30 suggest multicollinearity, which can destabilize the model coefficient estimates.

These diagnostic tests enable us understand the characteristics of the predictor variables, and hence, the choice of regression techniques

Table 4.4a: Statistics of Models' Performance

Variable	Omnibus	Prob (Omnibus)	Jarque-Bera	Prob (JB)	Durbin-Watson	Condition Number	R-Square	VIF	MSE
$[TII]_t$	0.202	0.904	0.362	0.834	2.204	138355.29	0.958	12.160	1395.46
$[KEI]_t$	1.413	0.493	1.187	0.552	0.378	12387.08	0.998	250.250	0.044
$[GSI]_t$	4.266	0.119	2.351	0.309	0.029	729891.93	0.997	166.917	0.00
$[ACT]_t$	11.956	0.183	9.063	0.111	2.526	35351.03	0.997	166.917	21.861
$[CPI]_t$	1.081	0.583	0.764	0.682	2.096	753787.24	0.996	125.251	1692.76

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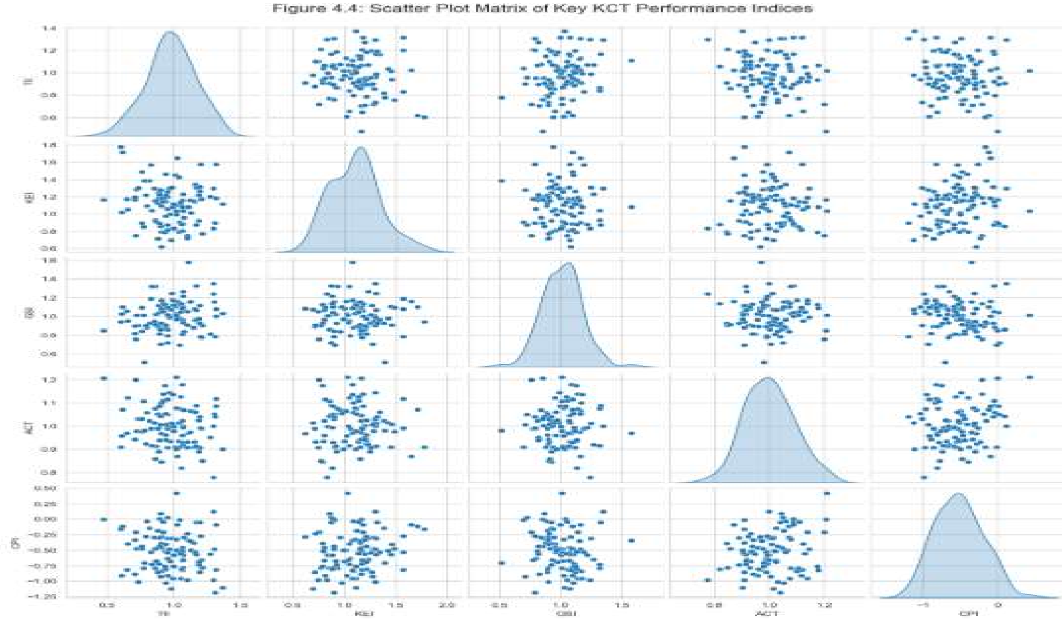
By Python implementation of the OLS Model diagnostic tests on (3.3.4 -3.4.2), Table 4.4 above shows the summarize statistics of the diagnostic tests.

- **Omnibus Test Statistic:** From the Table 4.4a, the Omnibus Test values range from 0.202 to 11.956, and their p-values are all greater than 0.05. This indicate that the residuals of the 5-models are normally distributed.
- **Jarque-Bera (JB) Test Statistic:** From the Table 4.4, the JB Tests values range from 0.62 to 9.063, and their p-values are all greater than 0.05. This confirm that the residuals show no significant deviation from normality.
- **Durbin-Watson (DW) Test:** From the Table 4.4, the DW tests values range from 0.029 to 2.526, indicating the existence of significant autocorrelation in the residuals of some predictor variables, KEI, and GSI to be specific.
- **Condition Number (CN):** From Table 4.4, the CN values are higher than the common threshold value of 30, indicating serious multicollinearity among the predictors.
- **VIF Statistics:** Detect multi-collinearity in the model. From Table 4.4, the VIF are greater than the threshold value of 10, indication severe multi-collinearity in predictors.
- **Scatter Plot:** Figure 4.4 below, represent pairwise scatter plot matrices - an EDA tools that reveal pairwise associations and potential multicollinearity among indices[78]. From figure, the diagonal panels show kernel density estimations (KDE) for each index. Most indices exhibit near-normal unimodal distributions, indicating consistent data spread without extreme skewness or heavy tails. This suggests stability in the measurements across the sampled period or observations. However, the plots reveal weak to no clear linear relationships between most pairs of indices, with notable dispersion - indicating variability and complex interactions rather than simple linear dependencies.

For instance, TII vs KEI and TII vs CPI show scattered points without a strong trend, suggesting that higher terrorism intensity does not correspond directly to proportional changes in KCT effectiveness or composite performance. Similarly, KEI and CPI do not show a clear linear pattern. Beyond simple correlation, the scattered nature of the data suggests that KCT performance indices interact in nonlinear or mediated ways. Also, the lack of tight clustering suggests variability in how KCT strategies perform across different time periods. This aligns with Contingency Theory[33] in CT - effectiveness depends heavily on situational factors

Figure 4.4: Scatter Plot Matrix of Key KCT Performance Indices



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In conclusion, given the large CN, and VIF values, the structure of the pairwise scatter plots, and the significantly low DW values of some predictors, the diagnostic tests indicate existent of strong multicollinearity and autocorrelation in the residual. These justify our choice for RRM, and Elastic Net regularization analysis techniques in particular.

Finally, the Python implementation of E-Net regression analysis of models (3.3.4 -3.4.2), shows the following results as indicated on Table 4.4 above.

- **R^2 (R-Square) Statistics:** Indicates how well our models explains the variability of the outcome. From Table 4.4, the R-Square values range from 0.958 to 0.998. This indicate that the models explain at least 95.8% of the variance in each model, hence, an excellent fit and strong predictive power.
- **Mean Squared Error (MSE):** Measures the average squared difference between predicted and actual values, and by Table 4.4, the MSE values range from 0.00 to 1692.76. Considering the scale of TII values (which can be large), the comparatively large MSE is considered relatively moderate, indicating that the models fit the data very well, with strong predictive accuracy and acceptable errors. This implies that the predicted values exactly match actual values for every data point in KCT performance dataset, and hence, no variance exists between predictions and observations.
- **Correlation Coefficients:** The coefficients of equations (3.3.4 -3.4.2), can be summarized by the following predictive results:

4.6.1 Terrorism Intensity Index (TII): By substituting the analysed coefficient values into model (3.3.4), we have:

$$[TII]_t = 0.552T_t + 0.408S_t \quad (4.0.5)$$

By the equation (4.0.5), given a unit change in all predictor variables, then the terrorism intensity will increase by approximately: $[TII]_t \approx 0.96$. This model indicates that TII increases with both the number of terrorism incidents (T) and the severity of these incidents (S). Specifically, a unit increase in terrorism incidents raises TII by 0.552 and a unit increase in severity raises TII by 0.408, summing approximately to an overall increase of 0.96 in TII for a unit change across predictors. This confirms that terrorism intensity is strongly driven by both frequency and severity of attacks, reflecting the multidimensional nature of terrorism threats. According to Threat Assessment Theory[47], understanding both the number and impact of terrorist attacks is crucial for assessing threat levels and guiding effective CT responses.

4.6.2 KCT Effectiveness Index (KEI): By substituting the analysed coefficient values into model (3.3.6), we have:

$$[\mathrm{KEI}]_t = 0.226\mathrm{A}_t + 0.73\mathrm{N}_t + 0.01\mathrm{E}_t + 0.134[\mathrm{TII}]_t \quad (4.0.6)$$

By the equation (4.0.6), given a unit change in all predictor variables, then KCT Effectiveness Index will increase by approximately: $[\mathrm{KEI}]_t \approx 1.1$. This model indicates that KEI is strongly influenced by internal factors – arrest (A_t) and neutralization (N_t) with a moderate positive response to terrorism intensity (TII). By implication CT efforts intensify when terrorism levels rise, consistent with threat-driven resource allocation and operational scaling. Theoretically, this result is supported by Threat Assessment Theory[47], which posits that CT responses adapt dynamically to threat levels.

4.6.3 Governance Stability Index (GSI): By substituting the analysed coefficient values into model (3.3.8), we have:

$$[\mathrm{GSI}]_t = 0.0201[\mathrm{PTI}]_t + 0.015[\mathrm{RLI}]_t + 0.023[\mathrm{SSI}]_t + 1.184[\mathrm{KEI}]_t - 0.236[\mathrm{TII}]_t \quad (4.0.7)$$

By the equation (4.0.7), given a unit change in all predictor variables, then governance stability index will increase by approximately: $[\mathrm{GSI}]_t \approx 1.00$. This model indicates that governance stability is strongly positively influenced by KCT effectiveness (coefficient 1.184), while terrorism intensity negatively affects it (-0.236). This implies that effective KCT efforts significantly bolster governance stability, mitigating the destabilizing effects of terrorism. Theoretically, Systems Theory [71] views governance and security as interdependent subsystems. This result validates that improving KCT effectiveness enhances the overall stability of governance, thereby fostering resilience against terrorism.

4.6.4 Anarchical Coefficient of Terrorism (ACT): By substituting the analysed coefficient values into model (3.4.2), we have:

$$[\mathrm{ACT}]_t = 0.9890[\mathrm{TII}]_t + 0.005[\mathrm{KEI}]_t \quad (4.0.8)$$

By equation (4.0.8), given a unit change in all predictor variables, then anarchical coefficient of terrorism will increase by approximately: $[\mathrm{ACT}]_t \approx 0.994$. This model indicates that ACT depends almost entirely on the Terrorism Intensity Index (TII) with a coefficient close to 1 (0.989), indicating a strong positive relationship. The meagre coefficient of KEI (0.005), suggest a minimal direct effect of implying KEI on ACT. This suggests that ACT, representing the chaotic or anarchic level of terrorism, is primarily driven by the intensity of terrorism incidents (TII), and KCT effectiveness has a negligible direct impact on reducing ACT in the short term. According to State Fragility Theory[59], terrorism intensity destabilizes state security (ACT) significantly. The near-zero KEI coefficient indicate that KCT effectiveness has a delayed or indirect effect on reducing anarchy caused by terrorism, consistent with complex system dynamics where governance and security improvements take time to affect entrenched anarchic conditions.

4.6.5 Composite Performance Index (CPI): By substituting the analysed coefficient values into model (3.4.2), we have:

$$[\mathrm{CPI}]_t = 0.818[\mathrm{KEI}]_t + 0.09[\mathrm{GSI}]_t - 0.711[\mathrm{TII}]_t - 0.736[\mathrm{ACT}]_t \quad (4.0.9)$$

By the equation (4.0.9), given a unit change in all predictor variables, then Composite Performance index will increase by approximately: $[\mathrm{CPI}]_t \approx -0.539$. This model indicates that, CPI - an integrative performance measure, increases with KCT effectiveness (0.818), and slightly with governance stability (0.09), but decreases with higher terrorism intensity (-0.711), and ACT (-0.736). The dominant positive effect of KEI on CPI emphasizes the central role of KCT effectiveness in improving composite security outcomes. The negative impact of ACT and TII confirms the detrimental influence of terrorism dynamics on overall performance. Theoretically, this finding supports Integrated Security Frameworks where CT effectiveness is critical to enhancing composite security performance, despite challenges posed by terrorism and governance complexities[59]; [71].

4.6.6 Implication of the Aggregate Performance Indices: According Threat Assessment Theory [47], the high positive value of $[\mathrm{TII}]_t \approx 0.96$, indicate that terrorism intensity increases sharply with number and severity of incidents, highlighting threat magnitude. By operational scaling principles, the strong positive value of $[\mathrm{KEI}]_t \approx 1.1$, reinforce that KCT effectiveness grows with operational inputs and terrorism intensity, reflecting adaptive CT response. By Systems Theory[71], the aggregate value of governance stability $[\mathrm{GSI}]_t \approx 1.00$ confirm that governance stability improves proportionally with KCT effectiveness, but is negatively impacted by terrorism intensity. Corroborating State Fragility Theory[59], the near unity positive value of $[\mathrm{ACT}]_t \approx 0.994$, suggest that anarchy in terrorism is almost fully driven by terrorism intensity, with minimal direct effect from KCT effectiveness. Finally, by Integrated Security Frameworks, complex system interactions suggest that the overall composite performance of KCT (-0.539), decreases when all predictors increase simultaneously, due to strong negative effects of terrorism and anarchy outweighing governance and KCT gains.

In summary, the high positive values for TII, KEI, GSI, and ACT confirm the strong interdependencies within the terrorism-governance-CT nexus. While the negative net composite effect on CPI signals that, despite improvements in KCT and governance, persistent terrorism and anarchic conditions pose serious challenges to overall security performance. This underscores the necessity

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for a holistic, multi-faceted approach combining robust CT, governance strengthening, and direct terrorism reduction strategies. These results align with relevant theories, emphasizing dynamic and systemic complexity in security environments[59]; [71], and thus, the importance of adaptive policy responses[47].

4.7 Visualization/Structural Representation of Key Indices Influencing KCT Performance

This sub-section presents a comprehensive visualization of the KCT performance assessment models. This is essential to this study as it provides critical insights into the complex interrelationships and temporal dynamics of the key indices underpinning KCT performance assessment. Visual tools facilitate understanding and interpretation of the multidimensional data, which is often challenging to grasp through numerical results alone. The time series plot predicts temporal trends and interactions among TII, KEI, GSI, ACT, and CPI from 2025 to 2035. The path diagram illustrates the directional causal relationships and quantified effects among key variables based on the model coefficients.

Figure 4.5: Path Diagram of KCT Performance Models

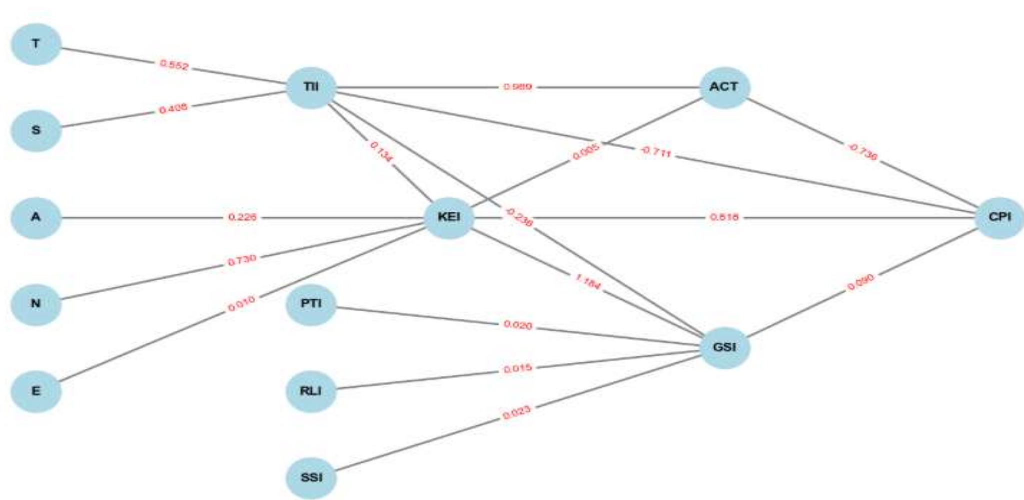

Figure 4.5 present the path diagram of the key KCT performance modes, which visually summarizes the complex causal relationships and quantified effects among key variables influencing KCT performance. The study of terrorism and CT operates within a complex adaptive system framework[71]. Therefore, visualizing the causal pathways via the path diagram aligns with General Systems Theory[59], enabling stakeholders to perceive how terrorism intensity (TII), KCT effectiveness (KEI), governance stability (GSI), and terrorism-induced anarchy (ACT) interact dynamically to influence composite performance (CPI). This systems perspective is crucial for designing integrated and effective security policies). Key observations of the path diagram include:

- Terrorism-incident (T) and the severity (S) strongly influence Terrorism Intensity Index (TII) with coefficients 0.552 and 0.408
-

  respectively, highlighting their prominent role in driving terrorism intensity.
- TII has a strong direct positive effect on ACT (0.989), indicating that increased terrorism intensity exacerbates anarchy-related conditions.
- TII also influences KEI (0.134) and GSI negatively (-0.236), suggesting that terrorism intensity slightly boosts KCT responses but undermines governance stability.
- KEI has a substantial positive effect on GSI (1.184) and CPI (0.818), indicating that effective KCT efforts contribute greatly to governance stability and overall KCT performance.

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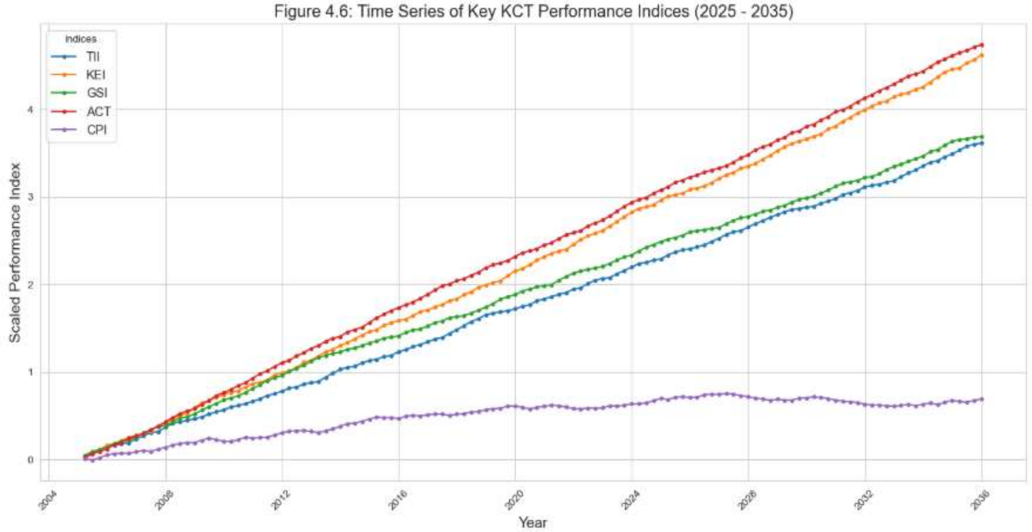
- ACT exerts a moderately negative effect on CPI (-0.781), emphasizing the detrimental impact of anarchy on overall KCT outcomes.
- GSI positively influences CPI (0.09), further underscoring the role of governance in successful CT.

Theoretically, the strong paths from T and S to TII reflect the Threat Assessment Theory[47], where environmental and terrorism-related factors drive intensity. The reciprocal influences between KEI, GSI, and CPI align with Systems Theory[59] in CT, suggesting feedback loops where effective KCT measures enhance governance, which in turn supports composite CT success. The negative impact of ACT on CPI is consistent with Anarchy Theory[63], and the idea that instability impedes effective CT. Overall, the model supports the Contingency Theory in CT[33], where multiple factors interact nonlinearly to affect outcomes. The path diagram confirms the central role of KEI in enhancing governance and overall CT performance, but also highlights the detrimental impact of terrorism-driven anarchy (ACT).

Similarly, Figure 4.6 below, represent a time series forecast, which captures the evolution of indices over the next decade, reflecting the expected changes in the security environment and interventions over time. This temporal visualization supports Threat Assessment Theory[47], by allowing policymakers to detect shifts in terrorism intensity and KCT effectiveness, facilitating timely and adaptive responses. Key observations of the time series forecast include:

- TII (red curve) and KEI (orange curve), both indices show a consistent upward trend with TII slightly leading KEI, indicating that terrorism intensity and KCT effectiveness are projected to rise in tandem.
- GSI (green curve) and ACT (blue curve), also increase but at a slower pace than TII and KEI. The positive trend in GSI suggests improvements in governance despite rising challenges.
- CPI (purple curve), remains relatively flat, indicating limited overall improvement despite rising KCT efforts and governance stability.

Figure 4.6: Time Series of Key KCT Performance Indices (2025 - 2035)



Theoretically, the upward trends in TII and KEI suggest an arms race dynamic, as terrorism intensity rises, KCT responses intensify to counter it[66]. The slower rise in

GSI implies gradual strengthening of governance structures, consistent with Institutional Theory[55], which argues that governance reforms take time to impact security outcomes. The flat CPI suggests a performance paradox: despite increased KCT activity and governance improvements, overall CT effectiveness does not improve proportionally, possibly due to adaptive terrorist tactics or civil-military tensions [46].

This underscores the need for multi-dimensional CT strategies that balance KCT and non-kinetic measures (community engagement, intelligence, governance reforms) to improve composite outcomes [19].

Overall, the time series projection warns that increasing KCT efforts alone may not suffice to significantly improve CPI, necessitating broader governance and socio-political interventions. Policymakers should focus on integrated CT approaches, combining kinetic precision with governance stability and community resilience, to sustainably reduce terrorism intensity and improve performance. These findings align with modern CT frameworks emphasizing systemic, multi-level strategies rather than solely kinetic-centric approaches [12].

5.0 Research Findings and Discussion

This section presents a meticulous deduction, and comprehensive discussion of the key findings from the study titled "Assessing the Effectiveness and Efficiency of Kinetic CT Strategies: A Multi-Dimensional Analysis of Nigerian CT Efforts", and justifying the proposition for a paradigm shift from the dominant Kinetic CT (KCT) strategies to Knowledge-Based CT (KBCT) strategies, grounded in the study's research objectives, questions, gaps, and the multidimensional analyses.

5.1 Key Findings and Justification for KB CT Strategies

The study investigates the effectiveness and efficiency of Nigeria's KCT strategies across 2007–2024, using a multi-dimensional analysis (MDA) integrating terrorism incident metrics (TIM), operational effectiveness (OEM), cost-efficiency (CEM), and strategic effectiveness (SEM), alongside governance and societal indices. Objectively, the study aimed to quantify terrorism trends, evaluate KCT operational success, assess governance impacts, analyze cost-efficiency, and explore the role of the anarchical coefficient of terrorism (ACT). The research questions focused on how terrorism incidents evolved, KCT operational outcomes, governance influence, cost-efficiency, and ACT's reflection on national stability. The study also identified some research gaps in context-specific Nigerian CT analysis, integration of governance and socio-economic factors, long-term assessment, and advanced regression modelling using Regularization Regression Models (RRMs). Key empirical findings of the study include:

5.1.1 Terrorism Trends and Operational Effectiveness: Terrorism incidents, severity, and spatial dispersion showed a sharp rise peaking around 2014-2015, which coincide with Boko Haram insurgency apex, then followed by a decline through 2024. KCT operational metrics, including arrests and neutralizations, increased steadily after 2014, alongside increased CT expenditure. This indicates intensified KCT operations responding to the insurgency peak. Despite operational gains, governance-related indices (PTI, RLI, SSI) remained low, but showed modest improvement after 2015. The Geographical Containment Index, revealed initial containment followed by territorial expansion during the insurgency peak and gradual recovery, indicating dynamic territorial control.

5.1.2 Cost-Efficiency and Strategic Impact: Cost per terrorist arrested (CPA), neutralized (CPN), and the attrition cost index (ACI) declined sharply, reflecting improved operational cost-efficiency through better targeting and intelligence. However, cost per terror incident (CPI) and cost per KCT operation (CKO) increased after 2015, suggesting rising complexity and resource intensity of operations. The effectiveness of KCT per expenditure (EKE) declined significantly after early years, indicating diminishing returns on investment in KCT operations. Governance stability (GSI) declined during insurgency peak (2014-2015) but recovered gradually, reflecting that governance improvements lag behind tactical gains.

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5.1. 3 Anarchical Coefficient of Terrorism (ACT) and Composite Performance: The ACT peaked in 2015, indicating high political and social instability, then declined steadily, signifying partial restoration of order. The Composite Performance Index (CPI), integrating KCT effectiveness, governance, terrorism intensity, and ACT, showed limited improvement, highlighting persistent challenges. The regression analyses revealed that Terrorism intensity (TII) is primarily driven by incident frequency and severity. KCT effectiveness (KEI) is strongly influenced by operational outputs (arrests and neutralizations) and terrorism intensity. Governance stability (GSI) positively influenced by KEI but negatively by TII, while ACT closely tracks terrorism intensity with minimal direct reduction from KCT effectiveness in the short term. Therefore, CPI positively linked with KEI and governance but negatively with TII and ACT.

5.1.4 Statistical and Analytical Insights: Strong multicollinearity and autocorrelation in predictor variables justified the use of Elastic-Net RRMs, providing robust modeling. The models yield high R-square values (>95%), indicating that the models accurately explained terrorism and KCT performance dynamics. The scatter plots and correlations (Figure 4.4) revealed weak linear relationships, implying complex, nonlinear interdependencies among indices. Findings aligned with Systems Theory[71], Threat Assessment Theory[47], State Fragility Theory[59], and Complex Adaptive Systems Theory[4], emphasizing the multifaceted and dynamic nature of terrorism and CT.

5.2 Discussion: Why Shift from KCT to KBCT Strategies?

While KCT operations have succeeded in arrests, neutralizations, and territorial containment, the limited improvement in governance and composite performance (CPI) signals that kinetic actions alone are insufficient for lasting peace and stability. Excessive reliance on kinetic force has led to civilian casualties and grievances, potentially fuelling insurgent recruitment and radicalization[19];[46]. By cost and efficiency implication, the diminishing returns on KCT expenditure (declining EKE) and increasing operational costs (rising CPI, CKO) highlight financial unsustainability of heavy KCT approaches, especially in resource-constrained contexts like Nigeria. The persistently low governance indices (PTI, RLI, SSI) despite kinetic efforts underline that weak institutions and socio-economic instability remain core drivers of terrorism, which KCT does not adequately address. The high ACT values until recent years reflect ongoing instability that KCT operations have not fully mitigated, consistent with State Fragility Theory[59].

5.2.1 Merits of Knowledge-Based CT (KBCT) Strategies: KBCT prioritizes intelligence-led, data-driven CT, integrating kinetic actions with governance reforms, rule of law strengthening, public trust building, and socioeconomic development, would addressing root causes of terrorism. Unlike the reactive KCT, the KBCT anticipates threats through surveillance, community engagement, and deradicalization programs, aligning with Complex Adaptive Systems Theory[4], allowing flexible responses to evolving terrorist tactics. By cost-effectiveness and sustainability, investing in governance and social resilience (as indicated by improving EEG values) would yield more efficient long-term security returns than KCT operations alone.

By shifting focus from brute force to knowledge, KBCT reduces opportunities for "terrorpreneurial" activities and false-flag incidents driven by budgetary incentives, improving transparency and accountability. As evidence from regression model, the positive influence of KEI on governance stability and CPI, combined with the near-zero direct impact of KEI on ACT, suggests that kinetic gains must be complemented by governance interventions to break cycles of anarchy and terrorism persistence. KBCT alignment with contemporary CT scholarship, as scholars have advocated multi-dimensional CT approaches - blending kinetic and non-kinetic methods[12];[19];[46], emphasizing

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community-driven and knowledge-based models for sustainable peace.

In conclusion, the study's multi-dimensional empirical evidence and advanced regression modeling reveal that while Nigeria's KCT efforts have achieved important tactical successes, these have not fully translated into strategic stability or sustainable security. Persistent governance deficits, socio-economic instability, and the resilience of terrorism indicate the limitations of a predominantly KCT approach. The KBCT strategy emerges as a necessary paradigm shift, emphasizing intelligence integration, governance reforms, community engagement, and socio-economic development alongside selective kinetic actions. This approach promises greater adaptability, cost-efficiency, and strategic depth, addressing both immediate threats and underlying drivers of terrorism. Therefore, the study justifiably proposes transitioning towards Holistic, KBCT strategies as the optimal framework for Nigeria and similar contexts, to enhance the overall effectiveness, efficiency, and sustainability of CT efforts.

6.0 Conclusion

This study undertook a rigorous and multidimensional assessment of Nigeria's KCT strategies over the period 2007 to 2024, aiming to quantify terrorism trends, evaluate operational effectiveness, analyze cost-efficiency, and assess strategic impacts on governance and national stability. By integrating terrorism incident metrics, operational data, governance indices, and the Anarchical Coefficient of Terrorism (ACT) within a multi-dimensional analytical framework, and employing advanced Elastic-Net Regularization Regression Models, the study addressed significant gaps in Nigerian context-specific CT research.

The findings reveal a complex and dynamic security environment where KCT operations have achieved notable tactical successes, including increased arrests, neutralizations, and territorial containment, particularly during and after the Boko Haram insurgency peak (2014–2015). However, the analysis also highlights persistent challenges: governance stability and socio-economic indices remain low despite KCT gains; diminishing returns on KCT expenditure signal resource inefficiencies; and the composite performance index (CPI) shows limited overall improvement, underscoring the insufficiency of KCT efforts alone to restore lasting peace and stability.

The regression results underscore strong interdependencies within the terrorism-governance-CT nexus, confirming that while KCT effectiveness positively influences governance stability, terrorism intensity and resultant anarchy continue to undermine national security. The near-neutral direct effect of KCT effectiveness on reducing anarchy (ACT) suggests that KCT operations must be complemented by broader governance and socio-political strategies to disrupt deeply entrenched instability.

The study thus validates the theoretical perspectives of Systems Theory[71], Threat Assessment Theory[47], State Fragility Theory[59], and Complex Adaptive Systems Theory[4], illustrating that terrorism and CT are embedded within a multifaceted socio-political system requiring adaptive and integrated responses. In conclusion, while Nigeria's KCT strategies remain crucial for immediate threat suppression, sustainable CT demands a paradigm shift toward KBCT strategies. Such approaches emphasize intelligence integration, governance reforms, community engagement, and socio-economic development alongside targeted kinetic actions, promoting holistic, cost-effective, and enduring security outcomes.

6.1 Recommendations

Based on the comprehensive analyses and findings, the study recommends the following:

(i) **Adopt Knowledge-Based CT (KBCT) Approaches:** The Nigerian government and security agencies should transition from a predominantly kinetic focus to integrated CT strategies that combine intelligence-led operations, governance strengthening, community engagement, and socio-economic development to address root causes of terrorism.

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(ii) **Enhance Intelligence and Data-Driven Operations:** Investment in intelligence capabilities, data analytics, and technological tools is essential to improve precision, reduce collateral damage, and anticipate emerging threats, thereby increasing operational efficiency and effectiveness.

(iii) **Strengthen Governance and Rule of Law:** Prioritize reforms that improve public trust, judicial independence, anti-corruption measures, and socio-economic stability, as these have a direct and positive impact on reducing terrorism and enhancing CT outcomes.

(iv) **Optimize Resource Allocation and Cost-Efficiency:** Given diminishing returns on KCT expenditure, budgetary allocations should be optimized by balancing direct military spending with investments in governance, social programs, and preventive CT measures to maximize overall security gains.

(v) **Implement Multi-Sectoral and Community-Centric Programs:** Foster partnerships across government, civil society, and local communities to support deradicalization, rehabilitation, and social cohesion initiatives, reducing the socio-political drivers of violent extremism.

(vi) **Institutionalize continuous Monitoring and Evaluation:** Develop robust frameworks for ongoing assessment of CT strategies using multidimensional metrics and advanced analytics to adapt policies responsively to evolving threat landscapes.

(vii) **Promote Regional and International Collaboration:** Terrorism transcends borders; therefore, Nigeria should strengthen cooperation with regional and global partners for intelligence sharing, joint operations, and capacity building.

(viii) **Address Data Gaps and Transparency:** Improve data collection, transparency, and access to comprehensive CT information to facilitate research, policy evaluation, and public accountability.

By implementing these recommendations, Nigeria can enhance the effectiveness, efficiency, and sustainability of its CT efforts, moving beyond short-term kinetic successes toward lasting peace and security.

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