DEVELOPMENT STRATEGY OF NATIONAL SPATIAL DATA INFRASTRUCTURE FOR VIETNAM

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Summary

At the end of 2011, the World Bank and Ministry of Natural Resources and Environment of Vietnam established a joint working group to implement a study on development strategy of National Spatial Data Infrastructure (NSDI) for Vietnam. This report is focused to present the results from the said above study.

The Vietnam NSDI (VNSDI) is considered including the components: (1) Spatial data set (including spatial data, framework spatial data and meta-data); (2) Standards (including Standard of spatial data contents, Standard of data exchange, Standard of meta-data and Standard of data services); (3) Access to data (including Data Discovery, Data Access and Data Process); (4) Technology (including Hardware and Software Equipment, Data Communication Network); (5) Policy - Legislation (including Mechanism, Policy and Legislation regulated by the State); (6) Organization - Institution (including Organizations Arrangement and Relationship between Organizations); and (7) Partnership (including Investment Funding, Human Resources Development, Public Awareness Raising, Scientific Research and International Cooperation). Up to now, these components are not regarded in the concept of an infrastructure. The Vietnam Government has spent more than USD 75 million per year for NSDI development but mostly for spatial data collection and a few for surveying and ICT equipment.

Based on analyses of experiences from other countries, Opportunities and Challenges for NSDI development in Vietnam, the report proposes a long-term vision and near future objectives of VNSDI development as follows:

1. Long-term vision:

Take advantage of benefit from using spatial data infrastructure to attract participation of community in NSDI development in order to bring more benefits to each user, each locality, whole Vietnam in spatial linkage with regions and the whole world. The goal of 'Spatially Enabled Governments and Societies' that has been shown in the UN Declaration from Kuala Lumpur is to be become the goal of NSDI development of Vietnam.

The State plays leading role in the process of NSDI development through promulgating policy, legislation and ensuring financial investment for fundamental infrastructure to encourage non-state sectors' investment for value-added services and for what the State isn't doing. For now, the State plays a dominant role in investment, but for the future, State's investment will be replaced step by step with growth of non-state sectors' contribution.

2. Major objectives for the next 10 years (2011-2020):

Objective 1: Agencies related to spatial data infrastructure at central and local levels are linked on the basis of an agreed general action program on VNSDI development, supporting directly for e-Government program and enhancing effectiveness of land administration and planning management.
Objective 2: Standardized and updated framework spatial data system (with adequate meta-data) is early completed for easy discovery and process of spatial data in order to meet all demands of spatial data use.

Objective 3: The VNSDI development program is introduced to business community, related professional associations, and individual by disseminating GIS, GNSS technologies, spatial data network in order to enhance knowledge, encourage using spatial data in daily works, promote market of spatial data and related services, gradually bring enterprises to participate in investment to VNSDI and people to participate in using, collecting, updating and supplying spatial data.

Objective 4: Vietnam effectively participates in international cooperation activities in order to connect spatial data network of Vietnam to global spatial data network, facilitate Vietnam's participation in international activities on sustainable development, implementation of millennium development goal and coping with climate change.

3. Specific objectives for the period of 2011-2015, 2016-2020, and after 2020:

Objective for the period 2011-2015: according to the approved VNSDI development strategy, it is necessary to concentrate on developing a master plan on VNSDI development in order to implement simultaneously all components of VNSDI in principle of giving priority to upgrade weak and insufficient components. State supplies spatial data free of charge or at low rate and technological services of spatial data in order to attract participation of enterprise community and people. The State issues a system of policy and legislation on VNSDI and increase investment from State's budget for VNSDI to create effectiveness and efficiency in using spatial data. Application of VNSDI is focused on land management and development planning with high priority to bring real effects in economic growth, social stability and environmental sustainability.

Objective for period 2016-2020: The VNSDI components that was upgraded in previous period are continuously improved; technological capability development is concentrated, in which user-based service network of geo-spatial data shall be developed to extend larger and larger community of delivering and using geo-spatial data. Based on benefits recovered from using spatial information, the State encourages investment from communities for VNSDI in order to reduce gradually investment from the state budget. From the experiences of VNSDI development in land management and development planning, continuous application of VNSDI in extended to other sectors.

Objective for the period after 2020: The VNSDI services system is linked to the e-Government services system in an unified services to implement e-Government program successfully in reforming totally administrative system aiming at serving people; and the VNSDI is actively participated in the regional and global spatial data infrastructure; together with other economies in the world the VNSDI realizes successfully the UN goal "spatial enablement of governments and societies".

The last content of the report is concentrated on proposals of specific objectives of each component of the VNSDI for the period 2011-2015, 2016-2020 and after 2020.
I. General Introduction

In 1970s and 1980s, development of 3S technology including GPS, RS and GIS have brought a breakthrough in conceptual knowing the Earth and supported people to decide their development steps correctly.

In the early 1990s, commencing in the US under the coordination mechanism of the Federal Geographic Data Committee (FGDC), there was a consensus that geo-spatial information needed to be considered as 'soft infrastructure' and in order to ensure its sustainability - the concept of infrastructure would mean that government would ensure that it was assigned recurrent and investment budgets - in the same manner that 'hard infrastructure' is funded. Since then, there was a new concept of enhancing role of geo-spatial data in development process. All geo-spatial data must be managed and exploited on the basis of an unified infrastructure including several elements which focus on not only data and data processing equipments, but also data standardization for common use, data access to extend scope of use, policy and legislation to ensure legal corridor; organization and institution for easy implementation, technology to increase capability of use, trainings on human resources and public awareness raising to enhance using effectiveness, etc. As a result, concept of Spatial Data Infrastructure (SDI) has been formed at different levels such as local, national, regional and global level.

In 1996, the UN initiated the Program 'Global Mapping' and in 2009, the United Nations started preparatory process to create Global Geospatial Information Management (GGIM), which aims at playing a leading role in setting the agenda for the development of global geospatial information and to promote its use to address key global challenges and provides a forum to liaise and coordinate among Member States, and between Member States and international organizations.

During 24 - 26 October 2011, the First High Level Forum on Global Geospatial Information Management (GGIM) held in Seoul and issued the Seoul Declaration on GGIM. In February 2012, a joint conference organized by GGIM and other international organizations held in Kuala Lumpur and adopted the Kuala Lumpur Declaration, in which there is an important content 'Agree that spatially enabled societies and governments, recognizing that all activities and events have a geographical and temporal context, make decisions and organize their affairs through the effective and efficient use of spatial data, information and services'. That means NSDI is the pre-requisite for what is now being universally called 'Spatial Enablement of Governments and Societies'.

II. What is SDI?

Definition in legal document of the US Federal Government (1994): SDI as a minimum infrastructure, includes applications, standards, technology and institutional governance necessary for effective and efficient spatial data and services management within or across organizations. The way to group elements of this definition is aim to exploit spatial data effectively and efficiently. Since then, several definitions of SDI have been proposed but almost all are based on description of SDI components. SDI of a country is called as NSDI. Analyzing these definitions, components of Vietnam NSDI (VNNSDI) can be defined as follows:
(1) Spatial data set (including spatial data, framework spatial data and meta-data);

(2) Standards (including Standard of spatial data contents, Standard of data exchange, Standard of meta-data and Standard of data services);

(3) Access to data (including Data Discovery, Data Access and Data Process);

(4) Technology (including Hardware and Software Equipment, Data Communication Network);

(5) Policy - Legislation (including Mechanism, Policy and Legislation regulated by the State);

(6) Organization - Institution (including Organizations Arrangement and Relationship between Organizations);

(7) Partnership (including Investment Funding, Human Resources Development, Public Awareness Raising, Scientific Research and International Cooperation).

**III. The benefits that NSDI can bring**

The report introduces benefits of NSDI including:

1. NSDI is a large data resource for setting up real world model to ensure completeness, accuracy and updating that help people to conceive exactly about current status, know thoroughly about potentiality and risks to decide development steps aiming at a better future.

2. NSDI is a large data bank accelerating speed up of developing the information society and knowledge-based economy.

3. NSDI is an important data infrastructure serving for development of e-Government with objectives of renovating administrative system aiming at serving people better, more effectively, transparently and democratically.

4. NSDI facilitates people to join hands to ensure sustainable development, implement the Agenda 21 and millennium development goal, and cope with climate change.

5. NSDI is the sole solution to economize geo-spatial data production in order to avoid overlapping investment and enhance information resources.

6. NSDI creates a platform to encourage all resources from community to update, manage, access and exploit data in principle of ensuring spatial data resources more and more adequately, accurately and timely.

**IV. Process of SDI formation**

Since 1990s, President of the US, Bill Clinton, took great actions to NSDI development process with the issuance of the Executive Order 12906 (1994) coordinating geographic data acquisition and access on the basis of the National Spatial Data Infrastructure - NSDI. Federal Geographic Data Committee (FGDC) of the US has operated actively in the US and international organizations to propagandize the concept of NSDI.

The United Nations has issued policies on encouraging formation of regional permanent committee on geographic information infrastructure including European Umbrella
Organization for Geographic Information, and Permanent Committees on GIS Infrastructure in America, in Asia and the Pacific, and in Africa.

From 24 to 26 October, 2011, the first high level forum on global spatial data management was organized in Seoul, and from 15 to 16 February, 2012, the International Symposium on Spatially Enabled Government and Society was jointly organized by GGIM, PCGIAP, GDSI, FIG in Kuala Lumpur. The concept of NSDI is now being universally called the Spatial Enablement of Governments and Societies (UN Declaration from Kuala Lumpur).

V. Experiences of NSDI development in some typical countries

The report presents the development process of NSDI in some typical countries including the US, Sweden, Australia and New Zealand, India, Republic of Korea, Malaysia, and European Union to provide some lessons can be learnt for Vietnam as follows:

1. Government’s policies and investments play an important role to lead NSDI development; The Government is both a large provider and a large user, and Government also plays the role in encouraging community to deliver and use geo-spatial data.

2. The Government takes the leading role in the process of NSDI development. However, active participation of non-State organizations, enterprises and citizens plays an important role in raising effectiveness of using spatial data, increasing value of spatial data in market and developing spatial information market and geo-services to make success of NSDI development.

3. NSDI development process must be associated with process of developing e-Government to ensure unification and suitability.

4. It is necessary to focus on technology to make more practical, effective and quicker steps in NSDI development process. Especially, popularization of using GNSS and GIS technologies has a direct positive impact on pushing up NSDI development process.

5. Open service-based architecture on the basis of Geo-spatial One-Stop portal must be set as a principle of developing NSDI.

6. It is necessary to select land administration as the central issue in NSDI development and then extend to other sectors in order to make cautious steps but to facilitate success of the NSDI development process.

7. Human resources development and public awareness raising play the decisive role in enhancing participation of community and assisting community to know how to use spatial data and helping people to participate in governance.

8. Usage of NSDI not only raises general effectiveness of economic development, social stability and environment protection but also increases State's revenue by raising effectiveness of land administration, property related tax collection, etc.

VI. Development process and status of SDI in Vietnam

Major achievements in developing NSDI’s components in Vietnam are described as follows:
1. **Spatial data has been collected including:**
   
   
b. Geodetic coordinates networks of the "0" and 1st and 2nd orders include over 2,000 points covering whole country and major islands; the 3rd order (cadastral coordinates network) includes over 10,000 points to ensure at least 1 point per one commune.
   
c. Digital topographic maps at the scales 1/1,000,000, 1/500,000, 1/250,000, 1/100,000 and 1/50,000 covering whole country were completed. Digital topographic maps at the scale 1/10,000 covering whole country and at the scale 1/5,000 and 1/2,000 covering urban areas are implementing (topographic map system includes the information layers: relief elevation, administrative boundary system, hydrologic system, transport system, vegetation cover, population distribution and economic infrastructure, and place name).
   
d. Geo-spatial databases and information network of natural resources and environment including land, water resources, geology, mineral resources, environment, meteorology, hydrology, sea and islands are implementing.
   
e. Marine hydrographic chart system at scale 1/250,000 is being re-edited on the basis of collecting available marine charts in association with updating survey. Seabed topographic map system at the scale 1/50,000 is being implemented in coastal zone.
   
f. Cadastral records including cadastral books and maps and real property certificates are completed at about 70% of total land parcels, in which 70% are made in digital form.
   
g. Other maps including national and administrative boundary maps, administrative maps, current land use map, land use planning map, soil map, etc. have been completed and are being updated in accordance with Government's plans.
   
h. Catalogues of administrative and international place names were published. Place names of geographic objects are being implemented.
   
2. **Data and service standards:**
   
The first version of geographic data standards, cadastral data standards and land registration standards was already completed and approved; information service standards have not been approved yet.
   
3. **Technology:**
   
a. Surveying and mapping technology has been completely changed into digital generation in both State and private sectors.
   
b. Satellite Receiving Ground Station regularly receives SPOT and EnviSat satellite images.
   
c. The network of 4 DGPS permanent stations are well operating for sea-bed topographic survey, national boundary demarcation, topographic and cadastral survey in mountainous areas.
   
d. Communication network infrastructure, computer software and hardware have been equipped adequately for accessing and processing geo-spatial data.
4. Policy and legislation:

National Assembly and Government have paid much attention to legal frame and policy on ICT application and development, aiming at building e-Government, implementing administrative reform and publicizing administrative information. MoNRE has initially regulated mechanism of delivering geo-spatial data for needs of the State and private use.

Since 2012, the State of Vietnam has considered the ICT as a national infrastructure with concentration on building the national database and encouraging the linkage with international networks to aim at developing e-government, e-citizen and implementing the promise of E-ASEAN. The development of ICT is decided as the first priority task in the process of country's industrialization and modernization. In June, 2012, the Vietnam ICT summit was held in Hanoi for discussing and issuing recommendations to the State and business community on the works which should be done to develop the ICT in Vietnam.

5. Community supplying and using geo-spatial data and related services:

Community supplying and using ICT service generally developed considerably in Vietnam with large investment of the State and great contribution from non-State sectors. This context promises a potential community of NSDI.

6. Current funding for components of NSDI

Vietnam Government has spent the State's budget for development of NSDI components at the following level:

a. Land administration sector: about USD 60 million per year for collecting spatial data and total USD 20 million for ICT equipments.

b. Topographic surveying and mapping sector: about USD 10 million per year for collecting spatial data and total USD 3 million for surveying and mapping equipments; it is expected to invest about USD 10 million for developing National Continuously Operating Reference Station network (CORS network).

c. Integrated management of information about natural resources and environment: about USD 2 million per year for building geo-spatial databases and USD 1 million per year for building information network.

d. Satellite images receiving sector: about USD 2 million per year for receiving satellite images and total USD 25 million for construction of satellite receiving ground station.

Thus, total expenses is USD 74 million per year for framework spatial data production, USD 1 million per year for spatial data network construction, and USD 2 million for technology and equipments (do not include investments for ICT general infrastructure).

VII. Outstanding issues in NSDI development in Vietnam

On practical point of view, outstanding issues during past time are easily seen as follows:

1. Vietnam has not had a policy on NSDI development according to the concept of unified infrastructure. Among 7 components of NSDI, Vietnam has just focused on data set
component only; standards component has been initiated; technology component is not yet synchronized; and other components are limited in implementation.

2. The Vietnam Government has invested a lot of expenses from State budget to develop geo-spatial data in the forms of topographic maps, cadastral maps, land records and satellite images. According to general evaluation, only 40% of cadastral data are put into use in land administration. Topographic maps are not powerfully used for modernization of planning on the basis of spatial analysis. Satellite images are not used to update topographic maps and to monitor current land use as well as other natural resources and environment. Moreover, these spatial data are not updated regularly and always out of date. Spatial data are archived in the form of data set or single database that are not connected in the form of an unified data network. Up to now, no province has publicized land information on a public network. State's agencies in charge of surveying - mapping, land administration and remote sensing management at Central level have not developed geo-spatial portal to deliver spatial data and related services. Information monopoly is occurring in State's agencies responsible to archiving and managing data. Therefore, enterprises and people are difficult to access to geo-spatial data.

3. Due to lack of a State's decision on NSDI development program, policy and legislation system does not have specific documents on NSDI development.

4. Regarding organization, State agencies responsible to collecting and managing framework spatial data are belonging to MoNRE. This is an advantage to concentrate on accelerating State’s role to NSDI development, but it may create monopoly in which driving force of development is lost.

5. Enterprises doing business in ICT in Vietnam are reaching perfectly to technology of the world level. However, they are afraid of doing business in geo-spatial data services. Community delivering and using spatial data in Vietnam includes State's agencies only.

6. Knowledge of people with geo-spatial data is not high because of impossible availability. However, enterprises and people have no urgent demands on use of geo-spatial data.

VIII. Opportunities for NSDI development in Vietnam

Analyzing the current status, advantages for NSDI development in Vietnam can be shown as follows:

1. The State's political line that information is considered as an important national infrastructure was defined which ensures appropriate conditions for Vietnam's NSDI development.

2. State has paid attention to and invested considerable expenses for geo-spatial data production.

3. State has focused on development of ICT, computerization of administrative system, formation of e-Government; and spent a lot of expenses on upgrading national communication network infrastructure.
4. National Assembly and Government are implementing Program on e-Government development that is focused on reforming administrative procedures on the basis of enhancing publicity and transparency of information as well as quality of public services. The development of e-Government will facilitate the process of NSDI development.

5. Technical staff in spatial data sector of Vietnam are not so adequate, but they are able to learn new technology easily and create particular technology features suitable with context of Vietnam.

6. ICT and GIS technologies are developing unceasingly in the world. Vietnam can select new technology solutions for NSDI development.

7. Technical assistances and experiences of international development organizations are advantages to help Vietnam to shorten NSDI development process.

**IX. Challenges for NSDI development in Vietnam**

1. Leaders at central level are not yet ready to make decision on issuance of policies and strategies for NSDI development in Vietnam. It takes time to submit needed reports to central Government to get agreement on approval of strategy and master plan of implementation, issuance of legal documents and policies for implementation.

2. Ministries get used to concept of power monopoly, in which there is information monopoly. Agencies responsible to archiving and managing information do not support to share and publicize information in large scale.

3. All spatial data are adequate and accurate but not updated. In order to develop a timely updated system, it takes enough time and needed efforts from several parties.

4. At present, there are no specialized geo-spatial portal to delivery and share geo-spatial data, no agencies to help interested people to access to needed spatial data.

5. There are no policies on encouraging enterprises and people to participate in collecting and delivering services on geo-spatial data.

6. Works on human resources development and public awareness raising are not focused during past time.

7. In order to develop comprehensively and uniformly all components of NSDI, it requires a large financial fund. Current financial fund is not enough and not regularly to satisfy demand, especially it is difficult to mobilize capital from community.

8. Framework spatial data are managed centrally in MoNRE. In this context, driving force of NSDI development is able to be lost because of monopoly mechanism in spatial data management.

**X. Main solutions**

Main solutions for NSDI development are proposed as follows:
1. To issue Government's regulations on forming open mechanism to access and use geo-spatial data sets archived in State's agencies with low fees or free of charge for all organizations and individuals those have demands.

2. To issue Government's regulations on compulsory use of geo-spatial data in policy analysis, development planning, investment decision, industry management, approaching the goal 'spatially enabled governments'.

3. To adopt a new law on NSDI and to supplement some current laws such as Law on Land, Law on Urban Planning, Law on Forestry Protection and Development, Law on Information Technology, Law on Electronic Transaction, etc. with the contents related to NSDI application, approaching the goal 'spatially enabled societies'.

4. To improve the National Geo-spatial Data Standards in order to suit the International Geo-spatial Data Standards. To arrange enough fund from State's budget for standardization of the geo-spatial data sets archived in State's agencies.

5. To increase investment from State's budget for NSDI development in current period together with to issue Government's policy on encouraging non-state partners to participate in NSDI investment. In further periods, State's investment will be decreased while financial contributions of non-state partners will grow.

6. In current context of Vietnam, NSDI development plan should give high priority in application to three sectors which can bring clearly effectiveness including land management and development planning.

**Vision and major objectives**

The first task is to define long term vision in developing VNSDI, then define development process for each stage. As mentioned above, studies on VNSDI development is a little bit late in comparison with demand of development process in the world and regions. According to the strategy defined by the State, Vietnam basically will become an industrial country by 2020. This means that it is necessary to develop VNSDI more quickly and urgently in order to contribute technical infrastructure for Vietnam to meet standards of industrial country. VNSDI continuously will be an important information infrastructure for development in post-industry period of Vietnam in order to meet standards of information society and high effectiveness of knowledge-based economy.

Vision of VNSDI development can be defined as follows:

Take advantage of benefit from using spatial data infrastructure to attract participation of community in NSDI development in order to bring more benefits to each user, each locality, whole Vietnam in spatial linkage with regions and the whole world. The goal of 'Spatially Enabled Governments and Societies' that has been shown in the UN Declaration from Kuala Lumpur is to be become the goal of NSDI development of Vietnam.
The State plays leading role in the process of NSDI development through promulgating policy, legislation and ensuring financial investment for fundamental infrastructure to encourage non-state sectors' investment for value-added services and for what the State isn't doing. For now, the State plays a dominant role in investment, but for the future, State’s investment will be replaced step by step with growth of non-state sectors' contribution.

Major objectives for VNSDI development in the next 10 years (2011-2020) are defined as follows:

**Objective 1:** Agencies related to spatial data infrastructure at central and local levels are linked on the basis of an agreed general action program on VNSDI development, supporting directly for e-Government program and enhancing effectiveness of land administration and planning management.

**Objective 2:** Standardized and updated framework spatial data system (with adequate metadata) is early completed for easy discovery and process of spatial data in order to meet all demands of spatial data use.

**Objective 3:** The VNSDI development program is introduced to business community, related professional associations, and individual by disseminating GIS, GNSS technologies, spatial data network in order to enhance knowledge, encourage using spatial data in daily works, promote market of spatial data and related services, gradually bring enterprises to participate in investment to VNSDI and people to participate in using, collecting, updating and supplying spatial data.

**Objective 4:** Vietnam effectively participates in international cooperation activities in order to connect spatial data network of Vietnam to global spatial data network, facilitate Vietnam's participation in international activities on sustainable development, implementation of millennium development goal and coping with climate change.

Specific objectives for the period of 2011-2015, 2016-2020, and necessary works for the period after 2020 are defined as follows:

1. For the period 2011-2015: according to the approved VNSDI development strategy, it is necessary to concentrate on developing a master plan on VNSDI development in order to implement simultaneously all components of VNSDI in principle of giving priority to upgrade weak and insufficient components. State supplies spatial data free of charge or at low rate and technological services of spatial data in order to attract participation of enterprise community and people. The State issues a system of policy and legislation on VNSDI and increase investment from State's budget for VNSDI to create effectiveness and efficiency in using spatial data. Application of VNSDI is focused on land management and development planning with high priority to bring real effects in economic growth, social stability and environmental sustainability.

2. The period 2016-2020: The VNSDI components that was upgraded in previous period are continuously improved; technological capability development is concentrated, in which
user-based service network of geo-spatial data shall be developed to extend larger and larger community of delivering and using geo-spatial data. Based on benefits recovered from using spatial information, the State encourages investment from communities for VNSDI in order to reduce gradually investment from the state budget. From the experiences of VNSDI development in land management and development planning, continuous application of VNSDI in extended to other sectors.

3. After 2020: The VNSDI services system is linked to the e-Government services system in an unified services to implement e-Government program successfully in reforming totally administrative system aiming at serving people; and the VNSDI is actively participated in the regional and global spatial data infrastructure; together with other economies in the world the VNSDI realizes successfully the UN goal "spatial enablement of governments and societies".

XI. Specific objectives of developing each components of VNSDI

Specific objectives of developing each components of VNSDI are presented in a table below.

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<tr>
<td>1. Standardize available spatial data in the 3D form</td>
<td>1. Upgrade national geodetic reference system on the basis of establishment of CORS network, connected with international system ITRF</td>
<td>1. Create 4D spatial data system (3D data integrated with temporal dimension)</td>
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<td>2. Continue to collect additionally no available spatial data</td>
<td>2. Upgrade technological level for geo-spatial data collecting and updating</td>
<td>2. Operate stable mechanism for collecting and updating spatial data with leading role of State's agencies and activities of enterprise and users community</td>
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<td>3. Create meta-data and geo-spatial data catalogues</td>
<td>3. Standardize, create meta-data and integrate other spatial data related to natural resources and environment to GOS portal</td>
<td>3. Issue next version of framework geo-spatial data standard to suit international standards</td>
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<td>4. Establish and operate updating mechanism for framework geo-spatial data</td>
<td>4. Encourage contribution of spatial data and update of spatial data from community</td>
<td>2. Study to extend geo-spatial data standard to temporal geo-spatial data standards (4D standard)</td>
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<tr>
<td>5. Integrate framework geo-spatial data to GOS portal</td>
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<td>3. Issue standards of spatial data related to natural resources and environment</td>
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<tr>
<th>STANDARD COMPONENT</th>
<th>1. Study to decide application and guidance on application of OGC and W3C services standards</th>
<th>1. Issue next version of framework geo-spatial data standard to suit international standards</th>
<th>Continuous aiming at full application of international standards issued by GSDI community to facilitate connection of SDI in global</th>
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<tr>
<td>2. Widely instruct creation of meta-data and standardization of geo-spatial data according to issued standards system</td>
<td>2. Study to extend geo-spatial data standard to temporal geo-spatial data standards (4D standard)</td>
<td>2. Study to extend geo-spatial data standard to temporal geo-spatial data standards (4D standard)</td>
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<td>3. Decide to permit use of under-standard geo-spatial data and instruct to accept these data</td>
<td>3. Issue standards of spatial data related to natural resources and environment</td>
<td>3. Issue standards of spatial data related to natural resources and environment</td>
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<td>4. Enhance public awareness about standard application for all stakeholders participated in NSDI</td>
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<td>5. Update other standards of OGC</td>
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and W3C in accordance with international standards

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<th>DATA ACCESS COMPONENT</th>
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<tr>
<td>1. Overcome information monopoly barrier in State's data center by issuing legal regulations, policies and mechanisms to facilitate access to spatial data</td>
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<td>2. While on-line access to data is not good enough, it is necessary to create off-line access to data mechanism</td>
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<td>3. Prepare catalogue of geo-spatial data services</td>
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<tr>
<td>4. Develop and operate GOS portal, and create connection to GOS portal of State’s agencies at central level and People’s Committee at provincial level</td>
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<th>TECHNOLOGY COMPONENT</th>
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<tr>
<td>1. Upgrade the national geodetic coordinates system and the national geodetic reference frame.</td>
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<td>2. Develop application of GNSS and RS to collecting and updating spatial data in order to enhance quality, shorten time and reduce expense</td>
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<td>3. Popularize application of GIS, Web-GIS, Mobile-GIS in order to enhance effectiveness of spatial data use</td>
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<td>4. Encourage to apply Cloud Computing in GIS technology aiming at development of spatial data service market</td>
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<th>POLICY AND LEGISLATION COMPONENT</th>
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<tr>
<td>1. Prime Minister approves VNSDI development strategy</td>
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<td>2. Government issues a decree regulating legal corridor for VNSDI development (with above introduced main contents)</td>
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<tr>
<td>3. Amendment of land and development planning legislations with contents of VNSDI application</td>
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<td>4. Prime Minister issues a decision on compulsory application of VNSDI to land management and development planning</td>
</tr>
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</table>

| 1. Apply Volunteered Geo-Information mechanism in order to enhance contribution and share of geo-spatial data from community |
| 2. Develop Cloud-Computing and next generations in order to develop spatial data services market and extend community of spatial data uses |
| 3. Upgrade activities of GOS portal and ensure connection to other portals |
| 1. Operate open spatial data system in order to easily access to different spatial data that serves for demands of an industrial country |
| 2. Operate well GOS portal in safe connection to whole portals of e-Government and to portals of community |
| 3. Make it possible to access spatial data easily in GSDI community |

| 1. Operate continuously application of advances of GNSS and RS to collecting and updating spatial data in order to encourage participation of community |
| 2. Apply Cloud-GIS technology and next generations to VNSDI |
| 3. Develop domestic technology aiming at application and development of open source software |
| Popularize GNSS, RS and GIS in VNSDI community and encourage development of open source GIS software in order to be active with technology and reduce expenses for VNSDI development |

| 1. National Assembly adopts Law on VNSDI |
| 2. Prime Minister decides to accelerate policy on encouraging communities’ contributions to develop VNSDI |
| 3. Amendment of other related legislations with contents of VNSDI application |
| 4. Prime Minister decides to extend compulsory application of VNSDI to other sectors |
| 1. Prime Minister issues a decision on comprehensive application of VNSDI to e-Government |
| 2. Prime Minister decides all-round cooperation with other countries/economies at regional and global levels to conduct UN goal ‘spatial enablement of governments and societies’ |
### Organization and Institution Component

<table>
<thead>
<tr>
<th>1. Government reviews functions and tasks of Ministries to establish a Steering Committee on VNSDI development</th>
<th>1. VNSDI Association links to other profession associations such as Vietnam Association of Geodesy - Cartography - RS, Soil scientific association, IT association in order to reach an agreement on a general action plan for VNSDI development</th>
<th>1. Extend functions of VNSDI association to manage NSDI standards and popularize technology of collecting, updating and processing spatial data</th>
</tr>
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<tbody>
<tr>
<td>2. The Steering Committee on VNSDI development orients to develop pilot VNSDI in land administration, development planning, monitoring natural resources and environment</td>
<td>2. The Steering Committee on VNSDI development in cooperation with VNSDI association submits to Government a system of policies to encourage community to participate in VNSDI development</td>
<td>2. Create regular connections between State's agencies and NSDI community in order to create high effectiveness in use of VNSDI for different purposes</td>
</tr>
<tr>
<td>3. Government encourages to establish VNSDI Association in order to orient development of VNSDI community</td>
<td><strong>PARTNERSHIP COMPONENT</strong></td>
<td><strong>XII. Conclusions</strong></td>
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### Partnership Component

<table>
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<tr>
<th>Every year State budget spends about USD 100 million for components of VNSDI and encouraging communities to participate in investment for VNSDI</th>
<th>Investment from State's budget is reduced annually by 5% and from non-State sectors is increased annually by 7% of total investment for VNSDI. In 2020, investment from State's sector is 75% of total, and from non-State sectors is 25%.</th>
<th>Total annual investment for VNSDI is USD 50 million, in which 50% from the State's budget and 50% from non-State sectors</th>
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<tbody>
<tr>
<td>Conduct short term training courses on VNSDI development for officials of State's agencies and public sector relating to spatial data</td>
<td>Generalize SDI subject in universities, colleges where are teaching ICT, survey-mapping, land administration and other related subjects.</td>
<td>Conduct short term training courses on VNSDI development for officials of State's agencies and public sector relating to spatial data</td>
</tr>
<tr>
<td>Government approves communication program to raise public awareness about VNSDI and simultaneously attach public awareness content about VNSDI to other communication programs relating to environment, land and climate change</td>
<td>Concentrate on enhancing public awareness in order to develop spatial data service market and encourage enterprises to participate in investment to collect, update and deliver spatial data services</td>
<td>Conduct short term training courses on VNSDI development for officials of State's agencies and public sector relating to spatial data</td>
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<tr>
<td>Government approves nation scientific program on research and development of VNSDI</td>
<td>Concentrate on research and development of open source software to apply to VNSDI</td>
<td>Concentrate on research and development of open source GIS software</td>
</tr>
<tr>
<td>Acceleration of Vietnam's activities in UN RCC and PC GIAP Active participation in activities of GGIM Active discussion with other countries in ASEAN on initiating a regional program on developing ASEAN SDI</td>
<td>Regionally and globally associated implementation of the UN goal 'spatially enabled governments and societies', firstly to build 'spatially enabled ASEAN'</td>
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**XII. Conclusions**
This report provides sufficient information about the formation process of SDI concept from 1992 at the initiative of the US Federal Geographic Data Committee to 2012 at the UN declaration from Kuala Lumpur with 'spatial enablement of governments and societies'.

The main contents of the report is to provide recommendations on development strategy for VNSDI with the vision to 2020, development objectives for each 5 year period and specific objectives of each component of VNSDI.

The report presents the benefits of NSDI development, the direct impacts on e-government construction and administrative reform, the indirect effects on economic development, social stability, environmental sustainability and coping with climate change. Based on this report, development strategy of VNSDI can be prepared to submit to Prime Minister for approval.

The report's suggestion is that implementation of VNSDI in land management and development planning should be selected as highly prioritized sectors. Geo-spatial information supports in these sectors will bring effectiveness and efficiency in governance and use of natural resources focused on sustainable development and spatial enablement of governments and societies.

References


