Enhancing Data Management for Decision Support Systems in Indonesian Government Internal Audit: A DMBOK Approach

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***Abstract*—Indonesian public institutions, including the Financial and Development Supervisory Agency (BPKP), face challenges such as fragmented standards and poor data quality, which hinder effective Decision Support Systems (DSS). This research aims to evaluate BPKP's current analytics maturity level using the TDWI Analytics Maturity Model and to formulate a Data Management Body of Knowledge (DMBOK)-based strategy to enhance its data management and analytical capabilities in support of decision-making. This qualitative descriptive case study methodology employed document analysis. The research stages involved assessing maturity using the TDWI model, conducting a gap analysis, formulating a strategy with DMBOK principles, and proposing an implementation roadmap based on Aiken's Data Management Value Pyramid. The research findings indicate BPKP's analytics maturity is at the "Early Adoption" stage (overall score 3.41), with the Analytics dimension scoring the lowest (2.60) and exhibiting the largest gap (1.40). Key challenges identified are underdeveloped institutional metadata and limited application of advanced analytics. A comprehensive DMBOK-based strategy and a four-phased implementation roadmap using Aiken's Pyramid were proposed to address these issues.**

Keywords*—*Data management; data management body of knowledge; Indonesian government internal audit agency; decision support system

I. Introduction

Modern public institutions are under increasing pressure to become more transparent, accountable, and adaptive in responding to rapid socio-economic and technological changes. Effective decision-making now requires not only administrative competence but also the strategic use of accurate, consistent, and reliable data. As such, data is no longer merely operational but foundational to evidence-based policymaking. Decision Support Systems (DSS) play a central role in enabling data-driven decisions using historical analysis and predictive models.

Despite this imperative, many public organizations still face structural challenges such as fragmented standards, poor data quality, and limited interoperability across units. These issues hinder information integration and impair decision consistency. Prior studies [1], highlight similar problems in Indonesia's public sector, where institutions like the Directorate General of Customs and Excise struggle with data quality due to the absence of a standardized governance framework.

To address these challenges, frameworks such as the Data Management Body of Knowledge (DMBOK) and the TDWI Big Data Maturity Model offer structured approaches to strengthen data governance and evaluate organizational readiness. In Indonesia, national policies like the One Data Indonesia (SDI) and Electronic-Based Government System (SPBE) further emphasize the need for integrated, interoperable, and accountable data management systems.

Within this context, Indonesia's Financial and Development Supervisory Agency (BPKP)—as Indonesia's internal audit institution—has initiated digital transformation programs. However, internal evaluations reveal that its data management practices remain uneven and lack full integration. Therefore, this study seeks to address the following questions:

- What is the current level of analytics maturity supporting decision-making systems in BPKP?
- What strategy can be formulated to improve data management and analytical capabilities at BPKP?

The objectives of this study are as follows:

- To evaluate the maturity level and identify gaps in BPKP's data-driven decision systems using the TDWI Analytics Maturity Model.
- To formulate a DMBOK-based strategy to enhance data management in support of decision-making within BPKP.

This research is expected to generate a strategic roadmap for enhancing data governance within public sector internal audit institutions. By aligning BPKP's data management practices with international frameworks and national policy mandates, the study contributes to improving the effectiveness of evidence-based decision-making and supports broader goals in Indonesia's digital government transformation.

The remainder of this paper is structured as follows. Section II provides a comprehensive Literature Review detailing key concepts such as Information System Management, Decision Support Systems, Data Governance in the Public Sector, and relevant maturity models and frameworks like DMBOK and TDWI. Section III, Methodology, describes the qualitative descriptive case study approach, data collection methods, and the maturity assessment process employed. Section IV presents the Result and Discussion, outlining BPKP's current data management and analytics maturity, identified gaps, and the formulated DMBOK-based strengthening strategies, along with a phased implementation roadmap. Finally, Section V offers the

Conclusion of the study, summarizing the key findings and discussing their implications for future research and practice.

II. Literature Review

A. Information System Management and Decision Support Systems

Information System Management (ISM) integrates technology, processes, and people to support organizational decision-making and strategic objectives [2]. The classic pyramid model by [3] delineates the hierarchy of information systems—TPS, MIS, DSS, and EIS—each enabling different levels of decision-making. Among these, Decision Support Systems (DSS) play a critical role in semi-structured and unstructured decision contexts, providing analytical insights beyond routine MIS reports [4]. The integration of Big Data Analytics into Decision Support Systems has transformed decision-making processes across sectors, enabling real-time, predictive, and multi-source data analysis that surpasses the limitations of traditional, historically driven systems [5][6].

B. Data Governance in the Public Sector

Effective data governance is essential for ensuring public accountability and reliable decision-making. DAMA International [7] defines data management as a strategic process encompassing data quality, security, interoperability, and governance. However, public institutions often face structural issues, such as data silos, inconsistent metadata standards, and unclear responsibilities. These challenges are both technical and organizational, requiring top-level leadership support [8][9]. High-quality, integrated data systems are vital for enabling performance-based monitoring, policy formulation, and public trust [10].

C. DMBOK Framework and Its Application

The Data Management Body of Knowledge (DMBOK), developed by DAMA International [7], provides a comprehensive framework for managing data as a strategic organizational asset. It outlines a holistic approach to data governance by integrating best practices, standards, and roles across eleven functional knowledge areas.

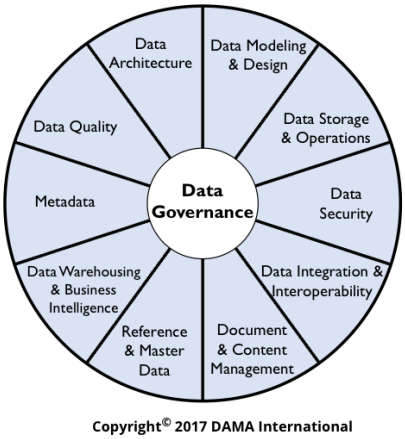

Fig. 1. DAMA Wheel [7].

Fig. 1 illustrates the eleven interrelated knowledge areas defined in the DMBOK framework. These domains represent the foundational components required to establish a comprehensive and integrated data management environment. Each area addresses a specific function ranging from governance, architecture, and quality to security, metadata, and interoperability that collectively support the organization's ability to manage data strategically. The DMBOK framework emphasizes that effective data management is not isolated to technical solutions, but rather requires a coordinated effort involving policy, processes, roles, and cultural change. This visual representation underscores the holistic nature of the DMBOK approach and serves as a guide for institutions seeking to align their data practices with international standards.

D. Maturity Models for Data Management

Maturity models, such as the TDWI Big Data Maturity Model, serve as diagnostic tools to assess and plan organizational data capabilities. These models identify gaps and guide progressive improvement across dimensions like infrastructure, analytics, and governance [11]. The TDWI model outlines five stages from Nascent to Visionary, offering a structured roadmap for organizations transitioning towards advanced analytics and data-driven strategies. Fig. 2 illustrates the primary dimensions and other factors considered in the TDWI Big Data Maturity Framework.

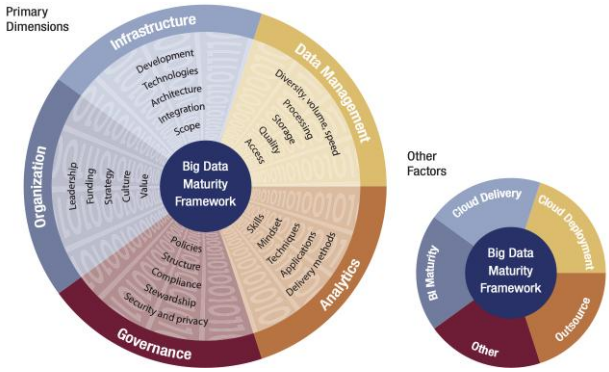

Fig. 2. Big data maturity assessment criteria diagram [11].

E. Regulatory and Institutional Context in Indonesia

National regulations such as in study [12] and [13] reinforce the urgency for standardized and interoperable data systems. These policies establish the foundation for digital transformation and evidence-based governance. Within this context, BPKP, as Indonesia's internal audit institution, plays a strategic role in integrating data management into its supervisory functions. Despite progress, BPKP still faces fundamental challenges in data fragmentation and governance [14], necessitating a systematic strategy aligned with DMBOK principles.

F. Document Analysis in Qualitative Research

Document analysis is a recognized method in qualitative research, particularly when exploring organizational processes, historical development, or policy implementation. Research in [15] emphasizes the analytical value of documents as credible, stable, and context-rich sources that provide insights into institutional behavior and decision-making processes. His framework underscores the importance of document authenticity, representativeness, and meaningful interpretation within social and policy contexts.

In parallel, the READ method by [16] offers a structured approach to document analysis in public policy studies. The acronym stands for Ready (defining document selection criteria), Extract (gathering data systematically), Analyze (applying thematic or comparative analysis), and Distill (synthesizing findings). This method ensures methodological rigor, particularly in desk-based research within constrained institutional settings.

Together, [15] conceptual grounding and the procedural structure of [16] support reliable and replicable document-based inquiry, especially relevant for studies on data governance in public institutions where internal reports, regulations, and strategic plans serve as primary data sources.

III. Methodology

A. Research Design

This study adopts a qualitative descriptive approach using a single-case design, focusing on data governance practices at (BPKP). The research aims to formulate a data management strategy by assessing the current state and aligning it with international frameworks such as DMBOK and national regulations like SPBE [12] and SDI [13]. Document analysis serves as the main method, justified by the nature of the study, which involves reviewing internal policy, system documentation, and regulatory materials.

B. Conceptual Framework

The research follows a multi-phase conceptual framework combining theoretical and empirical steps. The process begins with literature review and problem analysis, followed by document-based evaluation of BPKP's data governance maturity, and concludes with the formulation of DMBOK-based strategic recommendations. The framework integrates insights from internal policies, maturity models, and regulatory alignment to ensure applicability and relevance (Fig. 3).

C. Data Collection

Data were collected primarily through internal documentation, including maturity assessment reports, organizational policies, system development roadmaps, and national regulatory frameworks. Additional insights were gained through participatory observation of data governance processes. Document selection followed the READ method, which consists of four stages: Ready (criteria-based selection), Extract (structured data extraction), Analyze (topic and policy mapping), and Distil (strategic synthesis).

D. Maturity Assessment Using TDWI

The analysis utilized the TDWI Analytics Maturity Model to assess BPKP's readiness across five core dimensions: Organization, Governance, Analytics, Infrastructure, and Data Management. Each dimension was scored on a five-level maturity scale ranging from Nascent to Visionary. Table I provides a detailed breakdown of the maturity assessment criteria for each TDWI dimension, outlining the characteristics for levels 1 through 5. A scoring matrix was developed and applied to evaluate documented practices and observed operations. Identified gaps were mapped against DMBOK domains to formulate strategic interventions that are contextually relevant and scalable.

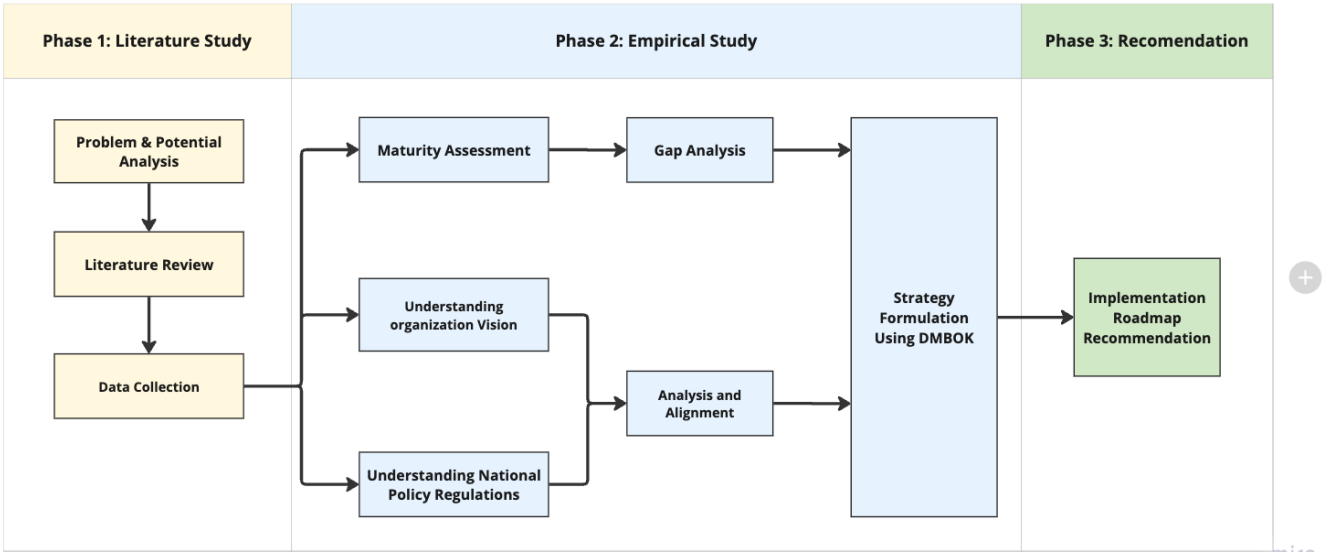

Fig. 3. Conceptual framework for the study.

Each dimension comprises several observed indicators reflecting current practice. Observations were scored on a 1–5 scale corresponding to the maturity level. The maturity score for each dimension was calculated as follows:

$$Dimension\ Score = \frac{\sum Indicator\ Scores}{Number\ of\ Indicators}$$

To identify the gap between actual and expected conditions, a gap analysis was performed using the following formula:

$$Gap\ Score = Ideal\ Score - Actual\ Score$$

TABLE I. MATURITY ASSESSMENT CRITERIA PER TDWI DIMENSION

Dimension	Level 1 - Nascent	Level 2 – Pre-Adoption	Level 3 – Early Adoption	Level 4 – Corporate Adoption	5 - Visioner
Organization	No structure, budget, or training.	Isolated initiatives, limited support, basic training.	Emerging structure, clear support, structured training.	Strong structure, sustained support, comprehensive training.	Strong data culture, active leadership, high innovation.
Governance	No policy or data security.	Incomplete policies, basic security.	Complete policies, clear roles, good security.	Monitored governance, measurable quality, strong security.	Automated governance, optimal quality, advanced protection.
Analytics	No analytics or reporting.	Basic reports, minimal analysis, intuitive decisions.	Use of analytics starts, advanced reporting, some AI.	In-depth analytics, dashboards, data-driven decisions.	Real-time analytics, machine learning.
Infrastructure	Fragmented and unplanned.	Basic systems, limited integration.	Integrated infrastructure, initial data warehouse.	Scalable infrastructure, cloud, big data capabilities.	Cloud-native, Data Mesh, Data Lakehouse architectures.
Data Management	No management, quality not addressed.	Basic processes, early attention to quality.	Defined processes, managed metadata, good quality.	Actively monitored, measured quality, integrated processes.	Automated management, certified quality, seamless data sharing.

In this study, the ideal score was set at Level 4 (Corporate Adoption) to represent the minimum threshold of systematic and standardized practices in public sector organizations.

Since a single indicator may reflect multiple dimensions, each observation was mapped to all relevant categories. For example, leadership support for big data initiatives could influence the Organization, Infrastructure, and Analytics dimensions. This approach acknowledges the interconnected and multidimensional nature of data governance and ensures that scoring reflects the systemic integration of practices.

The results of the maturity assessment provided a diagnostic basis for identifying priority areas and designing improvement strategies mapped to the DMBOK framework.

E. Validation Techniques

To ensure the reliability of findings, two validation techniques were employed. First, source triangulation was conducted by cross-verifying information across different types of documents and internal systems, such as official policy documents, internal assessment reports, and system architecture diagrams, to ensure consistency and comprehensiveness of the data gathered. Second, a limited member-checking approach was applied, in which selected results and interpretations regarding BPKP's current maturity levels and identified challenges were informally verified by internal stakeholders (e.g., data management leads and key BPKP personnel involved in digital transformation initiatives) to confirm consistency with organizational practices. This dual approach enhanced the trustworthiness and credibility of the assessment outcomes.

IV. RESULT AND DISCUSSION

This section presents the findings from the assessment of BPKP's big data and analytics capabilities, discusses the identified maturity levels and gaps, and outlines DMBOK-based strategies formulated to enhance its data-driven decision-making capacity.

A. Current State of Data Utilization and Management at BPKP: Key Findings

A systematic analysis of BPKP's internal documents, employing the READ (Ready, Extract, Analyse, Distil) approach, was conducted to understand the existing landscape. This investigation yielded key insights into organizational strengths and challenges pertinent to leveraging data for decision support.

1) Identified strengths: The document analysis revealed a strong commitment from BPKP's leadership towards digital transformation and enhancing data analytics capabilities, supported by strategic policies and resource allocation. This leadership support is crucial for successful data governance initiatives, a point strongly emphasized by research indicating the need for top-level support to overcome technical and organizational challenges in public institutions. Foundational elements include an established data custodian structure (walidata) aligning with national Satu Data Indonesia (SDI) principles, core operational systems like the Audit Management Information System (SIMA) and the STARA interoperability platform, alongside initiatives in knowledge management (KMS) and robust information security practices (evidenced by ISO 27001 certification). These elements provide a solid groundwork for future enhancements.

2) Identified challenges: Despite these strengths, significant challenges persist. The practical application of advanced analytics for risk-based decision-making and data-driven audits is not yet widespread. Comprehensive, standardized institutional metadata documentation is underdeveloped, and a formal, documented data lifecycle management process for digital supervision data is largely absent. Furthermore, an integrated system for managing all digital audit evidence is lacking. These issues resonate with prior studies on data quality and governance in Indonesia's public sector, where institutions often struggle with fragmented standards and the absence of standardized governance frameworks. Similarly, Nielsen et al. [8] emphasize the inherent difficulties in governing data within local government due to challenges such as data silos and inconsistent metadata standards.

B. Big Data Maturity Assessment

To objectively evaluate BPKP's proficiency in harnessing data for its decision-making systems, the TDWI (The Data Warehousing Institute) Big Data Maturity Model was employed. This model assesses maturity across five dimensions: Organization, Data Governance, Analytics, Infrastructure, and

Data Management. The scores for each dimension were derived from a systematic mapping of the documentary evidence (summarized in Section A) against detailed TDWI criteria. The overall big data/analytics maturity score for BPKP was 3.41, categorizing the institution at the “Early Adoption” stage. This finding aligns with observations in other public sector entities, where initial investments in digital transformation often precede full operationalization of data-driven capabilities, as highlighted by Di Vaio et al. [14] regarding the evolving role of digital technologies in governments. Fig. 4 visually represents the maturity scores across these dimensions.

The Infrastructure dimension scored highest (3.60, transitioning towards "Corporate Adoption"). This reflects strong evidence of BPKP's significant investments in IT architecture, core systems like STARA, and a Data Lake House initiative, indicating a good technical foundation for handling diverse datasets. Data Governance followed at 3.57, supported by the data custodian structure, ISO 27001 security standards, and various formal policies pertinent to managing data sources.

Both the Organization and Data Management dimensions scored 3.40 ("Early Adoption"). For the Organization dimension, while leadership commitment is strong, a pervasive data-driven culture and specific data management performance metrics are still evolving. For Data Management, practices such as reference code usage are in place, but comprehensive metadata and integrated data lifecycle management require substantial development.

The Analytics dimension received the lowest score (2.60, between "Pre-Adoption" and early "Early Adoption"). This low score is primarily due to the limited operational utilization of advanced analytics (e.g., predictive modeling) in core supervision processes, despite initial investments and planning. This gap highlights a common challenge in public sector organizations where the integration of big data analytics into core decision-making processes, particularly for predictive and proactive insights, is still in nascent stages, as discussed by Chen et al. [5] and Demirkan & Delen [6] on the transformation of decision-making by big data analytics, and also relevant to the discussions on AI in public governance.

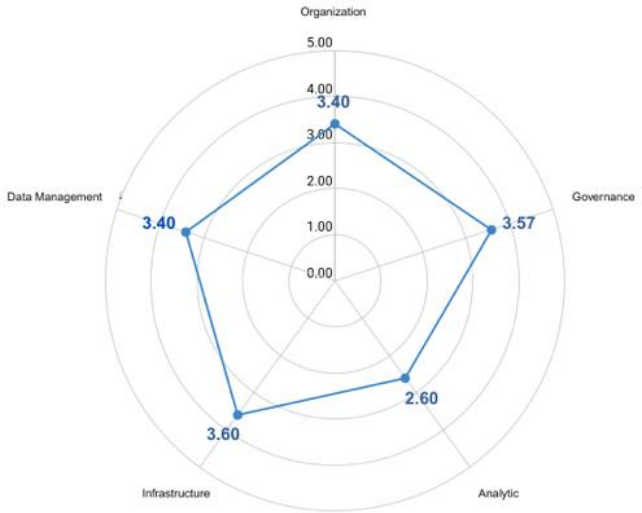

Fig. 4. BPKP's big data maturity assessment results.

C. Gap Analysis

A gap analysis compared BPKP's current maturity scores against a target of 4.0 ("Corporate Adoption"), essential for fully leveraging data for strategic decision-making. Table II summarizes this analysis.

TABLE II. GAP ANALYSIS OF BPKP'S BIG DATA MATURITY

Dimension	Reality	Exp.	Gap	Gap Analysis
Organization	3.4	4	0.6	The organizational area shows strong leadership commitment and effort to build a data culture. Policies and training are in place, and there is support for strategic initiatives. The main gaps are in the full implementation and measurement of the impact of these initiatives.
Governance	3.57	4	0.43	Data governance is already quite strong with structured policies and procedures, and efforts to comply with international standards. What needs to be improved is the validation, audit, and further evaluation of existing processes, as well as expanding the scope of data governance to all types of data.
Analytic	2.6	4	1.4	The analytics area shows great potential, but implementation is still in its early stages. There needs to be pilot projects, predictive models, or integration into business processes to make more effective use of analytics data. Training and platforms are available, but their use needs to be encouraged. In addition, there needs to be a more concrete implementation of big data analytics initiatives and the use of AI platforms. The use of analytics data needs to be encouraged and integrated into business processes.
Infrastructure	3.6	4	0.4	IT infrastructure is already well prepared, with attention to hardware, integrated systems, and big data management. It is necessary to ensure a comprehensive architecture and coverage for all data and analytics needs.
Data Management	3.4	4	0.6	Data management is already quite good with integration, quality assurance, and big data management. Further development is needed in metadata management, specific data architecture, and ensuring comprehensive data lifecycle and audit.

The analysis in Table II reveals the most substantial gap in the Analytics dimension (1.40). Significant gaps also exist in Organization (0.60) and Data Management (0.60), underscoring

the need for a more ingrained data-driven culture, specific performance metrics, comprehensive metadata standards, and systematic data lifecycle management. Smaller gaps in Data Management (0.43) and Infrastructure (0.40) indicate these areas are relatively more mature but still need enhancements for full corporate adoption.

D. Formulation of DMBOK-Based Strengthening Strategies

To address the identified gaps systematically, strengthening strategies were formulated based on the comprehensive DAMA Data Management Body of Knowledge (DMBOK) framework. DMBOK provides a structured compendium of data management principles and best practices across eleven key Knowledge Areas (KAs). The application of DMBOK here provides a structured approach to overcome common data management challenges in public institutions, offering a more standardized governance framework as suggested by Nugraha et al. [1] and aligning with the principles for reliable public sector data discussed by DAMA International [7]. For this research, practical solutions from these KAs were identified and tailored to BPKP's specific needs and context. Table III below summarizes the core DMBOK Knowledge Areas drawn upon and the key solution themes that inform the proposed strategies for BPKP. These themes are derived from a more extensive catalog of DMBOK practical solutions.

TABLE III. KEY DMBOK KNOWLEDGE AREAS AND CORRESPONDING SOLUTION THEMES APPLIED

DMBOK Knowledge Area	Key Solution Themes
Data Governance (DG)	Establishing a formal data governance function, roles (e.g., data stewards), and clear accountability; Developing and implementing comprehensive data governance policies, standards, and procedures; Managing compliance and data ethics.
Data Architecture (DA)	Evaluating and defining an enterprise data architecture that aligns with business strategy; Developing data flows and integration models; Ensuring architectural principles are followed.
Data Modeling & Design (DM)	Developing and maintaining enterprise conceptual, logical, and physical data models; Ensuring data models support business requirements and data quality.
Data Storage & Operations (DSO)	Managing physical data assets, including database administration, performance monitoring, and data lifecycle operations like backup, recovery, retention, and archiving.
Data Security (DS)	Defining and implementing data security policies, standards, and controls; Managing data access and privacy; Ensuring compliance with security regulations.
Data Integration & Interoperability (DI)	Designing and implementing solutions for data movement and consolidation between systems; Ensuring data consistency across integrated platforms.
Documents & Content (DC)	Managing unstructured data assets (e.g., digital audit documents); Establishing policies for document storage, access, versioning, and retention.
Reference & Master Data (RM)	Identifying and managing critical reference and master data; Establishing standards and processes for MDM to ensure data consistency and accuracy across the enterprise.
Data Warehousing & Business Intelligence (BI)	Designing, developing, and managing data warehouses, data marts, and BI solutions; Supporting analytical reporting, dashboards, and data exploration for decision-making.
Metadata Management (MM)	Defining metadata strategy, architecture, and standards; Developing and managing a metadata repository (e.g., data dictionary, business glossary); Ensuring metadata supports data understanding and governance.
Data Quality (DQ)	Defining a data quality strategy and dimensions; Establishing data quality rules and metrics; Implementing processes for data profiling, cleansing, monitoring, and continuous improvement of data quality.

Table IV outlines the core strengthening strategies.

TABLE IV. KEY DMBOK-BASED STRATEGIES TO ADDRESS TDWI MATURITY GAPS

TDWI Dimension	Key Strategic Thrusts for BPKP	Primary DMBOK KAs Addressed	Key Regulatory Alignment
Organization (Score: 3.40, Gap: 0.60)	1. Enhance organizational readiness and cross-functional collaboration for data initiatives. 2. Implement data governance scorecards & risk assessments for data projects.	Data Governance (DG), Data Architecture (DA)	SPBE principles (integrated governance, risk management)
Data Governance (Score: 3.57, Gap: 0.43)	1. Strengthen data governance policies, including data access, classification, and issue management. 2. Enhance data quality assessment and metadata governance practices.	Data Governance (DG), Data Quality (DQ), Metadata Management (MM)	SPBE, SDI (data quality, metadata standards)
Analytics (Score: 2.60, Gap: 1.40)	1. Develop targeted analytics use cases (e.g., anomaly detection, risk prediction) with supporting data marts. 2. Foster self-service BI and build/iterate on predictive modeling capabilities.	Business Intelligence & Data Warehousing (BI/DW), Data Science & Big Data Analytics	Supports SPBE data utilization goals
Infrastructure (Score: 3.60, Gap: 0.40)	1. Continuously evaluate and evolve data architecture for scalability, security, and performance. 2. Ensure robust database management and business continuity for critical data assets.	Data Architecture (DA), Data Storage & Operations (DSO)	SPBE (resilient infrastructure)
Data Management (Score: 3.40, Gap: 0.60)	1. Implement a comprehensive metadata architecture and standardized metadata for key data domains. 2. Define and operationalize a data quality strategy, including validation rules and monitoring. 3. Plan and model for Master Data Management (MDM) for critical reference data.	Metadata Management (MM), Data Quality (DQ), Reference & Master Data (RMD)	SDI (metadata, data standards, interoperability)

The strategies detailed in Table IV are designed to be comprehensive. For instance, to address the critical gap in Analytics, strategies grounded in DMBOK's Business Intelligence & Data Warehousing and Data Science & Big Data Analytics KAs include defining specific analytics use cases (e.g., anomaly detection, predictive risk modeling), developing supporting data marts, and creating interactive dashboards. For Data Management and Metadata Management gaps, key strategies focus on defining a complete metadata architecture, implementing consistent metadata standards, developing an enterprise data dictionary, and establishing robust data quality programs, directly relating to DMBOK's Metadata Management and Data Quality Management KAs and supporting SDI principles. Strategies for Data Governance and Organization emphasize developing comprehensive data governance policies and strengthening data stewardship roles, aligning with DMBOK's Data Governance KA and SPBE requirements.

E. Phased Implementation Roadmap Using Aiken's Pyramid

A comprehensive enhancement of data management capabilities, as envisioned by the DMBOK-based strategies (outlined in Table IV), requires a structured and incremental implementation. A "big bang" approach is often fraught with risk and may not yield sustainable results. Therefore, this research proposes a phased implementation roadmap guided by Aiken's Data Management Value Pyramid, a model that advocates for building foundational data capabilities before progressing to more advanced, value-driven initiatives. As depicted in Fig. 5, this hierarchical model organizes data management development into logical stages, ensuring that each phase builds upon the successes and outputs of the preceding one.

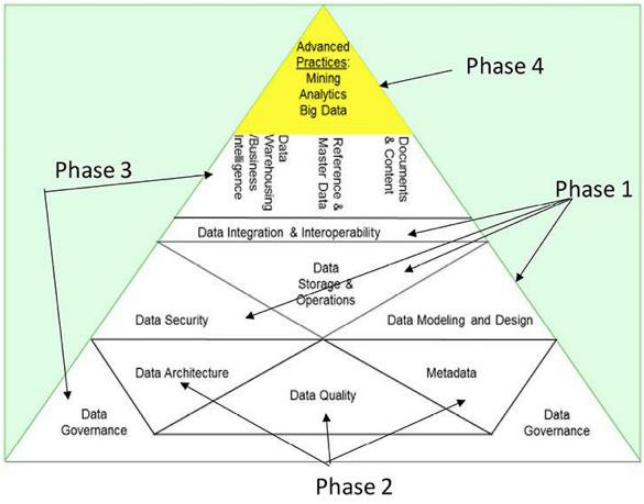

Fig. 5. Aiken's pyramid model [7].

The DMBOK-based strengthening strategies previously formulated have been mapped into the distinct phases of Aiken's Pyramid. Table V presents this phased roadmap, outlining the primary focus, prioritized DMBOK Knowledge Areas (KAs), key strategic themes for BPKP, and expected outcomes for each implementation stage.

TABLE V. PHASED IMPLEMENTATION OF DATA MANAGEMENT STRATEGIES TO ENHANCE DECISION SUPPORT SYSTEM AT BPKP

Prioritized DMBOK Knowledge Areas	Key Strategic Themes / Example Initiatives for BPKP	Expected Outcomes
Phase 1: Building the Technical & Governance Foundation Establish essential technical infrastructure and overarching governance principles for data.		
Data Governance (DG), Data Security (DS), Data Storage & Operations (DS), Data Modeling & Design (DD), Data Architecture (DA)	- Formalize core data governance policies, roles, and initial standards. - Strengthen data security protocols and operational data storage. - Define foundational data models and initial architectural principles.	- Reliable and secure data infrastructure. - Clearly defined basic data governance framework. - Initial data standards and models established-
Phase 2: Establishing Core Data Management Practices Develop and implement core practices for managing metadata, data quality, and refining data architecture.		
Metadata Management (MM), Data Quality (DQ), Data Governance (DG), Data Architecture (DA)	- Implement a comprehensive metadata architecture (data dictionary, business glossary). - Launch proactive data quality programs with defined rules & monitoring. - Refine enterprise data architecture and data models.	- Improved data trustworthiness and understandability. - Standardized metadata and enhanced data quality. - Mature data governance processes.
Phase 3: Enabling Business Value and Basic Analytics Leverage well-managed data to deliver direct business insights and support operational decision-making through analytics.		
Data Warehousing & Business Intelligence (DW/BI), Reference & Master Data (RMD), Documents & Content (DC)	- Develop initial data marts and implement descriptive/diagnostic analytics use cases. - Establish Master Data Management (MDM) for critical audit entities. - Improve management of digital audit evidence and content.	- Tangible business value from data (e.g., improved audit planning). - Initial analytical capabilities (dashboards, reports). - Consistent master data.
Phase 4: Exploiting Advanced Strategic Value Embed advanced analytics into core processes and strategic decision-making to drive innovation and significant organizational impact.		
Data Science & Big Data Analytics (DS/BDA), Business Intelligence & Data Warehousing (DW/BI)	- Develop and deploy predictive and prescriptive analytics models. - Integrate AI/ML capabilities where appropriate. - Foster a pervasive data-driven culture for strategic insights.	- Enhanced strategic decision-making through advanced analytics. - Proactive risk identification and improved audit effectiveness. - Data as a strategic asset.

The phased implementation detailed in Table V ensures a logical progression:

1) Phase 1: Building the technical & governance foundation. This initial and critical phase focuses on establishing the essential groundwork. Key DMBOK KAs prioritized include Data Governance, Data Security, Data Storage & Operations, Data Modeling & Design, and Data Architecture. Strategic themes involve formalizing core data governance policies and roles, strengthening data security protocols, optimizing data storage infrastructure, and defining foundational data models and architectural principles. The expected outcome is a reliable, secure data infrastructure and a clearly defined governance framework, directly addressing foundational gaps identified in the TDWI assessment for Data Governance, Infrastructure, and initial aspects of Data Management.

2) Phase 2: Establishing core data management practices. building upon the initial foundation, this phase emphasizes the DMBOK KAs of Metadata Management and Data Quality Management, while continuing to mature Data Governance and Data Architecture. Key strategic themes include implementing a comprehensive metadata architecture (including a data dictionary and business glossary), launching proactive data quality programs with defined rules and monitoring, and refining data models. This phase is crucial for ensuring data trustworthiness and understandability, which are prerequisites for effective analytics, thereby addressing core issues within the Data Management and Organization TDWI dimensions.

3) Phase 3: Enabling business value and basic analytics. With a more reliable data ecosystem in place, this phase shifts focus towards leveraging data for direct business insights. DMBOK KAs such as Data Warehousing & Business Intelligence, Reference & Master Data Management, and Document & Content Management become prominent. Strategic themes include developing initial data marts, implementing descriptive and diagnostic analytics use cases (e.g., performance dashboards for audit processes), establishing MDM for critical audit entities, and improving the management of digital audit evidence. This phase begins to directly tackle the significant gap in the Analytics TDWI dimension by delivering tangible analytical outputs.

4) Phase 4: Exploiting advanced strategic value. This most mature phase concentrates on DMBOK KAs like Data Science & Big Data Analytics. Strategic themes involve developing predictive and prescriptive analytics models, potentially integrating Artificial Intelligence (AI) capabilities, and embedding advanced analytics deeply into core supervision processes and strategic decision-making. Successful execution in this phase aims to fully address the remaining gaps in the Analytics dimension, transforming BPKP into a truly data-driven organization. This phase is contingent upon the successful establishment of capabilities in the preceding phases.

This staged roadmap allows BPKP to incrementally build its data management and analytics capabilities, manage change effectively, mitigate implementation risks, and demonstrate value progressively. Each phase is designed to provide a solid foundation for the next, ensuring that investments in data management translate into sustainable improvements in BPKP's ability to support its mandate through data-informed insights and decisions, in alignment with national SPBE and SDI objectives.

F. Conclusion

This study aimed to evaluate the analytics maturity of the Indonesian Financial and Development Supervisory Agency (BPKP) and propose a DMBOK-based strategy to enhance its data management capabilities in support of decision-making systems. Utilizing the TDWI Analytics Maturity Model, the assessment revealed BPKP is currently at an 'Early Adoption' stage (overall score 3.41). A significant gap was identified in the Analytics dimension (1.40), alongside notable areas for improvement in Organization and Data Management, particularly concerning comprehensive metadata and the operational application of advanced analytics.

To address these identified gaps, a comprehensive DMBOK-based strengthening strategy was formulated. This strategy is complemented by a phased implementation roadmap, guided by Aiken's Data Management Value Pyramid, which advocates for building foundational data capabilities before progressing to more advanced, value-driven initiatives. This structured approach prioritizes strengthening core data governance, data quality, and metadata management (Phases 1 & 2) to establish a reliable data foundation, followed by enabling business value and exploiting advanced analytics (Phases 3 & 4).

The findings and proposed roadmap offer a practical and actionable pathway for BPKP to systematically enhance its data management and analytical capabilities. Successful implementation of these strategies is anticipated to transition BPKP towards higher levels of data management maturity, enabling it to more effectively fulfill its mandate in the digital era by fostering more robust, data-informed decision-making in alignment with national Electronic-Based Government System (SPBE) and One Data Indonesia (SDI) objectives. This research contributes to the practical application of data management frameworks within public sector internal audit institutions, providing a blueprint for similar organizations seeking to leverage data as a strategic asset.

G. Discussion

The findings indicate that BPKP has established commendable foundational elements for data management, particularly in infrastructure and formal governance structures. However, the significant gap in the Analytics dimension, coupled with challenges in comprehensive metadata management and standardized data lifecycle practices, currently limits the full exploitation of data assets for strategic insight and predictive capabilities. The "Early Adoption" stage suggests that while awareness and initial projects exist, data management practices are not yet consistently applied or optimized across the organization.

The DMBOK-based strategies and the Aiken's Pyramid implementation roadmap provide a structured and actionable pathway for BPKP to address these gaps. By focusing initially

on strengthening data governance, data quality, and metadata (Phases 1 & 2), BPKP can build the reliable data foundation necessary for more advanced analytics. Subsequent phases focused on business value enablement and strategic analytics exploitation (Phases 3 & 4) will then be able to leverage this foundation to deliver tangible improvements in audit effectiveness and data-driven decision-making. The alignment with national directives like SPBE and SDI ensures that these internal improvements also contribute to broader governmental data initiatives. Successful implementation of these strategies is anticipated to transition BPKP towards higher levels of data management maturity, enabling it to more effectively fulfill its mandate in the digital era.

H. Future Work

This study provides a foundational assessment and a strategic roadmap for enhancing data management and decision support capabilities within the Indonesian Government Internal Audit Institution (BPKP). Building upon these findings, several promising avenues for future research and practical development emerge:

1) Empirical validation of the proposed roadmap: The current study formulates a DMBOK-based strategy and an Aiken's Pyramid implementation roadmap. Future research could focus on empirically validating the effectiveness of this proposed roadmap through pilot projects or case studies during its actual implementation within BPKP. This would involve tracking key performance indicators (KPIs) related to data quality, metadata completeness, and the adoption of advanced analytics to measure tangible improvements and refine the strategy.

2) Quantitative impact assessment of data management improvements: While this study provides a qualitative assessment, future research could employ quantitative methodologies to measure the direct impact of improved data management on audit efficiency, accuracy, and the overall effectiveness of decision-making processes within BPKP. This could involve analyzing audit findings, risk detection rates, and resource allocation before and after the implementation of specific data management initiatives.

3) Comparative studies across public sector institutions: Extending this research to other Indonesian government institutions or similar internal audit bodies in different countries would provide valuable comparative insights. Such studies could identify common challenges and best practices in data management within the public sector, contributing to a more generalized understanding of effective data governance models beyond a single case study.

4) Deep dive into specific DMBOK knowledge areas: Given the identified gaps, particularly in Metadata Management and the operationalization of advanced Analytics, future research could conduct more in-depth investigations into these specific DMBOK knowledge areas. This might involve developing detailed frameworks for institutional metadata standards or exploring the application of specific AI/Machine Learning techniques (e.g., natural language processing for unstructured audit evidence) tailored to the public audit context.

5) Long-term sustainability and change management: Research could also explore the long-term sustainability of data management initiatives and the organizational change management aspects required for fostering a truly data-driven culture within public institutions. This would involve studying factors influencing user adoption, continuous training needs, and the integration of data literacy into institutional curricula.

By pursuing these directions, future research can further contribute to the body of knowledge on data management in public sector auditing and provide more granular, evidence-based guidance for digital transformation initiatives.

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AUTHORS' CONTRIBUTION

1) Febrian imanda effendy: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft Preparation, Writing – Review & Editing.

2) Nilo legowo: Supervision, Validation, Writing – Review & Editing, Project Administration, Funding Acquisition.

Data Availability Statement: The datasets analyzed during the current study are internal documents of the Indonesian Financial and Development Supervisory Agency (BPKP) and are not publicly available due to their confidential nature and institutional protocols. Access to these documents is restricted and was granted solely for the purpose of this research under strict confidentiality agreements.

Finally, any remaining errors or omissions are solely the author's own. This research aims to contribute to the enhancement of data management practices within public sector audit institutions.

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