Data Interoperability Model in Integrated Public Service Applications Based on Government Service Bus (Case Study: Tangerang Regency Communication and Information Office)

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KEYWORDS	ABSTRACT
Interoperability Data, Government Service Bus, Government Public Service	The Tangerang Regency Government, as part of its digital transformation efforts, has been working to enhance public services through the development and implementation of e-Government initiatives. This research aims to conduct an in-depth analysis of data interoperability service modeling in e-Government applications based on Web Services using the Government Service Bus (GSB). The study will address the advantages and challenges associated with using the Government Service Bus, and provide practical recommendations for implementing the Government Service Bus as an effective application integration solution. COBIT 2019 is used as an assessment tool for the current condition. The research results reveal that a total of 138 applications have been identified, with 74 of them being public service applications. While 80% of the public service sector has been incorporated into integrated public service applications, their utilization remains limited. The current capability level of APO11 is at level 1, with an expected level of 2. Similarly, APO14 is at level 1, expected to reach level 2, and MEA01 is at level 0, with an expected level of 2. The author has proposed a data interoperability model that can be implemented within the Tangerang Regency Communication and Information Office, utilizing GSB as the middleware for interoperability processes, particularly for public service applications. Based on the proposed data interoperability model, the author also concludes that with its implementation, the Communication and Information Office will be able to address a significant portion of the technical recommendations derived from the gap analysis, although not necessarily all of them.

1. Introduction

The Tangerang Regency Government is actively engaged in digital transformation efforts, aiming to enhance public service through e-government implementation. The

broader objective of e-government is to improve public service quality, efficiency, and transparency using information and communication technology (Meiyanti et al. 2018). However, challenges arise during this journey, particularly in integrating diverse existing government applications.

To elevate public service quality, the Tangerang Regency Government continually introduces innovations. One of these involves leveraging information technology to make public services more accessible. While beneficial, the lack of regional regulations and standardized operating procedures has led to swift application development that isn't aligned with data sharing readiness. This data fragmentation creates a governance challenge as disjointed data exchange can lead to process overlap.

Amidst Tangerang's e-Government context, adopting a Government Service Bus framework emerges as a promising solution. GSB is tailored for government application integration (Darono 2017; Fajar and Shofi 2019). Unlike traditional point-to-point integration, GSB offers a centralized platform for secure and efficient communication across government systems. Implementing GSB can enhance interoperability, streamline operations, and improve efficiency. By embracing GSB, the Tangerang Regency Government can effectively manage data integration, leading to operational efficiency and better public service quality.

This research delves into an in-depth analysis of data interoperability service modeling in e-Government applications, specifically through the Government Service Bus. The research aims to unlock GSB's potential in simplifying government application integration in Tangerang Regency, offering insights and guidance for achieving operational efficiency and improved public service quality within the e-Government landscape.

2. Materials and Methods

The prelude to this chapter will delve into the Literature Review, a pivotal component in establishing the foundational knowledge and context for the researched topic.

e-Government

Electronic government (hereinafter referred to as e-Government) refers to the use of information and communication technology (ICT) in delivering public services, government administration, and citizen participation. In the last few decades, e-Government has become a primary focus for many governments worldwide, especially in developing countries, to enhance efficiency, transparency, participation, and services to citizens (Dardha 2004; Masyhur 2017).

e-Government can be defined as the use of information and communication technology (ICT) by the government in all aspects of its operations, including delivering public services, internal administration, interactions with the public, and citizen participation in decision-making (Masyhur 2017).

Enterprise Architecture

Enterprise Architecture (EA) is a systematic approach to designing, managing, and integrating key elements within an organization, including business processes, information

technology, data, applications, and infrastructure (Jonkers et al. 2006; Simon, Fischbach, and Schoder 2013).

Enterprise Architecture assists in identifying and understanding an organization's business needs. By analyzing business processes and organizational strategies, Enterprise Architecture enables a better understanding of goals, requirements, and needs that must be met. This undoubtedly aids organizations in designing and implementing appropriate technological solutions and optimizing resource utilization. Enterprise Architecture also aids in designing an integrated technological architecture (Rouhani et al. 2013; Simon et al. 2013). *IT Governance Framework.*

Information Technology Governance (IT governance) is a framework aimed at ensuring that Information Technology (IT) within an organization is managed effectively and aligned with the organization's strategic objectives (De Haes and Grembergen 2004).

In this study, the author will seek synergies, particularly focusing on the principles of data or information interoperability, from each Enterprise Architecture framework such as Control Objectives for Information and Related Technology (COBIT) 5, The Open Group Architecture Framework (TOGAF), Zachman Framework, and ITIL v3 Framework.

Data interoperability, the crucial principle across COBIT 5, TOGAF, Zachman Framework, and ITIL v3, underscores their shared recognition of seamless data integration for successful enterprise architecture. COBIT 5 emphasizes this within its APO and DSS Process Domains, urging robust data governance to ensure reliable data for decision-making. TOGAF adopts a broader approach by integrating data as a core part of business, data, and application architectures through standardized practices. Zachman Framework integrates data within its architectural model, focusing on consistent data elements across the enterprise. Similarly, ITIL v3's Service Transition and Service Design ensure that IT service changes prioritize data interoperability among applications.

Research Methodology

This research begins with a literature review on data interoperability. This study aims to analyze the fundamental concepts related to data interoperability and the IT governance framework used in the context of the digital transformation of Tangerang Regency Government. Subsequently, the research identifies the objectives and current state of data interoperability processes within the scope of Tangerang Regency Government. Through in-depth analysis, the mapping of primary goals to related goals and involved processes will be conducted. Afterward, the process capability levels will be evaluated based on COBIT 2019 standards. The research will then identify gaps between existing and expected capability levels and provide recommendations based on the gap analysis results.
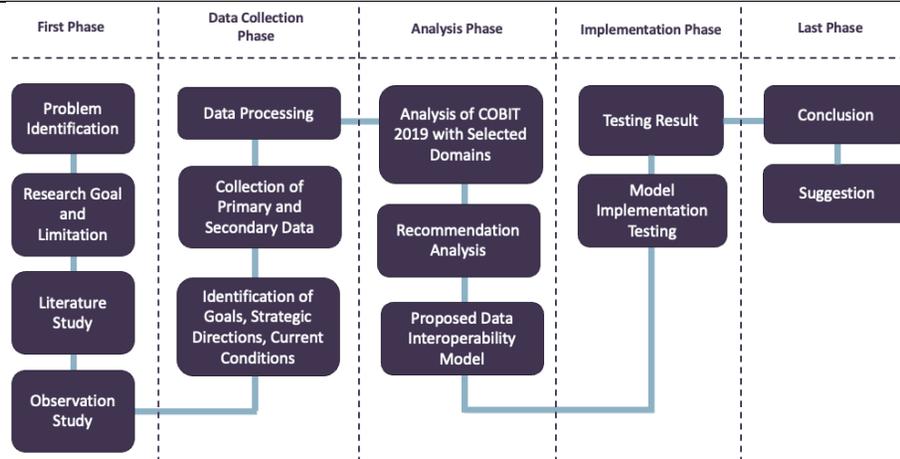
Figure 1. Research Methodology

The next step is to design the proposed data interoperability model. This model will illustrate the components of data interoperability processes during implementation. The implementation will use the Government Service Bus (GSB) within the Tangerang Regency Government, primarily for public services. Recommendations for implementing data interoperability processes using GSB will be developed, referring to the COBIT 2019 framework. The analysis will assess how well the GSB implementation aligns with the technical recommendations derived from the earlier gap analysis. Therefore, the research will conclude to what extent the proposed data interoperability model can address the technical recommendations from the result of gap analysis.

3. Results and Discussions

In this chapter, the author will conduct an in-depth analysis regarding the current state of data interoperability managed by the Tangerang Regency Communication and Information Office (Diskominfo). Accurate understanding of the current level of interoperability is crucial for designing effective solutions.

Existing Application Profiling

In the process of creating an information system profile, the author, along with the Electronic Government (e-Government) evaluation team, initiated a significant effort by designing an online form. This form was distributed to all Local Government Organizations (OPDs) within the government framework. The primary goal of the form was to comprehensively identify the information systems used by each OPD.

The data interoperability profile discussed in this section outlines an analysis within the government context to understand the extent to which existing public data and services can efficiently integrate and operate together. Based on the collected data, 54% of the total public services have been identified and accessible.
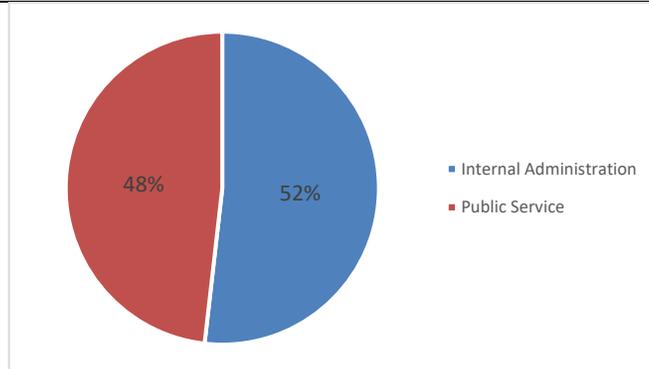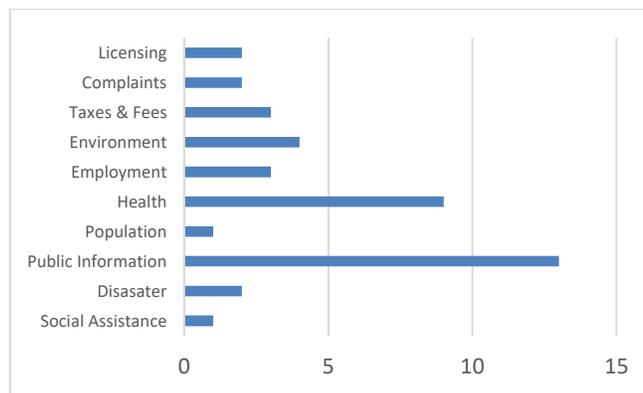
Figure 2. Percentage of application type

Figure 3. Comparing Number of Apps Based On Public Services Category

Based on the mapping results above, it can be concluded that a significant portion (approximately 80%) of the public service sectors available in Tangerang Regency have been accommodated within the "Tangerang Gemilang" application, albeit not entirely. For instance, aspects related to taxes and fees are not yet fully integrated with all the existing tax and fee objects. With this information, the interoperability process for services that can be shared with other applications can be depicted as follows:
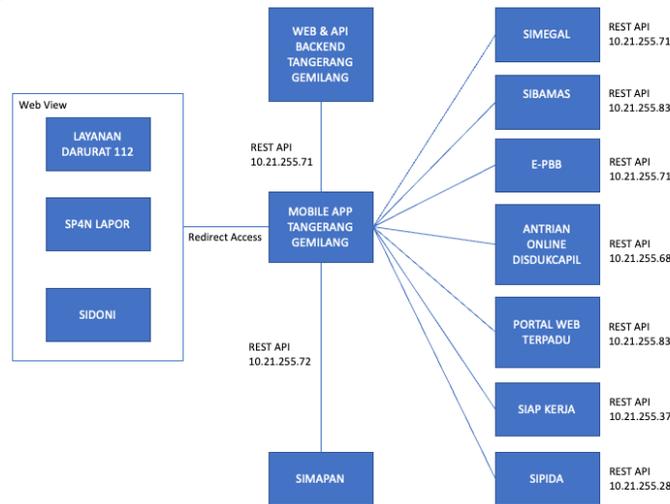
Figure 4. Existing data interoperability process in public services area

Selection of Chosen Domains in COBIT 2019 Process Mapping

In COBIT 2019, the selection of chosen domains for processes must go through several crucial mapping stages. The first stage involves identifying the organization's objectives for data interoperability, which serves as the foundation for further mapping. Subsequently, the organizational objectives are linked to relevant Enterprise Goals (EG), identifying the processes that need prioritization to achieve these objectives. Next, the Enterprise Goals (EG) are connected to relevant Alignment Goals (AG), which represent the goals to be achieved by the involved processes. The subsequent stage involves mapping Alignment Goals (AG) to COBIT 2019 Processes (GAMO), determining the relevant COBIT 2019 processes that should be considered in this research.
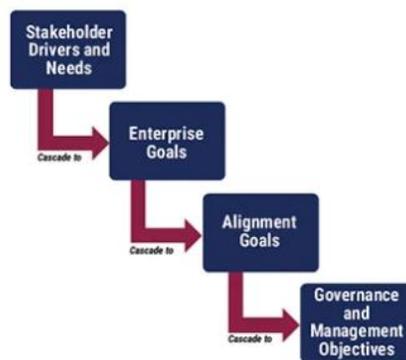

Figure 5. *COBIT 2019 Goal Cascade*

Finally, after identifying the relevant processes, the prioritization stage of COBIT 2019 Processes is conducted to determine which processes have the highest impact and urgency for the success of data interoperability at Diskominfo Tangerang Regency. By undergoing these mapping stages, the research can focus on key processes that will provide maximum benefits for the organization.

After mapping the organizational objectives and Alignment Goals (AG) to COBIT 2019 Processes, the next step is to determine the priority of the mapped COBIT 2019 processes. In the study (Susanti and Sucahyo 2016), prioritizing COBIT 2019 processes can be achieved by mapping them to the organization's challenges and involving key stakeholders. The mapping process can be conducted through Focus Group Discussions (FGD) with leaders and relevant personnel in the areas focused on during the assessment. This approach ensures that the recommendations resulting from the assessment process are aligned and relevant to the organization's challenges.

In discussions with the Head of the Application Division from the Department of Communication and Informatics, it was decided that the prioritized COBIT 2019 processes are APO11 (Managed quality), APO14 (Managed data), and MEA01 (Managed performance and conformance monitoring).

Assessment Process For Determining Capability Level in COBIT 2019 Selected Domains

The author will map the organizational structure of Diskominfo Tangerang Regency into the RACI Chart provided by COBIT 2019. After conducting the mapping, the author has identified a total of 5 respondents for each of the APO11, APO14, and MEA01 processes. These respondents will be provided with questionnaires based on the activities outlined in the respective Government and Management Objectives.

The determination of capability levels is a pivotal phase in the assessment process. This assessment is guided by the Capability and Maturity Model Integration (CMMI), which categorizes levels from 0 to 5 based on the sophistication of process implementation and organizational maturity. This determination aids in identifying the existing strengths and weaknesses of each process, enabling targeted improvements and strategic decision-making for enhancing overall organizational efficiency and effectiveness.
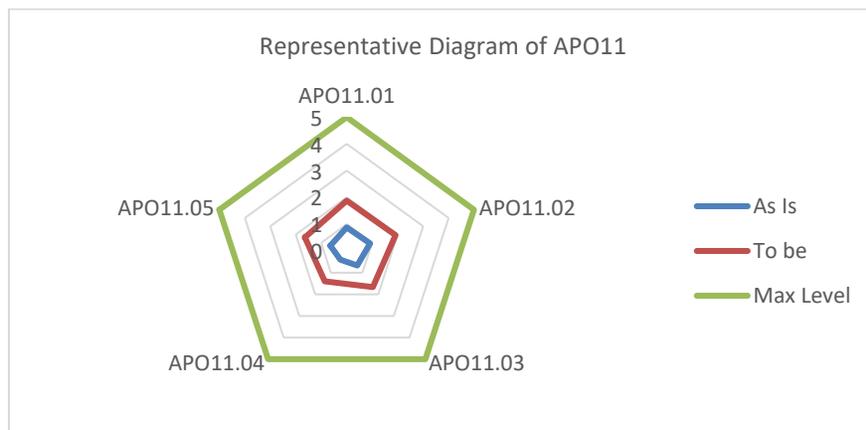

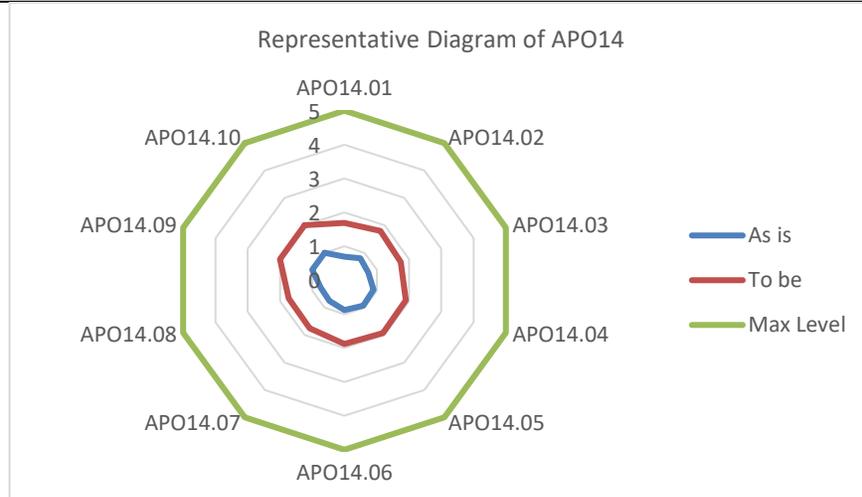
Figure 6. Gap Chart of APO11 Process
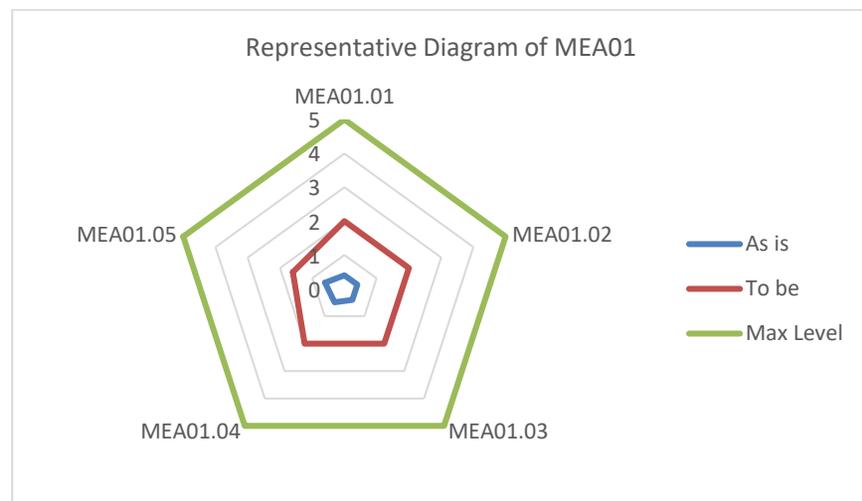
Figure 7. Gap Chart of APO14 Process

Figure 8. Gap Chart of MEA01 Process

The determined values and capability levels for each COBIT 2019 process are as follows: APO11 is currently at level 1 (performed), APO14 is also at level 1 (performed), and MEA01 is at level 0 (incomplete). For capability levels above 0, there is a requirement to provide evidence of capability conditions that need to be fulfilled by Diskominfo Tangerang Regency. According to COBIT 2019's Process Capability Indicator at level 1, there are Base Practices (BPs) and Work Products (WPs) that Diskominfo needs to provide as evidence that these processes are being executed. This evidence is derived from the inputs and outputs of each process.

From the PA 1.1 Process Performance results of APO11, it is evident that Diskominfo has attained a score of 50%, which indicates that its assessment level falls within the "largely achieved" category. The assessment process for the next level, level 2 (managed), cannot be conducted because, to be eligible for a level 2 assessment, the level 1 assessment must fall under the "fully achieved" category. For the APO14, it can be observed that Diskominfo

achieved a score of 53.84%, indicating that its assessment level falls within the "largely achieved" category. The assessment process for the next level, level 2 (managed), cannot be conducted because, in order to be eligible for a level 2 assessment, the level 1 assessment must be categorized as "fully achieved."

Gaps and Improvement Recommendation

      The next step involves compiling a comprehensive report based on the assessment outcomes of the APO11 (Managed Quality), APO14 (Managed Data), and MEA01 (Managed Performance and Conformance Monitoring) processes. The compilation will encompass all the gathered evidence and the verification of necessary documents related to the aforementioned Work Products.

      The outcomes of the assessment, including evidence and document verification, lead to the identification of gaps within the APO11, APO14, and MEA01 processes. These gaps represent areas where current practices fall short of meeting the desired capability levels. Based on the analysis of these gaps, a series of actionable recommendations will be generated. Here are the recommendations from the gap analysis process for APO11, APO14, and MEA01:

1. APO11 Improvement Recommendation
   - Diskominfo should create detailed procedures or guidelines that outline specific roles and responsibilities, particularly within the quality management process for interoperability in public services.
   - Develop a comprehensive Development Roadmap that outlines strategies for improving public services, specifically addressing areas not covered by the existing Tangerang Gemilang application.
   - Establish procedures for monitoring the quality of data interoperability and the utilization of information systems, ensuring proper oversight and governance of data exchange activities.
   - Consider implementing a system that streamlines the process of monitoring and controlling the quality of services related to data interoperability.
2. APO14 Improvement Recommendation
   - Diskominfo should propose regulations to govern data management strategies along with a development roadmap for data management.
   - Propose regulations for managing and governing data, accompanied by detailed implementation procedures to clarify roles and responsibilities.
   - Develop an implementation plan for data management involving all stakeholders to ensure a well-measured journey of management development.
   - Diskominfo needs to create a standardized list of terms related to data management processes.
   - Diskominfo needs to create documentation for metadata related to each integrated service. This can begin with identifying metadata such as data source, format, transformations (if needed), etc.
   - Diskominfo can create a data quality strategy document to ensure the quality of data from interoperability processes is maintained.

- Diskominfo needs to conduct an assessment for data interoperability processes that support public services to determine the current data quality.
- Diskominfo should include data cleansing in the data quality matrix to ensure that every data entering the data interoperability process maintains its data quality.
- Diskominfo needs to implement effective data asset lifecycle management to oversee data throughout its entire lifecycle, encompassing identification, cleansing, processing, storage, integration, security, and data updates in a structured manner.
- Diskominfo needs to establish a data storage strategy that defines classification, retention periods, and deletion methods in line with requirements and regulations to address the lack of archival and data retention support.
- The shortage of infrastructure assets poses a significant challenge for Diskominfo in implementing a Backup Plan. It is essential to promptly fulfill the recommended infrastructure requirements to achieve an optimal backup design.

3. MEA01 Improvement Recommendation
   - To address the absence of a monitoring strategy in the data interoperability process within public service applications, it's advisable to promptly develop and implement a monitoring plan. This plan should encompass real-time data flow monitoring, change and issue identification, as well as regular reporting.
   - It is recommended to promptly establish clear and measurable objectives for data performance and quality. Identify relevant key performance indicators (KPIs), such as data processing time, error rates, data accuracy, and others.
   - Diskominfo needs to promptly develop a structured data collection system. Identify relevant performance indicators for interoperability goals, such as response time, error count, and data processing efficiency.
   - To enhance quality management in the interoperability process, especially in the performance aspect, it's recommended to adopt a proactive approach by implementing structured and consistent improvement actions, not just in response to issues, but routinely as part of the operational cycle.

The Process of Developing Data Interoperability Model

In this subsection, a data interoperability model is proposed with the aim of presenting an effective framework to address challenges and complexities in the process of data exchange and integration. This model is designed to facilitate the workflow between various data sources within the context of an integrated public service application hosted by Tangerang Regency.

In the above subsection, the author provides several recommendations with technical and non-technical attributes. The classification of these recommendation attributes will serve as a reference for assessing how impactful the proposed interoperability model's implementation can address the existing technical issues.

In a study presented in reference (Istiyanto et al. 2012), the author discusses the necessity of data interoperability in scenarios involving separate and heterogeneous applications. The method employed utilizes web services, encompassing the modeling of data retrieval mappings between e-Gov applications remotely, modeling interoperability

infrastructures between e-Gov applications, and implementing them in a real-world case study. The study also introduces the concept of abstracting the Resource Registry/Discovery layer, which is ultimately implemented as the API Portal Layer in this research. The purpose of this layer is to provide centralized access to various services that can be accessed by subscribing parties.

In the study (González et al. 2016), the author adopts the concept of Enterprise Service Bus (ESB) as a data interoperability platform to support personal data protection regulations. In this context, the ESB functions as a platform enabling various applications to communicate and interact in a structured and integrated manner. The ESB serves as the middle layer underlying all communication processes, allowing different applications to share data securely and in a coordinated manner, while facilitating the implementation of access control rules in compliance with existing regulations. The ESB concept will also be adopted in this study, serving as an intermediary layer facilitating data interoperability processes, particularly in the context of public service applications.

In the study (Novakouski and Lewis 2012), the authors explain that the context of each e-government project differs, where diverse services require different technologies, semantics, processes, and are influenced by various factors. The study also highlights that interoperability isn't only machine-to-machine but can also encompass human-to-machine or even human-to-human interactions. These considerations should guide the design of interoperability models, especially in the application layer of public service that also involves operator interactions. Hence, alignment between existing regulations and the technical architecture used will be a focus in the data interoperability modeling of this study.

In the study, the authors explain the technical aspects of orchestration and choreography that can be implemented in web service applications. Orchestration can be performed by one web service to another that are interrelated. In this study, the concept of service orchestration is implemented in the abstraction layer of an API Gateway, which can route various web services supporting interconnected public services.

These reference studies will be taken into consideration in the proposed data interoperability modeling. The technical recommendations from the gap analysis will guide the selection of abstraction layers that can become components of the proposed data interoperability model.

Based on the results of technical recommendations and references to previous interoperability models discussed in the research, the following is the architectural design of the data interoperability process model in the public service application using the Government Service Bus, as depicted in the image below.
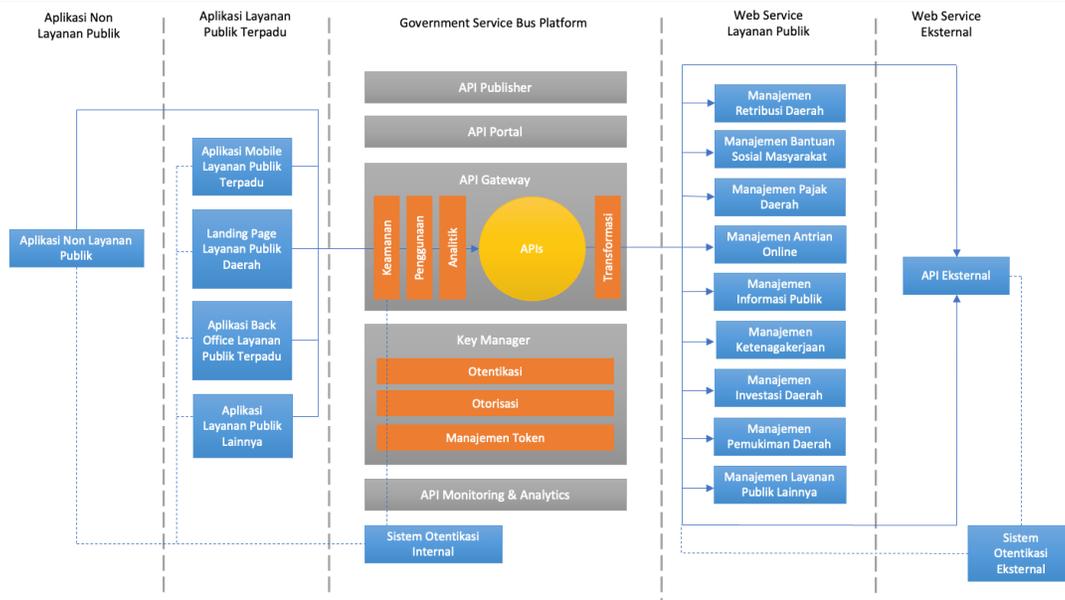
Figure 9. Proposed model of interoperability data using GSB

There are several sections in the above model with the following explanations:

- Non-Public Service Applications
  - These are internal applications within various local government organizations that are not public services but have relevant data. These applications could include internal management systems, business applications, or operational systems that need to interact with other systems within the scope of interoperability.
- Integrated Public Service Applications
  - These applications serve as interfaces for integrated public services, including various services used directly by users. Their purpose is to provide unified access to these services through a consistent and easily accessible interface. They can also use internal user authentication from if required in the public service workflow.
- Government Service Bus Platform
  - The Government Service Bus (GSB) is an integration platform connecting various systems and applications involved in interoperability. GSB manages data flow, requests, and responses, enabling data transformation, security policy enforcement, routing, and message management to facilitate secure and efficient data exchange. The WSO2 API Manager is used to implement the GSB in Tangerang Regency, providing functionalities such as API publishing, API portal, API gateway, key management, and API monitoring and analytics.
- Public Service Web Services
  - These are public services provided by the government accessible by other applications or the public over the internet. They usually have standardized interfaces like REST APIs for sending requests and receiving responses.

- External Web Services
  - o These are services provided by external entities that might need to interact with government systems. This could include business partners, non-governmental organizations, or other entities with collaborations with the government.

The GSB acts as an intermediary layer connecting various services within the e-government environment, allowing for better scalability by managing and coordinating the flow of data and communication between different applications. Through this modeling, the system's capacity to handle increased user numbers, higher service requests, and growing data complexity can be efficiently enhanced. As a result, the implementation of integrated public services becomes more responsive and effective while maintaining the expected quality and consistency of services for users.

4. Conclusion

Based on the discussed findings in the previous chapter, the following conclusions can be drawn in this chapter: It is evident that the capability level of the APO11 (Managed Quality) process at Diskominfo Tangerang Regency currently stands at level 1 (performed) with a capability value of 0.70. This indicates that Diskominfo has managed quality, though not comprehensively and in an organized manner. The expected capability level is level 2 (managed) with a capability value of 1.70. This signifies a gap of 1.00 to achieve the desired capability level.

The capability level of the APO14 (Managed Data) process at Diskominfo Tangerang Regency currently stands at level 1 (performed) with a capability value of 0.84. This indicates that Diskominfo has managed data quality, though not comprehensively and in an organized manner. The expected capability level is level 2 (managed) with a capability value of 1.84. This signifies a gap of 1.00 to achieve the desired capability level.

The capability level of the MEA01 (Managed Performance and Conformance Monitoring) process at Diskominfo Tangerang Regency is currently at level 0 (incomplete) with a capability value of 0.46. This indicates that Diskominfo has initiated performance and conformance monitoring, though not comprehensively and in an organized manner. The expected capability level is level 2 (managed) with a capability value of 2.26. This signifies a gap of 2.00 to achieve the desired capability level.

The author has proposed a data interoperability model that can be implemented within Diskominfo Tangerang Regency using GSB as the middleware for interoperability processes. The author also concludes that by implementing the model, Diskominfo will be able to address a significant portion, although not entirely, of the technical recommendations derived from the previous gap analysis.

In conclusion, this chapter provides a concise summary of the key findings from the previous chapter's analysis. It highlights the current state and capability levels of data interoperability processes at Diskominfo Tangerang Regency, emphasizes the identified gaps, and presents the proposed data interoperability model. These conclusions collectively

lay the groundwork for the subsequent steps in improving data interoperability and enhancing public service delivery within the context of the digital transformation initiative.

Based on the previous chapter's analysis and conclusions, several recommendations are put forward for Diskominfo Tangerang Regency's evaluation: firstly, the implementation of all provided recommendations for APO11, APO14, and MEA01 processes; secondly, adopting the proposed data interoperability model to meet technical recommendations; thirdly, extending assessment to other prioritized COBIT processes in future research; fourthly, utilizing the COBIT Toolkit for domain process selection, considering its integration of COBIT 2019's Design Factors; and fifthly, exploring a combination of COBIT 2019 with other governance frameworks to achieve a more comprehensive perspective in research outcomes. These recommendations aim to guide Diskominfo Tangerang Regency in enhancing its governance and management practices, ensuring effective implementation of improvements, and contributing to the success of its digital transformation efforts.

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