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# Understanding Governance Dynamics: The Governing System of Spatial Data Infrastructures*

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## Abstract

The importance and influence of spatial data has risen in all kinds of governmental and non-governmental processes, giving Spatial Data Infrastructures (SDIs) a key role in spatial data sharing and dissemination. SDIs are nowadays challenged by new technologies and user demands. Proper SDI governance seems essential, but it is a question to which extent current SDI governing systems are fully equipped to deal with the dynamics and complexity of Spatial Data Infrastructures. This research proposes a governing system framework for analysing the governing system of SDIs, adapted from the concepts of Kooiman. This framework is applied on two Dutch SDI cases: the Risk Map and the New Map of the Netherlands. With the help of the framework, more insights on the strong and weak aspects on the governing system of SDIs become apparent and insights emerge on which interactions, images, instruments, actions and structures enable or constrain SDI governance. By comparing governing systems over time, the changes and dynamics of it become visible. The governing system framework brings a new perspective to SDIs and SDI theory and is a potentially useful analytical tool for SDI governors.

**Keywords:** Spatial Data Infrastructure (SDI), governance, governing system



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## 1. INTRODUCTION

In recent years, governments, companies and NGOs professionalised their spatial data management by introducing a Spatial Data Infrastructure (SDI). Spatial data, also called geo-information, has become a 'critical component' providing understanding about what happens where. By integrating spatial data with (governmental) services, it contributes to '*economic growth, national security, sustainable social development, environmental sustainability and national prosperity'* (UN-GGIM 2018, p.4). In many instances, an SDI is implemented to facilitate efficient spatial data sharing between organisations in order to diminish data duplication and fragmentation of spatial information.

In the past, '*the principal objective of developing an SDI is to provide an appropriate environment in which all stakeholders, both users and producers, of spatial information can cooperate with each other in a cost-efficient and cost-effective way to better achieve their targets* (Rajabifard et al. 2002, p.13).' Later on, this objective shifted from cost-reduction to benefit increasing, by focusing more on the user and its needs (Rajabifard et al. 2003). With the rise of the internet and influence of the 'open government' paradigm, many governmental SDIs opened up and are not only focused on increasing benefits for their own organisation, but also for the society as a whole.

Open spatial data has resulted in a growth in the use of spatial data (Hansen et al. 2013), but it also put pressure on data business models (Welle Donker 2009) and resulted in a continuously growing group of SDI stakeholders (Vancauwenberghe and van Loenen 2017), with various needs and interests (Coetzee et al. 2018). SDIs are constantly challenged by new technologies and user demands. This is partly due to the complex, multi-stakeholders, multi-level, technical and open nature of SDIs. SDIs should therefore not be seen as stationary, but as complex adaptive systems that adapt and evolve over time (Grus et al. 2010, Sjoukema et al. 2017). A proper SDI governing system which enables SDI governance processes and navigates SDI development into the desired direction, appears essential, but it is a question to which extent current SDI governing systems are fully equipped to deal with the dynamics and complexity of Spatial Data Infrastructures.

In this paper, we will propose a framework for analysing the governing system of SDIs and its dynamics, so that we can understand the key processes that enable or constrain adaptive SDI governance. By applying the framework on two SDI cases, we can also evaluate the strong and weak points of this framework. First

we will conceptualize what we mean with ‘governance’ and the ‘governing system’ in this paper.

## 2. GOVERNANCE AND THE GOVERNING SYSTEM

### 2.1. Governance

The word ‘governance’ has many definitions and meanings. To distinguish the multiple governance concepts from each other, adjectives are added such as ‘good’ governance, ‘network’ governance (Rhodes 1996), ‘corporate’ governance (Kersbergen and Waarden 2004), ‘collaborative’ governance (Ansell and Gash 2008), ‘adaptive’ governance (Dietz et al. 2003), ‘fit-for-purpose’ governance (Rijke et al. 2012), ‘interactive’ governance (Kooiman 2003) and many more. Theories on governance are still an ever-expanding universe, which does not make it an easy subject to grasp.

Because of this large spread of governance definitions and ideas, we would like to explain the governance perspective we use in this research. Not to state that we have *the* governance definition, but to understand the governance lens we use to study SDIs in this research. Our perspective is a holistic one, in which we refer to governance as the governing process in which multiple actors (both public and private) can influence this process through interactions. Interactions are a key element in governance: *‘interactions shape actors and actors shape interactions’* (Kooiman 2003, p. 8).

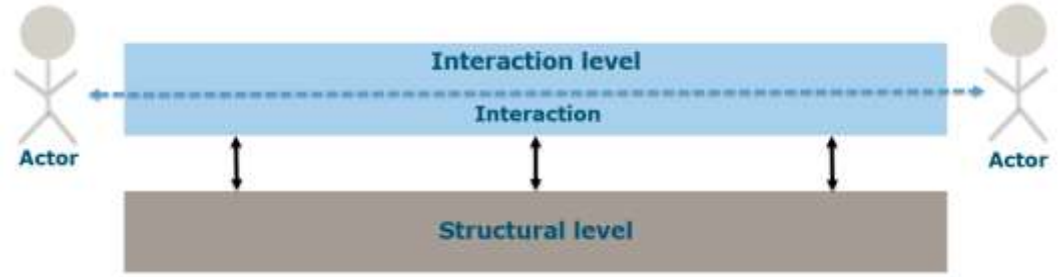
Structures or institutions will enable or constrain the governing process, ensuring that ‘things don’t fall apart’ (Giddens 1984, Kooiman 2003). Structures can be formal rules (e.g. laws, organisations, contracts, standards), but also informal (e.g. culture, norms and values). Structures have a dual nature: They shape action and are seen as stable in the short term, beyond control of one actor. However in the long term, structures are changeable and shaped by the actions of the interacting actors (Giddens 1984, Kooiman 2003, Sewell 1992).

Because structures influence governance interactions, a distinction is made between an ‘action’ or ‘intentional’ level where the day by day interaction between actors is happening and a ‘structural’ or ‘institutional’ level, where rules and resources enable and constrain the (inter)action level (figure 1) (Kooiman 2003).

‘Governance’ theories originated from insights about networks (Klijn 2008, Rhodes 1996), but we are also aware that these theories about governance networks did not replace older governing theories such as Weberian bureaucracies or the market-driven ideas from New Public Management, but

added an extra layer (Pollitt and Bouckaert 2011). Therefore, we try not to put boundaries around governance, but we see top-down or hierarchical interactions, horizontal, network or collaborative interactions and bottom-up or self-organizing interactions all play an important role in the whole governance process.

**Figure 1: Relation between the (inter)action level of governance, where actors interact and the structural level, which enables and constrains the interaction level.**




**Source: Adapted from (Kooiman 2003)**

## 2.2. Governance and SDI dynamics

Several scholars who tried to summarize and find parallels between the multiple governance forms (e.g. Kersbergen and Waarden 2004, Pollitt and Bouckaert 2011, Rhodes 1996) conclude that governance is shifting. Since the 90s, more and more authors describe a rise of network-oriented approaches in governing, besides hierarchal and market-driven forms. These networks are largely self-organizing (Rhodes 1996), posing challenges for 'classical' governing: '*traditional institutions of checks and balances on power and accountability could become obsolete, or at the very least less effective* (Kersbergen and Waarden 2004, p.155),*'* note Kersbergen & Van der Waarden (2004) regarding this shift. '*Governance as self-organizing networks is a challenge to governability because the networks become autonomous and resist central guidance* (Rhodes 1996, p. 667).'

Interestingly, the opposite development, from self-organizing networks towards more central guidance, is witnessed within in the SDI domain in both the Netherlands, Flanders (Belgium) (Sjoukema et al. 2017), the United States (Lance et al. 2009) and Australia (Masser et al. 2008). Spatial data infrastructures which originated from network initiatives in the early 90s (Masser 1999) were actually striving for more hierarchical influences later on, such as central coordination, laws and policies in order to gain legitimacy (Lance et al. 2009, Sjoukema et al. 2017). The reason could be that SDIs are relatively young infrastructures with not yet fully developed institutions (De Man 2006), where for

example Rhodes evaluates a shift within the long-established British government (Rhodes 1996). This maturing of SDI governance makes it an interesting subject to analyse how governing systems change.

As we see SDIs as complex adaptive systems (CAS) (Grus et al. 2010), it is questionable if there is an optimal generic governing system for SDIs. Or alternatively, it '*is the question of whether it is at all possible to govern the messy and unpredictable nature of CAS* (Duit and Galaz 2008, p. 329)*.'* As every SDI will have a different governing system and context due to its complexity, path-dependency and openness, every SDI maybe also need a different governing system. However, we can evaluate the governing system over time, compare the differences and analyse what works well and what does not.

A key feature of complex adaptive systems is their unpredictability and non-linearity. These features are also present in governance (Duit and Galaz 2008, Kooiman 2003, Kooiman and Bavinck 2013, Rijke et al. 2012). Periods of incremental change can be followed by fast and sudden change with irreversible and major consequences, due to threshold and cascading effects (Duit and Galaz 2008). Teisman (Teisman 2000) and Klijn & Koppenjan (Klijn 2008) call these tipping points in governing processes 'crucial decisions'. A crucial decision is identifiable when ideally the composition of the actors, the course of interactions and the content of the governance process dramatically change (Klijn 2008).

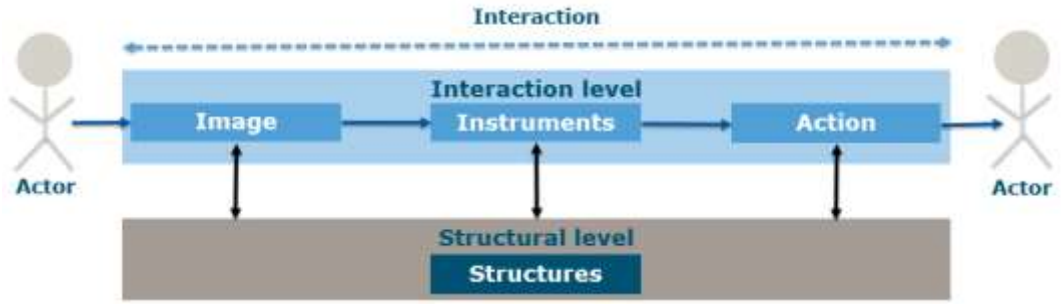
### 2.3. The Governing System

In this research we use the conceptualisations of the governing system by Kooiman (Kooiman 2003). We have several reasons to use these theoretical concepts. Kooiman is one of the few governance scholars who uses a system perspective on governance. This perspective, which has been categorized as the socio-cybernetic approach (Rhodes 1996), helps to provide an overview on governance, its relations and interactions, where many other scholars only focus on partial aspects of governance. As this approach also acknowledges the influence of complexity, diversity and dynamics on governance, these theories are a good fit for studying governance of complex adaptive systems such as SDIs (Kooiman and Bavinck 2013). His theories even explain changes in governance paradigms itself (meta-governance) (Kooiman 2003). As we earlier explained, governance paradigms such as New Public Management and Open Government have had an impact on the goals and development of SDIs (Sjoukema et al. 2017).

However, we are also aware that this highly dynamic system perspective has an downside as it is either too abstract or too difficult and too much encompassing to operationalize on a more detailed level. Nevertheless, as we witness SDI governors in practice struggling with gaining an overview on governance processes, we think it is an insightful analytical framework to use on SDIs. Furthermore, to scope our research we focus mainly on the conceptualisations of the governing system and adapt and apply it on SDIs to make it less abstract.

The governing system can be broken down into four elements: images, instruments, action and structures (figure 2). All governing action starts with a perceived problem, an image. Problems are not objective: '*they are social constructions; perception of actors on what makes a situation problematic* (Klijn and Koppenjan 2016, p.45).' Because every actor is autonomous yet interdependent, these 'perceptions' or 'images' can be dissimilar, leading to disagreements and conflict (Klijn and Koppenjan 2016).

**Figure 2: Simplified conceptual framework of the governing system, based on conceptualisations from Kooiman (2003).**




**Source: Adapted from (Kooiman 2003)**

Governing instruments are used to force, enable, detect or facilitate certain interactions. Choosing an instrument is close to image formation, while putting an instrument to use is close to governing action. In governance, all actors can apply instruments, but not every actor can apply all instruments: this depends on their governing position and resources. 'Soft instruments', such as information and advice, can be applied by more actors than 'hard instruments', such as taxes and regulations (Kooiman 2003).

When images are formed and instruments are chosen they will be applied for governing action. This does not necessarily mean, that the action will be properly adopted. The action element '*relies upon convincing and socially penetrating images and sufficient social-political will or support'.* Via feedback from affected

actors, it can be determined if the governing action was effective and appropriate. The initial image will be altered by this feedback (Kooiman, 2003, p. 62).

The structural level is where structures such as institutions and resources reside. Structures are necessary to steer, guide and facilitate governing action, but they can also frustrate and block governance. Governance focussed on changing the structural level, is what Kooiman calls ‘second-order governance’, compared to ‘first-order governance’ which can be seen as the day-by-day governance aimed at problem solving (Kooiman 2003).

## 3. RESEARCH METHOD

### 3.1. Cases

To understand the governance dynamics of Spatial Data Infrastructures, we use the conceptual framework of the governing system to study two Dutch SDI cases: the ‘Risk Map’ (Risicokaart) and the ‘New Map of the Netherlands’ (Nieuwe Kaart van Nederland). One of the reasons to choose these cases is their age as both cases date from around 2000, which allows reviewing the changes in governing system over time. Both cases can be seen as goal-oriented spatial data infrastructures as they focus on a certain theme to collect and disseminate spatial data. Both cases operate in a multi-actor environment where local, regional and national governments are involved. Most data of these SDIs is also openly accessible from quite an early start, making it also two of the oldest SDIs of the Netherlands with open data. However, their governing system and their development path are very different. By choosing two distinct cases, it can be determined if an analysis using the governing system framework is useful.

To order data on governance processes over time, we use the heuristic method from Klijn and Koppenjan (Klijn and Koppenjan 2016) to divide the cases in ‘rounds’. A ‘round’ is a time interval which starts and ends with an crucial decision. A crucial decision is identifiable when ideally the composition of actors, the course of interactions and the content of the governance process dramatically change (Klijn and Koppenjan 2016). In each case, we identified a crucial decision, forcing the governing system to change. The following part will describe the cases and the identified rounds.

#### *3.1.1. Risk Map (Risicokaart)*

In 2000 a big disaster happened in the city of Enschede, the Netherlands. A fireworks depot exploded in close vicinity of a neighbourhood area. Twenty-two people were killed, 950 persons became injured, around 500 homes were destroyed and 1500 buildings were damaged. One of the conclusions was that

many civilians were not aware that they were living near a fireworks depot and that information about such hazardous firms was fragmented (Oosting 2001). And with many more potentially dangerous companies and facilities in the Netherlands, the Dutch national government ordered to create a so-called 'Risk map' (Dutch: Risicokaart) with all potential hazards visible which should be accessible for all civilians (De Vries 2001).

To create the map, the national, regional and local governments of the Netherlands deliver information of potential hazards, based on granted permits. This information is collected in a central database and disseminated. Next to its usage to inform civilians, the risk map is also of value for emergency services to prepare and prevent potential disasters and for organisations preparing and planning new housing areas. The risk map is open for everyone, although more detailed information is only accessible for governments via a log-in.

Two rounds can be distinguished for the risk map: one round is the period from 2000 till 2013 and another one from 2014 till now. After multiple negative signals in 2013, such as a negative inspection report and a letter of escalation from civil servants, the crucial decision came that the Risk Map could not progress on the same foot. On a technical level the SDI became impossible to maintain, because of legacy software and many customized add-ons. On the institutional level, roles and responsibilities of actors were not clear enough to coordinate the Risk Map properly. Or with other words: the governing system did not function well enough anymore. Since then, a lot of effort is put in renewing the governing system and improving the Risk Map's data and technology.

#### *3.1.2. New Map of the Netherlands (Nieuwe Kaart van Nederland)*

As a densely populated and small country, the Netherlands has a long tradition in spatial planning. But to adequately plan how many new houses and commercial buildings are necessary and where they should be located, information and an overview about all the current plans is necessary. Therefore the 'New Map of the Netherlands' (Dutch: Nieuwe Kaart van Nederland) was presented in 1997, based on a project from several planning associations to collect all local and regional plans and present it into one national map.

The first 'New Map' was mainly an analogue, one-time affair. But people were aware that this was valuable information which should be updated. An organisation around the 'New Map of the Netherlands' was established which collected all plans from local municipalities, digitised and standardised these and disseminated it to the public as the 'New Map of the Netherlands'. As an important policy instrument for analysing and monitoring spatial planning, it

gained budgetary support from the Ministry of Housing, Spatial Planning and the Environment (VROM). This all continued until 2010, when funding from the ministry suddenly stopped, despite the popularity of this information source.

Due to its popularity and the valuable data it provided for spatial planners, researchers and governments, several initiatives were undertaken to research a rebirth of the New Map. In 2018, a few individuals involved in collecting and disseminating data about spatial planning, organised themselves, established a foundation and succeeded in relaunching the '*New* New Map of the Netherlands'.

Also two rounds can be identified around the New Map of the Netherlands. The crucial decision of the Ministry of Housing, Spatial Planning and the Environment (VROM) to stop fund this map in 2010 marks the end of round 1. Without these resources, the New Map was not able continue. However, this did not end the need and ideas for a New Map and by self-organisation, the New Map got his rebirth. This phase of self-organisation from 2010 onwards forms the second round.

### 3.2. Data collection

For our empirical analysis we used two kinds of sources. On the one hand we conducted semi-structured interviews with involved actors. By asking actors how they witnessed the SDI and its governing system in the past (when they became involved in the SDI), how the SDI and its governance developed from then and how they experience it nowadays, a lot of information about the governing system and its evolution unfolds. In total, we spoke to nine persons about the New Map of the Netherlands and eight about the Risk Map. The interviewed persons were all from several SDI positions, such as SDI coordinators, data users and data providers, and with several track records (long and short involvement) in order to gain a complete picture of the governing system and its inner workings.

However, as we want to study the longitudinal development and memories can change, we also used documents as complimentary source of information. An important advantage of documents is that they are stable and therefore not altered by memories. For our document analysis we used primary sources such as official policy documents, newsletters and reports as well as articles in industry magazines. Furthermore, in every interview it was asked if she or he had important document sources to study. In total 33 additional documents were analysed for the Risk Map and 26 for the New Map of the Netherlands.

### 3.3. Coding

Both sources of information, the documents and transcripts of the interviews, were coded with the help of ATLAS.ti coding software. For this coding, the qualitative content analysis method, also known as ethnographic content analysis is used. With this method, a coding framework is iteratively built up by going through the contents (Bryman 2012). In this case we started with four main categories (image, instrument, action and structures) and combined the categories with information about what kind of image, instrument, action or structure we found in a piece of text.

With the list of codes, first the documents and interview transcripts of the Risk Map were coded this way, resulting in a long list of codes about images, instruments, action and structures. During coding it became apparent that for a better understanding of SDI governance dynamics two extra categories where necessary to add: interactions and SDI qualities. As governance exists of interactions, we added the interaction category to understand the formality and direction of interactions used within a round. SDI qualities was added to get a basic understanding of the performance, data quality and use of the SDI. SDI governance shapes SDI qualities, but SDI qualities also shape SDI governance. Understanding this relation is necessary to explain SDI governance dynamics.

Thereafter, multiple codes were combined or refined, so they would be easier to analyse and find patterns. The creation of these subcategories was also based on findings from current scientific SDI and governance literature. For many subcategories, a judgement was added to make a distinction in whether it influences the governance positively or negatively. Every piece of coded text was revised with the new refined coding framework. Also the other Risk Map and New Map of the Netherlands texts were coded with this framework. At last all codes were checked on consistency and redundancy. Every interview and document is at least checked twice.

The next paragraph will operationalise and explain the used coding framework.

### 3.4. Coding framework

In the final version of the coding framework 60 codes were used. As most codes have both a positive and negative attribution, 30 code subcategories divided over six main categories (images, interactions, instruments, actions, structures and SDI qualities) are used. This paragraph will briefly explain these codes and its link with scientific literature.

### *3.4.1. Images*

The following codes were used to code the category images.

- Satisfaction (positive/negative)
- Feedback loop (positive/negative)
- Collaborative (aligned/unaligned)
- Goal/vision (explicit/individual)

Every involved actor has its own image about the SDI and the governing system. Collecting these images is useful for understanding the satisfaction of actors. In this research we coded both *positive* as *negative* remarks to gain an indication of the satisfaction of actors regarding the SDI and its governing system.

Feedback loops, both positive as negative, are an important feature of complex adaptive systems in order to adjust inputs and processes (Grus et al. 2010) and also essential for SDIs (De Man 2006). With continuous feedback, the governing image can be adjusted (Kooiman 2003). Therefore, we coded both *positive feedback* as *negative feedback* to get a sense of the feedback flow.

As images can be very dissimilar, actors should make their image explicit in order to make the image controllable and the governing action legitimate (Kooiman 2003). To converge images, actors need time, space and processes for discussion to reconcile their images with other actors (Dang et al. 2015). Converging images of involved actors is important to make the governing action more effective. We coded if the collaborative images between actors were *aligned* or *unaligned* by identifying agreement and disagreement among involved actors.

A very outspoken image is a vision or common goal. When a vision is shared and reviewed by all actors it is a powerful tool (Kok and van Loenen 2005). In this sense the vision will be shaped by the collective images of individual stakeholders and vice versa: images of individual stakeholders will mirror the shared and outspoken vision. We coded if goals or visions were *explicit* or *individual*. The latter code is mainly suitable for qualitative analysis to understand how actors see the future of the SDI.

### *3.4.2. Interactions*

The following codes were used to code the category interactions:

- Interferences (bottom-up/top-down)
- Interplays (bottom-up/top-down)

- Interventions (bottom-up/top-down)

Governance processes exist of interactions between actors, bound by structures. However, the choice for certain types of interactions explains whether an SDI is mainly hierarchical governed, network governed or self-governed. Kooiman (2003) distinguishes three interaction types: interferences, interplays and intervention. *Interferences* are the least organised kind of societal interactions and can be seen the 'primary' daily societal interaction processes. *Interplays* can be seen as 'horizontal', semi-formalized interactions. Interplays are the central interaction form of network governing. *Interventions* are the most formalised interactions and aimed at direct influence (Kooiman 2003).

To make a further distinction in interaction, the direction of interaction was assessed. Therefore, we made a distinction between '*bottom-up*' and '*top-down*', based on the hierarchical position of the actor and the direction of the interaction. It should be noted that for especially interplays this was not always easy to distinguish. Furthermore, 'top-down' does not mean in this context that the interaction came necessarily from the most hierarchical actor.

### *3.4.3. Instruments*

The following codes were used to code the category instruments:

- Information (detector/effector)
- Organisation (detector/effector)
- Rule (detector/effector)

There is an enormous array of potential governing instruments (Kooiman 2003). Multiple scholars have categorised governing instruments (e.g. Bemelmans-Videc et al. 1998) and also lists of useful SDI governance instruments exists (e.g. Crompvoets et al. 2018, Vancauwenberghe and van Loenen 2017). However, in this research we are more interested in the balance and choice for certain instrument types, than on exactly what an instrument aims for.

Kooiman (2003) describes three instrument categories, which are connected to his categorisation of interaction types: *information, organisation* and *rule.* Among information, we coded communication instruments, such as newsletters and presentations, as well as more informal and thus interferential type of interactions, such as phone calls and informal discussions for sending or gaining information. Among organisation we coded more formalised instruments such as task allocation and the formation of work and steering committees. Among rule we coded the most formal instruments, such as policies and laws.

An extension was made to make a distinction between ‘detectors’ and ‘effectors’ as Hood (1983) proposes. Detectors are instruments which are used for taking in information and thus strengthening the image. Opposed to detectors are the effectors: they are used to influence society (Hood 1983). An example of a detector for information could be gaining feedback on a conference floor. An example of a detector instrument of organisation is using research, reporting or key performance indicators to gain information in a more structured way. An example of a detector for rule is an official investigation, audit or inspection.

### *3.4.4. Action*

The following codes were used to code the category action:

- Leadership (present/lacking)
- Coordination (present/lacking)
- Self-organisation (present/lacking)
- Collaboration (present/lacking)

To steer governing action into the right direction, leadership, coordination and self-organisation can be used (Kooiman 2003). Also in SDI literature, leadership and the need for ‘white knights’ is coined as ‘critical’ for an SDI (Craig 2005, Kok and van Loenen 2005). Next to leadership, the need for coordination is in SDI literature recognised as essential (e.g. Dessers et al. 2012, Vancauwenberghe 2013). Therefore we coded *leadership* and *coordination*. For each code in the action category we coded if it was *present* or *lacking*.

Also *self-organisation* is an interesting governing action example for SDIs (Kok and van Loenen 2005, Welle Donker and van Loenen 2017). A self-organizing ability of the SDI community seems an important precondition for ensuring SDI survival (Sjoukema et al. 2017). Also for self-organisation we coded if it was available or lacking, although the latter is not often mentioned.

In addition to Kooiman, we added an extra action element which is *collaboration*, as close collaboration will foster governing action. It can be argued that collaboration is almost similar to self-organisation. However, during coding we witnessed that weak collaboration or coordination can lead to more self-organisation, as actors start to create various solutions by themselves leading to more information fragmentation. Like the other action categories also for collaboration we coded if it was *present* or *lacking*.

### *3.4.5. Structures*

The following codes were used to code the category structures:

- Roles & responsibilities (enabling/constraining)
- Ownership (enabling/constraining)
- Law (enabling/constraining)
- Budget resources (enabling/constraining)
- Time resources (enabling/constraining)
- Knowledge resources (enabling/constraining)
- Political capital (enabling/constraining)
- Social capital (enabling/constraining)
- Standards (enabling/constraining)
- Technology (enabling/constraining)
- Support (enabling/constraining)
- Trust (enabling/constraining)
- Culture (enabling/constraining)

As all governing actions are bound by structures, structures play a vital role in the governing system. However, they can both enable or constrain governing action. Therefore for each code in the structure category we identified if it is an *enabler* or a *constraint*.

The involvement of stakeholders can be institutionalized by creating coordinating functions or entities. In this way, roles and responsibilities are allocated and mostly some hierarchical difference between the coordinator and the coordinated organisations is implied (Crompvoets et al. 2018). A special kind of responsibility is ownership, which adds an extra dimension of commitment for stakeholders to (a part of) the SDI system (Ansell and Gash 2008). Therefore we coded both *roles and responsibilities* and *ownership.*

Legal frameworks, formal policies and regulations for data sharing are often mentioned as an important enabler for Spatial Data infrastructures (Rajabifard et al. 2002, UN-GGIM 2017, Vancauwenberghe et al. 2018, Vancauwenberghe and van Loenen 2017). Yet laws can also become a constraining factor. When these policies and laws where legally binding, we categorised these formal structures into the category *law*.

The choice for instruments is strongly connected with the availability of resources on the structural level. Indeed, the availability of *budgetary resources* is an important condition for SDIs (Vancauwenberghe and van Loenen 2017, Welle Donker 2009, Welle Donker and van Loenen 2017). However, in our coding framework we recognised also four other resources: *time resources, knowledge*

*resources, political capital* and *social capital*. Among *time resources* we understand the availability and allowance for actors to spend time on a certain subject. Among *knowledge resources* we understand the availability of knowledge and expertise. Although Kooiman (2003) uses social-political capital, we choose to split these. In our research, *social capital* is the availability and access to social networks. With *political capital* we mean the availability and access to (hierarchical) decision making power. This does not have to be a politician, but can also be an executive director of an organisation.

We used two codes which are especially applicable to SDIs. These are *technology* and *standards*. Technology (or access mechanisms) and standards are important enablers for SDIs and seen as core SDI components (Rajabifard et al. 2002). However we also witnessed during coding that these two structures can be constraining for SDI renewal.

Support can be seen as the structural component of governing action (Kooiman 2003). Support from both the political level as the 'work floor' is necessary to enable SDI development (Kok and van Loenen 2005, Vancauwenberghe et al. 2018, Vancauwenberghe and van Loenen 2017). We did not make a distinction between these levels, as by combining the *support* code with for example the political capital code the source of support can become clear.

Finally we coded two other soft structures: *trust* and *culture*. Trust is an important pre-condition for governing action such as collaboration. Culture appeared the most difficult to code from texts, as it is most of the times an unconscious structure. An enabling or constraining culture is only recognised by actors when persons are introduced to a new (organisational) culture.

#### *3.4.6. SDI performance qualities*

As it appeared that developments in SDI governance cannot be disconnected with the SDI performance, we added three codes to get a basic indication about the SDI performance:

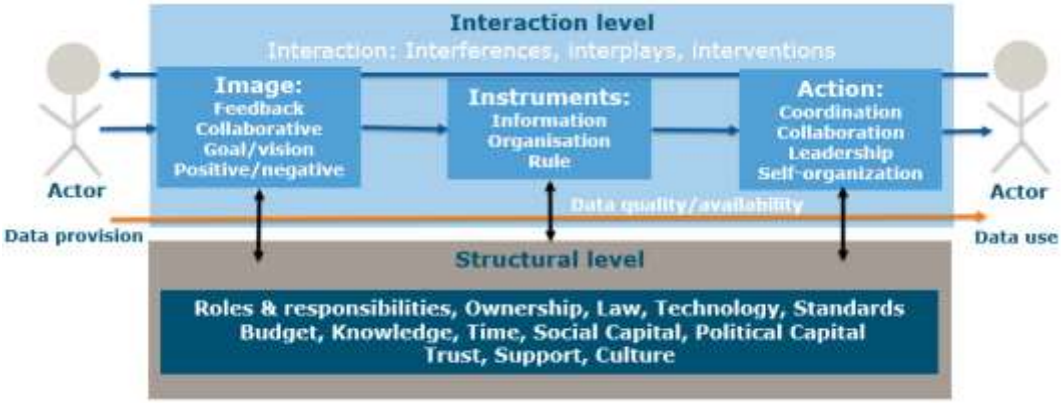
- Use (use/non-use)
- Data provision (good/bad)
- Data quality & availability (high/low)

Although the goal is not properly assessing an SDI, gaining insights in the SDI performance qualities during the governance rounds is helpful. We coded six SDI aspects: *good data provision* and *bad data provision* and high *data quality & availability, low data quality & availability* and *use* and *non-use*. Among data

provision we understand the willingness and the actual provision of data by actors. Data quality & availability is a combined code, regarding data quality aspects as well as the availability of services. Of course, data is shared to be used, the codes use and non-use indicate whether actors state that they deliberately use or not use the data provided by the SDI.

Figure 3 summarises the used coding framework embedded in the framework of the governing system.

**Figure 3: Visual summary of the coding framework, positioned in the framework of the governing system.**




### 3.5. Analysis

Coding the documents and transcripts had two purposes. On the one hand to gain more insights and interpreting the collected material better for a qualitative analysis on how the SDI and its governing system evolved. On the other hand to see patterns and trends emerge and discover differences in the governance system between rounds.

To discover these patterns and trends the frequency of a code can be used. However, as the total amount of coded texts was not equal between rounds, we had to look at the relative frequency of codes. These were calculated via two methods: one is to calculate a percentage per code based on the total amount of codes per round; the other was to look at the relative frequency within a category of codes, for example to look at the relative presence of the code ‘collaboration’ within the category ‘action’. When the difference between the first round and the second round of the first indicator was more than a 0.5% and/or the difference of the second indicator was more than 1.5%, it was noticed as shift. The appendix of this paper shows the coding results.

It should be mentioned that, despite the careful process of coding, looking at these relative code frequencies is not a trustworthy method to make strong statements of a governing system in a certain period. The codes can become biased due to its source material. For example, many documents and interview candidates explained the start of the Risk Map with the fireworks disaster in Enschede and the vision for a Risk Map which emerged from it. This causes a very high code frequency for 'explicit vision' in round one of the Risk Map compared two round two, but this does not necessarily mean there is a lack of explicit vision in round two. Nevertheless, using these frequencies as indicator in combination with the qualitative analysis proofed an helpful tool for distinguishing trends and shifts in the governing system.

## 4. RESULTS

### 4.1. Risk Map

#### *4.1.1. Round 1: 2000 – 2013*

After the fireworks disaster in 2000 in Enschede the image was clear: there is a lack of (central) information about potential hazards and the communication about these potential hazards to citizens is poor (Oosting 2001). This image was not entirely new. A few provinces already started to work on a risk registry before 2000. But after the disaster, the national government demanded that there should be a risk map at the national level (De Vries 2001).

Several roles and responsibilities were allocated by the national government: Municipalities gained the task to make an inventory of potential hazards and a crisis response plan for each hazard. The Ministry of Interior and Kingdom Relations took the initiative to develop a model for a risk map in collaboration with municipalities and provinces. The Ministry of Housing, Spatial Planning and the Environment got the task to set up a registry for hazardous substances (De Vries 2001). At first, this latter registry would be an independent database, but after a successful lobby it was decided in 2005 to integrate this registry into the Risk Map and use it as one of its main datasets. However, ownership of this registry remained at the Ministry of Housing, while the owner of the Risk Map was the Ministry of Interior. Because these two ministries both got the task to design laws and regulations (one for the risk map and one for the registry for hazardous substances), close collaboration between the provinces and ministries was necessary to prevent inconsistencies.

The provinces got the task to create and maintain a Risk Map. The development of an SDI was at that time technological challenging. This marked a period of

innovation and self-organisation. Several provinces took the initiative to develop and experiment with the creation of a risk map system. As provinces were not used to collaborate together to develop a central system, the first idea was to create a model from which each of the 12 provinces could create its own risk map SDI. By mixing several best practices and designing a flexible system which provinces could extend, a central SDI was designed (FO MRK projectteam et al. 2003). After several years of development the first version of the Risk Map was launched in 2006.

After the terrorist attack on the World Trade Center in New York in 2001, the scope and goal of the risk map became suddenly a point of political discussion. A public map which located all potential risks could easily be misused by terrorists was argued. The discussion was settled by creating a public view with less detailed information for citizens and a secured environment where crisis response teams and governments could get the more detailed information.

In 2007, the risk map and its accompanying laws were in place. The two ministries withdrew and transferred most responsibilities for coordinating, maintaining and developing the Risk Map to the twelve provinces of the Netherlands. Because twelve provinces had to maintain one national application, they founded a provincial shared service organisation for maintaining the technological part of the Risk Map. Each province stayed responsible for the policies around the Risk Map. The data is mainly provided by municipalities.

Experimentation and innovation went on around the risk map. New features were added and pilots for a cross-border data infrastructure were organised. In 2010 many legal tasks and responsibilities of the provinces around safety and crisis management were transferred to the newly created ‘safety regions’. These regions became one of the main users of the professional part of the risk map, while use by provinces diminished. Also ownership of the Risk Map was transferred from the Ministry of Interior to the Ministry of Justice and Security. However, tasks and responsibilities for the risk map itself, stayed at the provinces.

Support for the risk map crumbled. The national government already did not show much interest since the implementation of the legal framework and with the transfer of legal responsibilities to the safety regions also the provincial support weakened. During the years of innovation and experimentation features were added without revising the system itself, making it a very complex and costly system to maintain and improve. Furthermore, providing the data was very time consuming for the municipalities and not every municipality had the knowledge to provide the data accurately, which resulted in poor data quality. Because of this

situation and little trust in a solution, several provinces actively chose to diminish support and execute tasks only if they are legally necessary.

The inspection of the Ministry of Justice and Security concluded at the end of 2013 that the risk map was not an effective instrument for risk communication, because of the untrustworthy data quality and a lack of coordination around the risk map. These problems were seen as interrelated (Inspectie Veiligheid en Justitie 2013). In 2014 the twelve provincial coordinators plead for change as the technologies, the contents and the policies around the risk map were all outdated.

#### *4.1.2. Round 2: 2014 – Now*

This call for change was heard. A task force studied the problems around the risk map and made recommendations for improvements. A central programme manager was appointed and a plan to improve its governance was written. Roles and responsibilities were made more explicit. One provincial deputy, who is member of the Association of Provinces, now acts as owner and bears the provincial main responsibility for the Risk Map, instead of all twelve. Also the directing steering committee at the Association of Provinces changed towards a committee with a stronger focus on content instead of financial resources. By improving and centralizing this ownership, the Risk Map gained better political capital and ownership.

On the operational level, also more structures were added. The provincial shared service organisation improved their change management process so it became more transparent to the provincial coordinators. Every year an annual plan is made together with the programme manager. There are two provincial committees, one on the operational level and one more on the tactical level, where collaborative decision making takes place.

The provinces also try to involve the two ministries more, as they are still responsible for the Risk Map and its accompanying laws. Renewing the laws is seen as necessary, as some of its contents is outdated. Furthermore, new actors such as the safety regions are now involved, but their legal responsibilities and involvement towards the Risk Map are not clear.

The new goal and vision of the Risk Map is to build a new SDI to replace the old legacy system. The new system should be more lightweight and reusing existing data, so providing data would become easier. One idea is also to provide everything as open data, so the authorised part of the Risk Map could disappear. The new Environment and Planning Act, which is a programme to modernise, harmonise and simplify current rules in the Netherlands and improve its data

provision by building a spatial data infrastructure, is seen as an opportunity for the Risk Map by some actors, while others see it as a risk.

Still the Risk Map has some major challenges. Support for the Risk Map varies from province to province. Some argue responsibility for the Risk Map should be transferred to the safety regions. The safety regions are legally responsible for risk communication nowadays, but lack a formal role in the Risk Map. Therefore, they self-organise to build new Risk Map products on top of the old Risk Map. Also in many cases, environmental services (omgevingsdiensten) took over the job of data providers from municipalities. This led to an improvement in data provision, but these environmental services also lack a formal role in the governing system of the Risk Map.

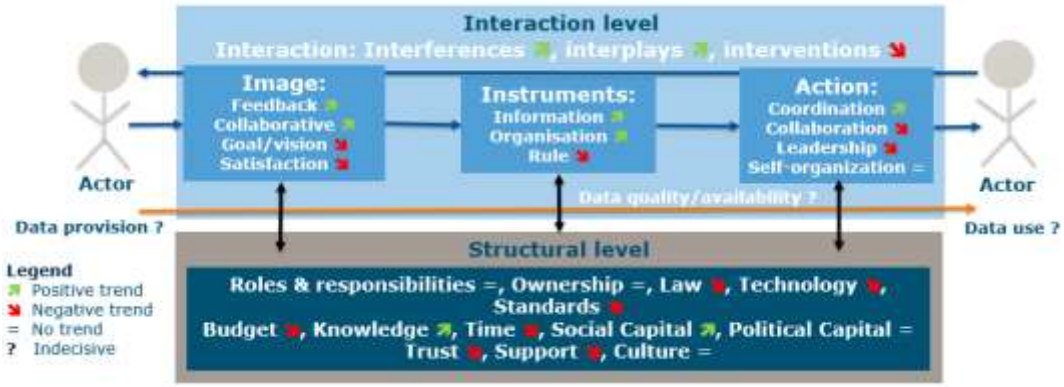
In 2019 a report from the Research and Documentation Centre of the Ministry of Justice and Security (Bongers et al. 2019) concluded that while the roles and responsibilities were made more clear, the legal and organisational context of the Risk Map still is too complex. More changes in the structural level of the Risk Map seem inevitable.

#### *4.1.3. Analysis of the governing system*

When we compare the relative frequencies of codes of round 1 with round 2, we can see interesting trends (see figure 4). When we look at the image, the collaborative image seems to be less unaligned in round 2 compared to round 1. A possible explanation could be that the emerged ‘governing crisis’ around the Risk Map, sparked more alignment of images. Also more positive feedback is now flowing through the system. However, in both rounds, the images seem to be more negative than positive.

When we look at the interaction patterns we can see that round 1 has more top-down interventions than round 2. This is easily explained by the assignment from the national government to realise a risk map after the fireworks disaster in Enschede. Interplays are the main form of interaction in both rounds. Because twelve provinces have the combined task to create a risk map, this interaction form seems a logic fit.

**Figure 4 Shift in the governing system of the Risk Map in round 2 compared to round 1, based on the relative frequency of codes.**




When we look at the interaction patterns we can see that round 1 has more top-down interventions than round 2. This is easily explained by the assignment from the national government to realise a risk map after the fireworks disaster in Enschede. Interplays are the main form of interaction in both rounds. Because twelve provinces have the joint task to create the Risk Map, this interaction form seems a logic fit.

Co-ordination is improved in the second round, as a lack of co-ordination was one of the main concerns in the first round. However, collaboration seems to be better in the first round. From the interviews it appeared that especially the collaboration with and coordination of the national government could be improved. Also we see a decrease in support and trust in the second round, which affects collaboration.

Self-organisation is present in both rounds. However, from the interviews it appears that this is not always positive. In many cases a rise of self-organisation is witnessed when co-ordination is lacking or not fulfilling the requirements of the stakeholder. Self-organisation could lead to fragmentation of information and systems.

Although coordination is improved, based on the codes, we do not see a strong change in roles and responsibilities and ownership. This can be explained by the fact that roles and responsibilities are made more clear within the provincial structures, however, the involvement and roles of the safety regions and environmental services remain unclear. Furthermore, many find the dual ownership by two ministries a constraining structure.

Law and standards are also seen as constraining structures in the second round, as many find these out of date. However, the legal framework also acts as life line for the Risk Map; quitting is legally not possible. Another clear constraint is technology as the current SDI has become too complex to maintain. On the other hand, there is a strong believe that technology can be enabler when a new risk map system is build.

This relates also to another constraint; the budgetary resources. Actually there is not a shortage of budget for the Risk Map, but many actors think the current system is too expansive for its value. The biggest share of the budget goes to maintaining the outdated technology. An important condition for the new risk map is the actor's expectations that its maintenance should be cheaper compared to its current predecessor.

The codes about SDI performance qualities give mixed results on every aspect (data provision, data quality/availability and use). From the interviews and reports it is clear that data quality has become slightly better in the past years, but that users still cannot fully trust the data.

## 4.2. New Map of the Netherlands

### *4.2.1. Round 1: 1997 – 2010*

The New Map of the Netherlands was born by a notion and information need of spatial planners to gain a better overview of the spatial dynamics in the Netherlands. This information need was not new, as the National Planning Office (Rijksplanologische Dienst) in the Netherlands already tried to gain statistics about the current and planned building capacity. However, what was new, was the need to spatially locate these plans. First, regional maps with spatial plans were made in Amsterdam and Rotterdam. The idea to do this for the whole of the Netherlands gained a lot of energy and the 'New Map of the Netherlands association' was formed.

Hundreds of urban and spatial planners volunteered in 1997 to collect data and create a map showing what the Netherlands would look like in 2005. The New Map of the Netherlands was widely introduced, gaining lot of attention from politicians, professionals and the general public. Because of its success, the ambition was to create a 'New Map' every two years, allowing to look even further into the future.

Meanwhile, around the same time, the National Planning Office also had a need to gain a geographical overview of all national plans. Therefore they made a national map, 'the Netherlands in Plans', not only showing concrete plans for the

near future but also ‘softer’ long-term plans. One of the used information sources was the New Map and in 2003 it was decided that the New Map of the Netherlands would gain a subsidy from the Ministry of Housing, Spatial Planning and the Environment (VROM). The New Map also embodied the idea to make a distinction between ‘soft’ and ‘concrete’ plans.

The organisation then was as follow: the Ministry acted as client to the New Map association. The actual execution was done at an association for spatial planners, NIROV, which hired several employees to call municipalities and scan newspaper articles to collect information about spatial plans. Typically they had to digitize analogue maps with GIS and fill in the attributes in a standardized manner while working with unstructured plans: a labour-intensive method.

The organisation was in a way ahead of its time. In 2006 they decided to open all data with a CC-BY Creative Commons license. The association also experimented with new dissemination channels, creating the first Web Mapping Service (WMS) in the Netherlands and a KML file to integrate in Google Earth. Also the update frequency was speeded up, from releasing a New Map every two years to updating it every month.

However, the New Map did not fulfil all information needs. By decentralisation, spatial planning in the Netherlands became less of a national affair and provinces became in charge of keeping an overview on all municipal plans. In the province of North-Holland, they developed therefore their own monitoring system, especially to gain better insights about the statistical side of new residential areas as the New Map was mainly spatially focussed. The advantage of this system was that it involved municipalities directly as data providers, giving the data an higher authoritative character. In 2009, the province of South-Holland developed a similar system, which they later also opened up to other provinces in the Netherlands.

In 2010, due to the economic crisis, the Ministry of Housing, Spatial Planning and the Environment had to cut its budget and decided not to fund the New Map anymore. Because of the labour intensive data collection method, it could therefore save easily a million per year. Furthermore, it was argued, that because of the decentralisation of spatial planning, involvement of the national government was not needed anymore. Next to this, in 2008 a digital system for legal zoning plans was introduced, already giving a much better overview of spatial dynamics in the Netherlands.

The decision to stop funding the New Map was a hard one for the association. Together with civil servants they tried to find other organisations to support the New Map, but they did not succeed as other organisations were in fear of the bill.

Furthermore, due to the economic crisis, spatial planning slowed down, pricing of houses dropped dramatically and there was a disbelief that it would become better. Without any budget, the association and the New Map of the Netherlands itself had to stop.

#### *4.2.2. Round 2: 2010 – Now*

A few initiatives started to bring the New Map back on the political agenda. In 2011 a research on behalf of the national government, showed the information gap and set up ideas for a new, affordable, official monitoring system. From the research, it became clear that almost every provinces already collects information about building plans for residential purposes, although their approach differs. However, the research did not get a follow up to centralise these different systems.

Meanwhile, the monitoring systems of the province of North-Holland and South-Holland were in place and multiple provinces joined. A research was done to decide which system better fits the purposes of other provinces. It was decided that the system of the province of South-Holland, would be better as it used open standards and open source software. In total six provinces of the twelve joined the system of South-Holland. The system of North-Holland is used by two provinces. Also the province of Limburg does have its own system, but this system was not assessed. The other three provinces of the Netherlands do not have a spatial monitoring system.

In 2016 an independent National Government advisor on the Built and Rural Environment took the initiative to collaborate with the two owners of the North and South Holland system. The three founders organised themselves into an association and launched the '*New* New Map of the Netherlands' in 2018. The initiative gained support from several users, among others the Ministry of Internal Affairs (nowadays responsible for spatial planning) and the Netherlands Environmental Assessment Agency. Both provide the association with some funding in exchange of participation in the association.

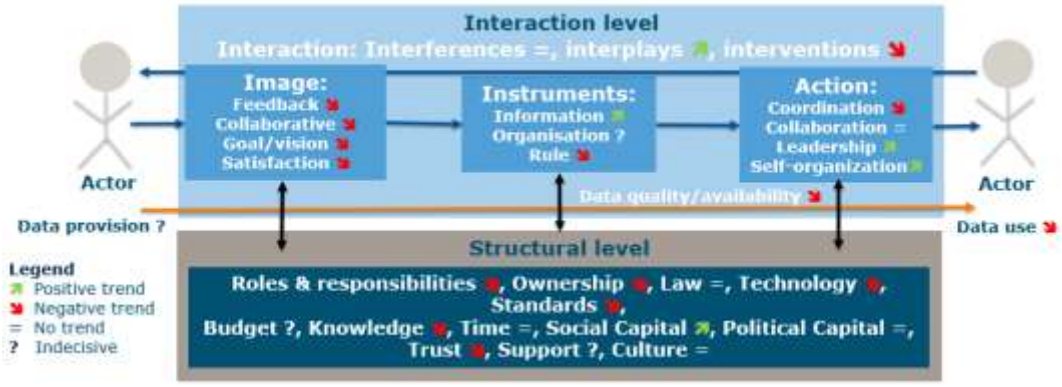
By combining the data of the two provincial systems they could create a map with plans of approximately the half of the country. However, municipalities can choose for various reasons to restrict access to their plans, making them not open to the public. Therefore, data of only a small part of the country is available to the public. The current challenge is to convince other municipalities and provinces to voluntary open up their plans. One instrument the association uses is to make the data provision as easy as possible, by allowing provinces to use

their own data model. The association then manually transforms the data itself and put it on the *New* New Map.

### *4.2.3. Analysis of the governing system*

The governing system of the New Map of the Netherlands changed drastically with the decision to stop producing and disseminating the New Map. When we compare the relative frequency of codes from round 1 to round 2, we see a decrease in most aspects regarding the organisation of an SDI, such as an explicit image (goal/vision), the action 'co-ordination', the instrument 'rule' and structures such as 'roles and responsibilities', 'standards' and 'ownership'. When we look at softer aspects, we also see that in the second round images are less aligned and there seems to be less trust. Also the data availability/quality and use seem less.

**Figure 5 Shift in the governing system of the New Map of the Netherlands in round 2 compared to round 1, based on the relative frequency of codes.**




Interestingly, support for the SDI and data provision is increased, as well decreased. This is all explained by the fact that in every interview, the candidates express the challenge in convincing all provinces and municipalities to open up and provide their plans. While there are clear and supporting advocates and data providers, at this moment the *New* New Map covers less than half of the Netherlands, which makes data availability the one of the main challenges for this SDI.

Perhaps surprising, but technology also seems more constraining in the second round compared to the first. This can be partly explained by the fact that both owners of the current provincial systems point out the drawbacks of their system. Furthermore, in the first round, the New Map was embracing new technologies and seemed in its dissemination channels ahead of its time.

But not everything has become less compared to the first round. Based on the codes, there is a relative increase in leadership, self-organisation and social capital. Not surprising is the fact that in both rounds most codes in the category action are about self-organisation, as the New Map is in both rounds a product of self-organisation. Interestingly budget resources have become less enabling but also less constraining. This can be explained by the fact that the necessary budget for the *New* New Map has become much less, some estimate that the current costs are 10 times cheaper, while there is also a challenge in raising enough money from supporting organisations compared to the years of stable financing from the ministry.

It is clear that the governing system of the New Map of the Netherlands has become much more vulnerable in the second round. This is not surprising as the current SDI is almost completely based on a self-organizing network of professional volunteers, with almost no structures at the structural level. Although making the SDI vulnerable, this approach also generates goodwill and support, as many interviewees argued that a legal, top-down approach would probably not benefit this SDI due to the uncertainty and unofficial character of the plans. As the *New* New Map initiative is very young, only time will tell how successful this SDI could be. It is clear from its own predecessor that from a self-organized SDI, a more structurally embedded SDI can emerge.

## 5. DISCUSSION AND CONCLUSION

This research tries to understand spatial data infrastructure (SDI) governance dynamics by a thorough analysis of the governing system. With the help of the governing system framework, more insights on the strong and weak aspects of the governing system become apparent. By repeating this over time, changes in the governing system appear. This could be a helpful analytical tool for SDI governors who want to assess the governing system of their SDI. For our research, we used a thorough analysis based on documents and interviews. However, possibly with some modifications, the framework can also be used for quick scan purposes or in combination with other data collection methods.

For analytical purposes we divided the cases into rounds to analyse the governing system. For the New Map, which had a sudden stop, this time interval seems to fit. However, for the Risk Map, which gradually evolved into a crisis situation and also incrementally tries to break away from it, a finer grained time interval would probably give even more insights about changes in the governing system. Longitudinal research which assesses the governing system of an SDI year by year, would be an insightful complimentary research.

A drawback by focussing only on the governing system is the fact that external factors are not taken into account. These external factors are unpredictable and beyond of control of the actors in the governing system, but in both case studies we see that external factors actually seemed to cause (partly) the crisis situation in the governing system. By changes in the political and economic system, it was decided to stop the New Map. Also the decision to reorganise the safety and disaster system in the Netherlands, caused problems for the Risk Map, which organisation remained largely based on the old system. The openness and sensitivity of a system is a central feature of complex adaptive systems (Grus et al. 2010), but this does not make SDI governing an easy job.

In this respect, the fact that many involved interviewees imagine a future where multiple SDIs and datasets are connected, is interesting. In both case studies an important future goal is to diminish the effort for data providers, by reusing existing data and connecting data to other datasets and SDIs. Spatial data provision is evolving from central, to decentral, towards an ecosystem of spatial and non-spatial data infrastructures where both centrally and decentrally provided data resides. In this way, data collection and sharing becomes more efficient, but the SDIs will also be more sensitive to each other's changes, increasing its governing complexity.

The proposed governing system framework does not only give another angle to look at SDIs, but also to existing SDI frameworks. For example, the five classical SDI components of Rajabifard (people, data, standards, access mechanisms and policy (Rajabifard et al. 2002)) fit in the governing system framework. When one would look at standards, access mechanisms (or technology) and policy as enabling structures for data sharing between people. However, these SDI components are not always SDI enablers as the case studies in this research point out. Also other SDIs such as INSPIRE suffer from too fixed structures such as standards (Borzacchiello et al. 2018), which could provide a risk for its support.

Analysing the governing system of an SDI with the used framework seems a useful method to better understand the governance and governability of an SDI. A weakness is that it does not give insights in its causalities and it does not embrace external effects, which could have a major influence on SDIs. Also comparability between different SDIs seems difficult with the used qualitative method, as it is only possible to make a comparison between rounds within the case itself. By applying the governing system framework with a more quantitative approach, such as surveys, the framework could be a useful tool for SDI governance benchmarking.

However, the two case studies in this research show that the combination of qualitative analysis and the governing system framework is a valuable one in order to understand SDI governance dynamics. With help of the proposed governing system framework, shifts and trends become visible, while the qualitative analysis helps to give meaning to these SDI governance dynamics. As these two cases were goal-oriented SDIs, applying the governing system framework to other types of SDIs and SDI contexts is essential in order to proof the true potential of this framework.

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## APPENDIX

When the relative difference based on the total amount of codes within a round, differs between round 1 and 2 more than 0.5% or -0.5%, the number is shown in bold. When the relative difference based on the total amount of codes within one category in a round, differs between round 1 and 2 more than 1.5% or -1.5% the number is shown in bold.

**Table 1: Code frequencies of the Risk Map**

| Category | Code | Attribute | Risk Map Round 1 | Risk Map Round 2 | Relative difference between rounds | Relative difference within category |
|---|---|---|---|---|---|---|
| **Action** | **Collaboration** | **Present** | 35 | 26 | **-1.8%** | **-12.3%** |
| | | **Lacking** | 17 | 23 | -0.4% | -1.2% |
| | **Coordination** | **Present** | 11 | 36 | **0.8%** | **8.9%** |
| | | **Lacking** | 40 | 58 | **-0.7%** | -1.1% |
| | **Leadership** | **Present** | 9 | 15 | -0.1% | 0.6% |
| | | **Lacking** | 3 | 20 | **0.7%** | **7.1%** |
| | **Self-organisation** | **Present** | 25 | 40 | -0.3% | 1.0% |
| | | **Lacking** | 5 | 1 | -0.4% | **-3.0%** |
| **Image** | **Collaborative** | **Aligned** | 21 | 43 | 0.2% | 0.0% |
| | | **Unaligned** | 30 | 33 | **-1.0%** | **-5.8%** |
| | **Feedback** | **Negative** | 39 | 67 | -0.2% | **-2.6%** |
| | | **Positive** | 23 | 53 | **0.5%** | 1.2% |
| | **Goal/vision** | **Explicit** | 61 | 71 | **-1.9%** | **-11.0%** |
| | | **Individual** | 18 | 97 | **3.0%** | **12.3%** |
| | **Observation** | **Negative** | 31 | 80 | **1.1%** | **3.4%** |
| | | **Positive** | 16 | 45 | **0.8%** | **2.5%** |
| **Interaction** | **Bottom-up** | **Interference** | 7 | 25 | **0.6%** | **7.7%** |
| | | **Interplay** | 32 | 75 | **0.8%** | **13.0%** |
| | | **Intervention** | 4 | 8 | 0.0% | 0.8% |
| | **Top-down** | **Interference** | 0 | 9 | 0.4% | **5.1%** |
| | | **Interplay** | 30 | 43 | **-0.6%** | **-3.3%** |
| | | **Intervention** | 35 | 16 | **-2.3%** | **-23.3%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Instrument** | **Detector** | **Information** | 10 | 32 | **0.7%** | **6.4%** |
| | | **Organisation** | 28 | 67 | **0.8%** | **10.3%** |
| | | **Rule** | 17 | 5 | **-1.2%** | **-5.9%** |
| | **Effector** | **Information** | 43 | 50 | **-1.3%** | **-2.2%** |
| | | **Organisation** | 74 | 123 | **-0.6%** | **8.8%** |
| | | **Rule** | 52 | 17 | **-3.7%** | **-17.4%** |
| **SDI qualities** | **Data Provision** | **Bad** | 12 | 12 | -0.5% | **-13.6%** |
| | | **Good** | 9 | 8 | -0.4% | **-11.0%** |
| | **Data Quality/Availability** | **Bad** | 15 | 40 | **0.6%** | **3.6%** |
| | | **Good** | 4 | 13 | 0.3% | **2.9%** |
| | **Use** | **Non use** | 2 | 15 | **0.5%** | **8.5%** |
| | | **Use** | 9 | 33 | **0.8%** | **9.6%** |
| **Structures** | **Roles and responsibilities** | **Enabling** | 57 | 112 | 0.4% | -0.7% |
| | | **Constraining** | 43 | 69 | -0.4% | **-2.5%** |
| | **Budget resources** | **Enabling** | 11 | 28 | 0.4% | 0.6% |
| | | **Constraining** | 6 | 37 | **1.2%** | **3.0%** |
| | **Culture** | **Enabling** | 2 | 0 | -0.2% | -0.5% |
| | | **Constraining** | 6 | 5 | -0.3% | -0.9% |
| | **Knowledge resources** | **Enabling** | 12 | 37 | **0.7%** | **1.5%** |
| | | **Constraining** | 9 | 19 | 0.1% | 0.0% |
| | **Law** | **Enabling** | 54 | 70 | **-1.3%** | **-5.1%** |
| | | **Constraining** | 13 | 45 | **1.0%** | **2.2%** |
| | **Ownership** | **Enabling** | 12 | 29 | 0.3% | 0.5% |
| | | **Constraining** | 8 | 23 | 0.4% | 0.8% |
| | **Political capital** | **Enabling** | 20 | 43 | 0.3% | 0.2% |
| | | **Constraining** | 6 | 23 | **0.6%** | 1.3% |
| | **Social capital** | **Enabling** | 1 | 15 | **0.6%** | **1.6%** |
| | | **Constraining** | 0 | 2 | 0.1% | 0.2% |
| | **Standards** | **Enabling** | 26 | 9 | **-1.8%** | **-5.5%** |
| | | **Constraining** | 9 | 21 | 0.2% | 0.3% |
| | **Support** | **Enabling** | 14 | 37 | **0.5%** | 1.0% |
| | | **Constraining** | 8 | 50 | **1.7%** | **4.1%** |
| | **Technology** | **Enabling** | 28 | 24 | **-1.3%** | **-4.2%** |
| | | **Constraining** | 23 | 49 | 0.3% | 0.2% |
| | **Time resources** | **Enabling** | 3 | 11 | 0.3% | 0.6% |
| | | **Constraining** | 2 | 24 | **1.0%** | **2.4%** |
| | **Trust** | **Enabling** | 1 | 7 | 0.2% | 0.6% |
| | | **Constraining** | 18 | 22 | **-0.5%** | **-1.9%** |
| **Total** | | | **1159** | **2110** | | |

**Table 1: Code frequencies of the New Map of the Netherlands**

| Category | Code | Attribute | Risk Map Round 1 | Risk Map Round 2 | Relative difference between rounds | Relative difference within category |
|---|---|---|---|---|---|---|
| **Action** | **Collaboration** | **Present** | 13 | 32 | **0.7%** | 1.1% |
| | | **Lacking** | 9 | 22 | 0.5% | 0.7% |
| | **Coordination** | **Present** | 15 | 10 | **-1.0%** | **-12.0%** |
| | | **Lacking** | 5 | 22 | **0.9%** | **5.2%** |
| | **Leadership** | **Present** | 9 | 29 | **1.0%** | **4.1%** |
| | | **Lacking** | 1 | 2 | 0.0% | -0.1% |
| | **Self-organisation** | **Present** | 34 | 83 | **1.8%** | **2.5%** |
| | | **Lacking** | 3 | 4 | -0.1% | -1.4% |
| **Image** | **Collaborative** | **Aligned** | 7 | 5 | -0.4% | **-2.4%** |
| | | **Unaligned** | 10 | 43 | **1.8%** | **7.1%** |
| | **Feedback** | **Negative** | 25 | 32 | **-0.6%** | **-4.4%** |
| | | **Positive** | 33 | 40 | **-1.0%** | **-6.4%** |
| | **Goal/vision** | **Explicit** | 35 | 38 | **-1.3%** | **-8.1%** |
| | | **Individual** | 13 | 77 | **3.7%** | **15.4%** |
| | **Observation** | **Negative** | 24 | 55 | **1.0%** | **2.9%** |
| | | **Positive** | 35 | 52 | -0.4% | **-4.0%** |
| **Interaction** | **Bottom-up** | **Interference** | 8 | 12 | -0.1% | 1.4% |
| | | **Interplay** | 30 | 45 | -0.3% | **5.2%** |
| | | **Intervention** | 2 | 0 | -0.2% | **-2.8%** |
| | **Top-down** | **Interference** | 1 | 2 | 0.0% | 0.7% |
| | | **Interplay** | 16 | 32 | 0.4% | **11.1%** |
| | | **Intervention** | 15 | 5 | **-1.3%** | **-15.6%** |
| **Instrument** | **Detector** | **Information** | 7 | 21 | **0.6%** | **9.0%** |
| | | **Organisation** | 1 | 34 | **2.2%** | **23.6%** |
| | | **Rule** | 1 | 0 | -0.1% | -0.9% |
| | **Effector** | **Information** | 34 | 44 | **-0.8%** | **1.8%** |
| | | **Organisation** | 63 | 35 | **-4.6%** | **-30.1%** |
| | | **Rule** | 8 | 5 | **-0.5%** | **-3.4%** |
| **SDI qualities** | **Data Provision** | **Bad** | 4 | 22 | **1.0%** | **12.1%** |
| | | **Good** | 32 | 22 | **-2.1%** | **-10.3%** |
| | **Data Quality/Availability** | **Bad** | 12 | 20 | 0.0% | **4.3%** |
| | | **Good** | 29 | 15 | **-2.2%** | **-12.8%** |
| | **Use** | **Non use** | 1 | 16 | **1.0%** | **10.3%** |
| | | **Use** | 47 | 49 | **-1.9%** | **-3.6%** |
| **Structures** | **Roles and responsibilities** | **Enabling** | 30 | 31 | **-1.2%** | **-3.7%** |
| | | **Constraining** | 13 | 32 | **0.7%** | **1.7%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Budget resources** | **Enabling** | 25 | 22 | **-1.3%** | **-3.8%** |
| | | **Constraining** | 29 | 18 | **-2.0%** | **-5.7%** |
| | **Culture** | **Enabling** | 1 | 3 | 0.1% | 0.2% |
| | | **Constraining** | 1 | 7 | 0.4% | 0.9% |
| | **Knowledge resources** | **Enabling** | 15 | 15 | **-0.6%** | **-2.0%** |
| | | **Constraining** | 3 | 6 | 0.1% | 0.1% |
| | **Law** | **Enabling** | 4 | 4 | -0.2% | -0.5% |
| | | **Constraining** | 10 | 15 | -0.1% | -0.4% |
| | **Ownership** | **Enabling** | 11 | 4 | **-0.9%** | **-2.7%** |
| | | **Constraining** | 3 | 15 | **0.7%** | **1.7%** |
| | **Political capital** | **Enabling** | 9 | 11 | -0.3% | -0.8% |
| | | **Constraining** | 4 | 15 | **0.6%** | 1.4% |
| | **Social capital** | **Enabling** | 5 | 30 | **1.5%** | **3.8%** |
| | | **Constraining** | 0 | 3 | 0.2% | 0.5% |
| | **Standards** | **Enabling** | 31 | 22 | **-1.9%** | **-5.6%** |
| | | **Constraining** | 14 | 35 | **0.8%** | **1.9%** |
| | **Support** | **Enabling** | 27 | 69 | **1.7%** | **3.9%** |
| | | **Constraining** | 16 | 63 | **2.5%** | **6.2%** |
| | **Technology** | **Enabling** | 38 | 39 | **-1.6%** | **-4.8%** |
| | | **Constraining** | 9 | 20 | 0.4% | 0.8% |
| | **Time resources** | **Enabling** | 8 | 20 | 0.5% | 1.1% |
| | | **Constraining** | 15 | 28 | 0.2% | 0.3% |
| | **Trust** | **Enabling** | 1 | 7 | 0.4% | 0.9% |
| | | **Constraining** | 3 | 30 | **1.7%** | **4.4%** |
| **Total** | | | **907** | **1489** | | |