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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 unclear to what extent current SDI governing systems are fully equipped to deal with the dynamics and complexity of SDIs. This research proposes a governing system framework for analysing the governing system of SDIs, adapted from the concepts of Kooiman. This framework is applied to two Dutch SDI cases: the Risk Map and the New Map of the Netherlands. With the help of the framework, the strong and weak aspects of the governing system of SDIs become more apparent and insights emerge on which interactions, images, instruments, actions and structures enable or constrain SDI governance. By observing changes in governing systems over time, SDI governance dynamics 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 have improved 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. Integration of spatial data with governmental services is favourable 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 by diminishing data duplication and fragmentation of spatial information.

Previously, '*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 maximising benefits, by focusing more on the users and their 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 society as a whole.

Open spatial data has resulted in 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 steers SDI development in the desired direction appears essential, but it is unclear to what extent current SDI governing systems are fully equipped to deal with the dynamics and complexity of SDIs.

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 SDI governance. By applying the framework to two SDI cases, we can also evaluate the strong and weak points of this framework. First, we will conceptualise what we mean by '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, many 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) or ‘interactive’ governance (Kooiman, 2003). Theories on governance are still an ever-expanding universe, which does not make it an easy subject to grasp.

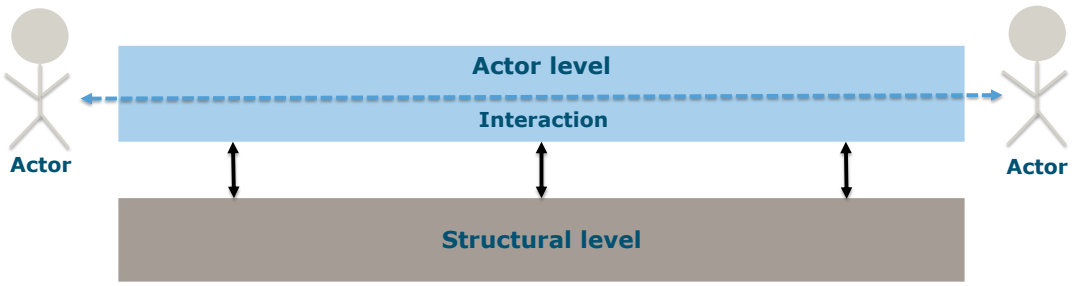
Because of this wide range of governance definitions and ideas, we would like to explain the governance perspective we use in this research. This is not to state that we have *the* governance definition, but to understand the governance lens we use to study SDIs in this research. Our perspective is a 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 (such as laws, organisations, contracts, standards), but also informal (such as culture, norms and values). Structures have a dual nature: they shape action and are stable in the short term, beyond the control of one actor. However, in the long term structures are changeable and shaped by the actions of the interacting actors (Giddens, 1984; Sewell, 1992; Kooiman, 2003).

Because structures influence governance interactions, a distinction is made between an ‘actor’ 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 actor level (Figure 1) (Kooiman, 2003).

‘Governance’ theories originated from insights about networks (Rhodes, 1996; Klijn, 2008), 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 set boundaries around governance; rather, we see that top-down or hierarchical interactions, horizontal, network or collaborative interactions and bottom-up or self-organising interactions all play an important role in the entire governance process.

Figure 1: Relation between the actor level of governance, where actors interact and the structural level, which enables and constrains the actor 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. Rhodes, 1996; Kersbergen and Waarden, 2004; Pollitt and Bouckaert, 2011) conclude that governance is shifting. Since the 90s, more and more authors have described the rise of network-oriented approaches to governance in contrast to hierarchal and market-driven forms. These networks are largely self-organising (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). Rhodes notes that '*Governance as self-organizing networks is a challenge to governability because the networks become autonomous and resist central guidance'* (Rhodes, 1996, p.667).

Interestingly, a different development, moving from self-organising networks towards more central guidance, has been witnessed in the SDI domain in several countries: the Netherlands, Belgium (Sjoukema et al., 2017), the United States (Lance et al., 2009) and Australia (Masser et al., 2008). SDIs which originated from network initiatives in the early 90s (Masser, 1999) began to strive later on for more hierarchical influences, such as central coordination, laws and policies in order to gain legitimacy (Sjoukema et al., 2017; Lance et al., 2009). The reason could be that SDIs are relatively young infrastructures whose institutions are not yet fully developed (De Man, 2006). 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 specific governing system and context due to its complexity, path-dependency and openness, every SDI may also need an individual governing system. However, we can evaluate governing systems over time, compare the differences and analyse what works well and what does not.

A key feature of CAS is their unpredictability and non-linearity. These features are also present in governance (Kooiman, 2003; Duit and Galaz, 2008; Rijke et al., 2012; Kooiman and Bavinck, 2013). Periods of incremental change can be followed by fast and sudden change with major and irreversible consequences, due to threshold and cascading effects (Duit and Galaz, 2008). Teisman (2000) and Klijn & Koppenjan (2016) call these tipping points in governing processes 'crucial decisions'. A crucial decision is identifiable when the composition of actors, the course of interactions and the content of the governance process dramatically change (Klijn and Koppenjan, 2016).

2.3. The Governing System

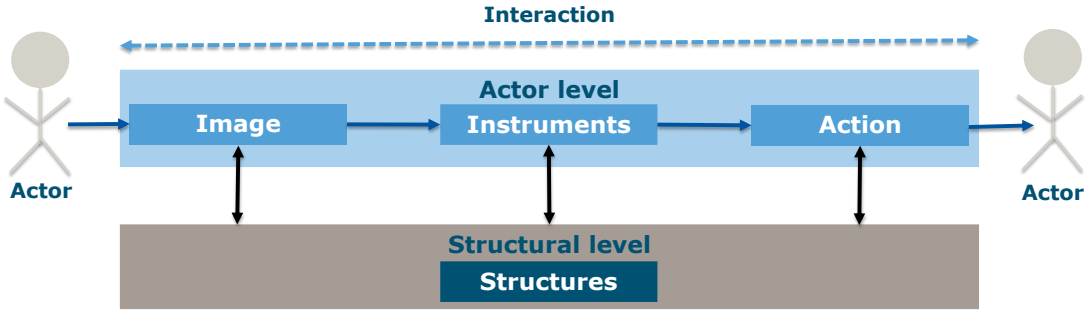
In this research, we use the conceptualisations of the governing system by Kooiman (Kooiman, 2003). We use his theoretical concepts, as Kooiman is one of the few governance scholars who uses a system perspective on governance. Many scholars only focus on partial aspects of governance, but Kooiman's perspective, which has been categorised as the socio-cybernetic approach (Rhodes, 1996), helps to provide an overview of governance, its relations and interactions. 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). Kooiman's theories even explain changes in governance paradigms themselves (meta-governance) (Kooiman, 2003). As we explained earlier, 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 a downside, as it is either too abstract or too difficult, and too all-encompassing for operationalisation on a more detailed level. Nevertheless, as we witness SDI governors in practice struggling to gain an overview of 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 to SDIs to make our system less abstract.

Kooiman's governing system can be broken down into four elements: images, instruments, action and structures (Figure 2) (Kooiman, 2003). 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 all actors 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).

Once 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*' (Kooiman, 2003, p.62). Via feedback from affected actors, it can be determined whether the governing action was effective and appropriate. The initial image will be altered by this feedback (Kooiman, 2003).

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', as opposed 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 SDIs, 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 for choosing these cases is their age, as both cases date from around 2000, which makes it possible to review the changes in their governing systems over time. Both cases can be seen as goal-oriented SDIs, 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 are also openly accessible from quite an early stage. However, their governing systems and their developmental paths are very different. By choosing two distinct cases, it can be determined whether it is useful to perform an analysis with the governing system framework.

To order data on governance processes over time, we use the heuristic method from Klijn and Koppenjan (2016) to divide the cases into 'rounds'. A 'round' is a time interval which starts and ends with a crucial decision. A crucial decision is identifiable when 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 that forced the governing system to change. The following section will describe the cases and the identified rounds.

*3.1.1. Risk Map (*Risicokaart*)*

In 2000, a great disaster struck the city of Enschede, the Netherlands. A fireworks depot exploded in close proximity to a residential neighbourhood. Twenty-two people were killed, 950 persons were injured, around 500 homes were destroyed and 1,500 buildings were damaged. One of the conclusions was that many citizens were not aware that they were living near a fireworks depot and that information about such hazardous locations was fragmented (Oosting, 2001). Realising that there were many more potentially dangerous companies and facilities in the Netherlands, the Dutch national government ordered the creation of a so-called 'Risk Map' (Dutch: *Risicokaart*) which should be accessible for all citizens and on which all potential hazards should be visible (De Vries, 2001).

To create the map, the national, regional and local governments with the responsibility to grant permits for these hazardous facilities, supplied information for the Risk Map. This information is collected in a central database and disseminated. Apart from serving to inform citizens, the Risk Map was also of value

for emergency services which prepare for and prevent potential disasters, and for organisations planning new housing areas. The Risk Map is open to everyone, although more detailed information is only accessible for governments via a log-in.

Two rounds for the Risk Map can be distinguished: one round is the period from 2000 till 2013 and the other is from 2014 till now. After multiple negative signals in 2013, such as a negative inspection report and a letter of protest from civil servants, the crucial decision came that the Risk Map could not continue in its current form. On a technical level, the SDI had become impossible to maintain, because it used legacy software and many customised add-ons. On the institutional level, roles and responsibilities of actors were not clear enough to coordinate the Risk Map properly. Or in other words: the governing system no longer functioned well enough. Since then, considerable effort has gone into 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 small and densely populated country, the Netherlands has a long tradition of spatial planning. However, to satisfactorily plan how many new houses and commercial buildings are required and where they should be located, one needs information on and an overview of all the current plans. Therefore, the 'New Map of the Netherlands' (*Nieuwe Kaart van Nederland*) was presented in 1997, based on a project from several planning associations to collect all local and regional plans and assemble them into one national map.

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

In view of 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 formed an organisation, established a foundation and succeeded in relaunching the '*New* Map of the Netherlands'.

As with the Risk Map, two rounds can be identified within the New Map of the Netherlands case. The crucial decision of the Ministry of Housing, Spatial Planning

and the Environment (VROM) to stop funding this map in 2010 marks the end of round 1. Without these resources, the New Map was not able to continue. However, this did not end the need and ideas for a New Map, and by self-organisation, the New Map underwent its 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. Actors were asked how they perceived 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 experienced it nowadays. In this way, a great deal of information about the governing system and its evolution unfolded. In total, we spoke to nine persons about the New Map of the Netherlands and to eight about the Risk Map. The interviewed persons held a variety of SDI positions, such as SDI coordinators, data users and data providers, and had varying track records (long and short involvement). This provided a complete picture of the governing system and its inner workings.

However, as we wanted to study the longitudinal development and memories can change, we also used documents as a complementary information source. 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, every interviewee was asked whether 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, was 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.

To begin with, the above method was used to code the documents and interview transcripts of the Risk Map, resulting in a long list of codes about images, instruments, action and structures. During coding it became apparent that, to

obtain a better understanding of SDI governance dynamics, we would need two extra categories: interactions and SDI performance qualities. As governance is founded on interactions, we added the interaction category to understand the formality and direction of interactions used within a round. The category of SDI performance 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. It is essential to understand this relationship in order to explain SDI governance dynamics.

In the next step, multiple codes were combined or refined, so that analysis of the codes is more efficient and it becomes easier to find patterns. The creation of these subcategories was also based on findings from current scientific SDI and governance literature. For many subcategories, it was decided to make an additional distinction as to whether the subcategory influenced the governance positively or negatively. Every piece of coded text was revised with the new refined coding framework. This framework was also used to code the other Risk Map and New Map of the Netherlands texts. Finally, all codes were checked for consistency and redundancy. Every interview and document was checked at least twice.

The next section will operationalise and explain the coding framework we used.

3.4. Coding framework

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

3.4.1. Images

The following codes were used to code the category of images.

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

Every involved actor has their own perception 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 and negative remarks to gain an indication of the *satisfaction* of actors regarding the SDI and its governing system.

Feedback loops, both positive and negative, are an important feature of complex adaptive systems when adjusting inputs and processes (Grus et al., 2010) and are also essential for SDIs (De Man, 2006). With continuous feedback, the governing image can be adjusted (Kooiman, 2003). Therefore, we coded both *positive feedback* and *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 the images of involved actors is an important step in making the governing action more effective. We coded the collaborative images between actors as *aligned* or *unaligned* by identifying agreement and disagreement among involved actors.

An explicit image is a vision or common goal. When a vision is shared 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 goals or visions as being *explicit* or *individual*. The latter code is mainly suitable for qualitative analysis aiming to understand how actors see the future of the SDI.

3.4.2. Interactions

The following codes were used to code the category of interactions.

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

Governance processes consist of interactions between actors, bound by structures. However, the choice for certain types of interactions explains whether an SDI is mainly hierarchically governed, network-governed or self-governed. Kooiman (2003) distinguishes three types of interaction: interferences, interplays and intervention. *Interferences* are the least organised kind of societal interaction and can be seen as the 'primary' daily societal interaction processes. *Interplays* can be seen as 'horizontal', semi-formalised interactions. Interplays are the central interaction form of network governing. *Interventions* are the most formalised interactions and are 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*, determined by the hierarchical position of the actor and the direction of the interaction. Top-down does not mean in this context that the interaction necessarily

came from the actor at the top of the hierarchy (such as the national government), but that the interaction came from an actor in a higher governing position.

Although interplays are meant as horizontal interactions, they can have a kind of direction. For example, in a working group where actors from both the national and the local governments participate, interplays can have an implicit direction. However, it is not always possible to distinguish this.

3.4.3. Instruments

The following codes were used to code the category of 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 lists of useful SDI governance instruments also exist (see 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 in exactly what an instrument aims for.

Kooiman (2003) describes three categories of instruments, which are connected to his categorisation of interaction types: *information, organisation* and *rule.* Under the category of 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 obtaining information. Under organisation, we coded more formalised instruments such as task allocation and the formation of work and steering committees. Under rule, we coded the most formal instruments, such as policies and laws.

An extension was made to draw a distinction between ‘detectors’ and ‘effectors’ as proposed by Hood (1983). The previously stated coding examples for instruments can be seen as effectors: instruments which are used to influence society (Hood, 1983). Detectors are instruments which are used for taking in information and thus strengthen the image. An example of a detector for information is collecting 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 of action.

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

To steer governing action in the right direction, leadership, coordination and self-organisation can be used (Kooiman, 2003). Additionally, in SDI literature, leadership and the need for 'white knights' is designated as 'critical' for an SDI (Kok and van Loenen, 2005; Craig, 2005). Besides leadership, SDI literature recognises the need for coordination as essential (Dessers et al., 2012; Vancauwenberghe, 2013). Therefore we coded *leadership* and *coordination*. For each code in the action category we coded them as *present* or *lacking*.

Self-organisation is also an interesting example of a governing action for SDIs (Kok and van Loenen, 2005; Welle Donker and van Loenen, 2017). The self-organising ability of the SDI community seems an important precondition for ensuring SDI survival (Sjoukema et al., 2017). In addition, we coded self-organisation as being available or lacking, although the latter is not often mentioned.

We added an extra action element not found in Kooiman, *collaboration*, as close collaboration will foster governing action. It can be argued that collaboration is almost the same as self-organisation. However, during coding we observed that weak collaboration or coordination can lead to more self-organisation, as actors start to create various solutions individually, which leads to more information fragmentation. Like the other action categories, we coded for collaboration as being either *present* or *lacking*.

3.4.5. Structures

The following codes were used to code the category of structures.

- Roles and 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 whether it is *enabling* or *constraining.*

The involvement of stakeholders can be institutionalised by creating coordinating functions or entities. In this way, roles and responsibilities are allocated and some hierarchical difference between the coordinator and the coordinated organisations is generally 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 important enablers for SDIs (Rajabifard et al., 2002; Vancauwenberghe et al., 2018; UN-GGIM, 2017; Vancauwenberghe and van Loenen, 2017). Yet, laws can also become a constraining factor. In cases where these policies and laws were 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 (Welle Donker, 2009; Vancauwenberghe and van Loenen, 2017; Welle Donker and van Loenen, 2017). However, in our coding framework we also recognised four other resources: *time resources, knowledge resources, political capital* and *social capital*. Among *time resources,* we assume that actors have permission and opportunity to spend time on a certain subject. Among *knowledge resources,* we assume the availability of knowledge and expertise. Although Kooiman (2003) uses the term social-political capital, we choose to split this concept in two. In our research, *social capital* denotes availability of and access to social networks. By *political capital,* we mean availability of and access to hierarchical decision-making power. A person with political capital does not have to be a politician, but can also be the executive director of an organisation.

We used two codes which are especially applicable to SDIs. These are *technology* and *standards*. Technology (or access network) and standards are important

enablers for SDIs and are seen as core SDI components (Rajabifard et al., 2002). However, we noticed during coding that these two structures can also act as constraints to SDI renewal.

Support can be seen as the structural component of governing action (Kooiman, 2003). Support from both the political level and the 'work floor' is needed to enable SDI development (Kok and van Loenen, 2005; Vancauwenberghe and van Loenen, 2017; Vancauwenberghe et al., 2018). We did not make a distinction between these levels, as by combining the support code with, say, 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 actions such as collaboration. Culture proved the most difficult structure to code from texts, as it is usually 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 from SDI performance, we added three codes to obtain a basic indication of SDI qualities:

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

Although it is not our goal to properly assess an SDI, it is helpful to gain insights into the SDI performance qualities during the governance rounds. We coded six aspects of SDI performance in three pairs: *good data provision/bad data provision*; *high data quality and availability/low data quality and availability;* and *use*/*non-use*. Under data provision, we understand the willingness and the actual provision of data by actors. Data quality and availability is a combined code, encompassing data quality aspects as well as the availability of services. Of course, data is shared to be used: the codes for use and non-use indicate whether actors state that they deliberately use or do not use the data provided by the SDI.

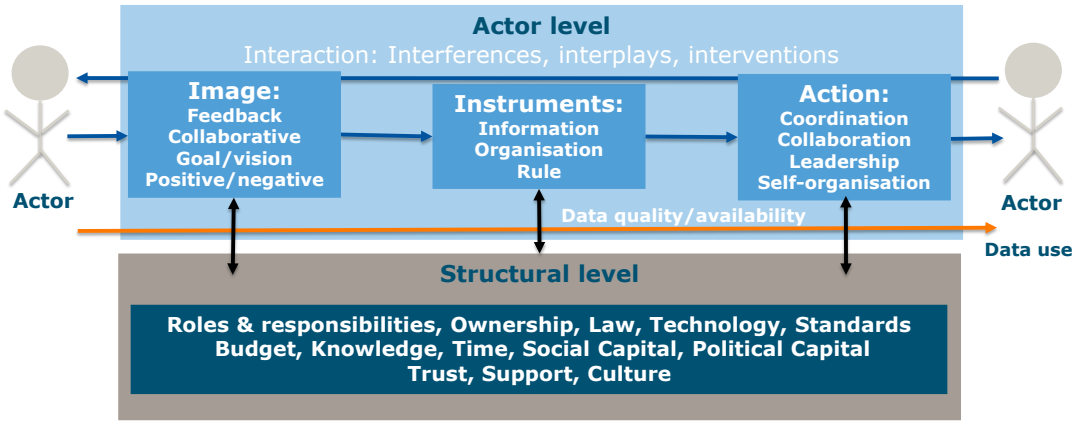
Figure 3 summarises the coding framework used, as embedded in the framework of the governing system.

3.5. Analysis

Coding the documents and transcripts had two purposes. On the one hand, it provided more insights and better interpretation of the collected material for a

qualitative analysis of how the SDI and its governing system evolved. On the other hand, it helped us to see patterns and trends emerge, and to discover differences in the governance system between rounds.

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



To discover patterns and trends in documents and transcripts, the frequency of a code can be used. However, as the total number 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 was to calculate an indicator per code based on the total number of codes per round; the other indicator was to look at the relative frequency within a category of codes, for example by observing the relative presence of the code ‘collaboration’ within the category ‘action’. If the difference between the first round and the second round was more than 0.5% for the first indicator and/or more than 1.5% for the second indicator, this difference was recorded as a 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 about a governing system in a certain period. This is because the codes’ source material can cause them to become biased. For example, many documents and interview candidates explained the origin of the Risk Map with the fireworks disaster in Enschede and the concept of 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 to round two, but this does not necessarily mean there is a lack of explicit vision in round two. Nevertheless, using these frequencies as an indicator in combination with the qualitative analysis proved a helpful tool for identifying 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 was a lack of central information about potential hazards and the communication about these potential hazards to citizens was poor (Oosting, 2001). This image was not entirely new. A few provinces had 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 were assigned the task of making an inventory of potential hazards and a crisis response plan for each hazard. The Ministry of the 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 was given the task of setting up a registry for hazardous substances (De Vries, 2001). At first, this registry was intended as 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 with the Ministry of Housing, while the Risk Map was owned by the Ministry of the Interior. Because both ministries had the task of designing laws and regulations (one of them for the Risk Map and the other for the registry for hazardous substances), close collaboration between the provinces and ministries was necessary to prevent inconsistencies.

The provinces had the task of creating and maintaining a Risk Map. At that time, the development of an SDI was technologically challenging. This assignment thus ushered in a period of innovation and self-organisation. Several provinces took the initiative to develop a Risk Map system and experiment with its creation. As provinces were not used to collaborating with one another 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 New York's World Trade Center in 2001, the scope and goal of the Risk Map suddenly became a point of political discussion. It was argued that a public map which located all potential risks could be easily misused by terrorists. The discussion was settled by creating a public version for citizens

providing a basic overview and a secured environment where crisis response teams and governments could obtain more detailed information.

In 2007, the Risk Map and its accompanying laws were in place. The two ministries withdrew their active involvement 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 aspects of the Risk Map. Each province stayed responsible for policy making concerning the Risk Map. The data was mainly provided by municipalities.

The Risk Map was subjected to continued experimentation and innovation. New features were added and a pilot for a cross-border data infrastructure was organised. In 2010, many legal tasks and responsibilities of the provinces concerning safety and crisis management were transferred to newly created 'safety regions'. These regions became main users of the professional version of the Risk Map, while use by provinces diminished. Additionally, ownership of the Risk Map was transferred from the Ministry of the Interior to the Ministry of Justice and Security. However, tasks and responsibilities for the Risk Map itself remained with the provinces.

After this shift in responsibilities, support for the Risk Map crumbled. The national government had been showing little interest since the implementation of the legal framework, and with the transfer of legal responsibilities to the safety regions, provincial support weakened as well. 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 these problems and the lack of confidence in a solution, several provinces actively chose to diminish support and execute tasks only if they were legally necessary.

At the end of 2013, an inspection by the Ministry of Justice and Security concluded that the Risk Map was not an effective instrument for risk communication, because of the untrustworthy data quality and a lack of coordination. These problems were seen as interrelated (Inspectie Veiligheid en Justitie, 2013). In 2014, the twelve provincial coordinators urged changes as the technologies and contents of the Risk Map, as well as policies for administering it, were all outdated.

4.1.2. Round 2: 2014 – Now

The provincial coordinators' call for change was heeded. A task force studied the problems associated with the Risk Map and made recommendations for improvements. A central programme manager was appointed and a plan to improve the Risk Map's governance was drawn up. Roles and responsibilities were made more explicit. Ever since, the main provincial responsibility for the Risk Map has been borne not by all twelve provinces, but by one provincial deputy, who is a member of the Association of Provinces and acts as owner. In addition, the steering committee of the Association of Provinces changed into a committee with a stronger focus on content rather than financial resources. This centralisation of the Risk Map's ownership endowed it with improved political capital.

On the operational level as well, more structures were added. The provincial shared service organisation improved its change management process by making it more transparent for the provincial coordinators. Every year, an annual plan is now drafted in collaboration with the programme manager. There are two provincial committees, one on the operational level and another on the tactical level, where collaborative decision making takes place.

The provinces are also trying 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 are outdated. Furthermore, new actors such as the safety regions are now involved, but their legal responsibilities and involvement with 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 reuse existing data, so providing data would become easier. Another idea is to provide all data 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 an SDI, is seen as an opportunity for the Risk Map by some actors, while others see it as a threat.

The Risk Map still faces some major challenges. Support for the Risk Map varies from province to province. Some argue that 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. As a result, they now self-organise to build new Risk Map products on top of data and services from the current Risk Map. Also, in many regions, environmental services have taken over the job of data providers from municipalities. This has led to an

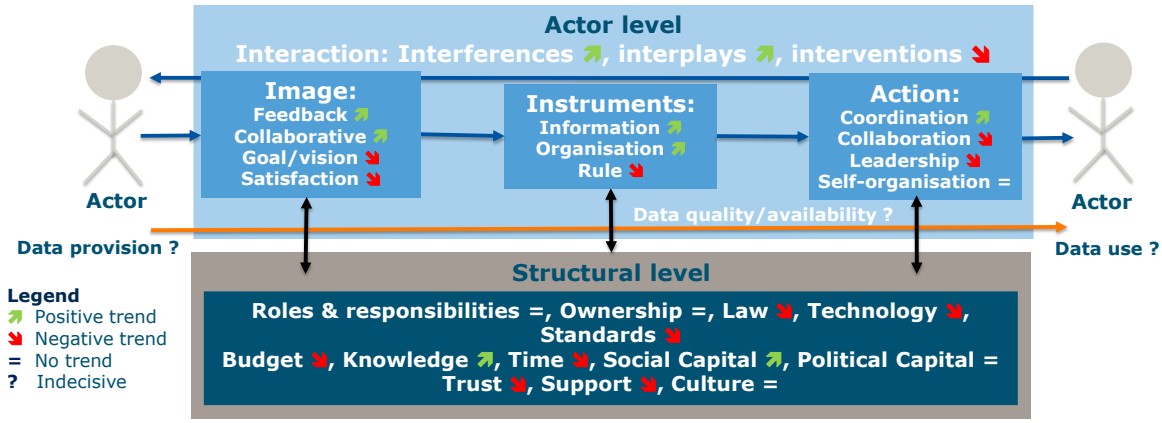
improvement in data provision, but these environmental services also lack a formal role in the governing system of the Risk Map.

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 have been made more clear, the legal and organisational context of the Risk Map still is too complex. More changes to the Risk Map on a structural level seem inevitable.

4.1.3. Analysis of the governing system

When we compare the relative frequencies of round 1 codes with those for 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 than in round 1. A possible explanation could be that the emergence of the Risk Map's 'governing crisis' sparked more alignment of images. Additionally, more positive feedback is now flowing through the system. However, the satisfaction in both rounds seem to be more negative than positive.

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 order from the national government to create a Risk Map after the fireworks disaster in Enschede. Interplays are the main form of interaction in both rounds. Because twelve provinces have the shared task of creating a Risk Map, this interaction form seems a logical fit.

Coordination is improved in the second round, as a lack of coordination 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. In the second round we also see a decrease in support and trust, 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, an increase in self-organisation occurs when coordination is lacking or the stakeholder's requirements are not fulfilled. This self-organisation can lead to fragmentation of information and systems.

Although coordination is improved, the codes indicate no strong change either in roles and responsibilities, or in ownership. This can be explained by the fact that roles and responsibilities have been made clearer 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 a lifeline 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 belief that technology can be an enabler when a new Risk Map system is built.

This relates also to another constraint; the budgetary resources. In fact, there is no shortage of funding for the Risk Map, but many actors think the costs of the current system outweigh its benefits. The greatest share of the budget goes to maintaining the outdated technology. An important condition for the new Risk Map is actors' expectations that its maintenance should be cheaper than that of its immediate predecessor.

The codes about SDI performance qualities give mixed results in every area (data provision, data quality/availability and use). From the interviews and reports, it is clear that data quality has improved slightly over 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 an idea of spatial planners who required more information to obtain a better overview of the spatial dynamics in the Netherlands. This need for information was not new, as the National Planning Office (*Rijksplanologische Dienst*) in the Netherlands had previously tried to gather

statistics about the current and planned building capacity. However, what was new here 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 great deal of momentum 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 much attention from politicians, professionals and the general public. Because of its success, the ambition was to create a 'New Map' every two years, making it possible to look even further into the future.

Meanwhile, around the same time, the National Planning Office also needed 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 information sources it used was the New Map, and in 2003 it was decided that the New Map of the Netherlands would receive a subsidy from the Ministry of Housing, Spatial Planning and the Environment (VROM). The New Map also incorporated the idea of making a distinction between 'soft' and 'concrete' plans.

From then on, the New Map was administered as follows. The Ministry acted as client to the New Map Association. The map itself was executed by 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 digitise analogue maps with GIS and fill in the attributes in a standardised manner while working with unstructured plans: a labour-intensive method.

In a way, the organisation was 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 into 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. As decentralisation continued, spatial planning in the Netherlands became less of a national affair and provinces became responsible for keeping an eye on all municipal plans. The province of North Holland noticed that the New Map was mainly spatially focussed; it therefore developed its own monitoring system, which included also statistical aspects of new residential areas. The advantage of this system was that it directly

involved municipalities as data providers, giving the data a more 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. By suspending its payment for the labour-intensive data collection, the Ministry could easily save one million Euros per year. Furthermore, it was argued that because of the decentralisation of spatial planning, involvement of the national government was no longer needed. A digital system for legal zoning plans was also introduced in 2008, 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 those organisations were wary of the costs. Furthermore, the economic crisis had slowed spatial planning down and caused house prices to drop dramatically, and there were great doubts that matters would improve. Without any funding, the association and the New Map of the Netherlands itself had to cease operations.

4.2.2. Round 2: 2010 – Now

Several initiatives started to bring the New Map back to the political agenda. In 2011 a study on behalf of the national government showed the need for more information about spatial planning and set up ideas for a new, affordable, official monitoring system. From the findings, it became clear that almost every province was already collecting information about building plans for residential purposes, although their approach differed. However, no follow-up study was commissioned to centralise these different systems.

Meanwhile, the monitoring systems of the province of North Holland and South Holland were in place, which raised interest from the other provinces. A study was performed to decide which of these two monitoring systems was a better fit for the other provinces' purposes. It was decided that the South Holland system would be better, as it used open standards and open source software. Six of the Netherlands' 12 provinces joined the system of South Holland, while the North Holland system was adopted by two provinces. The province of Limburg created its own system. The remaining three provinces of the Netherlands do not have a monitoring system for spatial plans.

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 systems. 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 them the Ministry of the Interior (nowadays responsible for spatial planning) and the Netherlands Environmental Assessment Agency. Both provide the association with some funding in exchange for participation in the association.

Combining the data of the two provincial systems made it possible to create a map with plans of approximately half the country. However, municipalities can choose for various reasons to restrict access to their plans, and deny access to the public. Therefore, data for only a small part of the country are available to the public. The current challenge is to convince other municipalities and provinces to voluntarily release 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 by itself and adds it to the *New* New Map.

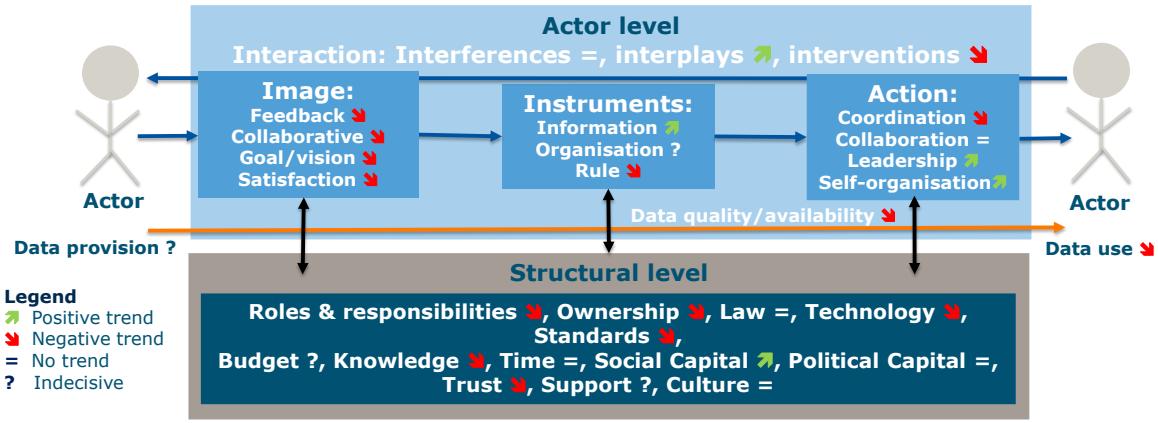
4.2.3. Analysis of the governing system

When the decision was made to stop producing and disseminating the New Map, the governing system of the New Map of the Netherlands changed drastically. When we compare the relative frequency of codes from round 1 to round 2 (see Figure 5), we see a decrease in most aspects regarding the organisation of an SDI, such as an explicit image (goal/vision), the action 'coordination', the instrument 'rule' and structures such as 'roles and responsibilities', 'standards' and 'ownership'. When we look at softer aspects, we also see in the second round that images are less aligned and there seems to be less trust. Also, the data quality/availability and use seem less.

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

Somewhat surprisingly, technology also seems to be more constraining in the second round than in 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 ahead of its time in its dissemination channels.

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.



Still, not everything has decreased in comparison with the first round. The codes indicate 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 budget for the *New* New Map has been greatly trimmed—some estimate that the current costs are ten times lower—while it is a much greater challenge to raise enough money from supporting organisations than it was during 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-organising network of professional volunteers, with virtually no structures. 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 in view of 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-organised SDI, a more structurally embedded SDI can emerge.

5. DISCUSSION AND CONCLUSION

This study has attempted to understand SDI governance dynamics by means of a thorough analysis of the governing system. With the help of the governing system

framework, more insights into the strong and weak aspects of the governing system became apparent. By comparing governing systems of an SDI 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, with some modifications the framework can perhaps 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 experienced a sudden stop, this time interval seems to fit. However, for the Risk Map, which gradually evolved into a crisis situation and also incrementally tried to break away from it, a finer-grained time interval would probably give even more insights into changes in the governing system. Longitudinal research which assesses the governing system of an SDI year by year would be a revealing topic for complementary study.

One drawback of our focus on the governing system only is the fact that external factors are not taken into account. These external factors are unpredictable and beyond the control of the actors in the governing system, but in both case studies we see that external factors actually seemed at least partly responsible for the crisis situation in the governing system. As a result of changes in the political and economic system, it was decided to stop funding the New Map. Similarly, the decision to reorganise the safety and disaster system in the Netherlands caused problems for the Risk Map, whose organisation remained largely based on the old system. Like other complex adaptive systems, this openness and sensitivity to external factors is a feature of SDIs (Grus et al., 2010), but this does not make SDI governing an easy and predictable job.

In this respect, it is interesting that many involved interviewees imagine a future where multiple SDIs and datasets are connected. In both case studies, an important future goal is to diminish data providers' effort by reusing existing data and connecting data to other datasets and SDIs. Spatial data provision is evolving from central to decentralised, towards an ecosystem of spatial and non-spatial data infrastructures where both centrally and non-centrally provided data resides. Not only governments, but also the private sector and citizens play a pivotal role in this ecosystem as users and/or producers of data (Budhathoki et al., 2008). In this way, data collection and sharing becomes more efficient and inclusive, but the SDIs will also be more sensitive to and dependent on each other's changes, which increases the complexity of their governance.

The proposed governing system framework gives another viewpoint for looking not only at SDIs, but also at existing SDI frameworks. For example, the five classical

SDI components of Rajabifard, people, data, standards, access network and policy (Rajabifard et al., 2002), fit in the governing system framework. Standards, access network (or technology) and policy are important 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. Additionally, other SDIs such as INSPIRE suffer from overly 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 framework used here seems a useful method to better understand the governance and governability of an SDI. Two weaknesses are that it does not give insights into causalities and it does not encompass external effects, which could have a major influence on SDIs. Moreover, with the qualitative method we used, we can only make comparisons between rounds within the case study itself. Comparisons between different SDIs would appear difficult. 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 tool for understanding SDI governance dynamics. With the 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, the governing system framework must be applied to other types of SDIs and SDI contexts in order to provide proof of its full potential.

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APPENDIX

Tables showing the coding results per case. First the absolute amount of code frequencies per round is shown. Thereafter, two indicators are shown. The first indicator is calculated by calculating a percentage of a code compared to the total amount of codes per round. This calculation is done for both rounds and then this percentage is subtracted from each other, resulting in the percentage shown in the column 'relative difference between rounds'. When the difference is more than 0.5% or -0.5%, the number is shown in bold. The second indicator is calculated in the same way, but then the percentage is calculated compared to the total amount of codes within a round per category (e.g. 'action'). Again, these percentages are subtracted, resulting in the indicator shown in the column 'relative difference within category'. When the difference is 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%**
	Satisfaction	**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 2: Code frequencies of the New Map of the Netherlands

Category	Code	Attribute	New Map Round 1	New 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%**
	Satisfaction	**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**		