International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 05 - Issue 03 || March 2019 || PP. 40-53

National Geospatial Platform Business Architecture for Ethiopia

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Abstract: Today, morethan one million people worldwide use GIS for thousands of different purposes, while the use of modern geospatial information for our daily use is still in its infant stage in Ethiopia. By combining geographic information with descriptive information you will be able to view the business information from a completely new perspective. The Geospatial Platform can effectively support problem solving and policy formulation for the complex issues facing our Nation. Issues and events that affect the economy, employment, the environment, public health and welfare, security, and quality of life will benefit from the decision support tools, shared applications, visualization, and trusted geospatial data made available through the Geospatial Platform.Whether one country is implementing geospatial information system for the first time or not it is very important to define its national geospatial governance and architecture for its national geospatial platform. Defining business and technological architectures for the national geospatial platform will enable participatory information sharing, interoperability, user-centered design, and collaboration..

Therefore, defining appropriate business architecture for national geospatial platform for Ethiopia has never been more important than now, as government agencies start to invest significant resources in geospatial data, services, technology, and expertiseto support their daily business operations. This study paper offers business architecture for the national geospatial platform of Ethiopia based on the definedgeospatial enterprise architectural principles and national governance stratures.

Keywords: National Geospatial Platform, GIS, Business Architecture, TOGAF, Enterprise Architecture, Ethiopia

1. Introduction

GIS is an information technology that enables us to understand, enquire, interpret and visualize data in a new ways. The technology gives the opportunity to make decisions based on a better information level. Business operations can provide many benefits to government and private sector organizations if they are supported by location as well as collaboration in the effective use of geospatial information (Ulla Skjelbo, et al 2009). Almost everthing that happens, happens somewhere. We humans confine our activities largely to the surface and near-surface of the Earth. We travel over it and through the lower level of the atmosphere, and we go through underground tunnels, keeping track of all this activity is important, and knowing where it occurs can be the most convinient basis for tracking if we went to send something there. Therefore gosgraphic location is an important component of activities, policies,strategies and plans (Paul A. Longley, et al 2015).

The geospatial platform provides a suit of well managed, highly available, and trusted geospatial data, services, and application for use by any user (FGDC, 2012).The geospatial platform can build on, enhance, and support, the use of geographically referenced, or geospatial information, providing a means for organizations to collaborate with organizations particularly in times of emergencies or where rapid decisions are needed for social, economic, and political purposes; common semantics and functional capabilities as components of shared geospatial partnerships, contributing to inter-agency and inter-governmental interoperability; spatial data infrastructure services and networks already exist in the web environment that describes the availability of geospatial data and services and can facilitate development and use of geospatial information and functionality within organizations; geospatial information resources have been created by many organizations, which have also documented these resources with standard documentation tools (metadata), making these resources potentially accessible and usable to many others; and many coordination mechanisms and examples of partnerships for shared data acquisition already exist within the geospatial community that can serve as models for those new to the use of geospatial resources (FCIOC and FGDC, 2006).

Geospatial assets are vital components for a nation on one side, for its people daily use and on the other side for sectors both private and governmental agencies' decision-making process. These assets consist of data/information, services, applications and infrastructure assets. Organizing these assets at a national level and putting them in a trusted platform will increase the reusability of these Geospatial assets (data, service, application and infrastructure assets). The Geospatial Platform is a managed portfolio of common geospatial

data, services, and applications contributed and administered by trusted sources and hosted on a shared infrastructure, for use by governmental agencies and partners to meet their mission requirements and the broader needs of the Nation. Thus, the Geospatial platform will offer access to a trusted geospatial asset. As a result, it will lead to a paramount cost saving at a national level and at the same time will allow wider use of national geospatial capability.

In this document, development of enterprise business architecture for the national geospatial platform for Ethiopia is defined.The purpose of enterprise business architecture is to optimize across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive to deliver the business strategy. Enterprise Business Architecture is one of the focal pillars in the national geospatial platform development for the national platform business strategy and must align with the realization of platform development in order to meet the national geospatial business goals.

2. Purpose of the study

Geographic information is a valuable common denominator in almost all business processes when it is delivered through a proper geospatial platform. A geographic approach may therefore provide significant leverage for improving efficiency, enhancing quality and strengthening collaboration within the public sector. This study paper targets in delivering "blueprint" for the national geospatial business architecture of Ethiopia. Both private and government sectors spatial and non-spatial assets management is consideredwhile developing the business architecture for national geospatial platform. The government and private sectors are considered as the providers of geospatial data for the national geospatial platform. Moreover, different aspects of enterprise architectures that incorporate a strategic business, information system (Data and application) and technology (platforms, infrastructure, etc.) are used in developing the national geospatial architecture. The development of national geospatial platform is with the objective of giving shared data, application and technology service to citizens, public and private sectors.

Enterprise architecture is delivered using artifacts of things as catalogs (list of things), diagrams (picture of things) and matrices (relationship among things). The strategic part of an enterprise architecture is made up of Architecture Vision and Principles which is developed in standalone documents (TOGAF, 2009). The business aspect of an enterprise consists of business roles, business services and business functions, actors of the National Geospatial Platform and their roles which are depicted as list of things; the business footprint diagram(to show how business services interacts with the external and internal business environment) and business service to information diagram(to show how business services interacts each other) arerepresented as pictures of things and finally the interaction between actors with roles, the business service interactions as a relationship between things. These three artifacts were wrapped up to form the business architecture deliverables. When coming to the information system architecture includes the conceptual level of application components that are application services, logically-grouped application components,and physical application components. Moreover, this document provides a comprehensive architectural overview of the data, using a number of different architectural views to depict different aspects of the data.

The Geospatial Platform will have the goals of: Improve mission outcomes and increase return on existing investments; enhance the availability of geospatial information by providing a centralized access point; provide a shared infrastructure; facilitate the use and application of geospatial information; and promote information sharing and collaboration across multiple levels of government and with partners in the private sector.

3. Development methodology

The Open Group Architecture Framework (TOGAF), TOGAF ADM and Archimate are used as a guideline, methodology and modeling language respectively. The architecture is presented from different perspectives of business requirements, business services, and functional descriptions are provided from a functional perspective (TOGAF, 2011). The functional views are translated to technical architecture defining applications and technical ICT infrastructure supporting the functional views. High level blueprint of the national geospatial platform architecture is defines as shown in the Figure 1.

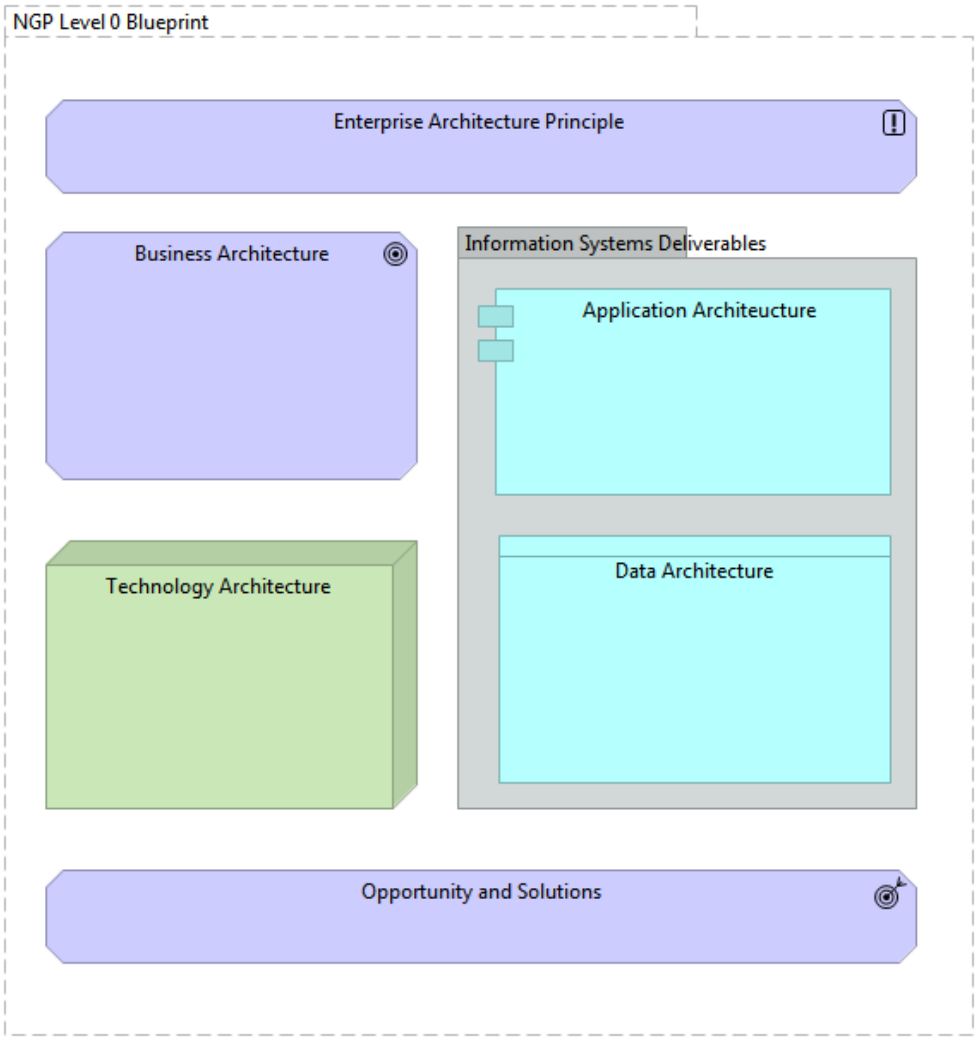

Figure 1 National Geospatial Platform Blueprint(Level 0)

Deliverables and artefacts are architecture work products in TOGAF. Deliverables represent a measurable, signed off and agreed architecture work product that consists of work product called as Artefacts. Artefacts are depicted as work product that are expressed in terms of picture of things (diagrams), list of things (catalogues) and relationship among things (matrices) (TOGAF, 2010). Given the above high level blueprint as a framework, Figure 2 shows how the high level description relates its respective deliverables and artefacts, which enables us to fully comprehend the enterprise architecture of the national geospatial platform.

Figure 2 National Geospatial Platform Detail Blueprint (Level 1)

4. Target business architecture

The value of the place or location-based analysis is often overlooked when modeling business processes because enterprise architects and program managers typically think of geospatial data only in the context of a map or a remotely sensed image created with GIS applications. The coupling of geospatial data, services, and technologies with conventional data, services, and technologies can be one of the most significant enablers of improved decision making within business operations. It increases the performance of key mission requirements across all levels of governments. Business requirements describe what must be performed and produced to provide value. These business requirements are the "what" while the functional and technical architecture (products, systems, and processes) describe the "how" to deliver or satisfy the "what".

4.1. Business Architecture - Motivation and Strategy Architecture

The enterprise principles that consists of business principle and other principles are depicted in the enterprise principle study paper by the researcher (Abraham, et al 2018). These principles guide the whole implementation of the national geospatial architecture. In addition, in the business function catalog the business goals that are going to be achieved by the business functions of the national geospatial platform are defined .

Table 1. Business Goals Description

Business Goals (Core)		
ID	**Name / Description**	**Description**
BA_GO_01	Enhance the availability of geospatial information by providing a centralized access point	By creating a central platform with shared business, application and infrastructure services, the country will improve the availability of the national geospatial information.
BA_GO_02	Increase service delivery	Though the ad-hoc process does not entertain service delivery, the National Geospatial platform shall increase business, application, and data service delivery in a secured manner.
BA_GO_03	Provide a shared infrastructure	The NGP will provide a shared infrastructure service to those in need.
BA_GO_04	Promote information sharing and collaboration across multiple levels of government and with partners in the private sector	Since different stakeholders and actors are available that will automatically create collaboration.
BA_GO_05	Reduce redundancy	NGP shall reduce redundancy with its collaboration practices, shared and common resources.
BA_GO_06	Increase access to shared data, services, applications, and infrastructure	NGP shall enhance an access to the shared services by availing one data source.
BA_GO_07	Facilitate the use and application of geospatial information	NGP shall facilitate the use and application of geospatial information by allowing Start-ups, Research Centres, Government and Non-Government Organizations to work collaboratively.
BA_GO_08	Increase return on existing investments	The above-mentioned descriptions shall increase ROI (return on investments).

4.2. Business Services

A business service is a service that fulfills a business need for a "customer" (the consumer of the service may be internal or external) - preferably a verb. A service is a function that is well defined, self-contained and does not depend on the context or state of other services. In this section, business services forenterprise architecture for the national geospatial platform are identified.

4.3. Business Foot Print Diagram

A business footprint diagram describes the links between business goals, organizational units, business functions and services, and maps these functions to the technical components delivering the required capability. In this regard, it helps the traceability between a solution component of the National Geospatial Platform (NGP) and the business goal that it satisfies. In Figure 3 association between business goal and business functions ; business functions with business services; and business functions with business actors are mapped.

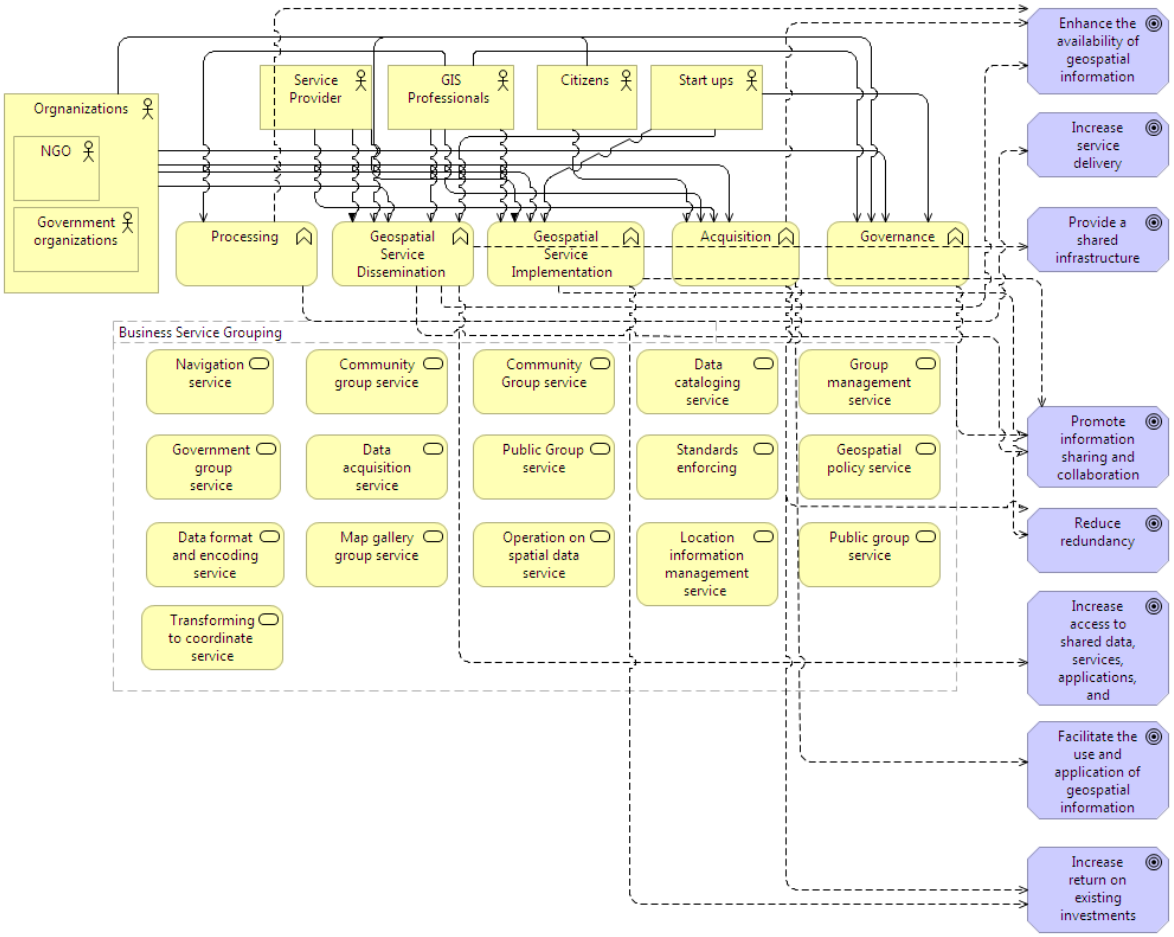

Figure 3 NGP Enterprise Business Footprint Diagram

4.4. Business function catalog

The recommended geospatial business functions are listed below.

Table 2 Business Functions description

Function (Core)		
ID	**Name**	**Description**
BA_FCT_01	Governance	This essentially involves localizing national and international geospatial standards for agency use, Providing policies and procedures for implementing agency geospatial services.
BA_FCT_02	Geospatial Services unit Implementation	This involves providing useful geospatial services—usually technology services—that are of most use for a particular agency, and "geo-enabling" existing applications and systems to take advantage of geospatial analysis. This function covers the intra-agency sharing of geospatial data and services.
BA_FCT_03	Geospatial Service dissemination unit	Not all agencies will be in the position of hosting geospatial data for external users, so this function and its related indicators may not always apply. When it does, this involves managing the geospatial data resource to make it responsive not only to internal users but to all potential government and private sector users to whom it is made available outside the agency. This function covers the extra-agency sharing of geospatial data and services.
BA_FCT_04	Acquisition Unit	Spatial data collection from multiple datasets(data providers)
BA_FCT_05	Processing Unit	Processing acquired spatial data

4.5. Business Services Catalog

This catalog gives a high-level description of what the business function from the enterprise emanated out and utilized the external and internal actors.

Table 3, Core business services

Business Service (Core)			
ID	**Name**	**Description**	**Category**
BA_SVC_01	Navigation service	Identifying routes and creating directions for navigating from one location to another	Location management
BA_SVC_02	Statistical information service	geospatial statistics report	Report management
BA_SVC_03	DataAcquisition service	Generally, the means to acquire, collect, process and/or generate new information (data) for the enterprise	Data Collection
BA_SVC_04	Data Correlation service	The family of functions for determining the spatiotemporal interrelationships andstatistical correlation between data sets, and elements and properties within thesesets.	Data Collection
BA_SVC_5	Data format and encoding service	specifies the formats of geospatial map images	Data format and encoding management
BA_SVC_6	Geospatial Data Transfer service	The means to move, copy or exchange geospatial data between enterprise databasenodes, which cuts across the agency enterprise.	Data management

BA_SVC_7	Geospatial DataStandards service	The accepted models of authority associated with geospatial information (data). Atype of standard under the Mandate subcategory of the Governance category.	Governance
BA_SVC_8	Geospatial Data Transfer Standard service	Geospatial data format specifications to facilitate the exchange of geospatial databetween organizations in a common data format. A type of standard under theMandate subcategory of the Governance category.	Governance
BA_SVC_9	Geospatial Policies service	manages geospatial related rules and regulations	Governance
BA_SVC_10	Common business service	The platform will deliver trusted and registered geospatial data, services, and applications that are valuable to multiple agencies or customers to meet their business requirements.	Geospatial management
BA_SVC_11	Community service	A service Community can get	Group management
BA_SVC_12	Government service	A service for government agencies	Group management
BA_SVC_13	Public service	A service for public users	Group management
BA_SVC_14	Map Gallery service	These groups are designed to organize maps so that they can easily be shared.	Map management
BA_SVC_15	Shared government content service	Authorized Government Users and Government Publishers will be able to share content with Government Groups.	Data management
BA_SVC_16	Shared community service	The process of allowing users to be able to share content with Community Groups.	Data management
BA_SVC_17	Sharedpublic service	Government Publishers will be able to share content with Public Groups.	Data management
BA_SVC_18	Individual Data asset service	The process of providing individual Geospatial data That can be trusted used reliably and shared across organizations	Data management
BA_SVC_19	Foundational Data assets service	The process of managing assets that are foundational geospatial data and can be trusted used reliably and shared across organizations.	Data management
BA_SVC_20	Operational spatial data service	the operation used to manipulate spatial data Common geoprocessing operations include geographic feature overlay, feature selection and analysis, topology processing, raster processing, and data conversion	Process management

BA_SVC_21	Import maps service	the process of importing maps from different source	Maps management
BA_SVC_22	Filter Datasets service	The process of filtering datasets by Theme and Agency or other parameters	Data management
BA_SVC_23	Processing Service	These services are designed to make generic processing of data, typically spatial data. These data can be provided while calling their operations, or the services can access some data repositories.	Process management
BA_SVC_24	Transformation Service:	Services that allow spatial datasets to be transformed, with a view toachieving interoperability.	Process management
BA_SVC_25	Catalog Service	These make it possible to discover, explore and evaluate datasets, services etc., bymeans of the metadata about them that catalogs publish.	Data management
BA_SVC_26	Gazetteer Service	The ability to determine the geospatial coordinates for a place, given place nameand/or attributes. This function accesses a database of geographic place names,together with their geographic locations and other descriptive information.	Location management
BA_SVC_27	Tracking service	The ability to track objects on a specific domain of locations	Location management

4.1.1 Actor catalog

Ten stakeholders are considered as key actors in developing the business architecture. The actors can be grouped as end users, data collectors and providers, data processors, governance, service providers and Implementers.

Table 4 Actors catalog

Actors (Core)			
ID	**Name**	**Description**	**Category**
BA_ACT_01	INSA		
BA_ACT_02	EGA		
BA_ACT_03	Ministry of Rural Development and Agriculture		
BA_ACT_04	Ministry of Urban Planning		
BA_ACT_05	Private Sectors		
BA_ACT_06	Incubators		
BA_ACT_07	Start ups		
BA_ACT_08	International Companies		
BA_ACT_09	Citizen		
BA_ACT_10	Academia		

4.1.2 Role catalog

Actor's role catalog is shown in the table 5 below. This are the possible roles for the actors defined above.

Table 5 Role Catalog

Role (Core)			
ID	**Name**	**Description**	**Category**
BA_ROL_01	Data Provider		
BA_ROL_02	Implementer		
BA_ROL_03	Data Processor		
BA_ROL_04	Service Provider		
BA_ROL_05	Governance		
BA_ROL_06	Service Consumer		

4.1.3 Actor-Role Matrix

The relationship between actors and their roles are shown in table 6 below. The actor role matrix is defined as for instance Actor BA_ACT_01 performs BA_ROL_01.

Table 1 Actor /Role Matrix

Actor / Role Map						
Actor / Role	BA_ROL_01	BA_ROL_02	BA_ROL_03	BA_ROL_04	BA_ROL_05	BA_ROL_06
BA_ACT_01	*performs*	*performs*	*performs*	*performs*	*performs*	*performs*
BA_ACT_02	*Performs*	*performs*	*performs*	*performs*	*performs*	*performs*
BA_ACT_03	*performs*		*performs*			*performs*
BA_ACT_04	*performs*		*performs*	*performs*		*performs*
BA_ACT_05	*performs*	*performs*		*performs*		*performs*
BA_ACT_06	*performs*	*performs*		*performs*		*performs*
BA_ACT_07	*performs*	*performs*		*performs*		*performs*
BA_ACT_08	*performs*	*performs*	*performs*	*performs*		*performs*
BA_ACT_09	*performs*					*performs*

4.1.4 Business Interaction Matrix

Table 2 High-level Business Interaction Matrix

Consuming Business Services	Location management	Data management	Governance	Map management	Data format and encoding	Data collection	Group management
Location management		Uses	Aligns with				Has
Data management	Exposes data to		Aligns with	Exposes data to	Exposes data to	Exposes data to	Exposes data to
Governance	Needs info about	Needs info about		Needs info about	Needs info about	Needs info about	Needs info about
Map management	Uses	Uses	Aligns with				Has
Data format and encoding		Uses	Aligns with	Exposes data to			
Data collection		Uses	Aligns with				
Group management	Needs info about	Needs info about	Aligns with	Needs info about	Needs info about	Needs info about	

5. Business Services to information Diagram

In this section diagrams that show information needed to support one or more business services and type of data that is consumed by or produced by a business service along with the source of information is illustrated. It also shows an initial representation of the information present within the architecture and therefore forms a basis for elaboration and refinement within Data Architecture.

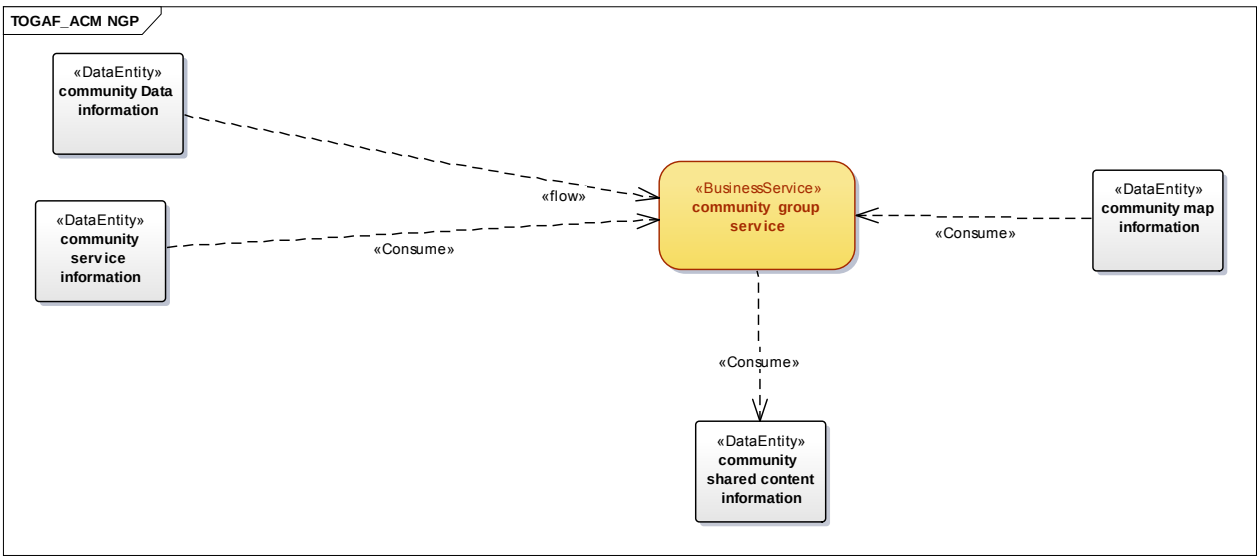

Figure 4 Community group Business Service to Information Diagram

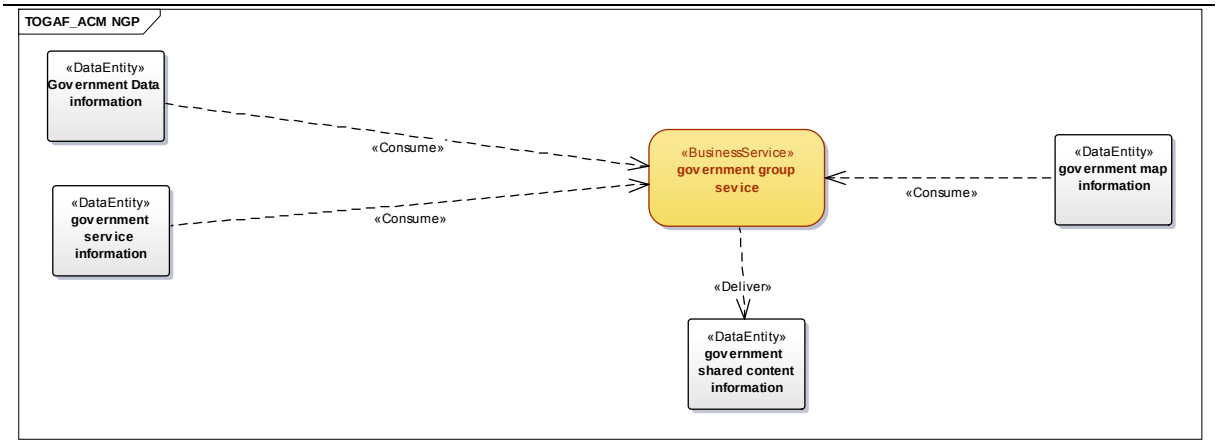

Figure 5 Government group Business Service to Information Diagram

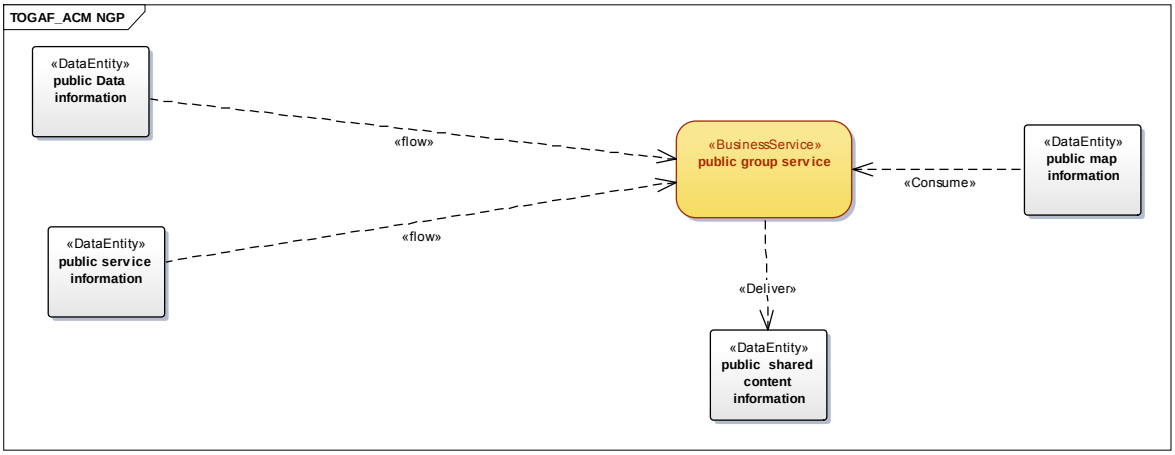

Figure 6 Government group Business Service to Information Diagram

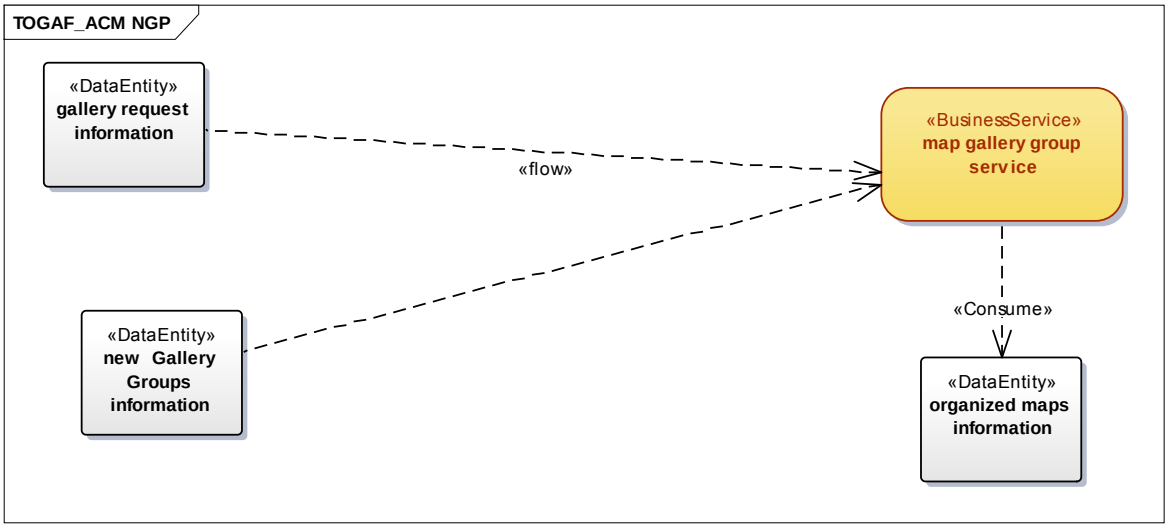

Figure 7 Map Gallery group Business Service to Information Diagram

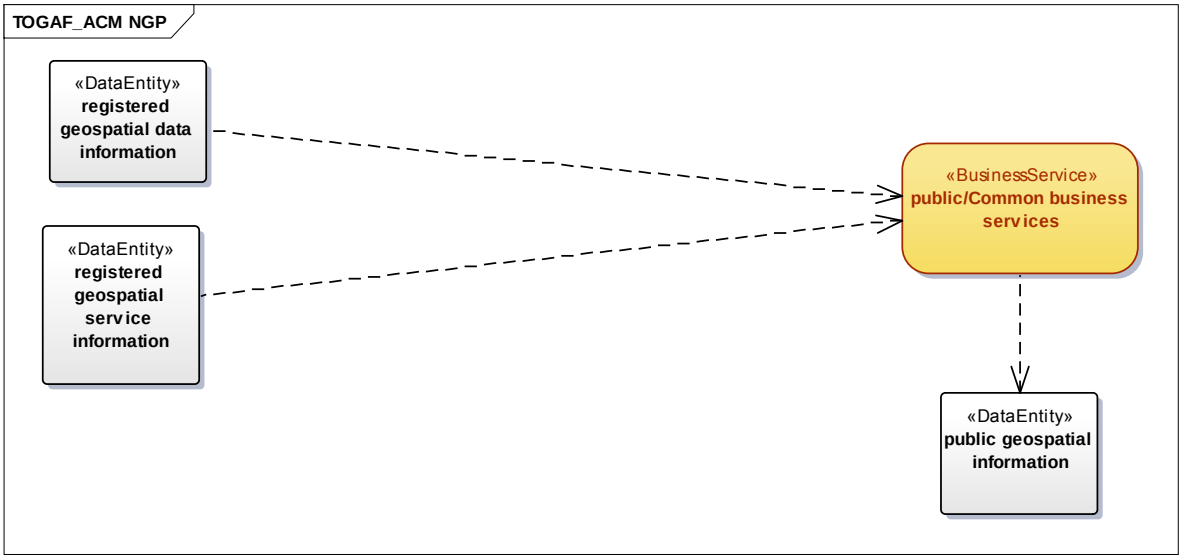

Figure 8 Public/Common Business Service to Information Diagram

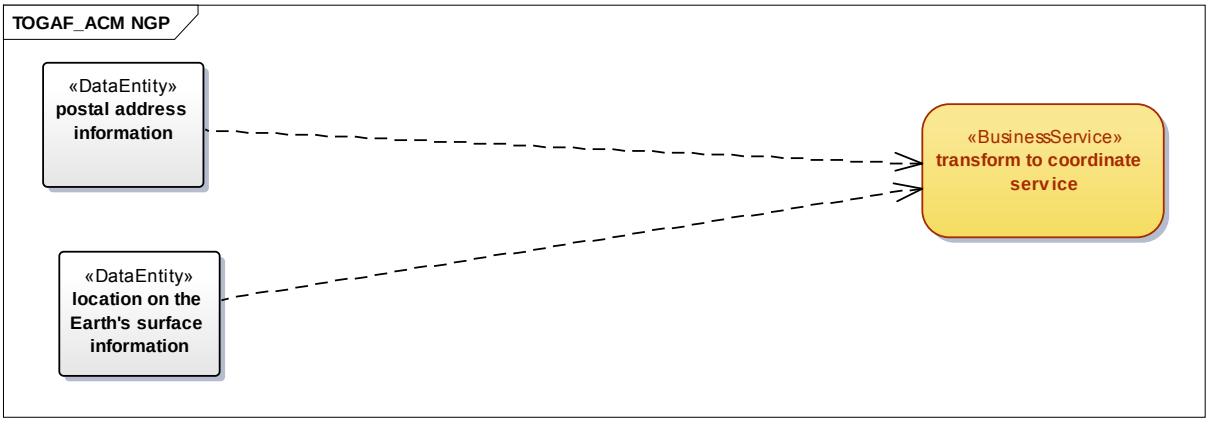

Figure 9 Transform to coordinate Business Service to Information Diagram

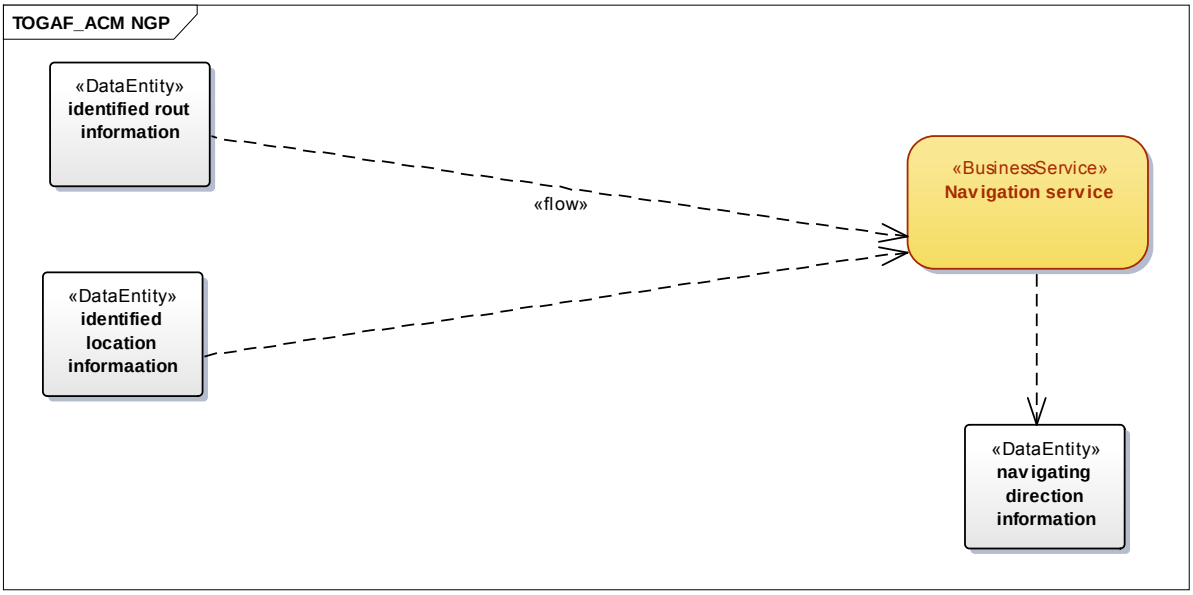

Figure 11 Navigation Business Service to Information Diagram

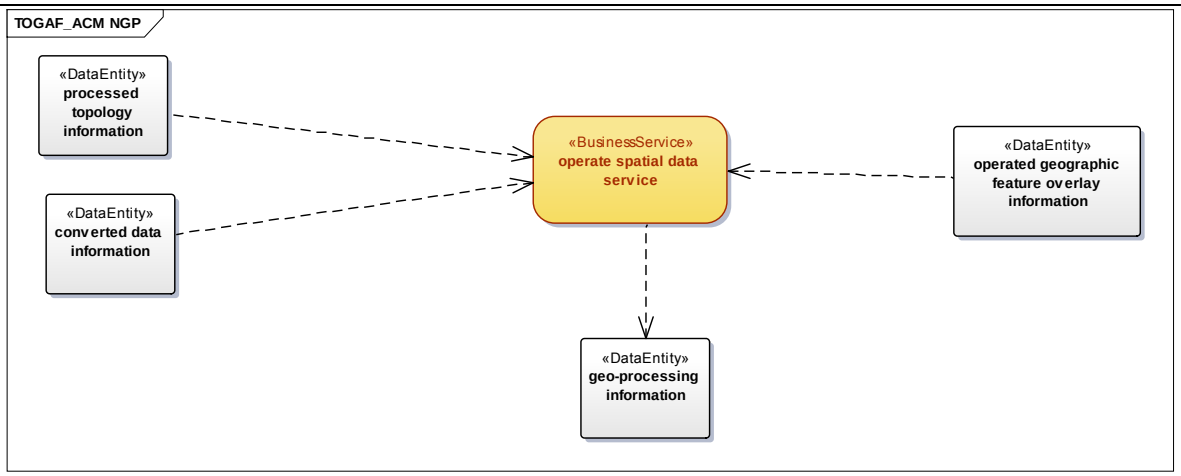

Figure 12Operation on spatial data Business Service to Information Diagram

6. Conclusions and Recommendations

This paper assesses the current status of national geospatial business architecture in Ethioiaand develops suitable geospatial platform business architecture based on TOGAF framework and the geospatial enterprise architectures and governance model developed by Abraham Belay (2017).

Based on the study the following recommendations for further research has been given. First, in the near future, similar research works could be done to develop technological geospatial enterprise architecture for Ethiopia . Second, more detailed research could be done to identify specific indicators and detailed initiatives, expected to be done, in order to realize the whole geospatial enterprise architecture at national level. Third, as the study only focuses on Ethiopian context, further studies can be conducted for other developing countries.

7. Acknowledgments

Thanks to the years of love and encouragement from my wonderful wife Halal, and thanks to all my kids who never lost faith in their dad.A special thanks also goes to my colligues Robel and Dereje for their technical support which helps me to deliver this level of quality study paper.

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