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Digital Strategies in Action - a Comparative Analysis of National Data Infrastructure Development

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ABSTRACT

In recent years, many countries have started to draft strategies and policies related to the data economy. To support new data-driven activities and innovations, the development of a national data infrastructure (NDI) is seen as key. The concept of NDI has entered governmental strategic discussions on data as an asset, the role of data infrastructures in innovation and economic activity, and the role of government therein. However, there is a gap between the ambitions as laid out in the strategies and the actual actions taken towards realizing them. To understand this gap and support NDI development, insight is needed in the components and processes of realizing NDI strategies. In this paper, we study NDI strategies 'in action' in the Netherlands and Switzerland using an analytical framework comprising strategies, stakeholders, design, components and governance. Special emphasis is put on the role of government in formulating and implementing strategies. Our cross-case analysis uncovers lessons that seem relevant for NDI development elsewhere, as well as challenges that need to be resolved before NDIs can hope to actually make the impact associated with them.

CCS CONCEPTS

• **Applied Computing → Computers in other domains → Computing in government → E-government**

KEYWORDS

National data infrastructure, Open Government Data, E-Government, Data Policy, Governance, Strategic Management

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1 INTRODUCTION

Infrastructures are key parts of the societal and economic fabric of societies. Typically, these include physical infrastructures that we see and use on a daily basis, such as road, rail or energy infrastructures, which particularly impact economic growth and competitiveness [27]. In a similar vein, policy makers and academics have started to look at digital infrastructures as a valuable public good that creates benefits for a large number of users. Over the last decade, a special focus has been on data infrastructures in terms of promoting open government data (OGD), as is reflected in the many OGD initiatives worldwide. Open data infrastructures would not just serve transparency and efficiency in government, but also enable or facilitate a data-driven economy [3, 34].

The concept of a national data infrastructure (NDI) is often seen as being represented in government open data, but is actually much broader in terms of data (beyond strictly open data, potentially including personal and closed data), implementation options (beyond OGD portals, including a range of building blocks, e.g. base registries) and goals in terms of data sharing and re-usage and the benefits associated with it [24].

More recently, the concept of an NDI as just outlined has entered governmental strategic discussions on data as an asset and the role of data infrastructures in innovation and economic activity. However, a transnational understanding of what an NDI is or should be has yet to emerge, both within research and practice [24]. The main challenge is that we are not talking about implementing new technology (e.g. data portal), but about adopting an integrated view on the many components (material and immaterial) that have been developed over the past couple of decades to support e-government infrastructures and inter-

agency data sharing. The problem of matching a high-level strategy to the many existing elements that are relevant to an NDI, but are hardly joined-up at a national level [22] is also a challenge for policy-makers.

To support NDI development, we need to know more on how to manage and govern national data infrastructures, what the role of the government can and should be and how to deal with decentralized building blocks and with fragmentation in ownership and control. To address this, insight is needed in the process of developing and realizing NDI strategies.

In this paper, we study 'strategies in action' by looking at the development towards national data infrastructures in two countries working on such infrastructures at a national level: Switzerland and the Netherlands. This paper answers the question: Which lessons can be drawn from a comparison of Swiss and Dutch strategies? To gain a structured insight in these two cases, we partially build up on our earlier work [9, 19, 20, 24] and review relevant literature in the field in order to develop an analytical framework that guides our discussion of the Dutch and Swiss NDI activities. Based on this we study and compare the paths that governments in these two countries are taking towards an NDI as well as where they are currently taking actions on this path. The lessons learned from the case comparison will be used to present initial considerations on developing a maturity model for NDI development that could be enhanced by future research activities and seems useful for guiding action.

2 THEORETICAL BACKGROUND

In recent years, technological developments have brought forward many digital applications and devices that use and produce data. The amount of data available digitally is growing very fast [15]. Ubiquitous computing and the omnipresence, at all levels, of ever more data, have a major impact on social life, business, economic activity, and government: they lead to a 'datafication' of society. This datafication holds the promise of being capable to support or even drive growth and innovation in civil society, the economy and public governance [8, 18]. Yet, the OECD argues that "seizing these benefits poses a formidable challenge to policy makers" [26]. They argue for treating data as an infrastructure. In recent years, many countries have indeed started to draft strategies and policies related to the data economy. These strategies relate to – for example – which technical building blocks should be provided to society, data sharing within and by government itself, open data, supporting sectorial or national data platform initiatives, or to incentivize new data-driven innovations, in a collaborative way [21]. There is however a gap between the ambitions laid out in those strategies and the actual actions taking place towards realizing them. In this section, we discuss a theoretical background of data infrastructures to get to an analytical framework that we use to study what actions two countries take towards enacting a national data infrastructure.

2.1 Data infrastructures

Data infrastructure can be understood as a community-wide need, respectively a public good [28], which is part of the digital infrastructure. Data has become an essential driver of innovation, and it can be considered as one of society's central infrastructure resources [26]. As they in principle support public goods, it may be desirable to manage them in an open and accessible manner. Data may be used as an input into a wide range of (private, public or social) goods and services [12]. This is not unlike the more traditional infrastructures (e.g. road, rail, energy) that are vital to society and the economy and in which governments often play a key role.

Compared to the common understanding of e-service or open data infrastructures, the notion of a national data infrastructure (NDI) is more open with regard to data, implementation options, fields of application and goals [24]. Data infrastructures can be made up of data owned by governments, businesses or non-profit organizations, the data can be openly licensed, can be made available for re-use by specific stakeholders or be closed. Several countries have adopted the concept of a NDI in order to effectively share core government data sets within and outside government and stimulate their use across boundaries in order to create value and realize data-driven innovation. The ultimate goal of a NDI is to provide a large variety of data to interested stakeholders. From a technological perspective, the NDI thus needs to support the provisioning of data in appropriate data formats and the consumption of selected data via easily accessible channels.

Infrastructures entail both technical and social elements and cannot be merely conceptualized as being technology-dominated [1, 7]. Jetzek distinguishes between an IT infrastructure and a regulatory infrastructure [17] and Klievink et al. [20] analyze public-private data platforms from separated (but interrelated) viewpoints starting from the technological framework on the one hand, and governance on the other. Therefore, in the remainder of this background section, we discuss both facets by starting with the strategies for NDIs and the actors involved on the one hand, and the design components and governance of the infrastructure on the other.

2.2 NDI strategies and strategies in action

Strategies are an instrument for fostering innovation and guiding action in the public sector. By making a governments intention to address a certain issue public and setting out how to do so, strategy documents can also be considered as policy instruments [5]. As public policies, strategic planning "may also have the symbolic function of demonstrating political will to certain interest groups [29].

The strategy process usually entails the following set of activities: definition (vision, mission, targets), situation analysis (internal, external), strategy formulation (options and selection), implementation (planning, resource allocation, change management), monitoring and evaluating [14, 33]. Thereby it

must be noted that in the public sector, a given strategy often cannot be considered as stand-alone concept, but shares interrelations to other strategies and policies, why the strategy process also requires considerations on strategy integration (or hierarchization). This is for instance typical for national e-government strategies [33], OGD strategies and is also relevant for NDI strategy development (with e.g. the European PSI directive [3] or the Digital Single Market strategy as possible reference points).

Related to e-government strategies, visions can be classified as being focused on targets, on organizational change, on competitive performance or on becoming a role model. The formulation of targets (goals) fulfills a coordinating function [33], within and beyond organizational boundaries. While strategy implementation refers to the activities taken within the decision-making structures of public administrations, we use the term "strategies in action" to also cover activities that are referring to a public strategy, while not being governed by it.

2.3 Actors

Digital infrastructures can be used by a wide variety of actors, with usage, roles and types of actors evolving over time [16]. NDI strategies typically depend on external stakeholders for access to technological, organizational or financial resources. Almost by definition, an NDI takes place in networks of organizations rather than by individual organizations. Given the inter-organizational nature of NDI, it is key to identify which actors are involved, in what role (e.g. realizing components, maintenance, data provision or use, stewardship), and what their position is in the stakeholder network (e.g. neutral, supporters or opponents). Especially the role of government is important given the dependencies on others on the one hand, but at the same time requiring sufficient control to ensure that the infrastructure meets the government strategy [20]. The latter has to be balanced with the need to make it relevant and attractive to other actors, ensuring critical mass and real use. Including their requirements into the implementation of the strategy, and obtaining stakeholder commitment become critical activities.

2.4 Infrastructure design and components

The term digital infrastructure is used to describe shared, heterogeneous systems that evolve through technology and actors [16, 30]. These include interdependent and interconnected collections of technical components, operating across organizational boundaries [13, 30]. Actors can use and extend the infrastructure and integrate it with their own operations. Components include systems, networks, standardized information exchange processes, data models, taxonomies, technology specifications, web services, authorization and authentication facilities, and security including public key infrastructures [2]. Data infrastructures allow for sharing and re-using data that may be held in different systems and can thus be considered as part of a digital infrastructure.

Infrastructure development is a core issue for improving public service-provision in the context of e-government. The focus is on shared infrastructures for enabling interagency collaboration [11]. A shared e-government infrastructure lays the ground for interoperable and re-usable solutions that allow for providing public services seamlessly, for example through web portals [22]. The relevance of interoperable data and information sharing is also stressed in the European Interoperability Framework (EIF), which provides a conceptual model for public services and considers data-related services as a basic component for service provision. The focus is on base registers that are legally controlled and maintained by public administrations and provide authentic sources of information on items such as persons, companies, buildings, or roads [10].

2.5 NDI governance

The transition from the concept stage of the NDI to its practical implementation requires that the involved stakeholders (as discussed in §2.3) agree upon an infrastructure governance framework in order to coordinate cross-organizational action based on a shared vision. Governance includes (social) practices, structure, control and processes for decision-making [32]. It includes formal and informal instruments and mechanisms to this end, including laws, administrative rules, practices, decision-making processes and institutional arrangements [6, 23]. Tiwana et al. [31] identify three main elements: the partitioning of decision rights, formal and informal mechanisms of control, and the ownership structure. Among the most critical issues when it comes to setting up and maintaining a NDI are the decisions concerning access and use rights with regard to the different parts of a NDI and in particular, the funding of both its components and the necessary coordination.

A particular difficulty here is the division of shared cost for the infrastructure maintenance and developments, especially since the costs and benefits are often distributed unequally across the various stakeholders. Seizing the benefits from data driven innovation requires the willingness to collaborate. In order to create public and economic value, incentive systems for cooperation and collective action need to be developed, covering the entire data life-cycle [1, 4].

2.6 Analytical framework

To facilitate the comparison we draw a rudimentary framework with different analysis dimensions (table 1). The framework is based on the four dimensions and sub dimensions as theoretically and conceptually described in sections 2.2-2.5. For both cases, we study the strategy in action (i.e. general activities related to pursuing an NDI), the building blocks (e.g. activities, portals, base registries) of the infrastructure, and infrastructure governance approaches. Such an approach including a comparison of national strategies has been proved useful in previous studies (e.g. in the open data context) [25]. Once more empirical research on NDI development is available, the

framework can be refined, e.g. in terms of development options. Currently, the authors consider the generic categories as sufficient for an initial cross-country comparison of ambitions and approaches for implementation.

Table 1: Comparative Analysis Framework

Strategies in action	Interconnections with other strategies/ policies Focus of the vision Target and goals Defined measures Other actions Expected value
Stakeholders, involvement and interaction	Actors involved Role of the government and other actors Design of interactions between actors Real interactions between actors Openness and costs Strategies for creating critical mass
Design and Components	Scope (e.g. corporate, regional, national or global) Socio-technical components provided / envisages Interoperability and openness of components
Governance	Formal and informal mechanisms of governance Partitioning of decision rights Governance principles Ownership structure Financing logic and models Evolvement of the types of users Evolvement of the infrastructure

3 RESEARCH APPROACH

We see a gap between the high-level policy papers and the isolated implemented components. We are interested in better understanding the various activities related to putting an NDI strategy in action and possible assessment models. This paper focuses on the comparison of two cases. The guiding question is: Which lessons can be drawn from a comparison of Swiss and Dutch strategies? The aim is twofold: to provide guidelines for the practice as well as first reflections for a theoretical discussion. We selected Switzerland and the Netherlands for the comparative analysis because in both countries, data politics and economy are on the policy agenda, but the approach and the concrete activities and existing components differ. In this early stage of the research we choose a case approach that allows the identification of components and activities in action inductively. The case information is based primarily on document analysis; for the identification of activities in action and for better understanding connections semi-structured interviews and workshops were conducted (see Table 2).

The Dutch and the Swiss cases in the next chapter will be presented along the four topics (1) strategies in action, (2) stakeholders picture, (3) design and components, and (4) governance issues.

Table 2. Overview of the information sources that were used in the cases

Sources	**Case 1: Swiss NDI**	**Case 2: Dutch NDI**
Document analysis		
Strategies	Digital Switzerland Strategy (2016) E-Government-Strategy for Switzerland (2016) OGD Switzerland Strategy (2014)	Dutch Digital agenda (based on EU Digital Agenda) (2016) Open Government Action Plan Netherlands (2016) Dutch National action Plan e-Government (2013) National open data agenda (NODA) (2016)
Reports and Documents	Action plan of Digital Switzerland (2016) Study Big Data in the Public Sector (2015) Swiss Data Alliance Statement Paper (2016)	Data landscape (Gegevenslandschap) Trend report Open Data (The Court of Audit 2014) Letters to the Second Chamber (Kamerstukken II 2014/15, 32 802, nr. 12; Kamerstukken II 2014/15, 32 802, nr. 18 Deloitte, 2015
Interviews and workshops (held in 2016)		
Workshop	Consultative brainstorming of the Federal Department of the Environment, Transport, Energy and Communications on Data policy	Workshop concerning Dutch open data user groups (Users of data.overheid.nl,
One-to-one Interviews	Three interviews with leading public administration officials One interview with a member of parliament One interview with a private initiative in the area.	Two interviews during mentioned workshop Interview with executive agency on infrastructure Interviews with private sector companies.

4 CASES

4.1 The Netherlands: Towards a 'data landscape' as a pillar of the economy

The Dutch Digital agenda (based on the European Digital Agenda) states the generic policy of the Dutch government to support the digitization of the Dutch economy. A part of this strategy is the digital infrastructure, which also concerns the physical infrastructure (e.g. broadband and mobile networks). In general, a shift can be witnessed in Dutch policy in that the digital economy and infrastructure are deemed ever more important. This is not just part of the government strategy, but also think tanks (RLI, specifically) and consultants have contributed to formulating the digital infrastructure as the third Dutch mainport (the other two being the Port of Rotterdam and the Airport Schiphol, both important pillars of the Dutch economy).

Related to the data infrastructure specifically, is the policy on moving towards a "data landscape". This policy explicitly states that good data are an essential resource for the government. The existing elements of this infrastructure are the base registries and other e-government building blocks (which we will discuss later). The data landscape aims to make more data accessible and usable and to provide the conditions for proper use of the data. Next to the digital base registries, the GDI (the common data infrastructure) consists of standards and products.

4.1.1 Dutch Strategies in Action. In terms of real action, the strategy is implemented through small, incremental steps. Currently, the government is working on: making arrangements for accessing and correcting digital data; methods and guidelines for the proper use of data; a federated knowledge network; a data catalogue; quality measurement of the base registries; and governance [I].

Next to these steps, the major 'strategies in action' (i.e. the real activities and implementation currently taking place) towards a national data infrastructure consists of two components. First, various organizations in the Netherlands are working on (open) data infrastructures for themselves or for their own specific domain. For example, there are various national research data infrastructures that are specific to research and innovation domains (e.g. one for the social sciences). Also, various organizations are working on opening up data. Improvements are being made regarding the release of government data through NDIs [II, III, IV]. A national portal to join-up many of these, also exists: data.overheid.nl. Second, the most tangible components are the 19 e-government building blocks that are being developed as part of the National Implementation Agenda. These will be discussed in section 4.1.3. The overall picture this paints is one of some fragmentation; although an overall vision on data infrastructures as enablers of data-driven innovations exists, the actual steps taken towards it are often either restricted to single organizations or domains (thus risking fragmentation) or are very small and practical in scope and ambition.

4.1.2 Stakeholders Picture in The Netherlands. The stakeholder situation is also fragmented. There are two major ministries involved in the digital policy in the Netherlands; the Ministry of the Interior (primarily working on the building blocks and e-services towards citizens) and the Ministry of Economic Affairs (primarily working on policy on the telecom infrastructure, on economic and innovation policy, and on facilities for companies). Next to these, there are also other ministries that play a role, for example the Ministry of Infrastructure (now starting to think about their role on the infrastructure side, besides their role in open data) and the Ministry of Justice (working on data for scientific documentation and insights). Next to these policy ministries, many of the building blocks are in fact implemented at the municipal level. There are 390 municipalities in the Netherlands, some of who collaborate specifically for the realization of the national digital goals. Finally, there are a couple of implementation agencies, such as ICTU and Logius, who maintain some of the national facilities or further develop policies.

4.1.3 Dutch Design and Components. In the National e-Government Strategy it was decided that the government pays for the development of ICT facilities, while municipalities, provinces and water board districts pay for connecting their own organizations to these ICT facilities [V]. The National e-Government Strategy provides 19 building blocks for an electronic government in five categories, namely:

- Electronic access to government
- E-authentication
- Information numbers
- Base registries
- Electronic information exchange

Dutch governmental organizations have decided to build this infrastructure (as a basis) and to use it collectively. Of these, the base registries, authentication and exchange facilities are important for the national data infrastructures.

There is potential for releasing more high value datasets and these have already been identified [IV]: "Despite data from Statistics Netherlands, only few datasets have been added (ref: additionally released) in the past year, while the data inventory showed that there are many datasets that may potentially be opened. Not everything that can be opened is currently open." [IV].

4.1.4 Governance Issues in The Netherlands. Since a variety of stakeholders are involved in the development of a Dutch NDI (see section 4.1.2), the governance of the NDI is challenging. The Ministry of the Interior and the Ministry of Economic Affairs are the main players involved, yet many other parties contribute to the NDI. The Dutch government is responsible for the digital infrastructure in two ways, namely 1) by providing the right preconditions, such as competition, cyber security and privacy and 2) by devoting itself to apply these preconditions in the digital economy [VI]. The basis for the preconditions has already

been developed with policy visions regarding telecommunication, media and internet.

Our study revealed that various formal and informal mechanisms of governance exist to deal with governance issues. For example, a first formal mechanism cluster of the Ministry of the Interior concerning the release of data for the NDI focuses on making an inventory, prioritizing high value datasets and releasing datasets. The second cluster concerns the monitoring of the progress and quality of data release and the related metadata. The third and final cluster governs activities related to the support for releasing data, for the use of technologies and for end-users. It provides an online and offline platform for data providers and users to meet and collaborate. An example concerns the physical open data user meetings organized by the Ministry of the Interior several times per year and the so-called open data lunch meetings, also organized by this ministry [II]. Such meetings are used to update interested parties with the latest developments, to exchange experiences, and to identify issues and next steps.

Interviews showed that informal mechanisms of governance are also taking shape. These include, for example, (open) data meetings where various governmental parties occupied with data release meet and exchange experiences and aim to learn from each other.

A variety of data portals and platforms are used to offer access to (open and closed) data. For instance, many municipalities, ministries and other governmental organizations have their own portal, while at the same time some central portals provide access to data that is also available at other places (e.g. via data.overheid.nl, nationaalgeoregister.nl and opendata.cbs.nl). Each organization can setup a platform, which results in a jumble of access points.

Regarding the financing logic and models, the Ministry of the Interior supports other governmental organizations in releasing data through NDIs, for instance, by prioritizing high value datasets. Examples of prioritized datasets concern education, healthcare, housing and energy. Each governmental organizations finances the data release itself and no financial support is provided by the Dutch government particularly for data release. Each governmental department has to develop a plan for data release (or express why it is not possible to release data through the NDI).

While an NDI in the Netherlands is still under development, it is slowly progressing and improving. It is stated that the Netherlands has a good point of departure due to the high quality of the digital infrastructure in the Netherlands [VI], which has attracted ICT-related companies and facilitates ICT business and activities (e.g. Deloitte). Nevertheless, to maintain the facilitating base for NDI developments, the Dutch government needs to provide appropriate preconditions. One important precondition concerns the economic situation. For instance, Dutch education should fit the needs for employees with digital capabilities [VI].

Providing appropriate and relevant preconditions for the development of the NDI is expected to result in further evolvement of the NDI and its types of users. For example, improved internet access, better data protection, increased data release and further development of data platforms may potentially attract new types of users (e.g. open data app developers).

4.2 Switzerland: Just a New Label for Open Government Data or the Core of a Data Policy?

Presently, an NDI in Switzerland is a strategic objective, not yet a reality. Politicians start looking at the provision of data as an infrastructure resource for the national economy. In recent years public authorities worked independently at different projects and activities that can be seen as part of such a shared infrastructure (e.g. sectorial portals, base registries, data inventory, metadata). The Digital Switzerland Strategy [C] sees the strategic basis of an NDI in the Swiss OGD policies [B] and claims the relevance of such an artefact as a holistic approach that enables"*good data governance*" within the Swiss data policy. Currently, the discussion is more about opening up government data (*content*) instead of facilitating the sharing of data for a national economy (*infrastructure*).

4.2.1 Swiss Strategies in Action. The Digital Switzerland Strategy [C] is an umbrella strategy adopted by the Federal Council for the exploitation of the opportunities of digitization in all areas of life. It intends to co-ordinate the numerous activities and existing expert groups already in place and embraces different action topics, as e.g. the digital economy. Key objectives of the strategy are innovation, growth and prosperity in the digital world, equal opportunities and the participation of all, transparency and security, and the contribution to sustainable development.

In the specific area of e-government the Confederation, the cantons and municipalities adopted a new strategy to jointly promote e-government in Switzerland (E-Government-Strategy for Switzerland, [A]). According to this, Swiss e-government solutions need to be service oriented, useful and effective, innovative and sustainable as well as promote the national economy [A]. With a focus on the openness of data, the Federal Council endorsed the OGD Switzerland Strategy [B]. OGD activities promote the release of official data, the coordinated publication and provision of official data, and the establishment of an open-data culture.

Even if the e-government and the OGD strategies are pointing to the implementation of a NDI, designing and realizing such an infrastructure is just a topic of the umbrella strategy [C]. A NDI is discussed under the topic of data and digital content. Focus of the vision is the promotion of an economically fair information ecosystem: "*As a potential driving force for new economic activities and new business models, such a national data infrastructure represents an opportunity for the Swiss economy. It*

will also help to provide new knowledge for research and society." [ibid.]. The construction of a NDI shall further help the open data principle permeate the entire administration, the research sector and parts of the private sector. Good data governance and the clarification of legal aspects are seen as key factors.

Based on the different one-to-one interviews statements the basic understanding of such a NDI is a nationwide distributed technical infrastructure that enables the access and/or the data exchange on the basis of a defined set of rules. It is seen as a strategic infrastructure resource and thus as a driver for data based value creation (see also [E]). The following outcomes are anticipated: the economy produces and distributes successful products, the state contributes through a "good data governance" to security, order and stability, the civil society gains due to participation trust in the society and the academia identifies pertinent challenges and finds solutions with the parties concerned.

This all requires revisions to the legal basis, the development of governance guidelines by 2018, the provision of online access to the Confederation's archives and a digitization infrastructure.

4.2.2 Stakeholders Picture in Switzerland. The Federal Council announced that data policy is one of the annual objectives for 2017 [G]. They want to define the main goals and principles as well as a roadmap by mid-2017. The Federal Office of Communications (OFCOM) is in charge for the coordination of the activities and the different dialogue groups along the digital strategy. Since the realization of the economic potential is crucial, other authorities will be on board, as e.g. the State Secretariat for Economic Affairs for the economic aspects, the Federal Office of Justice for the legal issues and the Federal Department of Home Affairs as important data owner and leader of open data. The other federal levels are not yet involved.

Even if the clarification of the role of the state in this context is imperative, the system needs other stakeholders: Industry, civil society and academia as important data producers and data users. Ideally, they need to be part of the co-creation process of conceptualizing such a NDI. This is not just about building a new infrastructure, but also about creating a concrete added value for the national economy and beyond. Several initiatives took place in the recent past: Research data portals e.g. were financed, state close companies as e.g. the Swiss Federal Railways and Swisscom launched new portals initiatives. NGO's as e.g. digitalswitzerland, the standardization organization eCH and Swiss Data Alliance took initiatives to strengthen the dialogue with public and private actors. It seems that the different stakeholders realize that they need to look across organizational boundaries. The dialogue is crucial: Only through use cases and concrete requirements an appropriate architecture can be designed. In terms of data policy, public authorities are seen in Switzerland as first movers, enablers and moderators.

4.2.3 Swiss Design and Components. The policy papers do not explicitly address topics for the conceptualization and realization of a NDI. However, the OGD-Strategy assesses the relevance of openness regarding government data and the Digital Switzerland Strategy focuses on legal matters and governance aspects as main action fields. It states the relevance of "good data governance". Switzerland collected various experiences in the field of open data, inter-organizational collaboration and joining-up base registries; however, it is at the very beginning of the process of establishing a NDI. Currently, the design process can be described as a consultative one, focusing on an inner circle of stakeholders.

Based on a broader set of the interviews we can state that the different actors have a vision regarding possible NDI elements:

- **Data**: Different typologies (see below)
- **Technical elements**: Basis infrastructure (data storage, data transport, data processing); Infrastructure components (data portals, platforms, interfaces, identity & access management, knowledge management functionalities)
- **Semantic elements**: Standards and metadata
- **Organizational elements**: access management, Data-life-cycle management, processes (e.g. data usage), knowledge management (e.g. co-creation, data analytics)
- **Legal elements and governance issues**: Legal basis, Regulation (compliance, data protection/security, data usage, data provision, responsibilities, information integration, usage of personal data); strengthening data self-determination (e.g. mydata-approach).

The implementation situation of the different components is fragmented: While on a technical and semantic level some work has already been done and different components isolated conceptualized and developed, on an organizational and legal level conceptualization work is still needed. Especially the consideration of interoperability issues and inter-organizational dependencies deserve more attention.

Even if the Digital Switzerland Strategy puts a strong focus on how to deal with policy requirements related to personal data, from the point of view of several interviewees it seems that object data will come before personal data. Different interviewed stakeholders claim that a NDI shall comprise all data sets that are relevant for the functioning of the state. This means basic registers on persons and companies, geo data, buildings, streets etc. On top of them the suggestion sees sectorial data, e.g. mobility, health, education. Another structuration try sees in a first step Federal agencies and public research data (FORS, Swiss National Science Foundation, universities etc.), in a second one corporate data and in a last one the personal ones. Different topics rose in the discussions: the question of ethical control, the establishment of compatibility, the politicians' sensitization, and the private public collaboration.

4.2.4 Governance Issues in Switzerland. In Switzerland, it is not defined what an NDI is, even though the term is used in the digital strategy. It is conceptualized along the line of opening data from different stakeholders. Given the early stage of discussion, it is not surprising that governance issues are still in their initial stage. The Federal Council asked the OFCOM to

formulate in 2017 guiding governance principles. Mechanisms of control and ownership structures are not yet ripe for a decision. The main tenor is that the state needs to protect people, not data. A good balance between the interests of the own organization, the demands of the public sphere (open data by default) and the single individuals (my data) is seen as the main goal. The statements regarding governance in the interviews can be divided into two categories: considerations on the government regulation in the data area and considerations on the management of NDI as (shared) infrastructure. The governance shall support the data usage with concrete rules; it seems relevant to identify not only what is prohibited now by law but also what can and should be allowed in the future. Concerning government regulation in the data area the fundamental attitude is "less is more". However, government regulation is seen as mandatory in the data protection and security area and with regard to new developments in the data economy (e.g. big data).

While discussing governance understood as the management of a shared infrastructure the main assumption is that the NDI has a decentral architecture and a central coordination. It is generally agreed that the coordination must be guaranteed; some interviewees suggest the Confederation in the leader role. Switzerland needs a clear definition of the responsibilities: Who operates the infrastructure and what are the responsibilities of the decentralized authorities?

The financing of the infrastructure and the data provision are seen as crucial issues. The federal structure is a challenge; suitable instruments are needed.

Different interviewees considered the option of having a central data office in the public administration. A data officer could support the exploitation of external data and take care of the consideration of parties concerned in the use of personal data. Associated with a bureaucratization, the necessity of such a position has however been called into question by the majority.

5 CROSS-CASE FINDINGS

In applying our analytical framework to structure the analysis of the two cases, there is also a basis for comparing how these two countries are doing with respects to their efforts of enacting NDIs. In this section, we compare the two cases on each of the four aspects of the analytical framework. The similarities among the cases provide lessons that transcend the individual cases and will be of value for further understanding and developing NDIs.

Strategies in action. Striking in both cases is that although NDIs have been on the agenda for some time, an NDI is not yet a real tangible thing in and of itself. Rather, it is largely a topic in the realm of objectives and strategies and as such is a loosely defined concept. Such vagueness works well at the policy level; it is convenient, shows ambition and any activity loosely related to it looks like real action. However, this does make it all the more difficult to enact real steering and control over infrastructure and infrastructure development, especially given that in the domain in which NDIs are developed are far from a greenfield.

This gap between policy and practice can be witnessed in both cases; the NDI is an idea, a vision, of which it is not always entirely clear what actual support there is.

Stakeholder involvement and interaction. With respect to stakeholders, the most interesting lessons pertain to the role of government. In both countries, the goal is that governments should not steer or regulate too much. Yet, in fact they currently do play a major role. In Switzerland, it is clear that government actors do see themselves as a first mover that should enable and motivate other actors to get involved. However, take-up of an active role by parties outside the government is very limited (not to say non-existent). In Switzerland, the NDI is not a topic that companies are concerned with and in the Netherlands there are companies that look at an NDI in terms of traditional infrastructures (e.g. road and rail); i.e. a responsibility of government. The government actors involved seem to not have a clear view on how to engage others and keep them engaged once the enabling part is done.

Design and components. As a consequence of the stakeholder setting, NDI development is largely 'inner circle'; there is no open innovation or large-scale inclusion yet. In federal Switzerland it currently stays at the federal level mostly, although other levels of government are important data providers and owners. While they are equal partners in the OGD and e-government strategy and/or implementation, they are not officially part of the NDI discussion yet.

When it comes to the artifacts that companies desire here; they would like to have clear rules that enable them to create business models. Regardless of the specific regulation, they need the government to resolve key topics such as data protection in NDI, to ensure stability enabling new business.

Third and also striking, despite the decades of studies in this domain and the practical experiences every large organization has on that interoperability issues can be a major hurdle, they still are today and make the realization of an NDI as a real infrastructure all the more difficult.

Governance. Governance of NDI is focused on three key topics: regulation of data (e.g. use, provision); design and management of the infrastructure; and creating incentives for others to get on board. These governance topics align with the lessons identified above.

Setting up a national strategy apparently has not been a very effective instrument to overcome fragmentation; especially within government there are many relatively isolated actors and activities that are only loosely coupled to the NDI. This can be explained by the first lesson above; because it is a strategy it doesn't serve as a very strong coordination instrument. The picture on the financing logic is clear, however; actors in central government pick up the bill.

6 CONCLUSION AND DISCUSSION

6.1 Conclusions

In this paper, we have drawn upon literature on strategy, open data, infrastructure and e-government to develop and use an analytical framework for studying National Data Infrastructure (NDI) strategies 'in action'. Our framework elicits a number of lessons from the two cases. The comparison shows a number of similarities, most notably the as of yet rather unsuccessful efforts of government in both countries to be a first mover, in the hope to be a catalyst that brings other actors on board. This is the case especially in Switzerland. In the Netherlands, the focus seems to be a bit more on the government itself. At the government level, the Dutch approach is more inclusive, with central government guiding and incentivizing (e.g. by paying for building blocks) other layers of government. In Switzerland, it still mostly is a federal level strategy and all action seems to take place there as well. This can probably be explained by the differences in polity between the two countries; the Dutch central government has a clear mandate for setting up an NDI, which gives more options for steering. In Switzerland's federal structure, the cantons are key as well, yet are not part of the federal Digital Switzerland strategy development.

As expected, we identify a significant gap between policy and practice of NDIs. This gap is strengthened by on the one hand having broad goals and strategies that do not offer substantive direction or control, and on the other hand by a diverse field of actors, existing systems, building blocks and practices that form or affect parts of the NDI. Resolving the fragmentation and setting up the capacity to exercise control over the activities that are undertaken are key steps towards realizing NDIs. For this, however, the leading actors will first need to determine who should be involved and how to involve them. Joining-up existing e-government components require vastly different activities than trying to get non-government actors into action.

Although our framework has helped to structure NDI-related activities in the two countries, we were not able to use it to discuss all activities that are potentially relevant. There are many activities that relate to specific components (e.g. data sets for base registries) but are beyond the strategies in action at the level we currently study them. This limits the depth of understanding of the NDI in the two countries, although it helps in the comparison. For example, it is to be expected that government capabilities that have developed extensively in the past, offer relevance for NDI's, such as those on data and infrastructure management. What additional skills and capabilities are needed or need to be developed further was not really covered in our study.

6.2 Discussion and future research

The goals of enacting an NDI may vary. Switzerland, (following a philosophy of open government data) is trying to find a dialogue with industry and civil society. The underlying idea here is to open up government in order to provide added value but for society altogether. In the Netherlands, the focus is more on improving the core business of government and on promoting public values such as transparency. In short, the Swiss seem to be more focused on NDI as a driver for value creation by society, the Dutch more on value creation by government. For future research, it would be interesting to expand this study to include other countries and understand the differences in goals, strategies and how these affect outcomes.

Furthermore, the authors believe it would be worthwhile to study the relation between enterprise architecture approaches and NDI strategies and to further the understanding of the NDI maturity in the two countries. At first glance, the Dutch maturity seems to be higher than the Swiss. However, upon closer inspection, we have to conclude that the Swiss may in fact be more ambitious in scope and goals. In general, future work should try to apply the maturity model thinking (that is popular in e-government research) to the domain of NDI. For this, Open Government Data benchmarks and e-government maturity models would be interesting starting points.

Based on our comparative case study, we would like to suggest a very rough, initial four stages that we see in both cases:

- First, there is a focus on policy development, which bears resemblance to how this is conceived in the world of Open Government Data;
- Second, with some kind of policy or generic strategy in place, the next step is to organize a governance process, including gaining an understanding of what is there already and how this relates to the NDI;
- Third, the basics of the NDI have to be implemented; the existing components have to be linked to the strategy and missing components (technical, regulatory, governance, etc.) have to be developed and implemented;
- Fourth, to live up to the promise of becoming a pillar for value creation beyond government, NDIs will have to open up to others. This can take various forms, for example by serving as a government-backed two-sided platform on which others can build services.

Work on such a maturity model will also help in the theoretical embedding of NDI research, which is definitely needed. Topics such as infrastructure, ecosystem and governance have theoretical and conceptual underpinnings that will be valuable in further understanding and developing national data infrastructures.

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