Geospatial Data Sharing: The Role of Coordination and Data Integration in Spatial Data Infrastructure

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Abstract

Spatial data comes in a variety of formats and includes more than just geographic information. It is projected that over 80% of government data has location. Several initiatives have been launched in recent years to promote and coordinate the sharing of spatial data from various sources. These initiatives are frequently referred to collectively as the 'Spatial Data Infrastructure' (SDI), which can be defined as a collection of technological and organisational components aimed at facilitating and coordinating spatial data sharing. Coordination and data integration are widely regarded as the most important aspects of an SDI. Coordination is required because the use and exchange of spatial data involves many actors at various levels and sectors while data characteristics of usable datasets is the readiness of spatial datasets for integration with other datasets. To gain insights of the role of coordination and data integration SWOT analysis was selected to categorise information into several themes and factors including internal and external factors. The aim of this paper is to show the importance of coordination and data integration in the context of a Spatial Data Infrastructure and how it increases the degree of spatial data sharing.

Keywords: *spatial data infrastructure, data sharing, data exchange, coordination, integration*

1. Introduction

The term Spatial Data Infrastructure (SDI) used to describe a combination of technology, police and institutional arrangements that help in the provision and availability of spatial data. SDI provides the foundation for spatial data search, assessment and application for users and suppliers at all levels of government, commercial sector, non-profit sector, academia and the public. Spatial data is a critical component in all decision-making information retrieval processes. The acquisition of spatial data requires a significant investment of both money and time [1]. The usage and sharing of geospatial data have risen in most countries. It has become part of human activities where an element of geospatial essentially used while working, travelling and planning. The usage of geospatial data can be seen in variety of field including land related analysis, environment, educational, health, administrative and disaster management [2,3,4,5]. To ensure the effectiveness of

geospatial data especially in decision making, an effective data sharing and distribution management is crucial. Data and information collection, management, exchange, and use are critical functions of government. Data sharing can be regarded as a requirement for e-government activities. Thus, the concept of Spatial Data Infrastructure (SDI) has emerged to ensure rapid growth of geospatial data is manageable [6]. The component of SDI is shown in a figure 1 below.

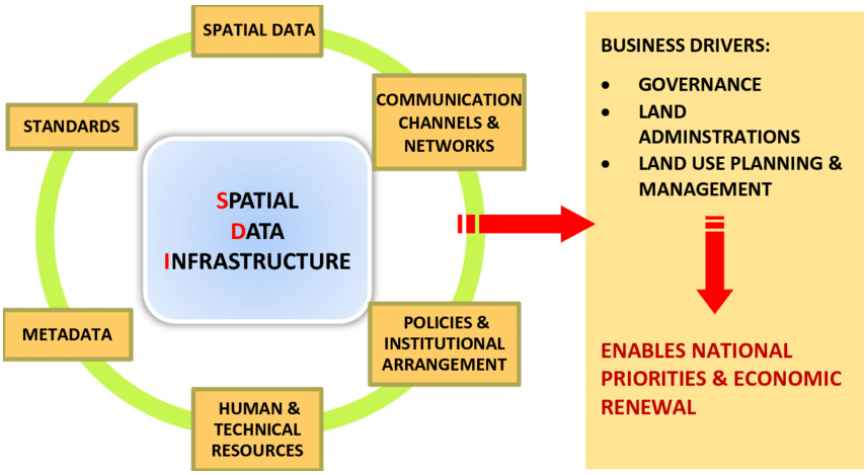

Figure 1: SDI Components (s Jafari Salim M, 2014).

The Spatial Data Infrastructure (SDI) is a set of technologies, measures, standards, implementing rules, services, human capacity, and other factors that enable the effective aggregation, management, and maintenance of spatial data sharing to meet national needs [7]. Furthermore, SDI provides a foundation for geospatial data discovery, evaluation, and application for users and providers at all levels of government, private industry, non-profit organisations, academia, and ordinary citizens. Coordination and data integration are regarded as critical component of an SDI because data producers and users may be in different sectors and at different levels.

2. Overview

2.1 Spatial Data Sharing in an SDI environment

SDI plays a vital role in any spatial data sharing in most of the data dissemination environment. SDI gathering, sharing, and disseminating spatially refenced data and information in a coordinated manner with technological support to ease policy formulation and decision making to meet societal needs at the local, national, and global levels [8]. To create an efficient environment for sharing spatial data between different institutions, an appropriate legal and business framework with the mandatory application of technical rules is required [9]. As a result, many

governments around the world created SDI to encourage geospatial data sharing among organisations [10]. There are various spatial data sharing models that increase data availability and access for users of public institutions (state, federal, municipal, and other institutions). No matter which model of sharing spatial data is adopted, it is necessary to previously implement legal, organizational, semantic, and technical interoperability. For each spatial data set, which is considered crucial, defining the legal framework and data management procedures is necessary. That includes metadata about the frequency: of data updates, data set sources and data quality assurance. Data sharing is enabled through a web service. Thus, using data is simplified, and available time in protecting against natural disasters is spent more efficiently.

Spatial data sharing entails more than just data exchange. To facilitate spatial data sharing, spatial stakeholders must address a variety of issues, including technical and non-technical aspects of data integration and coordination [11]. Data integration is the appropriate focus for data sharing. Data integration is an enticing reason to share data. Integrating data in a spatial system improves its effectiveness and opens opportunities for broader enterprise benefits that benefit entire organisations and consistency. To facilitate the integration of multi-source spatial datasets, the investigation of the data integration process, potential barriers and challenges of spatial data integration and coordination are the possible enabler.

2.2 Spatial Data Integration in SDI environment

Spatial data integration is the process of making different geospatial datasets, which may or may not have different spatial coverages, compatible with one another [12]. The ability to share access to data sources or access common databases is referred to as data integration. The use of an SDI as a data integration catalyst would allow users to overcome the issues and challenges of spatial data integration, resulting in less duplication of effort and expense in data integration. However, in order for this to happen effectively, socio-technical issues such as immature institutional arrangements, inconsistencies, and incomplete knowledge about data availability and quality, as well as technical issues, must be addressed. The purpose of spatial data integration is to enable the analysis, interpretation, querying, or visualization of the integrated spatial data.

Attempts to establish a sharing platform, such as SDI, will fail unless a coordinated approach is used to address all the issues and inconsistencies associated with multisource data integration, which are summarised in Table 1[13].

Table 1: Data Integration Issues

Technical Issues	Nontechnical Issues		
Institutional issues	Policy issues	Legal issues	Social issues
Computational heterogeneity (Standards and interoperability)	Existence of supporting Legislation	Definition of rights, restrictions, and responsibilities	Cultural issues

Maintenance of vertical topology Semantic heterogeneity Reference system and scale Consistency Data quality consistency Existence and quality of metadata Format consistency Consistency in data models Attribution heterogeneity Utilization of consistent collaboration models Funding model differences Awareness of data integration	Consistency in policy drivers and priorities (sustainable development) Pricing	Consistency in copyright and intellectual property rights approaches Different data access and privacy polici	Weakness of capacity building activities Different backgrounds of stakeholders

2.3 Coordination in SDI environment

In many applications, a data source may need to be co-ordinated with heterogeneous data sources on which it depends. The administrator of this contingent source needs to ensure it is up to date and consistent with the latest data provided by these base source [14]. Coordination serves as a critical link between governance processes and the 'activities of individual actors that move the community in the desired direction. The role of coordination is critical in the context of SDI and spatial information management, which include distributed capabilities that are owned by different parties and developed and operated independently. We can describe the institutional architecture and governance - authority structures by distinguishing between coordination and governance functions, both of which are important aspects of the institutional arrangement.

3. Method

To gain insights of the role of coordination and data integration a SWOT analysis was selected to categorise information into several themes and factors including internal and external factors. According to [15] A SWOT analysis is a framework for evaluating the strengths, weaknesses, opportunities, and threats that an idea or concept may have in a simple and straightforward manner. Connected paper was used to gather the literature. Figure 2 depicts the paper gathered from the findings. Nine (9) papers were selected out of twenty-five paper (25).

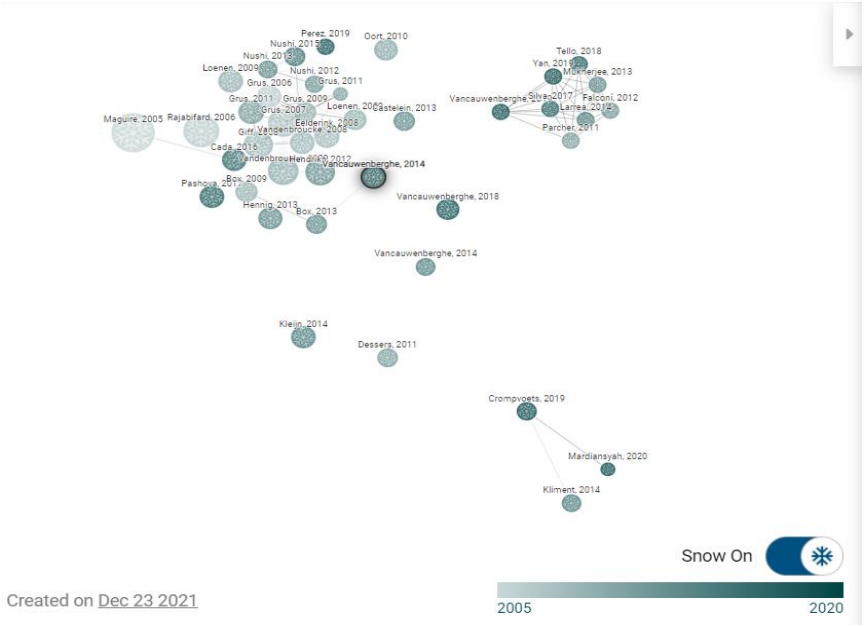

Figure 2: Literature papers

4. Findings

The results in Table 2 shows that coordination and data integration play an important role in geospatial data sharing for SDI. Each theme was divided according to the SDI components. Four (4) major components of SDI were identified as one theme. The four themes are technologies/access network, data/standards, people, and policy/legislation.

Table 2: SWOT Analysis

SDI Component	Strength	Weakness	Opportunity	Threats
Technologies / Access Network	Integration of system through data	Computational heterogeneity (Standards and interoperability)	Format consistency	Low decision making due to low data quality
Data/Standard	Data interoperability	Lack of standard applied to data	Data quality consistency	Inconsistency of data
People	Skilled in data management	Lack of knowledge about data from providers	More skilled personnel on data management. Training provided	Different backgrounds of stakeholders
Policy/Legal	Consistency in policy drivers and priorities	Do not adhere to policy	Consistency in copyright and intellectual property	Policy needs to be look into to accommodate recent problem

			rights	

5. Conclusions

Fully operational SDI has a great significance of achieving reliable and timely accessible data. Implementation of SDI will face several challenges concerning the data compatibility which can be caused by the coordination and data integration. Many organisations are using different projection systems, there are also lack of standard and lack of standard quality guidelines. Most of the organisations do not have any metadata standard. There is no standard guideline to share the relevant data during emergency period. Another challenge is the sustainability and security of the platform. Thus, spatial data sharing with good data coordination and integration aims to overcome the inconsistency between diverse systems. In addition, there are different drivers and needs for interoperability including:

a. Reduce costly data acquisition, maintenance and processing.
b. Provide direct, on-demand access that reduces time and cost. On-demand spatial information means being able to access the desired spatial information in its most current state, with correct representation when we need it.
c. Encourage vendor-neutral flexibility and extensibility of products. Vendor-neutral products comply with open standards and are independent from underlying software/hardware.
d. Save time, money and resources.
e. Enhanced decision-making.

Effective sharing of geospatial data and information will save money and reduce duplication of costly digital data activities. To ensure the use of geospatial data and information, emphasis needs to be placed on aspects of acquisition and processing to ensure availability of geospatial data, management and sharing with the community.

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