Chapter 5

Theoretical introduction to the Multi-view Framework to assess SDIs

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Abstract. The task of assessing SDI is difficult due to their complex, dynamic and constantly evolving nature. However as an SDI can be treated as a Complex Adaptive System, the assessment should include strategies for evaluating those kinds of systems. One such strategy is to use multiple assessment approaches and methods. We present the multi-view framework for assessing SDI initiatives around the world and argue that the strength of this assessment design lies in its flexibility, the multidisciplinary view on SDI and a reduced bias in the assessment results. The multi-view framework contains methods that not only evaluate SDI performance but also deepen our knowledge about SDI functioning, and may assist in its development. This chapter presents the assessment framework and describes its theoretical grounding in complexity theory and evaluation research. The application of the framework however is beyond the scope of this paper.
5.1 INTRODUCTION

When developing Spatial Data Infrastructure (SDI) initiatives it is increasingly important to assess their outcomes so as to justify the resources that are spent on the infrastructure. However assessing SDIs, especially by worldwide comparison or benchmarking studies is complicated and rather challenging. The reason for this issue may be the nature of SDIs, particularly their multifaceted and dynamic nature, complexity and vaguely defined objectives. Hansen (2005) stresses that the nature of the object being evaluated determines what type of evaluation model are chosen. Therefore an assessment framework that is going to be proposed must be based on proper understanding of SDI nature and recognising its key features.

In this chapter we try to build a coherent SDI assessment framework that acknowledges its complex and dynamic nature. First we identify and analyse the key SDI characteristics that underlie the dilemmas affecting the assessment strategy. To deal with these dilemmas we examine SDI through the lens of Complex Adaptive Systems (CAS) (Grus et al., 2006b). From this analysis we construct an assessment framework that is based on the principles of evaluating Complex Adaptive Systems (Eoyang and Berkas, 1998; Cilliers, 1998; De Man, 2006b) that apply multiple evaluation approaches to evaluate SDI from different perspectives and for different purposes. The general evaluation theory, research and experience provide additional motives for adopting such a multi-view framework. For the proposed framework we use multiple existing SDI assessment approaches.

In section 5.2 we introduce the key characteristics of SDIs that influence the way in which an SDI should be evaluated — multi-definitions, multi-objectives, complexity and dynamism are the issues of interest. Section 5.3 presents the theory of CAS and its assessment issues, along with a discussion on the issue of using multiple approach strategy in general evaluation practice. Section 5.4 presents the prototype evaluation framework for SDI infrastructures. The chapter closes with a discussion, conclusions and recommendations, particularly on the potential difficulties in applying the framework. We do not discuss the drawbacks or benefits of the particular approaches as these will become evident after the framework is applied.
In this chapter we use several terms regarding the evaluation domain. For clarity the following terms used in the text are explained below:

- **SDI assessment framework** — a construct of various assessment approaches and methods built around CAS assessment principles and general assessment theory to structure and organise SDI evaluation.
- **Assessment purpose** — one of three main purposes of performing an assessment: accountability, knowledge and development.
- **Assessment approach** — whole methodology of assessing particular SDIs from a certain viewpoint, e.g. SDI development, clearinghouse, or performance.
- **Assessment view** — use of assessment approach or approaches for a specific assessment purpose; and
- **Assessment methods** — the techniques used in SDI assessment approaches to collect indicators. They include different types of surveys such as questionnaires and web surveys, document studies such as country reports, key informants having unique knowledge related to the issue being evaluated, such as SDI coordinators, and case studies (Frechtling and Sharp, 1997).

Whenever the terms ‘evaluation’ and ‘assessment’ are used, they both refer to the characterisation and judgement of the merits of SDI.

### 5.2 SDI NATURE AND ASSESSMENT ISSUES

In the first step of developing the SDI assessment framework it is necessary to explore the key characteristics of the SDI in more detail to justify the choice of the assessment strategy.

An SDI is defined in multiple ways. For example, Chan (2001) collected the 11 most popular SDI definitions by different organisations and authors in different parts of the world at different times. Each of these definitions describes SDI from slightly different aspects and none of them describe an SDI completely. The variety of ways in which an SDI is defined reflects its multifaceted character (De Man, 2006). Rajabi-fard et al. (2002) claims that some SDIs may be treated as products while others as processes which raises fundamental questions about SDI evaluation. Van Loenen (2006) argues that each SDI will need a hybrid approach to address both the products and processes. To be able to assess and compare the objects of the evaluation, an agreement must be reached on a single definition of the objects and about the criteria and values of merit. Referring back to
Rajabifard’s classification, as to whether we assess SDIs as products in terms of their structure or the processes they should facilitate or whether we assess both products and processes, the criteria and values of merit may therefore depend on how we understand the SDI concept.

It can be stated that the **conceptual objective** of the SDI is to enhance the access to, and the sharing of, spatial data needed by the user community. The principal purpose of SDIs may be defined in different ways for example, “let geographic information promote economic development, improve our stewardship of natural resources, and protect the environment” (Clinton, 1994); “to help avoid fragmentation, gaps in availability of GI, duplication of data collection and problems of identifying, accessing or using the available data” (SADL, 2003); and “to support information discovery, access, and use of geographical information for example in crime management, business development, flood mitigation, environmental restoration, community land use assessment and disaster recovery” (Nebert, 2004). Different countries do not define the objectives of their SDI in the same way. Some stakeholders may only accept the SDI role as facilitating data exchange where others may see an SDI only as a facility for spatial data production and storage. To allow the worldwide benchmarking of SDI, we will need a uniform definition of the objectives of an SDI, but the variety of interpretations of what SDIs are suggest that it will not be possible to find a single SDI definition that everybody will agree on. This means that the framework should be able to incorporate different understandings and views on the objectives of SDIs.

During the workshop on Exploring SDIs held in Wageningen in January 2006, **SDI complexity** was indicated as being one of the main obstacles and challenges to its evaluation (Grus et al., 2006a). The complexity of SDIs is due to the dynamic and non-linear interactions between its entangled components. Chan and Williamson (1999) state that its functionality becomes more complex over time as new SDI requirements emerge and are adopted by its users. As an SDI model moves from being data-centric to service-centric, complexity increases and its identification and measurement benefits become more problematic (Georgiadou et al., 2006). As a result the nature of an SDI and the interactions between its components cannot be described in a simple and uniform way. Moreover, each SDI has a different character and works in different ways in different parts of the world. This complexity makes it difficult to implement an particular SDI in
diverse environments in the same way and with the same results, which in turn makes assessment difficult because of the problems in attributing its success or failure of implementing an SDI to one or more concrete factors. In other words, because SDIs are complex it is difficult to track cause-and-effect relationships (Rodriguez-Pabón, 2005).

The dynamic nature of SDIs is reflected in the intensive flow of information between data producers and users (Masser, 2005). According to Rajabifard et al. (2003b) and Chan (2001) this nature of SDIs is reflected in changes in SDI technology, people and their needs. As SDI requirements and expectations change, the mediation of rights, restrictions and responsibilities between people may also change. Such changes imply that the behaviour of the system is unpredictable, which presents a challenge for assessment practice. The assessment framework should allow assessment practitioners to detect and analyse the predictable, as well as the unpredictable, changes. Another aspect of the dynamic nature of SDIs is its evolving nature. Most assessment practices measure SDIs at one moment in time but the SDI assessment framework should also be able to describe its evolution over time, for example through longitudinal assessment approaches.

5.3 TOWARDS THE ASSESSMENT FRAMEWORK

There is strong evidence that SDIs behave like CAS (Grus et al., 2006b), and the principle of evaluating CAS (Eoyang and Berkas, 1998) underpins the design of the SDI assessment framework. CAS are open systems where different elements interact dynamically to exchange information, self-organise and create many different feedback loops, in which relationships between causes and effects are non-linear, and where the system as a whole has emerging properties that cannot be understood by referring to the component’s parts (Barnes et al., 2003). Analyses of the structure and behaviour of Dutch, Australian and Polish SDIs indicate that the SDIs share the same behavioural characteristics as CAS (Grus et al., 2006b). We therefore decided to use the principles of evaluating CAS for SDI assessment. These principles specify that the framework should be flexible and have a structure that permits frequent reconsideration and redesign as the baseline (understanding, definition, and objectives) of CAS (and also SDIs) is constantly changing. The assessment programme should concentrate on both the expected and unexpected
system behaviour. It should also capture long-term and short-term outcomes from both close and distant points of view by containing more general, regional or cross-national comparisons (distant view) as well as more detailed case study analyses of national or local SDIs (close view). At national and regional levels, the SDI scale dramatically affects the amount of detail that can be accommodated in the assessment. Wider national or transnational initiatives (e.g. worldwide assessment of benchmarking) require the involvement of a much broader stakeholder network, many more assumptions (not all of which will be accepted by all stakeholders) and much less specificity than local initiatives. Because of the complex interconnections, assessment programmes should include multiple strategies and approaches, including those for linear systems, and a variety of data should be collected to reflect the variability and complexity of the system. The assessment framework should also contain methods that can capture the patterns of causal relationships. However, as these patterns of causation can change in CAS (SDIs) it is essential to capture the baseline, or reference point, of these causal relationships (Eoyang, 1998). For example, it may be helpful to describe the relations between the five standard SDI components (people, standards, technology, policy and data) and then observe the emergent patterns, changes and evolution of these relationships. Detailed analyses of case studies may help to reveal these interactions and rules of causation.

The recommendations for assessing complexity that are given above are in line with Cilliers’ (1998) analysis arguing that truly complex problems can only be investigated using complex resources. In the same way, the SDI assessment strategy must also be complex if it is to represent the system’s variability and richness in information which is important from the assessment perspective. Accordingly, different assessment approaches and methods must be used simultaneously which is also in line with De Man (2006b), who states that a multifaceted view is needed to understand concrete SDI initiative. The assessment framework should not try to capture and control complexity but acknowledge multiple SDI realities shaped by heterogeneous and reflective actors.

If we agree that SDIs are complex systems, the discussion above, implying the use of rather complex and multiple assessment approaches and methods, would be a valid strategy to assessing or analysing these complex systems (see Eoyang and Berkas, 1998; Cilliers, 1998; De Man, 2006b). We may then analyse the experience
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Scriven (1983) stresses that “evaluation is a multiplicity of multiples” in a number of ways: Evaluation is multipled, [that is] concerned with programs, products, proposals, personnel, plans, and potentials; multidisciplinary; with multidimensionality of criteria of merit; needing multiple perspectives before synthesis is done; multilevel in the “wide range of levels of validity/cost/credibility among which a choice must be made in order to remain within the resources of time and budget” and in the different levels of analysis, evidential support, and documentation that is appropriate in different circumstances; using multiple methodologies, multiple functions, multiple impacts, multiple reporting formats: “Evaluation is multiplicity of multiples” (Scriven, 1983). This multiplicity of evaluation is in line with the characteristics of SDIs mentioned above in terms of its multifaceted nature, the multiple purposes of evaluation, multiple definitions and multiple objectives. Datta (1997) confirms moderately high to high acceptance of mixed methods, analysis and data in evaluation practice, but the difficulty of defining the quality of such multimethod studies should be recognised. Using multiple analyses (descriptive analysis and various statistics within one evaluation) is highly acceptable, although the need to deal with the biases inherent in different techniques is borne in mind. Using multiple data is also highly acceptable, as long as due consideration is given to the weighting of different data sources. Based on Datta’s evaluation experience, the benefits of using multimethod analysis seem to be depth, methodological equity and transparent findings from all methods.

Assessing the multiple dimensions of the assessed object is also epistemologically motivated. The more vantage points taken, the better picture of truth is constructed. For example, the reality might be that one particular SDI has a very well developed clearinghouse but an inadequate legal framework for access policy. In such cases, assessing only the access network (clearinghouse) of this particular SDI would draw an incomplete picture of reality. Using multiple evaluation models also reduces potential biases in evaluation (Shadish et al., 1991) in case some methods generate considerably different results than others.
Assessments are made for many specific reasons, for example to measure and account for the results and efficiency of public policies and programmes, or to gain explanatory insights into social and other public problems, or to reform governments through the free flow of evaluative information (Chelimsky, 1997). Chelimsky (1997) distinguishes three general classes of evaluation purposes that cover all of the specific purposes: the accountability purpose, the developmental purpose and the knowledge purpose of evaluation. Accountability evaluation measures the results of the programme by asking cause-and-effects questions. The developmental class comprises strategies to measure and recommend changes in organisational activities and to monitor how projects are being implemented across a number of different sites. The purpose of knowledge evaluation is to generate a better explanation of the programme or to acquire a more profound understanding in some specific area or field (Chelimsky, 1997). These three classes of purposes are not mutually exclusive with regard to methods, but they may be needed at different times. For example, evaluation for knowledge or evaluation for development may be needed before evaluation for accountability. Georgiadou et al. (2006) presents a different taxonomy of evaluation purposes. They classify existing SDI evaluation approaches through a taxonomical lens from information systems evaluation research and explore four types of evaluation approaches: control, learning, sense-making and exploratory approaches. In principal, Chelimsky’s and Georgiadou’s classifications are comparable. Control evaluation and Chelimsky’s accountability approach asks questions about achieving the goals of the programme. Georgiadou’s learning and exploratory evaluation and Chelimsky’s knowledge approach both set out to learn and create knowledge about the assessed phenomena. Furthermore, both Georgiadou’s sense-making evaluation and Chelimsky’s developmental evaluation aim to modify and improve the evaluated phenomena.

For the purpose of this paper we will use Chelimsky’s three classes: accountability, knowledge and developmental, as they originate from the evaluation theorists and appear more generic. All the purposes of evaluation described above are valid for SDI assessment. There is a demand for accountability evaluation (Lance et al., 2006) to justify and monitor in a systematic way the relations between the investments in SDI initiatives and the results obtained. The assessment approaches that fall into the accountability class may help to answer questions such as did the use of spatial data increase as a result of implementing a more liberal access policy to spatial data, and what is the impact of
implementation of new SDI agenda on stakeholders’ activities? Questions about the efficiency and effectiveness of various SDI activities are also valid for accountability approaches. Developmental evaluation is needed to monitor the transitions of SDI initiatives, such as the transition through generations described by Rajabifard et al., (2003a). The analysis of the development, transitions and changes of SDI may help to capture and better understand its dynamic nature, and in monitoring whether SDI is being implemented according to the intended direction and recommend ways of SDI development. The primary functions of the developmental assessment should be to measure and recommend changes in SDI activities and development, to monitor in a continuous way how SDIs are being implemented across many countries and to find out whether SDI implementation is being realised according to the agenda. Knowledge evaluation is crucial to better understand the mechanisms and forces behind the SDI. A better understanding of the mechanisms and rules behind SDI frameworks allows action to be taken to improve them as “…once one understands the nature of the evaluand (evaluand = object of the assessment), one will often understand rather fully what it takes to be a better and a worse instance of that type of evaluand. To exemplify, understanding what a watch is leads automatically to understanding what the dimensions of merit for one are [being] – time-keeping, accuracy, legibility, sturdiness, etc.” (Scriven, 1980). SDI assessment could therefore contribute significantly to increasing our knowledge about its key qualities. The need to better understand the ideas and mechanisms behind SDI is also stressed by Georgiadou et al. (2006), who argue that more attention should be paid to conducting exploratory SDI evaluations.

The remainder of this paper focuses on the presentation and description of the prototype framework. The prototype framework acknowledges and deals with the SDI assessment issues discussed above.

5.4 MULTI-VIEW SDI ASSESSMENT FRAMEWORK

The previous chapters justified the use of multiple assessment approaches, considering the multifaceted and complex nature of SDI. This section presents the assessment framework to potentially fulfil all of the requirements mentioned in the previous paragraphs. A multi-view framework is proposed in order to assess SDIs. Figure 5.1 presents the conceptual model of the framework. The main idea behind the framework is that it covers all three purposes of assessing
SDIs — accountability, knowledge and development. It also acknowledges the multifaceted character of SDIs.

Figure 5.1: Multi-view SDI assessment framework

The core of the proposed assessment framework is represented by the multiple assessment approaches that focus on different aspects (facets) of the SDI. To overcome the problem of multiple definitions, SDIs are treated here as a complex system with multiple facets. As we concentrate here on SDI assessment, the facets are related to the assessment approaches included in the framework. Each approach treats
SDIs from a different perspective. Principally we concentrate only on the specific objectives of each approach that SDIs should meet. For example, the Clearinghouse assessment approach concentrates only on the SDI’s data access facility; for this approach the objectives of an SDI are related only to data access technology. The essence of the multi-view framework is that it accepts the multiple facets of an SDI and therefore accepts its complexity in terms of multiple definitions. Moreover, each assessment approach covers at least one of the three purposes of the assessment — accountability, knowledge and development. All approaches use one or more assessment methods, such as case studies, surveys, document analysis to evaluate SDIs. The proposed assessment methods are both qualitative and quantitative.

The SDI-Readiness assessment approach is an existing model that assesses whether a country is ready to embrace SDI development (Delgado Fernández et al., 2005; Delgado Fernández and Crompvoets, 2007). When building an SDI readiness index, various factors like organisation, information, access network, people and financial resources are taken into account. Each of these factors consists of numerous indicators that can be quantitatively measured. This model falls within the knowledge and developmental evaluation purpose. The results can be used to answer questions about comparing the progress made with implementing SDIs by different countries. It also helps to identify obstacles in SDI programmes implementations. SDI-readiness is measured by collecting and analysing predefined indicators that are based on surveys. Chapter 6 describes this approach in more detail.

The Clearinghouse Suitability assessment is based on research by Crompvoets et al. (2004) into measuring and assessing the development of National Spatial Data Clearinghouses worldwide. A method for measuring a specific set of quantitative indicators of clearinghouse portals can be applied as a continuation of longitudinal studies started in 2000. This knowledge and developmental assessment aims at exploring and showing the advances and trends in the development of clearinghouses (and web portals). This assessment approach uses survey (website visits) and contacting key informants to measure indicators for developing clearinghouse and web portals. Chapter 7 describes this approach in more detail.

The State of Play assessment approach is a study covering the period from mid 2002 to 2007 in order to describe, monitor and analyse activities related to National Spatial Data Infrastructures in 32 European countries — 25 EU member states, 3 Candidate Countries
and 4 EFTA countries. The major activity of this study is to collect and structure all the relevant information on the status of the six building blocks that together, according to this approach, constitute an SDI — the legal framework and funding, reference data and core thematic data, metadata, access and other services, standards along with the thematic environment (SADL, 2005). The same approach and methods can be used as a component of the multi-view framework, also in regions of the world outside Europe. Document studies (country reports), surveys (website visits) and contacting key informants (i.e. national SDI experts) are the methods used in this approach. Chapter 8 describes this approach in more detail.

The Organisational (Institutional) assessment approach is based on Kok and van Loenen’s (2004) research into the assessment of the different stages of development of geographic information infrastructures, when viewed from the institutional (organisational) perspective. This approach focuses on measuring the development of the following GII (SDI) aspects: vision, leadership, communication, self-organising ability, awareness, financial sustainability and status of delivery mechanism. This approach falls into the developmental perspective of evaluation as it measures SDI development from an organisational (or institutional) perspective. So far, the authors of this approach have measured and analysed the development of five SDIs using the case study method (van Loenen, 2006). This approach has also been successfully applied to assess SDIs in developing countries (Eelderink, 2006) and in Dutch municipalities (De Graaf, 2006). Chapter 9 describes this approach in more detail.

The legal assessment approach (see Chapter 13) concentrates on assessing the legal framework that underpins the functioning of an SDI. This approach consists of three levels of assessment: 1) compliance – assessing how an SDI complies with an existing legislation; 2) coherence – assessing the interaction between all the laws that make an SDI legal framework; 3) quality – assessing whether the legal framework of an SDI stimulates its development.

The Performance-Based assessment approach (see Chapter 11) uses the Performance-Based Management (PBM) technique to evaluate, demonstrate and improve the performance of an SDI (Giff, 2006). This approach is based on the assumption that an SDI is an infrastructure and that methods like PBM normally used for assessing the performance of infrastructure can be used for assessing an SDI. This method aims to develop performance indicators based on the specific objectives of an
SDI that are used to measure its effectiveness, efficiency and reliability. This approach is still in the conceptual stage and specific indicators and methods for their measurement are yet to be developed. The approach falls under the purpose of evaluation for accountability as it mainly seeks to answer questions about SDI efficiency and results.

The Cadastral assessment approach (see Chapter 10) was originally developed as a land administration evaluation framework by Steudler et al. (2004). It presents a number of indicators for five areas in evaluating Land Administration Systems (LAS): the policy level, the management level, the operational level, influencing factors and assessing performance. The reason for including this approach in the SDI assessment framework is that there are significant similarities between efficient and effective SDIs and Land Administration Systems and therefore there is a strong ground for using LAS evaluation and performance indicators for SDIs (Steudler, 2003). This approach however is still a conceptual one and has not even been used for evaluating LAS. Therefore the approach still needs to be developed and operationalised in order to apply in practice. If applied it may give us answers about the performance of SDIs as it contains a number of performance assessment indicators (accountability purpose of evaluation). Furthermore, its application would increase our knowledge about the policy, management and operational levels of SDIs (knowledge purpose of evaluation). The survey method will be used to measure predefined indicators on a worldwide scale.

The aim of the user’s perspective assessment approach is to measure the effectiveness of an SDI from the user’s perspective (see Chapter 14). It derives measures mainly from information systems that are based on concepts such as: usefulness, effective use, information and organizational effectiveness. This assessment approach focuses on identifying its existing and potential users, and also investigating how useful SDI ‘products’ are for meeting their particular needs.

The Metaphorical assessment approach (or Organisational assessment approach as discussed in Chapter 12) analyses the relationship between an SDI and its organisational aspects. A framework based on organisational metaphors and paradigms has been developed to provide an overview of possible approaches for organisational analysis and to analyse existing literature on the organisational aspects of an SDI. This kind of assessment provides a basis to deepen the existing knowledge about SDI theories and might
be the starting point to intervene in practice. This approach falls into Chelimsky’s ‘knowledge’ assessment purpose.

Table 5.1 summarises the attributes of all the evaluation approaches proposed for the multi-view framework. Some of the approaches presented exist only as theoretical constructs and need to be elaborated on further in order to develop application methods. These approaches include the Cadastral, Performance-Based, Legal, Metaphorical and Users’ perspective. The SDI-Readiness, Clearinghouse Suitability, Organisational and State of play approaches can be applied to the framework in a straightforward manner as the methodologies and application practices already exist. The variety of assessment methods guarantee that a wide range of data on SDIs can be collected. The set of views constituting the framework also cover all three classes of evaluation purposes presented by Chelimsky (1997) — accountability, knowledge and developmental purposes.

<table>
<thead>
<tr>
<th>Assessment approach</th>
<th>Goal Description</th>
<th>Method</th>
<th>Applicability</th>
<th>Assessment purpose class</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDI-Readiness</td>
<td>To assess if the country is ready to embrace the SDI development</td>
<td>Survey</td>
<td>Applicable</td>
<td>Developmental Knowledge</td>
</tr>
<tr>
<td>Cadastral</td>
<td>To measure five evaluation areas of LAS</td>
<td>Survey</td>
<td>Needs improvement</td>
<td>Knowledge Accountability</td>
</tr>
<tr>
<td>Organisational</td>
<td>To measure the SDI development from the institutional perspective</td>
<td>Case study</td>
<td>Applicable</td>
<td>Developmental</td>
</tr>
<tr>
<td>Performance-Based</td>
<td>To measure the SDI’s effectiveness, efficiency and reliability</td>
<td>Not available</td>
<td>Needs improvement</td>
<td>Accountability</td>
</tr>
<tr>
<td>Clearinghouse Suitability</td>
<td>To measure the development and impact of SDI clearinghouses worldwide</td>
<td>Survey, key informants</td>
<td>Applicable</td>
<td>Developmental Knowledge</td>
</tr>
<tr>
<td>State of Play</td>
<td>To measure the status and development of SDIs</td>
<td>Document study, survey, key informants</td>
<td>Applicable</td>
<td>Developmental Accountability</td>
</tr>
<tr>
<td>User’s perspective</td>
<td>To measure the SDI’s effectiveness from the user’s perspective</td>
<td>Case study</td>
<td>Needs development</td>
<td>Accountability, Knowledge</td>
</tr>
<tr>
<td>Metaphorical</td>
<td>To analyse organisational and management aspects of the SDI</td>
<td>Literature review</td>
<td>Needs development</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Legal</td>
<td>To measure compliance, coherence and quality of the SDI legal framework</td>
<td>Case studies</td>
<td>Needs improvement</td>
<td>Knowledge</td>
</tr>
</tbody>
</table>

The application component of the assessment framework focuses on measuring the indicators of each assessment approach. The selection
criteria for these indicators are the criteria of merit — the descriptors of an evaluand that reflect its capacity to meet needs (Shadish et al., 1991). For example, if interoperability is the criteria of merit of an SDI, it should be measured with an indicator that best reflects the level of interoperability. The scale of the measure should be defined to allow comparison and ranking of the values measured. The result of the measuring selected data forms the basis to assess a particular SDI. The best assessment approach and method can be chosen according to the purpose of the evaluating the SDI (ie. accountability, development or knowledge).

The result part of the framework has two functions: (1) evaluating the SDI and (2) evaluating each approach and the whole assessment framework. The first is the primary function as the main purpose of the research is to assess SDIs. The evaluator makes a judgement of an SDI, taking into account the standard of merit determined for each criterion of merit for the particular assessment approach. For example, if interoperability is being measured, each value measured should be placed on a defined scale to make it possible to assess (or evaluate) and compare the value of interoperability, either between countries or as a reference to some standard value (to benchmark). A more holistic and less biased picture of specific SDI initiatives can be obtained by interpreting the assessment results for those SDIs from different viewpoints. This interpretation will enhance our understanding and the assessment of SDIs.

The second function of the result component is assessing the evaluation approaches and the whole framework itself, or meta-evaluation, in order to ensure that they are acceptable to stakeholders. Meta-evaluation refers to a variety of activities intended to evaluate the technical quality of evaluations and the conclusions drawn from them. Its purpose is to identify any potential bias that there might be in an evaluation and, using a variety of methods, to estimate their importance (Straw and Cook, 1990). Meta-evaluation can also provide information about the impact of evaluation activities. Several models of meta-evaluation exist (Cook and Gruder, 1978), however at this early stage in the development of the multi-view assessment model it is difficult to choose the model that is most suitable. Nevertheless the meta-evaluation must be performed, especially by the users of the framework, and must follow the application of the multi-view framework. However, given that the principal feature of the proposed framework is the use of multiple views, the same indicators can be used for different assessment views and methods. Coming to similar conclusions about the value of
one particular SDI using multiple assessment views would therefore confirm the validity of the whole assessment framework. This design is in fact a kind of built-in self-evaluation mechanism — the use of multiple, independent views and methods used by a number of evaluators guarantees SDI assessment results that accurately reflect reality and have a low bias. The potential overlap between the methods used for different assessment approaches may help to validate the approaches themselves. Moreover, the design of this assessment framework relates to the triangulation research methodology which applies, and combines, several research methodologies in the study of the same phenomenon. Triangulation is the preferred line of research in the social sciences because combining multiple observers, theories, methods and data sources can overcome the intrinsic bias inevitable in single-method, single observer and single-theory investigation (Denzin, 1990). Evaluating the assessment framework, and its approaches, is crucial to ensuring their future usability as stakeholders will only use its results to improve an SDI’s performance if they accept the framework.

5.5 DISCUSSION

The objective of this paper was to present the conceptual model of the SDI assessment framework. The multi-view assessment strategy was based on the principles of assessing CAS and general evaluation research. A combination of multiple approaches and methods generates more complete, more realistic and less biased assessment results. Multiple assessment methods, case studies, surveys, key informants and document studies, capture the multifaceted and complex character of SDIs. They guarantee a diversity of data, which in turn can reflect the complexity of the SDI. The framework is flexible because it permits evaluation approaches and indicators to be added, removed or corrected — an especially important feature when the framework is applied iteratively and refined successively. The relative complexity of the assessment framework presented here also meets the requirement that such systems should be explored and understood with complex methods to properly reflect reality. The aim of the proposed framework is not only to assess an SDI’s performance, but also to deepen our knowledge about the mechanisms of an SDI and to support its development.

Some obstacles and difficulties may be encountered when applying the assessment framework. The issue of timing is the first important consideration, especially in such a dynamic and constantly
evolving environment like SDIs. The simultaneous use of several assessment approaches will generate more realistic results than if assessments are conducted sequentially. Therefore the intervals between data collections for various approaches should be as short as possible to allow the application of multiple assessment approaches to be synchronised. The next consideration is the difference in data availability between various assessment approaches and methods. Because the SDI concept is still very young, some countries may not produce reports or any other data that could be used in the assessment analysis. For some assessment approaches and their methods it may be impossible to collect reliable and complete data, such as reports on SDI finances, expenditure or revenues figures, and there may be no internal self-assessment reports available. The last consideration is concerned with integrating multiple approaches. The intended outcome of integrating all the assessment approaches included in the framework is to give tangible information on the merits of the SDIs. It is possible, though, that the findings of several assessment views will present different pictures of an SDI. These differences must be reported so future investigators can build on such observations (Denzin, 1990).

5.6 CONCLUSIONS

In this paper we have argued that the SDI assessment framework should be based on the principles of assessing CAS by using multiple assessment strategies, a flexible framework and a multi-perspective view of the assessed object. We argued that the application of the proposed framework would lead to a more complete, realistic and less biased assessment of SDIs. We proposed a number of applicable, and not yet-applicable, SDI assessment views as building blocks for the framework. We also discussed issues relating to the application of the framework in future research. Despite the fact that the multi-view assessment framework is strongly supported in complexity theory and evaluation practice, and its application results are promising for evaluating SDIs worldwide, we also suggest that the issues of harmonising the different approaches at one point in time, and the difficulties of collecting data for all views and for all countries, should be examined critically during the future application of the assessment framework.
REFERENCES


Spatial Application Division (SADL) of Catholic University of Leuven (2003). Spatial Data Infrastructure in Europe: state of play during 2003, Summary report.


