

# Evaluation and Performance Indicators to Assess Spatial Data Infrastructure Initiatives

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**Abstract.** Many countries are developing Spatial Data Infrastructures (SDIs) to improve access, sharing and the integration of spatial data and services. However the challenge of designing, building and managing an SDI draws on many different disciplines and requires the examination of a large number of factors and issues. In this regard, the comparison and evaluation of SDIs can help to better understand the issues, to find best practice for certain tasks and to improve the system as a whole. Evaluating and comparing public and private administration systems can be significant in terms of improving processes and institutional structures. The application of these principles to the development of SDIs will therefore come to play a crucial role in the management of our spatial data and that pertaining to the administration of our societies.

This chapter therefore aims to introduce the role and value of evaluation and performance indicators for assessing and comparing SDIs by using experiences in the field of land administration systems. Evaluation involves assessing the strengths and weaknesses of

programs, policies, personnel, products and organisations to improve their effectiveness. The evaluation is about finding answers to questions such as 'are we doing the right thing' and 'are we doing things right'. These are prominent questions for SDIs, the development of which has been very dynamic over the last decade and has involved significant learning from other national or local initiatives.

The commonalities between SDIs and the objectives of efficient and effective land administration systems provide strong grounds for deriving evaluation and performance indicators for SDIs from land administration principles. Key issues include sustaining a culture of sharing, establishing a common language and maintaining reliable financial support. To achieve this, the chapter first presents and discusses major classes of factors which influence, or contribute to, the development of an SDI initiative followed by a reviewing key components of land administration systems and SDIs. It is then proposed that a general evaluation framework which can be applied to SDI and its different components be developed before drawing some conclusions.

## **10.1 INTRODUCTION**

The comparison and evaluation of SDIs can help to better understand the issues, to find best practice for certain tasks and to improve the system as a whole. In keeping with this line, this chapter aims to introduce the role and value of evaluation and performance indicators for SDIs. Evaluation involves assessing the strengths and weaknesses of programs, policies, personnel, products and organisations to improve their effectiveness. It is about finding answers to questions such as 'are we doing the right thing' and 'are we doing things right'. These are prominent questions for SDIs, the development of which has been very dynamic over the last decade and has involved a lot of learning from other national or local initiatives.

Evaluating and comparing public and private administration systems can be significant in terms of improving processes and institutional structures. The application of these principles to the development of SDIs will therefore come to play a crucial role in managing our land information and that pertaining to the administration of our societies.

The field of land administration is one where evaluation principles are being developed, with much of these principles relevant

to SDIs. Land administration systems are essential parts of countries' national infrastructures (UN-FIG, 1999) as they are concerned with the administration of land and land resources and therefore also with land-related, spatial data.

Spatial data is required for managing and locating land issues, land resources and other land related phenomena. Within national administrations, spatial data is often acquired and maintained by different organisations, resulting in problems such as datasets not being compatible with each other and data not being shared across organisations, leading to inefficiencies and the duplication of effort. The common objectives of different organisations have resulted in the development of the SDI concept at different political and administrative levels in regard to the facilitating and coordinating the exchange and sharing of spatial data between stakeholders (Rajabifard et al., 2002).

The commonalities between SDIs and the objectives of efficient and effective land administration systems provide strong grounds for deriving evaluation and performance indicators for SDIs from land administration principles. To achieve this, the chapter first presents and discusses major classes of factors which influence, or contribute to the development of an SDI initiative followed by a review on the key components of land administration systems and SDIs. The chapter then presents a general evaluation framework, which can be applied to SDI and its different components before drawing some conclusions.

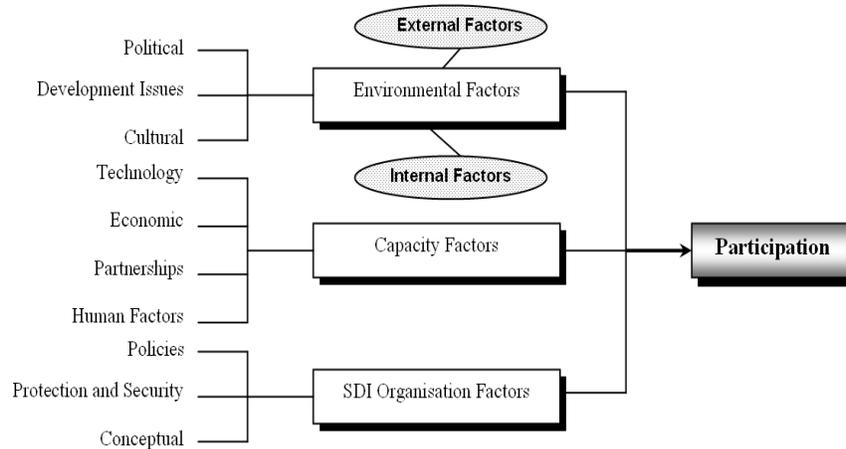
## **10.2 INFLUENCING FACTORS FOR SDI DEVELOPMENT**

The SDI is fundamentally a concept about facilitating and coordinating the exchange and sharing of spatial data between stakeholders from different jurisdictional levels in the spatial data community. The concept is well explained as an integrated, multi-levelled hierarchy of interconnected SDIs based on partnerships at corporate, local, state/provincial, national, regional (multi-national) and global (GSIDI) levels. Therefore, it is essential that SDI practitioners understand the significance of human and community issues, as much as technical issues, as they determine the long running success of an SDI development. SDIs, therefore, can no longer be regarded, or taught, primarily as just a technical matter.

Developing a successful SDI initiative depends at least as much on issues such as political support, clarifying the business objectives which the SDI is expected to achieve, sustaining a culture of sharing,

maintaining reliable financial support and enlisting the cooperation of all members of the community; as on technical issues relating to spatial data access, networking and standards. Therefore the argument is that developing a successful SDI at a jurisdictional level must be seen as a socio-technical, rather than a purely technical, exercise; and the communities concerned are expecting to reap benefits from their investment in the SDI in terms of improved corporate performances and cooperation. For example, based on the participation rate in the regional SDI development of the Asia-Pacific, as part of activities the UN sponsored Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), remains an innovative concept among its 56 member nations. This innovation is due to the region having a complex social and political environment that is typified by competing and often conflicting priorities and motivations. Every case in this region is unique because of its national context, language and characteristics (such as size, population, political systems, varied infrastructures and skills), the national traditional and cultural attitudes, along with the people who participate, develop and use SDIs. Therefore in order to develop a functioning regional SDI efficiently for this region, the coordinating agency must manage such diversity to gain the support necessary to meet their objectives. Identifying critical social factors and processes in the acquisition, implementation and utilisation of a technology can facilitate the management of such diversity. It is expected that the decision-making responses of individual nations, groups and regional organisations may be predicted and therefore may also be accommodated or redirected through prescriptive strategies.

By identifying key human and technical factors within classes of potential users, SDI coordinating agencies will be able to better define and develop strategies to achieve their objectives. For example Rajabifard (2002) has identified three major classes of factors which are influencing, or contributing, to the development of the Asia-Pacific regional SDI initiative. These classes of factors are Environmental Factors, Capacity Factors, and SDI Organisation Factors, as illustrated in Figure 10.1. According to this figure, the three classes of factors together affect the participation rate.



**Figure 10.1: Factors influencing the development of a regional SDI**

### **A. Environmental Factors**

The environment is the overall structure within which the social system operates and is characterised by internal and external factors. Therefore the different characteristics of social systems, or communities, adopting the SDI concept can be attributed to a number of environmental factors, including the different cultures of the communities, political factors and development issues. External factors are those factors outside the border of the social system which affect, or could potentially affect, the performance of an organisation. These factors impinge more on the levels of management. Internal factors are those factors inside the border and affect both management and member levels. Therefore, determining an appropriate social border for the study and analysis of a social system is very important.

Some examples of external factors are Globalisation (such as the global market, global economics and other global initiatives); the GSDI initiative and the global environment. In terms of internal factors, examples include the political climate; political structure and procedures; relationships with regional organisations; technological pressure; financial stability of each member nation; organisational structure of the coordinating agency (one of the most important factors) and the degree of culture of data sharing.

In terms of the effectiveness of factors, the effects of cultural factors on regional SDI development can be extremely high. The social dynamics of national relations can cause enormous effects on

cooperation and costs within the business environment as well as poor decision-making. By examining the social dynamics of cultural differences within jurisdictions it would be possible to understand why a high proportion of capabilities of member nations are hidden or not functioning. Regional SDI coordinating agencies must therefore assess the impact of cultural factors in SDI development. If the risk of these factors is seen to be too high then the strategy for its development can be redesigned.

### **B. Capacity Factors**

Capacity building may refer to improvements in the ability of institutions and (government and non-government) organisations to conduct their functions and achieve desired results over time. It may also refer to the provision of foundation data, metadata standards, clearinghouse functionalities and a facilitating environment for decentralising the GIS application to manageable application domains within the SDI concept. Therefore, capacity building for an SDI, in a broad sense, may refer to improvements in the ability of all involved parties to perform appropriate tasks within the broad set of principles of that particular SDI initiative. With this in mind, capacity factors are those that cover technology, economic factors, partnerships, and human factors, therefore encompassing technological capacity, human capacity and financial capacity. Some examples of capacity factors are: the level of awareness of values of SDIs; the state of infrastructure and communications; technology pressures; the economic and financial stability of each member nation (including the ability to cover participation expenses); the necessity for long-term investment plans; regional market pressures (the state of regional markets and proximity to other markets); the availability of resources (a lack of funding can be a stimulus for building partnerships, however, there should be a stable source of funding) and the continued building of business processes.

### **C. SDI Organisation Factors**

Organisation factors are related to the way that an SDI is defined, designed and implemented. These factors mainly include all core components of the SDI including technical and institutional issues such as access policies, access networks, technical standards and the SDI as a conceptual model. Some examples of SDI organisation factors are: the suitability and degree of complexity of the SDI conceptual model; the availability of spatial data and metadata; the integration and inter-flow of datasets from different parties (this has

important implications for the ownership and control of information); access networks and multiple trusted data sources.

### **10.3 LAND ADMINISTRATION SYSTEMS AND THE ROLE OF SDIS**

The UN-ECE (1996) defines land administration as "the processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies. It is considered to include land registration, cadastral surveying and mapping, fiscal, legal and multi-purpose cadastres and land information systems".

Dale and McLaughlin (1999) define land administration as "the process of regulating land and property development and the use and conservation of the land, the gathering of revenues from the land through sales, leasing, and taxation, and the resolving of conflicts concerning the ownership and use of the land." They continue that the basic building block in any land administration system is the cadastral parcel and that land administration functions can be divided into four functions: juridical; regulatory; fiscal and information management. The first three functions are traditionally organised around three sets of organisations while the latter, information management, is integral to the other three components.

Along with progress in information technology, the information management function has been developed considerably over the last few decades, as there have been many efforts to establish information systems dealing with land information that is based on the cadastral parcel. Within national administrations, spatial data is however often acquired and maintained by different organisations, resulting in problems such as datasets not being compatible with each other and data not being shared across organisations, leading to inefficiencies and duplications of effort.

The SDI is an initiative attempting to overcome these shortcomings and to create an environment where all stakeholders in spatial data can co-operate and interact with technology to better achieve their objectives at different political and administrative levels. SDIs have become important in determining the way in which spatial data is used by an organisation, a nation, different regions and the world. By reducing duplication and facilitating integration, along with developing new and innovative business applications, SDIs can produce significant human and resource savings and returns.

Regardless of the fact that different interest groups view SDIs differently, researchers have identified a number of core components that are common to all SDI implementations (Coleman and McLaughlin, 1998; Rajabifard et al., 2002): people; access networks; policy; technical standards and datasets. All components are strongly related to each other which results in an interrelated infrastructure.

While land administration systems are fore mostly concerned with supporting the management of land issues — ownership, use, value — and land resources, the focus of the SDI is mainly on the data and information about the land. As such, SDI is the underlying infrastructure for operating land information systems (Dale and McLaughlin, 1999) which by themselves are underpinning the land administration process.

It is this interaction between SDIs and land administration systems that is crucial for both parts. The interaction can be investigated and understanding fostered by searching for 'best practice' and for evaluation methods that look at those specific issues through qualitative and quantitative indicators which describe the relationships between them.

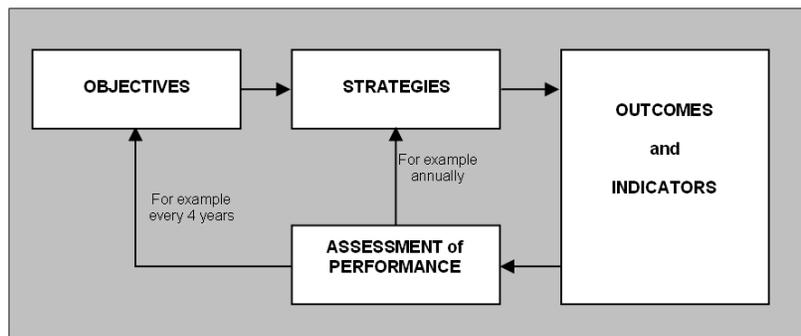
#### **10.4 EVALUATION AND A FRAMEWORK FOR EVALUATION**

Evaluation is mainly concerned with questions such as: are we doing the right thing, are we doing things right, what lessons can we draw from experiences and what can we learn from similar situations. Such questions are an integral part of the steering and management tasks for programs and projects which can be formulated, and partly answered, by an evaluation (SDC, 2000). The objectives of an evaluation can be to verify the impacts, the objectives, or the efficiency of a project or a system, to find answers to specific questions associated with the project or system context, to prepare information for reporting or to draw lessons for future phases.

An important decision that has to be taken into account beforehand relates to how the evaluation has to be conducted. For the purpose of better being able to handle and understand large projects or systems, an evaluation needs to be broken down and divided into comprehensible subclasses. In a World Bank Seminar about 'Public Sector Performance — The Critical Role of Evaluation', Baird (1998) emphasised four elements that are central in how to evaluating the performance of an organisation or system:

- a) well-defined *OBJECTIVES* (to know where to go to):
  - define the targets for the whole system;
  - might involve historical and social aspects, the cultural heritage as well as the political, legal, and economic basis;
- b) clear *STRATEGY* (to know how to get there):
  - defines the way forward to reach and satisfy the objectives (institutions, organisations, finances, activities);
- c) *OUTCOMES* and *INDICATORS* for monitoring (to know if on track):
  - outcomes are the results of the activities arising from the objectives and strategies;
  - indicators must be able to be monitored and relevant for feedback to objectives and strategies; and
- d) *ASSESSMENT OF PERFORMANCE* (to gain input for improvements):
  - the process which takes the outcomes and indicators into account in order to evaluate and review the objectives and strategies on a regular basis;
  - looks at the performance and reliability of the system and how the initial objectives and strategies are satisfied.

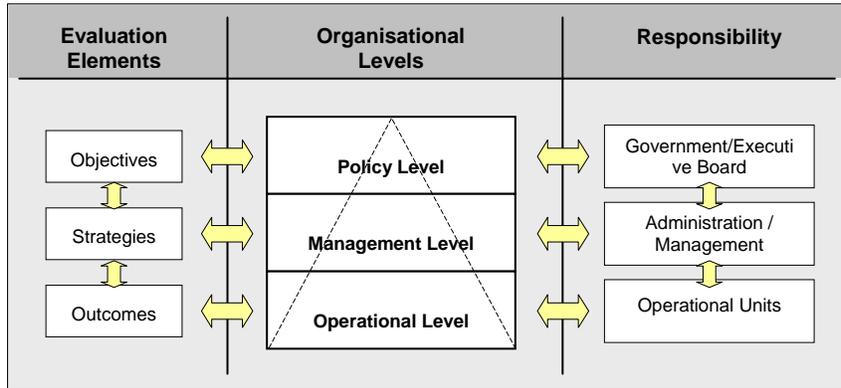
These four evaluation elements must be thought of as a cyclical process, allowing a regular assessment of the performance and a review of the initial objectives and strategies. The review cycle can, for example, be conducted annually for the strategies whereas the objectives might be reviewed only every four years (Figure 10.2).



**Figure 10.2: Basic Evaluation Elements and Cycle of Assessments**

In order to fill the elements with content, they would also have to be brought into context with the relevant stakeholders. For that purpose, the organisational pyramid with the three organisational levels can provide a valuable basis. Any organisation is structured into different divisions, subdivisions and sometimes even external units, each with separate functions. Regardless of the organisation, the three levels of the organisational pyramid can, in general, be distinguished to represent the different organisational tasks and responsibilities. The three levels are the policy level, the management level and the operational level.

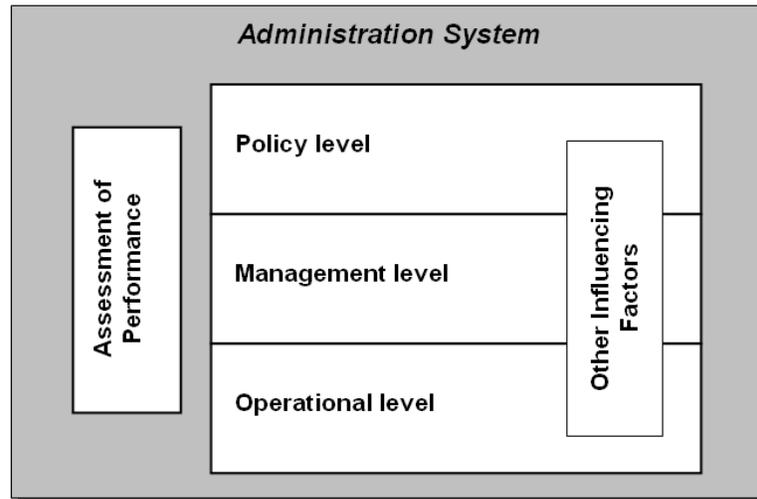
The organisational levels can be correlated with the evaluation elements introduced in Figure 10.2 as well as with the stakeholders. The policy level can be related with defining the objectives, for which the government or the executive board is responsible. The management level includes the definition of the strategy, for which the administration or management of the organisation is responsible. The operations required for the outcomes are handled in the operational level, for which the operational units are responsible (Figure 10.3).



**Figure 10.3: The relationship between Evaluation Elements and Organisational Levels**

The organisational levels provide the basis for defining the actual fields or areas of evaluation. For evaluating an administration system as a whole, however, another two areas would also need to be considered. Firstly is the assessment of a performance area that focuses on how the whole system performs and how the objectives and strategies are satisfied. Secondly, there are other influencing factors that have an impact on all three organisational levels, such as human resources, capacity building, or technology. All factors

influence the organisational levels in one way or another and also need to be addressed (Figure 10.4).



**Figure 10.4: Areas for Evaluating an Administration System**

These areas for evaluation provide the basis of the evaluation framework where each area is evaluated separately, while maintaining a holistic perspective and respecting the overall purpose of the system. For the evaluation, the areas need to be broken down into smaller units which are supported by performance indicators, measuring the performance of key variables such as quality, time and cost. The evaluation of the areas and indicators can then be done on the basis of the predefined 'good practice' criteria representing a presumed 'ideal' system. The criteria of this ideal system are based on the actual objectives and strategies of the system, the results of previous lesson-learning and comparison projects, or ideally on both.

Table 10.1 illustrates a generalised evaluation framework where the evaluation areas are further expanded with the possible aspects, indicators and good practice criteria.

## **10.5 EVALUATION OF SDIS**

Masser (1998) used an analytical framework to compare first generation national SDIs. The framework considered the main criteria of the geographic and historic context, main data providers, institutional context, and national geographic information strategy elements.

**Table 10.1: Evaluation Framework with Possible Aspects, Indicators and Good Practice for Each Area**

Area	Possible Aspects	Possible Indicators	Good Practice
Policy Level	<ul style="list-style-type: none"> <li>objectives and tasks of the system</li> <li>historic, legal, social, cultural background</li> <li>equity in social and economic terms</li> <li>viability of system (economical, social)</li> </ul>	<ul style="list-style-type: none"> <li>list of objectives and tasks</li> <li>legal and historic indicators</li> <li>social indicators</li> <li>economic indicators (expenses, incomes, fees, costs)</li> </ul>	<ul style="list-style-type: none"> <li>system is well defined by objectives and tasks</li> <li>system responds to needs of society</li> <li>system is equitable for all</li> <li>system is economically viable</li> </ul>
Management Level	<ul style="list-style-type: none"> <li>structural definition of system</li> <li>strategic targets</li> <li>institutional and organisational arrangements</li> <li>cooperation and communication between institutions</li> <li>involvement of private sector</li> </ul>	<ul style="list-style-type: none"> <li>definitions and characteristics of system</li> <li>list of strategic targets</li> <li>list of institutions and their responsibilities and strategies</li> <li>links between institutions (legal, organisational, technical)</li> <li>number of contracts with private sector</li> </ul>	<ul style="list-style-type: none"> <li>structure of system is useful and clearly defined</li> <li>strategies are appropriate to reach and satisfy objectives</li> <li>involved institutions have each clearly defined tasks and cooperate and communicate well with each other</li> <li>private sector is involved</li> </ul>
Operational Level	<ul style="list-style-type: none"> <li>outcomes</li> <li>technical specifications</li> <li>implementation</li> </ul>	<ul style="list-style-type: none"> <li>products for clients</li> <li>technical indicators</li> <li>implementation factors</li> </ul>	<ul style="list-style-type: none"> <li>products respond to objectives</li> <li>technical specifications and implementations are appropriate to strategic needs</li> </ul>
Influencing Factors (Human Resources, Capacity Building, Technology)	<ul style="list-style-type: none"> <li>Human Resources (personnel, training)</li> <li>capacity building</li> <li>professional association</li> <li>technical developments</li> </ul>	<ul style="list-style-type: none"> <li>number of personnel, education</li> <li>continuing education (seminars, etc.)</li> <li>number of universities and students</li> <li>is there a professional association (y/n)</li> <li>new technologies on the market</li> </ul>	<ul style="list-style-type: none"> <li>appropriate number of personnel in relation to task and population</li> <li>continuing education on a regular basis</li> <li>appropriate number of universities and students</li> <li>professional association takes active role</li> <li>new technologies are evaluated on a continuing basis</li> </ul>
Assessment of Performance	<ul style="list-style-type: none"> <li>review of objectives and strategies</li> <li>performance and reliability of system</li> <li>user satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>review of objectives and strategies (y/n)</li> <li>turnover, time to deliver, number of errors</li> <li>review of user satisfaction (y/n)</li> </ul>	<ul style="list-style-type: none"> <li>regular review process</li> <li>system is efficient and effective</li> <li>system delivers in time and with few errors</li> <li>appropriate, fast and reliable service to clients</li> </ul>

The evaluation framework that was developed in the previous section, however, attempts to take a more comprehensive approach and to also consider issues such as the different stakeholders in the organisational pyramid, and the recurring and regular review of the objectives and strategies through performance assessment. If an SDI is evaluated through the general evaluation framework that has been developed (Table 10.1), the SDI components as highlighted by Rajabifard et al. (2002) as policies, standards, access networks, people as well as data can be mapped into the evaluation areas mentioned in Figure 4. The policy component can obviously be associated with the policy level and the standards component of the management level; while the access network and data components are attributed to the operational level. The access network component may have to be considered in both management and operational levels given the varying maturity of SDI developments that have been established over the last decade. The people component has an influence on all three organisational levels and is therefore associated with the other influencing factors area. The result is shown in Figure 10.5.

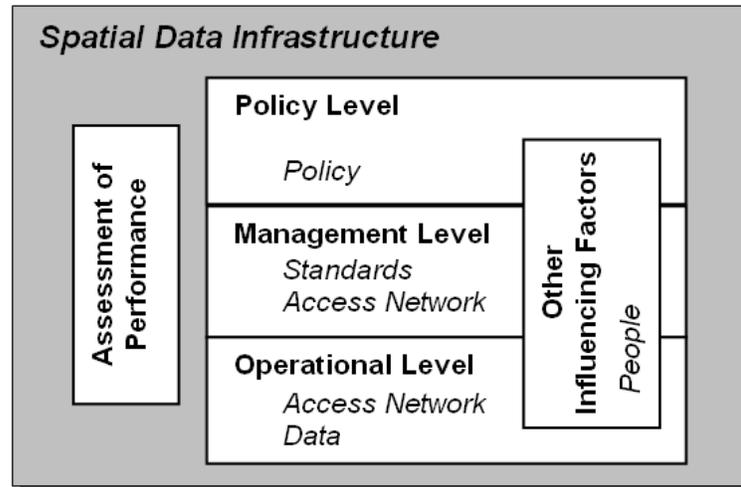


Figure 10.5: Evaluation Areas for the SDI

If the evaluation areas for SDIs are further expanded according to the suggested framework in Table 10.1, each area would need to be specified in terms of ASPECTS, INDICATORS, and GOOD PRACTICE. For the SDI, the evaluation framework may consider the following aspects according to Steudler (2003):

**(a) Policy Level**

*Policy:* One aspect to be considered for the policy component is the geographic, historic and social context of the country. A second aspect is how the government handles the overall policy regarding the collection, dissemination and legal protection of spatial data; for example the issues such as intellectual property rights, privacy issues and pricing. Indicators might be the existence of a government policy regarding the mentioned issues and how the issues are dealt with. Good practice is when the government has taken actions for an SDI and when issues have been handled in a comprehensive and satisfying way in relation to the geographic, historic and social context of the country.

**(b) Management Level**

*Standards:* The evaluation of the standards component includes how the government administration is dealing with organisational arrangements for the coordination of spatial data. This component may include the assessment of government agencies involved in providing spatial data for land titles, for large- and small-scale

mapping, and for socio-economic statistics. The evaluation has to consider standardisation issues like the definition of core datasets, data modelling practices and interoperability at the national level. Indicators for the management level might be a list and the size of government agencies involved in spatial data, their size and activities and how they communicate and cooperate with each other. In order to permit comparisons with other countries, indicators might point out the definitions of the core datasets, the data modelling techniques used for defining spatial datasets and the standardisation decisions for the access networks.

*Access Networks:* The evaluation of the access networks component may include issues like the definition of data summaries, formats of available data, delivery mechanisms for the data, whether access will have associated costs and whether data-access privileges will be defined for different user groups. Indicators might point out access pricing, access delivery mechanisms and procedures, whether access is defined by privileges or is open to all users, as well as whether there are inter-institutional links for data access, or value-adding arrangements established with the private sector.

#### ***(c) Operational Level***

*Access Network:* The responsibility for the operational level is with the government's operational units that have to make things happen in terms of access network and data provision. The access network component is to be evaluated by considering the type of available network and its capacity and reliability. Indicators might be the data volume and response time and good practice would be when the network can handle a large data volume reliable with a short response time.

*Data:* The data component can be evaluated by assessing the data models of the spatial datasets of the different agencies, the creation of a national core dataset, the data formats, data capture methods, data maintenance as well as data quality and accuracy. Good practice might be when data is defined in clear and transparent ways (content, quality, accuracy) so that they can easily and readily be shared among the different agencies and users.

#### ***(d) Influencing Factors***

*People:* The evaluation of the people or human resources component has to take the three groups into account which have been identified as relevant in the SDI context: end-users; data integrators respectively

value adders and data providers. The evaluation will have to assess the situation within these three groups in terms of personnel, opportunities for training and capacity building and the market situation for spatial data. Good practice will be when end-users are easily and readily getting the data product that they are looking for, when integrators can operate and prosper in favourable market situations and when data providers are able to deliver the data in efficient and effective ways.

***(e) Assessment of Performance***

This aspect has not significantly been addressed in SDI research papers so far, but is equally important for the overall assessment of national infrastructures. The assessment might include the review of objectives, strategies, performance and the reliability of the system, as well as user satisfaction. Indicators can be the adoption of SDI principles, its use and diffusion of spatial data and user satisfaction surveys. Good practice can be considered as when all SDI principles are adopted, when there is large use and diffusion of spatial datasets and when users indicate satisfaction about the products and services offered.

The areas and possible indicators suggested in Table 10.2 are only a general framework for evaluating SDIs but are nonetheless useful for providing a first-order evaluation of an SDI and eliciting valuable indicators. An example of the indicators that can emerge from such an application is summarised as a strength-weakness-opportunity-threat (SWOT) matrix in Table 10.3, which is based on a state-level SDI analysis in Australia as presented by Steudler (2003). The five evaluation areas were reviewed for the State SDIs with the main findings being fed into the SWOT matrix. The insights provided from this first-order evaluation indicate the value that may be derived from more in-depth applications of the evaluation areas and further developing the indicators and criteria specific to the SDI being evaluated. It must be emphasised that the areas and possible indicators suggested in Table 10.2 are only a general framework for evaluating SDIs and would require further development in order to optimise the benefit of an evaluation.

**Table 10.2: Possible Indicators for Evaluating SDIs**

Area	Possible Indicators
<b>Policy Level</b> – <i>Policy</i>	<ul style="list-style-type: none"> <li>existence of a government policy for SDI</li> <li>handling of intellectual property rights, privacy issues, pricing</li> <li>objectives for acquisition and use of spatial data</li> </ul>
<b>Management Level</b> – <i>Standards</i>	<ul style="list-style-type: none"> <li>standardisation arrangements for data dissemination and access network</li> <li>institutional arrangements of agencies involved in providing spatial data</li> <li>organisational arrangements for coordination of spatial data</li> <li>definition of core datasets</li> <li>data modelling</li> <li>interoperability</li> </ul>
<b>Management Level</b> – <i>Access Network</i>	<ul style="list-style-type: none"> <li>access pricing</li> <li>delivery mechanism and procedure</li> <li>access privileges</li> <li>value-adding arrangements</li> </ul>
<b>Operational Level</b> – <i>Access Network</i>	<ul style="list-style-type: none"> <li>type of network</li> <li>data volume</li> <li>response time</li> </ul>
<b>Operational Level</b> – <i>Data</i>	<ul style="list-style-type: none"> <li>data format</li> <li>data capture method</li> <li>definition of core datasets</li> <li>data maintenance</li> <li>data quality and accuracy</li> </ul>
<b>Other Influencing Factors</b> – <i>People</i>	<ul style="list-style-type: none"> <li>number of organisations and people involved</li> <li>opportunities for training</li> <li>market situation for data providers, data integrators, and end-users</li> </ul>
<b>Performance Assessment</b>	<ul style="list-style-type: none"> <li>degree of satisfying the objectives and strategies</li> <li>user satisfaction</li> <li>diffusion and use of spatial data and information</li> <li>turnover and reliability</li> </ul>

**Table 10.3: SWOT Matrix Summarising a General (first-order) Evaluation of a State SDI**

<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Comprehensive review of land information strategy takes place on a regular basis</li> <li>One government department is responsible for spatial data, which is favourable for strong leadership and decision-making</li> <li>Strong academic sector</li> <li>Good cooperation between public-private-academic sectors</li> </ul>	<p><b>Weaknesses:</b></p> <ul style="list-style-type: none"> <li>Strategy does not consider the cadastral issues to their full merits</li> <li>No promotion of data modelling and interoperability and hence freedom of systems and methods</li> <li>No independent board which could promote and coordinate spatial information</li> </ul>
<p><b>Opportunities:</b></p> <ul style="list-style-type: none"> <li>Vision of spatial information being crucial for good governance</li> <li>Strengthen political support</li> </ul>	<p><b>Threats:</b></p> <ul style="list-style-type: none"> <li>Not being able to bring the diverging interest groups together</li> <li>Losing political support</li> </ul>

## 10.6 CONCLUSIONS

This chapter sets out a broad strategy for evaluating SDIs. It presented three major classes of factors namely Environmental Factors, Capacity Factors and SDI Organisation Factors. The chapter argued that these classes of factors are influencing the development of an SDI, and together they can affect the participation rate. The chapter then suggested an evaluation framework based on an approach originally developed for evaluating land administration systems. This framework attempts to accommodate the well-recognised SDI components namely people, access network, policy, standards and data, which may be considered as the main evaluation areas within the suggested framework. However, the main evaluation areas need to be complemented by the additional evaluation area of performance assessment which evaluates the progress towards objectives and strategies that were initially defined. In this respect, the framework mainly assesses the effectiveness and efficiency of SDIs.

There is a substantial amount in common between land administration systems and SDIs, especially at the state level where cadastres are a main component of both. Therefore, while the SDI evaluation strategy is still evolving, much can be learned from systems being developed that evaluate land administration and where a number of benefits have been identified such as:

- standardised benchmarking provides an unbiased way of comparing systems;
- standardised benchmarking procedures can improve productivity, efficiency, and performance;
- cross-jurisdiction or cross-country comparisons can help better understand one's own system;
- benchmarking and evaluation can help identify categories of processes and systems;
- they provide a basis for comparisons over time; and
- they provide help to demonstrate strengths and weaknesses.

The main innovation that the suggested framework provides is incorporating performance assessment as an evaluation area. The SDI field is still under development and the body of knowledge is still growing, yet there is already considerable attention given to its development, while not specifically relating to its quantification and qualification. Therefore, for the further developing SDI evaluation, greater emphasis must be placed on the recurring and regular review of objectives and strategies.

The most important benefit from evaluating and comparing SDIs with each other will be the lessons learnt and identifying good practices. Performance indicators that measure the performance of key variables will provide the basis for this approach. The broad framework presented in this chapter is strongly related to land administration but suggests a way forward for SDI evaluation.

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