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van Loenen, B; van Rij, HE

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Assessment of Spatial Data Infrastructures From an Organisational Perspective

Bastiaan van Loenen, Evelien van Rij

OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology, Delft, The Netherlands
Email: b.vanloenen@tudelft.nl , h.e.vanrij@tudelft.nl

Abstract. The development of a Spatial Data Infrastructure (SDI) not only has to address technical and non-technical data issues but the organisational component is also relevant, to the extent that the SDI is able to address societal challenges. This chapter elaborates on different stages of SDI development from an organisational perspective which has been modelled within an SDI maturity matrix. The chapter identifies four stages of SDI development and provides key factors for the organisational development of an SDI. However, this model gives the impression that developing an SDI that is as 'mature' as possible should be aimed at. On the basis of the theoretical framework on telecommunication networks evolution, this is put in perspective.

9.1 INTRODUCTION

A spatial data infrastructure (SDI) develops gradually. Step by step the components needed are improved and the most pressing issues are addressed. It may be argued that this may ultimately result in an ideal situation.

However, Chan argues that because of internal and external dynamics, it will never be possible to specify the ideal SDI (Chan et al., 2001). As the SDI develops, the environment in which this development occurs also changes. Innovations result by introducing new technology, and products, which may change the way an SDI performs, or the role it plays in society, among others. This context implies that the needs of communities change overtime and that, therefore, the ideal will change accordingly. Organisational conditions are relevant to developing a mature and sustainable SDI. These conditions need to change with the changing requirements for the SDI. This process never ends.

This chapter elaborates on the different stages of SDI development from an organisational perspective. The chapter builds on the work presented in Van Loenen (2006) and Kok and Van Loenen (2005). First, this chapter explains four stages of SDI development (Stand alone, Exchange/standardisation, Intermediary and Network) and key factors for the organisational SDI's development are provided which, together, they present an SDI maturity matrix. The chapter then reviews the maturity model. An institutional and economic theoretical framework on the evolution of telecommunication networks is used to discuss why it is not self-evident that an SDI should develop into more 'mature' stages.

9.2 THE SPATIAL DATA INFRASTRUCTURE

An appropriate definition of an SDI is: a framework continuously facilitating the efficient and effective generation, dissemination, and use of needed geographic information within a community or between communities (after Kelley, 1993). This definition describes the facilitating function of the SDI, provides its components (the framework), and the focus on the needed geographic information presupposes the interaction between users and suppliers, addressing the dynamic nature of the SDI. The framework consists of seven inter-depending components being datasets and framework datasets, institutional framework, policies, technology, standards, financial resources and human resources.

Datasets with an infrastructural status, the framework datasets, are datasets that are commonly used as a base dataset upon which other datasets can be placed (Phillips et al., 1999), datasets commonly referred to, or a sufficient reference for most geo-located datasets (Luzet et al., 2000). Framework datasets may refer to the fewest

number of features and characteristics required to represent a given information theme. Framework datasets are the foundation on which the SDI builds. Common framework datasets are topographic datasets, administrative boundary datasets and land ownership datasets (Onsrud, 1998). Framework datasets can be used as a base for thematic datasets, the business systems. Specific thematic datasets, or themes, are added to the framework dataset. In this way they build on framework datasets and in some instances the thematic layer may become a basic layer for other themes. We would call this new framework layer a 'second order' framework layer, a sectoral framework layer (see Chan et al., 2001). In the view of infrastructure and business systems, it may be that some datasets we consider application datasets (business systems) today, will become framework datasets (infrastructure) tomorrow (see also Chan and Williamson, 1999). In this chapter we focus on the network of the organisations responsible for the framework data sets ─ SDI's inner circle (see Figure 9.1).

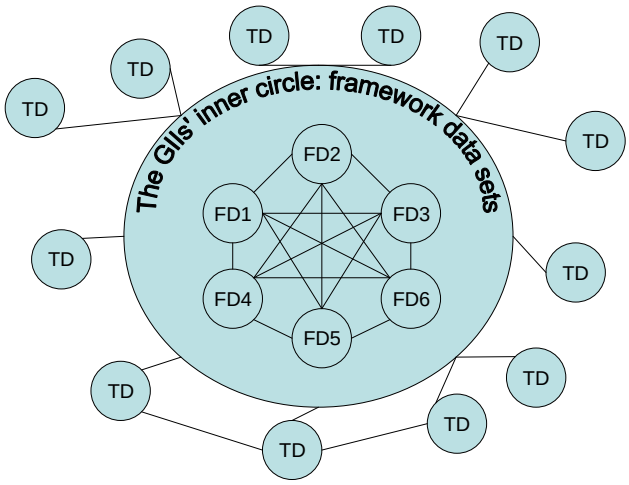

Figure 9.1: The SDI's inner and outer circle (FD= framework data set; TD= thematic data set)

9.3 STAGES OF SDI DEVELOPMENT

In the following paragraphs four stages of SDI development ─ Stand-alone, Exchange, Intermediary and the Network stage are identified (see Figure 9.2). The description of the stages of the model builds on

the work of Camarinha-Matos and Afsarmanesh (2005), Layne and Lee (2001), Van Kerkhoff et al. (1999), Watson et al. (2001), Bemelmans (1999), Bemelmans and Matthijsse (1995), Graafland (1993; 1997; 1999), Hopstaken and Kranendonk (1991), Nolan (1973 and 1979), Greiner (1972), Kok and Van Loenen (2005), and Van Loenen (2006). These models may be captured under the concept of system integration, even if they are called different names. Camarinha-Matos and Afsarmanesh (2005) clarify that systems integration can be addressed and initiated at different levels of complexity and abstraction. They distinguish the cell-level, the shop-floor level, the intra-enterprise level and the inter-enterprise level. At the cell-level the work of several robots may be integrated into one robot. At the shop-floor level the subsystems within a department may be merged into one system. At the intra-enterprise level the objective is to integrate all areas of the enterprise, which may be a municipality. Further, the inter-enterprise level envisions cooperation among various organisations. Together these organisations can be considered a virtual organisation - a network of collaborating enterprises in which each node of the network contributes some value to the value chain (Camarinha-Matos and Afsarmanesh, 2005). Finally, they foresee integration at the global level. The SDI would be categorised as an inter-enterprise organisation. An inter-enterprise organisation is a more stable, though not static, group of organisational entities that have developed preparedness to cooperate in the case of a specific task (Kürümlüoglu et al., 2005; see also Oosterwijk, 1995), developing the SDI. The SDI concerns a network of organisations, in which individual organisations become a component of an inter-depending network of organisations.

According to Graafland (1999) each stage of organisational development requires a specific organisational setting. Between stages, the organisations may need to change their structure and culture to further develop. Organisational culture can be regarded as one of its potential barriers (Rezgui et al., 2005). In accomplishing successful organisational change, the organisational theoretical framework of Boonstra (2000; see also Bennebroek Gravenhorst et al., 2003; Boonstra, 2004) can be used to identify the characteristics of the stakeholders in an organisation, or community, in a certain stage of developing the change process. Boonstra's theory aims to fit a single organisational context. Although the multi-organisational setting of an SDI may be more complicated than a single organisational environment, conceptually the issues are similar (see Oosterwijk,

1995). Therefore, the model has been assessed as useful to include in the stages of SDI development model. The stage model aims to explain how the SDI may evolve from several 'stand-alone' organisations to an institutionalised network of collaborating organisations.

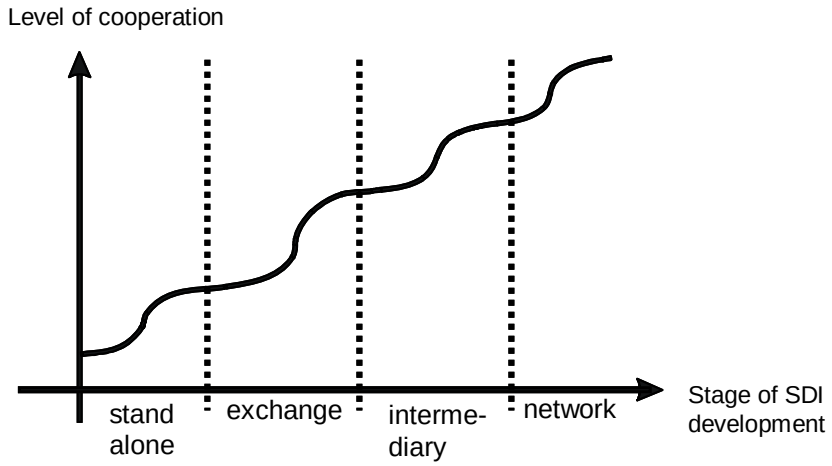

Figure 9.2: Stages of SDI development

9.3.1 Stage I: Stand-alone

The first stage is named stand-alone because of the different organisations that build their own infrastructure. According to Bemelmans and Matthijsse (1995), these islands of infrastructures may find a commonality in the slumps, which lack infrastructural facilities such as a road network. Everybody is concerned with surviving the slump and nobody recognises the need to invest in common interests: leadership is lacking. Although at an individual level this may be adequate and inexpensive for some (e.g, owners of four wheel drives), at the general level (society) it is not only expensive, but especially ineffective (Bemelmans and Matthijsse, 1995). In this stage, every organisation, builds its own 'infrastructure' with organisation specific data models, and standards, among others. Further, the organisation's database is filled by the own organisation's source system (see Watson et al., 2001; Graafland, 1993 and 1999). Information collection and the organisation's performance are independent of other organisations (Edwards et al., 2007): therefore individual organisations may have organisational visions but there is no common vision for the SDI.

The internal focus of the (public) organisation results in using the information for a single, or a few, subject areas (Watson et al., 2001) which may be limited to predefined and legislated tasks. The internalism or departmentalism of the organisations is synonym to a passive attitude towards *new* questions that arise from society. The ability of the geo-information sector to organise itself to address pressing issues that require different approaches (e.g., multidisciplinary, inter-organisational) is non-existent because of a lack of awareness of the existence of others and consequently the unawareness of the opportunities of cooperation in a geographic information network. For example, a Cadastral authority may collect independently from others all information that is necessary to execute its task, and relies on this information. Therefore, ownership transfers are registered with personal information such as name and address. The cadastral map includes physical objects to identify real property at ease. This information is only updated after a new transaction is registered. Other institutions, which build on the cadastral database, for example municipalities or the national revenue service, may have difficulty in linking their more up-to-date systems to the information provided by the cadastre. This difficulty results in redundancies, inconsistencies, and duplicate information collection efforts. As a result the integration of systems is difficult if not impossible.

In this stage, only a few understand the potential value of the SDI concept, but they lack the means to convince potential key players of the need to participate in the SDI. The SDI is not a priority of the individual organisations, but rather another development that is followed, but not considered as relevant for the organisation. Communication between organisations is not open and top management does not feel the need to change the internalism of organisation towards a more externally focused one.

Boonsta (2000) characterises this organisations in such stages as ‘cynical’ (Boonstra, 2000). In a cynical organisational context the individual organisations that are potentially participating in the SDI do not experience any bottlenecks. Change is considered unnecessary and almost no support will exist for change. The culture within organisations is conservative, pursuing their own interests, and the willingness to change is lacking. In these instances, external developments, such as new legislation, new personnel, or technological developments may stimulate change (see, for example, De Graaf et al., 2007).

9.3.2 Stage II: Exchange and standardisation on technical level

In the exchange stage, external developments drive the change of organisations: the increased pressures for organisations to operate efficiently and new technology. In addition, organisations may become aware that the greater use of other organisations' information resources may be more efficient and effective than the internally supplied information (cf. Williamson, 1975). 'Outsourcing' some information supply allows the organisation to concentrate on its core activities, and to rely on other organisations for subordinate information. Outsourcing results in a dependency on other organisations is the first step towards a network of organisations. According to Watson et al. (2001), cooperation may also be a way to address the increasing pressure to reduce costs, especially in an economic climate of recession.

In addition, according to Rezgui et al. (2005), the challenges faced by society require solutions that go beyond the specific focus and capabilities of organisations. Several factors "have forced business and industry to adapt to new challenges triggered by an ever sophisticated society characterised by an increasing demand for customised and high quality services and products". Also government entities may feel external pressure from citizens (Van Kerkhoff et al., 1999). Citizens are increasingly accustomed to the technological advances and demand on-line services instead of having to go to a specific location to complete paperwork (Layne and Lee, 2001). Simple transactions such as renew licenses and pay fines or taxes are beginning to emerge. These applications, however, are localised and fragmented (Layne and Lee, 2001). The demands of citizens and the subsequent changes in society may require the "integration of underlying processes not only across different levels of government, but also different functions of government[…]also, from the viewpoint of all levels of government, this could eliminate redundancies and inconsistencies in their information bases for citizens" (Layne and Lee, 2001). Cooperation between departments and between organisations is required to provide the required multidisciplinary solutions, and integrating scattered systems at different levels is required (Layne and Lee, 2001), the framework datasets need to be integrated to be the real basis on which society can build. Awareness is growing that an SDI may address this issue.

In this stage, for the further development of an SDI, support from the actors is considered important, especially when a clear hierarchy

between the participants does not exist. Then, according to Bemelmans and Matthijsse (1995), a common goal and the recognition of a (potential) win-win situation are critical, (see also Hopstaken and Kranendonk, 1991; Rezgui et al., 2005) and required to reach the intended synergies (Bemelmans and Matthijsse, 1995). Agreeing on a common goal is further important since ultimately the actors become interdependent (Bemelmans and Matthijsse, 1995). In addition, the reasons for organisations to cooperate do not need to be identical as this may lead to different expectations on all sides of the partners. Therefore, agreement on the goal of the SDI is essential to guarantee involvement of the relevant organisations (Kürümlüoglu et al., 2005).

In this stage, the SDI as a concept gains momentum but is still fragile. Individual information producers start to experiment with exchanging information. Within these organisations, the difficulties experienced increase the awareness for the need of an SDI. The first steps of SDI development are the start of coordination activities in informal settings with voluntary participation. Focus is on informing each other, recognising bottlenecks, exploring potential solutions and ways to cooperate. The recognised bottlenecks are accompanied by acknowledging the difficulty to solve all barriers at once ─ problems are prioritised. Organisations or communities start to think along common lines, which may result in a sense of community and the development of trust between participants.

At the end of this stage, a first vision is created and priorities set (Watson et al., 2001). The dominant role of the information producers in these SDIs results in the primary focus on standardisation, digitisation (see Graafland, 1993), information integration and reducing duplication; the product-based strategies (see Rajabifard et al., 2003; Rajabifard et al., 2002). The strategy includes agreements on the content and quality of the framework datasets (Schepers et al., 2001). Further, the definition of an architecture to reference for the cooperation process is required and the development of a support infrastructure, including the protocols and services for information exchange, communication and cooperation (Camarinho-Matos and Afsarmanesh, 2005). Significant investments are made to create a framework data set for an entire jurisdiction, either by integrating existing data sets, or through new information collection. Developing datasets and continuing the existence of the datasets are the key drivers for SDI development (cf. Rajabifard et al., 2002; Rajabifard et al., 2003; Masser, 1999 and 2000). Therefore, a product-based

strategy is typically discussed and agreed upon: *the SDI is going to be built*.

In the beginning of this stage, the cadastral dataset is difficult to exchange in order to incorporate in another organisations' system: each of the organisations uses unique exchange formats and data specifications and supposed identical information is different (for example the address of owner of real property). This stage ends if agreement about the responsibility for framework information exists: for example, the cadastre for ownership information and the national address register for address information. Further, by that time agreement must be made about the exchange formats and protocols to exchange information. Discussion remains about implementing the agreements and whether they should be institutionalised.

From an organisational perspective, Boonstra (2000) describes this stage as the "sceptical stage" ─ there is sufficient dissatisfaction about the current situation and/or organisations desire a new situation (see also Hopstaken and Kranendonk, 1991). Some concern exists about the change process but change is supported. In this stage, the existing organisational structures which focus on the internal organisation can change into a structure supporting a more external focus; stimulating cooperation and information exchange (see also Graafland, 1999). According to Boonstra (2000) parties might encounter resistance to safeguard their position (see Boonstra, 2000). Another reason why an organisation might not be willing to contribute is the risk a change might impose on the current effective and efficient operations. A proposed change might also imply that one organisation will become more 'visible' than another or that benefits are distributed in another way. However, if the organisation is aware of the need to change and alternative strategies are lacking, change will find little resistance (Boonstra, 2000).

9.3.3 Stage III: Intermediary

The intermediary stage is the stage between that of problem identification and the envisioned situation. Central in this stage is implementing the vision developed in the previous stages. Several components of the visions have been implemented, others still need to be addressed or further developed.

In this stage the islands of organisations are becoming a network of organisations. This network is considered to be led by an accepted non-threatening leader, for example an independent coordination body. This leader initiates activities, supervises SDI development,

informs the network with relevant developments outside the sector and performs the function of the SDI communication channel where stakeholders, both producers and users, are stimulated to discuss, comment on, suggest improvements for, and implement the SDI strategy.

The key organisations have changed from internally centred towards organisations more open to external developments. To a certain extent, each organisation's strategies align with the SDI vision without sacrificing their own core business. The responsibilities of organisations and their roles in the SDI are made explicit. Participation in the SDI is less voluntary and results in a formal distribution of tasks or responsibilities for information management and system management (Bemelmans and Matthijsse, 1995). The distribution of tasks is aimed at the more efficient allocation of the sector's limited resources, allowing the sector to grow through coordination (Greiner, 1972).

The potential of new technology gains awareness and new applications emerge. The availability of information used in multiple subject areas makes participants in the SDI start to realise the potential of the network (cf. Watson et al., 2001). Consequently, the strategy is not only focusing on information creation and exchange but also aims to address the SDI from a broader society perspective. Capacity building, coordination and meeting user needs are central to these SDIs, the so-called process model (see second generation in Rajabifard et al., 2002). The driving forces behind the process model are the desire to reuse data collected by a wide range of agencies for a great diversity of purposes and a shift from centralised structures to the distributed networks of the internet (Masser, 2007; Van Loenen, 2006). Especially, the existence of interoperable web services and other information applications are regarded as one of the main technological drivers or indicators because "such services are partly able to fulfil the needs of users and improve the use of data" (Crompvoets et al., 2004; see also Rajabifard et al., 2003). In this stage the SDI objectives are formulated in terms of fulfilling the needs of users.

The data perspective focuses on fulfilling the initial vision and starts the process to institutionalise the SDI framework datasets. This process may be aimed at legislation for framework datasets, specifying at varying levels of detail, the custodian, content, quality, and use arrangements. The user part addresses user issues such a

barriers for using framework datasets. These barriers may be technical of nature, but also non-technical issues of use will be addressed.

The coordination body is not only the communication channel for the parties within the SDI, it also seeks recognition of the SDI outside the sector, especially with politicians and high-level bureaucrats. It informs these decisions-makers about the potential of the SDI, its needs and raises issues critical for SDI development. Through influencing the external channels, the SDI may obtain high-level support, which may help further SDI development.

The hybrid approach, incorporating both the data-centric and process-based strategy, may allow for interoperable datasets, awareness for the SDI at many levels also outside the sector and financial resources specifically dedicated to SDI development. In this stage, the distribution of tasks, and the requirement of organisations to focus on their core tasks, results in far-reaching interdependencies between organisations. For example, a cadastral database can, instead of being filled with information from the own organisation, be directly linked to the database of more up-to-date national registrations of people, enterprises and to the topographic data of the national mapping agency. This ensures that the cadastral database contents current information, which is nation-wide consistent within government. Similarly, governmental organisations depending on the information of the cadastre may have direct access to the cadastral system(s). However users outside this network lack the same level of service.

The intermediary stage has the characteristics of Boonstra's (2000) 'desiring context'. In his model, in the desiring context many bottlenecks exist in the organisation. Therefore the organisation desires a new and better situation. The need for change is then evident and support for change is high but has to be communicated effectively, for example through best practice examples. According to Graafland (1999), the extent to which organisations are willing to cooperate with each other and the powers of top management to steer the development are critical factors in this stage.

9.3.4 Stage IV: Network

In the network stage, the SDI has become a network organisation with players that respect each other's position, have a clear vision and operate pro-actively (Van Kerkhoff et al., 1999). The organisations involved are depending on each other because of shared responsibilities for the SDI. This uncertainty has been addressed by

the institutionalisation of the network and its relations (cf. Oosterwijk, 1995).

The SDI has become a 'multipurpose system' with clear distribution of responsibilities and shared leadership. It includes well-integrated information from multiple systems and sources (Watson et al., 2001). Information is maintained at the source which implies that information is only collected at the largest scale needed, and the consistent framework datasets are generalised to smaller scales. Further, the dependencies require comprehensive metadata documentation (Watson et al., 2001). Standardisation has shifted from supplier or product specific to adherence, then to international standards that are supplier independent (Bemelmans and Matthijsse, 1995).

The SDI concept is not challenged, but exploited and enjoys broad support since it provides the foundation for the information society. Many virtual organisations, a temporary consortium of partners from different organisations established to fulfill a value added task (see Kürümlüoglu et al., 2005), temporarily build on the framework the SDI provides. Experiments in new applications are promoted through the ease of access to multiple systems and encouraged by the SDI (cf. Greiner, 1972). The consortia innovate the SDI through applications or solutions for specific needs (see Amit and Zott, 2001), which are commonly found and vary widely. For example, the cadastral map might be available for location based services, which allows one to find a nice field (without an address) along a pool, to contact the owner without obtaining his/her personal information and obtain directly permission to camp on his/her land. The automated note further informs the hiker that the water quality monitor for yesterday revealed that the quality of the water in the pool is okay for swimming.

Kok and Van Loenen (2005) related this network stage to Boonstra's 'innovative context'. According to Boonstra's model, in such a stage few organisational bottlenecks exist and the change process is driven by innovative motives:

> "The goals of the change process are clear and there is broad support for them. Technological change can easily be realised and the process does not cause tensions within and between organisations. Top managers are actively involved in the process and are stimulating full support from all organisation members. Members of the

> organisations have positive expectations regarding the development and outcome of the change process, believe that change is necessary and want to contribute to the change process" (Bennebroek Gravenhorst et al., 2003).

At the end of this stage an SDI has been developed and the mission completed. However, new challenges may arise with extra complexity and new dimensions. An example may be the European spatial information infrastructure (see INSPIRE, 2007), which builds on national SDIs with each of their own SDI organisation, culture, data specifications and priorities. A further step may be to develop a true global spatial data infrastructure. The development of these new SDIs may follow a similar path, from several stand-alone national SDIs to mature networks of national SDIs.

Although in an SDI context this view might be considered unrealistic, it may translate in an SDI context into open communication channels with healthy discussions on the future direction and strategies which result in broad support for the SDI vision and is continuously reviewed by various stakeholders. Periodically, the development of the SDI is reflected upon. In this stage a proactive community is increasingly working together on innovative solutions for societal problems if this is considered to be justified by their tasks.

9.4 ORGANISATIONAL MATURITY MATRIC

The above results are evident in an SDI maturity matrix (see also Van Loenen, 2006; Kok and Van Loenen, 2005). This matrix describes the way a vision, leadership, communication channels and the ability of the geographic information community for self-organisation are present or perform in an SDI depends on the stage of development (see Table 9.1).

The SDI maturity matrix consists of four stages of SDI development. In the network stage, ultimate, most advanced stage, it is commonly understood what an SDI consists of and what its objectives and ideal are. In this idealistic view, leadership, open communication channels and a pro-active geographic information sector have resulted in a capacity that is such that the SDI enjoys broad support at all levels, resulting in sustainable funding for SDI development.

The organisational maturity matrix has been used to assess the coherence of the geo-information community. From that perspective,

the more coherent the community was said to lead to more successful SDI development. Successful implies in this view a network, a 'multipurpose system' with a clear distribution of responsibilities and shared leadership (Kok and Van Loenen, 2005). In other words, a more 'mature' SDI in terms of the model was regarded as a more successful SDI.

Table 9.1: Maturity of SDI from an Organisational Perspective

Stage / Aspect	Stand alone/ initiation	Exchange/ standardization	Intermediary	Network
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders; 'champion'
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational 'SDI'	Professionals of organisations together: SDI	Awareness at many levels incl. decision making	Commitment at all levels/continuous support in politics and management
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed

9.5 DISCUSSION: TOWARDS ONE IDEAL SDI?

The application of the theory discussed in the first part of this chapter might give the impression that establishing a wide single interoperable network, as discussed in section 9.3, is a goal that does not have to be questioned. It is considered to better service the public needs and to be more efficient. The fact that such a network has not been established yet is attributed to a lack of vision, leadership, communication, the ability of the geographic information community for self-organisation and limited awareness for SDI.

However, this analysis ignores other aspects that influence the formation of networks, such as technological, social and economic aspects. Research on the evolution of telecommunication networks has shown that an evolutionary economic approach is especially useful (Noam, 1994). The analysis falsified the presumption that the further

development of a network is always economically preferred. It distinguishes good reasons for integration as well as centrifugation ─ bigger is not always better.

Like network advantages, network disadvantages also exist. According to Noam (1994), at some point in the evolution of networks, the average costs of a network, the total cost of the network divided by the number of subscribers, can increase. This may be due to congestion, growing complexity of the network and the different characteristics of early and later subscribers of the network. Another reason to form a new network is to reduce risk since large networks are more complex and therefore more likely to be unstable. Compared to later subscribers, early subscribers are often large-scale consumers for which the development of connecting infrastructure per transferred piece of data is relatively inexpensive. For the large-scale users, it can be attractive to develop their own network and not to share all the network costs with other subscribers with different, more expensive, requirements.

The lesson for the SDI may be that the size of the network is not dominant over its efficiency and functionality ─ bigger is not always better and might be counter-productive. A first focus on the framework datasets may not necessarily be extended with a same level of exchange or formal cooperation between the inner core and the outer circles. A major size network may require significant coordination efforts and be characterised by slow decision-making processes. This approach may be against the interests of innovative solutions on a specific theme that are evolving in a highly competitive market. It may very well be that a loose relation of several Thematic Datasets (TDs) with a single Framework Dataset (FD) is more beneficial than linking a single TD with the complete inner circle of FDs, even if the resulting service is similar.

The presented model may suggest that a network stage is the ideal, the thing to strive for. However one size does not fit all. One must realise that the context of an SDI is decisive for its ability to develop. Each SDI is unique in terms of, for example the institutional setting, key stakeholders, financial and human resources and FDs with a wide variety of needed non-technical and technical characteristics. Consequently, each SDI may have unique (short-term) objectives and strategies to arrive at the objectives. Since the success of an SDI is directly related to meeting its objectives, the provided model should not be regarded as the assessment of an SDI compared to other SDIs.

Each SDI is unique with regard to needs and priorities. Similarly, stakeholders have their own agenda which may not always align with the SDI. The presented maturity model may suggest that individual organisations that remain focused on their own business model have a negative effect on well-intended SDI initiatives around the globe. It should be noted that an organisations' willingness to contribute to the SDI, or to embrace the concept, depends to a major extent on the net benefits to participate, in both financial and non-financial (credits, image, outreach, public-relations, visibility) terms. Organisations might invest in the SDI if the concept fits the organisations' own agenda. Why should organisations contribute, what should be their role and function in the development, who are the other participants and how will the promised benefits and credits be distributed? These may be relevant questions. From a political-economic perspective, even the resistance of organisations may be felt due to a conflict between the SDI vision and an organisation's business model. The development of an SDI may then be seen as a threat to individual organisations instead of an opportunity for society. This, however, does not automatically imply an undeveloped SDI.

The model might give the impression that a more 'mature' SDI, in terms of the model, was regarded as a more successful SDI. By using insights provided by institutional economic theory developed in the field of telecommunication networks evolution, this can be questioned; more 'mature' stages do not necessarily have to be economically more optimal stages. However the model was not developed with the idea that for each SDI a trend from stand-alone towards network will be observed. In fact, in the original model, presented in Kok and Van Loenen (2005), the Dutch SDI was assessed to be somewhere between the third and fourth stage. In Van Loenen (2006) the Dutch SDI was back to the third stage and for some aspects even assessed to be in the second stage. Similar developments can be found in Portugal and the UK, for example. Therefore, it should be noted that the SDI maturity matrix is a pattern to assist SDI practitioners to develop their strategies for SDI development. It helps to roughly identify the status of several organisational SDI aspects. The model has been assessed to function well for the assessment of the organisational aspects of several SDIs in developing countries (Eelderink, 2006), municipalities (De Graaf, 2006) and organisations active in the nature domain (Huisman van Zijp, 2008) in the Netherlands. However, we believe that further developing the model

(‘s indicators) is required to better support SDI practitioners in their efforts to address organisational issues in their SDI.

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