

A Contextual ICA Stakeholder Model Approach for the Namibian Spatial Data Infrastructure (NamSDI)

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Abstract. In 2011, the Namibian parliament presented and promulgated the Namibian Spatial Data Infrastructure (NamSDI) with the aim of promoting the sharing and improved access and use of geospatial data and services across Namibia. Notable SDI models, developed from the enterprise, information and computational viewpoints of the Reference Model for Open Distributed Processing (RM-ODP), comprise direct and indirect roles of stakeholders and special cases of each general role in an SDI. Hence, the International Cartographic Association (ICA) model was used to identify the stakeholders in and around NamSDI, which is still at the infancy stage of development. The application of a high-level ICA model proved to be relevant and useful in discriminating and categorizing NamSDI stakeholders according to their roles and vested interests. Some stakeholders, such as official government mapping agencies, assume multiple roles, while others, such as database administrators, are not yet active. In the absence of baseline data and given the infancy status of NamSDI, attributes such as skills, capacity of producers and service providers, were not considered. Modelling NamSDI stakeholders in the context of ICA's stakeholder model contributed significantly to a better understanding of NamSDI stakeholder types and subtypes and pointed out gaps that may hinder its successful and effective implementation.

Keywords: SDI, NamSDI, Stakeholder, ICA Stakeholders Model, RM-ODP Viewpoints

1. Introduction

A *spatial data infrastructure (SDI)* is an evolving concept for facilitating, coordinating and monitoring the exchange and sharing of geospatial data and services, and the metadata about both. It encompasses stakeholders from different levels of representation (local, regional and national) and disciplines. An SDI is more than just the technology of a *geographical information system (GIS)*: it is a collection of technologies, policies and institutional arrangements and provides the basis for the discovery, evaluation and application of geospatial data and services (Cooper et al. 2013), adapted from Hjelmager et al. (2008) and Nebert (2004).

Namibia, with a land surface of 825,418 km², is the 34th largest country in the world, and has a population of about 2.1 million.

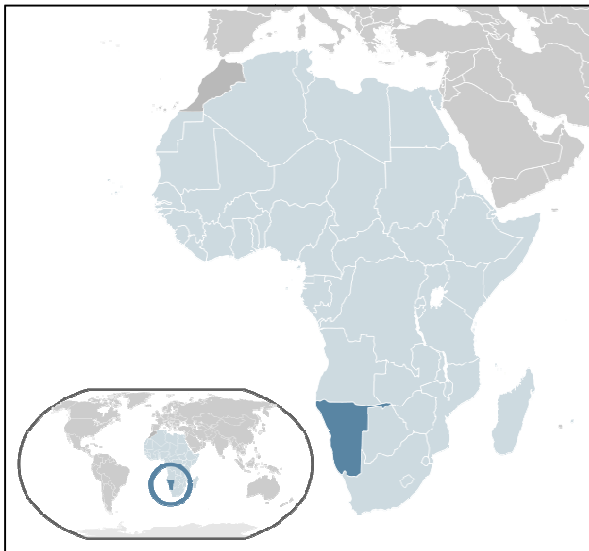


Figure 1. Map of Namibia in Africa and the world (Wikipedia, 2012).

During 2011, the Statistics Act (No 9 of 2011) (NPC,2011a), the Draft National Spatial Data Infrastructure Policy of Namibia (NPC, 2011b) and the National Spatial Data Infrastructure Standards Schedule of Namibia (NSA 2011) brought into being NamSDI. The Commission on Geoinformation Infrastructures and Standards of the International Cartographic Association (ICA) has been using the RM-ODP (ISO/IEC 10746-1:1998) to develop formal models of an SDI from the *enterprise* and *information viewpoints* of RM ODP (Hjelmager et al. 2008), and from the

computational viewpoint (Cooper et al. 2013). These viewpoints contribute towards a more holistic interpretation of an SDI, independent of specific SDI legislation, technology and implementations (Cooper et al. 2013). A key part of these models is the identification of general roles of stakeholders within and around an SDI: *Policy Maker, Producer, Provider, Broker, Value-added Reseller (VAR)* and *End User* (Hjelmager et al. 2008). The Commission also identified 37 special cases of these general roles (Cooper et al. 2011).

As NamSDI is still in its early days of development, it was useful to apply the Commission's models and identify the stakeholders within and around NamSDI, their general roles and the special cases of these general roles, as a contribution to the development of NamSDI. The community of stakeholders for NamSDI is relatively small, concentrated and has a high degree of acquaintances among them. Sinvula et al. (2012) explored and established that the composition of NamSDI corresponded with the enterprise viewpoint of the RM-ODP in terms of purpose, objectives and policies as documented in NamSDI legal frameworks.

This paper presents NamSDI stakeholders as sub-types of the stakeholder types as identified in the ICA model. The remainder of the paper is structured as follows: section 2 provides background information on NamSDI and the models used; section 3 explains the methodology followed to identify NamSDI stakeholders; in section 4 NamSDI stakeholders are presented; section 5 discusses the results; and section 6 concludes.

2. The Namibian Spatial Data Infrastructure (NamSDI)

The geospatial community of Namibia recognized the common usage of fundamental datasets (base data) by different users across various applications. Sections 47 and 48 under Part 9 of the Statistics Act (No 9 of 2011), established the NamSDI. The Statistician-General of the Namibia Statistics Agency, in consultation with the CSD, issued the schedule for standards relating to NamSDI, in terms of section 36(2) of the Statistics Act (No. 9 of 2011) (NSA 2011a).

The successful implementation of SDIs is reliant on relevant expertise, which Namibia lacks. Based on the authors' observations and experience, Namibia has very few people with a clear and systematic understanding of SDIs. The gap in expertise has implications on the implementation of NamSDI.

Many stakeholders from various organizations in Namibia constituted a team that played a major role in initiating and currently implementing

NamSDI. A contextual analysis of these stakeholders improves the understanding of NamSDI, which is required in shaping its future evolution.

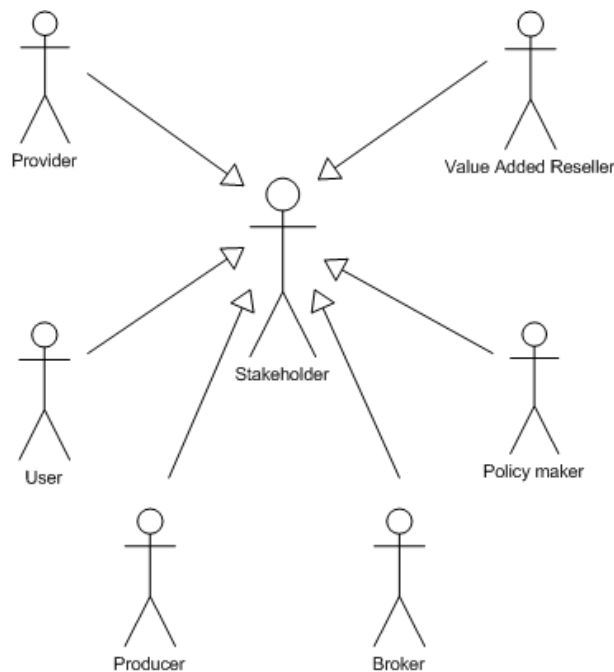


Figure 2.The ICA's Stakeholders from the enterprise viewpoint of RM-ODP (Hjelmager et al. 2008)

3. Methodology

Hjelmager et al. (2008) identified and described six stakeholders in the enterprise viewpoint of an SDI using UML use case diagrams (Figure 2), and recognized that an individual stakeholder can execute different roles. For example, an organization can act as a *policy maker*, who sets out rules and policies for an SDI, and at the same time, be a *producer* of data and services required in an SDI. Cooper et al. (2011) discussed these stakeholders from the perspective of volunteered geographical information (VGI), but also took this further by identifying various special cases of these general roles termed 'sub-types'.

The ICA's model describes the characteristics of an SDI at a high level of abstraction. The objective here is to model NamSDI stakeholders as subtypes of the ICA's model stakeholders, i.e. in practice. Such a modelling

exercise improves the understanding of NamSDI, but also serves to test the behavior and applicability of the abstract model to specific SDI instances.

The ICA's stakeholder features and patterns (scientific and theoretical in nature) were associated with NamSDI stakeholders and their roles (observed or operational). This procedure included direct observation of NamSDI in the form of impressions, literature and formal objective measurement. NamSDI stakeholders were first identified at a workshop of the South Africa/Namibia bilateral project with representation from Namibia, members of the ICA Commission and other scholars who reviewed and confirmed the validity of the facts regarding the description and definition of NamSDI in terms of the ICA model.

4. NamSDI Stakeholders

Hjelmager et al. (2008) identified and defined six individual stakeholders from the ICA model (Table 1).

STAKEHOLDER	DESCRIPTION
Policy maker	<i>A stakeholder who sets the policy pursued by an SDI and all its stakeholders</i>
Producer	<i>A stakeholder who produces SDI data or services</i>
Provider	<i>A stakeholder who provides data or services to users through an SDI</i>
Broker	<i>A stakeholder who brings users and providers together and assists in the negotiation of contracts between them</i>
Value-added reseller (VAR)	<i>A stakeholder who adds some new feature to an existing product or group of products, and then makes it available as a new product</i>
End user	<i>A stakeholder who uses the SDI for its intended purpose</i>

Table 1. Types of ICA model stakeholders (Hjelmager et al. 2008, Cooper et al. 2011)

4.1. Policy Maker

The Government of the Republic of Namibia (GRN) is the notable **policy maker** and **producer** of fundamental (base/reference) spatial datasets, through various line ministries and state owned agencies (e.g. National

Planning Commission (NPC), Ministry of Lands, Namibia Statistics Agency).

The legal and policy framework of NamSDI was approved and promulgated by the Namibian Parliament in their role as *legislators* (a sub-type stakeholder of policy marker). The legislators played a key role in determining the framework within which NamSDI had to exist (NPC 2011a). The NamSDI legislation was integrated in the Statistics Bill that was initiated and prepared by the Office of the President (OP) through NPC and the Ministry of Lands, Resettlement and Rehabilitation (table 2). The Minister for Presidential Affairs under OP initiated and tabled the bill in parliament for approval after consultation with the Ministry of Justice.

The *decision maker* for the NamSDI involves the Committee for Spatial Data (CSD), whose role is to advise the Minister and NSA and consists of members appointed in accordance with the Act (i.e. Statistician General and others) under the chairmanship of the Surveyor General (SG). The NamSDI was initiated by the geospatial community which consisted of members from the office of the SG, the Central Bureau of Statistics under NPC and other government ministries. The NamSDI secretariat within NSA is mandated **secretarial** roles and responsibilities. A number of individuals working in various organizations such as the NPC (before the Act), NSA (after the Act), GRN Ministries, Non-governmental organizations and the private sector expressed the need for standardized data and are working as NamSDI **champions**.

4.2. Producer

Producers of official geospatial datasets for the NamSDI community include GRN ministries and their agencies (table 2) because of their budgets, resources, expertise, mandates and interests. These datasets include topographical and cadastral maps (Ministry of Lands), hydrographic and hydrological (Min. Agriculture), meteorological and transportation (Min. Works), geological (Min. Mines and Energy), social statistical (NSA), environmental (Min. Environment) and other fundamental datasets produced by other mapping agencies. Local authorities also produce spatial data such as cadastral and infrastructure services. No **commercial mapping agencies** or **community interest** groups produce spatial data suitable for NamSDI at present. Meanwhile, the environmental information system (EIS) managed by Raison (private company) produces **crowd sourced** geospatial datasets from citizens.

4.3. Provider

The majority of official producers and parastatals provide data or services for their internal use and for others through NamSDI. ConInfo, established and managed by the Ministry of Environment, is one such example. The current NamSDI legislation mandates the NamSDI secretariat within NSA to establish the metadata catalogue of all official data producers and played the role of **data distributor** (under NPC, before the Act). In addition to EIS mentioned earlier, the Ministry of Environment and Tourism is another example of web-based distributors of spatial data in Namibia. The NamSDI Secretariat within NSA will in future play the role of **data arbiter** (table 2).

4.4. Broker

Crowd sourcing facilitators for NamSDI include the EIS, which brings together End Users and Providers and allow groups of individuals to access on-demand data and services. Finders of spatial data and services through NamSDI involve private companies as **client/user finders** (table 2) as they promote and sell a portfolio of data and services from *producers, providers and VARs*, to end users. Many of the private companies work also as **provider's finders** by sourcing data or services for NamSDI, through mandates and contracts.

NamSDI secretariat through the act is mandated to play the roles of **harvester** and **cataloguer** of geospatial metadata and services, by building and maintaining the catalogue for NamSDI. Private companies, technical advisors in Ministries and NGOs are the major **négociants** who bring end users and providers together and assist in the negotiation of contracts.

4.5. Value-added reseller (VAR)

Official mapping agencies (table 2) and satellite receiving stations (e.g. Polytechnic, SADC image processing, Okaukuejo's Etosha satellite imagery, National remote sensing's fire monitoring) are examples of VAR **publishers** whose duties involve collecting data from various sources, and integrating and editing them to produce new products. The VAR **service integrator** is currently non-existent, and **data and metadata aggregators/ integrators** include Ministry of Environment (Namibian Atlas), NSA (Poverty Atlas) and Ministry of Land (Land-use suitability; regional environmental impact assessments).

4.6. End user

End user stakeholders use NamSDI for their intended purpose and include citizens and visitors, government employees, consultants and private companies who are either **naive consumers** or **advanced users**. End users who use whatever spatial datasets available due to limited ability in discerning the quality of the data or services are categorized as naive consumers. In contrast, advanced users are experts with the ability to make informed decisions regarding the quality of geospatial data and services.

Stakeholder			Examples
Type	Sub-type	Sub-sub-type	
<i>Policy Maker</i>	Legislator		<ul style="list-style-type: none"> ▪ NPC within the Office of The President (OP) prepared the Act in consultation with line ministries ▪ Different levels of government were consulted (they are not legislators) and GIS community. ▪ Min. of Justice assisted with legal drafting (polished). ▪ OP presented the Act before Parliament. of Namibia (PoN) ▪ National Council (NC) reviewed the Act. ▪ PoN modified and approved the Act.
	Decision maker		<ul style="list-style-type: none"> ▪ Committee for Spatial Data (CSD) <ul style="list-style-type: none"> ✓ Advises the Minister and NSA ✓ Members as per Act include Statistician General (St.G) and others ✓ CSD is chaired by the Surveyor General (SG) ▪ Ministry of Lands and Resettlement (MLR) <ul style="list-style-type: none"> ✓ Implement own standards without consulting CSD ▪ Minister responsible for Statistics (Minister for Presidential Affairs within OP) ▪ NSA through St.G administers the Act

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	Secretariat		NamSDI Secretariat within NSA
	Champion		<ul style="list-style-type: none"> ▪ Individuals at various organizations <ul style="list-style-type: none"> ✓ NPC (before the Act) ✓ NSA (after the Act) ✓ MLR ✓ Ministry of Environment and Tourism (MET) ✓ NGOs & Private sector
<i>Producer</i>	Status	Official mapping agency	<ul style="list-style-type: none"> ▪ Official producers <ul style="list-style-type: none"> ✓ GRN (e.g. Min. Lands: topographic maps, cadastral; Min. Mines & Energy (MME): geotopo; Min. Works & Transport (MWT): , Min. Agric: soil, vegetation, boreholes; MET: EIA, EIS); and parastatals (e.g. NSA: stats) • satellite data via SADC AMESD project ✓ Local authorities: cadastral, services etc.
		Commercial mapping agency	None yet
		Community interest	None yet
		Crowd source	Environmental Information System (EIS) managed by Raison
	Motivation		
		Special interest	None yet
		Economic	<ul style="list-style-type: none"> ▪ Profit - for private companies ▪ Mandate (not for profit) <ul style="list-style-type: none"> ✓ All official producers for socio-economic development ✓ Organization and employees are paid to do it

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		Process	None yet
	Role		
		Captor of raw data	Official data producers
		Submitter of revision notice	<ul style="list-style-type: none"> ▪ Currently: Users notify producers about errors; producer takes decision regarding rectification. ▪ In future: Secretariat will receive notices, and take decision regarding rectification.
		Passive producer	None yet
		Database administrator	<ul style="list-style-type: none"> ▪ Each data producer ▪ NSA CSD Secretariat in future
	Skill	Neophyte	None yet
		Interested amateur	None yet
		Expert amateur	None yet
		Expert professional	Yes, including pseudo professionals
		Expert authority	Yes, contract based
<i>Provider</i>			
	Data provider	A producer who provides own data	<ul style="list-style-type: none"> ▪ All official producers ▪ ConInfo
		Data distributor	<ul style="list-style-type: none"> ▪ NSA ▪ EIS (crowdsourcing) ▪ MET (e.g. Nam. Atlas and Northern Environmental Profile and Caprivi Environmental Profile) ▪ Fire, etc (EMIN2)

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		Data arbiter	In Future: NamSDI Secretariat within NSA
	Service provider	Producer is its own service provider	Yes, EIS
		Service distributor	None yet
		Service arbiter	None yet
<i>Broker</i>			
	Crowd-sourcing facilitator		EIS
	Finder	Clients/users finder	Private companies (PCs) (e.g. GeoCarta, Geobusiness Solutions, Prime GIS Technologies (PGT))
		Providers finder	PCs (e.g. PGT)
	Harvester		In future: NamSDI Secretariat
	Cataloguer		EIS, NamSDI Secretariat
	Négociant		PCs (e.g. PGT), Technical advisors in Ministries, NGOs.
<i>Value-added reseller (VAR)</i>			
	Publisher		<ul style="list-style-type: none"> ▪ Satellite receiving station (Polytechnic of Namibia, SADC, etc – image processing), Okaukuejo (Etosha) satellite imagery <ul style="list-style-type: none"> ○ Value: (image processing), Clark Labs (NDVI for Namibia), ▪ Ministry of Agriculture (value-addition: fire monitoring and alerts) early warning ▪ Ministry of Lands: publish topographic maps with data from different sources (e.g. schools)

			<ul style="list-style-type: none"> ▪ NSA & Geological Surveys: maps
	Aggregator/ integrator	Service integrator	None yet
		Data and metadata aggregator/ integrator	MET (Nam. Atlas), NSA (Poverty Atlas), MLR (Land-use suitability; regional environmental impact assessments)
<i>End user</i>			
	Naive consumer		<ul style="list-style-type: none"> ▪ Some citizens and visitors, ▪ Some government employees, ▪ Some consultants and private companies
	Advanced user		<ul style="list-style-type: none"> ▪ Some citizens and visitors, ▪ Some government employees ▪ Some consultants and private companies

Table 2. NamSDI stakeholder types and sub-types

5. Discussion

As emphasized throughout this paper, the motivation of Namibian stakeholders is to contribute towards the successful implementation of NamSDI. The results of our research show that the use of a high-level ICA model in contextualizing a policy and legal dependent NamSDI is robust. It is prevalent in NamSDI that the motivation of GRN, agencies, NGO's and private sector involved direct economic and financial rewards, business awareness promotion and end users unwilling to pay for institutional data (Cooper et al. 2012). Special interest groups such as donor agencies, academic institutions and non-governmental organizations produce data for their own specialized interest. Meanwhile, academic and research institutions also produce data as part of their training processes.

This study also reveals that many NamSDI stakeholders assume multiple roles and use cases, for example, all *official mapping agencies, commercial agencies, community interest mappers and crowd sourcers* can be classified as *captors of raw data*. The NamSDI secretariat within NSA acts as recipient of *submitted notices* in order to revise or correct data. Since NamSDI is still at an infancy stage, some of the stakeholder sub-types, like

the roles of *database administrators*, are executed by each official producer.

Neophyte and *Interested amateur* producers *do not exist yet* in NamSDI. *Special interest* and rainfall data *crowd sourcing* are producers of data with *expert amateur* skills. All NamSDI spatial data producers are *expert professional* and/or *expert authority* because they studied and practice the subject and rely on that knowledge when engaged in spatial data production.

There are several challenges to consider regarding the significance of using the ICA model in describing stakeholders in NamSDI. No NamSDI official stakeholder classification or study is documented that could serve as a reference point for this paper. Some of the ICA model stakeholders and sub-types were not applicable due to the infancy status of NamSDI (i.e. no study was conducted to assess the skills of stakeholders in their capacity as producers and service providers in NamSDI). In respect of these viewpoints, the contribution of this paper enhances the understanding of NamSDI.

6. Conclusion

The aim of this paper was to model the NamSDI stakeholders as types and subtypes of the ICA's model stakeholders. The experience gained in modelling the stakeholder types and subtypes improved the understanding of the NamSDI and served to test the behavior and applicability of the high level abstract model to a specific SDI instance. Exploring NamSDI stakeholder types and subtypes as ICA's model stakeholder revealed an interesting trend of current research in defining and characterizing stakeholders of a policy and legalistic dependent SDI.

The ICA's model helped in identifying and contextualizing NamSDI stakeholders, as well as their roles and responsibilities. Thus, NamSDI stakeholder modelling has produced results that make intuitive sense from an SDI perspective and has enhanced the ability to define stakeholder type and subtype trends of legislative dependent SDIs in a relatively short period. It is also important to note that NamSDI stakeholder identification cannot be exclusively restricted to a stakeholder model but should include SDI objectives, purpose and user needs.

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