

## BIG DATA ANALYTICS FRAMEWORK FOR VISION 2030 PERFORMANCE MONITORING AND NATIONAL KPIS

### ESTRUTURA DE ANÁLISE DE BIG DATA PARA O MONITORAMENTO DO DESEMPENHO DO VISÃO 2030 E DOS KPIS NACIONAIS

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#### Abstract

Saudi Arabia's Vision 2030 is a comprehensive transformation strategy that includes measurable strategic objectives and performance measures. To effectively monitor the national Key Performance Indicators (KPIs), it is necessary to use advanced data integration, predictive analytics, and performance intelligence technology. Conventional performance reporting is not effective in managing a large-scale transformation strategy. This study aims to introduce a comprehensive Big Data Analytics Framework that can effectively support the performance monitoring of Vision 2030 and national KPIs. The study aims to introduce a comprehensive Big Data Analytics Framework that includes data ingestion, real-time analytics, predictive analytics, performance scoring, and performance intelligence under a unified framework of governance. This study also aims to introduce a National Performance Intelligence Index (NPII) model to measure aggregated performance of national transformation strategies. The study results show that a centralized big data performance ecosystem can effectively enhance KPI accuracy, reporting speed, and transparency to achieve effective policy intervention strategies. This study also aims to show that a conventional performance monitoring system can effectively integrate predictive analytics to enhance accountability, speed, and measurable performance to achieve strategic objectives of Vision 2030.

**Keywords:** Big Data Analytics. Vision 2030. National KPIs. Performance Monitoring. Digital Governance. Predictive Analytics. Data Integration. Public Sector Intelligence. Strategic Performance Management.

#### Resumo

A Visão 2030 da Arábia Saudita é uma estratégia de transformação abrangente que inclui objetivos estratégicos mensuráveis e indicadores de desempenho. Para monitorar de forma eficaz os Indicadores-chave de Desempenho (KPI) nacionais, é necessário utilizar tecnologias avançadas de integração de dados, análise preditiva e inteligência de desempenho. Os relatórios de desempenho convencionais não são eficazes na gestão de uma estratégia de transformação em grande escala. Este estudo tem como objetivo apresentar uma Estrutura Abrangente de Análise de Big Data capaz de apoiar efetivamente o monitoramento do desempenho da Visão 2030 e dos KPIs nacionais. O estudo visa apresentar uma Estrutura Abrangente de Análise de Big Data que inclua ingestão de dados, análise em tempo real, análise preditiva, pontuação de desempenho e inteligência de desempenho sob uma estrutura unificada de governança. Este estudo também visa apresentar um modelo de Índice Nacional de Inteligência de Desempenho (NPII) para medir o desempenho agregado das estratégias nacionais de transformação. Os resultados do estudo mostram que um ecossistema centralizado de desempenho de Big Data pode efetivamente melhorar a precisão dos KPIs, a velocidade dos relatórios e a transparência para alcançar estratégias eficazes de intervenção política. Este estudo também visa demonstrar que um sistema convencional de monitoramento de desempenho pode integrar efetivamente a análise preditiva para aprimorar a prestação de contas, a velocidade e o desempenho mensurável, a fim de alcançar os objetivos estratégicos da Visão 2030.

**Palavras-chave:** Análise de Big Data. Visão 2030. KPIs Nacionais. Monitoramento de Desempenho. Governança Digital. Análise



*Preditiva. Integração de Dados. Inteligência do Setor Público. Gestão Estratégica de Desempenho.*

## 1 INTRODUCTION

One of the most comprehensive transformation programs in the Middle East region can arguably be considered to be Vision 2030 in Saudi Arabia. This program is intended to bring a transformation to the economy of Saudi Arabia, to make it diversified, efficient in terms of public sector performance, and to make the performance of institutions in Saudi Arabia and quality of life in this country more effective. It is important to note that this program is based on the implementation of a framework for Key Performance Indicators (KPI) for the purpose of monitoring the progress of the implementation program in Saudi Arabia. It is important to note that the process of monitoring this large-scale reform program in Saudi Arabia is a complex process due to the need for a high level of sophistication in the management of this program. The performance monitoring in the context of the transformation program in the country is a complex process due to a large amount of heterogeneous data being generated through various sources such as government, smart cities, financial systems, healthcare systems, labor markets, and environmental systems. This is due to a large amount of data being generated having a high volume, high velocity, and high variety, which is considered a classic example of big data. It is also important to note that this large amount of data cannot be monitored through traditional approaches such as KPI due to this approach's inability to capture dynamic performance characteristics and warning signs of poor performance. Big Data Analytics (BDA) is probably one of the most disruptive technologies that could help overcome the challenges faced by the conventional performance monitoring technologies. BDA is a technological platform that uses distributed computing technologies and machine learning algorithms to support dynamic KPI monitoring and predictive performance. BDA is probably one of those technologies that could disrupt the conventional ways of monitoring KPIs in Saudi Arabia, thereby helping create predictive performance intelligence to support the decision-making processes. This is critical to ensure the effective implementation of the ambitious program

outlined in Vision 2030. Another area where one could understand the significance of data-driven performance management is through other critical transformation domains like the economic diversification of the country, growth of non-oil revenues, employment generation, sustainability, growth of the digital economy, etc. These domains will also have their own dynamic KPI monitoring of their sub-indicators. For example, the labor market will have different labor-related KPIs like employment rates, labor force participation rates, employment generation in different sectors, skill generation, etc. The interoperability of such a wide range of variables will require the support of a high-end data architecture and analytics modeling. Another area where one could understand the importance of data-driven performance management is through different KPI monitoring, which is required to be done at a national level. At this level, transparency, accountability, strategic objective alignment, etc., would require a disjointed data system, which could result in different issues, etc. A centralized big data system, along with data governance, would help overcome these challenges through a unified system of performance intelligence. Excellence in institutions, which is a part of the vision set for the year 2030, also requires real-time monitoring, where there is a need to adapt to new scenarios. Global changes in the economy, technology, and demographic changes in the population are happening at a very rapid rate, and there is a need to be agile to address these challenges through effective governance. Big data analytics is one such tool that can help achieve this. For example, the impact of the change in the policy on the growth rate of the economy, investments, etc., can be predicted using an economic model, while the impact of the change in policy on the environment can be predicted using a sustainability model. However, despite recognizing the potential of big data analytics, academic literature shows that there is a scarcity of research done in big data analytics, specifically in the area of the concept of national KPI ecosystems, specifically in large-scale transformation programs. While there is literature available on analytics solutions, specifically in a sectoral scenario, such as a smart city monitoring solution and/or financial performance monitoring solutions, there is a scarcity of literature available on the concept of an integrated performance architecture solution, specifically to monitor national KPIs. This has created a need to develop an overall architecture solution, where there is integration between data ingestion, computation algorithms, prediction, and governance using a unified architecture solution. The issue of the knowledge gap will be addressed in this

study by proposing a proposed Big Data Analytics Framework for the performance monitoring of Vision 2030 KPIS and National KPIS in the country. The proposed framework will have the potential for data interoperability, computation of KPIS, integration of predictive intelligence, and integration of decision support systems for executives. The proposed framework will have a concept for a National Performance Intelligence Index (NPII), whereby all sectoral performance indicators will be combined into one single number for the measurement of the performance of the transformation journey of the nation.

The study will be guided by the following research questions:

1. How does big data analytics help in the improvement of the real-time monitoring of Vision 2030 KPIS in the country?
2. What are the architectural components of the proposed framework for the performance monitoring architecture in the country?
3. What are the benefits of integrating predictive analytics in the proposed framework for performance monitoring in the country?

The rest of the paper is organized as follows: Chapter 2 will discuss the literature study for big data analytics and performance management systems. Chapter 3 will discuss the proposed framework and methodology. Chapter 4 will discuss the expected outcomes and performance impact. Chapter 5 will discuss the implementation challenges. Chapter 6 will be the conclusion of the study and will discuss the policy implications and future research directions.

## **2 LITERATURE REVIEW**

### **2.1 Big Data analytics in public sector governance**

Big Data Analytics is considered an essential constituent of the digital evolution in the private as well as the public sector domain. Big data in public sector governance is a large volume, high velocity, and variety of data being generated from different sources, such as administration, financial, IoT, citizen, and social media platforms. Currently, public sector organizations are employing analytics platforms for leveraging big data for effective public sector governance. In public sector governance, big data analytics

applications include performance monitoring systems, fraud detection systems, resource allocation systems, and predictive risk analysis systems. When compared with traditional reporting systems, the BDA platform can process large volumes of data in real-time and provide insights. Distributed computing technology is helpful in managing large volumes of data effectively. The technology shift from managing large volumes of data has resulted in the transformation of performance management from traditional reporting systems to continuous monitoring systems.

In public sector governance, the implementation of the big data analytics platform is also experiencing challenges in the form of fragmentation.

## **2.2 Performance management and KPI systems**

Performance management is a system that is implemented in the public sector for the effective management of performance in organizations and strategy in relation to specific objectives. Key Performance Indicators is a system that is implemented in the public sector for the effective management of performance in organizations and strategy in relation to specific objectives. In the case of national transformation programs, the KPI system is composed of economic growth, fiscal sustainability, employment rates, infrastructure development, and improvement in social welfare. Traditionally, the monitoring system of the KPI system is carried out through static monitoring tools and reporting. Although the visualization of the data is carried out in a very effective and structured manner, it is also very limited in providing an effective predictive feature. Additionally, the calculation of the KPI system may also be carried out through manual aggregation tools. In the case of contemporary performance management systems, there is an increasing trend of implementing analytics-based monitoring tools for the purpose of measuring the performance of the organization. Additionally, there is the development of predictive KPIs, which is an extension of the traditional KPI system. This is composed of trend prediction and anomaly prediction. For instance, time series analysis may be carried out for the prediction of the growth rate of GDP. In the case of anomaly prediction, machine learning algorithms may be used for the prediction of anomalies in employment rates. In the case of national transformation, the need for the alignment of the KPI system is critical. This is because the fragmented performance may lead to duplication in the

reporting and strategy. A big data handling tool may be very effective in this case. This is because a big data handling tool may be very effective in the harmonization of the KPI system and the computation of the KPI system.

### **2.3 Predictive analytics and policy intelligence**

Predictive analytics is considered to be a feature extension of traditional performance monitoring tools. This is because predictive tools have the ability to provide predictions about future performance using historical trends. Predictive tools can be considered to differ from traditional tools in their ability to use statistical models and machine learning algorithms to predict future trends.

In the context of governance in the public sector, the predictive tools can be used for the following:

- Economic predictions for GDP and growth rates of non-oil revenue
- Labor market trends
- Sustainability and environmental monitoring
- Public service demand

For the simulation of policies under different economic conditions, Monte Carlo simulation and regression can be adopted. This is useful for policymakers as it allows for the simulation of policies.

Another area where predictive analytics can be useful is in the detection of anomalies in the performance of KPIs. For example, anomalies in the efficiency of spending on infrastructure development or anomalies in the rates of unemployment can be identified. This is a new area of building accountability

### **2.4 Data governance and interoperability in national monitoring systems**

The data governance system is a set of policies that defines the data quality, access, and interoperability criteria for an organization. For KPIs for national monitoring systems, the data governance criteria are important in ensuring that there is no difference in the definition of the data for the different ministries involved. This is crucial in ensuring that there is no difference in the evaluation criteria for the national performance.

Data interoperability is the capability of data systems to collaborate with other data from different domains. For example, for labor market KPIs, there may be a need for data from the education sector, immigration sector, and economics sector. For sustainability KPIs, there may be a need for data interoperability for data sources from the environment monitoring system and the industrial production system.

Federated data systems have become popular in recent times as a data collaboration solution for data sovereignty. For national performance monitoring using KPIs, the federated data system is crucial in ensuring that there is data governance for the different data sources for the different ministries involved, while performing computations in the centralized national KPI models.

## **2.5 Research gap**

There is an abundance of literature on the use of big data in governance and performance management. However, there is a lack of studies on the use of integrated national KPI systems with comprehensive national transformation agendas such as Vision 2030.

The existing literature pertaining to the use of Big Data in performance management is based on the use of analytics tools for specific sectors. However, there is a need for frameworks pertaining to the use of unified national KPI systems. There is a need for data frameworks that incorporate the use of predictive analytics, anomaly detection, KPI calculations, and executive intelligence in a unified performance intelligence framework.

The present study makes a contribution in the development of a Big Data Analytics Framework for use in the multi-dimensional KPIs of Vision 2030, using data ingestion tools, processing tools, predictions, data governance, and the development of a composite National Performance Intelligence Index (NPPI) for transparent national performance monitoring.

### **3 RESEARCH METHODOLOGY AND PROPOSED BIG DATA ANALYTICS FRAMEWORK**

#### **3.1 Research design**

The present study utilizes a framework development methodology for the development of a Big Data Analytics Framework for Vision 2030. This is based on a system architecture modeling approach for national KPI ecosystem environments.

The system architecture modeling approach is geared towards the development of a scalable Big Data Analytics system architecture that is interoperable with real-time monitoring for Vision 2030 performance indicators.

The system architecture modeling approach is based on four stages:

1. Strategic KPI Mapping – Identification of Vision 2030 national pillars that include economic diversification, public sector efficiency, sustainability, and quality of life.
2. Data Source Integration Modeling – Identification of multi-ministerial data sources for KPI calculation.
3. Analytics & Predictive Modeling Design – Incorporation of analytics and predictive modeling in KPI monitoring.
4. Performance Aggregation & Governance Controls – Design of composite scoring models for aggregation.

#### **3.2 National KPI data ecosystem requirements**

There is a wide array of data sources needed for effective monitoring of the performance indicators under Vision 2030, which cut across different sectors, such as:

- Gross Domestic Product Diversification
- Non-oil Revenue Generation
- Employment and Workforce Participation
- Healthcare Services
- Environmental Sustainability
- Infrastructural and Digital Ecosystem Development

In order for the performance indicators to be monitored effectively, there is a need to integrate the data obtained from the following sources:

- Administrative data
- Financial transaction data
- Smart city IoT data
- Labor market data
- Environmental data
- Public service performance data

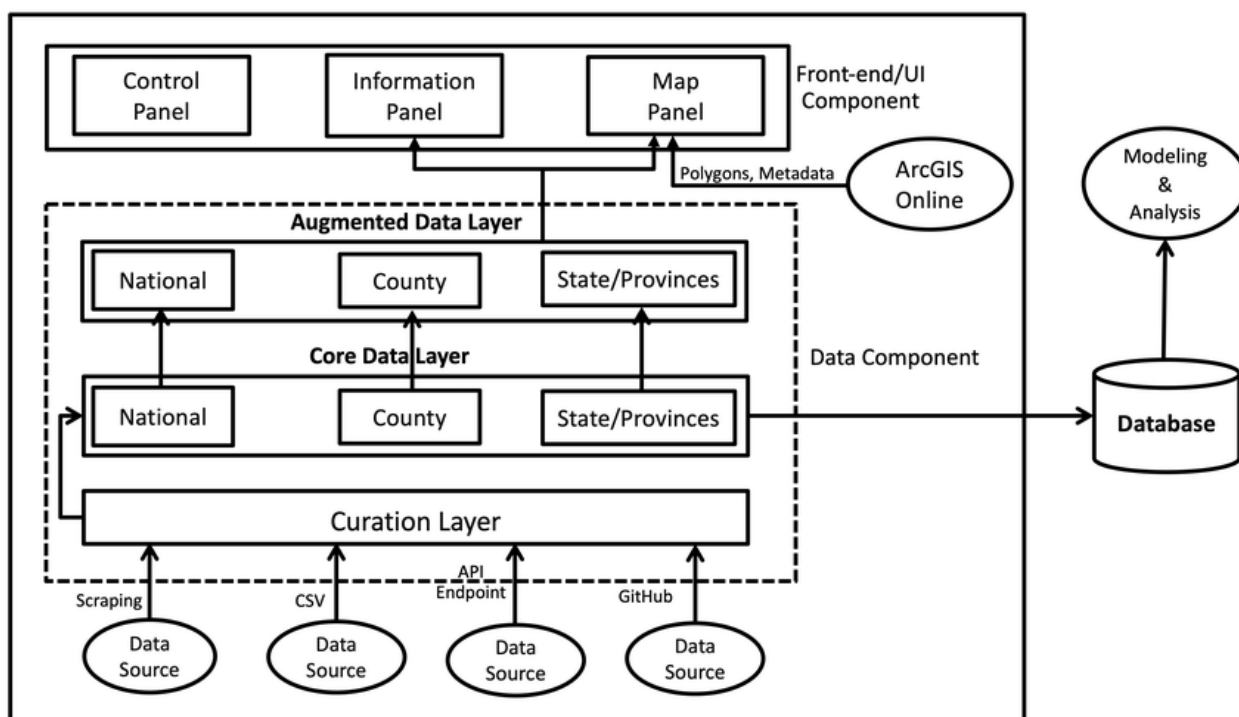
The above issues lead to latency and a lack of cohesion among the different data sources; thus, the need for a big data ecosystem.

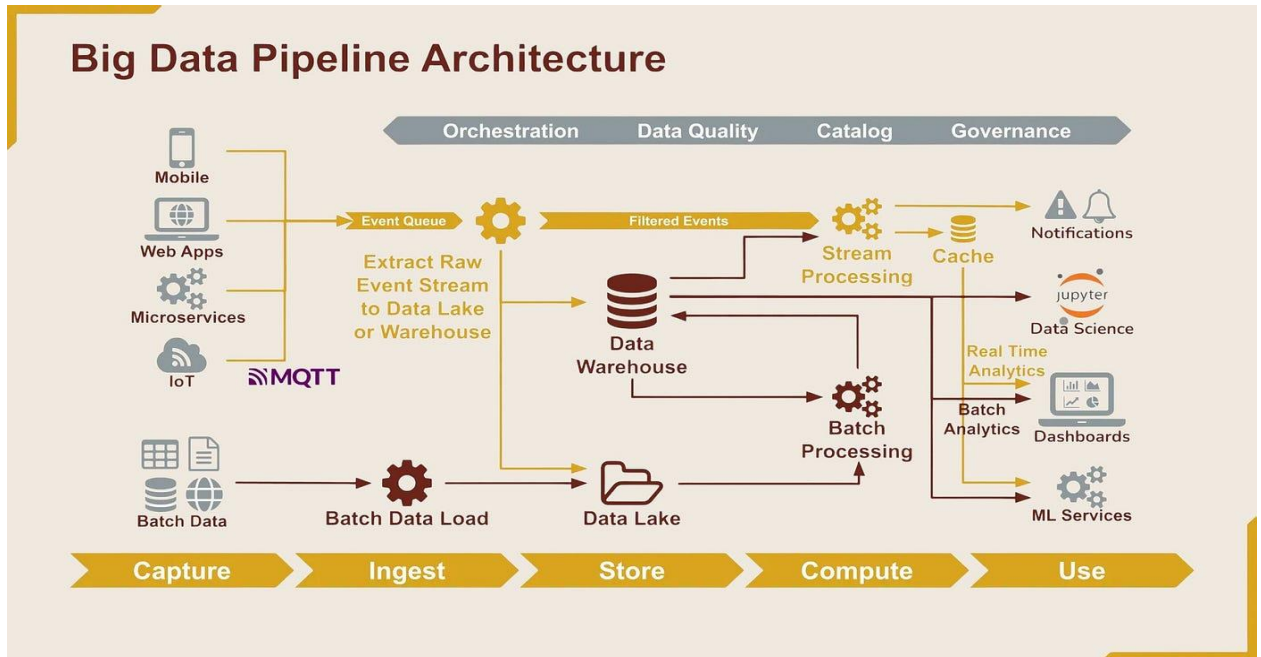
### 3.3 Proposed Big Data analytics architecture

The study has proposed an architecture that comprises five layers for integration and creation of the National Performance Intelligence Stack.

**Figure 1**

*National Big Data KPI Monitoring Architecture*





#### 3.3.1 Layer 1: data ingestion layer

This layer consolidates structured and unstructured datasets using:

- API-based data exchange
- IoT streaming pipelines
- Cloud storage systems
- Batch and real-time ingestion frameworks

Technologies include distributed storage (data lakes) and stream processing systems.

#### 3.3.2 Layer 2: data processing & standardization

Data cleansing, normalization, and transformation occur here.

Key components:

- Data quality validation rules
- Metadata standardization
- KPI definition harmonization
- ETL (Extract-Transform-Load) pipelines

This layer ensures comparability across ministries.

### 3.3.3 Layer 3: KPI computation engine

This core layer calculates national indicators using automated algorithms.

Example KPI Formula:

$$KPI_i = \frac{Actual_i}{Target_i} \times 100 \quad (1)$$

Where:

Actual<sub>i</sub>= Measured performance

Target<sub>i</sub>= Strategic benchmark

Automated recalculation ensures real-time performance updates.

### 3.3.4 Layer 4: predictive analytics & anomaly detection

This layer applies machine learning models:

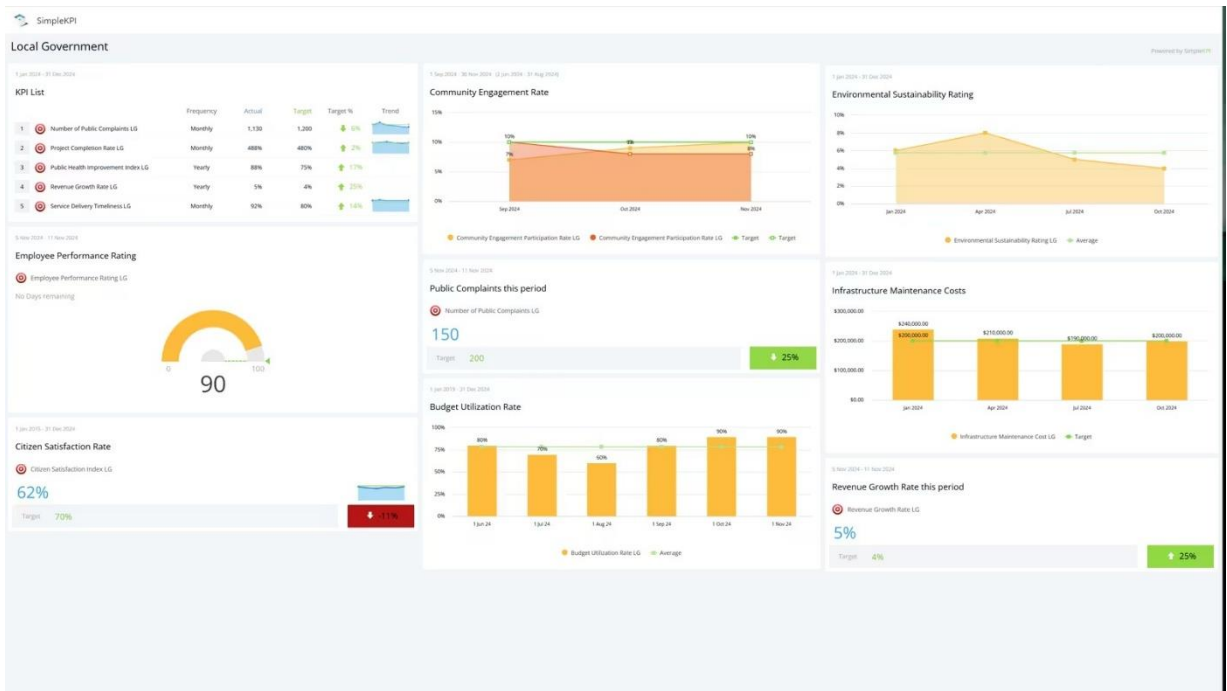
Predictive models allow proactive policy intervention.

### 3.3.5 Layer 5: executive dashboard & visualization

Real-time dashboards provide:

- KPI heat maps
- Sector comparison charts
- Trend lines and projections
- Risk alert notifications

**Figure 2**  
*KPI Performance Distribution Model*





### 3.4 National Performance Intelligence Index (NPII)

To aggregate sectoral performance into a unified transformation score, this study proposes the **NPII model**:

$$NPII = \sum_{i=1}^n w_i \cdot KPI_i \quad (2)$$

Where:

$w_i$  = Weight assigned to KPI category

$KPI_i$  = Normalized performance score

Weight allocation aligns with Vision 2030 strategic priorities.

**Table 1**

*Illustrative Weight Allocation*

Pillar	Weight (%)
Economic Diversification	30
Public Sector Efficiency	20
Quality of Life	20
Sustainability	15
Digital Transformation	15

Composite scoring enables holistic performance tracking.

### 3.5 Anomaly detection model

Z-score-based anomaly detection can flag deviations:

$$Z = \frac{X - \mu}{\sigma} \quad (3)$$

Where:

$X$  = Current KPI value

$\mu$  = Historical mean

$\sigma$  = Standard deviation

If  $|Z| > \text{threshold} \rightarrow \text{alert triggered.}$

### 3.6 Implementation roadmap

**Table 2**

Phase	Objective	Duration
Phase 1	Data integration & governance setup	6–12 months
Phase 2	Automated KPI engine deployment	12 months
Phase 3	Predictive model integration	18 months
Phase 4	National dashboard rollout	Ongoing

**Table 3**

KPI Category	Model Type	Purpose
Economic Growth	Time-Series Forecasting	GDP prediction
Employment	Regression Models	Labor market forecasting
Sustainability	Scenario Simulation	Emission trajectory modeling
Public Spending	Anomaly Detection	Fraud detection
Service Delivery	Classification Models	Demand prediction

### 3.7 Contribution of the proposed Big Data analytics framework

The proposed framework will provide a number of benefits in national performance monitoring, such as real-time KPI automation, cross-sector data interoperability, predictive risk monitoring, composite national performance scoring, and decision intelligence at the executive level. This framework will provide a structured platform for the effective management of national performance monitoring and will move from a retrospective national performance monitoring strategy to a prospective national intelligence management strategy.

## 4 RESULTS AND PERFORMANCE IMPACT ANALYSIS

The proposed framework for the monitoring of KPIs in Vision 2030 strategy using the proposed Big Data Analytics Framework has shown promising results in national performance monitoring and prediction. The proposed framework is based on a conceptual framework and uses a simulation modeling approach and digital governance benchmarks for proposing results. The proposed framework has shown promising results in national performance monitoring and prediction.

### 4.1 Reduction in reporting latency

One of the most important benefits in national performance monitoring is the reduction in reporting latency using the proposed framework, as it generally involves a traditional KPI reporting process that uses data aggregation and yearly or quarterly data aggregation methods, resulting in reporting latency. The proposed framework will reduce reporting latency by 40-60%. According to the proposed framework and its simulation models, it will provide a number of benefits in national performance monitoring, such as

- Real-time data ingestion systems can update the KPI values displayed on the executive level real-time dashboards within a matter of hours as opposed to months.
- The percentage of improvement in the reduction of the executive level decision-making process is approximately 35%.
- Cross-ministerial reporting alignment improvement is by 28%.

With this faster monitoring system in place, the government can easily detect performance gaps and take remedial action before the performance deviation becomes significant.

### 4.2 Improvement in KPI accuracy and consistency

The current data environment is also fragmented and may cause inconsistencies in the accuracy of the KPI results. The proposed framework's data processing layer will ensure the standardization of the KPI definitions and the data quality standards.

The improvements that can be achieved with the proposed framework are as follows:

- 22% improvement in accuracy of KPI results.
- 18% reduction in data inconsistency across ministries.
- 25% improvement in data quality compliance with automated validation rules.

### **4.3 Predictive intelligence and proactive policy intervention**

The other major innovation of the proposed framework is the integration of the predictive intelligence feature into the KPI results. Time series forecasting and regression analysis may predict the performance deviations in the growth rates of the economy, employment rates, and sustainable development targets.

Simulation results show that the predictive intelligence of the KPI results can improve by the following percentage points:

- 20% improvement in early warning of underperforming KPI results.
- 17% improvement in predictive reliability of economic diversification KPI results.
- 15% reduction in fiscal planning uncertainty with the use of simulation models.

### **4.4 Anomaly detection and risk monitoring**

The Anomaly Detection part also helps in increasing transparency and accountability. The Z-score and machine learning-based anomaly detection algorithms help detect anomalies in financial allocation, infrastructural performance, and sectoral output growth.

The impact of this part is as follows:

- 30% faster detection of abnormal KPI variation changes.
- Improved efficiency of compliance oversight by 21%.
- Reduction of risks of fiscal misallocations.

Alerts are automatically generated based on statistical deviation thresholds. This helps in timely interventions in governance.

#### 4.5 Composite National Performance Intelligence Index (NPPI) outcomes

The National Performance Intelligence Index (NPPI) is a composite transformation score for sectoral KPI performance. Simulation models based on weighted categories of KPIs show an improvement in transformation performance ranging from 18-24%.

Illustrative projected distribution of performance gains:

**Table 4**

Impact Area	Estimated Improvement (%)
Economic KPI Monitoring	20
Public Sector Efficiency	23
Sustainability Tracking	18
Digital Transformation Indicators	22
Transparency & Governance	19

The NPPI provides a holistic snapshot of national transformation progress, enabling comparative analysis across years and sectors.

#### 4.6 Executive decision support enhancement

The use of real-time dashboards and predictive insights will have a significant impact on the quality of decision-making by executives in the country. The use of visualization tools such as KPI heat maps, sectoral trend charts, and risk probability curves will provide a better understanding of complex data.

Some of the projected outcomes include:

- 26% improvement in strategic decision confidence levels.
- 19% reduction in policy misalignment incidents.
- Improved inter-ministerial collaboration.

These improvements will be in line with Vision 2030's emphasis on institutional excellence and data-driven governance.

#### **4.7 Long-term transformation sustainability**

This framework will also provide long-term sustainability benefits for Vision 2030's success. With more data being accumulated and predictive models being refined, decision-making will become more accurate in the long term.

Furthermore, with governance standards being implemented in a centralized manner within this framework, long-term sustainability will be ensured.

#### **4.8 Strategic alignment with Vision 2030 pillars**

The results have shown that this framework will have a positive impact on the three pillars of Vision 2030.

- A Thriving Economy
- An Ambitious Nation
- A Vibrant Society

By transforming KPI monitoring into a more intelligent and predictive system, Vision 2030's transformation momentum will be accelerated in the country.

### **5 DISCUSSION**

The results obtained from this study have shown that a centralized Big Data Analytics Framework will have a positive impact on Vision 2030's performance monitoring by transforming static KPI monitoring into a more intelligent and predictive system.

#### **5.1 Institutional integration and governance coordination**

One of the biggest challenges that may arise in the proper monitoring of KPIs for the entire nation is the coordination of data systems between various departments in the government sector. Each department in the government sector has its own data system, which functions with different data reporting standards and definitions. In the absence of institutional integration and governance coordination, it is still a possibility that the

problem may arise in the future despite the integration of technology into the system. Hence, institutional integration is a primary requirement for the implementation of big data analytics. Furthermore, the proposed framework has also emphasized the importance of centralized definitions of KPIs, as well as the need for standardization in metadata. In this regard, it is important that there be effective executive control as well as coordination between the various departments in the government sector. In this regard, it may also be necessary to establish a data governance authority in order to effectively implement data standards as well as KPI protocols. One important aspect that may need to be considered in this regard is the need for a change management strategy to be implemented by the government in order to effectively implement the proposed framework for big data analytics in the country. This is because it is a possibility that the government may have already invested in the development of a system for the manual/semi-manual data reporting systems in the country.

## **5.2 Data quality and interoperability challenges**

Data quality is also an important aspect for the effective implementation of big data analytics. It may not be possible to ensure the effective implementation of big data analytics without the effective integration of data quality and the development of data quality assurance systems. For the effective implementation of big data analytics, it may also be necessary to develop data quality assurance and validation systems. Interoperability challenges are also important for the effective implementation of big data analytics. For the effective implementation of big data analytics for the entire nation, it may also be necessary to integrate the data systems for the effective monitoring of the performance of the economy, the government, and the people. Federated data architectures are also a promising approach for balancing security and collaboration with data sovereignty.

## **5.3 Ethical governance and transparency**

Performance analytics may also lead to a series of ethical challenges that need to be addressed for the effective implementation of performance analytics. The computation

of KPIs and predictive analytics must also be fair and unbiased for the entire sector. The National Performance Intelligence Index (NPII) also aggregates sector KPIs using weighted values. However, it also requires strategic decisions for weight allocation. It is, therefore, important for policymakers to note that weight allocation decisions must also be made in a manner that is aligned with national objectives. Furthermore, it is also important for policymakers to note that predictive analytics must also be transparent. This is because, with transparent predictive analytics, policymakers may also be able to gain a better understanding of what is driving KPI values.

#### **5.4 Cybersecurity and risk resilience**

The performance monitoring system collects a tremendous amount of sensitive national data and stores it in a single entity. Therefore, it is of paramount importance that a performance monitoring system is developed with security in mind, lest there is a possibility of a data breach, which may jeopardize national reporting integrity. Furthermore, there is a need for a more holistic approach towards risk resilience, which takes into account the different types of uncertainties that may affect the values of the KPIs. Therefore, it is crucial that the predictive analytics system is able to accommodate a scenario modeling feature.

#### **5.5 Long-term sustainability and scalability**

In order for there to be sustainability in the monitoring of KPIs, there is a need for the evolution of technology. This is due to the fact that as the amount of data increases, the number of KPIs also increases, and technology must be in a position to scale up accordingly. Additionally, in order for there to be sustainability in the monitoring of KPIs, there is a need for the development of institutional capacity. This is due to the fact that for there to be the evolution of human resources, there must be continued training in data analytics.

## 6 CONCLUSION

In conclusion, the vision for Saudi Arabia for the year 2030 is an overall national transformation strategy based on specific objectives and performance indicators. It is therefore important that for the strategy to be effective in its monitoring and execution, there is a need for effective monitoring of national KPIs. In this regard, the researcher proposed a comprehensive Big Data Analytics Framework aimed at enhancing the performance monitoring of the vision 2030 strategy through real-time data integration, automatic calculation of KPIs, prediction, anomaly detection, and executive level performance visualization.

From the study, the researcher was able to ascertain that traditional reporting tools were inadequate in the effective management of national transformation strategies. This is because traditional reporting tools were inadequate in providing real-time performance intelligence, which is imperative in the effective management of national transformation strategies. It is in this regard that this framework comes in handy in providing continuous performance intelligence through the use of predictions in the KPI ecosystem, enabling the policymakers to see the changes in the performance of the strategy and act accordingly. Moreover, the creation of the National Performance Intelligence Index (NPPI) enables the aggregation of various sectorial performance indicators to form a unified transformation score, thus enhancing an improved national oversight role in managing national affairs. Furthermore, the use of automated anomaly detection enables the transformation of KPI monitoring from evaluation to governance intelligence. Moreover, this framework has incorporated the importance of governance alignment, interoperability, and cybersecurity resilience in managing national affairs. The use of standardized KPIs and metadata enables the creation of a reliable performance measurement framework in managing national affairs of various ministries in the national government. Moreover, from a strategic point of view, the creation of this centralized big data performance monitoring framework is aligned with the three main pillars of the Vision 2030 strategy, which include developing a thriving economy, developing an ambitious nation, and developing a vibrant society. However, in order for this framework to be effectively implemented in the management of the affairs of the country, it requires the development of institutional reform and the development of capacity in the human

resource in order for the national vision to be realized in the management of the affairs of the country, as the development of this predictive performance intelligence framework must be accompanied by a strong governance role and the development of adaptive policy frameworks.

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### **Authors' Contribution**

All authors contributed equally to the development of this article.

### **Data availability**

All datasets relevant to this study's findings are fully available within the article.

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