Stakeholder analysis of the governance framework of a national SDI dataset – Whose needs are met in the buildings and address register of the Netherlands?

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Abstract

National spatial data infrastructures are key to achieving the Digital Earth vision. In many cases, national datasets are integrated from local datasets created and maintained by municipalities. Examples are address, building and topographic information. Integration of local datasets may result in a dataset satisfying the needs of users of national datasets, but is it productive for those who create and maintain the data? This article presents a stakeholder analysis of the *Basisregistratie Adressen en Gebouwen* (BAG), a collection of base information about addresses and buildings in the Netherlands. The information is captured and maintained by municipalities and integrated into a national base register by *Kadaster*, the Cadastre, Land Registry and Mapping Agency of the Netherlands. The stakeholder analysis identifies organizations involved in the BAG governance framework, describes their interests, rights, ownerships and responsibilities in the BAG, and maps the relationships between them. Analysis results indicate that *Kadaster* and the municipalities have the highest relative importance in the governance framework of the BAG. The study reveals challenges of setting up a governance framework that maintains the delicate balance between the interests of all stakeholders. The results provide guidance for SDI role players setting up governance frameworks for national or global datasets.

1. Introduction

Access to harmonised national datasets is key to the success of national data infrastructures. Similarly, harmonised global datasets are key to achieving the Digital Earth vision. A spatial data infrastructure (SDI) aims at making spatial data available and accessible for all. An SDI consists of several key components that contribute to the main objective: standards, policies, access networks, people, data and governance frameworks (Rajabifard, Feeney, and Williamson 2002). These components should be implemented in such a way that they ensure optimised use of the data provided by the SDI. 'SDI' is an evolving concept about facilitating and coordinating the exchange and sharing of spatial data and services between stakeholders from different levels in the spatial data community (Hjelmager et al. 2008). National SDIs are directed at addressing national challenges and therefore their focus is at users at the national level. However, national SDI data is often created and processed at the local level. As such the local SDIs are important building blocks for national SDIs (Rajabifard et al. 2006; Van Loenen 2005). However, researchers have noted that research on local SDIs is limited (Coetzee and Wolff-Piggott 2015; Hećimović, Marasović and Crompvoets 2014Vancauwenberghe et al. 2010; Van Loenen 2006).

Users at the national level, such as national agencies or ministries, require harmonised quality and semantics in the data, or one single dataset of uniform quality according to a standardised data model (see Jetzek 2016). A process that harmonises a myriad of local datasets into a national dataset is likely to result in a national dataset satisfying the needs of national users, but the question arises whether this is conducive to the objectives of those who create and maintain the data. The latter may

be confronted with a national standard that is enforced upon them, and which is not close to meeting their own organizational needs.

One of the critical infrastructural datasets of a national SDI is address data. Addresses are widely used as a locational reference for all kinds of information, such as information about people, organizations and services (Coetzee and Bishop 2009). Linking information about citizens, services, buildings and businesses to each other through a common address, makes it possible to analyse, visualize and share the information in a virtual representation of the Earth. To achieve reliable linking, a common address reference data source is required. Address data is therefore often included as one of the base or fundamental datasets in an SDI (Commission of the European Communities 2007; UN-GGIM 2017) and is an important component of e-government services and government operations (NGSIC 2014). Despite the importance of addresses for city management and for achieving national objectives, discourse on the topic is scant (Njoh 2010).

This article aims at providing strategic direction towards governance frameworks that respect and balance national and local stakeholder interests in initiatives where harmonised national datasets are derived from local datasets. Similarly, balancing stakeholder interests when deriving global datasets from national datasets is required to achieve the Digital Earth vision, and the results of this study may inform such global initiatives. Stakeholders play a significant role in ensuring the long-term success of the e-government enterprise, but one has to be aware that different stakeholders may seek different benefits (Rowley 2011). Therefore it is important to know who the stakeholders are and how they are, or should be, involved in the integration and governance of data from the local level 'upwards'.

The Netherlands may be considered to be a good practice example for national address data. The country has a well-established physical addressing system represented in a single national address dataset, the *Basisregistratie Adressen en Gebouwen* (BAG). The BAG is a collection of base information about all addresses and buildings in the Netherlands. The information is captured and maintained by municipalities and integrated into a national base register by *Kadaster*, the Cadastre, Land Registry and Mapping Agency of the Netherlands. The BAG has been available and operational since 2011 and the timing is therefore opportune for evaluating BAG stakeholders to obtain insights how to best implement national address registers in general. The lessons learned from this study are valuable for other countries planning to develop national address registers that balance national and local interests.

The article commences with a review of stakeholder theory that informs the methods in this paper, followed by a brief overview of related work on SDI stakeholders. To achieve the aim of this paper, we describe the BAG and its governance framework (section 3). Next, stakeholders are identified and described. In addition, the relationships between them are mapped and their relative influence on the BAG is evaluated (section 4). Results are discussed in Section 5 with specific reference to the balancing act between local and national benefits. Section 6 concludes.

2. Stakeholder theory and related work

2.1 Stakeholder analysis

Based on Freeman (1984), a stakeholder is defined as any group or individual who can affect or is affected by the achievement of an objective. A key distinction between stakeholders is those who affect decisions and those who are affected by decisions

(Brown et al. 2016). Because we are interested in stakeholders in a governance framework, this paper considers only organizations and committees as stakeholders (not individuals).

According to Carroll and Buchholtz (2008), a stakeholder has one of three types of stakes in an endeavour:

- A stakeholder with an *interest* is affected by a decision.

- A stakeholder with a *right* has a legal claim to be treated in a certain way or to have a particular right protected.

- A stakeholder with an *ownership* stake has a legal claim to an asset or property.

For the stakeholders in the BAG governance framework analysed in this paper, we considered a fourth stake, namely *responsibility*, i.e. a stakeholder with a legal mandate or responsibility in the endeavour.

A stakeholder analysis reveals the behaviour, intentions, interrelations, agendas, interests, and resources of actors in an endeavour. Such information is useful for developing strategies for managing stakeholders, for facilitating implementation of specific objectives, or for understanding the context so that future directions can be assessed (Brugha and Varvasovszky 2000). The purpose of the stakeholder analysis in this paper is to understand the relative influence of stakeholders involved in a national SDI dataset. In particular, we want to understand if and how local and national interests are balanced. The results can help to build effective and sustainable governance frameworks required for collective endeavours, such as a register of building and addresses like the BAG. Generally, there are three steps in a stakeholder analysis: 1) identifying stakeholders; 2) describing stakeholder characteristics and interests; and 3) investigating relationships between stakeholders (Brown et al. 2016).

Many methods have been proposed and applied for the identification and analysis of stakeholders. Mitchell, Agle and Wood (1997) argued that all stakeholders are not equal. Their stakeholder theory measures stakeholder influence according to

- *Power*, i.e. degree to which stakeholder can impose its will in a relationship.
- *Legitimacy,* i.e. degree to which stakeholder is socially accepted
- *Urgency,* i.e. degree to which stakeholder is prepared to go to any length to achieve the desired outcomes.

Authors contend that assessing legitimacy in a stakeholder analysis is difficult to operationalize (Bourne 2005; Mitchell, Agle and Wood 1997; Yang 2014) and it is therefore not always included in a stakeholder analysis. We considered power and urgency, but not legitimacy as a factor that impacts the relative influence of a stakeholder, because the BAG stakeholders that were analysed have legitimacy based on the governance framework described in the BAG legislation.

Bourne (2005) developed the Stakeholder Circle method based on three attributes for assessing a stakeholder's relative importance, which we used in this study:

- *Power*: Can the stakeholder influence the objectives significantly or in a relatively limited way?
- *Proximity*: Is the stakeholder closely associated with the project or relatively remote (no direct involvement in processes)?
- *Urgency*: Is the stakeholder prepared to take immediate action, irrespective of other commitments, or is there little need for action outside routine activities?

Social network analysis is another approach to stakeholder analysis. It goes beyond describing individual stakeholders by focusing on the relationships between pairs of stakeholders in a network. The social behaviour of the persons involved is

interpreted by analysing the network (as compared to studying individual stakeholders in other methods) and reveals, amongst others, the centrality, density and relationship strength of actors in the network. Social network analysis could reveal interesting social behaviour underlying the informal and less tangible relationships among organizations and their employees involved in the BAG, but is beyond the scope of this paper.

2.2 Related work

A variety of different categorizations for stakeholders in e-government and SDI can be found in literature (Table 1). Authors consider stakeholders as individuals (e.g. Richter, Miscione and Georgiadou 2010; Dessers et al. 2014), as organizations (e.g. Harvey and Tulloch 2006; Vandenbroucke et al. 2009), or both (e.g. Vancauwenberghe and Van Loenen 2018; Rowley 2011; Hjelmager et al. 2008). As mentioned above, our study considers mostly organizational stakeholders because we are focusing on the governance framework.

In the literature, the purpose of the study dictated how stakeholders were grouped or characterised, e.g. by their training needs (Rautenbach et al. 2012), by involvement in a process (Dessers et al. 2014) or by the area of jurisdiction of public sector stakeholders (Vandenbroucke et al. 2009). Rowley (2011) argues that in e-government, both individuals and organizations can play several roles; therefore stakeholder categorization by role (rather than by group or individual) is more appropriate. For the study reported in this article, stakeholders were categorized based on their interest in the dataset, namely as data user, data provider or facilitator of the national dataset. They were also characterised based on their roles (funders, implementers, trainers, influencers, etc.), their involvement in the BAG (their interests, rights, ownerships, responsibilities) and whether they affect decisions or are

affected by decisions. This categorization serves the purpose of our study, namely to

analyse stakeholders in the governance framework of BAG.

Table 1. Stakeholder typologies for SDIs and e-government initiatives

Source	Typologies
Local planning stakeholders in SDIs (Nedovic-Budic et al. 2004)	Producer, user (planners, decision makers, community groups)
Stakeholders in local government sharing (Harvey and Tulloch 2006)	Data producer, data provider, data coordinator, data distributor, data user, collaborator in data sharing initiative.
Stakeholders in data integration (Harvey and Tulloch, 2006)	Local agencies, state agencies, federal agencies, regional agencies, private companies, utilities.
SDI stakeholders (Van Loenen 2006)	Providers (of communication networks, makers of information suppliers, of content: information, information services, education), ($1^{st}, 2^{nd}, 3^{rd}$, end-) users, legislators, policy makers, coordinators, communicators (including lobbyists)
SDI stakeholders (Hjelmager et al. 2008)	PolicyMaker, Producer, Provider, Broker, Value-Added Reseller (VAR), User
Stakeholders in an SDI network (Vandenbroucke et al. 2009)	Stakeholders are coordinating, hosting, producing, processing and/or using spatial data.
Stakeholders from the public sector (Vandenbroucke et al. 2009)	Municipal, provincial, regional, and federal authorities; inter-municipal organisations, organisations with mixed public-private status.
Views of people in SDI literature (Richter, Miscione and Georgiadou 2010)	People as makers, people as adapters, people as elements of the SDI; people as SDI makers and adapters *in potentia* (practitioners).
Stakeholder roles in e-government (Rowley 2011)	People as service users; People as citizens; Businesses; Small-to-medium sized enterprises; Public administrators (employees); Other government agencies; Non-profit organizations; Politicians; E-government project managers; Design and IT developers; Suppliers and partners; Researchers and evaluators.
Actors fulfilling roles in an SDI (Béjar et al. 2012)	User, contributor, custodian, governing body, operational body, contact, educator, promoter, funder, member.
Target audiences for SDI education and training (Rautenbach et al. 2012)	CSI members; Decision makers, funders, and policy makers; Custodians of base datasets; Producers of non-base datasets; Producers of SASDI services; Providers of SASDI base datasets and services; End users and consumers of SASDI datasets and services.
Stakeholders in inter-organisational processes with spatial data (Dessers et al. 2014)	Process owner (such as a spatial planner), a GIS user or expert involved in the process, GIS manager of the organisation, organisational development manager
SDI stakeholder groups in Flanders Stakeholders in SDI assessment (Macharis and Crompvoets 2014)	Flemish government, private sector, utility sector, research and development sector.
Stakeholders in a national observatory for spatial planning (Coetzee and Smit	Funders, collaborators (e.g. researchers on a project), data producers (e.g. municipalities, scientists on a project), users (e.g. planners at municipalities, policy makers, decision makers, citizens), reviewers (of

Source	Typologies
2015)	data before publication), advisors (e.g. advisory board members), trainers, communicators (e.g. public relations, media)
Public sector information value chain (Welle Donker and Van Loenen 2016)	Suppliers, aggregators, enablers, developers and enrichers.
INSPIRE stakeholders (INSPIRE 2018)	INSPIRE coordination team, INSPIRE committee, national contact points, INSPIRE maintenance and implementation group, Spatial Data Interest Communities (SDIC), Legally Mandated Organizations (LMO).
Marine SDI stakeholders (IHO/HSSC Marine Spatial Data Infrastructure Working Group 2018)	Private sector; standards experts; national mapping agencies and survey departments; public sector stakeholders at the administrative, policy and political level; users; IHO working groups and committees; regional or national SDI initiatives; GSDI; other data providers; marine/maritime organisations.

3. *Basisregistratie Adressen en Gebouwen* (BAG), a base register of addresses and buildings for the Netherlands

3.1 Base registers of the Netherlands

The Netherlands government has established 12 base registers, a central source of vital information about citizens, companies and organizations, and the physical environment. The aim of the registers is to create a single authentic source of reference of such quality that government can use the information in its work without further investigation. The registers are essential for service delivery by the government to its citizens, but also play a role in maintaining public order and safety, in combating fraud and in policy development. The quality of the information in the registers is constantly improved through a self-cleansing approach: should users who are legally obliged to use the register doubt the reliability of information in the register, they may deviate from the information only if they report the concern or error to the source holder.

There are five base registers with a geographical component:

(1) the cadastre (*basisregistratie kadaster*, BRK);

(2) (small scale) topographical information (*basisregistratie topografie,* BRT);

(3) large scale topographical information (*basisregistratie grootschalige topografie*, BGT);

(4) sub-surface geographic information (*basisregistratie ondergrond*, BRO); and

(5) base information about addresses and buildings (*basisregistratie adressen en gebouwen*, BAG*).*

Until 2017, the Ministry of Infrastructure and the Environment (*Ministerie van Infrastructuur en Milieu*) was responsible for the registers. This responsibility was transferred to the Ministry of the Interior and Kingdom Relations *(Ministerie van Binnenlandse Zaken en Koninkrijksrelaties)* in 2017, following a reorganisation of ministries*.*

Figure 1 shows the relationships between the base registers. The responsible ministries and governing bodies are indicated for each register. For example, the BAG has links with the Business Register (*Handelsregister)*, the BRK and the Register of Persons (*Basisregistratie Personen). * Because the Income Register (*Basisregistratie Inkomen)* is linked to the Register of Persons – Resident in NL (*Basisregistratie Personen – ingezetenen),* an address from the BAG may end up being used in the

Income Register (*Basisregistratie Inkomen).*

Shaded base registers are directly linked to the BAG

* In 2017, the responsibility was transferred to the Ministry of Infrastructure and Water Management
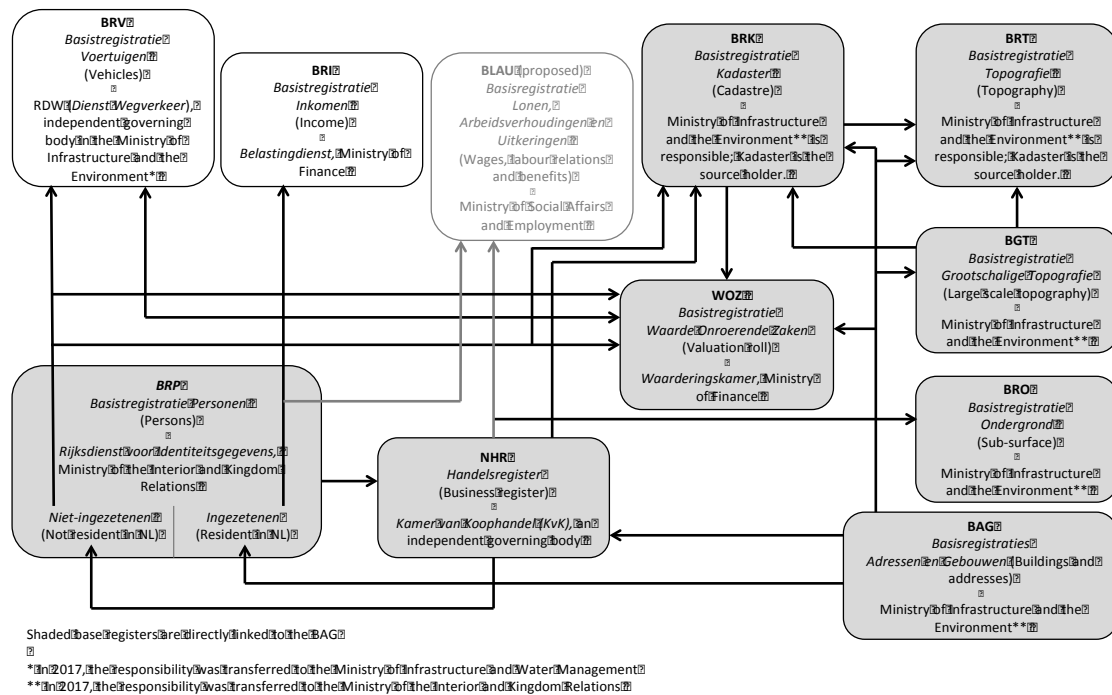** In 2017, the responsibility was transferred to the Ministry of the Interior and Kingdom Relations

Figure 1. Relationships between base registers, adapted from Digitale overheid (2015)

The Ministry sets policies and monitors the implementation of the registers.
The BRK and the BRT are maintained by *Kadaster*. The other registers are
implemented and maintained according to legislation through close cooperation by a
number of government organizations, such as municipalities and various ministries.

The registers containing spatial data are publicly available through a geo-
platform, *Publieke Dienstverlening Op de Kaart* (PDOK), hosted by *Kadaster*. The
platform is a collaboration between *Kadaster, Rijkswaterstaat* and the responsible
ministries.

3.2 The BAG

Since 2009 legislation is in force to regulate the roles and responsibilities of parties
involved in the BAG (Netherlands 2008). Amongst others, the BAG law specifies
quality assurance and privacy protection. Until 2017, the Ministry of Infrastructure

and the Environment administered the law and was responsible for its national implementation. This responsibility was transferred to the Ministry of the Interior and Kingdom Relations in 2017. Municipalities establish and manage the BAG for their areas of jurisdiction. They take responsibility for the collection, capturing and quality of address and building data and contribute this data to the central BAG repository, hosted by *Kadaster. Kadaster* also makes the national dataset available to users.

The BAG is a source of reference for the current state of address and building data. It includes references to the authentic documents with justification for and background of each current address and building, which are kept in the administrations of municipalities. Within four working days after receiving documentation about a decision, a municipality adds the information to its own dataset and records the source documents in the register. One day later, the information has to be submitted to the central BAG repository.

The BAG is governed by the *bronhouders- en afnemersoverleg* (BAG BAO), i.e. the BAG council of source holders and mandatory government users. The BAG BAO has representation from source holders (municipalities), the ministry responsible for the BAG (previously Ministry of Infrastructure and the Environment, now Ministry of the Interior and Kingdom Relations), mandatory government users of the BAG, such as the *Belastingdienst* (BD), *Waarderingskamer* (WOZ), *Rijksdienst voor Identiteitsgegevens* (RvIG), the *Kamer van Koophandel* (KvK) and Statistics Netherlands (CBS). *Kadaster* has representation in its role as host of the central repository, mandatory user and Secretary of the BAG BAO. The system of base registers is represented by the Ministry of Interior Affairs and Kingdom Relations (BZK) and the municipalities are represented by the *Vereniging Nederlandse*

Gemeenten (VNG), an association representing municipalities in the Netherlands. The BAG BAO is responsible for the following:

- Advice to the Minister on policy development and innovation of the BAG;

- Planning of releases and IT services;

- Strategic management based on planning, reporting and evaluation;

- Information management;

- Oversight and maintenance of architecture and standards for the BAG; and

- Advising the Minister and/or the Ministry responsible for the BAG

The BAG BAO Agenda Committee (*Agendaoverleg BAG BAO*) takes care of tactical management:

- Maintains an inventory of wish list items, and prioritizes these;

- Planning the content and schedule of releases;

- Tactical management based on reports about service delivery by *Kadaster*; and

- Any other topics of a tactical nature.

The BAG Users Committee (*Gebruikersoverleg*) discusses practical issues. Its members exchange helpful information and inspire each other, which may lead to BAG change requests or wish list items. The BAG Suppliers Committee is consulted to inform suppliers and to be advised by suppliers.

Apart from service delivery, fraud combating and policy development, BAG data is also used for public order and safety, e.g. by the police, fire brigades and emergency responders; energy providers who use BAG data for asset management; banks, utilities and other organizations with a large customer base who use the BAG data to improve the quality of their customer information; insurance companies who use the BAG data for risk assessments and claims on real estate properties; and other

providers of geographic information who integrate BAG data with their information, e.g. for navigation on handheld devices.

An amendment to the BAG legislation was approved in 2017 and will become effective in 2018. This will assign the responsibility for quality assurance to the municipality; before, this was done by external auditing institutions. Municipalities will have access to a dashboard of monthly quality reports and have to provide an annual self-evaluation report about the quality of their address and building data. *Kadaster* will support the municipalities with monitoring tools and quality management consultants. The legislation was also changed to stipulate guiding principles only; details were removed from the legislation to make adjustments and developments possible.

4. BAG stakeholders

This section is structured according to the three steps in a stakeholder analysis: 1) identifying stakeholders; 2) describing stakeholders; and 3) investigating relationships between stakeholders. The final subsection presents the relative influence of different stakeholders on the BAG.

Information about the BAG and its stakeholders was collected from peer-reviewed scientific literature, documentation (e.g. legislation, project reports) and handbooks that describe BAG processes and BAG implementation (VROM 2018). This information was complemented with semi-structured interviews with representatives of selected stakeholders, namely the Ministry of Infrastructure and Environment (the interviews were conducted when this ministry was responsible for the BAG), *Kadaster*, Geonovum who developed and maintains the BAG standard, VNG and the municipalities of Amsterdam, Den Haag, Eindhoven and Rotterdam. These municipalities were selected because they are among the largest municipalities

in the Netherlands. The semi-structured interviews were conducted in an open-ended fashion and helped to contextualise and understand the information sourced from journals, documentation and legislation. Guiding questions included:

- How is your organization involved in address data and building information in the Netherlands?

- How does your organization contribute to an integrated dataset of addresses and building information at the national level?

4.1 Stakeholder identification

In Table 2, the stakeholders in the BAG governance framework are listed, together with their organizational objectives (sourced from the respective websites). The table reflects stakeholders before the change in responsible ministries in 2017. The implications of this change are discussed in section 5.

Table 2. Organizations and committees involved in the BAG governance framework

Stakeholder	Objectives
Ministry of Defence (MoD)	Contributes to peace, freedom and security in the world by protecting the Netherlands, its economic interests and befriended countries, and by providing support during disasters.
Ministry of Infrastructure and the Environment (MIandE)	To create a liveable, accessible and secure Netherlands by providing a road, rail, water and air transportation infrastructure in a safe and clean environment that is protected against disasters.
Kadaster, Ministry of Infrastructure and the Environment	*Kadaster* collects and registers administrative and spatial data on property, including ships, aircraft and telecom networks, and the rights involved. It is also responsible for national mapping and maintenance of the national reference coordinate system, and acts as advisory body for land-use issues and national spatial data infrastructures. Main customer groups include civil-law notaries, local authorities, businesses, financial institutions and private individuals. *Kadaster* performs its public tasks in service of society. This is reflected in the way they are organised and publicly account for how they work.
Ministry of the Interior and Kingdom Relations (MIAandKR)	Safeguards the core values of democracy; aims to achieve effective public administration and public authorities that the public can trust.
Rijksdienst voor Identiteitsgegevens (RvIG) (National authority for identity information), Ministry of the	To maintain and exchange personal data and to manage travel documents for the Netherlands.

Stakeholder	Objectives
Interior and Kingdom Relations	
Ministry of Economic Affairs and Climate Policy (MEA)	Promotes the Netherlands as a country of enterprise with a strong international competitive position and an eye for sustainability; committed to creating an entrepreneurial business climate, e.g. by encouraging cooperation between research institutes and businesses.
Ministry of Finance (MF)	To guard the national treasury and work towards ensuring the Netherlands is financially healthy and prosperous.
Kamer van Koophandel (KvK) (Chamber of Commerce), Ministry of Finance	To provide business information, advice and support to entrepreneurs by registering, informing and advising entrepreneurs.
Waarderingskamer (WD) (Valuation Chamber), Ministry of Finance	To provide reliable and quality valuations of real estate at socially acceptable costs.
Belastingdienst (BD) (Tax Authority), Ministry of Finance	Responsible for customs and tax collection in the Netherlands.
Centraal Bureau voor de Statistiek (CBS), also known as Statistics Netherlands.	To publish reliable and coherent statistical information which responds to the needs of Dutch society.
Geonovum, governmental foundation	To make geoinformation of the public sector accessible through development of standards and assistance to government for improving its use of geographic information.
National Police	Safety and security in the Netherlands.
PostNL	Mail and parcel delivery in the Netherlands.
Municipalities (388 in 2017, at the time of writing)	Municipalities are responsible for the delivery of a wide variety of services, including spatial planning, public housing, transport, environmental management, education and some social services (Figee, Eigeman and Hilterman 2008).
Vereniging van Nederlandse Gemeenten (VNG) (Association of municipalities in the Netherlands)	The Association of Municipalities of Netherlands supports local municipalities with the development of local policies based on national policies; supports them with the implementation of these; and represents and promotes the interests of municipalities.
BAG BAO Committee – coordinated by *Kadaster*	Committee for BAG governance and strategic management, i.e. policy development, planning, coordination and management of the infrastructure.
BAG BAO Agenda Committee – coordinated by *Kadaster*	Committee for the tactical management of the BAG, and advises the BAG BAO on operational matters.
BAG Users Committee – coordinated by *Kadaster*	Committee for knowledge exchange and for discussing practical issues related to the BAG. Four meetings per year. Regular user surveys (every 2-3 years) are conducted to gather feedback from which wish lists are compiled. These are complemented by feedback from the BAG helpdesk.
BAG Suppliers Committee (*Leveranciersoverleg*) – coordinated by *Kadaster*	Committee of representatives of private sector companies who supply municipalities with software solutions that implement the BAG legislative provisions.

A number of organizations are not directly involved in the BAG governance, or their involvement will seize or may start in the future. They are therefore not included in the above list. For example, the *Dienst Wegverkeer* (Road Traffic Authority) is an independent governing body with an implementing role, amongst others, for the licensing of vehicles. It implements another base register (BRV), which is indirectly linked to the BAG via the BRP. Also, under current legislation, the BAG auditing institutions have to conduct BAG quality controls on behalf of the Ministry. With the new legislation (and already in practice), this role is replaced by more frequent data quality checks by *Kadaster* when data is submitted to the BAG. Further, a register for wages, labour relations and benefits has been proposed to be maintained by the Ministry of Social Affairs and Employment. If implemented, this will be indirectly linked to the BAG via the NHR and the BRP. Finally, additional BAG stakeholders, such as utility companies, private sector representatives (e.g. GeoBusinessNL), universities and emergency responders (e.g. ambulance, fire fighters), are not assigned a specific role in the BAG governance framework, but they are represented and have a 'voice' through the respective Committees for users and suppliers.

Additionally, a number of other organizations are not directly involved in the BAG, but of strategic and tactical relevance to the BAG. These include the INSPIRE committee, the committee responsible for the Dutch standard for a base model for geographic information (NEN 3610, *Basismodel Geo-informatie - Termen, definities, relaties en algemene regels voor de uitwisseling van informatie over aan het aardoppervlak gerelateerde ruimtelijke objecten*), VNG *Realisatie* (formerly known as *Kwaliteitsinstituut Nederlandse Gemeenten* (KING)) (Local Government Quality Institute) and committees related to the system of base registers.

4.2 Stakeholder description

In Table 3, the interests, rights, ownerships and responsibilities of the different BAG stakeholders are described. The second column indicates the stakeholder's interest in the *national* dataset, namely as *provider* of local data (source holder), as *facilitator* of the national dataset, as source holder of a *related* register, or as a *user-only* stakeholder (most providers and facilitators are also users).

Table 3. Stakeholder interests, rights, ownerships and responsibilities in the BAG

Stakeholder	Interest	Other interests, rights, ownerships and responsibilities
MoD	Facilitator	Have to prevent that objects of military strategic importance are included in the BAG (explicitly mentioned in the BAG legislation).
MIandE	Facilitator	Responsible for the BAG and its governance; includes development of legislation and policies. Appoints BAG auditing institutions. Responsible for four other base registers (BRK, BRT, BRO, BGT), all of them directly related to the BAG. Collaboration with and WD on certain aspects of WOZ and BAG, also with RvIG on BRP and KvK on NHR.
Kadaster	Facilitator	Executive organisation for the BAG and also for three other base registers (BRK, BRT, BGT), all of them directly related to BAG. As such, hosts and maintains the national registers. Serve as front office for BAG. Responsible for communication between the BAG BAO, BAG BAO Agenda Committee, BAG Users Committee and BAG BAO Suppliers Committee. Collaboration with MIandE and WD on certain aspects of WOZ and BAG.
MIAandKR	Facilitator	Responsible for another base register (BRP), directly related to BAG. System responsibility for the entire system of base registers.
RvIG	Related	Executive organisation for another base register (BRP), directly related to BAG.
MEA	Related	Responsible for another base register (NHR), directly related to BAG.
MF	Related	Responsible for two other base registers (WOZ, BRI).
KvK	Related	Executive organisation for another base register (NHR), directly related to BAG.
WD	Facilitator	Executive organisation for another base register (WOZ), directly linked to the BAG. Important user of BAG data for the valuation roll. Collaboration with MIandE and *Kadaster* on certain aspects of WOZ and BAG.
BD	Related	Executive organisation for another base register (BRI), linked to the BAG via the BRP. Important user of BAG data for tax collection purposes.
CBS	User-only	Important user of BAG data, e.g. for household surveys and Census.

Stakeholder	Interest	Other interests, rights, ownerships and responsibilities
Geonovum	Facilitator	Facilitates the development of BAG standards.
National Police	User-only	Important user of BAG data for public safety purposes.
PostNL	Provider	Supplies the postcode, one of the components of an address in BAG. Postcodes are added to BAG by municipalities.
Municipalities	Provider	Manage, maintain and provide the address and building information in compliance with the BAG legislation.
VNG	Facilitator	Represents the municipalities' interests.
BAG BAO Committee	Facilitator	BAG governance and strategic management
BAG BAO Agenda Committee	Facilitator	Tactical management of BAG.
BAG Users Committee	User-only	Consultation platform for important users, such as the municipalities, BD, CBS, National Police, and other organizations in the public safety sector.
BAG Suppliers Committee	Facilitator	Consultation platform to inform suppliers and to be advised by suppliers (no decision-making).

To further describe the stakeholders, the roles below were identified for BAG stakeholders. Table 4 shows which roles a stakeholder fulfils in BAG.

- Stakeholders who *set the framework* for the BAG, e.g. through legislation, policies and standards.
- Stakeholders who *govern the BAG*, e.g. through long-term strategic management of processes and quality based on reports, monitoring and evaluations, and trough short-term tactical management of service delivery.
- Stakeholders who (have to) provide *funding* for the BAG.
- Stakeholders who *implement and/or host* BAG data and services, e.g. for BAG maintenance and for making BAG data available.
- Stakeholders who *support* the BAG initiative, e.g. by providing training, through awareness and marketing.
- Stakeholders who *create and maintain* data in the BAG.
- Stakeholders who *manage the quality* of data in the BAG.
- Stakeholders who *use* (read and query) data from the BAG.
- Stakeholders who *influence opinions and perceptions* of the BAG, e.g. media, politicians, citizen organizations (lobbying).

Table 4. Stakeholders and their roles in BAG

Stakeholder	Roles in BAG								
	Set Framework	Govern	Provide funding	Implement and host	Support	Create and maintain	Manage* quality	Use*	Influence opinions
MoD									
MIandE	X		X		X		X	X	
Kadaster		X		X (national)			X	X	
MIAandKR					X			X	
RvIG								X	
MEA								X	
MF								X	
KvK								X	
WD								X	
BD								X	
CBS								X	
Geonovum	X							X	
National Police								X	
PostNL						X**			
Municipalities		X	X	X (local)	X	X	X	X	
VNG					X				X
BAG BAO Committee	X	X					X		
BAG BAO Agenda Committee		X					X		
BAG Users Committee			X***				X	X	X
BAG Suppliers Committee				X	X		X		X

*All users influence the quality because they have to report any errors found in the BAG.
** PostNL supplies post codes to municipalities, but the municipalities register them in the BAG.
*** The BAG is freely available; there is a small income stream from the provision costs for certain products.

Table 5 shows which stakeholders affect decision-making in the BAG governance framework, namely those involved in BAG BAO (strategic advice and decisions) and the BAG BAO Agenda (tactical advice and decisions). The other stakeholders are affected by decision-making. The information in this table reflects the membership of respective Committees as specified in the BAG legislation. However, it does happen that a stakeholder does not have a representative appointed

on the Committee for a period of time. In practice the stakeholder then forfeits its representation on the Committee. It also happens that appointed representatives do not attend meetings and therefore cannot influence decision-making. Because this is a stakeholder analysis of the governance framework (not its realization), these latter conditions were not considered in the stakeholder analysis.

Table 5. Stakeholder involvement in BAG decision-making

Committee / Stakeholder	BAG BAO	BAG BAO Agenda Committee	BAG Users Committee	BAG Suppliers Committee
MoD	-	-		
MIandE	1 Member	1 Member		
Kadaster	4 Members, one is the Secretary	4 Members, one is the Secretary	Coordinator	Coordinator
MIAandKR	1 Member	1 Member		
RvIG	1 Member	1 Member		
MEA	-	1 Member		
MF	-	-		
KvK	1 Member	1 Member		
WD	1 Member	1 Member	Member	
BD	1 Member	1 Member	Member	
CBS	1 Member	1 Member	Member	
Geonovum	-	1 Member		
National Police	-	1 Member	Member	
PostNL	-	-	Member	
Municipalities	Represented via VNG*	Represented via VNG*	See VNG	
VNG	2 Members, one is the Chair	6 Members, on is the Chair		
Users**			Member	
Suppliers**				Member

* Some of the VNG members on the respective Committees are municipal representatives.
** The users and suppliers on these Committees vary over time.

4.3 Stakeholder relationships

Figure 2 shows how stakeholders are connected to each other in the BAG governance framework. Relationships are weighted and directed (i.e. from source to origin). For example, the governance and strategic management relationship is from the BAG BAO to the BAG and carries a weight of 5. Weights were assigned based on the strength of the relationship, e.g. Chair and Secretariat relationships carry more weight

than normal membership. Table 6 shows the weights assigned to different kinds of

relationships.

Table 6. Stakeholder involvement in BAG decision-making

Type of relationship	Weight
Secretariat of BAG BAO	5
Chair of BAG BAO	5
Strategic management and governance of BAG	5
Tactical management of BAG	5
Responsible for BAG	5
System responsibility for BAG (and other registers)	5
Direct link to BAG	4
Member of BAG BAO	4
Member of the BAG BAO Agenda Committee	3
Member of the BAG Users Committee	2
Member of the BAG Suppliers Committee	2
Any other relationship between stakeholders	1
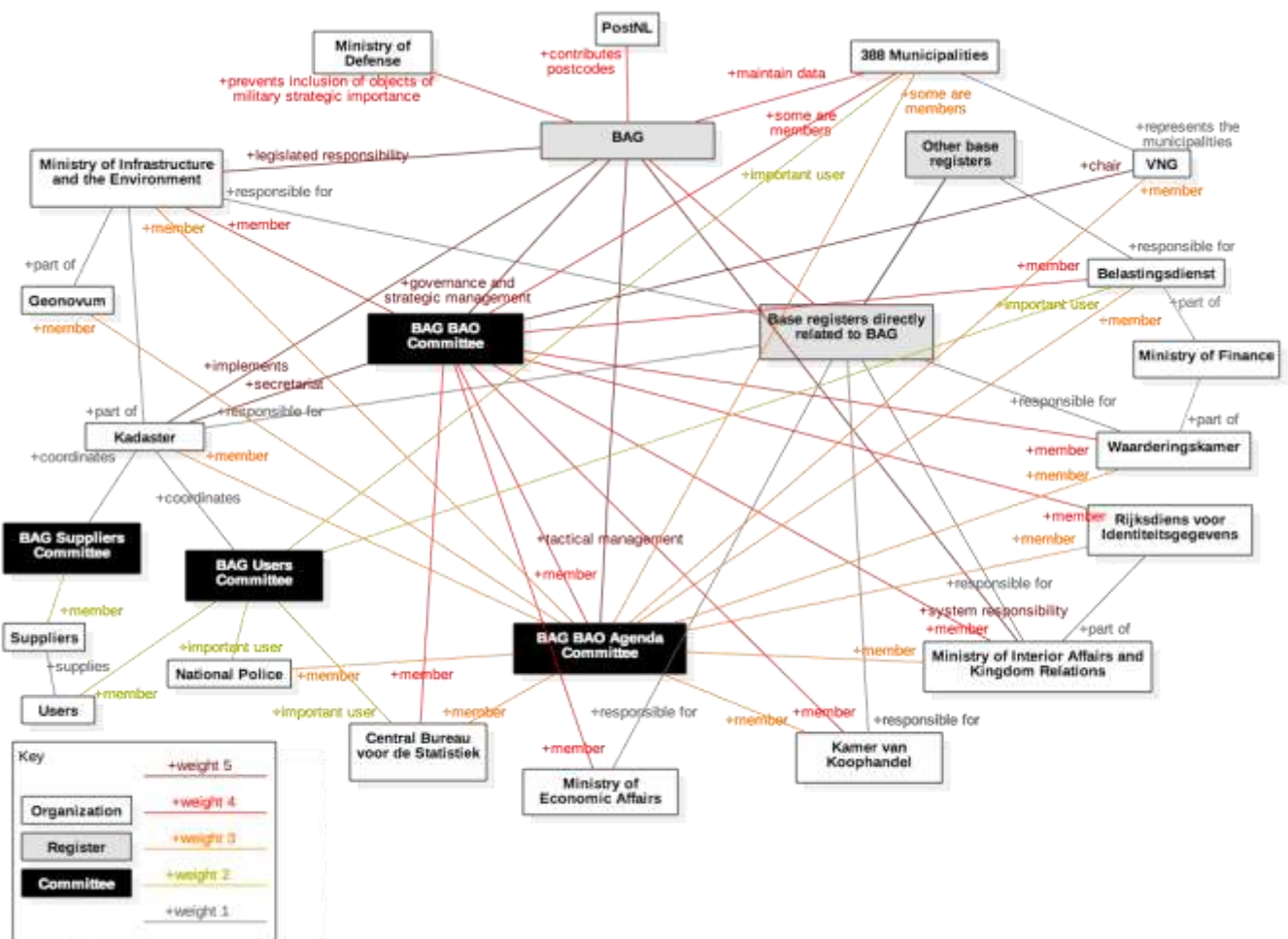
Figure 2. Stakeholder relationship network in the BAG governance framework

4.4 Relative influence of stakeholders

The relative influence of each stakeholder was evaluated as follows based on the

power, proximity and urgency of each stakeholder in the BAG stakeholder

relationship network:

- *Power to influence the BAG*: Weighted sum of edges *from* the stakeholder *to*

  others in the network. For example, there are two edges from Geonovum to

  other nodes in the network with weights of 1 and 3 respectively, i.e.

  Geonovum's power value is 4.

- *Proximity to the BAG*: Weighted shortest distance from stakeholder to the BAG in the network. For example, the shortest distance from Geonovum to the BAG is through the MIandE. The sum of weights along this route is 1+5=6, i.e. Geonovum's proximity value is 6.

- *BAG urgency*: A value was assigned based on stakeholder descriptions, ranging from *high* (prepared to take immediate action, irrespective of other commitments) to *low* (there is little need for action outside routine activities). See Table 7. To determine relative urgency, values were quantified as high=10, intermediate=5 and low=0.

Table 7. BAG urgency values of stakeholders

Stakeholder	BAG Urgency
MoD	Low
MIandE	High
Kadaster	High
MIAandKR	Intermediate
RvIG	Intermediate
MEA	Low
MF	Low
KvK	Intermediate
WD	Intermediate
BD	Intermediate
CBS	Intermediate
Geonovum	Low
National Police	Intermediate
PostNL	Low
Municipalities	High
VNG	High
BAG BAO	High
BAG BAO Agenda Committee	High
BAG Users Committee	Intermediate
BAG Suppliers Committee	Low
Users	Intermediate
Suppliers	Low
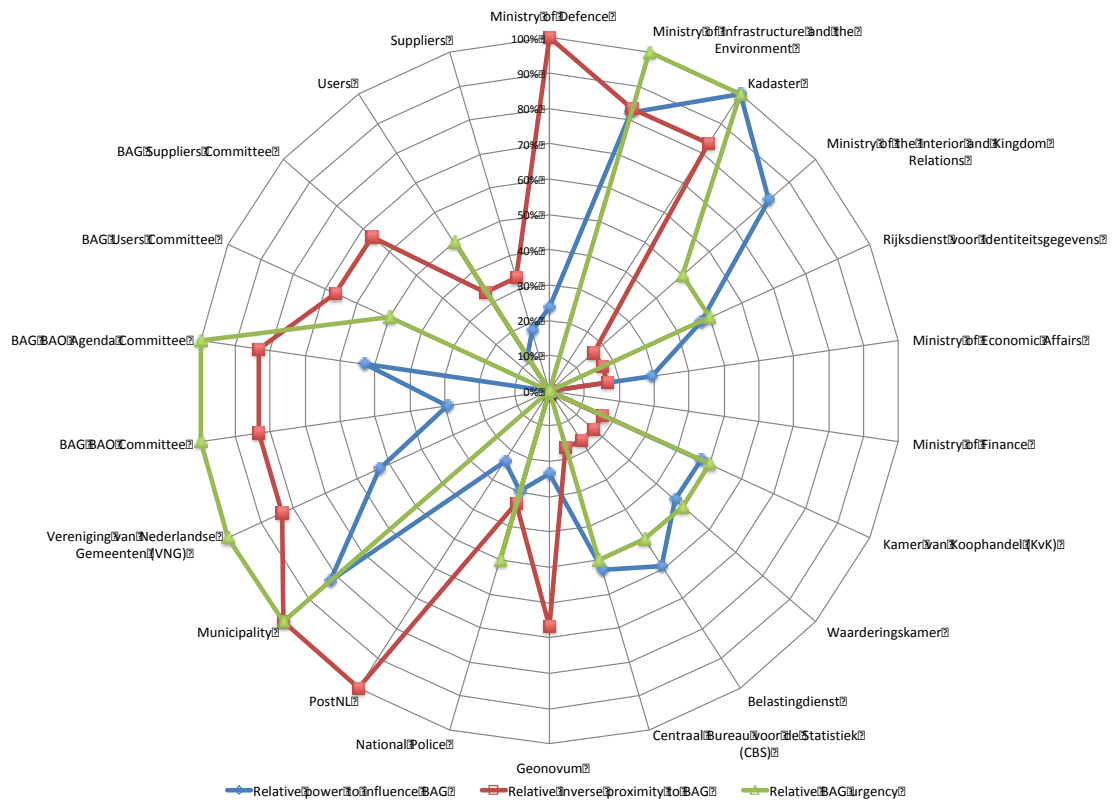
Figure 3. Relative power to influence the BAG, proximity to the BAG and BAG urgency of stakeholders in the BAG governance framework

The relative power to influence BAG, proximity to BAG and BAG urgency of stakeholders are illustrated in Figure 3. To simplify the comparison between the three variables, the inverse of proximity is displayed so that low proximity is represented by high percentages. The graph reveals that *Kadaster* is the most influential stakeholder in the BAG governance framework. *Kadaster* is the only stakeholder with a facilitating interest in the national dataset that has more relative power to influence the BAG than the providers of local data (Municipalities, PostNL). Two other facilitators (MIandE, MIAnadKR) have the same relative power to influence as the municipalities. The latter are collectively considered as a single stakeholder in the analysis, but in practice they sometimes have more than one seat on a Committee and their relative influence is likely to be higher than the values in Figure 3 suggest.

Individual BAG users and suppliers have the least power to influence decision-making in the BAG governance framework. However, their influence is not entirely negligible as the graph may suggest. Through regular user surveys and coordination with the BAG Users and BAG Suppliers Committees, their input is channelled via *Kadaster* to the respective committees were strategic and tactical decisions are taken. Additionally, users influence the BAG through the *Kadaster's* help desk, which is contacted by about 700 users each month, half of these from municipalities. Frequent and recurring help desk issues and requests are also channelled to the respective committees.In Figure 4, the relative importance of a stakeholder is represented by the average of the three relative values (influence, proximity and urgency presented in Figure 3), showing that *Kadaster* and municipalities (94%) have the highest relative importance. The high values can be explained by *Kadaster's* responsibilities in many aspects of the BAG implementation and coordination; Municipalities are important because they create and maintain the local data and interact (in close proximity) with the BAG on a daily basis.
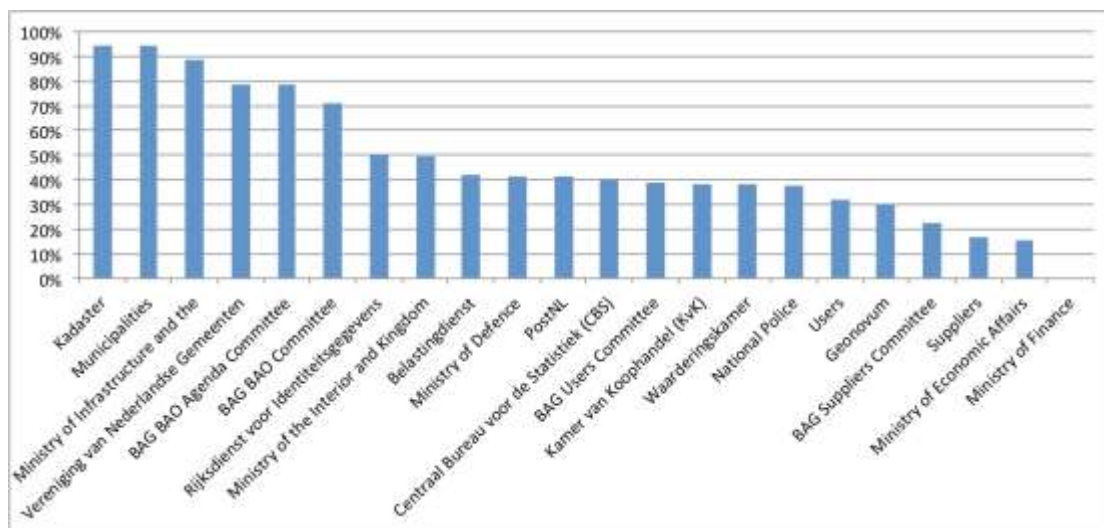

Figure 4. Relative importance of stakeholders in the BAG governance framework

5. Discussion

A stakeholder analysis is useful for revealing the intentions, interrelations, agendas, interests and influences of respective stakeholders, so that strategies for managing stakeholders can be developed, the implementation of decisions or objectives can be facilitated or the feasibility of future directions can be assessed (Brugha and Varvasovszky 2000). The results of the stakeholder analysis in this paper show that municipalities provide local data are in close proximity to the BAG and are prepared to take immediate action if things go wrong, yet they have less power than facilitating stakeholders to influence how their work on the BAG is done. This may lead to unhappiness among stakeholders providing local data, because they could feel that they have to use their resources to meet the objectives of other stakeholders. This sentiment was reflected in some of the semi-structured interviews, and is also echoed in a report on stakeholder engagement regarding a national address point database conducted in the USA (NGSIC 2014). To avoid such sentiments escalating, a number of measures have been implemented in the Netherlands to support municipalities with their BAG responsibilities, including a dedicated implementation campaign, the BAG help desk and the BAG quality dashboard.

When implementing SDIs, the question is often raised whether one should follow the carrot, the stick or the preach approach (Winsemius 1986). Should compliance be rewarded (carrot approach), should non-compliance be punished (stick approach), should benefits of compliance be explained (preach approach)? In the first years after the BAG legislation was enforced, there was little encouragement for municipalities to contribute data to the BAG, apart from the BAG legislation itself. The responsible Ministry realized that some intervention was needed. Therefore, it conducted a dedicated three-year campaign to assist municipalities with their

implementations of the BAG. A team of account managers paid regular visits to municipalities who were in the process of implementing the BAG. They offered advice and guidance, and also built up pressure by signing contracts and monitoring administrative meetings. The campaign led to compliance regarding data contributions to the national BAG dataset by all municipalities at the end of the campaign in 2011.

The same issue is currently debated for the expansion of the BAG to include 3D information. There are three options:

(1) 3D information is optional in the BAG and municipalities can decide whether they want to maintain 3D information for buildings (which can be supported by an initial automated filling of the z-attribute using point clouds);

(2) 3D information is mandatory in the BAG and municipalities are legally forced to maintain this information.

(3) a national governmental organisation (e.g. *Kadaster*) adds and maintains the 3D information for buildings (and roof shapes) in the BAG.

The second option is not very likely given the response by many municipalities to the legally enforced 2D BAG ("we have to pay for something that is mainly of interest to the national government"). Others, mainly organisations with an interest in 3D information, e.g. big cities, consider legal enforcement the only way to realise a national 3D BAG

A next (and ongoing) challenge is the quality of the data in the BAG. Here also, it is difficult to follow through with a stick approach. If a small municipality does not have the resources to comply with BAG provisions, no amount of punishment for non-compliance will change anything about that (on the contrary).

The newly introduced quality management, with quality dashboards and an annual

self assessment by each municipality are aimed at supporting municipalities with

managing and improving the quality of their BAG data. The dashboard monitors the

quality of BAG data as soon as it is contributed to the BAG. In the past, static audits

by external auditors were conducted every three years. According to Huisman-Van

Zijp (2018), this quality management initiative has encouraged municipalities to

improve the quality of their BAG data.

The BAG BAO has approved very few changes since the BAG standard was

first published in 2009, because stability and backward compatibility are very

important for the users and all the value chains in which the BAG is used.

Additionally, the realities of smaller municipalities with fewer resources serve as a

natural counter-balance to any changes to the BAG. The legislation is not specific

about how the balance between local and national objectives should be maintained. It

is the responsibility of the BAG BAO Committee to ensure that its decisions, as well

as information and advice to the ministry, maintain balance between user requests and

wish lists (and source holders) and the amount of work for the local data providers.

Local SDIs are important building blocks for national SDIs (Rajabifard et al.

2006), but the stakeholders in local SDIs may seek different benefits than the

stakeholders in a national SDI (Rowley 2011). Stakeholders with an interest in the

local dataset, such as municipalities, benefit from the BAG because it is a standard.

Standards describe good (or best) practice, and the smaller municipalities can benefit

from following the tried and proven practices represented in the standard. A vendor

can sell source holder products based on the BAG standard to more than one

municipality. Similarly, vendors can sell BAG-based products and services for any

region of interest in the country. This should lower the selling price of the products. In

theory, standards make it easier to switch from one vendor to another. In practice, this is often more complicated.

Stakeholders with an interest in the national dataset benefit from the BAG because it delivers a single harmonised and authoritative dataset with national coverage. The integration, harmonisation and quality management is done for them (at no cost) and they are assured of an up-to-date dataset distributed according to the BAG standard. This allows them to integrate address and building information into their tools and processes without having to spend time and resources on collecting and managing the information. The stakeholder analysis in this paper did not venture into understanding the extent to which benefits are actually realized by the different stakeholders. Such information would help to assess the balance between local and national interests, and could inform future BAG revisions.

Until 2017, the Ministry of Infrastructure and the Environment (*Ministerie van Infrastructuur en Milieu*) was responsible for the registers. Due to the results of the national elections 2017, the Ministry was abolished and the responsibility for the registers was transferred to the Ministry of the Interior and Kingdom Relations *(Ministerie van Binnenlandse Zaken en Koninkrijksrelaties). Kadaster* was also moved to Ministry of the Interior and Kingdom Relations. Since the organizational objectives of the two ministries differ, it remains to be seen if and how this will affect the BAG governance framework.

6. Conclusion

In this paper, we identified and described the stakeholders in the BAG governance framework. Relationships between stakeholders were mapped and weighted in order to assess the relative importance of stakeholders on the BAG. Results show that *Kadaster* and the municipalities have the highest relative importance in the BAG.

Similar to other studies (Rajabifard et al. 2006; Harvey and Tulloch 2006), the results of this stakeholder analysis show that national datasets are often established through a collective effort of many stakeholders. The multitude of stakeholders involved in the BAG governance framework confirms that address and building information is relevant in a wide range of applications.

The lesson to be learnt for other national SDI datasets is that a delicate balance is required between the carrot and the stick approach; additionally, one also has to assist with clearing the way to the carrot (the preach approach). Without an intervention, such as a dedicated campaign, it is highly unlikely that providers of local data will bring up the energy and resources to implement something that has only indirect or longer-term benefits for them. Additionally, it may be necessary to build capacity at the smaller municipalities before any implementation can take place (NGSIC 2014). These lessons also suggest challenges to be encountered when integrating global datasets from national datasets, which is one of the aims of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM).

Our study reveals the challenges of setting up a governance framework that maintains the delicate balance between the interests of all stakeholders. The Dutch base registers may well be the result of a Dutch governance culture in which local and national governments frequently work together and are therefore used to cooperation based on trust and mutual support. Cooperation of this nature endures an open discussion that can lead to decisions that balance all stakeholder interests.

This study considered stakeholder relationships specified in the BAG legislation. Informal relationships between stakeholders (or their employees) were not

considered. A study of these informal relationships would provide further insight into the BAG context and assist with managing and planning of the BAG.

Further work could investigate in more detail whether stakeholders are actually reaping the benefits of implementing and using the BAG. The information would be useful to further assess the balance between local and national interests. A positive outcome could provide additional motivation for municipalities to maintain and improve their BAG data, and may make them more open and susceptible to BAG enhancements.

This research contributes to the current gap in literature about local SDIs and contributes to the important discourse on addresses and the management of address data, which are relevant and important in an increasingly urbanized world. The results can guide other countries embarking on the integration of national SDI datasets from local ones, as well as global initiatives with the objective of establishing a virtual representation of Earth through the integration of national datasets. Similar studies on stakeholders and governance frameworks for global datasets would be topical, given the current stage of work at the UN-GGIM on global fundamental geospatial data themes.

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