

Microservices Architecture As a Data Governance Tools in Decentralized E-Government

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Abstract— Electronic government, or e-Government, is the use of information and communication technology by the public sector (ICT). Additionally, it can be viewed as a paradigm shift in terms of how governments operate. The government protects public values, while citizens act as problem solvers, co-creators, and active participants in value creation. On the other hand, decentralized systems have grown in popularity over the last few years. Data has become a significant issue in decentralized E-Government; each local entity has their own data, which is private. A suitable data governance tool is required to ensure that data governance is properly implemented and to prevent the organizational entity from leaking information. The purpose of this research is to examine the data governance tools mechanism utilizing microservices.

Keywords—government, governance, data, microservices, decentralize

I. INTRODUCTION

Electronic government, or e-Government, is the public sector's use of information and communication technology (ICT). Additionally, it can be viewed as a new paradigm for how governments should function, in which the government serves as a guarantor of public values and citizens serve as problem solvers, co-creators, and active participants in value creation. This new paradigm embodies a networked, multi-sectoral, collaborative, and power-sharing government. Government agencies can improve their transparency, efficiency, and effectiveness by collaborating. Despite increased investment in e-Government, adoption rates remain low, in part due to unstructured and untrustworthy decision-making processes that impede the development of public values and citizen trust. Organizations and systems must be able to communicate with one another in order to perform inter-organizational integration[1]. E-government is a service that can help the government and other stakeholders in the field of information technology and information systems strengthen their relationship. The purpose of e-government is to use information technology to improve the quality of public services. Additionally, communication is necessary during the process of administering government at the central and regional levels in order to form a clean, transparent government that is capable of effectively responding to the

demands of change. The objectives of e-government include the following: Establishing a network of information and public service transactions that are not time or location-bound and are accessible to the community at an affordable cost (Government to citizen). Construct cooperative business relationships (Government to business). Establish mechanisms and channels of communication with all state institutions and provide for public dialogue (Government to government). Establish an open and transparent management and work system, as well as facilitate transactions and services between government agencies. The ability of e-government to foster public trust and satisfaction is strongly influenced by its quality. The quality of e-government plays a critical role in the community's ability to continue using e-government services.

A growing proportion of cultural, political, economic, and other human activities taking place in the digital realm risk exacerbating pre-existing issues of division, inequity, exclusion, fraud, insecurity, and power imbalance, to name a few. In this case, 3 billion people use the Internet, but 90% of the remaining population lives in developing countries; digital natives account for 30% of the youth population, but less than one in four young citizens vote; Facebook has 1.44 billion and YouTube has one billion active users, but 12% of social media users report that someone has hacked into their social media accounts and pretended to be them; smart phone users spend 89 percent of their mobile media time on social media; While it is self-evident that governments and policymakers cannot leave the digital space unattended or ungoverned, the question is how the core government functions — providing public services and infrastructure, formulating and enacting public policies, ensuring social order and security, and administering social programs — will be carried out [2].

Nowadays, the majority of organizations offer e-services in order to provide public services; these services are delivered via information and communication technologies in order to better serve their customers. At first, developing an e-service may be difficult, owing to the complexity of government policies or the citizens' disinterest in new technologies. There are, however, opportunities to increase interest and collaboration in e-government by providing a secure, rigorous, autonomous, and transparent digital system for its

services. As a result of its speed and transparency, it will be more likely to be accepted by the public. For example, the digitization of government services enables the use of mobile phones and email to replace costly in-person or postal communication[3].

On the other hand, decentralized systems have gained popularity in recent years. Numerous countries, including China, Spain, and the United Kingdom, have established significant programs aimed at decentralizing policymaking away from the central government and toward local governments. 1 Simultaneously, we witnessed Europe's process of centralization and the evolution of the European Union, a new top-level government established in 1993. The UK, on the other hand, will formally "Brexit" in 2020, leaving the EU after 47 years to pursue greater decentralization. The trade-off between centralization and decentralization in government hierarchy has never been resolved and appears to be interminable. Governments should be as decentralized as possible. This is a contentious issue for both economists and politicians.[4]. In recent decades, many developing countries have decentralized with the explicit goal of improving service delivery. They appear to have encountered similar difficulties (as well as with additional ones). As a result, recent work has concentrated on government decentralization in the context of development. While the majority of countries that have pursued decentralization have been democracies, not all have been. China's recent history provides an excellent example of devolution in a non-democratic setting, as local decentralization began in the 1980s, coincidentally before the introduction of elections.[5]. Richard Heeks in 2006 said the decentralized E-Government have potential benefits Because the technology underlying e-government has gotten smaller, cheaper, easier to use, more reliable, and more powerful, decentralized approaches appear to be becoming a more viable option. Some of decentralized benefit such as Increased alignment of systems with local needs, accelerated system development, and perceived cost savings. However, despite the agility of decentralized government, sharing data is the most barriers to implement the decentralized systems [6]. This paper will construct the data governance method using microservices to avoid the security issue in decentralized government.

Another study conducted in 2014 concluded that electronic government is a critical component of any strategy aimed at increasing the effectiveness and efficiency of government programs and services. According to the US Government Accountability Office, e-Government is the government's use of technology to enhance citizens' and government entities' access to and delivery of government information and services. Similarly, researchers define e-Government as the delivery of government services via information and communication technologies in order to streamline daily operations, reduce costs, and enhance service quality. The importance of information sharing between government agencies has grown in the public sector. Cross-border information sharing has been established as a critical component of the e-Government development process by researchers. Government programs become increasingly interconnected as complex inter-organizational services become available. Government agencies are accountable for their programs and collaborate with other agencies on closely related programs. Cross-border information sharing enables the effective resolution of more complex problems. On the other hand, cross-border information sharing in the public

sector is a difficult task. Related projects can be considered information technology initiatives because they involve the development of systems, the establishment of standards, and the modification of business processes to enable government agencies to share data with other government agencies and public organizations. [7]. According to previous studies, data interoperability is the primary issue in decentralized government; additionally, data governance is the solution for avoiding privacy and security concerns when sharing data. The data governance framework will be designed in this paper using a microservices architecture.

II. METHOD

Data management has become a significant issue in decentralized E-Government; some local entities maintain their own private data. For instance, in some organizations that have embraced decentralized governance, some of their local data is inaccessible to other organizations, even if they are members of the same global organization. Information sharing is inextricably linked to and dependent on process integration and information system interoperability in e-Government, both of which are frequently quite complex phenomena. Integration is the process of combining separate government entities to form a larger unit for the purpose of sharing information and integrating processes. Interoperation is a term that refers to the effective collaboration of disparate or autonomous information systems from various government entities in order to share information or consolidate processes[7]. Furthermore, Data governance focuses on maximizing the value of an enterprise's data assets. Data quality is critical for enterprises to meet a wide variety of business requirements, which include regulatory and legal compliance[8].

Data governance is the process of exercising authority and control over data management. Its mission is to implement an enterprise-wide data strategy, maximize the value of the organization's data assets, and manage data-related risks. While data governance was once considered a luxury item, it is gaining traction in businesses and government institutions. This is because several significant trends have converged. Annual data creation is expected to more than double globally, from 4.4 zettabytes in 2013 to 44 zettabytes in 2020. As the volume of data from diverse sources continues to grow, it is critical to identify and resolve data inconsistencies prior to making decisions based on incorrect data. Businesses are increasingly relying on self-service reporting and analytics, necessitating the development of an organizational-wide shared understanding of data. The continued impact of regulatory requirements such as the General Data Protection Regulation (GDPR) places a greater emphasis on businesses exercising tight control over the data they store, where they store it, and how they use it. For data provisioning and sharing settings, contractual agreements between participating internal departments or external organizations are required. Contracts of this type include service level agreements (SLAs) and data sharing agreements (DSA). A DSA establishes the legal and data governance frameworks prior to two or more organizations sharing data. [9].

Collaborative data frameworks appear to be the most advantageous approach for implementing the data governance framework. With the right policies in place for data sharing and cross-organizational data transfer, data governance will run smoothly and comfortably. In 2021, Erna Ruijter recently published one of the most recent studies on collaborative data

management, stating that collaborative data management is founded on concepts of collaborative governance and information sharing. There are several drawbacks to data sharing. Numerous studies on information and data sharing have identified three influential factors: technical (such as information security), organizational and management (such as diverse origins and values), and political and policy (such as diverse sources and values) (e.g., information as power). On the other hand, data collaboratives are committed to resolving public problems collaboratively through data sharing.[10]. Procedural governance mechanisms are designed to ensure that data is captured accurately, securely stored, efficiently used, and appropriately shared. These are the following: i strategy for data management; ii policies; iii standards; iv processes; v procedures; vi contractual agreements; vii performance measurement; viii compliance monitoring; and ix issue management.[9].

A proper data governance tool is necessary to ensure that data governance is applied correctly and to prevent data leakage from organizational entities. One of the latest technologies capable of managing both local and external data is microservices. The ability of business software to be flexible is a critical requirement. Microservice architecture is a relatively new architectural style that is rapidly gaining traction in the industry. A microservice is a small component that can be developed and deployed independently, is easily scalable, and performs a single function. Due to these characteristics, microservices are ideally suited to continuous delivery. Microservices are centered on business capabilities and provide an architectural style that enables collaboration between cross-functional teams around services[11][12][13][14]. Microservices architecture is a technique for developing flexible software by developing and deploying self-contained, small-scale software components. Individual services can be modified or replaced without causing a system-wide outage by utilizing the concept of independent deployment. Numerous solutions have been suggested for resolving this issue. According to one approach, another way to manage data in a Microservices architecture is to create a database for each service[15].

Based on the previous study and the microservices definition, the data governance framework using microservices as a tool is possible to develop. The microservices will play a role as a policy setting regarding data sharing and data combined cross entity. The purpose framework is presented in table I to III below.

TABLE I. THE DATA GOVERNANCE FRAMEWORK USING MICROSERVICE STEP

No	Activities	Method
1.	Identifying organizational requirements.	Focus Group Discussion
2.	Mapping organizational requirements into Data Architecture Elements & Policy.	Data Governance
3	Developing Data Interopability Infrastructures.	Microservices

TABLE II. THE DATA ARCHITECTURE ELEMENTS

No	Elements	Policy Require
1.	Data Sources.	Access Policy

No	Elements	Policy Require
2.	Data Storage	Standardizations of Storage and type of data
3	Data Process	Access Policy
4	Analytical Data	Access Policy
5	Data Vizualitation	Access Policy

TABLE III. DATA INTEROBALITY ELEMENTS

No	Elements	Policy Require
1.	Data Transfer	Transfer Policy
2.	Data Exchange	Access and exchange Policy
3	Data Access	Access Policy

In the table I to table III can be seen that policy is one of important thing to develop in first step before developing data governance framework. The policy should develop by the organizational leaders. The leaders should define the rule which data is should be share inter-organizational as well as the data should keep in the local government. The example of data policy is presented in the table IV below.

TABLE IV. DATA ACCESS POLICY

No	Database	Data Owner	Equal Elements	Wider Element	Data Location
1.	Member Data	Local Government	Summary of Data Access Only	Summary of Data Access Only	Local Server
2.	Member Activity	Local Government	View Only	View Only	Local Server
3	Feedback	Local Government	Restricted Access	Full Access	Local Server

Table IV presents the access policy of the database. On that table, the database of members in local organizational is not permitted to be fully accessed by broader elements. Broader elements are only allowed to see the summary of membership data, such as the total number of active members, inactive members, and members. In order to provide the overview of data, microservices will access the database and process the request, then present the result of the request. The microservices API provide in the systems shown in table V below.

TABLE V. MICROSERVICES API

No	Microservices	Services Owner	Database Involve
1.	Summary of member data	Local Government	Member data
2.	Summary of member activity	Local Government	Member Activity
3	Member classified by jobs	Local Government	Member data

Microservices function as a data governance tool is presented in table V. Based on that can be seen that microservices will process the request by accessing the database, processing the data based on request then showing the result into the appropriate format. On the previous studies

state that Microservices make use of a variety of functionalities (Cross Cutting Functionality), including logging, metric collection, and health check, among others. By their very nature, they are cross-cutting and are generally treated as distinct services. Apart from increasing modularity, separating such peripheral functions into separate services enables the development of more robust systems[16]. Furthermore, Microservices are self-contained services that are deployed independently and have a single, well-defined purpose. Microservices propose decomposing applications vertically into a subset of business-driven, self-contained services. Each service can be developed, deployed, and tested independently by distinct development teams utilizing a variety of different technology stacks. Microservices offer a plethora of benefits. They can be written in a variety of programming languages, scale independently of other services, and be deployed on any hardware that meets their requirements. Additionally, their small size makes them easier to maintain and more fault-tolerant, as the failure of a single service does not disrupt the entire system[17]. Based on the previous studies can be seen that microservices is one the essential tool for developing data governance framework especially in implementing data policies.

III. RESULT

The conceptual IT infrastructure of this research is presented in the figure 1. The conceptual infrastructure also involves cloud computing as emerging technologies for data storages.

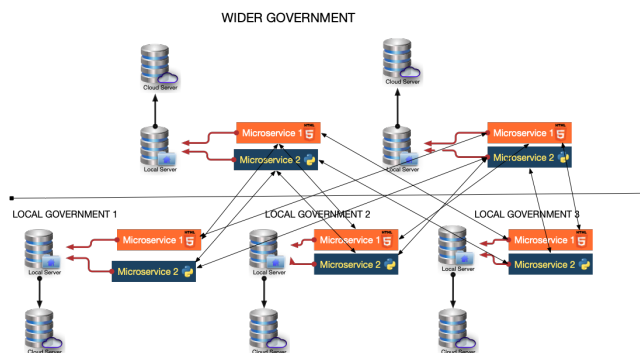


Fig. 1. IT Infrastructure Design

The communication between microservices is presented in the figure 1 above, from the diagram is clear that the database only can be accessed by microservices, once the other entity want to access the database to gather some information should through the microservices and the microservices will check the policy regarding the request in order to securing the whole systems, this result inline with previous study that said Security is also causing design headaches, primarily as a result of access control and endpoint proliferation. Access control is a significant issue, as the design of a microservice-based application should enable the microservices that comprise the application to quickly and consistently determine the provenance and authenticity of a request (which is far from being easy due to the heavily distributed nature of microservice-based applications). Additionally, microservice-based applications have an abundance of endpoints, as all of their microservices expose remotely accessible APIs. As a result, the attack surface to be secured is significantly larger than that of traditional monolithic/service-oriented applications[18]. The Infrastructure design is develop in order to prevent anonymous access to the database as well as

governing the data for decentralization government. Once the data governance framework developed, the most valuable assets of some organization is protected. The other past research already state that Data must be managed and governed in the same way that any other valuable business asset is, even more so in regulated industries and global markets. Furthermore, Microservice could be setup as a authentication and authorization management in accordance with the accounts required to view sensitive data.[19][20].

IV. CONCLUSION AND DISCUSSION

Decentralized government is an emerging trend in the last couple years, data privacy, data collaborative is the major issue the decentralized government. Data governance become ultimate solution in the decentralized government to prevent privacy issue .Microservices is emerging tool to support the data governance framework, with microservices access policy of data would be more easier to manage as well as the authorization of the data. The future research in this area is identify the communication process between microservices, the encryption process should define to ensure that the data will delivery secure and fast.

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