Developing a goal-oriented SDI assessment approach using GIDEON – the Dutch SDI implementation strategy – as a case study.

Łukasz Grus[1], Arnold Bregt[1], Joep Crompvoets[1,2], Watse Castelein[3], Abbas Rajabifard[4]

[1]Wageningen University, Centre for Geo-Information, Wageningen, The Netherlands, lucas.grus@wur.nl, arnold.bregt@wur.nl, joep.crompvoets@wur.nl

[2]Public Management Institute, Katholieke Universiteit Leuven, Leuven, Belgium, joep.crompvoets@soc.kuleuven.be

[3]Geonovum, Amersfoort, the Netherlands, w.castelein@geonovum.nl

[4]Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, University of Melbourne, Australia, abbas.r@unimelb.edu.au

Abstract

In 2008, the Dutch government approved the GIDEON document as a policy aiming at the implementation of the National Spatial Data Infrastructure (NSDI) in the Netherlands. The execution of GIDEON should take place by pursuing seven implementation strategies which lead to the achievement of the GIDEON goals. GIDEON also expresses the need to monitor the progress of implementing its strategies and realization of its goals. Currently, the work has been started on monitoring the GIDEON implementation strategies. However, there is still a lack of knowledge and methods to monitor GIDEON goals realization. The challenge is to come up with an approach to assess to what extent these goals are achieved.

As a response to the challenge of assessing the GIDEON goals, this paper explores the possibility of using the Multi-view SDI assessment framework (Grus et al., 2007). This paper presents and discusses the method that applies the Multi-view SDI assessment framework, its indicators and measurement methods to create a GIDEON assessment approach. The method of creating a GIDEON assessment approach consists of several procedural steps: formulating specific GIDEON objectives, organizing a one-day workshop involving focus group of specific stakeholders responsible for creation and execution of NSDI, asking the workshop participants to select from a long list those indicators that best measure the achievement of each GIDEON goals. The key step of GIDEON approach is a one-day workshop. The workshop participants represented all organizations that cooperated and/or created GIDEON. The workshop consisted of two parts: first part explained the context of a challenge of assessing GIDEON, second part included participants activity to select and come to the consensus on the list of indicators that would best measure GIDEON goals realization. Additionally, the participants were asked to evaluate and express feedback on the usefulness of the method of creating GIDEON assessment approach.

The results show that several indicators that relate to specific SDI goals could be selected by a significant number of workshop participants. The indicators that have been selected are not the final ones yet, but provide a guideline and form a base of what has to be measured when assessing GIDEON goals. Involving the representatives of all parties committed to GIDEON into the process of GIDEON assessment approach creation will strengthen its robustness and acceptance. The results of the feedback form filled by each participant show that the presented method is useful or very useful to create GIDEON assessment approach. Additionally, some of the participants provided already their own indicators which are very specific for Dutch SDI monitoring.

The method presented in this research, assuming that SDI goals are defined and the organizations that participate in SDI creation are known, can be applied in any other country to develop country-specific and practical SDI assessment approach.

Keywords: GIDEON, Spatial Data Infrastructure, Assessment, Evaluation

1. INTRODUCTION

Spatial Data Infrastructures (SDIs) have become an important issue in Geo-Information Science. Large sums of money have been invested into SDI initiatives over the last few years. Worldwide around €120 million is spent each year just on clearinghouse management (Crompvoets, 2006). The investment requirements for an Infrastructure for Spatial Information in the European Community (INSPIRE) at European, national, regional and local levels are estimated to be in the range of €202 to €273 million each year (INSPIRE, 2003). The realization of SDIs is usually described in a form of public policy documents. Consequently, the main financial stream for establishing and operating SDIs comes from the public funds. To assure the justification of the money spent on those SDIs the requirement for monitoring and assessing SDI gains attention. In SDI assessment domain a shift is observed from a more intuitive to a more rational assessment of SDIs. Therefore formal progress reports on implementing and using SDIs are needed (Bregt et al., 2009). One of the most straightforward ways of monitoring SDI development is by assessing the realization of SDI intended goals.

As a response to the growing need for SDI assessment a Multi-view SDI assessment framework (Grus et al., 2007) has been developed.

Figure 1: Multi-view SDI assessment framework
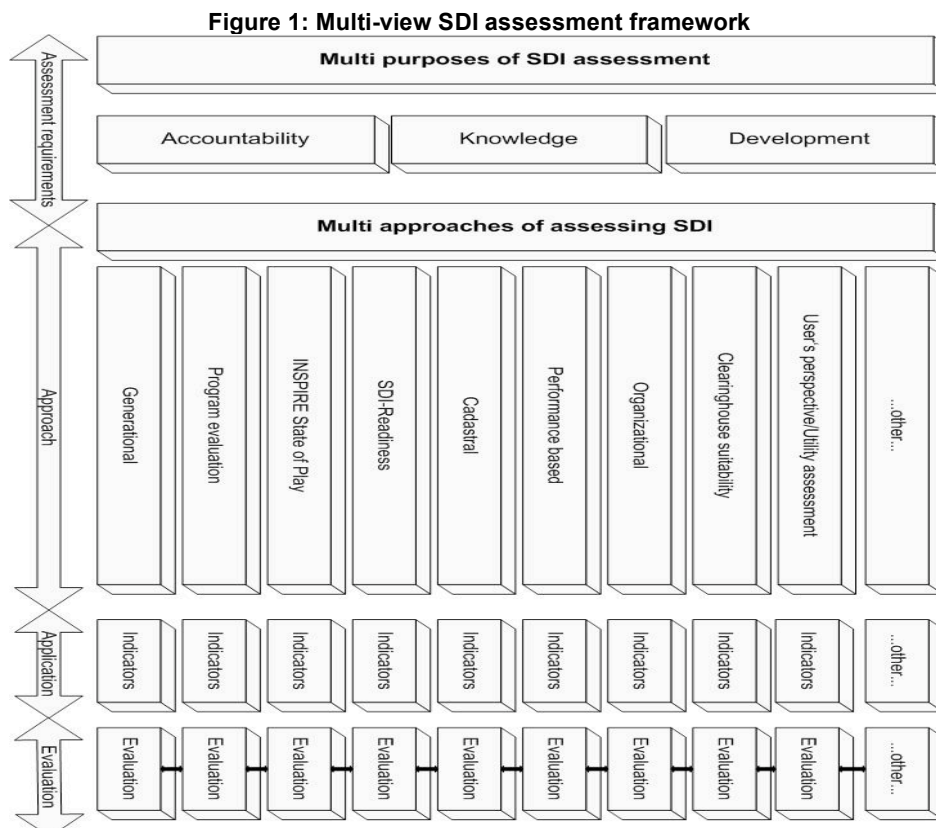
The framework is a combination of several SDI assessment approaches varying from assessing SDI organizational aspect to SDI clearinghouses. Each approach uses several indicators to measure specific SDI aspects. The results of the application of the Multi-view SDI assessment framework are supposed to provide SDI practitioners with a multi-view, comprehensive and unbiased picture of SDI performance. Multi-view SDI assessment framework can also be applied in a purpose driven way. For example, a SDI practitioner who is interested in an assessment of a specific SDI aspect can select those assessment approaches that fit best his/her purpose of the assessment. However the assessment of the specific SDI goals may be challenging due to a number of reasons. Due to different cultural, economical, social, organizational circumstances of each National SDI the goals can be different. Therefore it can be expected that each NSDI will need a specific goal-oriented assessment approach. The multi-view framework (see figure 1) offers a number of assessment approaches, each with a variety of operational indicators. This collection of indicators could potentially be used to create an assessment approach to measure the realization of specific SDI goals. This paper aims at developing an approach for goal oriented SDI assessment.

2. METHODOLOGY

2.1 Method

To the authors' knowledge, a practical goal-oriented assessment approach for SDIs is not described in the literature. Moreover, the methods to arrive to a goal-oriented assessment approach have not been found. In this paper we propose a method for developing a practical and goal-oriented SDI assessment approach. The method consists of eight steps. Table 1 presents in a chronological way eight methodological steps to develop a goal oriented SDI assessment approach.

Table 1: Methodological steps for developing a goal-oriented SDI assessment approach.

Step 1	Identify SDI goals
Step 2	Identify the key SDI stakeholders
Step 3	Compile a long list of potential indicators
Step 4	Organize a workshop
Step 5	Select and match the indicators with SDI goals
Step 6	Formulate a goal-oriented SDI assessment approach
Step 7	Apply a goal-oriented SDI assessment approach
Step 8	Evaluate the application of a goal-oriented SDI approach and if necessary improve the earlier steps.

In Step 1, the specific SDI goals have to be identified. SDI goals are commonly agreed target which SDI aims to achieve in a specific time period. Usually the goals are formulated and described in a SDI implementation strategy document or policy.

In Step 2, the key SDI stakeholders have to be identified. SDI stakeholders are the parties who have interest in achieving SDI goals. Usually the key SDI stakeholders have been cooperating in writing and/or approving SDI implementation strategy

document or policy. The SDI stakeholders can usually be identified in the SDI implementation strategy document or policy and those are usually: ministries, research centers, advisory committees, private companies, etc.

In Step 3, the list of indicators that potentially could measure SDI goals has to be compiled. To do so a Multi-view SDI assessment framework can be used as a base for selecting indicators for a goal oriented assessment approach. The Multi-view SDI assessment (Grus et al., 2007) framework at present consists of four SDI assessment approaches i.e. Clearinghouse suitability, SDI-readiness, INSPIRE State of Play and Organizational approach which are fully operational (Grus et al., 2008). This means that their indicators are measurable in practice. For this reason we compiled the list of indicators taken from those four operational assessment approaches. The list consists of 72 potential indicators (See Appendix 1 for the list of potential indicators). The order of the indicators in the list was random. The indicators were not grouped in any way because grouping would require subjective interpretation of the indicator meaning in assigning them into specific group.

In Step 4, a workshop needs to be organized to bring all SDI stakeholders or their representatives together to select and match the indicators with SDI goals. The workshop should be divided in two subsequent sessions. The first session should discuss the goals of a SDI and requirements of assessing SDI goals. The second session should involve SDI stakeholders into selecting the key indicators that measure SDI goals. The workshop can take one day.

In Step 5, the SDI stakeholders should decide which indicators from the long list would best measure the realization of each SDI goal. This step should be done in the second session of the workshop. To focus only on the most important indicators the SDI stakeholders should be asked to select no more than 5 indicators. Additionally, the stakeholders should also have a possibility to propose their own indicators which are not in the long list but are, according to stakeholders, crucial for measuring SDI goals realization. Depending on the number of SDI stakeholders, they can also be divided into groups to decide on the indicators. The reason for working in group is that with larger numbers of stakeholders it is more efficient and already allows for achieving some level of consensus between each group members about the choice of key indicators.

In Step 6, a goal-oriented SDI assessment approach is formulated. It has to be stressed that the formulated SDI assessment approach is case-specific. This means that for each SDI, the final set of key indicators can be different due to different SDI goals.

In Step 7, a goal-oriented SDI assessment approach should be applied to measure SDI goals realization. An approach should be applied by measuring all the indicators. After the application an assessment should be made about the level to which the intended SDI goals has or has not been realized.

In Step 8, an evaluation of the application process of the goal-oriented SDI assessment approach should be made. The evaluation can be made by measuring the stakeholders' satisfaction with the results of the goal-oriented assessment. This step may also serve as a feedback loop mechanism. After the evaluation of the approach application process, each step can be again reconsidered and refined according to the potential shortcomings identified in the evaluation.

It has to be noted that the results of Step 6, 7 and 8 are not described in this paper. The focus of this paper was only on the method to develop a goal-oriented SDI

assessment approach. The formulation of the final goal-oriented SDI assessment approach, its application and application evaluation was beyond the scope of this paper. However, the authors of this paper have strong intention to complete also those three steps in the successive research on the goal-oriented SDI assessment approach.

2.2 Materials

As test case for developing a goal-oriented SDI assessment approach we used GIDEON - the policy of the Dutch government for the further development of SDI in The Netherlands (VROM, 2008). The document has been developed in close cooperation with the stakeholders. GIDEON formulates the following objectives for the Dutch SDI:

- *the public and businesses will be able to retrieve and use all relevant geo-information about any location;*
- *businesses will be able to add economic value to all relevant government-provided geo-information;*
- *the government will use the information available for each location in its work processes and services;*
- *the government, businesses, universities and knowledge institutes will collaborate closely on the continuing development and enhancement of the key facility.*

Various parties are working together on GIDEON. For the realization of the GIDEON policy seven implementation strategies are formulated. Jointly, these strategies will lead to the creation of a key geo-facility for The Netherlands. The seven strategies aim at:

1) Give the use geo-information an appropriately prominent place in the e-service strategy;
2) Encouraging using of the four statutory key geo-registers and creating two new ones;
3) Implementation of the INSPIRE directive and realization of the technical infrastructure;
4) Supply optimization by standardization of geo-information, creating joint facilities (national geo-register, services) for access and joint management of the infrastructure;
5) Stimulate the use of geo-information by chain cooperation in the policy areas of disaster and crisis management; sustainable living environment; mobility; area development of urban areas and neighborhoods; area development of rural areas.
6) Value creation; conditions will be created with a view to enabling the geo-industry to create as much value as possible for itself, based on public sector geo-information.
7) Encouraging collaboration in knowledge, innovation and education to continuous develop and enhance the key facility for geo-information.

In the mid 2008 implementation of GIDEON has started under the political and administrative responsibility of Minister of Housing, Spatial Planning and the Environment (VROM). One of the first steps in the GIDEON implementation process has been to work out the plans in greater detail. The detailed plan provides a clear picture of the milestones, while it also provides a transparent view of how the various milestones and implementation strategies interrelate. Based on the route plans, the

Minister of Housing, Spatial Planning and the Environment should report periodically on GIDEON implementation progress (e.g. once a year) to the parliament. Furthermore the GIDEON progress reports should be used to inform the GI-council – with the representatives of the SDI stakeholders listed in GIDEON - about the progress of the GIDEON implementation. The GI Council then acts as a steering group to create conditions for GIDEON implementation and to monitor progress and consistency in its implementation.

With the formulation of the GIDEON objectives and the associated implementation strategies also the demand for assessment changed. The national government requested an assessment approach that focuses on a) progress monitoring and reporting based on millstones defined in GIDEON b) realization of the GIDEON goals. Currently, the work has been started on monitoring the GIDEON implementation strategies. However, there is still a lack of knowledge and methods to monitor GIDEON goals realization.

2.3 Evaluation

In order to evaluate the proposed method the workshop participants were asked to fill in an evaluation form. The evaluation form includes questions asking for the participants' opinion about the methodological steps (see Method). Moreover, the evaluation addresses the following features of the proposed method: clarity, usefulness and easiness.
The evaluation form consisted of the following questions:

1) How do you evaluate the instructions given before the GIDEON work session?
2) How do you evaluate the completeness of the list with indicators?
3) How do you experience the individual selection of 5 indicators from the list?
4) How do you evaluate the group discussion over the indicators?
5) How do you evaluate the discussion over the results of the work session?
6) What is your general impression over the work session to come to the indicators for GIDEON goals monitoring?

The questions could be answered by indicating the number from 1 to 7 (where 1 meant [depending on the question] "very unclear" or "very incomplete" or "very difficult" or "very useless"; and 7 meant [depending on the question] "very clear" or "very complete" or "very easy" or "very useful".

3. RESULTS AND DISCUSSION

On 22nd October 2008 a one-day workshop "Monitoring GIDEON" was organized at the Wageningen University in the Netherlands. The objective of the workshop was to develop an approach for goal-oriented SDI assessment using GIDEON as a case study. 23 representatives of 21 organizations which were involved in creating GIDEON participated in the workshop. Those 21 organizations are listed as the stakeholders in the GIDEON policy document (VROM, 2008). The workshop had three sessions. The first session aimed at introduction of the topic and objective of the workshop. The second session aimed at development of a goal-oriented SDI assessment approach using a method proposed in this research. The third session aimed at evaluation of the method to develop a goal-oriented SDI assessment approach.

3.1 Results and discussion of the first workshop session

In the first session of the workshop, the GIDEON goals and monitoring requirements were discussed. There were eight presentations which placed the SDI monitoring issue in the wider perspective of the: assessment and evaluation theory; multi-view SDI assessment framework; national e-service monitoring; and requirements for the INSPIRE monitoring. In the discussion during the first session, the main issues raised by the participants that need to be taken into account for GIDEON monitoring are:

- Link GIDEON monitoring as much as possible with exiting monitoring approaches and requirements of the e-services and INSPIRE;
- Monitoring is important for the implementation of GIDEON and gives focus and direction. However for implementation networking and contacts are crucial. Monitoring can support SDI in strengthening the network and helping to build relationships with SDI stakeholders.

3.2 Results and discussion of the second workshop session

In the second session of the workshop, the participants were given a task to individually select from the long list those indicators which best measure each GIDEON goal. The participants selected five indicators per each goal and matched them with four goals of the Dutch SDI formulated in the GIDEON document. The results of the selection and matching are presented in the four tables below. The results presented in the tables below show only those indicators which were selected by more than (or equal to) 5 workshop participants.

Table 2 list those indicators which according to the workshop participants best measure the realization of the first goal of the Dutch SDI.

Table 2: Indicators selected by 5 or more participants for measuring the first goal of the Dutch SDI.

Indicator description	Number of particpants
Goal 1: the public and businesses will be able to retrieve and use all relevant geo-information about any location.	
Availability of view (web mapping) services in the national SDI geoportal	10
Use of maps for searching in the national SDI geoportal	7
Monthly number of visitors of the national SDI geoportal	7
Number of datasets available in the national SDI geoportal	7
Mechanisms for searching available in the national geoportal	7
The initiative and territorial coverage is truly national	6
Spatial data producers as well as end users are participating in the NSDI	6

Table 3 list those indicators which according to the workshop participants best measure the realization of the second goal of the Dutch SDI.

Table 3: Indicators selected by 5 or more participants for measuring the second goal of the Dutch SDI.

Indicator description	Number of particpants
Goal 2: businesses will be able to add economic value to all relevant government-provided geo-information	
There is a freedom of information act which contains specific legislation for the GI-sector	10
There is a pricing framework for trading, using and/or commercializing of	9

geoinformation	
Involvment of private parties in developing the long term vision or strategic plan of NSDI	8
Metadata availability	5
Availability of data download services in the national Geoportal	5

Table 4 list those indicators which according to the workshop participants best measure the realization of the third goal of the Dutch SDI.

Table 4: Indicators selected by 5 or more participants for measuring the third goal of the Dutch SDI.

Indicator description	Number of particpants
Goal 3: the government will use the information available for each location in its work processes and services;	
There is an institutional framework or policy for sharing geo-information between public institutions	12
Mechanisms for searching available in the national geoportal	6
The initiative and territorial coverage is truly national	5

Table 5 list those indicators which according to the workshop participants best measure the realization of the fourth goal of the Dutch SDI.

Table 5: Indicators selected by 5 or more participants for measuring the fourth goal of the Dutch SDI.

Indicator description	Number of particpants
Goal 4: the government, businesses, universities and knowledge institutes will collaborate closely on the continuing development and enhancement of the key facility.	
There are true Public-Private Partnerships or other …with respect to the development and operation of the NSDI-related projects	9
Existence of long-term vision statement or strategic plan for your NSDI	7
The long-term financial security of the national SDI - initiative is secured	5
Organizations which have agreed to the long term NSDI vision or strategic plan	5
Use of open source services	5
Spatial data producers as well as end users are participating in the NSDI	5

The results in the tables show that for each SDI goal there are several indicators that were consistently selected by more than 5 (out of 23) workshop participants. The workshop participants were the most consistent in selecting and matching indicators for monitoring the GIDEON goal 3 (see Table 4). Only three indicators (out of possible 72) were selected more than five times by the workshop participants. Indicator described as *"There is an institutional framework or policy for sharing geo-information between public institutions"* was even selected by twelve participants as the most suitable to measure the realization of the third GIDEON goal. These results might mean that there is rather strong consensus among the workshop participants on the key indicators for measuring the realization of the GIDEON goal 3. On the other hand for monitoring GIDEON goal 1, seven indicators were selected more than 5 times by the workshop participants. This might suggest that there is some level of disagreement about the key indicators for measuring the GIDEON goal 1. For monitoring GIDEON goals 2 and 4 the workshop participants indicated (more than five times) five and six indicators respectively.

Apart from selecting indicators from the long list, the workshop participants could also propose their own indicators. See Appendix 2 for the list of indicators formulated by the workshop participants.

After the individual selection of the indicators, the workshop participants discussed their own indicators in 6 groups. Each participant was assigned to a group in a random way. During the group discussion the participants had also chance to communicate and defend their choice of indicators with other participants of the workshop. The objective of discussing the individual results in groups was to come to a consensus about the key indicators. However, none of the groups reached the consensus to propose an agreed set of key indicators to monitor GIDEON goals realization.

3.3 Results and discussion of the third workshop session

In the final session of the workshop the participants were asked to evaluate the second work session (=method) to develop a goal oriented SDI assessment approach for GIDEON monitoring. The evaluation of the method has been done by answering 6 questions. The results of the evaluation are presented in Figures 2 to 7 and each figure is followed by a discussion of the results.

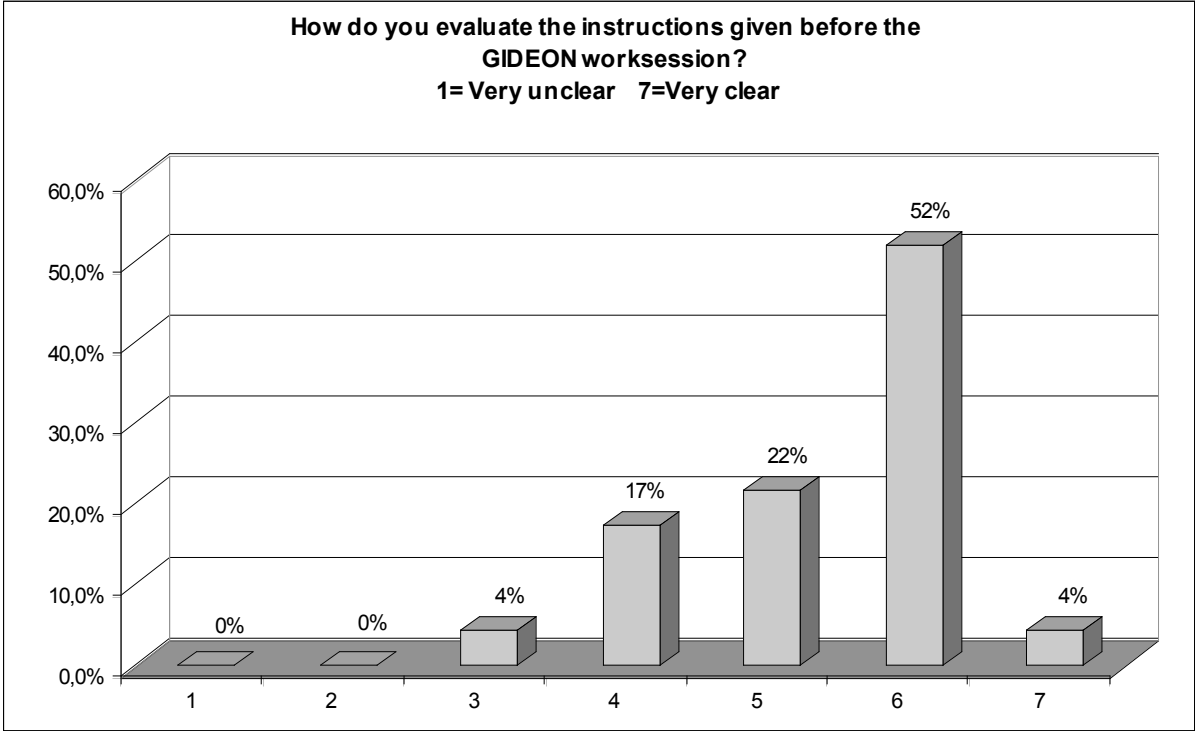**Figure 2: The evaluation results of the work session instructions.**

Figure 2 presents the results of evaluation of the clarity of the instructions for the second work session. Due to the fact that each participant is working alone and has exactly the same time for completing each task as other participants, the clarity of the instructions is crucial for the efficiency of the work session. On a scale from 1 to 7 (1 = very unclear and 7 = very clear) 52% of the respondents indicated answer 6. 4% of the workshop participants indicated value 7 (very clear). This might mean that the instructions for most of the participants were clear but there is still room for improvements. Probably more time for explaining the work session and for answering questions from the participants' side would

help to make the instructions more clearly to everyone. None of the respondents indicated answer 1 or 2 and only 4% indicated answer 3. This might mean that to none of the respondents the work session instructions were very unclear.

Figure 3: The evaluation results of the completeness of the indicators' list.
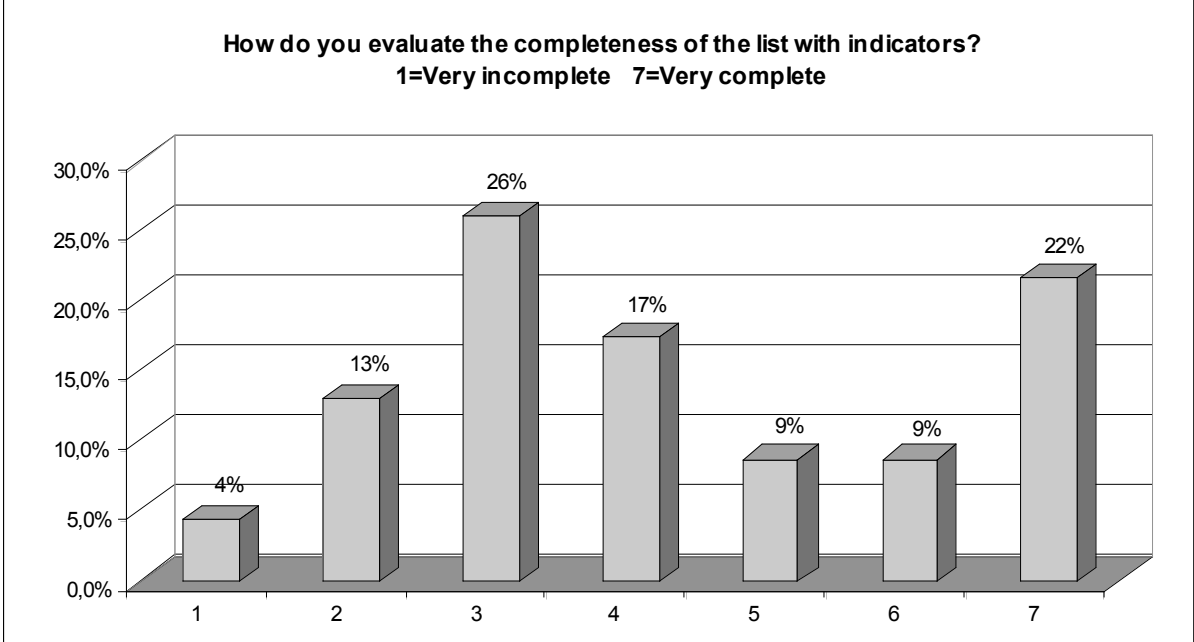
According to 22% of the participants the list with potential indicators to measure the realization of the GIDEON goals was very complete (see Figure 3). At the same time, 26% of the participants indicated value 3 on the evaluation scale. The relatively high rate of responses for value 7 can be explained by relatively high number of indicators (72) from which the workshop participants could choose from. Therefore for those 22% participants considered the list as very complete. On the other hand, 26% of the participants could not choose indicators that would measure the goals realization. Therefore they had to propose their own indicators to which they were better convinced. In this sense, for those 26% of the participants the list was rather incomplete. This incompleteness can additionally be explained by the fact that while selecting indicators for the four GIDEON goals an average of 27% of the respondents proposed their own indicators. The issue of the completeness of the long list with indicators was further discussed among the workshop participants. The conclusion was that apart from indicators in the long list which were rather quantitative, also more qualitative indicators are needed. According to the workshop participants qualitative indicators would help explaining the "story" behind the SDI performance which is also important in the monitoring of goals realization.

Figure 4: The evaluation results of the "easiness" of selecting 5 indicators from the list.

How do you experience the individual selection of 5 indicators from the list?
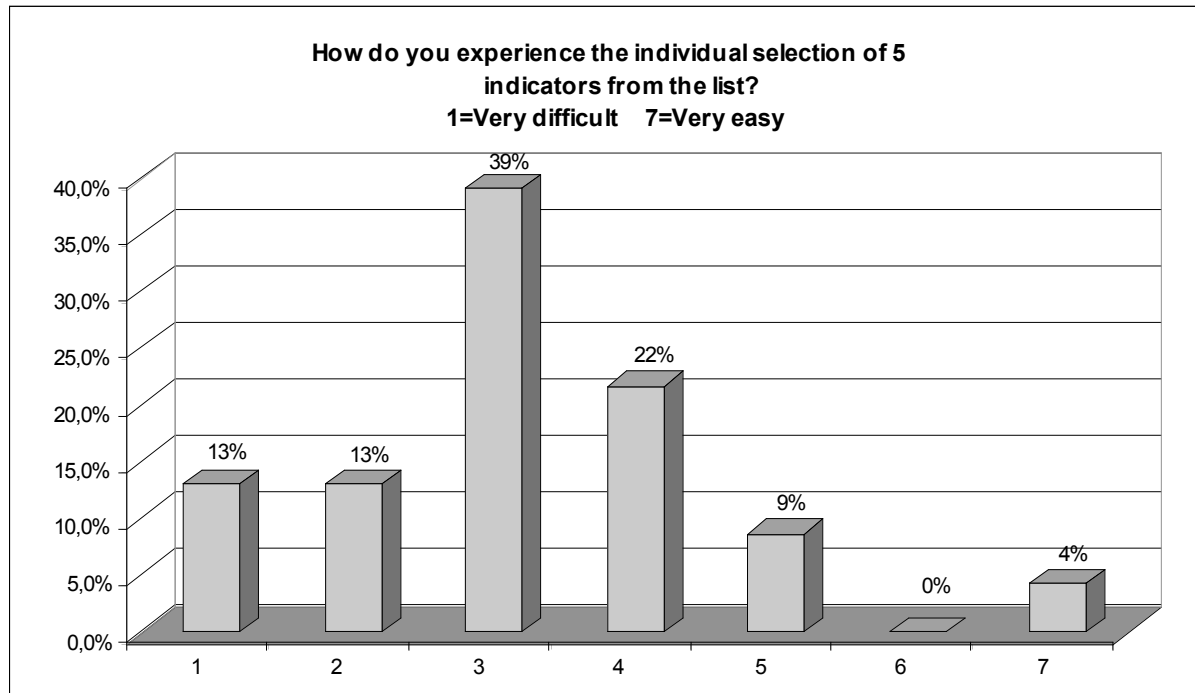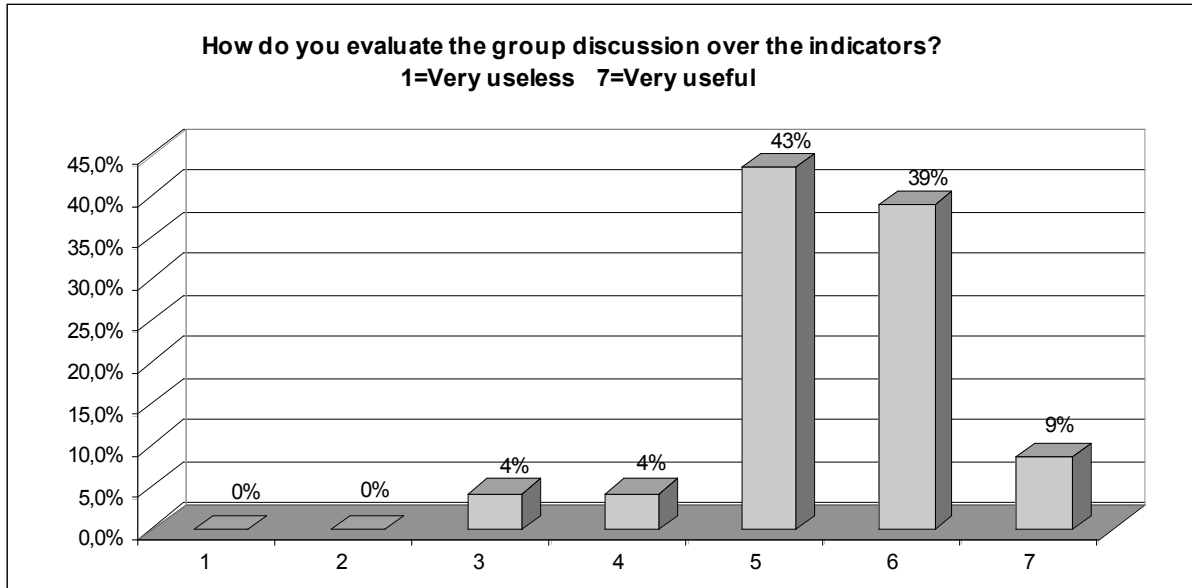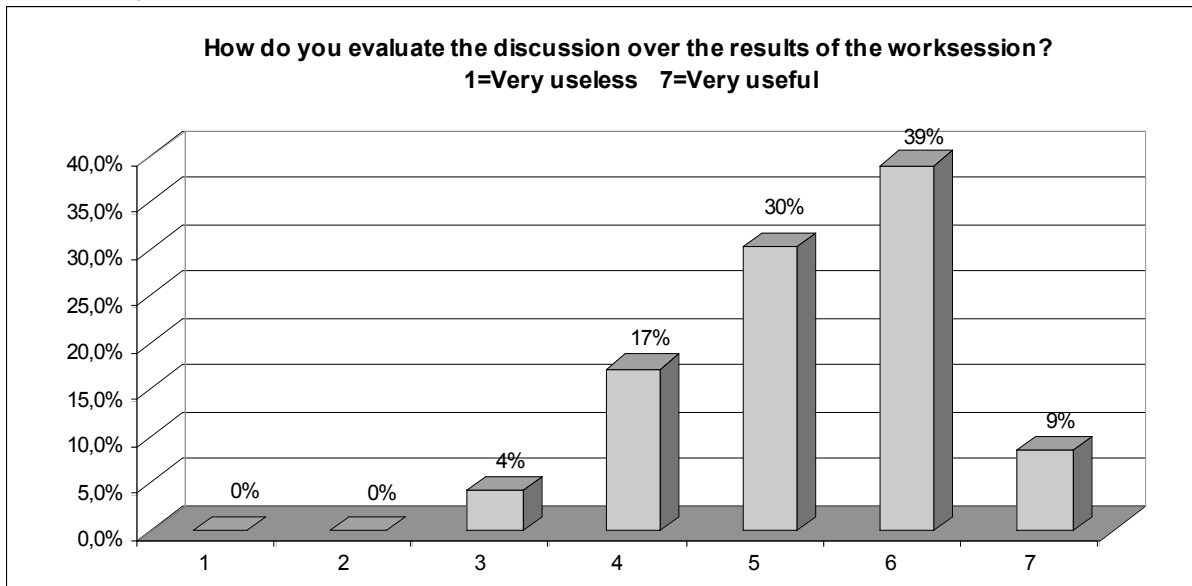**1=Very difficult   7=Very easy**

Figure 4 presents the results of evaluation of the easiness of selection of the 5 indicators from the long list. The results show that for the workshop participants it was rather difficult to select the indicators. According to the remarks expressed by the workshop participants, it was difficult to select the indicators because they were not grouped in any way. The results of the method evaluation suggest that in the future applications the indicators should be grouped in some way to make the selection easier. Grouping the indicators will especially be needed when the long list consists of a large number of indicators. The difficulties with the individual selection of the indicators may also be explained by the ambiguous names of some of them. Some of the workshop participants were not sure about the exact meaning of the indicators names and they were not provided with any description of the indicators. Moreover, to many participants some of the indicators from the list seemed to be almost the same despite having slightly different names. It is clear that in the future applications of the method the long list of the potential indicators should be reviewed to make indicators selection easier for the workshop participants.

Figure 5: The evaluation results of the group discussion over the indicators.

How do you evaluate the group discussion over the indicators?
1=Very useless   7=Very useful

| Value	Percentage
1	0%
2	0%
3	4%
4	4%
5	43%
6	39%
7	9%

The workshop participants evaluated the discussion over the individual indicators as rather useful. The discussion was probably useful to them in a sense that it allowed them to communicate their own opinion about the key indicators for monitoring GIDEON goal realization. Additionally they could better understand the reasons and arguments for choosing various indicators by different group members. Nevertheless, from the method point of view, the group discussion was not successful because it did not result in any consensus which would allow for formulating key GIDEON goals realization indicators.

Figure 6: The evaluation results of the discussion over the results of the work session.

How do you evaluate the discussion over the results of the worksession?
1=Very useless   7=Very useful

Value	Percentage
1	0%
2	0%
3	4%
4	17%
5	30%
6	39%
7	9%

The evaluation of the discussion of the work session results shows that the workshop participants found it useful (see Figure 6). The discussion allowed them to share opinion about the advantages and limitation of the work session. The discussion allowed also reaching some level of consensus about the actual content of the GIDEON goals monitoring framework. Additionally it was agreed that the indicators for the goals monitoring should measure to what level the SDI intended goals have been realized.

Figure 7: The evaluation results of the general impression over the work session.
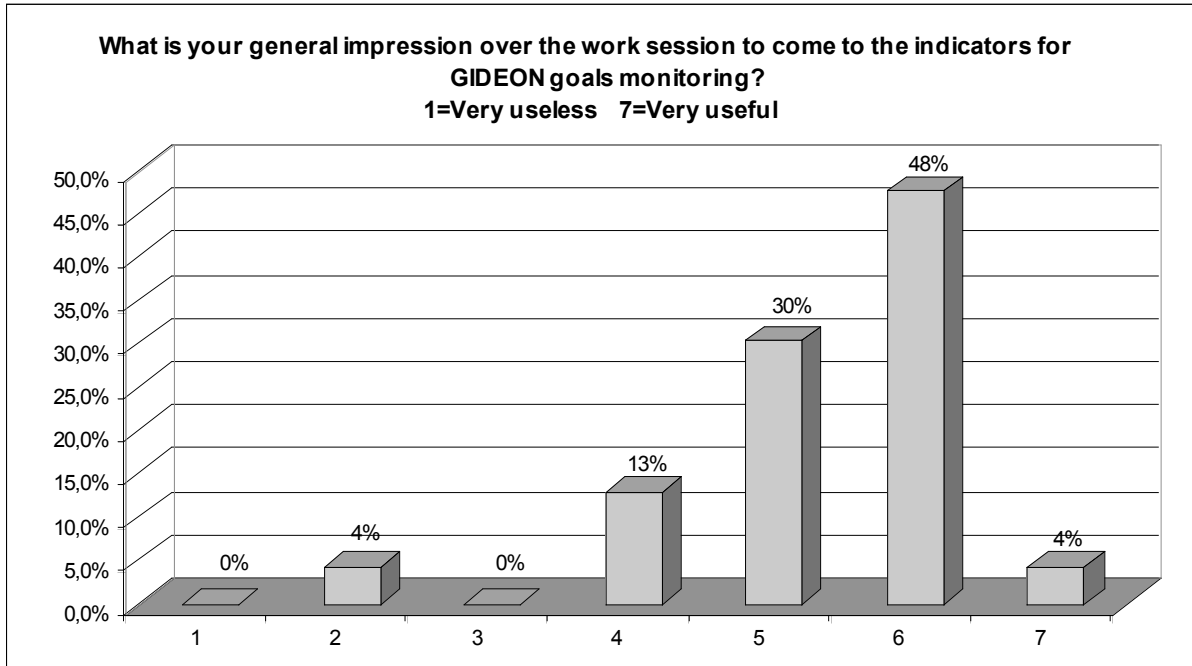
The evaluation results of the whole work session to come to the indicators for GIDEON goals monitoring are shown in Figure 7. 4% of the respondents indicated that the work session was very useful (value 7). Value 6 and 5 was indicated by the majority of the respondents - 48% and 30% respectively. This results show a general appreciation of the work session and thus a method. The workshop participants stressed a very transparent character of the whole session due to clear procedures of selecting indicators and immediate discussions during and after each session about the results. Additionally, it was appreciated that the method proposed and applied during the workshop is very efficient. In a timeframe of one day it was possible to come to the first approximation of the GIDEON goals monitoring framework.

4. CONCLUSIONS

The aim of the paper was to develop an approach for goal-oriented SDI assessment. We proposed a method which was applied for developing a goal-oriented assessment approach for GIDEON goals monitoring. The eight steps proposed in the method, are strongly in line with the main steps of the Multi-view SDI assessment framework: assessment requirement, approach, application, evaluation (see the arrows on the left side of the figure 1). The method is proposed to fulfill the assessment requirement of monitoring the SDI goals realization. Steps 1-6 aim at formulating an assessment approach for the aforementioned assessment requirement. Step 7 refers to the application part of the framework. Step 8 refers to the evaluation of the application of the assessment approach. The method application allowed for formulating a first set of key indicators for GIDEON goals monitoring (see tables 2, 3, 4, 5). The indicators presented in those tables can be treated as a first approximation of a content of a goal-oriented SDI assessment approach for GIDEON monitoring. The strength of the proposed method is that it involves the key SDI stakeholders in defining the key indicators for measuring SDI goals. Therefore, the presented set of indicators is built on consensus among the key GIDEON stakeholders. The strength of the method is that it is universal because it can handle different SDI goals. It can also be applied to formulate goal-specific assessment approaches for many different SDIs. The method evaluation results show that the method was appreciated by the workshop participants (see figures 5, 6, 7).

The results also show that there is a room for improvement of the method. The results of the evaluation of the method (see figure 3 and 4) show that the list of potential indicators can be improved. Dividing the long list of indicators into thematic groups of indicators would make the selection of the key indicators easier for the SDI stakeholders. Also there was some criticism the indicators themselves. It was suggested that more indicators are needed which could potentially measure the progress of achieving SDI goals, that the presented long list of indicators did not cover all aspects of goal oriented assessment and that more qualitative indicators are needed. The strength of using the indicators from the Multi-view SDI assessment framework was that those indicators were measureable i.e. the methods to collect data for the indicators are known and had been tested. The weakness of using the indicators from the Multi-view SDI assessment framework was that some of the indicators from the four operational assessment approaches might have been very similar. Also the indicators in the long list presented to the workshop participants related only to the aspects of the operational assessment approaches from the Multi-view SDI assessment framework and not to the other domains of SDI activity.

This research shows that the usage of the proposed method for developing goal-oriented assessment approach gives promising results for developing a goal-oriented assessment approach. Therefore, the authors of this article are highly motivated to continue refining and improving the method in their future research. In their future research they also intend to carry out the three methodological steps which were beyond the scope of this paper. This will allow seeing how the goal-oriented assessment approach works in practice and will contribute to the improvement of the whole method.

REFERENCES

Bregt, A., K., Grus, L., Crompvoets, J., Castelein, W., T. and J. Meerkerk (2009), "Changing demands for Spatial Data Infrastructure assessment: experience from The Netherlands", in Crompvoets, J., Rajabifard, A., van Loenen, B. and T. Delgado Fernandez (Eds), *A Multi-view Framework to Assess Spatial Data Infarastructures*, Melbourne, Digital Print Centre, The University of Melbourne, Australia, pp. 383-399.

Crompvoets, J., (2006). National Spatial Data Clearinghouses. Worldwide development and impact. Wageningen, PhD thesis, Wageningen Universiteit.

Grus, L., Crompvoets, J. and A.K. Bregt (2007). Multi-view SDI assessment framework, International Journal of Spatial Data Infrastructures Research, 2, 33-53.

Grus, L., Crompvoets, J., Bregt, A., van Loenen, B. and T. Delgado-Fernandez (2008). "Applying the Multi-view Spatial Data Infrastructure Assessment Framework in several American countries and The Netherlands", in Crompvoets, J., Rajabifard, A., van Loenen, B. and T. Delgado Fernandez (Eds), *A Multi-view Framework to Assess Spatial Data Infarastructures*, Melbourne, Digital Print Centre, The University of Melbourne, Australia, pp. 371-382.

INSPIRE, (2003). *Contribution to the extended impact assessment of INSPIRE*, Environment agency for England and Wales, at http://inspire.jrc.it/reports/fds_report.pdf, [accessed 27 March 2008]

VROM (2008). GIDEON – Key geo-information facility for the Netherlands. VROM, The Netherlands.

Appendix 1. List of potential indicators

☐1. There are one or more on-line services to download core spatial datasets that contribute the national SDI-initiative.

☐2. An organization of the type 'National GI-association is involved in the coordination of the national SDI

☐3. Existence of individual leadership (champion)

☐4. The national SDI-initiative is supported by someone with strong leadership

☐5. Use of maps for searching in the national SDI geoportal

☐5. There is a pricing framework for trading, using and/or commercializing geo-information

☐7. Last national SDI geoportal web address change.

☐8. There are one or more web mapping service available for core spatial data

☐9. The initiative and territorial coverage is truly national

☐10. Nature of participants' involvement in building NSDI

☐11. There is an independent thematic environmental SDI.

☐12. The long-term financial security of the national SDI-initiative is secured

☐13. Level of SDI funding from the government

☐14. There is a policy focusing on the access of thematic environmental data

☐15. Monthly number of visitors of the national SDI geoportal

☐16. Organizations which have agreed to the long term NSDI vision or strategic plan

☐17. There is a coordinating authority for metadata implementation at the level of the SDI

☐18. The SDI-initiative can be implemented by enough qualified staff capable to lead and work in national SDI-initiatives.

☐19. Existence of commitment building fora or platforms for NSDI

☐20. There have been taken initiatives in your country to launch the development of a National Spatial Data Infrastructure (SDI).

☐21. Network architecture of the national SDI geoportal

☐22. The national SDI-initiative takes into consideration capacity building issues in order to perform appropriate tasks within the broad set of principles relating your SDI-initiatives

☐ 23. Existence of long-term vision statement or strategic plan for your NSDI

☐ 24. There are true Public-Private Partnerships or other co-financing mechanisms between public and private sector bodies with respect to the development and operation of the national SDI-related projects.

☐ 25. Frequency of the national SDI geoportal website updates

☐ 26. Geo-Information can specifically be protected by copyright

☐ 27. Availability of view (web mapping) services in the national SDI geoportal

☐ 28. The geodetic reference system and projection systems are standardized, documented and interconvertable.

☐ 29. The national language is the operational language of the national SDI

☐ 30. Availability in digital format of core spatial datasets crucial for the national SDI

☐ 31. English is used as secondary language.

☐ 32. Metadata-standard applied in the national SDI geoportal

☐ 33. The officially recognized or de facto coordinating body of the national SDI is a national organization

☐ 34. One national on-line access service for metadata (clearinghouse) is available providing metadata of more than one data producing agency

☐ 35. There is documented data quality control procedures applied at the level of the national SDI

☐ 36. Types and extent of participants involved in building the NSDI and their roles

☐ 37. Number of data suppliers in the national SDI geoportal

☐ 38. One or more standardized metadata catalogues are available covering more than one data producing agency

☐ 39. There is an institutional framework or policy for sharing geo-information between public institutions

☐ 40. Kind of NSDI leadership

☐ 41. Availability of commercial or in-house spatially- related software

☐ 42. Number of thematic environmental datasets available in the national SDI geoportal

☐ 43. Metadata are produced for a significant fraction of spatial datasets

☐ 44. Only public sector actors are participating in the national SDI

☐ 45. Nature of the institution(s) with a role of SDI leader

☐ 46. The officially recognized or de facto coordinating body for the national SDI is an organization controlled by data users.

☐ 47. Thematic environmental data are covered by the described SDI-initiative

☐ 48. Metadata Availability

☐ 49. Recognition (for example, in Governmental laws or formal orders) of the need to establish or further develop NSDI

☐ 50. Most spatial datasets are available in digital format that provide a basis for contributing the national SDI-initiative

☐ 51. Availability of data download services in the national SDI geoportal

☐ 52. The national SDI-initiative is devoting significant attention to standardization issues

☐ 53. The level of legal support for SDI framework (existence of legal instruments such as laws, policies, directives and commitments

☐ 54. There are simplified and standardized licenses for personal use

☐ 55. Use of Open source services

☐ 56. Privacy laws are actively being taken into account by the holders of geo-information

☐ 57. There is a legal instrument or framework determining the SDI-strategy or development

☐ 58. Languages used in the national SDI geoportal

☐ 59. Concern for interoperability goes beyond conversion between data formats

☐ 60. Nature of a vision and strategies to accomplish SDI

☐ 61. SDI community addresses issues arising from society to which geographic information may contribute

☐ 62. Number of datasets available in the national SDI geoportal

☐ 63. Metadata records of thematic environmental datasets in the national SDI geoportal

☐ 64. Level of capacity building and awareness of the SDI impact on well functioning of society including business, public, and academia

☐ 65. Level of funding by means of cost recovery

☐ 66. Spatial data producers as well as end users are participating in the national SDI

☐ 67. Funding continuity of the national SDI geoportal

☐ 68. Level of private and enterprise sector funding

☐ 69. There is a freedom of information (FOI) act which contains specific FOI legislation for the GI-sector.

☐ 70. Involvement of private parties in developing the long term vision or strategic plan of NSDI

☐ 71. Mechanisms for searching available in the national SDI geoportal

☐ 72. Most recently produced dataset available in the national SDI geoportal

Appendix 2 List of indicators defined by the participants of the workshop

Goal 1: the public and businesses will be able to retrieve and use all relevant geo-information about any location.

Indicators:
- Existence of the research/innovation SDI program financed from the government
- Place for feedback is available
- Number of view/requests of public and private services
- There are forums, radio or TV news over SDI

Goal 2: businesses will be able to add economic value to all relevant government-provided geo-information.

Indicators:
- Number of services based on SDI

Goal 3: the government will use the information available for each location in its work processes and services.

Indicators
- There is an active organizational attention towards implementation of geo-information into work processes.
- Level of funding for innovation within SDI domain
- Level of cooperation between governments
- Yearly monitoring of the governmental processes
- There is public-relation activity towards the use of geo-information
- The level of the use of geo-information is applied in work processes

Goal 4: the government, businesses, universities and knowledge institutes will collaborate closely on the continuing development and enhancement of the key facility.

Indicators
- the level of stimulation of innovations in geo-information
- the number of conferences/seminars about SDI/Geo-information use
- Availability of resources for development and enhancement of the key facility
- Level of funding for innovation within SDI domain
- Spatial datasets can be integrated with other datasets
- Existence of EduGIS type of program
- Existence of Research and Application program