SMART KOREA 2011
2011 디지털국토엑스포

The 15th International Seminar on GIS

International Collaboration for Global Geospatial Information Society

Korea Research Institute for Human Settlements
Korea Institute of Construction Technology

History of International Seminar on GIS

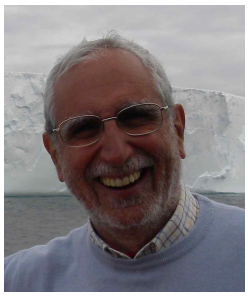
	Theme	Date	Place	Organizing Committee	
				Chair	Member
1st (1996)	Strategies for NGIS Development	4.18-19	Seoul Education & Culture Center, KRIHS	Young-Pyo Kim, Director, Geospatial Information Center	Woo-Seok Cho, Mi-Jeong Kim Moon-Sub Chung
2nd (1997)	GIS Applications in the Public Sector	10.16-17	Seoul Education & Culture Center	Young-Pyo Kim, Director, Geospatial Information Center	Yong-Bok Choi, Mi-Jeong Kim
3rd (1998)	GIS Development Strategies for the 21st Century	9.10-11	Renaissance Seoul Hotel	Young-Pyo Kim, Director, GIS Research Center	Mi-Jeong Kim, Sung-Mi Park
4th (1999)	GIS in Local Government	9.16-17	Renaissance Seoul Hotel	Young-Pyo Kim, Director, GIS Research Center	Mi-Jeong Kim, Sung-Mi Park, Hong-Jun Choi
5th (2000)	Toward a Knowledge-based Society: NGIS Policy and Technological Development	9.28-29	Ritz-Carlton Seoul Hotel	Young-Pyo Kim, Director, GIS Research Center	Sung-Mi Park, Hong-Jun Choi
6th (2001)	Present and Future of GIS Technologies	5.17-18	Seoul Education & Culture Center	Young-Pyo Kim, Director, GIS Research Center	Sung-Mi Park,
7th (2002)	GIS Workshop & Seminar	11.8	COEX Intercontinental Hotel	Hyung-Min Yeom, Director, GIS Research Center	Dong-Han Kim
8th (2003)	Envisioning Cyber-geospace and Spatially enabled E-government	11.20-21	COEX	Young-Pyo Kim, Director, GIS Research Center	Jung-Hoon Kim, Dong-Han Kim, Seung-Mi Hwang, Ki-Hwan Seo
9th (2004)	Emergency and Disaster Response with GIS	9.8-9	Seoul Education & Culture Center	Young-Pyo Kim, Director, GIS Research Center	Jong-Taek Park, Dong-Han Kim, Ki-Hwan Seo
10th (2005)	NGIS Policy in Ubiquitous Computing Environment	11.14-15	Seoul Education & Culture Center	Byoung-Nam Choi, Director, GIS Research Center	Jung-Hoon Kim, Dong-Han Kim, Jung-Yeop Shin Jin-Hyeong Park
11th (2007)	Collaborative GIS toward the Geospatial Information Society	10.24	KRIHS	Ho-Sang Sakong Director, Geospatial Information Research Center	Jung-Hoon Kim Young-Joo Lee Jae-Il Han
12th (2008)	NSDI Policy for National Spatial Data Integration	10.9	KINTEX	Ho-Sang Sakong Director, Geospatial Information Research Center	Jung-Hoon Kim Chun-Man Cho Mi-Jeong Kim Hae-Kyong Kang
13th (2009)	The World Geospatial: Trends and Prospects	9.10	KINTEX	Moon-Sub Chung Director, Geospatial Information Research Center	Ki-Hwan Seo Dae-Jong Kim Kyung-Hee Kim
14h (2010)	GI Application Strategies for Realizing SMART KOREA	9.1	KINTEX	Moon-Sub Chung Director, Geospatial Information Research Center	Young-Joo Lee Gye-Wook Kim Jae-Sung Choi
15h (2011)	International Collaboration for Global Geospatial Information Society	10.27	KINTEX	Moon-Sub Chung Director, Geospatial Information Research Center	Dong-Bin Shin Mi-Sook Yi Joo-Hee park Kyo-Min Kim

Seminar Program

09:40~10:10	Registration
10:10~10:30	Opening Address (President, KRIHS) Congratulatory Address (President, KICT)
10:30~11:10	Keynote Speech(1) Geospatial Networking in Europe: The Vision and Actions of EUROGI (Mauro Salvemini, AMFM GIS Italia)
11:10~11:50	Keynote Speech(2) Key Issues on the Management of Geographic Information: An International Perspective (Fraser Taylor, Carleton University)
11:50~13:00	Lunch
Session 1	**Global Collaboration(Ⅰ): International R&D Cooperation**
13:00~13:40	R&D Policy on Geospatial Information and International Cooperation in Korea (Hyun Sang Choi, KICT)
13:40~14:20	The Implementation of Interoperable Massive Sensors Data Processing by Cloud Technology (Tien-Yin Chou, Feng Chia University)
14:20~15:00	Applied-GIS development and Proposal on Building Urban Planning Information System in Vietnam (Luu Duc Minh, Vietnam Ministry of Construction)
15:00~15:20	Coffee Break
Session 2	**Global Collaboration(Ⅱ): Global Research Network**
15:20~16:00	Evacuation and Sheltering Assistance Planning for Special Needs Population: Kobe GIS-Mapping Project of People with Special Needs in Times of Disasters (Shigeo Tatsuki, Doshisha University)
16:00~16:40	Strategies for Building a Global Geospatial Information Research Network (Dong Bin Shin, KRIHS)
16:40~17:00	Coffee Break
Session 3	**Discussion**
17:00~18:00	Panel Discussion "Reinforcement of International Research Cooperation"

Profile

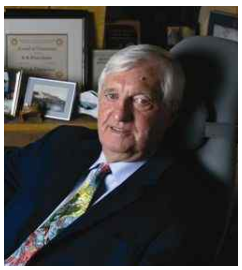
Mauro Salvemini



nternationally recognized expert in applied informatics to spatial planning, environment and e-government. Pioneer of spatial data infrastructure SDI.

Civil engineer since 1972, he taught applied computer technology in planning and urban design in several foreign universities, professor at Sapienza University of Rome , he is now Senior Researcher . UN expert already for the UN Human Settlements initiative, recently he has been invited to join to the small group of world experts to implement the UN World Conference on Geospatial Information Management. Expert and evaluator of European Commission for e-government and the spatial information in Framework Programs of Research, he has been involved since the beginning in the INSPIRE directive of European Union. Head of Laboratory of Geographic and Environmental Information Systems, University of Rome and president of Italian Association AMFM GIS Italy, he is the past president European Association EUROGI. Former President of AGILE European association of research laboratories for geospatial information, he taught in Chinese, American, Spanish and Egyptian universities. He has been the initiator and author of ECDL-GIS certification programme. He is member of Global Advisory Committee of OGC. Head of research for public and private organizations, designer and project manager of major public contracts in the field of information systems and digital mapping. Author of more than eighty publications, most refereed and presented at international conferences. Member of national and European committees, already director of public corporations, he is settled in Italy between Rome and Anzio often world widely traveling for evangelizing geospatial information and his sustainable utilization.

Fraser Taylor



Dr. Taylor is Distinguished Research Professor of International Affairs and Geography and Environmental Studies at Carleton University in Ottawa, Canada. He is also Director Geomatics and Cartographic Research Centre. In 2008 he was elected a Fellow of the Royal Society of Canada. He is widely recognized as one of the world's leading cartographers.

His main research interests in cartography lie in the application of geographic information processing to the analysis of socio-economic issues in both a national and internationall context and the presentation of the results in the form of cybercartographic atlases. He is a member of as the international CODATA Task Group on Preservation and Access to Scientific and Technical Data in Developing Countries, a member of the Group on Earth Observations System of Systems (GEOSS) Data Sharing Task Force and the CODATA Task Group on Data at Risk. He is also a Board member of the OGC (Open Geospatial Consortium) Interoperability Institute and the OGC Global Advisory Council. Dr. Taylor's current funded research involves working with aboriginal and Inuit communities to empower these communities to express their perceptions of their own environmental and socio-economic reality in new ways utilizing the Cybercartographic Atlas Framework.

Hyun Sang Choi

Hyun Sang Choi is Director of U-Land Implementation Research Division in Korea Institute of Construction Technology. He received Ph.D. in Water Resource Management based on GIS Technology. His Major research fields are convergence of Construction and ICT technologies, Ubiquitous Sensor Network application for Smart City(u-City) and National R&D strategy for National SDI Technical development, etc. He had contributed in 「Strategic Planning for Korean Land Spatialization Group」 (2006) and also recently has taken the lead in「Strategic Planning for Advanced Technologies of National Spatial Digital Infrastructure」(2011)

Shigeo Tatsuki

Shigeo Tatsuki is a professor of sociology at Doshisha University in Kyoto, Japan. He received Ph.D. in Social Work at University of Toronto. He is also a senior research scientist at Disaster Reduction and Human Renovation Institution in Kobe, Japan. His major research topics include counter-disaster measures for people with special needs in times of disaster, long-term life recovery from mega-disasters, and the power of social capital in controlling crimes. He is a Vice Chairperson of the Institute of Social Safety Science, Japan.

Luu Duc MINH

Luu Duc MINH is the head of Database-GIS Division of Vietnam Institute of Architecture, Urban and Rural Planning which is under Vietnam Ministry of Construction. His major was urban development policy and strategy since studied from University of Tokyo, Japan until now. Recently, he has moved to research on applying GIS into urban planning formulation and management as well. The project proposal on building Vietnam Urban Planning Information System is now in research which is leading by him in expectation of strengthening and enhancing urban development management of Vietnam at both central and local government.

Tien-Yin (Jimmy) Chou

Prof. Chou had his doctorate degree from Department of Resources Development at Michigan State University in 1990. He has been the Director of GIS Research Center of Feng Chia University (GIS.FCU) for 20 years, and served as a Distinguished Professor since 2009. With his profession and enthusiasm, Prof. Chou has worked hard with his 140 employees to bring the GIS.FCU as one of the leading role in the GIS-related academic and industry field. GIS.FCU has implemented a wide range of GIS projects, including resource management, hazard monitoring, e-Learning, fleet monitoring, etc. He also supervises graduate students and teaches courses pertaining to GIS science, land management, and resources management at FCU.

Dong Bin Shin

Dong Bin Shin is a Research Fellow in Korea Research Institute for Human Settlements. He received Ph.D. in Civil Engineering at Yonsei University. Major research fields are National GIS policy, Geographic Information Circulation and Quality Control of GIS Database. Recent research works include 「A Strategy to Construct the Spatial Information of National Territory for Socially Vulnerable Groups」(2009), 「GIS-based Public Participation in Urban Planning : Design of Prototype Web2.0 Site and Policy Implication」(2008), 「Policy Framework for introducing World Geodetic Reference System」(2007),「Strategies for Enhancing National Geographic Information Clearinghouse」(2006), 「A Study on the Promotion of Integrated Management Plan of Roads and Underground Facilities Database」(2003).

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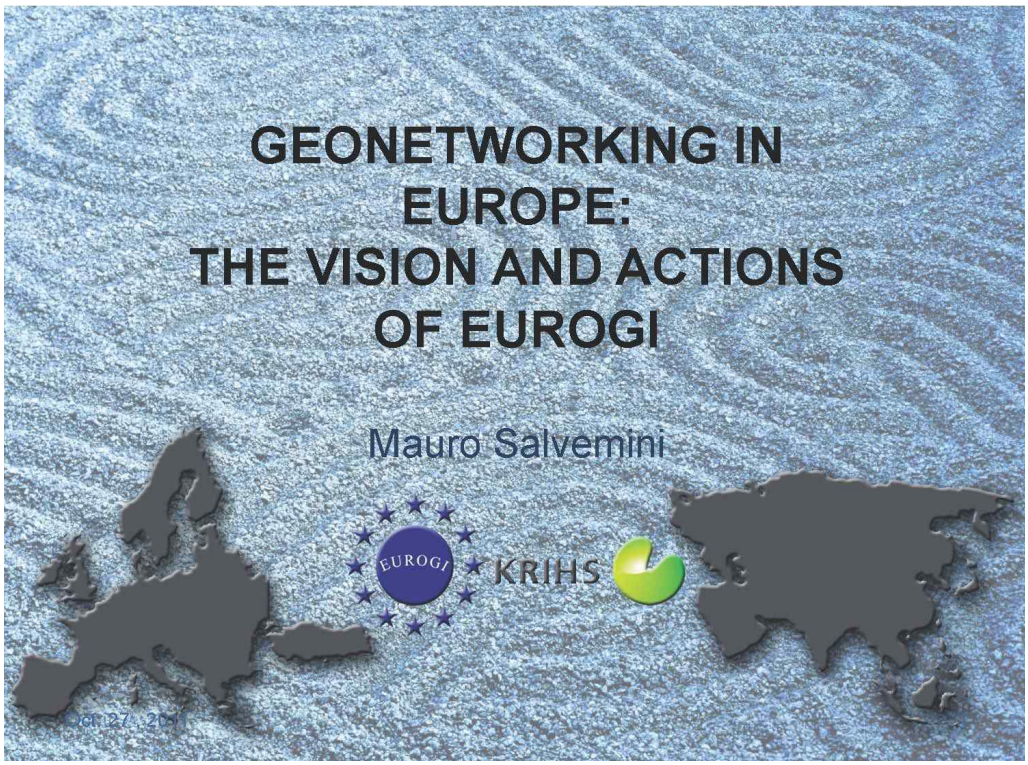
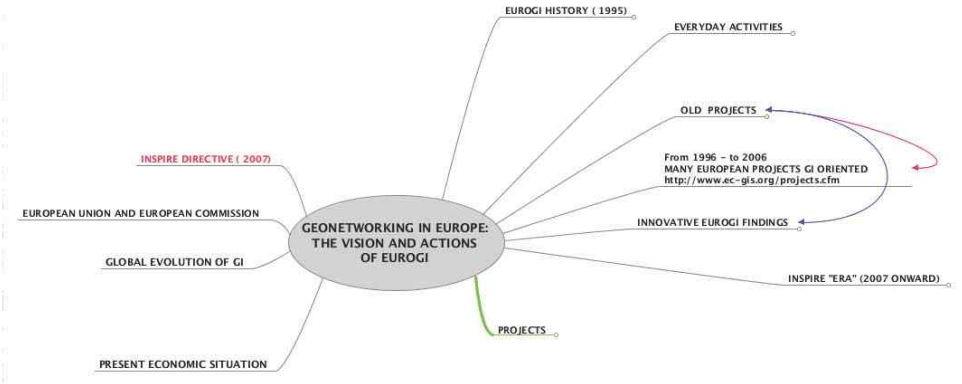
Mauro Salvemini

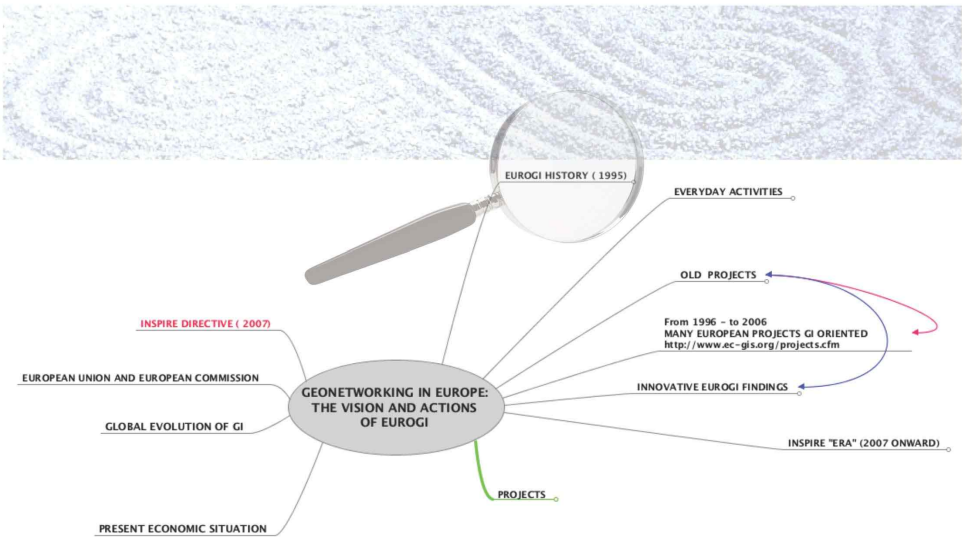
EUROGI/AMFM GIS, Italia

mauro.salvemini@uniroma1.it



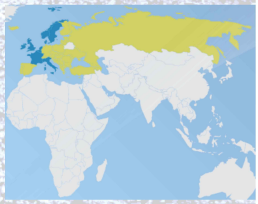
Mapping the speech





EUROGI - BACKGROUND

- Established in 1994 at suggestion of European Commission
- Non Governmental Organisation (NGO)
- Independent and non-aligned
- European – Council of Europe area
- Network of networks



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EUROGI - VISION & MISSION

- **Vision**
  - Geographic Information (GI) in all its aspects should become a fully integral component of the European knowledge-based society
- **Mission**
  - In order to ensure good governance, economic and social development, environmental protection and sustainability, and informed public participation, the mission is to maximise the availability, effective use and exploitation of GI throughout Europe. This requires EUROGI to stimulate, encourage and support the development and effective use of GI and relevant technologies, and to act as the voice for the European GI community.

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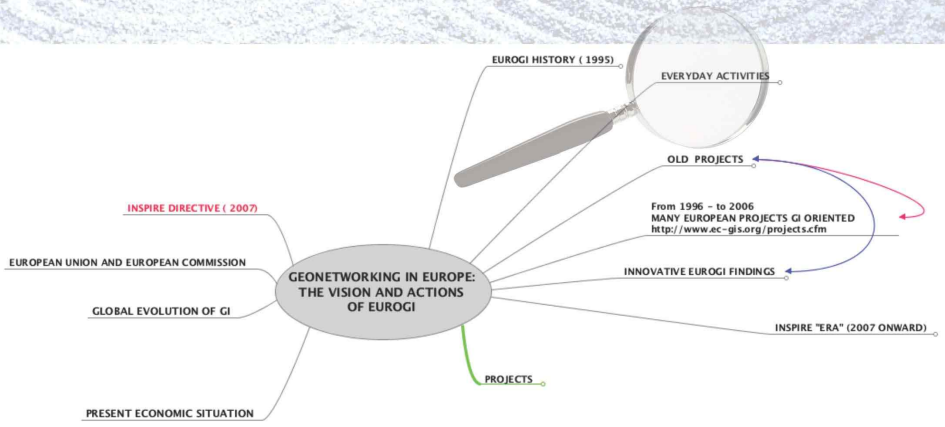
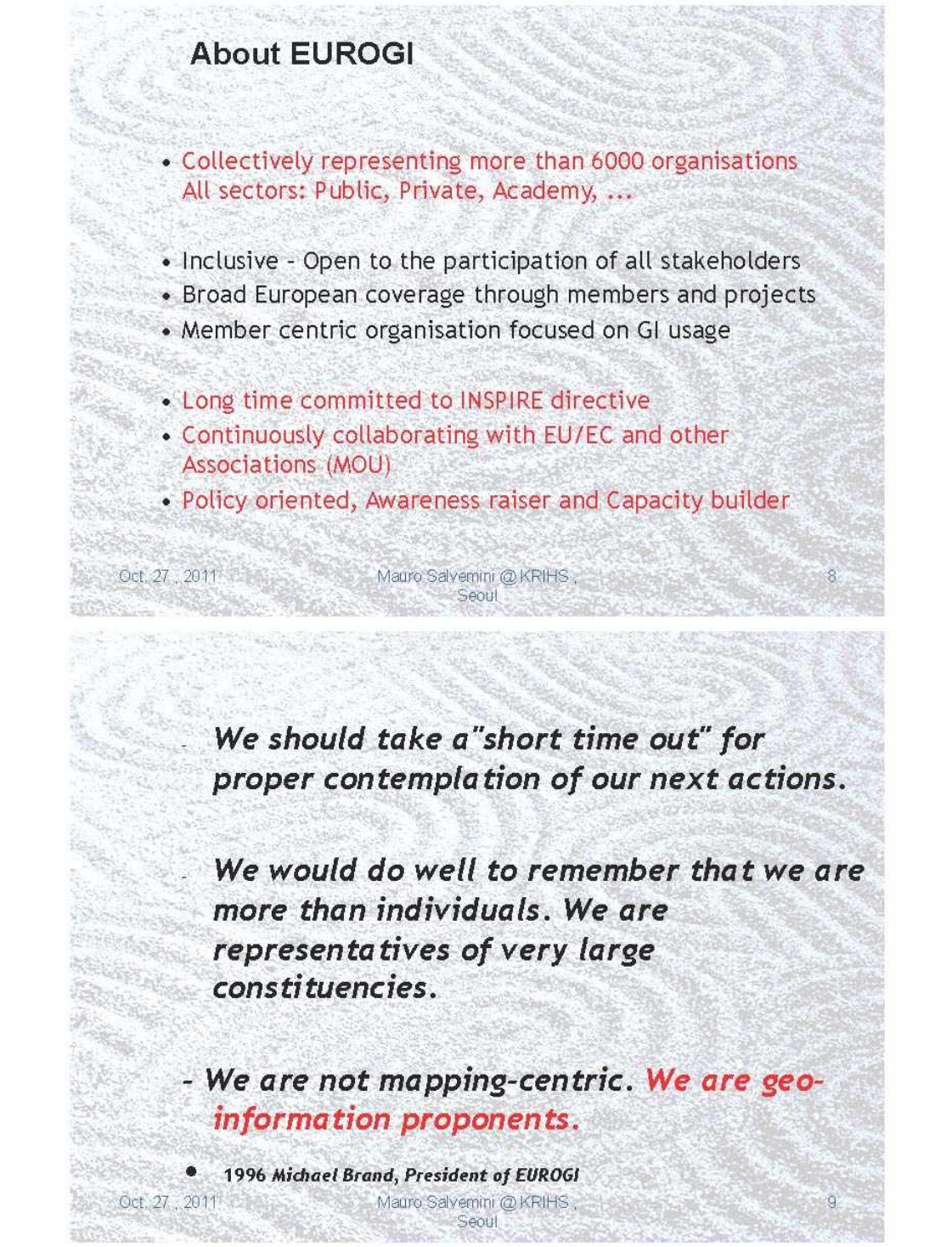
EUROGI MEMBERSHIP

- National GI Associations (NGIAs)
  - Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Iceland, Italy, Ireland, Netherlands, Portugal, Slovenia, Spain, Sweden, Switzerland
  - About 6000 organizations represented by the 16 NGIAs
- Corporate members
  - Autodesk
  - ESRI
  - Intergraph
  - Navteq
- Other members
  - GI Norden - a GI association for all Scandinavian countries
  - EARSC - European Association of Remote Sensing Companies




About EUROGI
• Collectively representing more than 6000 organisations
All sectors: Public, Private, Academy, ...
• Inclusive - Open to the participation of all stakeholders
• Broad European coverage through members and projects
• Member centric organisation focused on GI usage
• Long time committed to INSPIRE directive
• Continuously collaborating with EU/EC and other Associations (MOU)
• Policy oriented, Awareness raiser and Capacity builder
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We should take a"short time out" for proper contemplation of our next actions.
We would do well to remember that we are more than individuals. We are representatives of very large constituencies.
- We are not mapping-centric. We are geo-information proponents.
• 1996 Michael Brand, President of EUROGI
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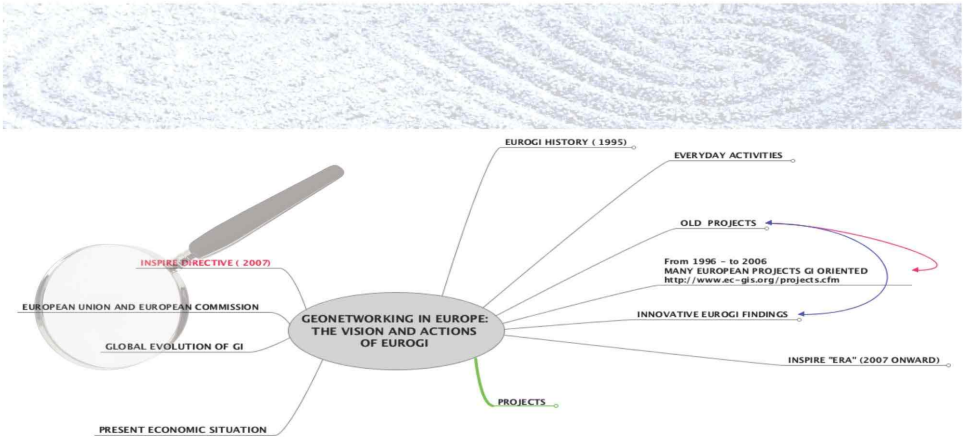
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Madeira (P)
Canarias (E)
Guadeloupe (F)
Martinique (F)
Guyane (F)
Suriname
Brasil
Réunion (F)
Ísland
Suomi Finland
Norge
Sverige
Eesti
Latvija
Lietuva
Rossija
Ireland Eire
Danmark
United Kingdom
Nederland
Belarus'
Qazaqstan
België Belgique
Deutschland
Polska
Luxembourg
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Srbija
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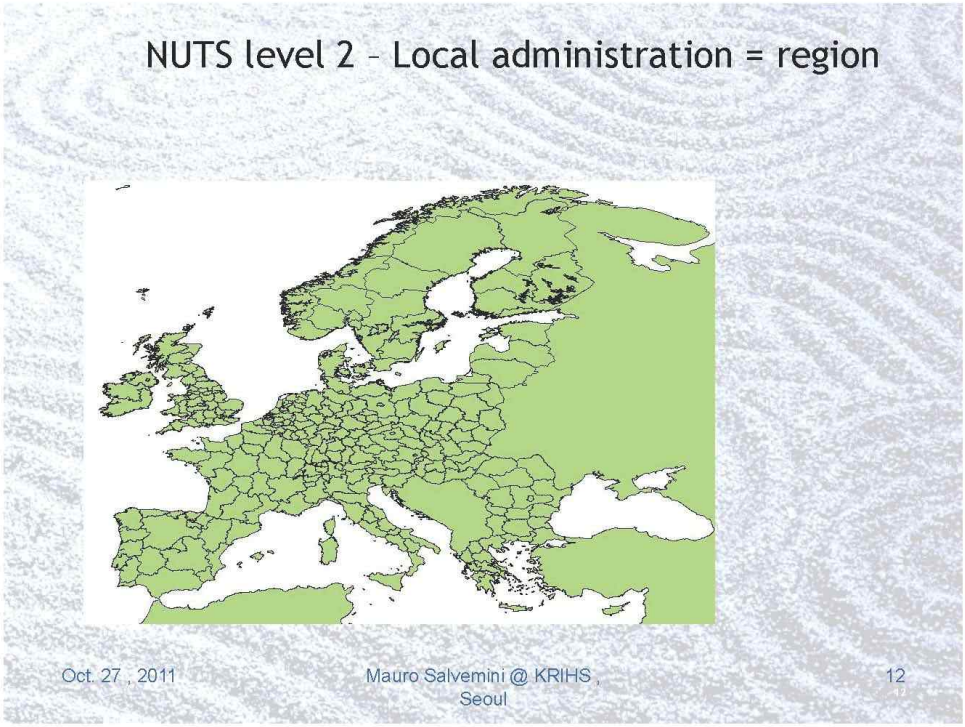
NUTS level 2 – Local administration = region
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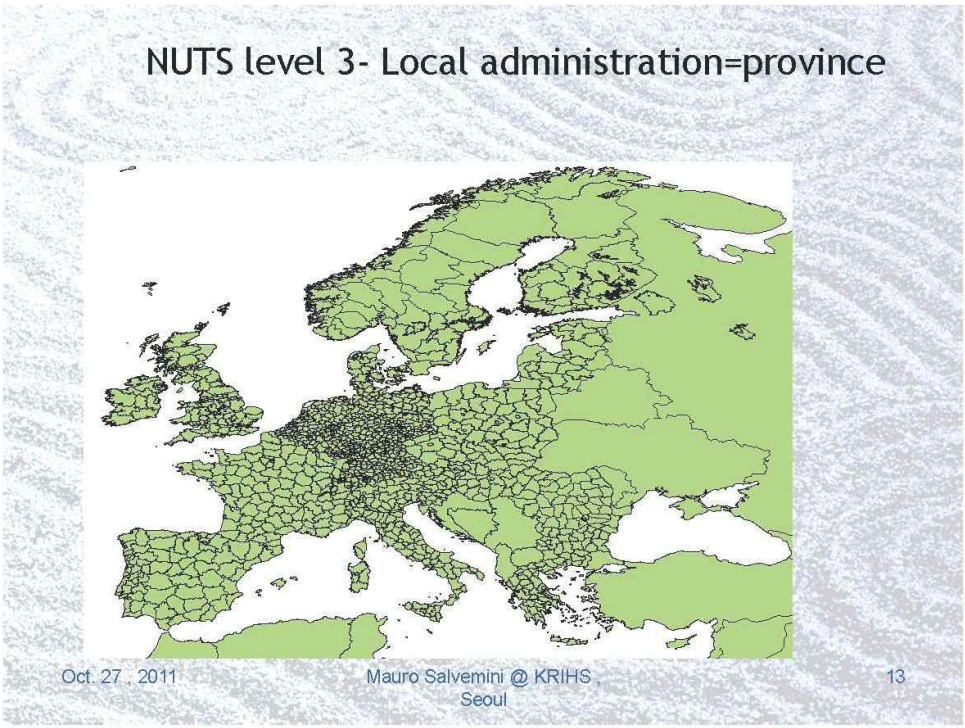
NUTS level 3- Local administration=province
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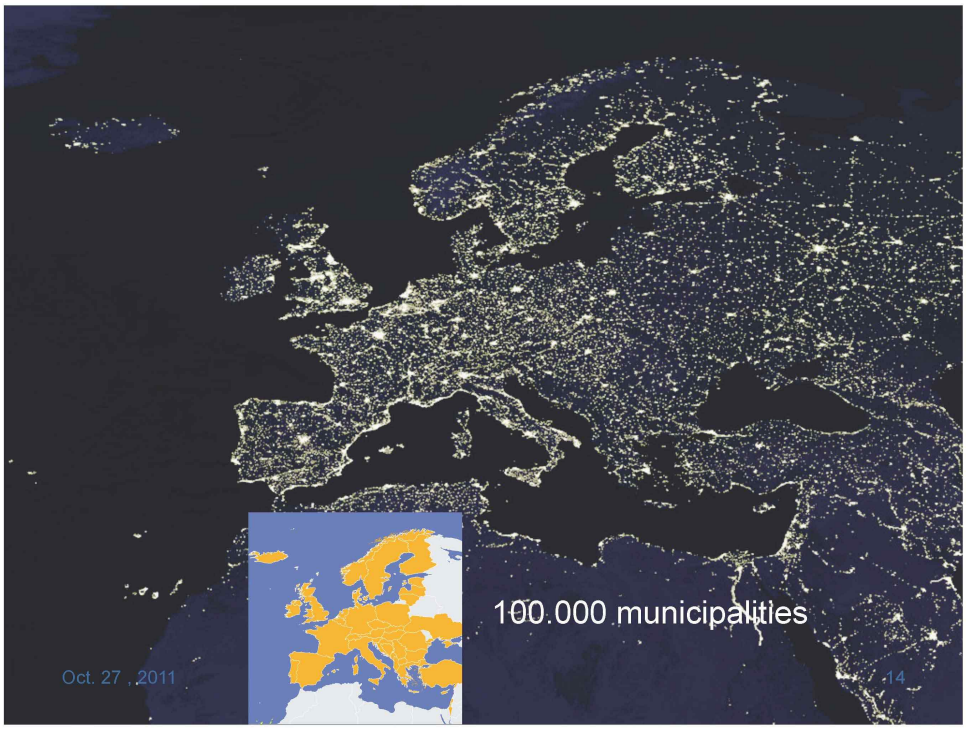
100.000 municipalities
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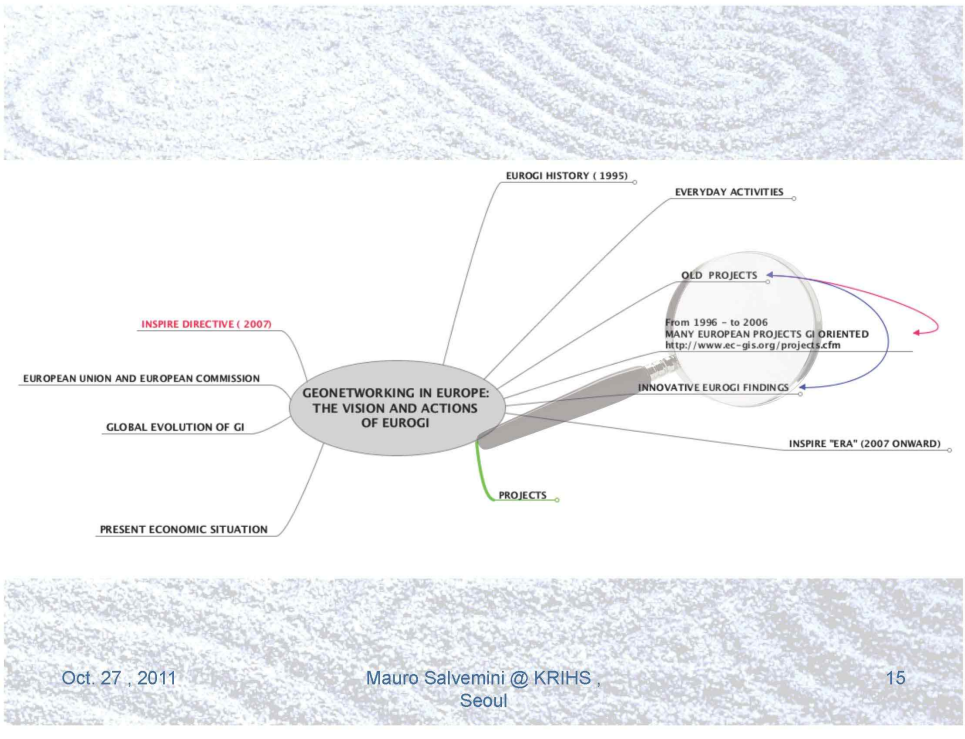
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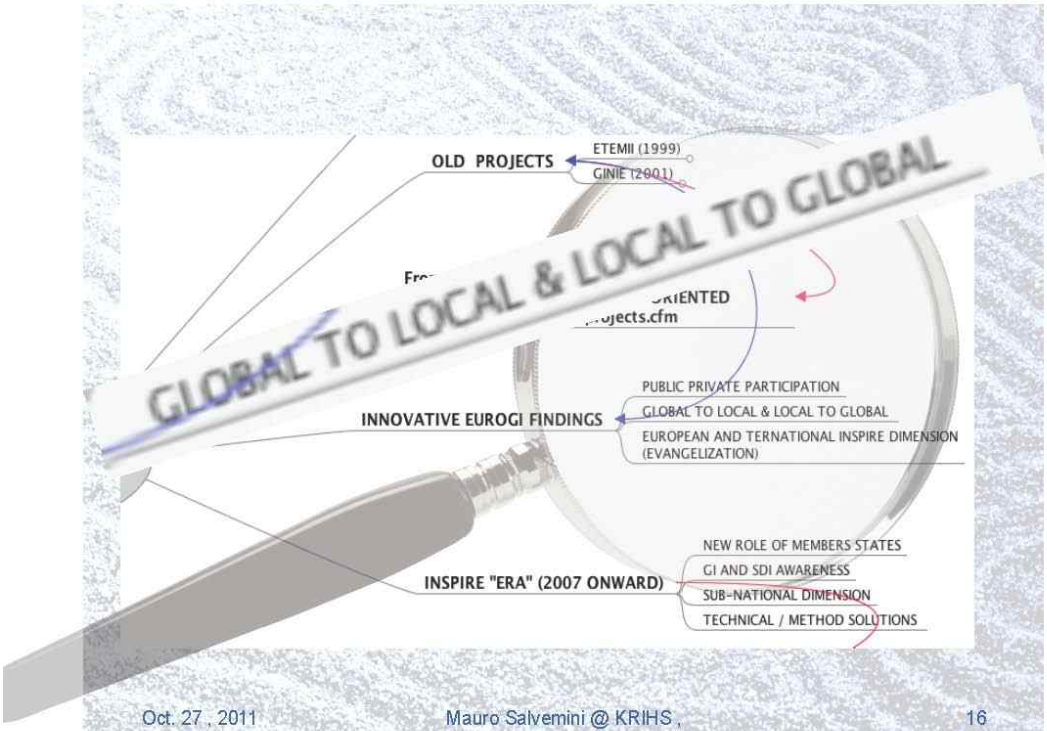
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Some …. Findings
9th EC-GI & GIS Workshop ESDI: Serving the User A Coruña, Spain June 25-27, 2003
The concept and the realization of SDI span from the global dimension to the local dimension being characterized by different functioning political and administrative models;
With local authorities being custodian of a number of strategic geospatial datasets, their role is crucial to the development of SDI at national level (NSDI);
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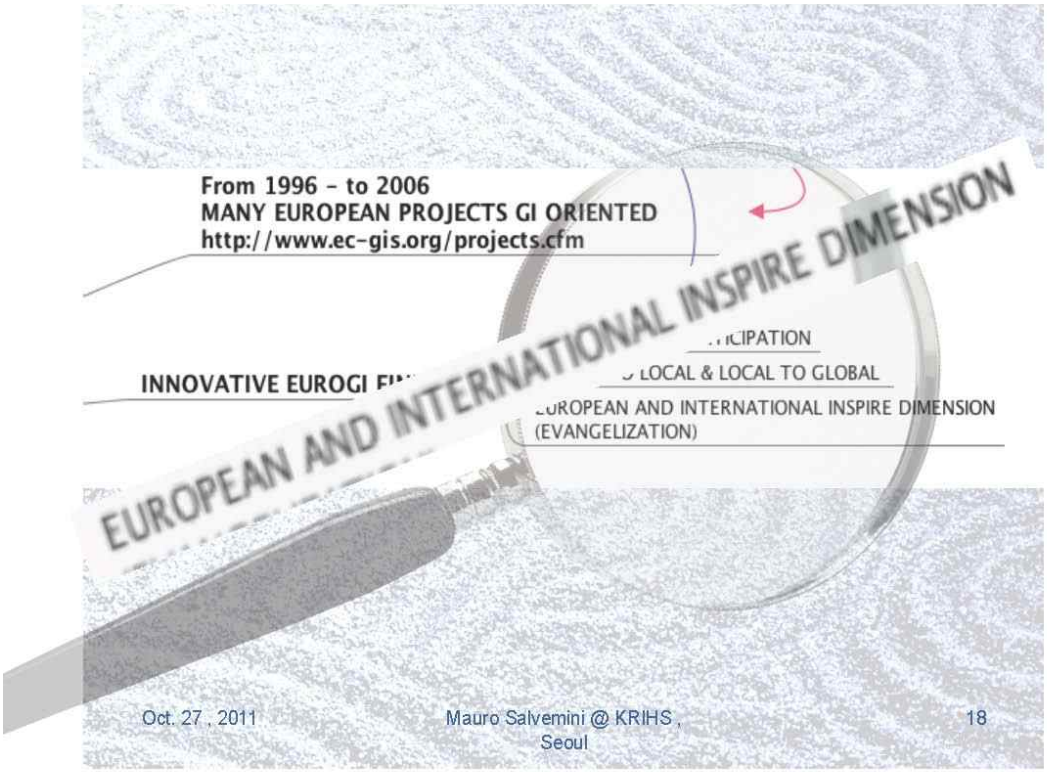
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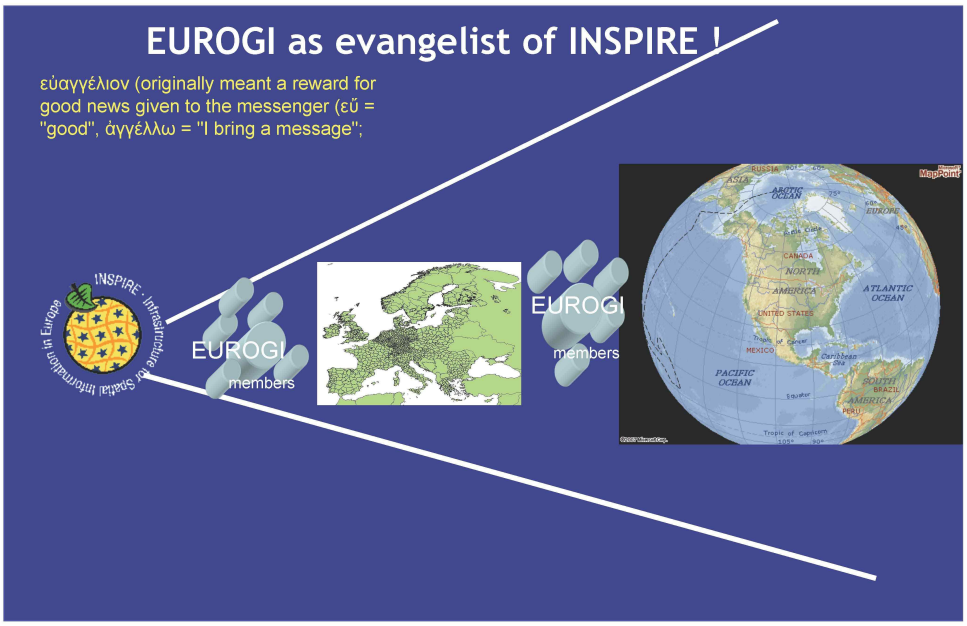
EUROGI as evangelist of INSPIRE !
εὐαγγέλιον (originally meant a reward for good news given to the messenger (εὖ = "good", ἀγγέλλω = "I bring a message";
INSPIRE - Infrastructure for Spatial Information in Europe
EUROGI
members
EUROGI
members

GI UN resolutions : reference to INSPIRE

United Nations Nations Unies

Resolution of Ninth United Nations Regional Cartographic Conference for the Americas
- New York 10 - 14 **August 2009**

2. Mechanisms for the building of spatial data infrastructures

The Conference, ….. Omissis …..

1. Recommends that the Permanent Committee on Spatial Data
Infrastructure for the Americas set up mechanisms to develop guidelines on geospatial data (creation, management and dissemination), metadata, and geospatial information policies and legal issues relevant to the region, using as a model the various initiatives developed by the INSPIRE Directive;

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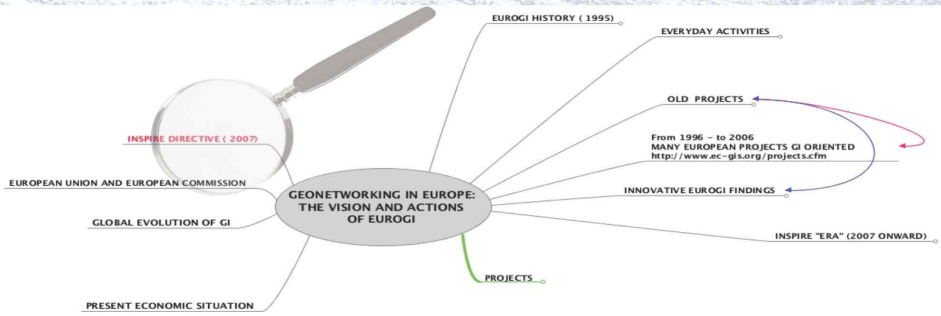


INSPIRE foundations

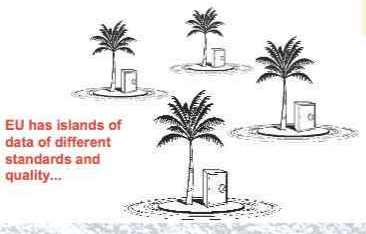
INSPIRE is needed….

Needs

- **Better information** needed to support policies
- Improvement of existing **information flows**
- **Differentiation across regions** to be considered
- Revision of approach to reporting and monitoring, moving to concept of **sharing of information**

Situation in Europe

- **Data policy restrictions**
  - pricing, copyright, access rights, licensing policy
- **Lack of co-ordination**
  - across boarders and between levels of government
- **Lack of standards**
  - incompatible information and information systems
- **Existing data not re-usable**
  - fragmentation of information, redundancy, inability to integrate



EU has islands of data of different standards and quality...

July 2004 - EC Proposal COM(2004) 516 for a Directive establishing an infrastructure for spatial information in the Community – INSPIRE
Political Agreement 21 November 2006
Entry into Force 15 May 2007

INSPIRE Governance - 13th EC GIS Workshop, Porto 4-6/07/07 – slide 11

Spatial data = focus of '90ies

INSPIRE PRINCIPLES

1. Spatial data have to be stored, made available and maintained at the most appropriate level.
2. It should be possible to combine spatial data from different sources across the community in a consistent way and share them among several users and applications.
3. It should be possible for spatial data collected at one level of public authority to be shared among other public authorities.
4. Spatial data are made available under conditions which do not unduly restrict their extensive use.
5. It should be easy to discover available spatial data, to evaluate their suitability for a given purpose and to know the conditions which apply to their use.

INSPIRE Directive

- INSPIRE lays down general rules to establish an infrastructure for spatial information in Europe
  - for the purposes of Community environmental policies and
  - policies or activities which may have an impact on the environment.
- INSPIRE to be based on the infrastructures for spatial information established and operated by the Member States
  - INSPIRE is a distributed infrastructure.
- INSPIRE does not require collection of new spatial data
- INSPIRE does not affect existing Intellectual Property Rights
- Entry into force 15 May 2007


Official Journal of the European Union L 108/1

(Acts adopted under the EC Treaty/Euratom Treaty whose publication is obligatory)

DIRECTIVES

DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 14 March 2007

establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

Scope INSPIRE Directive

- Spatial data held by or on behalf of a public authority operating down to the lowest level of government when laws or regulations require their collection or dissemination
- INSPIRE covers 34 Spatial Data Themes laid down in 3 Annexes
  - ***required to successfullv build environmental inf ion systems***

INSPIRE Spatial Data Scope

Annex I

1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

Annex II

1. Elevation
2. Land cover
3. Ortho-imagery
4. Geology

- Harmonised spatial data specifications more stringent for Annex I and II than for Annex III
- Difference in roadmap for IR adoption and implementation

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INSPIRE Thematic Scope

Annex III

1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and governmental services
7. Environmental monitoring facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
10. Population distribution – demography
11. Area management/restriction /regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions
17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy Resources
21. Mineral resources

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INSPIRE Components

- Metadata
- Interoperability of spatial data sets and services
- Network services (discovery, view, download, invoke)
  - Made available trough the European geo-portal
- Data and Service sharing (policy)
- Coordination and measures for Monitoring & Reporting

INSPIRE is a *Framework Directive:*

Detailed technical provisions for the issues above will be laid down in Implementing Rules

Once adopted, Implementing Rules become European legislative acts and national law in 27 Member States and in some EFTA countries

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Context Conclusions

- Spatial Data Infrastructures are a GLOBAL concern
- A conceptual shift in policy development
  - Towards integrated (spatial) assessments
  - Towards risk based environmental management
- Risk based environmental management requires:
  - For Risk Assessment (local to global)
    - Comprehensive, co-ordinated/common Monitoring programmes
    - Long-term Archiving and Access-to-data organised at the point of use
    - Consensus on models and mapping/portrayal of risks
- Recent Community Environmental policy developments are both a challenge and an opportunity for INSPIRE

The Community needs INSPIRE

INSPIRE Governance - 13th EC GIS Workshop, Porto 4-6/07/07 – slide 16

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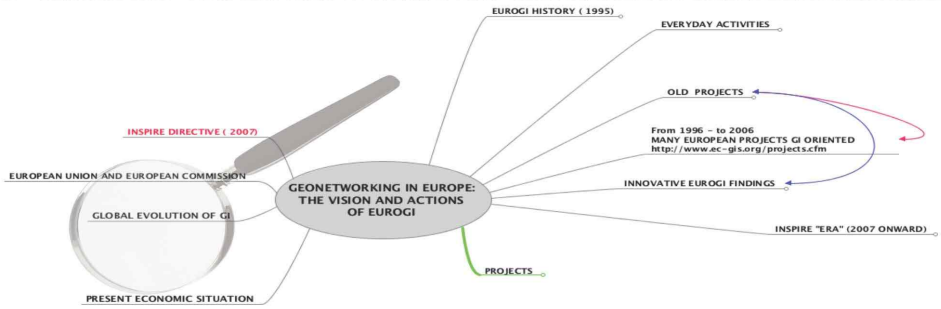
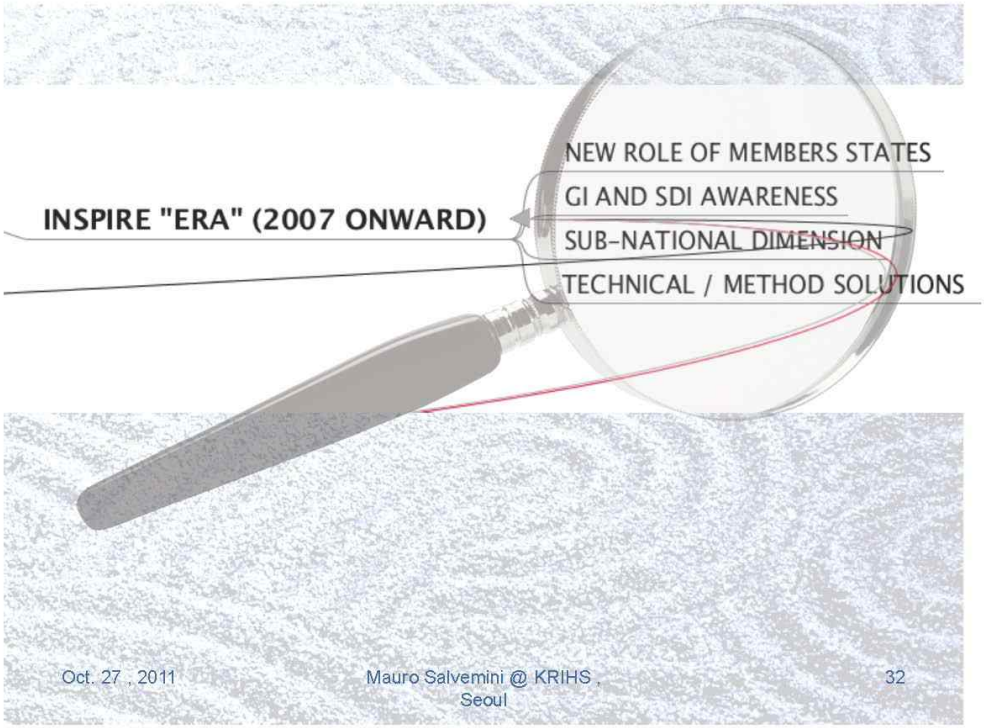


Theories and visions of SDIs ……

- GSDI privileges the access to data, protocols and standards ;
- EU (Inspire directive) => data and interoperability;
- Authors => euphoric of Web GIS services;
- Authors=> addressing complexity and public administration / user needs (capacity building) ;
- Authors=> basic theories (semantics, cognition, grid computing, ubiquitous, etc.)

Today vision of M. Salvemini

SDI as part of *geo*-gov
which is the evolution of *e*-gov


INSPIRE "ERA" (2007 ONWARD)
NEW ROLE OF MEMBERS STATES
GI AND SDI AWARENESS
SUB-NATIONAL DIMENSION
TECHNICAL / METHOD SOLUTIONS
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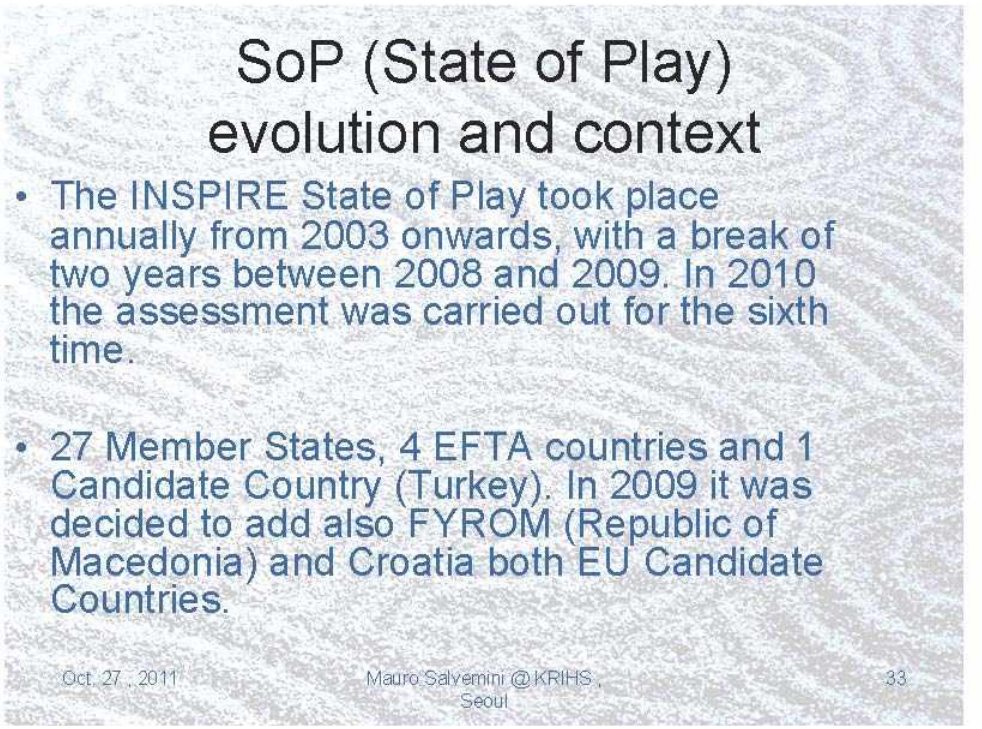
SoP (State of Play) evolution and context
• The INSPIRE State of Play took place annually from 2003 onwards, with a break of two years between 2008 and 2009. In 2010 the assessment was carried out for the sixth time.
• 27 Member States, 4 EFTA countries and 1 Candidate Country (Turkey). In 2009 it was decided to add also FYROM (Republic of Macedonia) and Croatia both EU Candidate Countries.
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Lessons learnt

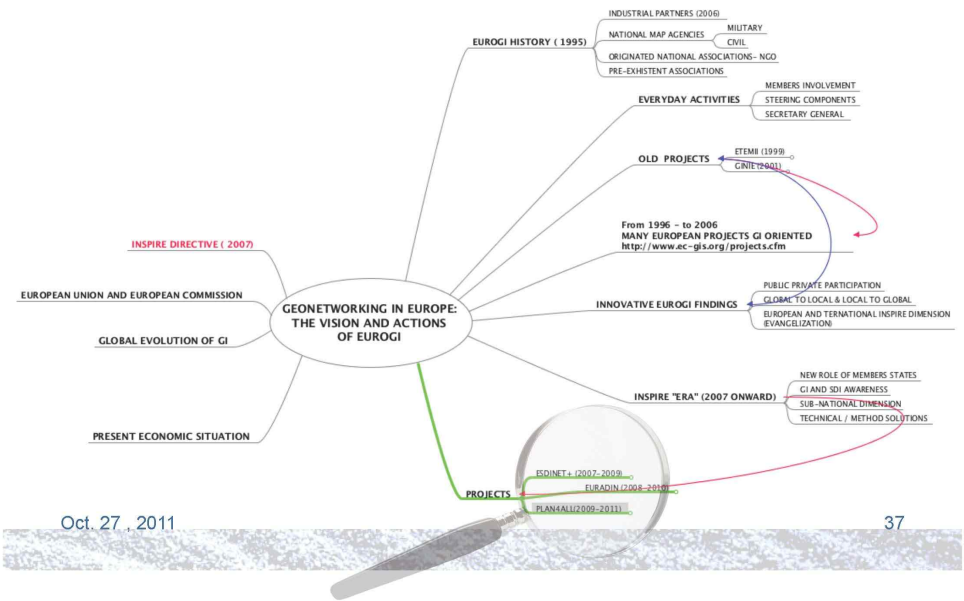
- Potentially useful for other developments worldwide - Content
  - Spatial Data Infrastructures are not to be treated as 'information systems', but as 'complex configurations'
  - SDIs in larger regions have to cooperate across borders ;
  - A good coordination mechanism is imperative;

Lessons learnt

- Potentially useful for other developments worldwide - Content
  - Legislation and a more explicit strategic and/or implementation plan can facilitate
    - overarching whenever possible, avoiding a multitude of individual agreements and too complex
  - Creation of technological and organizational "laboratories"
    - could take the form of testbeds to find out the best (technological) solution before going operational and to learn from it
  - From an operational infrastructure to an active uptake of components in work processes
    - ultimate goal is to serve the needs of different user communities and their applications

Lessons learnt

- Potentially useful for other developments worldwide – Methodology
  - State of Play approach allows
    - assess the status of SDIs at a certain point in time
    - assess its development over time
    - lessons to be learnt, practices that work well and problems that were successfully overcome
  - The approach can be 'easily' applied on any SDI.



Contemporary Projects

EURADIN project for the infrastructure of European addresses (2009-2010) **To significantly contribute to harmonizing the European Addresses, it will promote the creation of new added value products and services across Europe.**

EURADIN
European Address Infrastructure

ESDInet+

eSDI-NET plus

Network for promotion of cross border dialogue and exchange of best practices on Spatial Data Infrastructures(SDI's) throughout Europe

PLAN4ALL

Plan4all

The project **Plan4all** is focused on the harmonisation of spatial planning data based on the existing best practices in EU regions and municipalities and on the base of results of current research project.

eSDI-Net+ a project within INSPIRE context

Network for promotion of cross border dialogue

and exchange of best practices on Spatial Data Infrastructures(SDI's) throughout Europe

Establishment of a Thematic Network funded within the eContentplus programme of the European Commission

ECP-2006-GEO-320005


eContent
eSDI-NET plus
Why eSDI-Net+?
Obstacles SDI's have to face:
1. Technological Barriers
(Lack of Reusability and Clustered Data)
2. Organisational Barriers
(Fragmentation and Lack of Harmonisation and Interoperability)
3. Legal Barriers
4. Cultural and Linguistic Barriers
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eContent
eSDI-NET plus
Objectives of eSDI-Net+
To establish a Thematic Network as platform for communication and exchange among stakeholders involved in the creation and use of SDI's
To bring together potential SDI stakeholders in order to increase awareness and to facilitate the creation of
- guidelines
- standards
- best practices
To establish communication mechanisms between European and local levels to maximize benefits of INSPIRE, GMES, GALILEO and e-government programmes
To develop solutions for multicultural and multilingual access, exploitation, use, and reuse of digital GI content in Europe
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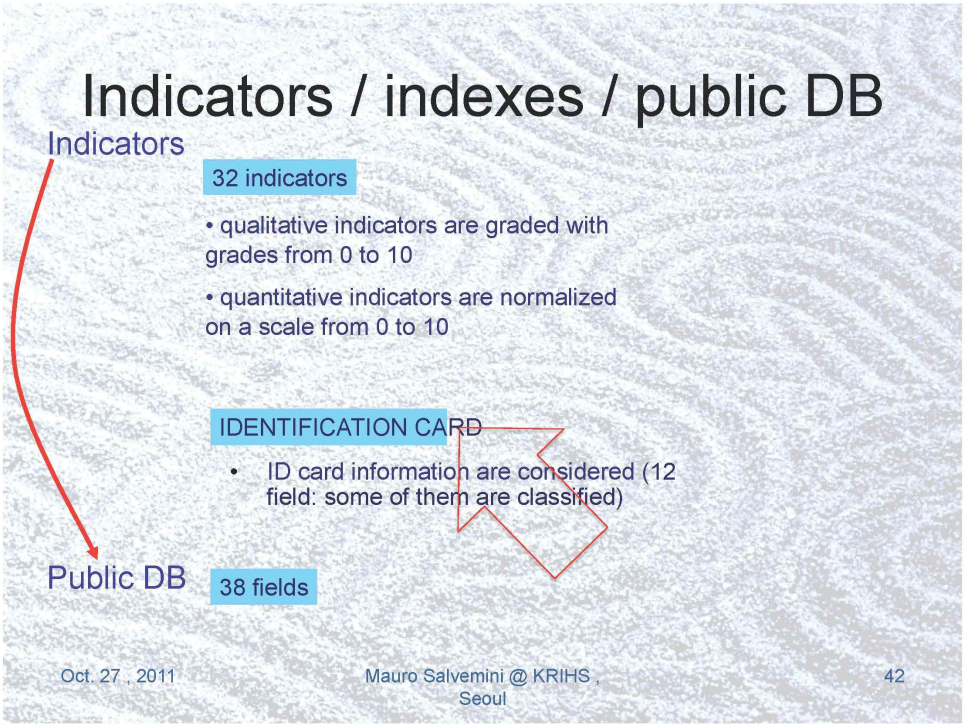


United Nations Nations Unies

OFFICE OF THE DIRECTOR
STATISTICS DIVISION (UNSD)
DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
TWO UNITED NATIONS PLAZA, DC2-1670, NEW YORK, NY 10017
TELEPHONE NO: 1 (917) 367-4130; FAX NO: 1 (212) 963-9851
Internet location: unstats.un.org/unsd

Resolution VII: Global geographic information management (*)

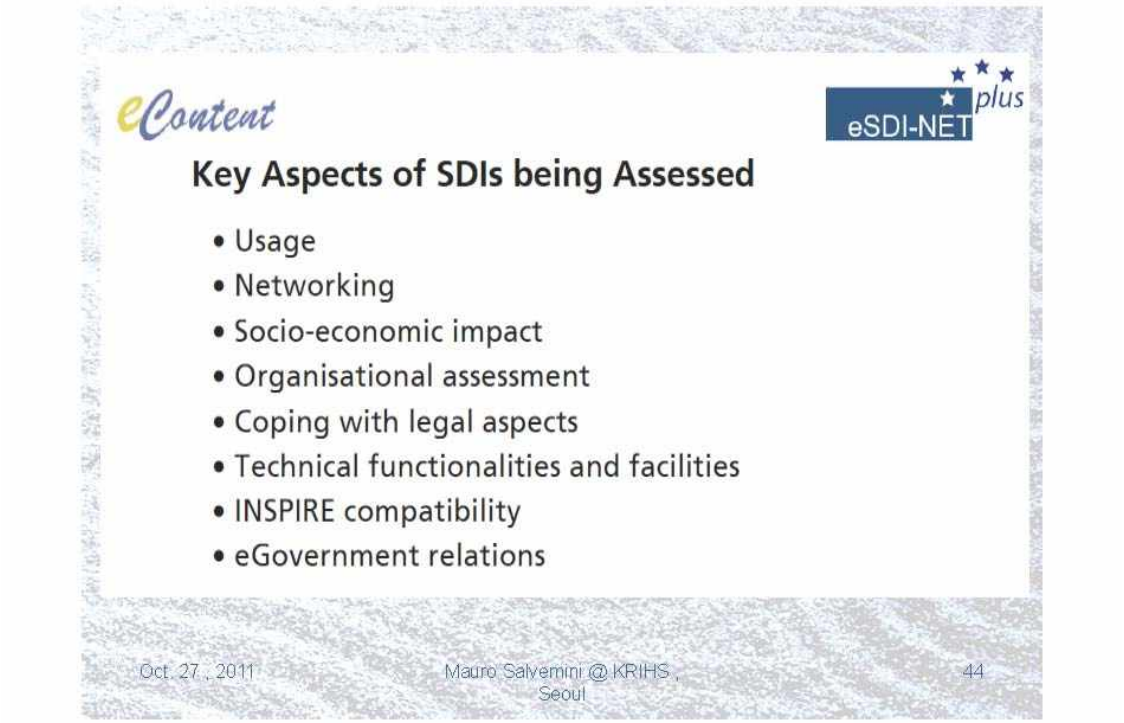
The Conference,

Recalling the recommendations made in Economic and Social Council resolution 131 (VI) of 19 February 1948, entitled "Coordination of cartographic services of specialized agencies and international organizations", and subsequent resolutions,

Recognizing the absence of a United Nations consultation process led by member States, which deals with global geographic information management, coordinates regional efforts, promotes global norms on geographic information and brings such information to bear on global issues,

Also recognizing the requests of member States for a global mechanism, the work to develop common frameworks and tools and a process of standardization, for which the United Nations has a key mandate, to address the need and the necessity for experience exchange and technology transfer on geographic information tools and infrastructures, with specialized, regional and international organizations,

Requests that, by 1 November 2010, the Secretary-General and the United Nations Secretariat initiate discussions and prepare a report, for a future session of the Economic and Social Council, on global coordination of geographic information management, including consideration of the possible creation of a


eContent
eSDI-NET plus
Key Aspects of SDIs being Assessed
• Usage
• Networking
• Socio-economic impact
• Organisational assessment
• Coping with legal aspects
• Technical functionalities and facilities
• INSPIRE compatibility
• eGovernment relations
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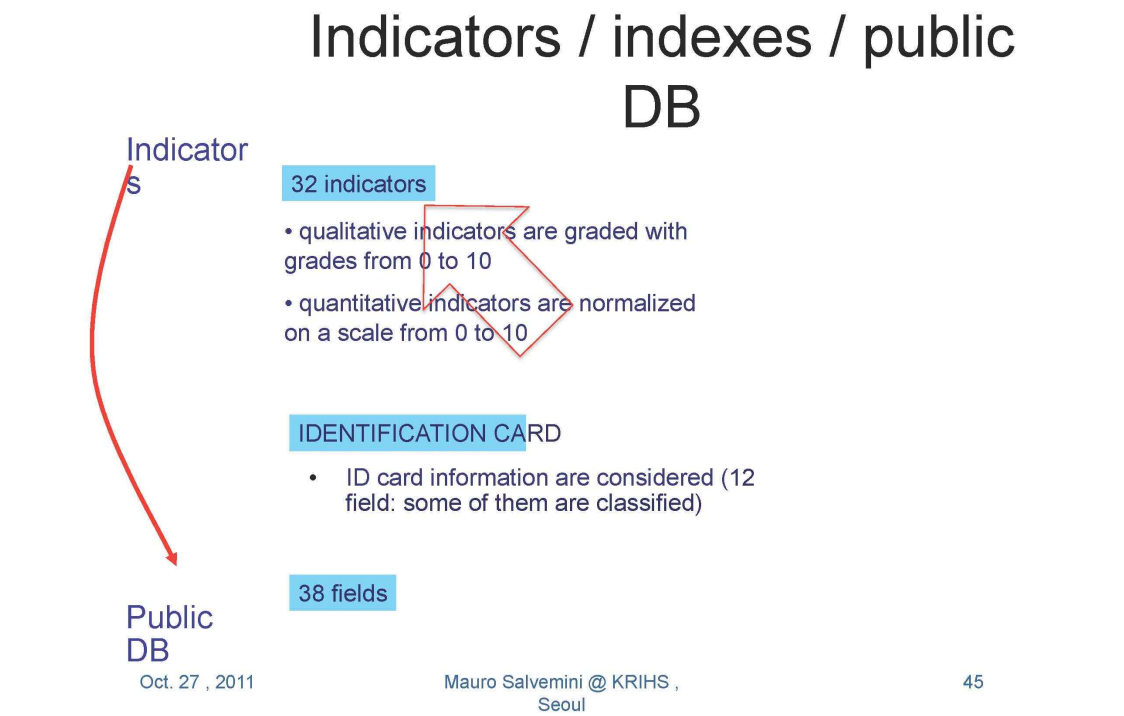
Indicators / indexes / public DB
Indicators
32 indicators
• qualitative indicators are graded with grades from 0 to 10
• quantitative indicators are normalized on a scale from 0 to 10
IDENTIFICATION CARD
• ID card information are considered (12 field: some of them are classified)
38 fields
Public DB
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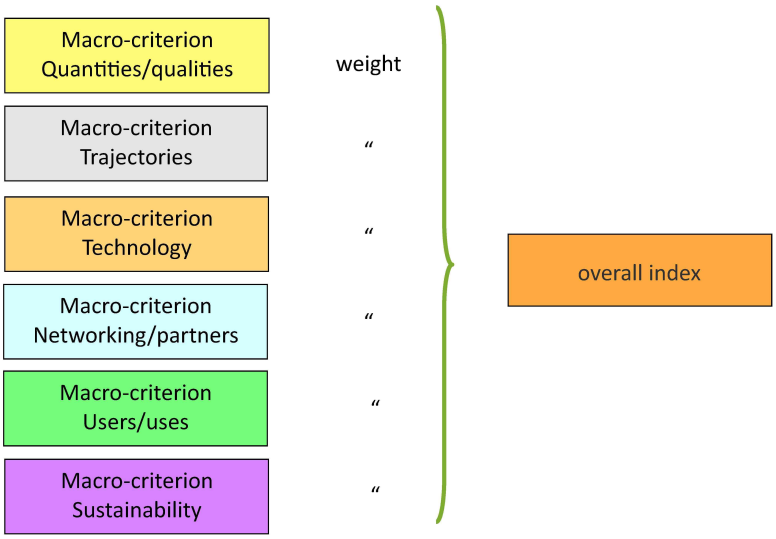
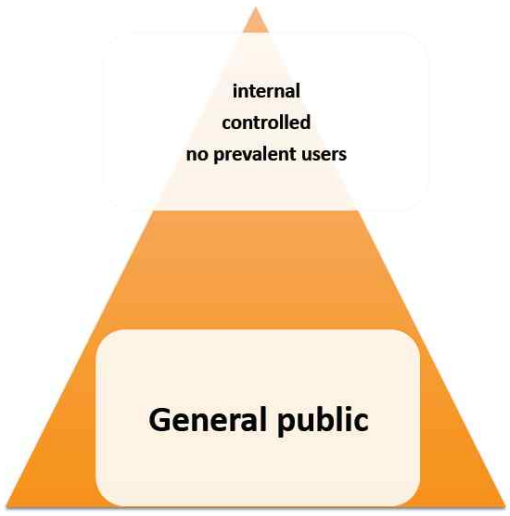
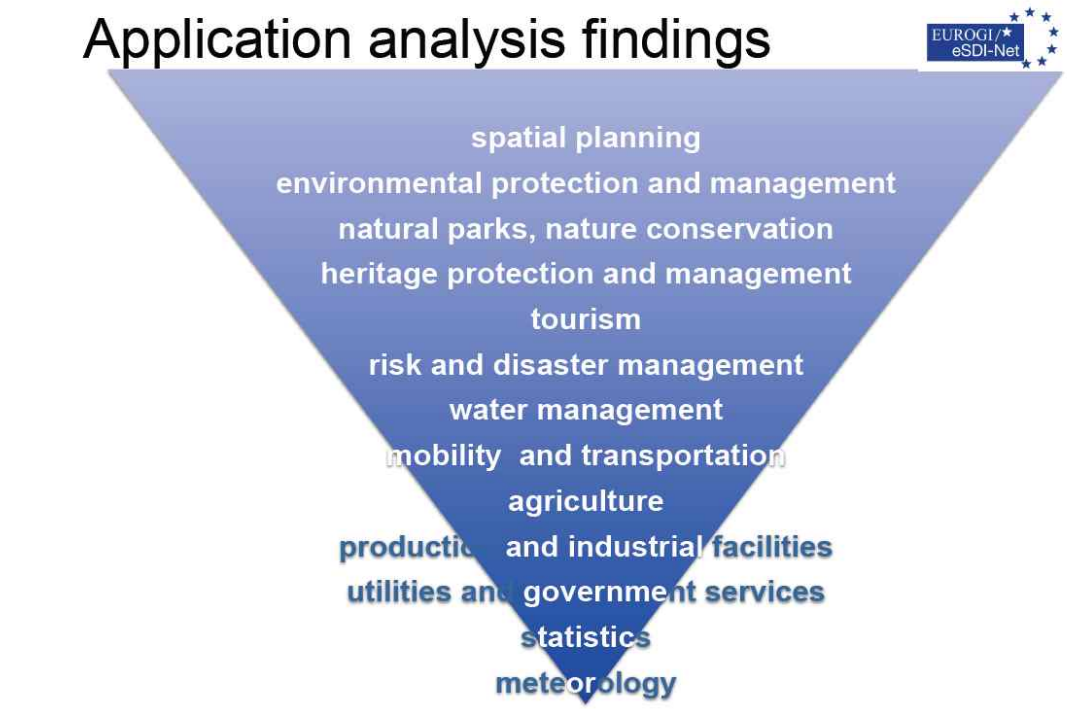
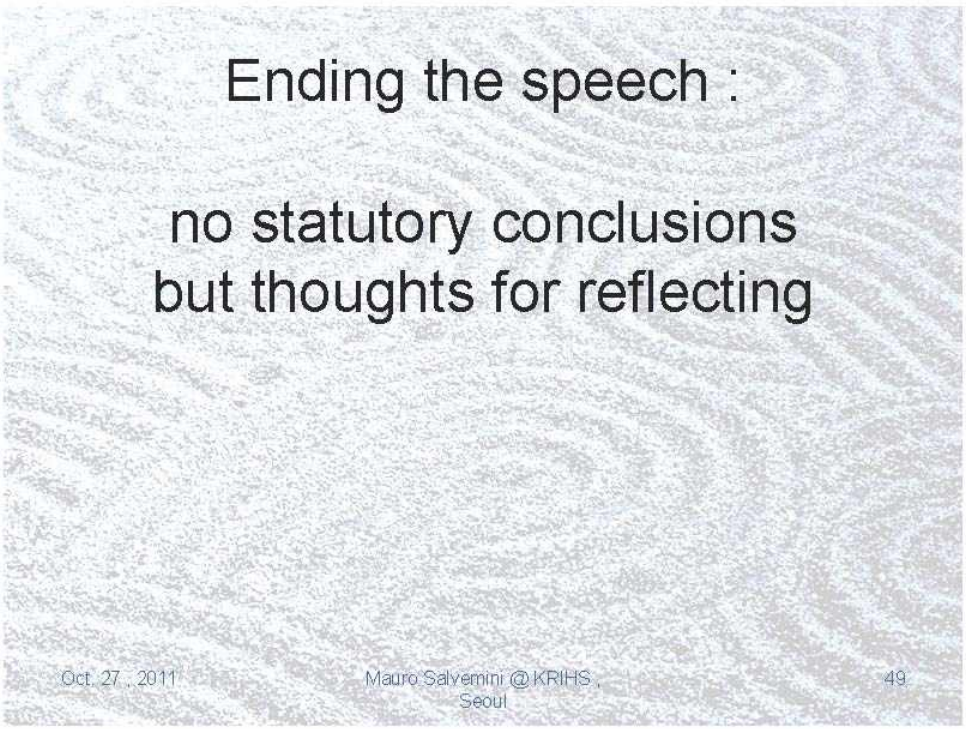
Awarding process: overall index



Users/uses analysis findings




Application analysis findings
EUROGI eSDI-Net
spatial planning
environmental protection and management
natural parks, nature conservation
heritage protection and management
tourism
risk and disaster management
water management
mobility and transportation
agriculture
and industrial facilities
government services
statistics
meteorology


Ending the speech :
no statutory conclusions
but thoughts for reflecting
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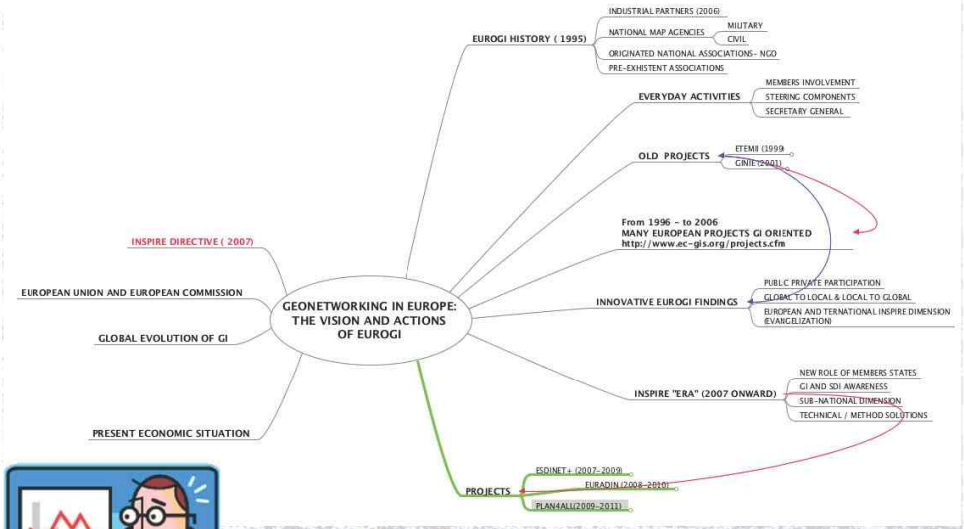
One dubious aspect !



How NGO and the "culture" may complement institutional actions

- Educating and sensitizing the wider public (with workshops, seminars);
- Awareness raising through members (meetings, collaboration & cooperation, dialogues, circulation of ideas, initiatives, programs, best practices);
- Attuning officials programs to public needs ,by acting as a conduit for public opinion and local experience, (e.g thematic network) ;
- Operational collaboration with official bodies (acting as independent counsellors) ;
- Helping national governments through staff training and improving management capacity (with educational and professional training initiatives);


Thank you , Grazie
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EUROPEAN UMBRELLA ORGANISATION
FOR GEOGRAPHIC INFORMATION

VISION

Geographic Information with all its aspects should become a fully integrated component of the European knowledge-based society

MISSION

In order to ensure good governance, economic and social development, environmental protection and sustainability, and informed public participation, the mission is to maximise the availability and effective use of GI throughout Europe

This will require EUROGI to stimulate, encourage and support the development and effective use of GI and relevant technologies, and to act as the voice for the European GI community

MEMBERS OF EUROGI

AESIG, Spain
AFIGEO, France
AGEO, Austria
AM/FM GIS Italia, Italy
CAGI, Czech Republic
CC Belgium, Belgium
CEKTRA, Slovenia
DDGI, Germany
GEOFORUM Danmark, Denmark
GEONOVUM, The Netherlands
HUNAGI, Hungary
IGP, Portugal
IRLOGI, Ireland
LISA, Iceland
SOGI, Switzerland
ULI, Sweden
AUTODESK
ESRI
INTERGRAPH
NAVTEQ
EARSC
GI NORDEN

EUROGI ACTIVE IN GI FOR OVER 17 YEARS

In the early 1990's the European Commission saw the need for the organisations dealing with Geographic Information (GI) to get together under a single umbrella body.

Such a body would enable the GI sector to speak with one voice to the Commission and to have a more meaningful impact generally within Europe.

After an extended period of discussion and analysis, EUROGI was formed as a Foundation under Dutch Law (Stichting) on 20th May 1994. EUROGI is thus very pleased to be in a position this year to celebrate its 17th anniversary.

The Commission funded EUROGI for its first two years, but since that time it has relied on securing its own funding.

Governance
The General Board, which comprises all members is the highest decision-making body and is charged with the management of the Foundation. An Executive Committee of up to 9 members is elected from amongst EUROGI members. The President, who is elected by and chairs the Board is responsible for the governance of EUROGI. A Secretary General has responsibility for the day to day running of EUROGI. A Vice President and Treasurer are elected from members of the Executive Committee.

WHAT IS EUROGI?

EUROGI is an independently funded, not-for-profit NGO operating in Europe, but which also makes contributions in a wider international context. From its earliest days EUROGI members have been National GI Associations (NGIAs) and official national representative organisations.

The NGIAs are the NGOs in each country which draw together organisations (government departments, state agencies, research institutes, private companies etc.) and individuals who have an interest in GI/ Spatial Data Infrastructure matters. Thus although the number of members in EUROGI has always been relatively small, through its NGIA members it has over 6 500 organisations or individuals who are incorporated under the EUROGI umbrella.

In recent years EUROGI has identified a need to expand its membership base and thus in 2009 new statutes came into force which enabled any European GI/SDI organisational stakeholder to become a member through one of three categories of membership, namely *National GI Representatives* (only one from each country), *Corporate Organisations* (private companies), and *Other Organisations and Networks*.
Although this broadening of the membership base has taken place, the National Associations will still provide the core of the organisation.

The EUROGI Vision is that 'GI with all its aspects should become a fully integrated component of the European knowledge-based society'. Its Mission is 'In order to secure good governance, economic and social development, environmental protection and sustainability, and informed public participation, the mission is to maximize the availability and effective use of GI throughout Europe'.

Influencing policy and practice
Over many years EUROGI has contributed to the European GI/SDI policy debate. In the 1990's it championed the need for what is now INSPIRE and more recently it has made representations to the European Union on climate change, funding for the GMES programme and on the structuring of research programmes. It has also provided input into and support for an initiative to get Union approval for a European Location Framework.

WHAT DOES EUROGI DO?

EUROGI membership provides exciting opportunities to:

- participate in EC funded projects;
- contribute towards submissions to the European Commission and Parliament regarding emerging policy and practice issues in the broadly defined GI and SDI) fields;
- join a network of organisations interested in GI and SDI matter and in so doing develop personal networks and contacts;
- share experiences and information through the networks;
- contribute at a global level to ongoing developments in the GI and SDI fields.

EUROGI
Tel: +32 484 485 100 Catharina Bamps, Secretary General
Tel: +31 88 183 3130 Bino Marchesini, Administrative and Legal Officer
www.eurogi.org – eurogi@eurogi.org

17 YEARS
1994-2011

EUROPEAN UMBRELLA ORGANISATION
FOR GEOGRAPHIC INFORMATION

CURRENT AND RECENT EUROGI PROJECTS

EUROGI/eSDI-Net

In 2010, EUROGI took over the legacy of the eSDI-Netplus project, a thematic Network confounded by the European Commission' s eContentplus programme. The main public activity of the eSDI-Netplus project was the international conference "European SDI Best Practice Awards 2009. Learning from Best Practices" in Turin, Italy, November 2009, where twelve outstanding sub-national SDIs were awarded.
The Conference was the provisional conclusion of a process that started in 2008 with the identification of promising SDIs in more than 20 European countries and the definition of a methodology to analyse SDIs:more than 200 sub-national or thematic SDIs were evaluated.
http://www.eurogi.org/esdinetplus

Two years after the previous Awards ceremony held in 2009 in Turin, EUROGI organises the second sub-national SDIs Best Practices Awards Conference and Ceremony on October 12th 2011 in Brussels.
All type of stakeholders in charge of sub-national (at any level, regional, local) SDIs, of any size and from any region of Europe, were invited to participate.
SDIs had to meet the following criteria:
- they must have been operating for at least 12 months
- they must be web-based.

The evaluation process of the 46 completed submitted sub-national SDIs took place based on the SDI self-assessment framework (SDI-SAF). The Jury included members with various SDI experiences and backgrounds: two of the members are from SDIs awarded in 2009. The underlying principle is: the SDI community assesses itself.

Seven outstanding SDIs are identified and receive awards. Further information about the EUROGI-eSDI-Net initiative and the awards:
http://eurogi.org/esdinet/awards/2011

EURADIN

The EURADIN (*European Address Infrastructure* - ECP-2007-GEO-317002) is a *Best Practice Network* aiming to promote the harmonisation of addresses across Europe.

As a main result, the project delivered a proposal for a European addresses Infrastructure, together with the implementation, testing and validation of a pilot case.

Since the addresses theme is included as a priority for the implementation of INSPIRE (Annex I), the results of EURADIN will be used as a reference for all European Member States to fulfill the requirements of the Directive with respect to this matter.

EUROGI was leading the *Work Package* on *Networking and Dissemination*, which among other achievements establed the *European Addresses Forum* (EAF) as a long term platform for information exchange and for promoting national address related events through its members. The Forum was officially inaugurated in Brussels on June 15, 2010.

https://www.euradin.eu

PLAN4ALL

The Plan4all - European Network of Best Practices for Interoperability of Spatial Planning Information - is 80% co-funded by the European Commission in the context of the eContentplus program.Plan4all is a Best Practice Network of local, regional and national public bodies and other stakeholders dealing with planning issues and regional development.http://www.plan4all.eu

It aims are to find consensus regarding interoperability and harmonisation of the information related to spatial planning according to the INSPIRE Directive and also to contribute to standardisation of the planning related Spatial Data Themes set out in the INSPIRE Directive Annexes.

In brief, the themes addressed by Plan4all are: Land cover, Land use, Utility and Government services, Production and industrial facilities, Agricultural and aquaculture facilities, Zoning and reporting units, and Natural risk zones.

EUROGI leads the Task for the *Analysis of INSPIRE requirements* and plays a substantial role in holding national events through its members which were aimed at involving relevant planning and other stakeholders.

Ten EUROGI members organized a national Plan4allL workshop in reply to the specific call issued by EUROGI on 7th April 2010. The workshops took place between October 2010 and June 2011.

EUROGI has been entrused to produce a book summarizing the results of the Project, to collect and disseminate the results of PLAN4ALL, directed both to the professionals of the spatial planning and to the ICT experts, aiming to reduce the cultural gap between the two categories. The book 'Plan4all Project. Interoperability for Spatial Planning' is officially presented during the EUROGI/eSDI-Net Conference (12/10/2011) and Plan4all conference in Brussels (13/10/2011).

INTERNATIONAL INVOLVEMENT

To date, EUROGI's activities on the international arena have been directed in a number of directions. As a founding member of the Global SDI Association, EUROGI has a long term record of engagement with global GI/SDI matters.

EUROGI has been active in identifying ways in which it could support European development co-operation (aid) efforts, with a particular focus on Africa. This had entailed developing contacts and networks with both organisations in Africa and in the European Commission, preparing funding proposals, participating in relevant conferences and identifying ways of supporting capacity building.

EUROGI has also identified a need to explore ways in which it could possibly be of assistance in supporting GI/SDI development in Central and Eastern Europe and has actively participated in events in that area.

As a result of invitations from the United Nations organisations, EUROGI has made significant inputs into the preparatory work for the Eye on Earth Summit to be held in Abu Dhabi in December 2011 and to the UN's Geoinformation Management initiative.

WHAT DOES THE FUTURE HOLD FOR EUROGI?

17 years of solid achievements creates a sound platform on which to move forward into the future. However no organisation can be complacent and rest on its laurels.

Broadly some of the main future directions would include expanding and deepening membership and consolidating and building EUROGI's networks, continuing to support INSPIRE implementation, strengthening its relationships with a number of relevant European Commission bodies, playing a strong and cooperative role with other pan-European organisations in the broad GI/SDI field, and expanding its ability to support GI/SDI developments aimed at addressing development issues in an international context.

Over the past 17 years much has been achieved. However EUROGI is very much aware that much more needs to be done to ensure that GI/SDI fulfills the critical role in addressing pressing European and international challenges.

EUROGI is a vigorous and vibrant organisation which we believe will play a significant role in the years ahead.

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Tel: +31 88 183 3130 Bino Marchesini, Administrative and Legal Officer
www.eurogi.org – eurogi@eurogi.org

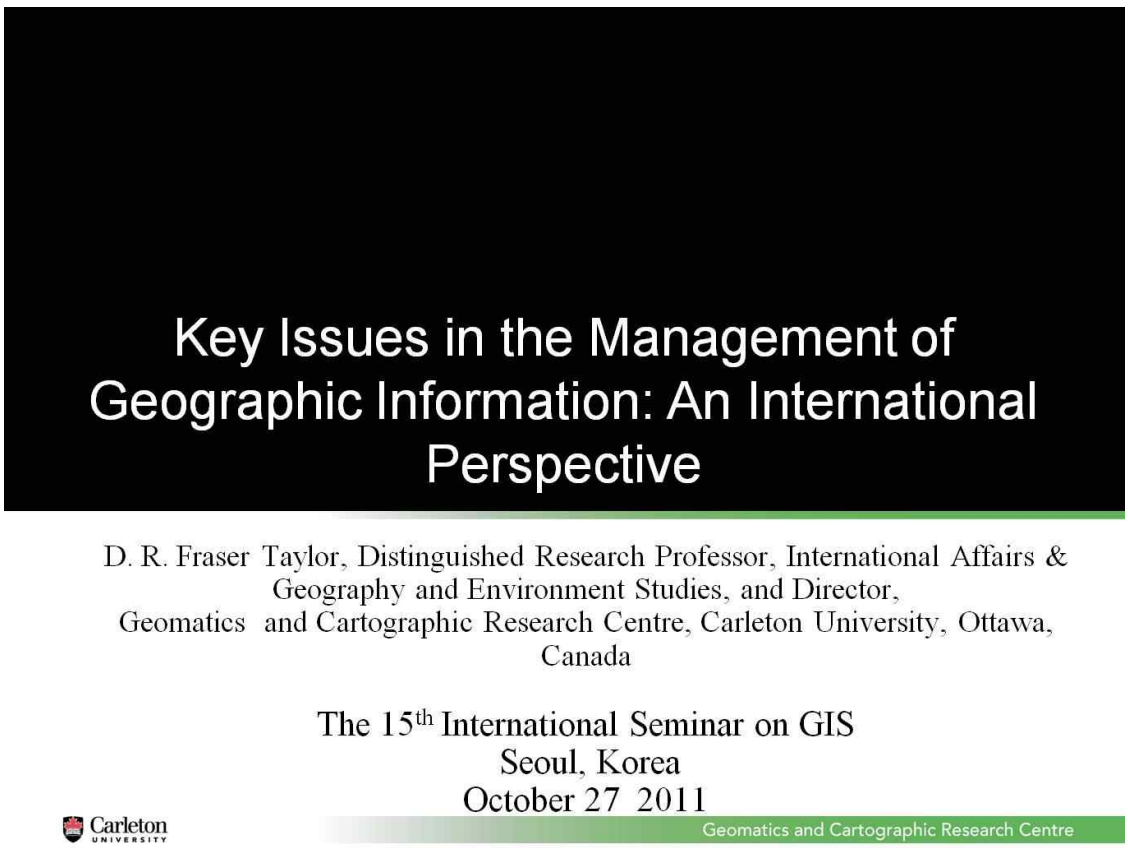
17 YEARS
1994-2011

The association was formerly established in the 1990s as the Italian chapter of Automated Mapping and Facilities Management International and was subsequently renamed Automated Mapping Facilities Management Geographic Information Systems Italia. It is a non-grant funded, non-profit making association of institutions, companies and users (professionals and students) who have specific interests in geospatial information and applications. AMFM is based in Rome. According to the tendencies of the 90s, AMFM GIS Italia was established to create awareness about geo-spatial information; to facilitate the exchange of knowledge and experience of Geographic Information Systems and Spatial Information between public and private sectors within Italy; and to promote the development of applications for the territorial applications and the management of services and infrastructure, supporting coordination among different levels of government (central, local and sub-local). At the European level, AMFM GIS Italia joined as a founder member to EUROGI (European Umbrella Organisation for Geographic Information). Their president was also president of EUROGI for two mandates. In Italy, AMFM GIS Italia founded, together with some other organisations, the Italian Federation ASITA (Italian Scientific Associations for Geographic and Environmental Information). AMFM GIS Italia members are industrial members, user members and individual members. Some honorary members are indicated by Italian Governmental Institutions related to GI and to cartography. It is worth noting that user members are strongly characterised by energy and facilities companies as they are among the most relevant users of GI. Each year, the association holds one national conference and some workshops and seminars on specific themes. AMFM GIS Italia has been involved as an NGO, since the foundation, in all Italian initiatives related to geospatial information. The Association promotes the dissemination of methodologies and processes of standardisation, communication and sharing of geo spatial information to enhance in-interoperability. The Italian Forum of Open Geospatial Consortium has been established under the aegis of AMFM GIS Italia, which has been the initiator and promoter of the INSPIRE initiative in Italy.

Key Issues on the Management of Geographic Information: An International Perspective

Fraser Taylor

Carleton University, Canada
fraser_taylor@carleton.ca



Outline

My central argument is that geographic information is important to all aspects of modern societies but if that potential is to be realized then several challenges must be met. I have identified 6 challenges.

- Enabling more effective data sharing among the stewards of locationally-referenced data
- Enabling a greater degree of interoperability between and among datasets
- Making locational data an integrated part of mainstream ICT, not a stand alone system
- More effectively linking geographic information with socio-economic information
- In the emerging digital economy there are an increasing number of participatory information infrastructures. Should these be integrated with more formal approaches, and if so, how?
- Communicating the results of analyses in more effective ways.

Outline (continued)

- I will consider each of these topics by drawing on my international experience and personal involvement with a number of ongoing projects such as Global Map, GEO and GEOSS, the OGC Interoperability Institute and OGC Global Advisory Council, the United Nations Expert Group on Geographic Information, and the Joint Board of the Geospatial Information Societies.

Outline (continued)

- Each of the six challenges does, of course, have a technical component but my experience suggests that the technical challenges are much easier to resolve than the institutional, attitudinal, cultural, legal and administrative/political challenges.

- Providing technical solutions is necessary but by no means sufficient. If human "interoperability" problems are not resolved then the benefits of using geographic information will never be fully realized. I will concentrate on this aspect of the six challenges I outlined earlier.

The Importance of Location-based Information

- Eighty percent of digital information has a locational component.
- "Everything is Somewhere" and location can be used as an integrator for both qualitative and quantitative information.
- Society is increasingly using location-based information in everyday life, including GPS, Google Earth and related spatially referenced databases. Such information can often be accessed on mobile devices.
- Governments are using location or place in planning and budgeting, e.g. Obama administration budget memorandum of August 2009.
- The emergence of spatial data infrastructures at the local, regional and global scales
- The creation of location-based information through "crowd sourcing" activities by citizens all over the world. Mobile devices are increasingly used for such purposes.

The Importance of Semantics

- A major problem for geographical information management is arriving at a mutual understanding of our jargon both among ourselves and with the general public.
- Definition of "navigation"
- "Geospatial information", "spatial data infrastructure", "geographic information science", "neo-geography" etc. Should we replace these by the more understandable "locational information" or "place-based information"?

  For example the Obama administration "Developing Effective Place Based Policies for FY 2011 (M-09-28) Memorandum

Data Sharing – The GEO and GEOSS Experience

- The Group on Earth Observations (GEO) and the Global Earth Observation System of Systems (GEOSS)

GEOSS Vision: The 10 Year Implementation Plan

- "…to realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth Observations and Information."

GEOSS Objectives

To address nine topics of societal benefit as a contribution to meeting UN Millennium Development Goals, including:

- Humanitarian response to disasters
- Climate change impacts
- Weather forecasting
- Public health
- Biodiversity
- Water management and desertification control
- Renewable energy
- Education and research
- Special attention to developing nations

Sharing Data In GEOSS

- Nations participating in GEO are endorsing the GEOSS 10 Year Implementation Plan and are de jure committing to making the geospatial data they control easily available.

GEOSS Data Sharing Principles

1. There will be full and open exchange of data, metadata and products shared with GEOSS, recognizing relevant international instruments and national policies and legislation.

2. All shared data, metadata and products will be made available with minimum time delay and at minimum cost.

3. All shared data, metadata and products will be made available free of charge or at no more than he costs of reproduction for educational and research use with special consideration being given to users in developing nations.

Implementation

"The devil is in the details."

The first principle has an important modifying clause:

"…recognizing relevant international instruments and national policies and legislation"

- This allows nations to adhere to the principles but ignore full implementation.

Implementing GEOSS Data Sharing Principles

- GEO Architecture and Data Committee
- White Paper by the Committee on Data for Science and Technology (CODATA), an interdisciplinary committee of the International Committee for Science (ICSU)
- "Toward Implementation of the Global Earth Observation System of Systems Data Sharing Principles", Paul Uhlir et. al., *Journal of Space Law*, 35(1): 201-289, summer 2009
- The creation of a Data Sharing Task Force by GEOSS which reported in November 2009 and again in November 2010. A new report will be presented to the 2011 Plenary.

GEOSS Data Sharing Task Force Report

- A comprehensive case for sharing geospatial data including a careful consideration of the barriers. The Task Force produced guidelines for sharing data for all stakeholders, including the private sector, within GEO member nations
- The Task Force presented an implementation plan which was accepted by the 2010 Plenary
- The 2011 report identifies the requirements for data sets contributed to the GEOSS Data-CORE.

Legitimate Restrictions on Access to Data

- Copyright
- Proprietary rights
- Personal privacy
- Confidentiality
- National security
- Indigenous rights
- Conservation and protection of sensitive ecological, archeological or cultural resources

The Guidelines

1. Government and public sector institutions should provide most, if not all, of their data and information without any re-use or re-dissemination restrictions.

2. For the private sector at least a useful sub-set of data and information should be made available without re-use or re-dissemination restrictions.

The Guidelines (continued)

3. Recognizes the need for restrictions related to national security, proprietary interests, privacy, confidentiality, indigenous rights, sensitive ecological and cultural resources but suggests a minimization of these restrictions wherever possible and an authoritative point of contact to deal with them in each nation.

The Guidelines (continued)

4. The pricing of data, metadata and products be based on minimum costs.

   Data collection and systems development not be considered an allowable cost and the metadata should be available free.

The Data Sharing Action Plan

- Will these guidelines be followed? They have already been formally adopted by GEO but are voluntary in nature.
- Is the power of persuasion enough?

The Data Sharing Action Plan

- The Task Force has prepared a detailed Action Plan which was adopted at the Ministerial Summit in Beijing in November 2010. This includes a proposal to establish a GEOSS Data Collection of Open Resources for Everyone (GEOSS Data-CORE). The 2011 report includes descriptions of data sets which have already been contributed.

- Adopted as a result of a political consensus process which involved compromise and it still remains a voluntary, not a mandatory, action plan.

Data Sharing: The GEOSS Experience

- GEOSS is clearly designed to meet what are indisputable major societal needs in nine key areas. If agreement cannot be reached to share data in these circumstances, e.g. natural disasters, then the use of geospatial data will be much reduced.

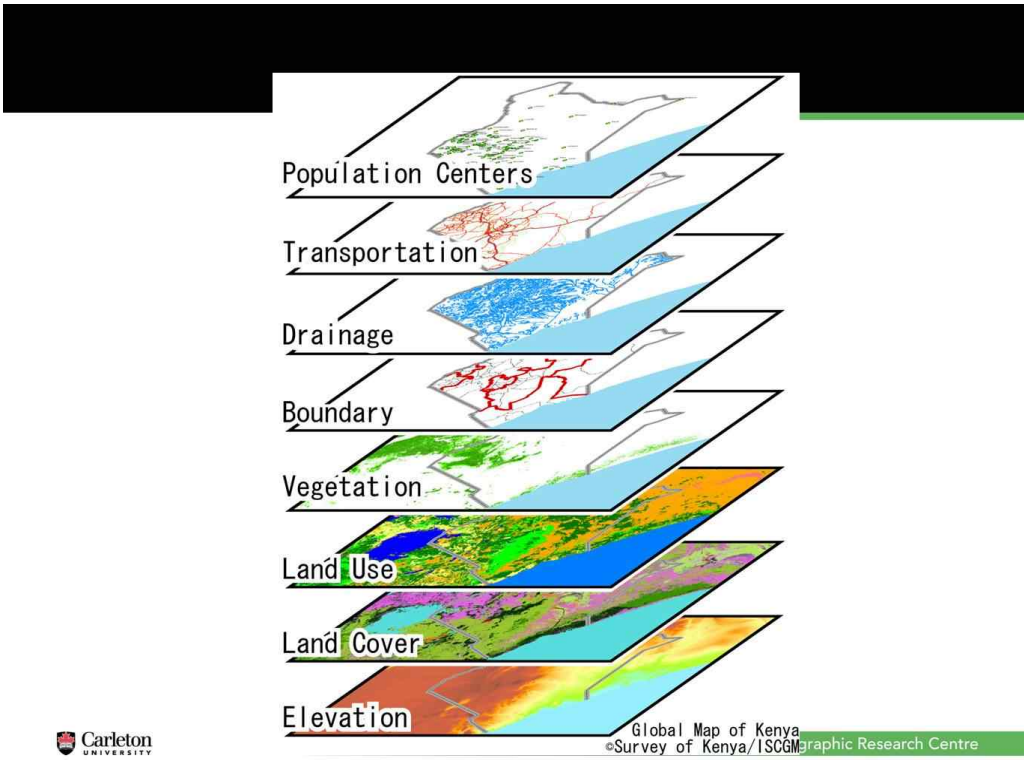
- Even in times of national disaster the United Nations agencies involved have reported that in almost every case they have had to purchase remote sensing data.

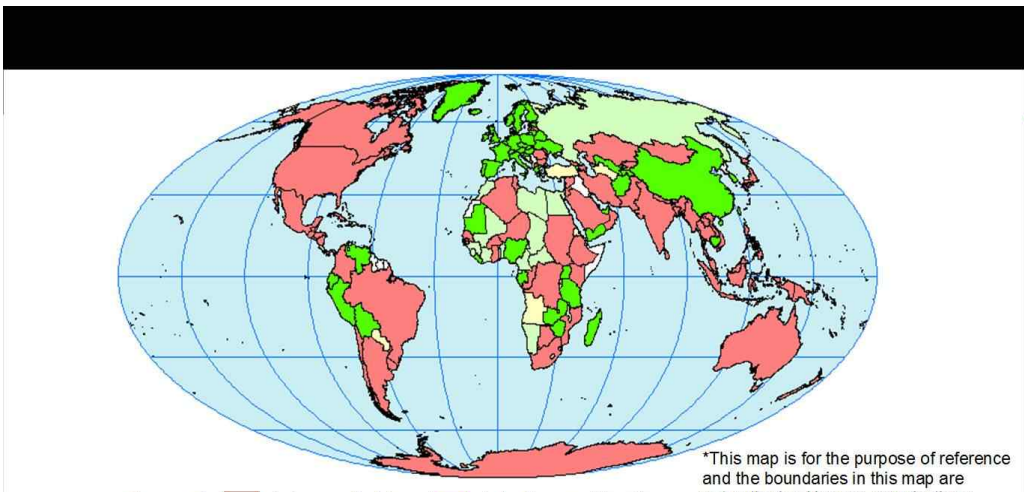
Data Sharing: The GEOSS Experience

- National self interest and the legal restrictions on licensing through public/private partnerships are major problems. These non-technical problems may severely limit data sharing in GEOSS. The 2011 Task Force Report includes suggestions on legal interoperability and liability issues.

Data Sharing: The Global Map Experience

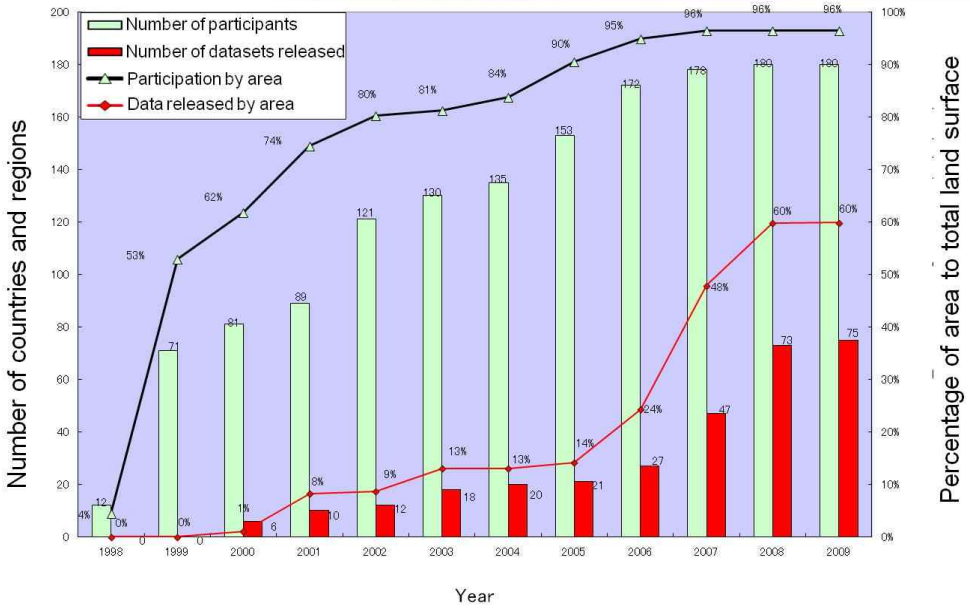
- Global Map is an international project to prepare a digital map of the world in eight data layers with common specifications at the scale of 1:1 million. It is produced by the National Mapping Agencies (NMOs) of the world with each nation being responsible for its own coverage.
- Global Map is an operational global spatial data infrastructure.
- Some Global Map data sets have been contributed to the GEOSS Data-CORE.





	Countries and Regions	Area ratio (%)	Population ratio (%)
Available	75	59.9	52.5
Verification	62	19.1	38.2
Developing	43	17.6	6.5
Total	180	96.6	97.2

Progress of participation and data development



Remarkable Progress but…

- Russia – developing data. This category on the participation map is a euphemism in this case.
- Eurogeographics – full cost recovery management model
- El Salvador – scale and politics
- India – national security

Interoperability Challenges

- Considerable and ongoing progress with technical interoperability through OGC and ISO
- Emergence of the "science of interoperability": David Schell and D. R. F. Taylor, 2008. The Science of Interoperability, *Coordinates*, Vol. 4, Issue 3, March, 18-20.
- Technical challenges remain such as semantic interoperability
- Major ongoing challenges are non-technical

Interoperability Challenges (continued): The OGC

- OGC seen largely as a North American and Western Europe organization.
- Limited knowledge and acceptance elsewhere
- "Build it and they will come" not working as well as it should
- Establishment of OGC Interoperability Institute and OGC Global Advisory Council to address these challenges
- OGC interoperability seminars such as the one being held in parallel with this meeting today.

Making Locational Data an Integral Part of the ICT Mainstream

- The main organizational structure for geospatial data is the spatial data infrastructure.
- A wide variety of models emerging – Canada, USA, Korea, Brasil, China, INSPIRE, Global Map, OneGeology
- In almost all cases these are not an integral part of the emerging location-aware ubiquitous computing environment. Most SDIs are stand-alone creations isolated from the ICT mainstream.
- Many SDIs are supply, rather than demand, driven and existing SDIs are rarely oriented to respond directly to high priority societal or policy problems.

Making Locational Data an Integral Part of the ICT Mainstream (continued)

- Technically there is no reason why this should be so
- One problem is that this reflects an old model and attitude where the national mapping agencies were independent of the agencies developing the ICT mainstream.
- In Canada we currently have two largely independent consultations going on: "Developing Canada's Digital Advantage" and "A National Mapping Strategy for Canada".
- Many geospatial specialists tend to isolate themselves in their own protective cocoons. This must change.

Linking Geographic Information with Socio-economic Information

- National mapping organizations are the major custodians of geospatial information
- National statistical organizations are the main custodians of socio-economic information
- They tend to act independently of each other even in situations where the two are part of the same institution, here in Mexico and also in Brazil.
- Increased cooperation requires a re-examination of institutional structures and procedures.
- UN Meeting on this topic here tomorrow

Linking Geographic Information with Socio-economic Information (continued)

- There are technical challenges such as data collection techniques, timeframes, data types, standards and specifications but the major problems are not technical ones.
- Statistical agencies are governed by formal legislation and have different policy mandates from NMOs.
- Privacy and confidentiality are of special concern.
- In Canada the problem of "mandate silos" is acute. We have excellent technical interoperability specifications but limited institutional capacity to link datasets.

Linking Geographic Information with Socio-economic Information (continued)

- This has been identified as a major challenge by the United Nations and a Group of Experts has been appointed to address it
- A major international conference is taking place here this week to address the challenge involved.

Participatory Information Infrastructures

- There are an increasing number of such infrastructures such as Open Street Map.
- Many are concerned about data quality, accuracy and the lack of metadata and, as a result, tend to disparage and ignore them.
- They are here to stay and ways will have to be found to integrate them. Again, attitudinal and political problems loom larger than the technical ones.
- One way ahead is to identify topics where participatory infrastructures can be linked with more formal ones in a "win-win" scenario, e.g. road and street maps.

Communicating the Results of Analyses in More Effective ways

- the resurgence of the map as a communication tool – the importance of imagination and art.
- Tim Berners-Lee on the next Web (TED, March 2010). Hans Rosling shows the best stats (TED, 2006).
- Complex location-based analyses but little attention to communicating the results effectively
- Use and usability studies – human-computer interaction (HCI)
- New mapping approaches - online multimedia cybercartographic atlases
- Direct community involvement in atlas creation – Nunaliit software – living atlases.

Conclusion

- Effective management of geographic information is both a technical and a human challenge. Both of these issues and the important relationships between them must be considered together if the benefits of locationally-referenced information to society are to be realized.

R&D Policy on Geospatial Information and International Cooperation in Korea

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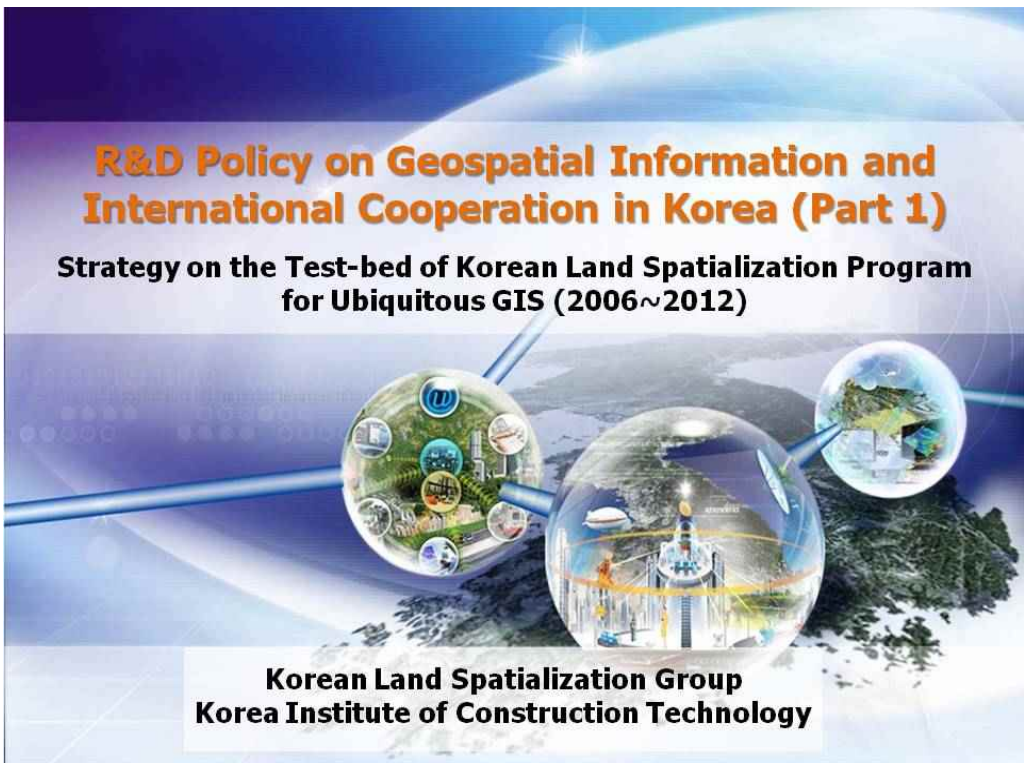
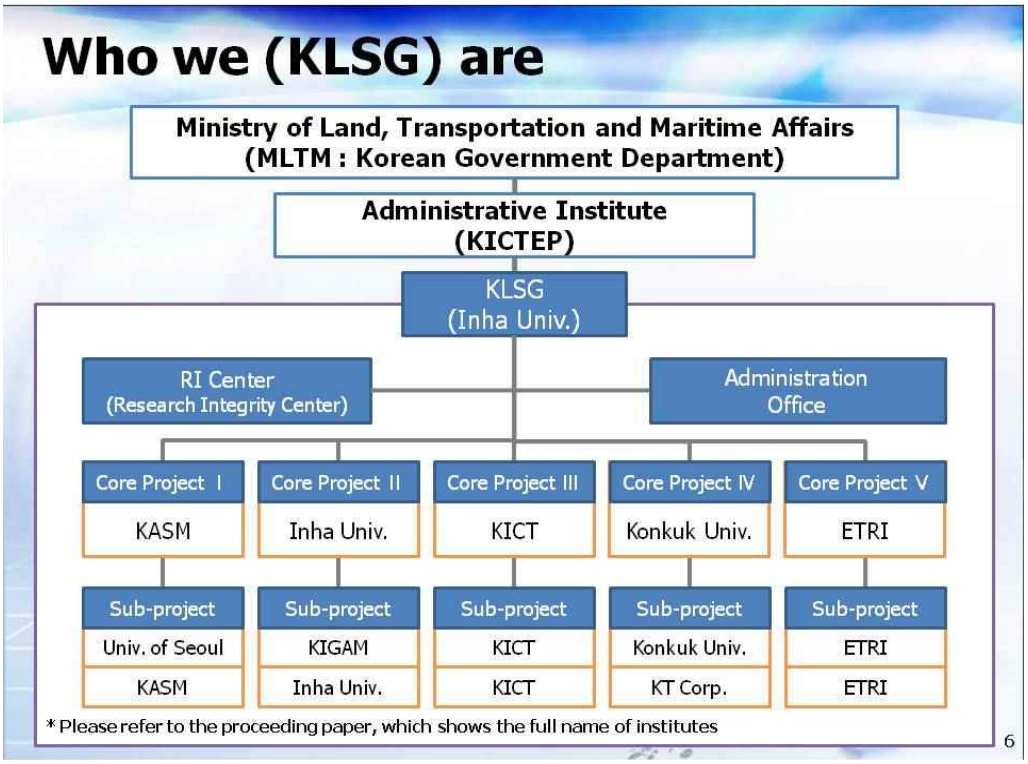



Contents
I Introduction
II What we do
III What is Test-bed of KLSP
IV Conclusions
KLSG
Korean Land Spatialization Group


Ⅰ. Introduction
Background of the Korean Land Spatialization Program = "MLTM R&D Roadmap, 2005"
• R&D Roadmap for 10 years(2006 ~ 2016)
• Planned and Funded by MLTM of Korean Government
• Managed by KICTEP (Korea Institute of Construction & Transportation Technology Evaluation and Planning)
MLTM R&D consists of 7 Fields, 20 programs.
– 10 major programs were designated as "VC10(Value Creators 10) Programs"
KLSG
Korean Land Spatialization Group
"The First Program of VC10"
3


Why need KLSP?
Powerful IT Infra in Korea
Needs of Value Chain
Result of Korean National GIS
Advent of Ubiquitous Concept
Innovation of Geospatial Technology
for Ubiquitous Society
Future Growth Engine
for Commercialization
4


Korean Land Spatialization Program
Vision : GIS Technology Leader For Ubiquitous Society
Missions
❖ Future growth engine to create value added products
❖ World-class GIS proving-ground and monitoring center
❖ Top 5 in world GIS market share
Programs
❖ Program Period : Nov. 2006 – Jun. 2012(5 years 7 months)
❖ Budget : $ 161 million USD
✓ Funded by MLTM : $ 119 million USD
✓ Funded by business sector : $ 42 million USD
❖ 5 Core Projects : 144 institutes
✓41 universities, 83 companies, 13 research center,
7 international organizations,
5


Who we (KLSG) are
Ministry of Land, Transportation and Maritime Affairs
(MLTM : Korean Government Department)
Administrative Institute
(KICTEP)
KLSG
(Inha Univ.)
RI Center
(Research Integrity Center)
Administration
Office
Core Project I
KASM
Core Project II
Inha Univ.
Core Project III
KICT
Core Project IV
Konkuk Univ.
Core Project V
ETRI
Sub-project
Univ. of Seoul
KASM
Sub-project
KIGAM
Inha Univ.
Sub-project
KICT
KICT
Sub-project
Konkuk Univ.
KT Corp.
Sub-project
ETRI
ETRI
* Please refer to the proceeding paper, which shows the full name of institutes
6


II. What we do
I. Geospatial Infrastructure
II. Land Monitoring
V. u-GIS SW Technology
KLSG
5 u-GIS
Projects
IV. Indoor/Outdoor Spatial
Information Construction
III. Urban Facility
Management
7

Project 1: Geospatial Information Infrastructure

- **Goal**
  - to provide accurate position datum and
  - to serve demands on future-oriented land information
- **Research Issues**
  - Future positional reference frameworks
  - Future equipments for geo data acquisition
  - Future maps
- **Participants**
  - KASM, U. of Seoul,..
  - 11 universities, 19 companies, 2 research institutes
  - 1 international organizations
- **Budget (2006~2012)**
  - 24 + 8 million USD

8

Project 2: Land Monitoring

- **Goal**
  - Real time and/or periodic land monitoring from the air and the ground
- **Research Issues**
  - Real-time remote sensing technology
  - Ground monitoring with In-Situ sensors
  - Integration of monitoring systems for various applications
- **Participants**
  - Inha U., KIGAM,..
  - 11 universities, 15 companies, 4 research institutes
  - 2 international organizations
- **Budget (2006~2012)**
  - 23+5 million USD

9

Project 3: Intelligent Urban Facility Management

- **Goal**
  - U-GIS tech. for smart management of urban facilities (for U-City)
- **Research Issues**
  - Application of USN for underground/ground facilities
  - Integrated platform for urban facility management
  - Standardization of urban geo information services
- **Participants**
  - KICT,..
  - 2 universities, 9 companies, 5 research institutes
  - 1 international organizations
- **Budget (2006 ~ 2012)**
  - 26 + 12 million USD

10

Project 4: Information-based Indoor/Outdoor Geospatial Information & Application Technology

- **Goal**
  - To implement the indoor GIS
  - To utilize GIS tech. in construction
- **Research Issues**
  - Geospatial DB using construction drawings
  - Indoor 3D positioning and establishment of indoor DB
- **Participants**
  - Konkuk U., KT,..
  - 10 universities, 30 companies, 0 research institutes
  - 3 international organizations
- **Budget (2006 ~ 2012)**
  - 22 + 15 million USD

11

Project 5: Ubiquitous GIS Core S/W Technology

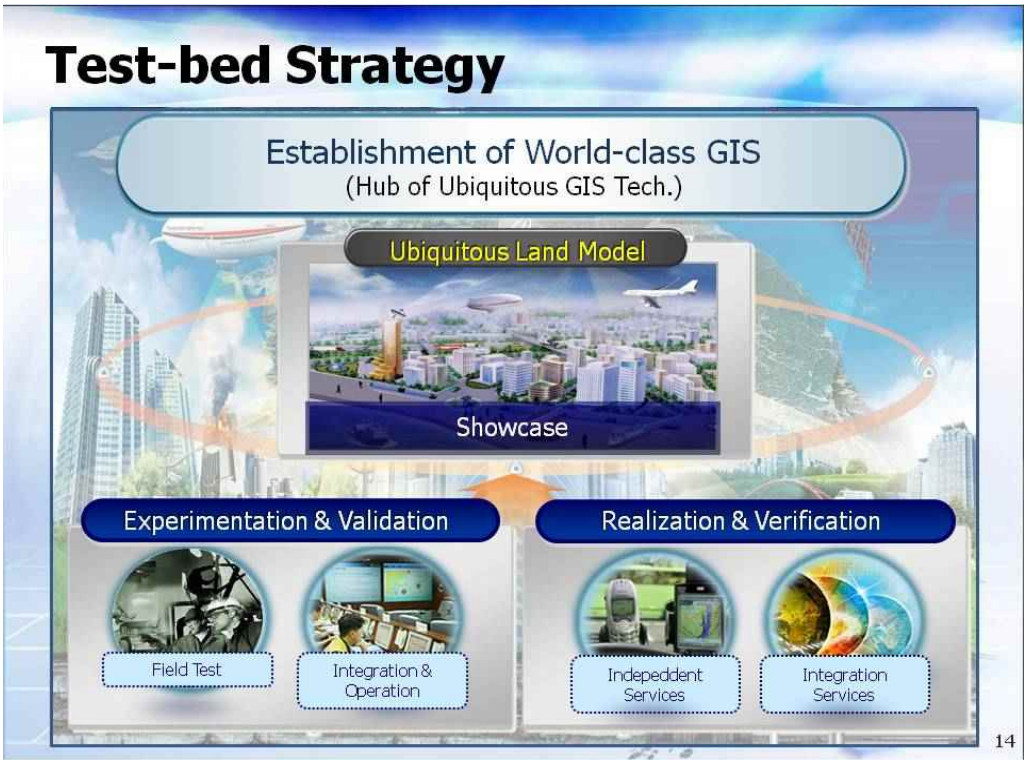
- **Goal**
  - To develop future u-GIS SW technology
- **Research Issues**
  - Future GIS SW for u- era
  - u-GIS visualization and augmented reality for u-GIS
- **Participants**
  - ETRI,..
  - 7 universities, 10 companies, 2 research institutes
- **Budget (2006～2012)**
  - 23 + 8 million USD

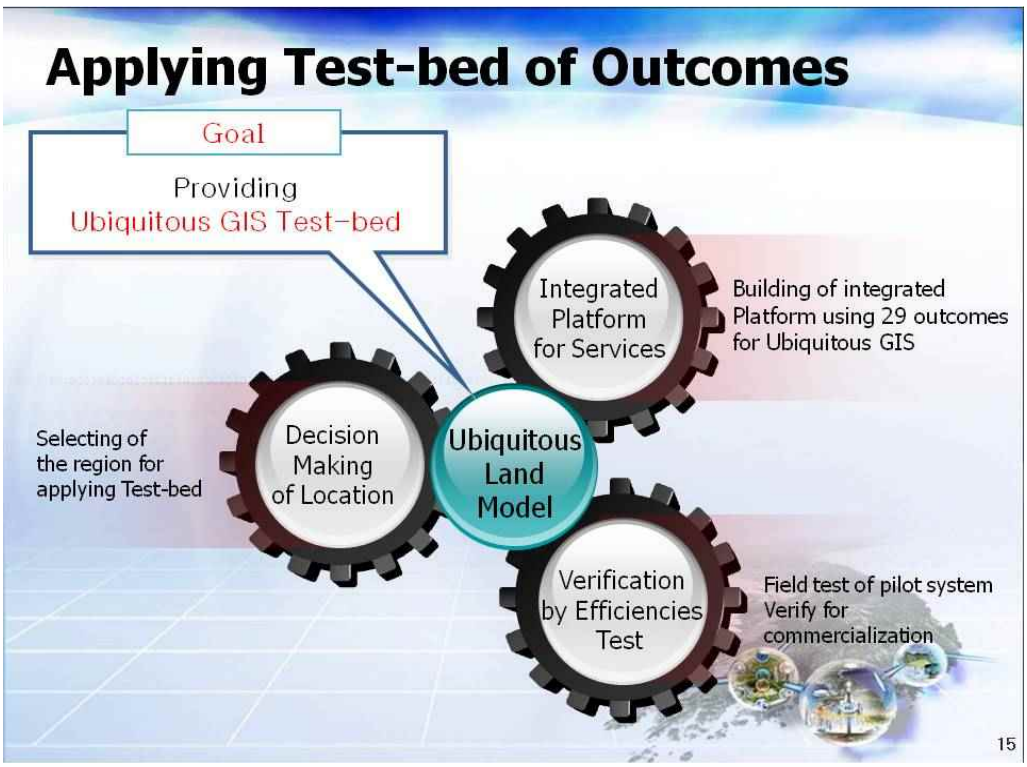
12

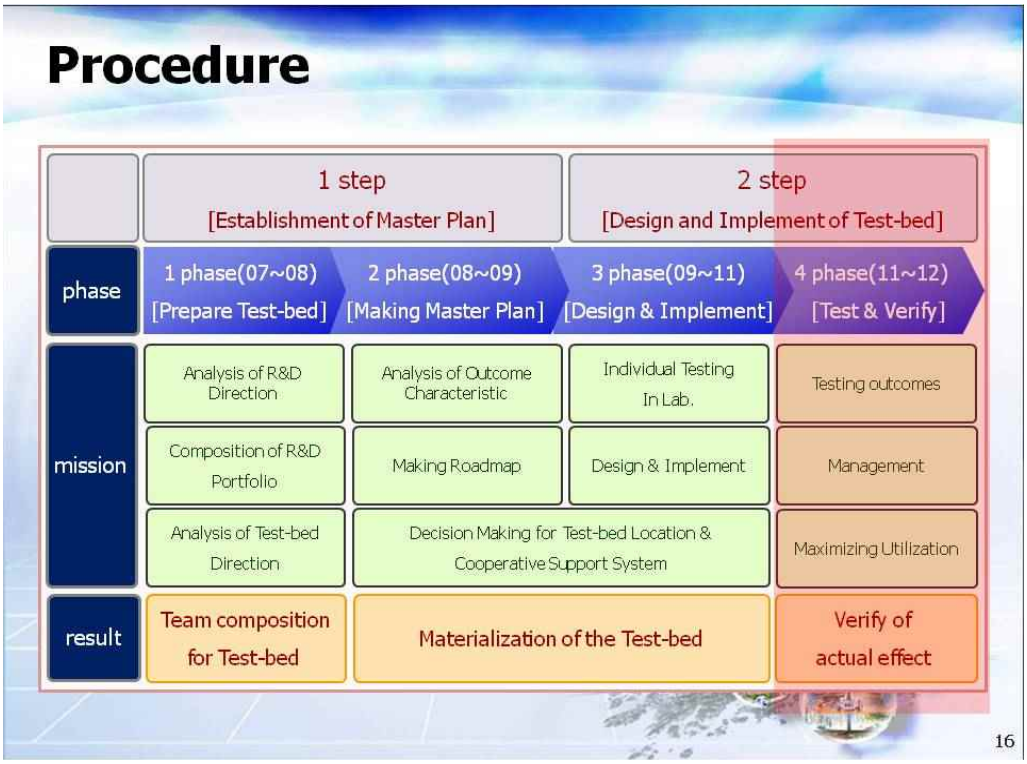
Ⅲ. What is Test-bed of KLSP

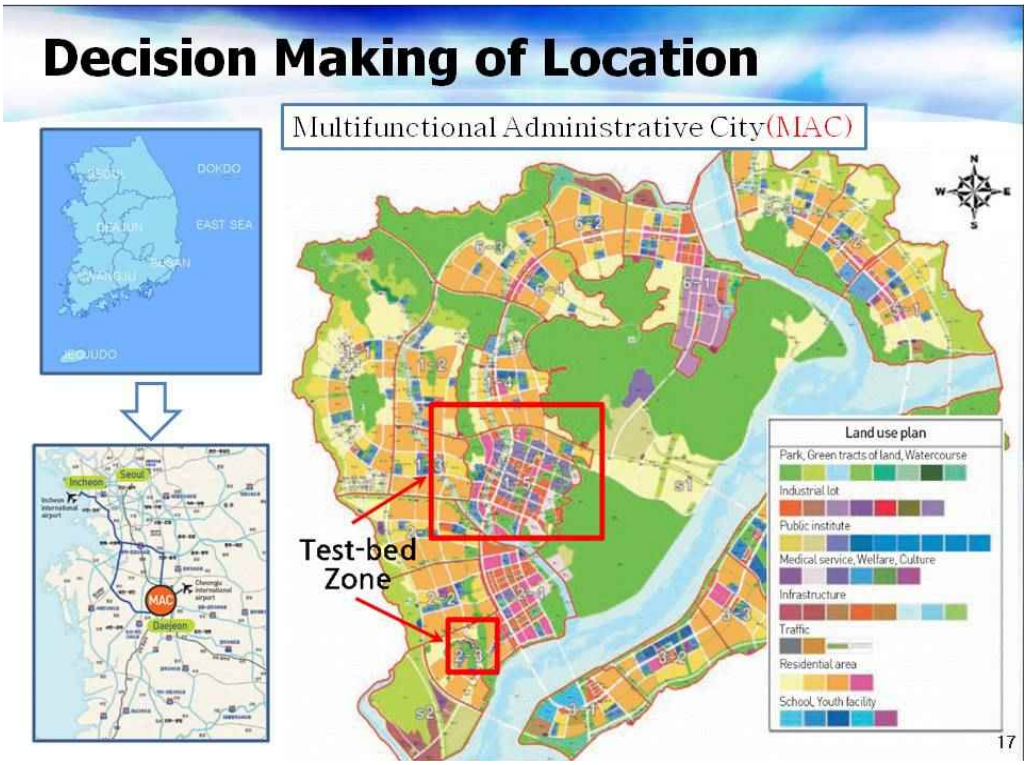
- ❖ Poorly practical use of R&D outcomes ➔ Ensure the Validation
- ❖ Field testing on the R&D outcome for minimizing trial & error
  - ➔ Improvement of Maximizing commercialization by Test-bed

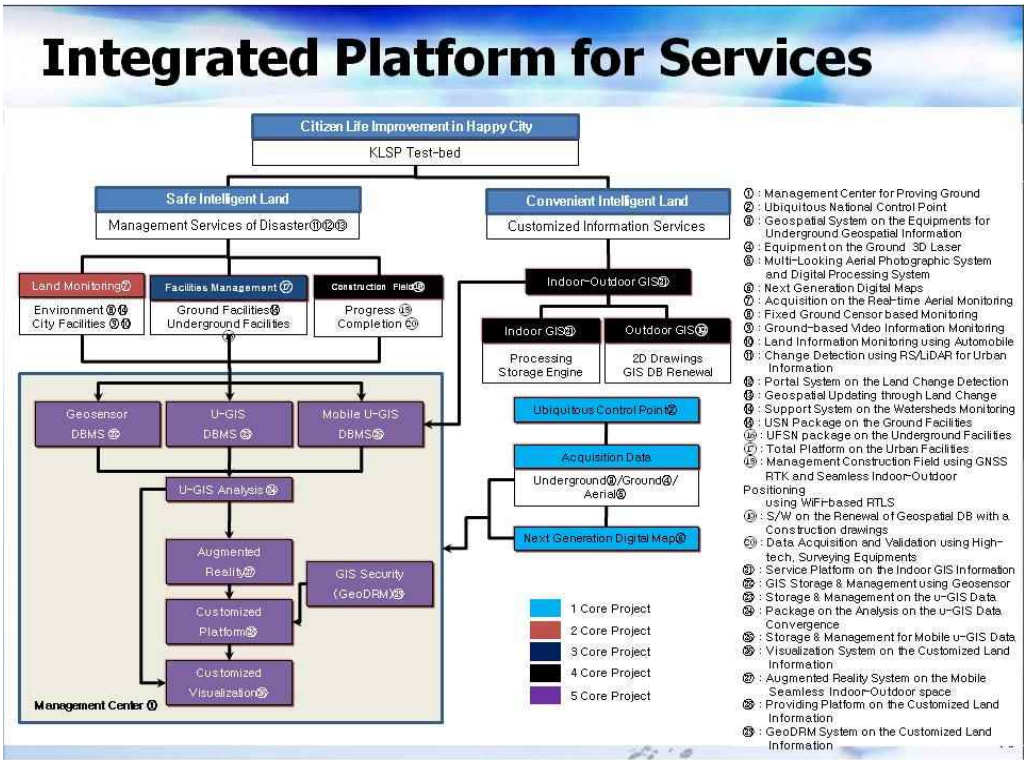
13


Test-bed Strategy
Establishment of World-class GIS
(Hub of Ubiquitous GIS Tech.)
Ubiquitous Land Model
Showcase
Experimentation & Validation
Realization & Verification
Field Test
Integration & Operation
Indepeddent Services
Integration Services
14

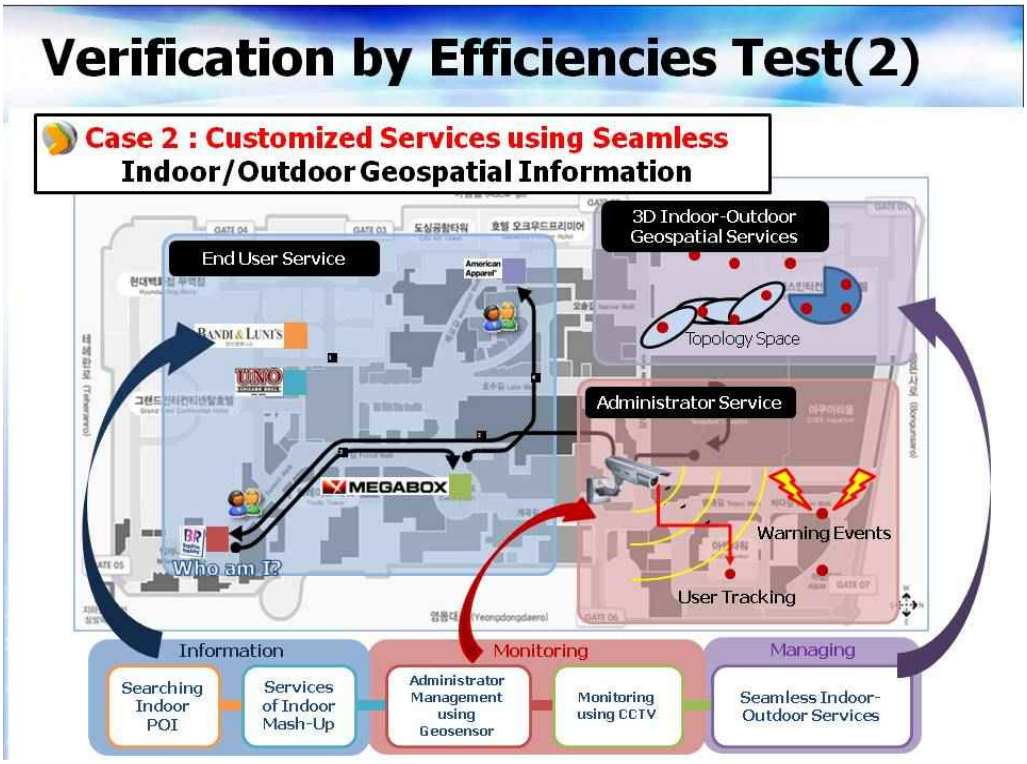

Applying Test-bed of Outcomes
Goal
Providing
Ubiquitous GIS Test-bed
Integrated Platform for Services
Building of integrated Platform using 29 outcomes for Ubiquitous GIS
Selecting of the region for applying Test-bed
Decision Making of Location
Ubiquitous Land Model
Verification by Efficiencies Test
Field test of pilot system Verify for commercialization
15

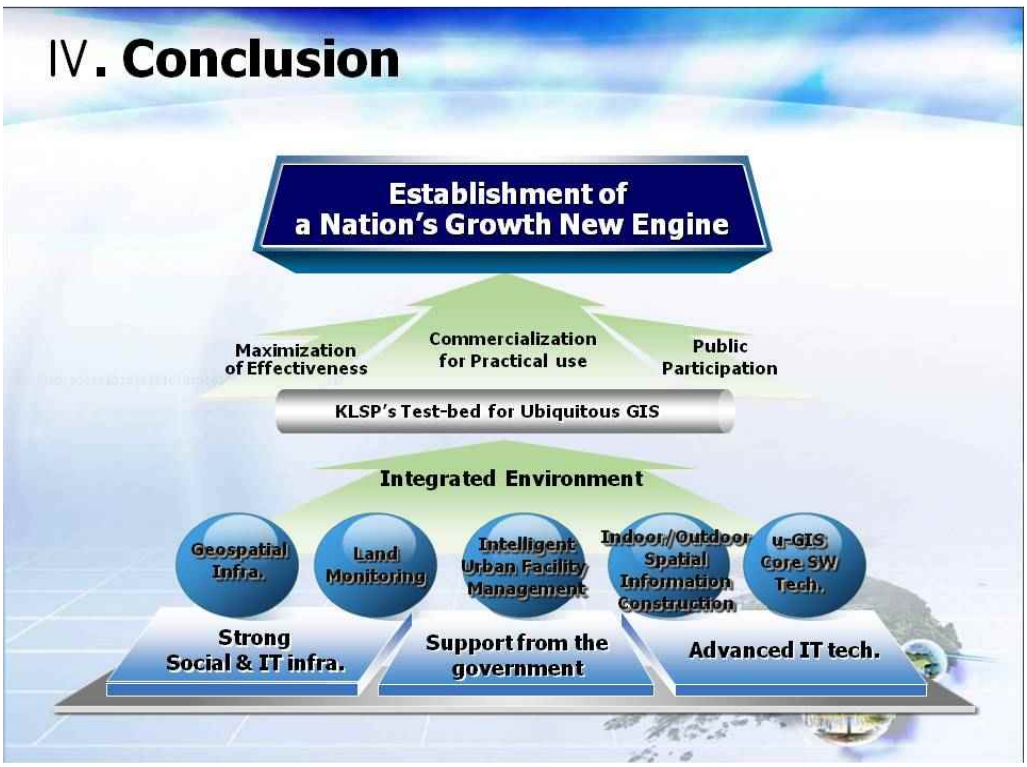

Procedure
1 step
[Establishment of Master Plan]
2 step
[Design and Implement of Test-bed]
phase
1 phase(07~08)
[Prepare Test-bed]
2 phase(08~09)
[Making Master Plan]
3 phase(09~11)
[Design & Implement]
4 phase(11~12)
[Test & Verify]
mission
Analysis of R&D Direction
Analysis of Outcome Characteristic
Individual Testing In Lab.
Testing outcomes
Composition of R&D Portfolio
Making Roadmap
Design & Implement
Management
Analysis of Test-bed Direction
Decision Making for Test-bed Location & Cooperative Support System
Maximizing Utilization
result
Team composition for Test-bed
Materialization of the Test-bed
Verify of actual effect
16


Decision Making of Location
Multifunctional Administrative City(MAC)
DOKDO
EAST SEA
JEJUDO
Incheon
Seoul
MAC
Daejeon
Test-bed Zone
Land use plan
Park, Green tracts of land, Watercourse
Industrial lot
Public institute
Medical service, Welfare, Culture
Infrastructure
Traffic
Residential area
School, Youth facility
17


Integrated Platform for Services
Citizen Life Improvement in Happy City
KLSP Test-bed
Safe Intelligent Land
Management Services of Disaster①②③
Convenient Intelligent Land
Customized Information Services
Land Monitoring⑦
Environment ⑧⑭
City Facilities ⑨⑩
Facilities Management ⑫
Ground Facilities⑱
Underground Facilities
Construction Field⑯
Progress ⑮
Completion ⑳
Indoor-Outdoor GIS㉑
Indoor GIS㉒
Processing
Storage Engine
Outdoor GIS㉓
2D Drawings
GIS DB Renewal
Geosensor
DBMS ㉔
U-GIS
DBMS ㉕
Mobile U-GIS
DBMS㉖
Ubiquitous Control Point⑫
Acquisition Data
Underground⑰/Ground④/
Aerial⑤
U-GIS Analysis ㉗
Augmented
Reality㉗
GIS Security
(GeoDRM)㉙
Customized
Platform㉘
Customized
Visualization㉚
Management Center ①
1 Core Project
2 Core Project
3 Core Project
4 Core Project
5 Core Project
① : Management Center for Proving Ground
② : Ubiquitous National Control Point
③ : Geospatial System on the Equipments for Underground Geospatial Information
④ : Equipment on the Ground 3D Laser
⑤ : Multi-Looking Aerial Photographic System and Digital Processing System
⑥ : Next Generation Digital Maps
⑦ : Acquisition on the Real-time Aerial Monitoring
⑧ : Fixed Ground Censor based Monitoring
⑨ : Ground-based Video Information Monitoring
⑩ : Land Information Monitoring using Automobile
⑪ : Change Detection using RS/LiDAR for Urban Information
⑫ : Portal System on the Land Change Detection
⑬ : Geospatial Updating through Land Change
⑭ : Support System on the Watersheds Monitoring
⑱ : USN Package on the Ground Facilities
⑯ : UFSN package on the Underground Facilities
⑰ : Total Platform on the Urban Facilities
⑮ : Management Construction Field using GNSS RTK and Seamless Indoor-Outdoor Positioning using WiFi-based RTLS
⑳ : S/W on the Renewal of Geospatial DB with a Construction drawings
⑳ : Data Acquisition and Validation using High-tech, Surveying Equipments
㉑ : Service Platform on the Indoor GIS Information
㉒ : GIS Storage & Management using Geosensor
㉓ : Storage & Management on the u-GIS Data
㉔ : Package on the Analysis on the u-GIS Data Convergence
㉕ : Storage & Management for Mobile u-GIS Data
㉖ : Visualization System on the Customized Land Information
㉗ : Augmented Reality System on the Mobile Seamless Indoor-Outdoor space
㉘ : Providing Platform on the Customized Land Information
㉙ : GeoDRM System on the Customized Land Information


Verification by Efficiencies Test(1)
Case 1 : Services of Disaster Management
- u-Map based maintenance of monitoring center
- In emergency, 1) Individual evacuation info. system,
2) Facility control system
Precise geo-infrastructure
Monitoring systems
Indoor evacuation
Ortho photo
Seamless map
DEM
Object oriented
U-ref. point
Next-generation Map
Aerial/ground monitoring
Facility USN monitoring
(underground)
Facility control
(Prevention of 2nd emergency)


Verification by Efficiencies Test(2)
Case 2 : Customized Services using Seamless Indoor/Outdoor Geospatial Information
End User Service
3D Indoor-Outdoor Geospatial Services
Topology Space
Administrator Service
Warning Events
User Tracking
Who am I?
Information
Searching Indoor POI
Services of Indoor Mash-Up
Monitoring
Administrator Management using Geosensor
Monitoring using CCTV
Managing
Seamless Indoor-Outdoor Services


IV. Conclusion
Establishment of a Nation's Growth New Engine
Maximization of Effectiveness
Commercialization for Practical use
Public Participation
KLSP's Test-bed for Ubiquitous GIS
Integrated Environment
Geospatial Infra.
Land Monitoring
Intelligent Urban Facility Management
Indoor/Outdoor Spatial Information Construction
u-GIS Core SW Tech.
Strong Social & IT infra.
Support from the government
Advanced IT tech.

The Implementation of Interoperable Massive Sensors Data Processing by Cloud Technology

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Feng Chia University, Taiwan
jimmy@gis.tw

1. Introduction

With the advances in geospatial information technologies, sensors have been widely used in almost every industry around the globe. Most sensors for monitoring, such as rain gauges, surveillance cameras, or traffic flow detectors, are carrying out a long period of observation, which results in a rapid accumulation of observation records in databases and enormous demand on computing resources. Meanwhile, the interoperability among sensor data generated by different manufacturers remains a big issue when different disciplines desire to access those sensor resources for interdisciplinary applications. This paper will examine issues of massive data processing and interoperability by presenting the implementation of 2 monitoring systems in Taiwan. It also intends to propose a solution to those issues by adopting Cloud Computing and Open Geospatial Consortium (OGC) standards.

2. Background

2.1 Cloud Computing and Monitoring Systems

Cloud computing is aimed to solve problems of large-scale data analysis and storage. Features of the cloud computing include system scalability, implementation flexibility, and high fault tolerance. It is often used in a distributed architecture where data are stored in a cluster of separated machines while computing resources from those machines can be summed up and allocated evenly to different processes at the same time, which can greatly reduce the loading on a single machine, and meanwhile makes the best use of computing

resources.

Monitoring systems with sensors is one of common applications that may benefit from computing because most of monitoring tasks are required to process a large number of data collected by sensors with long periods of observation. There are sensors almost everywhere in our daily life even though most people are not aware of their existence. For example, weather forecast systems collect data from rain gauges, moisture meters, and barometer. Landslide monitoring systems gather data from geophones, water level gauges, and cameras. Modern traffic control systems coordinate traffic signals by analyzing real-time data from vehicle detectors, probe vehicles, and surveillance cameras. Thanks to those sensor data around us, people can thus be aware of current situations and make suitable decisions based on the right observations to this world.

Figure 1 illustrates the framework of a monitoring network for debris flow in Taiwan. There are 17 on-site monitoring stations installed along a debris-flow-prone stream and 3 mobile stations in this network. The instruments used for monitoring include rain gauges, wire sensors, geophones, soil moisture sensors, water level meters, and CCD cameras. The monitoring stations works for 24/7 to collect data from the site, providing useful information for debris flow researches and hazard response tasks. The monitoring system has been proved to be useful for emergency response regarding debris flow hazards.

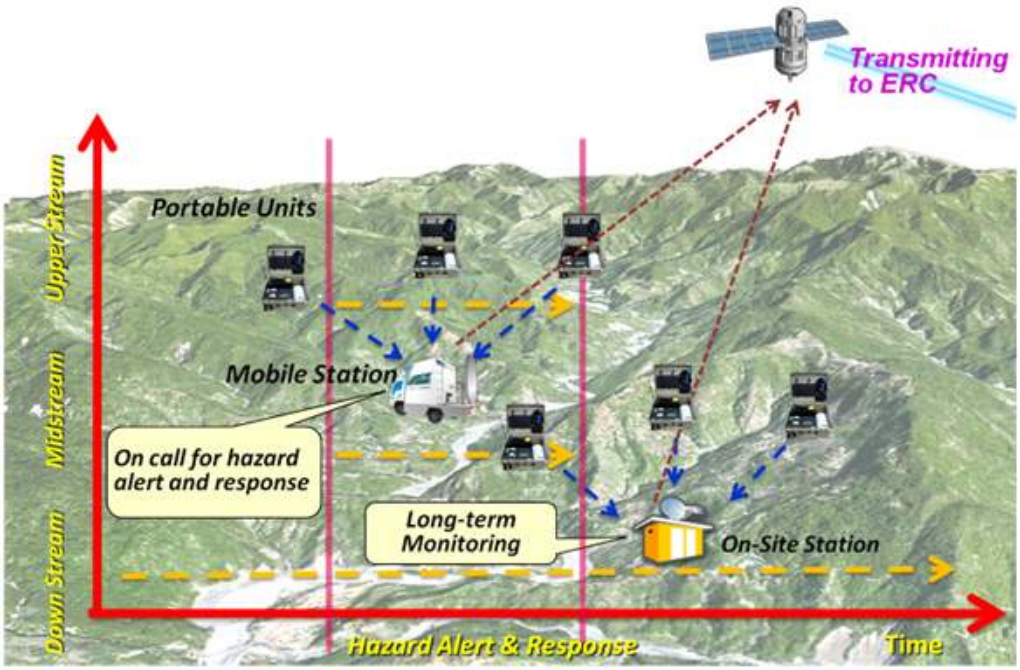

Figure 1 . Framework of monitoring network for debris flow in Taiwan

Figure 2 shows another example of monitoring system where monitoring targets are vehicles equipped with a GPS receiver. Vehicles to be monitored are equipped with a GPS-enabled car kit, a small box keeping tracks of driving information, such as speed, tire pressure, bearing, etc. When starting the engine, the vehicles regularly transmit the driving data through car kits via wireless communication, either 3G or GPRS, to the centralized control center. Web-based Fleet Management System is mounted on the control center with a collection of map services and web services associated with spatial analysis. Control staff can then real-time monitor all vehicles on the digital map with visual aids in web browsers. For a typical fleet company with a fleet of 1500 vehicles, it would produce around 2 million records each single day. The computing demand on these data, such as spatial identification and delivery routing, is also tremendous.

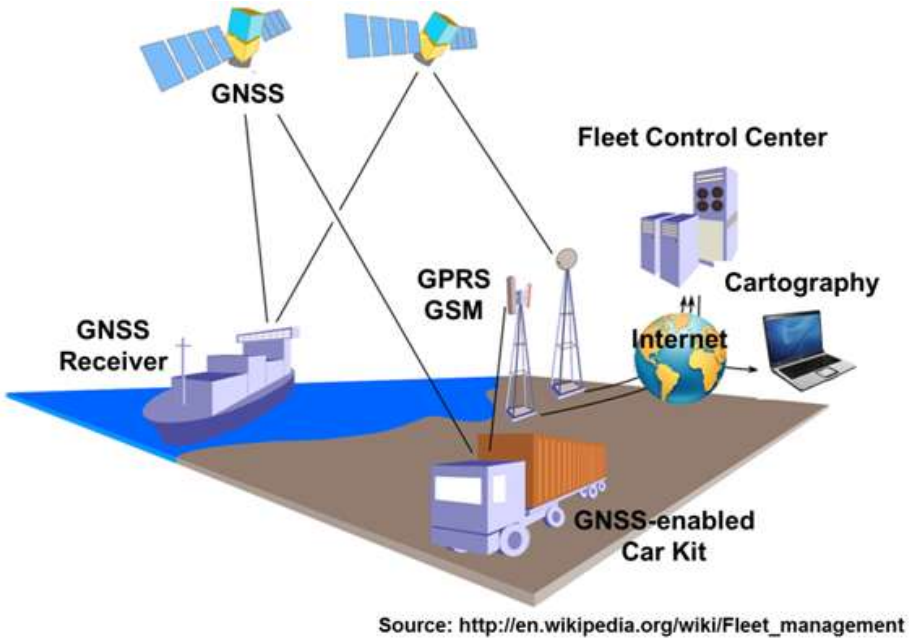

Figure 2 . Architecture of fleet management systems

2.2 OGC Standards

Open Geospatial Consortium (OGC) is an international non-profit organization whose mission is dedicated to developing all kinds of spatial information exchange standards and to address interoperability challenges and issues in geospatial industry. Table 1 shows some of major standards that OGC developed over the past decades.

Take Geographic Markup Language (GML) as an example. It defines the format of basic

components in a map, such as points, lines, surfaces, locations, directions, elevations and other spatial information. Any existing geographic information system (GIS) wishing their map data to be read in other systems would adopt GML as the standard to formulate and export their map data, which can significantly reduce developers' burdens when transforming the data.

Table 1: List of major OGC standards for data exchange since 2001

Standard	Year
Coordinate Transformation Service (CTS)	2001-01-12
Filter Encoding (FES)	2005-05-03
Web Feature Service (WFS)	2005-05-03
Geographic Objects (GOS)	2005-05-04
Web Map Service (WMS)	2006-03-15
Symbology Encoding (SES)	2007-01-18
Transducer Markup Language (TML)	2007-07-02
Sensor Model Language (SensorML)	2007-07-24
Sensor Planning Service (SPS)	2007-08-10
Web Processing Service (WPS)	2007-10-05
Geography Markup Language (GML)	2007-10-05
Observations and Measurements (O&M)	2007-12-26
OGC KML	2008-04-14
Web Coverage Service (WCS)	2008-04-29
City Geography Markup Language (CityGML)	2008-08-20
OGC Location Service (OpenLS)	2008-09-08
OGC Web Service (OWS)	2010-04-07

Case Study 1: Fleet Management System (FMS), SkyEyes

SkyEyes GPS Technology Co., one of leading FMS service providers in Taiwan, has currently established an online commercial fleet with up to 1,500 vehicles. For a typical work day with 12 service hours, the database has to accommodate around 2 million records each day in order to render the daily vehicle trail on the map upon the request by fleet managers, or 0.18 billion records every 3 months for fleet company executive officers to produce managerial reports for business analysis. For near real-time monitoring, it requires a great amount of CPU time for spatial and analytical computation; for example, mapping geographic coordinates into map features, such as roads, factories, or administrative zones, with surrounding buffers for Georeferencing or Geofencing.

The vehicles being monitored by SkyEyes can be used as Probe Vehicles that represent

one aspect of traffic conditions and publish this information to road users for making their journey decisions. SO, we establish a data center called Traffic Information Publisher, or TIP, which collects, integrates, and processes traffic data into meaningful traffic information, and publishes the information timely using standardized formats. To be interoperable across different GIS applications, we'll follow a series of international geospatial standards defined by Open Geospatial Consortium, OGC, an international organization that dedicates the process of making standards for exchange and sharing of geospatial information. Figure 3 shows the framework of TIP, where a Data Adapter collects raw data from different data providers, and a Data Wrapper prepares the filtered and processed information for publishing by using three major OGC Web Services (OWS), Web Feature Service (WFS), Geo Simple Message Service (GeoSMS), and Sensor Observation Service (SOS).

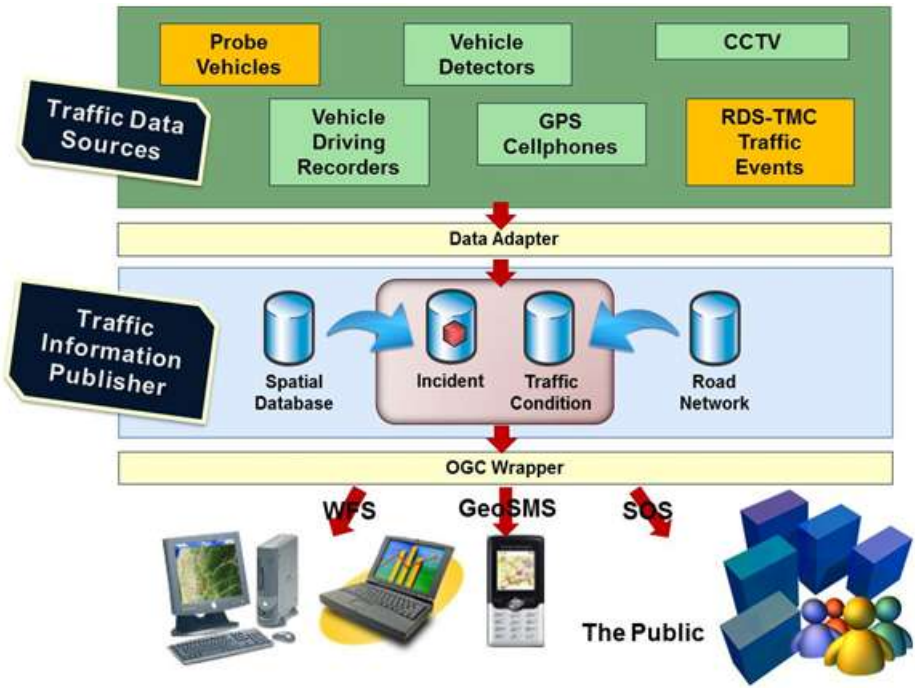

Figure 3 . Framework of Traffic Information Publisher (TIP)

Driving records, digitalized and transmitted by the car kits in vehicles, are essential to every fleet management system. They provide fundamental information for vehicle tracking and other managerial measurements for fleet companies. Table 2 shows a simplified example of driving records, including vehicle identification, sending time, driving speed, mileages, position in a form of coordinates, driving status, and so on. Every vehicle

monitored by SkyEyes periodically sends one record to the control center every 30 seconds since the engine is started. As mentioned earlier, SkyEyes currently accommodates about 1,500 vehicles in total from over 200 customers around Taiwan, producing around 2 million driving records a day on a daily basis of 12 service hours for typical commercial vehicles, such as tanker trucks, freight trucks, or waste trucks. The annual driving records can reach up the number of half billion, which poses an enormous burden both on storage and on system performance.

Table 2: A simplified example of driving records

Car	Time	Speed	Mileage	X	Y	Status
ABC-01	2009-12-01 01:23:45	91	132001	167029.5951	2630698.927	Speeding
EFG-99	2009-12-01 01:23:48	25	4500	166781.4617	2630828.813	Running

Daily driving records are used for rendering vehicle location and driving trail on the digital map by fleet company staff in a real-time manner while historic driving records, say 2 months before the query, are often retrieved to analyze the efficiency of vehicle dispatching or serve as the evidence to claim compensation from insurance companies when accidents occur. Due to limitations of relational database (RDB) on which SkyEyes kernel is established, the system only provides 3-month historic driving records for real-time queries. This constraint causes many complaints from our customers when some of them started to adopt data mining techniques for better transportation plans in recent years. As the number of total vehicles in the system keeps growing, SkyEyes has been looking for an effective and financially feasible solution to solve this problem such as to sustain competitive in the market.

In order to enhance scalability and performance of SkyEyes, Cloud Computing is introduced and a framework based on open source projects, Apache Hadoop, is adopted. The core of Hadoop framework is Hadoop Common, which provides access to the filesystems supported by Hadoop, HDFS. The HDFS filesystem uses name of the network switch as its location awareness when replicating data, keeping different copies of the data on different racks. The filesystem HDFS and HBase provide a high throughput access to application data, and supports large structured data storage. The framework also consists of Map/Reduce, a software framework to support distributed computing on large data sets on clusters of computers.

A typical Hadoop cluster includes a single master and multiple slave nodes. The master node consists of a jobtracker, tasktracker, namenode, and datanode. A slave or compute node consists of a datanode and tasktracker. Figure 4 illustrates the framework of 'private cloud' adopted by SkyEyes for the experimental study. The framework consists a master and two slaves, each of which is built on PC with two-core 2.3 GHz CPU and 4 GBytes memory. The master provides the HBase APIs for SkyEyes Socket Server to transmit historic driving records into Hbase as well as the Hbase Thrift for clients to place query on the database.

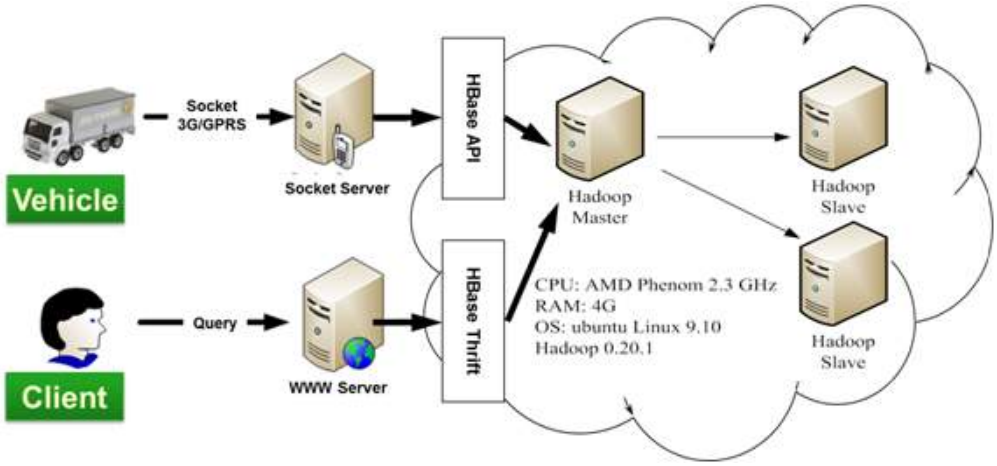

Figure 4 . Framework of SkyEyes on the 'Cloud'

The Map/Reduce algorithm developed in our framework splits the writing process into multiple threads on different slaves with distributed computing resource, and thus greatly decreases the processing time while writing driving data into HBase, as shown in Figure 5.

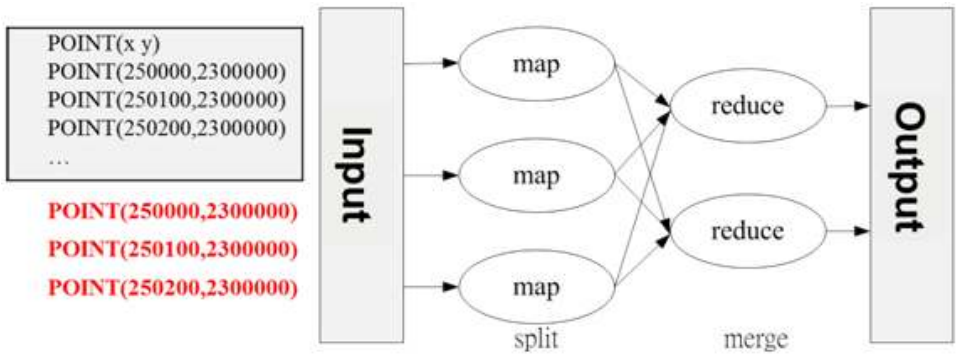

Figure 5 . Framework of SkyEyes on the 'Cloud'

The experiment of cloud computing consists of two parts: data feeding and querying. In the phase of data feeding, we bulit a cluster of 3 nodes, which totally provides a computing capacity of 30 maps at a time to process the data transmission from a relational database where the original driving records are stored into HBase. In this experiment, we fed the HBase with a real drving record set from SkyEyes between August 6, 2010 and August 28, 2010, with a total records of 27.24 millions. The Map process time is 2 hours and 11 minutes. Table 3 detailed the statistics of experiment by using Hadoop Map/Reduce Administration.

Table 3: Summary of experiment: data feeding

Cluster Summary (Heap Size is 8.94 MB/963 MB)

Maps	Reduces	Total Submissions	Nodes	Map Task Capacity	Reduce Task Capacity	Avg. Tasks/Node
0	0	64	3	30	6	12.00

Completed Jobs

Jobid	Priority	Name	Map % Complete	Map Total	Maps Completed	Reduce % Complete
job_201103020920_0071	NORMAL	SkyEye	100.00%	29	29	100.00%

Hadoop job_201103020920_0071

Job Name: SkyEye

Job File:

hdfs://cloud-a:9000/opt/hadoop-data/mapred/system/job_201103020920_0071/job.xml

Job Setup: Successful

Status: Succeeded

Started at: Mon Apr 18 11:40:39 CST 2011

Finished at: Mon Apr 18 13:51:42 CST 2011

Finished in: 2hrs, 11mins, 3sec

Job Cleanup: Successful

	Counter	Map	Reduce	Total
Job Counters	Launched map tasks	0	0	29
	Data-local map tasks	0	0	29
FileSystemCounters	HDFS_BYTES_READ	1,692,848,859	0	1,692,848,859
Map-Reduce Framework	Map input records	11,882,564	0	11,882,564
	Spilled Records	0	0	0
	Map input bytes	1,692,775,113	0	1,692,775,113
	Map output records	0	0	0

In the phase of querying, we developed a web service for client to place query on the historic driving record. The average response time of querying upon this data collection is less than 10 ms, which is over one hundred time than previous system without cloud computing.

Case Study 2: Sensor Web Enablement (SWE) for Debris Flow Monitoring System

Debris flow is a tremendous threat to humans' living environment and safety. The landforms and geologic structure in Taiwan are peculiar, and terrains are easily broken and unstable. Washout and rainstorms resulting in debris flows and landslides in mountain areas occur frequently during the typhoon season. To protect inhabitant's life and properties, scholars and disaster response sectors continuously search for the cause of debris flow, and try to build a preventive mechanism. The Taiwan government had set up 17 debris flow monitoring stations and 3 debris flow monitoring vehicles since 2002. These stationary stations and monitoring vehicles have been used to construct a monitoring network that can collect the real time data and analyze the energy variation during the debris flows. The system is aimed to help establish an alert mechanism. In order to integrate the observation resources, the OGC framework, Sensor Web Enablement (SWE), was used to develop a debris flow information platform. The Sensor Observation Service (SOS) of SWE was implemented into the monitoring system. The purpose of debris flow information platform is to integrate various resources from different organizations, such as local governments, disaster prevention organizations, and local communities, and thus enhance the efficiency of decision making in response to disasters.

All debris flow stations have at least 400 sensors. One of the important issues of debris flow monitoring system is sensor data integration. To achieve the goal of data sharing and information integration, the Sensor Web Enablement (SWE) framework was implemented in the debris flow monitoring system. Figure 6 shows the overview of the monitoring scenario. In the scenario, each station contains sensors such as CCD camera, rain gauges, geophones, soil moisture sensors, etc. The observation data from sensors are collected and transmitted to the data center via Internet (ADSL) or satellite. Three web services are used in the operation: Sensor Observation Service (SOS), Sensor Planning Service (SPS), and Sensor Alert Service (SAS). Users can interact with the monitoring system through these web services to send request, receive data, and notification about the debris flow.

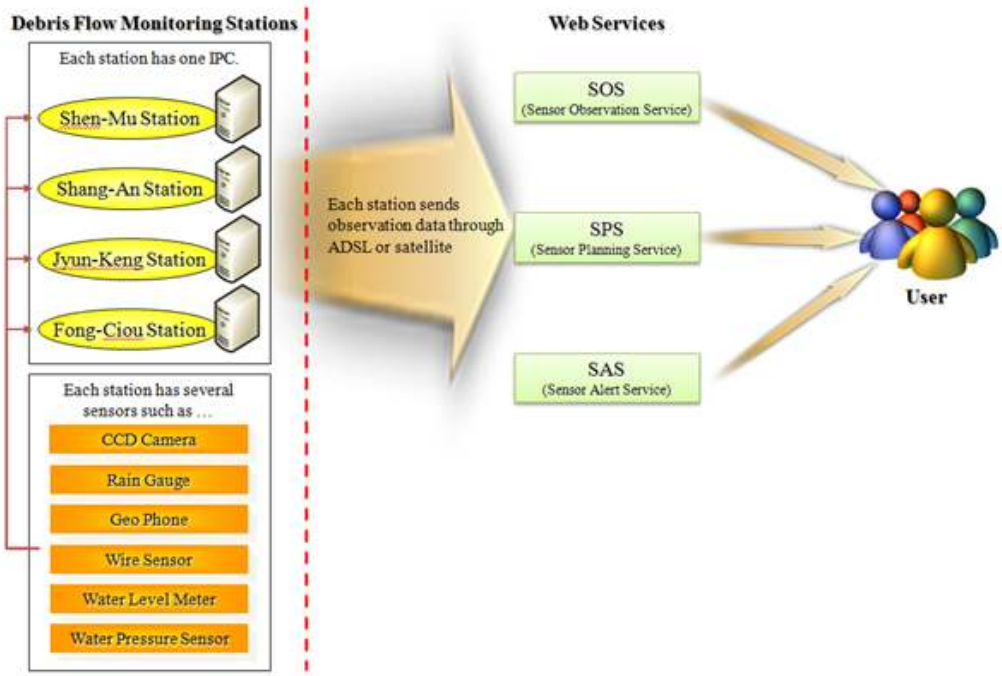

Figure 6 . Overview of Monitoring Scenario

The debris flow monitoring system has implemented the "GetCapabilities", "DescribeSensor", and "GetObservation," the three components of operations in SOS. "GetCapabilities" is one of the operations that allow clients to retrieve service metadata about a specific service instance. No "request" parameter is included, since the element name specifies the specific operation. "DescribeSensor" obtains metadata that describe the characteristics of an observation procedure (sensor or sensor constellation). However, a catalog may only contain high-level information about the observable properties, locations, contact information, etc. The "GetObservation" operation is designed to query a service to retrieve observation data structured according to the "Observation and Measure" specification. Upon receiving a "GetObservation" request, the SOS shall either satisfy the request or return an exception report. Figure 7 is the architecture of debris flow monitoring system in SWE framework. Applications can connect to SWE server and use "GetObservation", "GetCapability", or "DescribeSensor" operations to get observation information, service capabilities or sensor capabilities from SOS operations.

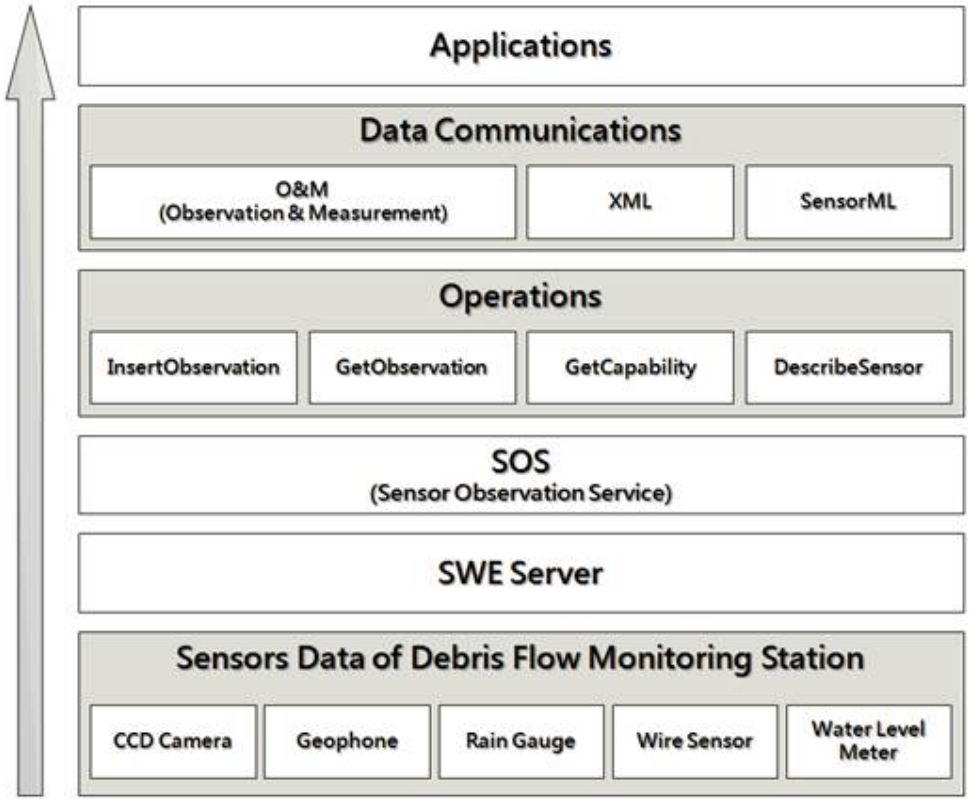

Figure 7 . System Architecture of debris flow monitoring system in SWE framework

2.2 Conclusion

This paper proposed a method for storing large-scale sensor data that adopting cloud-based distributed database-HBase along with OGC standards for data exchanges. HBase is the Open Source version of the Google BigTable that is different from the row-oriented relational database. HBase used column-oriented paradigm that retains high flexibility and is more capable to meet the needs of a variety of sensor formats.

In the case study of SkyEyes, we analyzed the data writing and reading performance based on large scale sensor data of the fleet management system. From our experiment conducted by this study, we can conclude that cloud computing can provide an effective distributed infrastructure for large-size data storage by clustering several separated hosts, but processing the jobs as a whole. Moreover, it can also provide a parallel computing

capability to deal with queries on huge data storages, greatly reducing the cost of hardware and process resources, and meanwhile retain the satisfactory performance of querying conducted by web clients.

In the case study of Debris Flow Monitoring System, an OGC framework, SWE, was implemented, and the practice of using SOS, SPS, and SAS had shown the benefits of interoperability. The goal of SWE is to enable all types of Web and Internet-accessible sensors, instruments, and imaging devices to be accessible and, where applicable, controllable via the Web. The successful example of SWE on debris flow monitoring network indicates the remarkable outcomes of interoperability, and this will encourage the application of SWE between different locations and organizations in the future.

Applied-GIS development and Proposal on Building Urban Planning Information System in Vietnam

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Abstract

Since 1995, with the close cooperation and experience sharing between Vietnam and Korea, the needs of building Vietnam NGIS has been pushed at that time. However, the strategy on building the Vietnam NSDI didn't reach the success when the project on building common sharing layer just finished with the result as digitized maps. Since then, the lack of coordination among ministries/agencies, the incomplete of building a common national GIS standard has caused the independent GIS development at each ministries/agencies with the result of the their own plan on building geospatial database separately. This paper will review the applied-GIS development situation in some major offices in Vietnam in general, the development strategy on surveying and mapping of Vietnam which is the closest effort on pursuing NGIS target, the proposal on building Vietnam urban planning information system and lastly the expectation on re-cooperation for buildingVietnam NGIS.

Key words : GIS development, Vietnam NGIS, Vietnam UPIS.

1. Introduction and Background

GIS was known in Vietnam by studies and international exchange in 1980's. Several

scientists has begun to introduce GIS concepts or referred it from foreign documents, or to make definition themselves; concurrently, there were some researches on GIS in small-scale tests. However, the IT development in Vietnam at that time is not strong and lack of hardware and software.

In the 1990's, GIS has been widely studied and multiple applications have been deployed and some GIS projects at national level has been realized. Thus, the decade of the 1990's is regarded as the time that GIS has been widely applied in Vietnam as in Korea.

In the years of 1997-1998, Ministry of Science, Technology and Environment, currently known as Ministry of Science and Technology implemented a great project of GIS which aimed to set up 14 layers of digitalized maps including: natural topography, administrative boundary, hydrographic network, vegetation, land use, geology – geomorphology, industrial and agricultural structure, population structure and distribution, tourist–culture-education potentials, pedology, climate regional division, marine resources, environmental information" and each province and city has a component from the main project.

Depending on the specific conditions of the local governments, Departments of Science, Technology and Environment, Cadastral Departments or Offices of Provincial People's Committee at local levels are the leading agencies. However, those who implemented the project were mostly GIS experts from the research institutes and universities and up to now, the equipments were bought such as computers and color printers are now fully depreciated. It is unknown that whether the above 14 layers of digitalized maps would be used any more or not, the project was not succeeded causing by the wrong awareness that GIS is just digitalized maps.

In 1999, the remote sensing and geographic information systems was applied in environmental planning inside the project "Capacity Building for Sustainable Development" with the collaboration between the Institute of Geography (Ha Noi University of Natural Sciences) and Belgium. The research results and good lectures have been introduced in the project.

For effective application of GIS in sectors, digitalized base map compilation by GIS technology has been developed. GIS software was gradually programmed by Vietnam's companies.

During over the past 10 years, Vietnam has made significant progress on GIS application in all fields. Currently, GIS is being applied in government agencies, research institutes and companies. In terms of training aspect, many universities particularly in Hanoi and Ho Chi

Minh city have included GIS subject in formal teaching program at universities and post graduate education, the number of GIS software firms have increased considerably. However, so far GIS development in Vietnam is still slow and hasn't met actual demands yet.

2. Existing situation on GIS development in Vietnam

Though the necessary on building Vietnam National GIS has been raised on many conferences and debates in more than 10 years, however neither any steering committee has been established nor an overall policy or strategy is approved.

Vietnam geospatial database is now being researched and proposed separately by independence bodies caused by the loose coordination among ministries/agencies.

GIS is now being applied in many ministries/agencies but at different levels and accessibility.

2.1 Applied-GIS in Ministry of Natural Resources and Environment

Ministry of Natural Resources and Environment which include the field of surveying and mapping that belonging to the former General Land Administration is now responsible as the leading GIS of Vietnam. As comparing with Korea's NGIS, the GIS application capacity in Vietnam is far lag behind. However, it's still necessary to affirm the important role of surveying and mapping sector of Vietnam even it's still currently very weak as compare to other developed countries. Vietnam Department of Surveying and Mapping is now developing map database for GIS and preparing the national GIS standards; but so far there is still no national GIS standard for using widely at all.

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The situation of GIS application in a number of institutions under Ministry of Natural

Resources and Environment can be described as follows:

- Aerial photograph company: its main functions are to compile map of digital images, scale: 1/2,000 – 1/50,000, digital topographic, cadastral maps, surveying and to establish coordinate grid and elevation, to set up GIS database for cities. The GIS software to be used: Intergraph, MapInfo, Arc/Info
- Cadastral and Engineering Survey Company: Its function is to set up coordinate grid type III, elevation grid type I, II, III and IV by using GPS technology, to conduct surveys and compile topographic map, cadastral map, database of topography for the southern provinces. The GIS software to be used: Intergraph, MapInfo, Arc/Info.
- Map publishing house: its functions is to edit and compile topographic map and other types of map, set up database for map, edit, produce film processing and printing of maps. GIS technology to be applied: Intergraph, MapInfo, Arc/Info.
- Institute of Geological Information, Archives and Museum: its function is to build a database of geology at many scales, geological map for many regions; this is one of the first agencies to apply Intergraph technology.
- Other institutions including agencies, enterprises that conduct survey to compile maps, cadastral research institute, center of land planning investigation, etc… are state agencies that perform functions and tasks of building national coordinate system, types of topographic and cadastral maps, etc…

2.2 Applied-GIS in some Provinces/Cities of Vietnam

Hochiminh city

In land use planning investigation: very few GIS data, mostly digitized maps of existing land use, remote sensing image, cadastral map, and lack of lack of attribute data such as population, socio-economic. Topographic base map is made from aerial and satellite image.

At the moment, GIS database have been completed in the field as follows: topographic base map at scale 1/5000 for entire Mekong River delta, updated topographic map covered entire south region in scale 1/10,000, topographic and cadastral map of Hochiminh city at scale 1/5000 and 1/2000. The popular GIS software to be used are: Microstation, ArcGIS, Mapinfo and the official projection to be used is VN2000 which compatible to global projection.

In construction planning field in Ho Chi Minh city

GIS is now being used and trained in some units: Southern branch Institute of architecture, urban and rural planning, Ho Chi Minh Institute of construction planning, Planning Faculty (Hanoi Architecture University), etc. Although not many project has applied GIS into urban planning formulation but it's still higher than in other provinces. The difficulty on applying GIS into urban planning is the lack of facilities, a correct policy, human resource, and data sharing mechanism.

Dong Nai province

Besides Hanoi and Ho Chi Minh city, Dong Nai is one province that apply GIS on planning information management powerfully. The natural resource and environment technology center has established a program on land use planning information management with some major functions such as:

- Querying information, archives, assessing and exporting data, summarizing, reporting
- Searching planning facility from planning database by year, by area, summarizing and exporting data for report

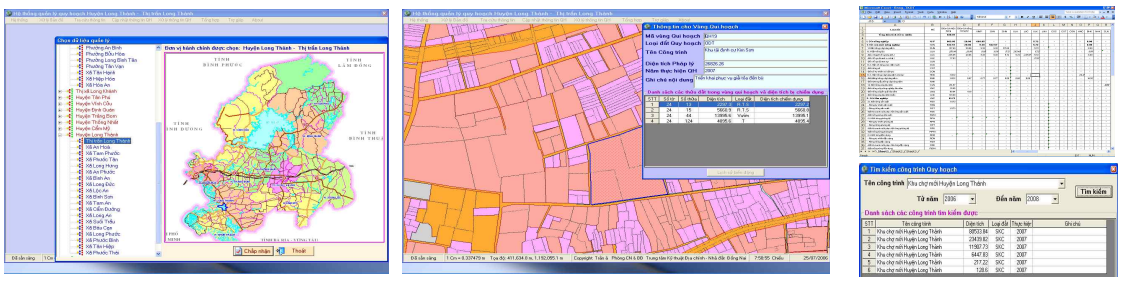


Figure 1 . Example on GIS system of Dong Nai province

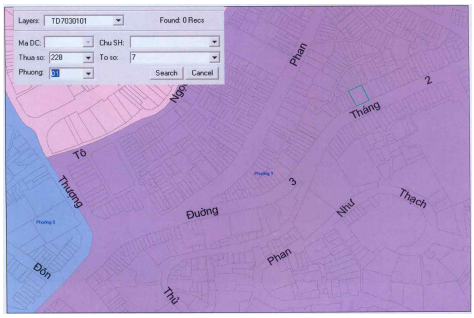
Da Lat city

Da Lat city (Lam Dong province) is good example on applying GIS application in the field of urban management. The GIS system has been built and succeed with long-term objectives such as: ensuring the support for professionals in urban management, land use, construction; supplying modern tools for easy and accurate information updating; ensuring the ability to look up information quickly in supporting for leaders to have overview and consistent vision for decision making and execution; enhancing land management efficiency serving for stable social environment; supporting for real estate market development under supervision of State.

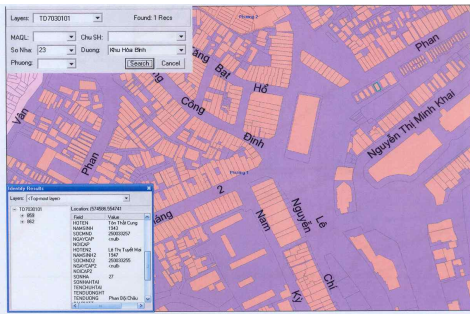
Dalat GIS database includes layers such as: cadastral, planning, technical infrastructure, architectural building , etc. The detail applications are as follows:

- Planning information layers: support the leaders on making a strategic vision on urban spatial development, land exploitation, territorial expansion
- Land use planning layer: support the leaders to make decision on land management and construction permit.
- Cadastral layer: allow to overlay with land use planning layer for accurate determination on the zoning status of land plots in order to decide specific purpose for each plot: land use rights certificate, construction permits, etc.
- Information of cadastral layer is updated frequently and it's helpful for monitoring the adjustment, duplication of lots of land plots and comparing area, land statistics every year, the suitability of land division in comparing with planning or infrastructure management (electricity, drainage, sewage, water supply, etc.)
- Searching land status information for real estate market.

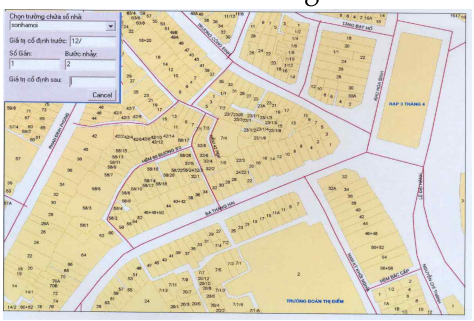
Figure 2: Example on GIS system of Da Lat city



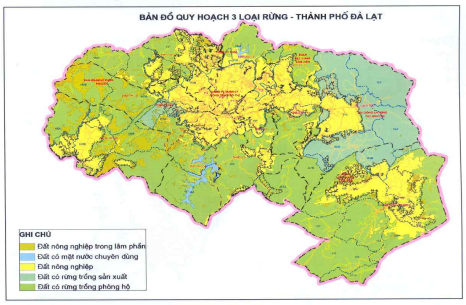
Land slot management



Housing and construction management



Address management



Forest management

2.3 Overall assessment on applied-GIS development in Vietnam

The National GIS has yet to become the basis for sectors. The digitalized map compilation using GIS technology is being improved but not enough. Most companies found the GIS application is necessary and paid much attention to their own fields, however the multidiscipline link is still weak.

The level of GIS application in many fields are uneven. This can be attributed to different quick and slow approaches: some agencies were boosted by the foreign projects, resulted in staffs sent for training and receiving new equipments; some were paid more attention due to their functions (such as the field of map, remote sensing); software companies have high level but lack of real practices and data.

Assessed by Traub's model (1997) with criteria: Technoware, Infoware, Humaware, Orgaware, preliminary assessment of GIS application's general level in Vietnam as follows:

- Technoware: Although GIS has been used on Unix workstations, in general, GIS is only used on PC or LAN network, and in some places it is used by manual ways. However, technoware (both hardware and software) can be easily imported from developed countries. For example, these are common software applications in Vietnam: Imported GIS software, integrated with graphics and database software such as: ArcInfo, Arcview, ArcGIS, Mapinfo, Intergraph, Microstation, AutoCAD, AutoCADMap, Access, FoxPro, SQL...; as for domestic products, there is Dolsoft's software and many other Software companies.
- Infoware: Because the National GIS database is limited and base maps are still in completing (including topographic maps, cadastral maps, administrative maps), currently paper base maps are still in use; whenever needed, the sectors shall digitize them according to the desired uses. Topographic maps with the scales 1:10000, 1: 25000, 1: 50000, 1: 250000, 1: 500000 and 1: 1000000 are made on a national scale by specialized agencies under Ministry of Natural Resources and Environment. Recently, topographic map scale 1/10,000 had been established for entire nation and the scale of 1/2,000 & 1/5,000 for all urban areas and key economical zones are going to be completed. Remote sensing applications are available to adjust the map efficiently. There is a shortage of statistics and survey analysis, and no national database clearing house yet. There are also demands from various sectors for the data standardization - which has yet to be conducted for sectors nor national scale. The base map projection is presently united defined as VN-2000.

- Humaware: GIS is still not completely popular even only within the research agencies. Even in the field of territory space research is considered necessary to apply GIS technology but the level of experts is also very different, not to mention fields that don't use GIS application frequently. If considered GIS will be applied in professional agencies, proficient and fluent skills in both professional and GIS technology are required, a number of those skillful people are very rare, many people only know GIS concepts, lack of skillful team; there were some professional staffs who are proficient in GIS technology and qualify to be key persons, but it is unable to widely deliver their knowledge to their staffs. Basic knowledge of GIS has been taught in the universities but it is not sufficient unless the using level is improved during works performance. Currently, short term training course at training centers have attracted learners like staffs and students (e.g. DITAGIS, FPT centers). The agencies also focus on providing on job training courses of GIS for staffs.
- Orgaware: multi-sectoral coordination is very rare and usually implemented through joint projects. Most project is done independently. GIS isn't widely applied in agencies except some individuals who prefer to coordinate internally himself while implementing projects.

GIS application has been developed in sectors that their respective fields are in charge. Institutions under Ministry of Natural Resources and Environment are responsible for compiling base maps – if certain areas or certain scales couldn't meet demands, other sectors also will develop it for themselves. GIS also has been applied in the land use planning, researches on natural resources and environment.

Institutions under Ministry of Construction are in charge of formulating plans for urban and rural residential areas nationwide and GIS has been applied more or less in each planning process.

The Institutes under the ministries are in charge of planning has applied GIS and remote sensing into their works such as: socio-economic planning, transportation planning, agricultural planning, etc.

The institutes under Vietnam Institute of Science and Technology has applied GIS and remote sensing in research projects on natural resources and environment.

Local administrations also have developed GIS application in local territory management, especially in urban management, land use, environment management, notably such as: Ha

Noi, Ho Chi Minh, Hai Phong, Can Tho city, Lam Dong province (particularly Da Lat city), Thua Thien Hue, Binh Duong, Binh Thuan province, etc…

In general, the level of using GIS in the professional agencies is still slower than that of international level, there are some other sectors more or less a bit in certain aspects, but it only achieve an average level as compared to the world. If problems on equipping facility can be overcome in a short time, the human resources and database building require much longer time.

However, Vietnam is now focusing on training human resources in various forms such as regular, on-job, long and short term, public/private training programs, a contingent of experts trained abroad and expanding international cooperation is to promote technology in general and GIS in particular and to quickly get access to advanced technology as well as experiences learnt from other countries. A pressing concern is to establish National GIS in combination with sectors and local administrations along with legal background.

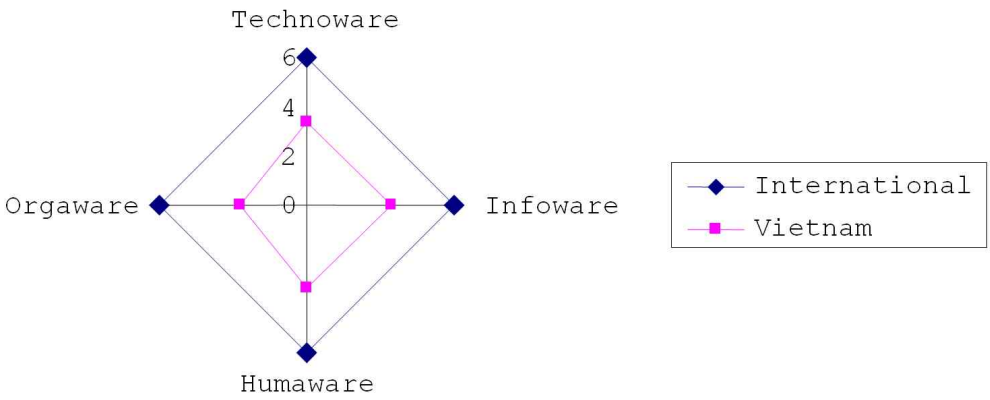


Figure 3a: Comparison GIS skill between Vietnam and highest international level.

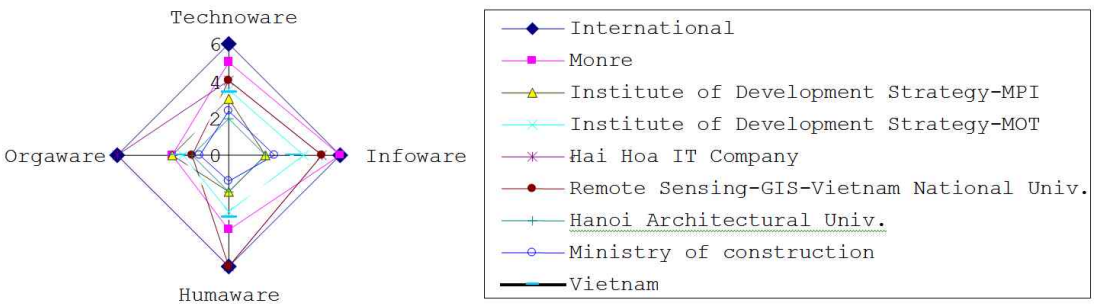


Figure 3b: Comparison GIS skill among ministries/agencies in Vietnam

3. Vietnam development strategy on surveying and mapping up to 2020

A good signal has been realized recently when the "Vietnam development strategy on surveying and mapping up to 2020" was approved by Vietnam Prime Minister on 27th February, 2008 which could be the foundation for building Vietnam NGIS in the near future. The main implementation body is the Department of Surveying and Mapping, which under the Ministry of Natural Resource and Environments (MONRE). The detailed scope of this strategy is set into 03 development phases: up to 2010, 2011~ 2015 and 2016~ 2020 with financial source from State budget as follows:

(1) First phase - Present to 2010:

- To complete the legal document system, standard system, economical norm on surveying and mapping.
- To improve the administrative management system on map surveying from local to central authority.
- To improve the GPS system support for navigation, the remote sensing application supporting for receiving quickly and precisely the geographic information, to apply GIS support for geographic infrastructure organization.
- To complete the first phase of the project "Building the projection and coordination supporting for security and defense".
- To correct and update topographic map scale 1/50,000 for all country; to construct geographic information system base on the topographic map scale 1/50,000; to establish topographic map scale 1/10,000 for entire nation and 1/2,000 & 1/5,000 for all urban areas and special economical zones; to complete cadastral maps for 20 administration units at provincial level; to establish DEM for all country; to edit topographical map at small scale and subject map & thematic map.
- To establish seabed map system, river mouth, sea port in supporting for defense.

(2) Second phase - from 2011 to 2015:

- To construct projection, national coordinate point network, national elevation point network in suitable with international standard.

- To complete the system of earth information receiving by using satellite, radar, and laser technology.
- To complete GIS system for the country included earth image from satellite image, aerial photos, topographic map, seabed map, administrative map, sectoral map, and DEM model.

(3) Third phase - from 2016 to 2020:

- To complete IT infrastructure integrated with GPS technology, remote sensing and GIS system in following the international standard that is suitable in Vietnam.
- To complete IT infrastructure for surveying and mapping which includes: coordination network, elevation and gravity network in an unify national projection and integrated with international projection; remote sensing image receiving system; to establish active GI system including common databases, sectors' maps, subject maps and thematic maps.

Those main scopes have been developed into more detailed scopes with specific key projects for implementation. And the two key projects has been being implemented since 2008 are: "Building GIS database at scale 1/10,000 in attached with DEM of entire nation; and Building GIS database at scale 1/2,000, 1/5,000 of urban regions, industrial zones, and key economic zones" with the budget of about 25 million USD. The database includes 7 layers as follows: surveying base, resident, road, topography, water, administrative boundary and vegetation. Those projects have almost completed within early of 2012, the topographic GIS database of some provinces has been delivered to local Department of Natural Resources and Environment. Those projects have been succeeded when deliver the GIS database which conformity with the Vietnam geographical information standard. It will be used as base map for other ministries/agencies in establishing the Vietnam NSDI.

Table 1: Some key implementation projects for Vietnam development strategy on surveying and mapping up to 2020

Programs	Projects	Period	Current status
I. Program on building legal framework			
1	Building Law on Surveying and Mapping[1]	2008-2009	Not completed
2	Building National Standard on GIS	2006-2008	Not completed
3	Building Vietnam Geographical Name for map editing	2005-2009	Not completed

II. Program on consolidation of surveying and mapping organization		2009	
III. Program on building the national projection, coordination, elevation, and gravity system			
1	Completing the national projection system	2011	Unknown
2	Building fixed GPS network of Vietnam	2008-2009	Unknown
3	Completing the national elevation point network	2004-2008	Completed
4	Completing the national gravity point network(2)	2005-2009	Completed
IV. Program on information receiving system and building surveying map databases			
1	Building receiving and processing satellite image station(3)	2005-2009	Completed
2	Building GIS database at scale 1/10,000 in attached with DEM of entire nation	Start in 2008	Almost completed
3	Building GIS database at scale 1/2,000, 1/5,000 of urban regions, industrial zones, and key economic zones	Start in 2008	Almost completed
4	Modernizing land management system of Vietnam(4)	Start in 2008	Almost completed
V. Program on building national geographic information infrastructure			
1	Publishing Vietnam mapping system on Website	2007-2009	Not completed
2	Building the management system on basic geographic information, surveing and mapping databases	2008-2011	Not completed

(1) Implemented by Ministry of Natural Resource and Environments (MONRE)
(2) Implemented by Scientific Institute on Surveying and Mapping, MONRE
(3) Remote sensing center, MONRE
(4) Department of Natural Resource and Environments (DONRE) at provincial governments

4. Vietnam urban planning information system

While the development strategy on surveying and mapping is being implemented, each ministries/agencies has their own plan on building GIS database serving for their management respective tasks. One of which is the proposal on building Vietnam urban planning information system hosted by Ministry of Construction.

Currently, Viet Nam has 63 provinces/cities under central government with 752 cities/towns; wide range of construction activities have been being implemented at about 663 new urban areas, over 1000 urban residential areas, 15 coastal economic zones and 253 concentrated industrial zones, etc…; and Ministry of Construction (MOC), a central agency

under the Government of Viet Nam is responsible for performing the management of urban development and activities in construction sector.

There haven't been any central agencies of MOC that serve as an integrated database center for urban development management in particular or construction sector in general. In addition, GIS almost hasn't been applied in the State management at MOC at central level as well as at Department of Construction (DOC) or local government.

Pursuant to the Directive No 09/2008/CT-TTg dated February 28th, 2008 by Prime Minister on strengthening urban construction formulation and management, the Prime Minister has delegated to MOC the following assignments: "Intensively verify, supervise construction planning management at local level and particularly publicly announce and provide construction planning information to improve State management efficiency at local level"; Provinces/Cities under the central government have been entrusted with the following tasks: "Establishment, arrangement of locations and budget for the database and information center in the field of planning which is based on the establishment of GIS, mock-up (model) according to construction planning projects and development situations of construction investment projects as planned to improve efficiency of information provision of relevant construction planning and issuing certificate of construction planning".

In order to develop the geospatial information on urban planning, it's being proposed the project on building Vietnam urban planning information system with main objectives as follows:

- Establish database system on planning and urban development management of Vietnam
- Establish legal framework, standardize information in planning and urban development management.
- Provide information of Viet Nam planning and urban development situations at National Planning Exhibition Palace to satisfy demands of interdisciplinary and multi-level management; agencies, organizations and citizens in the whole country.
- Strengthen State management capacity in the field of planning and urban development management in Viet Nam through information technology application.

The project proposal on building Vietnam urban planning information system includes 05 main components:

(1) Establish an integrated database center on planning and urban development

(2) Set up vertical connection and horizontal sharing amongst central agencies at MOC and management units at 63 cities/provinces and local governments

(3) Building GIS database on urban development management:

- GIS database on urban development management at central level: database of 752 cities/towns system including: name, urban category, administrative management level, population, labor force, socio-economic, social and technical infrastructure, 49 index on urban development management, etc...
- GIS database on urban development management at local level (cities/towns): (first phase implementation at capitals of 03 pilot provinces)
    - Layers & attributes on existing land use (land use code and type using the MOC classification scheme)
    - Layers & attributes on power supply and lighting network (layers of power station - location, voltage, capacity, status…; power line - type, voltage, materials, length…; streets with lighting - name of streets, lighting hours, statu s…; lighting poles - codes, lighting hours, status…; light-control stations - code, area coverage, type, status…)
    - Layers & attributes on greenery network (layers of green spaces - type, area, status, management…; street trees - code, type, heights, ages, status…)
    - Layers & attributes on urban transportation network (layers of road centerlines, road area, railways, stations, bus stop,..; name, road width, setback line, road length, materials, road type, other road status, etc.)
    - Layers & attributes on water supply network (layers of WS plant - codes, water sources, capacity, owner…; pipe - code, size, type, length, materials, depth…; water tower, vaults, fire horses, etc.)
    - Layers & attributes on drainage network (layers of drainage lines - code, type, size, length, materials, depth, slope…; manholes - codes, type, size, elevation, materials…; wastewater treatment facilities - codes, type, capacity, quality, owners…)
    - Layers & attributes on solid waste management (layers of landfill - location, type, capacity, environment, status, owner…; waste collection routes - codes, type, collection time, status…)

- Layers & attributes on housing address management (layer on housing address - location, name of road, street, alley, owner, current address, new address, status,...)
- Layers & attributes on real estate related to license land use rights certificate (house owner, land boundary, land slot code, land area, building area, floor area, number of floor, height of building, status, etc.)
- Layers & attributes on building construction for construction permit license (polygon-type layer of houses, construction permit status, etc.)

(4) Building GIS database on urban planning:

- GIS planning database at central management level (collect and standardize drawings with linkages to planning information):
  - The amendment orientation of Viet Nam urban system development master plan up to 2025 and vision to 2050
  - Inter-Provincial construction planning
  - Provincial regional planning, urban master plan for urban category IV and over
  - Other master plans managed by central level (e.g. complex economic zone, frontier economic zone, concentrated industry zone, etc...)
- GIS planning database at local government: master planning (1/10,000, 1/5,000), zone planning 1/2,000, detailed planning 1/500 (GIS maps, main attributes, explanation report, approval decision, etc.)

(5) Establish system mechanism, policy, institutional framework and training programs for capacity building:

- Capacity building on information technology application for management tasks for central and local staffs
- Mechanism, policy and institutional framework for system operation and maintenance

The first phase of this project will focus on building the GIS database at central management level and 03 pilot provinces at local level.

5. Expectation on building Vietnam NGIS

Vietnam NGIS is not built yet, though the digital map is created by GIS application but it's not the true geospatial information foundation using in the whole country. As a good signal recently that is the project on building the topographic map at scale 1/10,000 and DEM for entire Vietnam and scale 1/2,000 & 1/5,000 for all urban areas and special economical zones has almost completed and delivered to Departments of Natural Resources and Environment at Local Government. However, it's just the base topography map only and it mostly belongs to the Natural Resources and Environment sector while the sharing mechanism for common use by other ministries/agencies is not clear at the moment.

Meanwhile, the project on building GIS national standard started from 2008 is now still in research and not completed yet.

In the same time, other Ministries/agencies are also running their own GIS projects which also request creating the base map, and the problem that those projects are going to face with is the waste of money on building overlap base map as well as the potential conflict on common GIS standard. Since the horizontal coordination among ministries/agencies quite weak, no national GIS standard yet, and respective database is built almost independently by separated bodies, the question on how it works when combined all the database to the national system is still remained.

The key issues and steps for building Vietnam NGIS should include below proposals:

- Establishing a steering committee on building Vietnam NGIS with the present of leaders and profession board from all related key ministries/agencies
- Building coordination and sharing mechanism for using common database by all related ministries/agencies
- Defining set of database to be used as common base maps which include: topographic map at different scale (1/10,000, 1/5,000, 1/2,000) hosted by MONRE and other necessary layers hosted by other respective ministries/agencies.
- Coordinating closely among inter-ministries for finalizing the national GIS standard (first phase focusing on the common geospatial database)
- Building the common geospatial database by respective ministries/agencies
- Analyzing and selecting the technology solution, investing & equipping hardware, software, etc.

- Building advance geospatial database of each ministries/agencies which conformity with the Vietnam NGIS and national GIS standard
- Setting up the mechanism on operation, maintenance and updating database periodically to the Vietnam NGIS.
- Training and capacity building for specific staffs on running the system.

Among above proposals, the two most difficulty to be faced with are the weakness on horizontal coordination for building the national GIS standard and the sharing mechanism on common database for using by inter-ministries/agencies.

Another difficulty as if the horizontal coordination and sharing mechanism to be solved will be the financial source for building database; and lastly will be the technology and capacity building issue.

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Evacuation and Sheltering Assistance Planning for Special Needs Population: Kobe GIS-Mapping Project of People with Special Needs in Times of Disasters

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Abstract

This paper reports the results from the 2008 Kobe GIS-Mapping project of people with special needs in times of disasters, which demonstrates the use of GIS for mapping special needs populations in order to facilitate community-based evacuation and sheltering assistance planning. In response to a national government request, Kobe city administration collated separate social service recipient databases, resulting in an integrated database involving one hundred and twenty thousand individuals who were considered being potentially vulnerable in times of disaster. The database identified 4,329 people with physical disabilities in Hyogo Ward. The 2008 project geocoded and mapped them on land slide, flood and tsunami hazard layers. 914 individuals were found residing in hazardous areas. These individuals were visited by interviewers and 612 or 67% responded to a structured questionnaire which measured demographics (i.e., age and gender), levels of disability, social isolation, housing fragility, and physical immobility. A social vulnerability score was then calculated as a function of these five variables for each respondent. As a result, 17% of those who responded were found the most vulnerable and requiring priority assistance at times of disaster. Furthermore, a social vulnerability weighted kernel density map of people with special needs was created. The weighted kernel density map indicated which particular areas would require more man power for assisting a special needs population for evacuation and sheltering. After 2011 Great East Japan Earthquake , it

became evident that recent developments in GIS-based preparedness measures had been uncritically relying on the assumption that maximum probable event (MPrE) would occur. In reality, maximum possible event (MPoE) occurred in Tohoku regions. Fundamentally re-thinking entire hazard estimation process from MPrE to MPoE framework was discussed in the end.

Key words : persons with special needs in times of disaster, hazard vulnerability, GIS mapping of social vulnerability, person-in-environment model, maximum probable event, maximum possible event

1. Introduction and Background

The issue of special needs population gained high attention after 2004 when a series of natural disasters hit the Japanese Archipelago. Those included July Niigata-Fukushima flood, October typhoon 23 and October Niigata Chuetsu earthquake disasters, wherein notably more than 60% of the victims were over the age of 65. As a response to these tragedies, Japan's Cabinet Office established a committee on "Communicating Disaster Information and Evacuation and Sheltering Assistance for the Elderly and Other Population during Heavy meteorological and Other Disasters." The committee published the first edition of the "Evacuation/Sheltering Assistance Guideline for People with Special Needs in Times of Disasters" in the following March 2005. After the guideline publication, the term saigaiji-youengosha or People with Special Needs in Times of Disasters (PSND) was popularized in place of saigai-jakusha or Disaster Vulnerable Population. PSND is defined as "a person who is able to function daily, whereby living independently given the proper resources and services when necessary". In normal time, institutionalized long-term care services for the elderly and/or for people with disabilities provide a safety net so that their special needs are met for living independent lives. However, when a disaster strikes, it becomes extremely difficult for institutionalized cares/supports to reach people in need for a prolonged period, causing their vulnerabilities to manifest. The emergence of new terminology, PSND, reflects a shift on the side of society from viewing difficulties experienced by the target population as being intrinsic to themselves to viewing ones as products of social interactions that fail to meet special needs in time of disaster (Tatsuki and Comafay, 2010; Comafay, 2011). Thus, the shift in societal view led a new set of

questions, who should take care of people in need when the institutionalized care/support systems break down in time of disaster?

Following another series of heavy rainfall, flood and land slide disasters in the year 2005, another Cabinet Office committee conducted field research of the 2005 meteorological disaster sites and revised the evacuation and sheltering assistance guideline in March 2006. The 2006 guideline emphasized 1) establishing a special team in each municipal government that was in charge of coordinating assistance to the target population, 2) encouraging the information sharing of special needs population within the local government and, if possible, with local community organizations such as neighborhood associations and community emergency and response team, and 3) planning individualized evacuation and sheltering procedures for each PSND.

In the following fiscal year 2006, the committee on PSND continued to work on more detailed procedures and workflows in order to collect and share information on PSND and to make individualized evacuation and sheltering assistance plans. In March 2007, the committee published the "Report on Preparedness Procedures for PSND." The 2007 report emphasized the establishment of a system to assist PSND by facilitating cooperation between the local/municipal government disaster management department and its health and welfare department. The role of the disaster management department is to provide local hazard information, while the health and welfare department provides information on potential vulnerabilities within the target population. The 2007 report encouraged the use of map where potential vulnerable individuals such as frail elderly and people with disabilities (PWD) are projected onto multiple hazard layers such as flood, landslide and seismicity. The map can help identify who are at more risk because of their functional needs (Kailes and Enders, 2007) as well as of their geographic locations.

Since the publication of the 2006 guideline and the 2007 report, the Fire and Disaster Management Agency (FDMA) has requested every municipality in the country to formulate its own master plan that directs policy formation on PSND assistance, to identify potential target groups, to clarify ways to collect and share their personal information. Based on the master plan, municipalities have been further encouraged to start project planning to assign local resident helpers to each individual PSND in time of evacuation. According to the

survey conducted by FDMA, as of April 1, 2011, 1,262 out of 1622 municipalities (76.8%) finished formulating PSND assistance master plan and additional 349 municipalities (21.2%) were expected to finish within one year. Similarly, 864 (52.6%) municipalities reported that they have finished creating and have been updating the PSND registry. 684 (41.5%) municipalities said that they were currently in the process of making the registries. Municipalities have been working hard even on assigning local residents/helpers to each PSND for evacuation, much more time consuming process. 361 (22.0%) reported that they have completed the assignment, 998 (60.7%) in the process, and 285 (17.3%) not yet initiated (FDMA, 2011).

2. Mapping PSNDs as an Effective Counter-Disaster Measure

2.1 Use of Maps to assist PSNDs during the 2007 Noto Peninsula Earthquake

At around the time when the 2007 report was about to be released, the Noto Peninsula earthquake occurred in March 25, 2007. A study was conducted by Comafay, Tatsuki and associates (2008) on to find out how PSND, especially the elderly population, was responded to during the Noto Peninsula Earthquake from the framework of the 2007 report. A series of workshop was conducted with those who provided assistance, this included representatives from the public health department of Wajima city, the private long-term care service providers and local community organizations. The results revealed that, as shown in figure 1, during the first 10 hours after the earthquake the local community organizations were first to respond to the most urgent needs of PSND. Meanwhile, the government organization was able to provide formal services 100 hours after the disaster impact. Finally, sustained service delivery from the formal organizations increased as those coming from the community organizations decreased after the first ten hours.

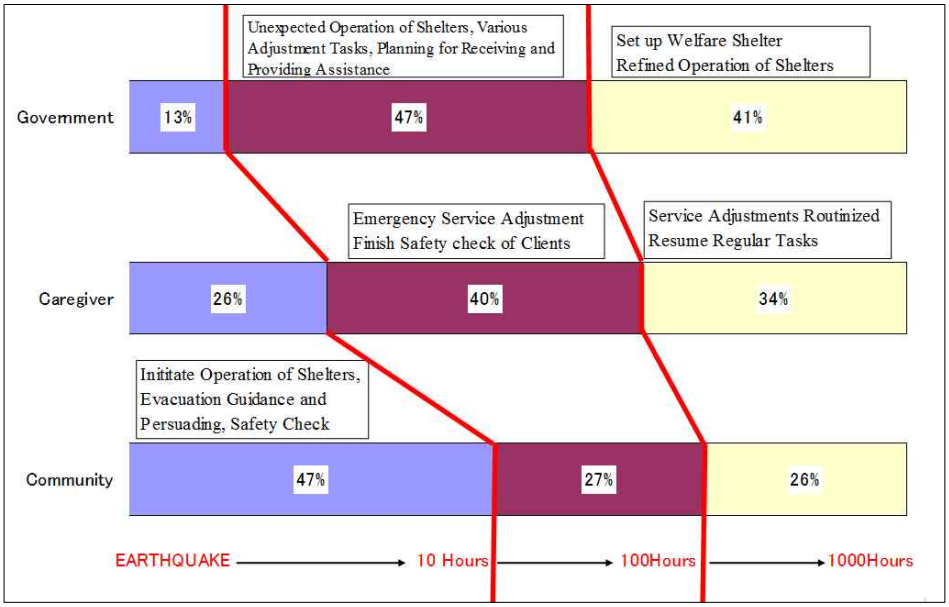

Fig 1: Responses to PSND during the Noto Peninsula Earthquake by Local Community, Long-term Care Providers and Health Service Office

It was learned that community-based help for the elderly had been predesigned and cultivated in Monzen area during normal times by indigenous community-based workers called *minseiiin*[1] or commissioned welfare volunteers who were active in building elderly-person-watch networks. The percentage of people over the age of 65 in Wajima areas[2] is very high at 35.2 percent. A way before the 2007 earthquake, the local health and welfare offices in then township of Monzen (currently a part of Wajima city) launched an initiative to build elderly-persons-watch networks with the *minnseiiin*. Even before that, right after the 1995 Great Hanshin-Awaji earthquake, the local health office in Monzen town which was one of the most affected areas during the Noto Peninsula earthquake, started commissioning the *minseiiin* to create a welfare-map plotting the exact location of persons with special needs who require constant supervision in their respective area of jurisdiction. As shown in figure 2, welfare maps are created based on existing residential maps. Buildings with households are then marked with colors according to 4 categories: a)pink for bed-ridden persons; b) yellow for elderly persons living alone; c) green for elderly only

1) A minseiiinor commissioned welfare volunteer is a community-based volunteer friendly visitor commissioned by the Ministry of Health and Welfare to assist and maintain regular watch over persons with special needs, especially the elderly, living in that district.

2) In February 1, 2006, just a year before the Noto Peninsula Earthquake, Monzen town was merged with the former city of Wajima city to create a new Wajima city.

households (elderly couples); d) blue for household with disabled persons. Along with the *minseiiin*, local volunteers would conduct safety checks and provide services such as delivering food or helping with their groceries to name a few.

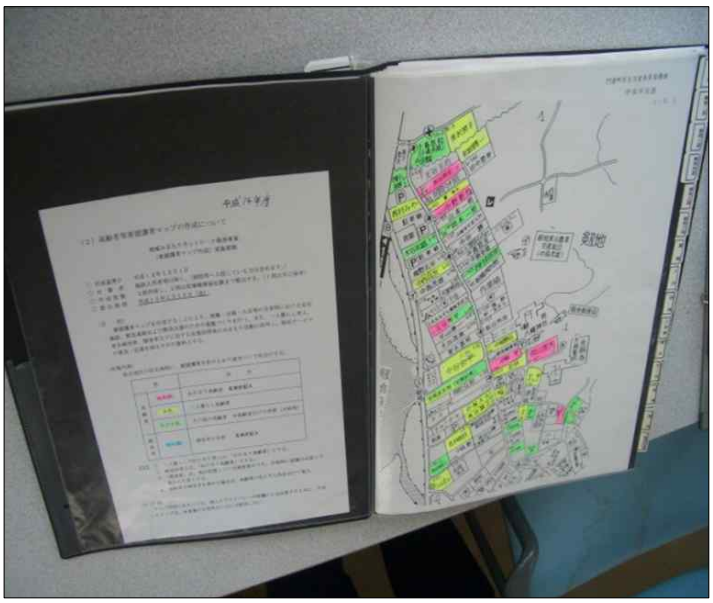

Fig 2: A picture of "welfare map" that are currently used by minseiiins in Monzen area, Wajima city.

The paper-based welfare map was very crucial because according to the *minseiiin*, although they did not need the actual map during the emergency evacuation, making the maps helped them be better familiarized with the neighborhood. Therefore immediately after the earthquake they were able to identify the persons with the most urgent needs and not only that since they had a mental map of the area they also knew their exact locations. The actual map was later used in guiding the volunteers and health nurses and non-locals who were not familiar with the area.

The above study has provided empirical evidence that community actors, being geographically accessible are the most reliable service providers during the first 10 hours after a disaster strikes. The experience of the service providers during the Noto Peninsula earthquake also demonstrated the importance of identifying during normal times the PSND with the most immediate need for assistance. As well as, providing insights on how mapping the location of disaster vulnerable members of the community would be useful for

identifying actual locations of those who require immediate assistance. The familiarity of the people who provided assistance and services, mainly the minseiiin and the local volunteers, was developed by the creation of paper maps to identify the location and condition of the special needs population.

2.2 Kobe PSND Mapping Project

Tatsuki and Comafay (2010) reported the 2008 Kobe PSND Mapping Project, which was characterized by a combined use of GIS and the social survey in order to assess overall hazard vulnerability of PSNDs. In response to the FDMA request as explained in the above, 1.5- million-resided Kobe city administration collated separate social service recipient databases, resulting in an integrated registry involving one hundred and twenty thousand individuals who were considered being potentially vulnerable in time of disaster. The registry database identified 4,329 people with physical disabilities in 107- thousand-resided Hyogo Ward. The 2008 project geocoded and mapped them on land slide, flood and tsunami hazard layers. 914 individuals were found residing in hazardous areas (see figure 3).

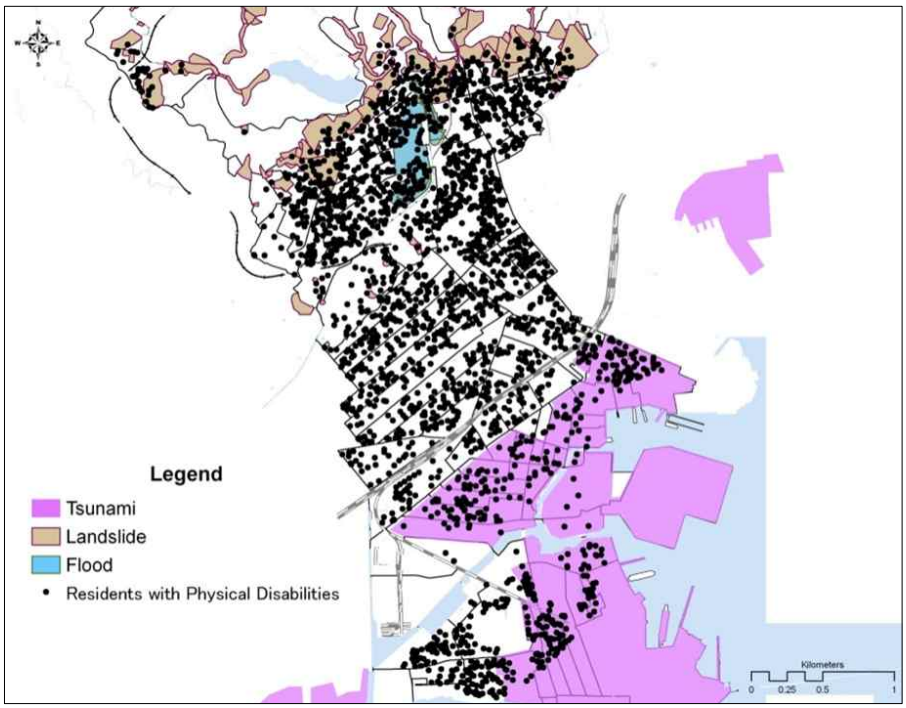

Fig 3: Persons with disabilities living in Kobe's Hyogo ward (N= 4,411)

These 914 individuals were then visited by interviewers and 612 or 67% responded to a structured questionnaire which measured those six variables as demographics, physical impairment, physical immobility, responsiveness of social environment (social capital), social isolation and housing fragility (see figure 4). The demographic, physical impairment and physical immobility variables measured a person factor, social capital and housing gragility an environment factor, and social isolation a person-by-environment factor.

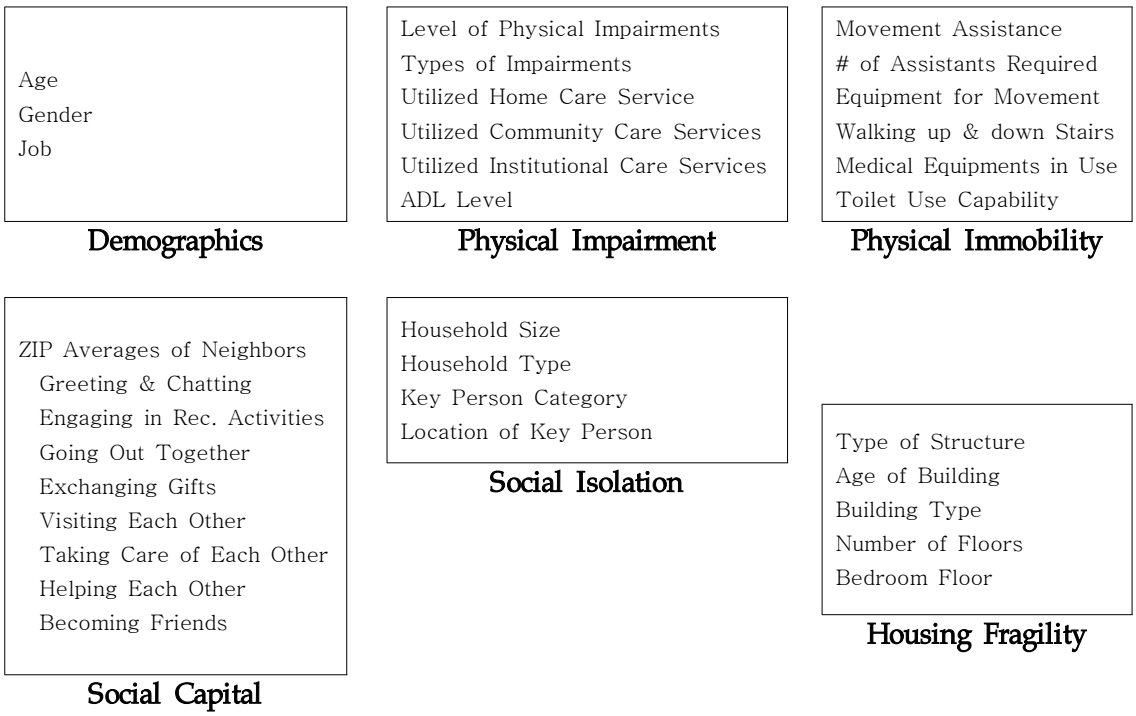

Fig 4: Variables Measured/Obtained in the Study

The 2008 project was based on the person-in-environment model of vulnerability, which defined hazard vulnerability (V) as a function of hazards (H), person (P), and environment (E) factors or V = f(H, f(P, E) as illustrated by figure 5.

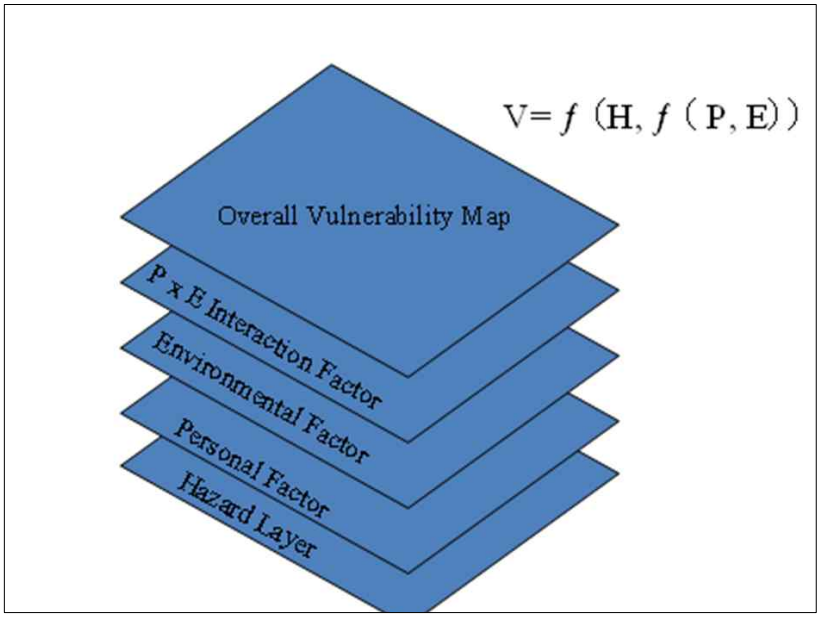

Fig 5: Person-in-Environment model of mapping hazard vulnerability

Based on the model, respondents' scores for each factor/component were calculated from social survey results and they were plotted as shown in figure 6.

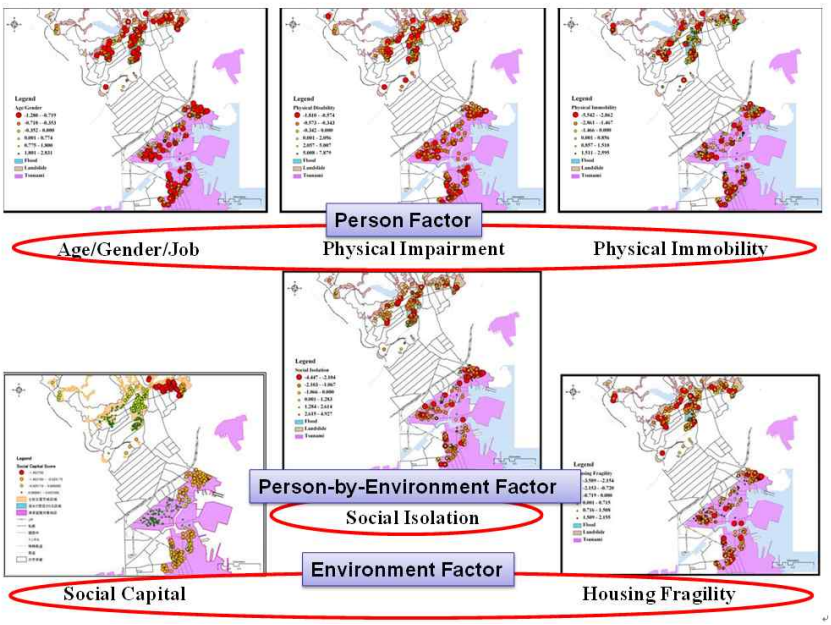

Fig 6: Componet vulnerability scores mapped on to hazard layers

Finally an overall vulnerability score was then calculated as a function of hazards and the six variables for each respondent. As a result, 17% of those who responded were found the most vulnerable and requiring priority assistance in time of disaster (see figure 7).

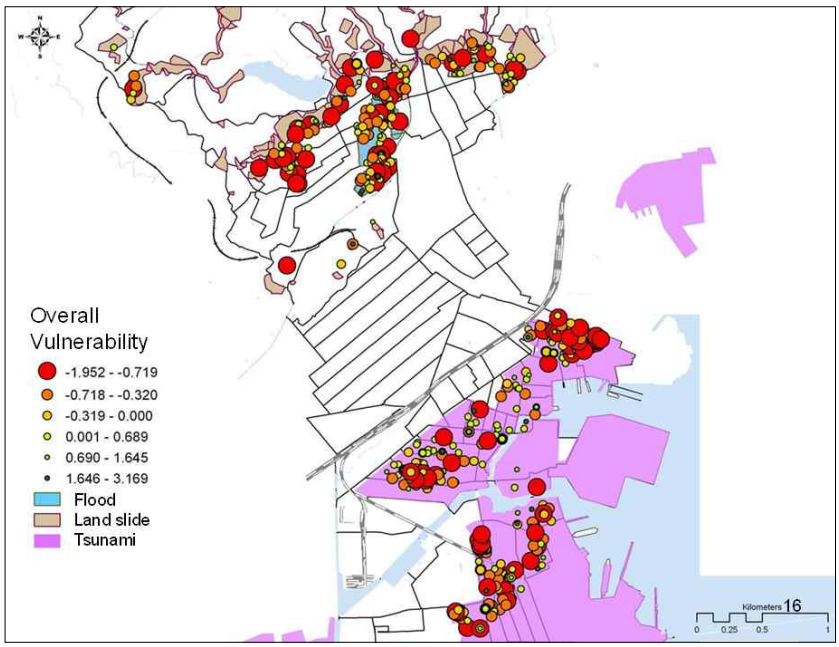

Fig 7: Overall vulnerability scores mapped on to hazard layers

Furthermore, a social vulnerability weighted kernel density map of people with special needs was created (see figure 8). This map indicated which particular areas require more human resources for assisting a special needs population for evacuation and sheltering. The project product maps helped representatives from special needs groups, community emergency response teams, community social services, and emergency management centers initiate evacuation and sheltering assistance planning in the project areas.

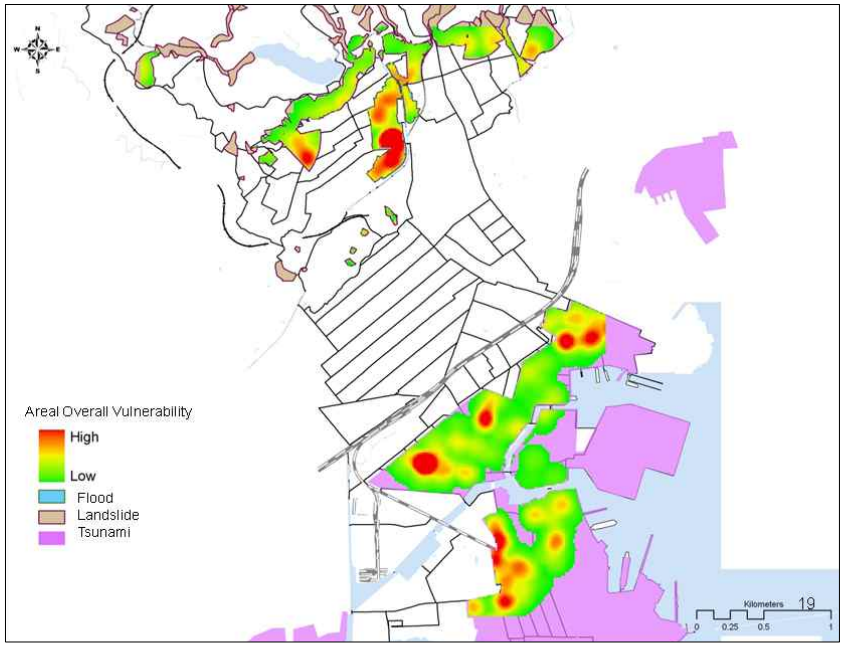

Fig 8: kernel density estimation weighted by overall vulnerability index

The 2008 Kobe PSND mapping project was an attempt that aimed to provide a standardized method using individual social vulnerability mapping as analysis tool to identify more comprehensively the risks that could affect a given community. This could help different stake holders, special needs groups, community emergency response teams, community social services, and emergency management centers initiate evacuation and sheltering assistance planning in high risk communities.

3. Toward a Refinement of Person-in-Environment Model: Maximum Probable to Maximum Possible Event Framework

Despite recent developments of PSND counter-disaster measures as illustrated in the abvoe, serious problems confronted municipalities, communities, PSNDs and their families at the onset of March 11 Great East Japan Earthquake Disaster. Three reconnaissance missions conducted by the author team in March and April identified several challenges on counter-disaster measures for PSNDs. One of these challenges demanded re-thinking "correct" hazard estimates in the person-in-environment model of hazard vulnerability (Tatsuki, 2011).

Recent developments in preparedness measures for PSND in Japan have been uncritically relying on the assumption that hazard maps represent "correct" estimates of future hazardous events. As figure 9 in the below illustrates, this turned out to be a horribly wrong assumption. Hazard maps were created according to maximum probable event (MPrE) framework. In reality, however, maximum possible event (MPoE) has occurred in Tohoku regions. This has tremendous implications for fundamentally re-thinking entire hazard estimation process from MPrE to MPoE framework.

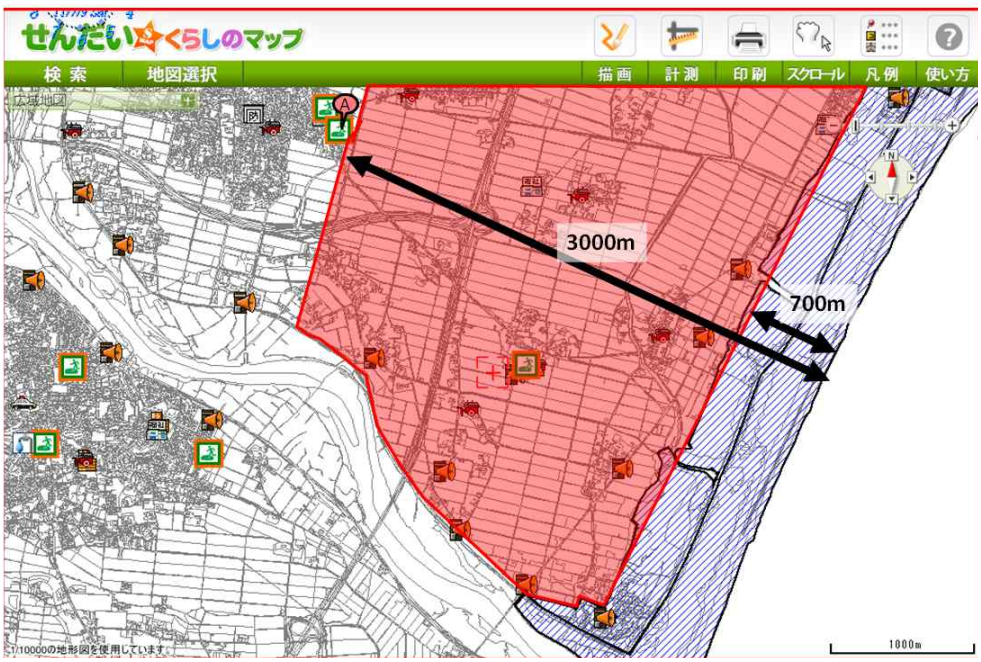

Fig 9: Tsunami hazard map and actual inundation east of Rokugo Junior high school, Wakabayashi ward, Sendai city

In the previous section, the person-in-environment model of hazard vulnerability (V) was introduced as a function of hazard (H), person (P) and environment (E) factors or V = f(H, f(P, E)). In practice, hazard factor was estimated by maximum probable event framework and therefore the model could be represented as V = f(MPrE, f(P, E)). The challenge here is to replace maximum probable event hazard estimate with an alternative hazard estimate by incorporating maximum possible event framework. The modified person-in-environment model will therefore be represented as V = f(MPoE, f(P, E)).

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Strategies for Building a Global Geospatial Information Research Network

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1. Introduction

The interest on spatial information increases according to the development of information and communication technologies. Such an interest is now spreading out to building for research collaboration network and data sharing. In the environment of globalization, the construction of global research network is a basic infrastructure that improves national knowledge competitiveness. For efficient global research network, it is required to investigate and analyze the cases of researchers, research institutes, and research organization in advance. The purpose of this paper is to suggest the methods on building the global geospatial information research collaboration network based on the foreign countries' cases and domestic status analysis.

2. Cases of Building Global Geospatial Information Research Collaboration Network

In world wide, research collaboration network has been constructed in the fields of education, science, medical care, and environment. The representative examples of global geospatial information research collaboration network are the EuroSDR(European Spatial Data Research) and the Setinel Asia. The EuroSDR deals with collaborative research on

spatial information and the Sentinel Asia focuses on environmental problems in Asian regions. The domestic geospatial information research collaboration network has been led by institutions related to production, management, and research of geospatial information.

2.1. EuroSDR

EuroSDR is the representative institution composed of 17 countries in Europe and it produces and researches national geospatial information. EuroSDR is now supporting the development of geographic information sciences according to social change and the development of ICT. It also connects research fields related to production, management and distribution of geospatial information through the international collaboration.

Fig 1: Members of EuroSDR and EuroSDR Homepage

※ EuroSDR Homepage http://www.eurosdr.net/

EuroSDR was founded for global research collaboration and have dealt with collaborative works related to standards and specifications of OGC, ISO, and CEN. EuroSDR hosted several workshops and published official reports on research collaboration. A collaborative research is performed by five sub-commissions.

Table 1: Composition of EuroSDR Commission

Commission	Theme
Commission 1	**Sensors, Primary Data Acquisition and Georeferencing**
	- Sensor orientation and calibration - Accuracy and reliability of orientation, calibration and georeferencing - Earth Observation platforms - Standards for sensor orientation and calibration
Commission 2	**Image Analysis and Information Extraction**
	- Information content of multi-spectral, multi-sensor, multi-resolution, and multi-temporal

	imagery. - Methods and algorithms for automated acquisition of geospatial data and the description of data quality. - Methodology for the integrated acquisition and update of geo-spatial data from imagery and additional information.
Commission 3	**Production Systems and Processes**
	- Semi-automatic and automatic feature extraction. - Evaluation of performance (time, costs, versatility) of current production processes - Incorporation of multi-spectral image sources. - Incorporation of multi-sensor data in production. - Quality assurance in production processes - Change Detection - Transformation of 2D datasets in 3D datasets - Data models for national data sets - Incorporation of user generated content - Incremental updating - Data harmonisation processes - Formulation of data archiving policies for geospatial data and meta-data
Commission 4	**Data Specifications**
	- Data/information structures (incorporating data models and classification mechanisms) supporting interoperability between and sharing of geodata from different sources - Linking & integrating data in registers and geodata, - Linking & integrating 3rd party data. - Developing the height and temporal component of spatial data models - Deriving smaller scale datasets/products from the definitive database.
Commission 5	**Network Services**
	- Methods and mechanisms for integrating core (framework) data with other geoinformation and business (or value-added) data, both by data linking and by interoperable data access. (Strong interaction with Commission 4) - Harmonisation requirements on core data, including cross-jurisdiction issues. - The adoption of new delivery mechanisms, including mobile communications and distributed spatial data infrastructures, and their effect on the business models and practices of NMCAs - Methods and mechanisms for delivery of metadata with emphasis on discovery and registry services and data quality information - Multi-purpose deployment of data, including schema translation services and semantic query - Applications of visualisation technology to geoinformation data and added-value refinements

2.2 Sentinel Asia

The Sentinel Asia was founded by the Asia-Pacific Regional Space Agency Forum (APRSAF) to support disaster management activity in the Asia-Pacific rims by using the WEB-GIS technology and space based technology, such as earth observation satellite data. Currently Sentinel Asia has 78 JPT(Joint Project Team) members(67 organizations from 24 countries/regions and 11 international organizations).

Table 2: Sentinel Asia Members

No.	National/ Region	Organizations
1	Australia	CSIRO Office of Space Science and Applications (COSSA), 2 other organizations
2	Bangladesh	Bangladesh Space Research and remote Sensing Organization (SPARRSO)
3	Bhutan	Ministry of Home & Cultural Affairs, 2 other organizations
4	Brunei	Survey Department, Ministry of Development
5	Cambodia	Ministry of Land Management, Urban Planning and Construction
6	China	National Disaster Reduction Center of China (NDRCC), 4 other organizations
7	Fiji	Fiji National Disaster Management Office (NDMO)
8	India	Indian Space Research Organisation (ISRO), 2 other organizations
9	Indonesia	National Coordinating Board for Disaster Management (BAKORNAS PBP), 4 other organizations
10	Japan	Keio University, 4 other organizations
11	Kazakhstan	National Center of Space Reseaches and Technologies (NCSRT)
12	Korea	Korea Aerospace Research Institute (KARI)
13	Kyrgyz	Central Asian Institute of Applied Geosciences (CAIAG)
14	Lao P.D.R	Ministry of Labor and Social Welfare, 1 other organization
15	Malaysia	National Security Division, Prime Minister's Department, 2 other organizations
16	Mongolia	National Remote Sensing Center of Mongolia (NRSC)
17	Myanmar	Department of Meteorology and Hydrology, 1 other organization
18	Nepal	Department of Water Induced Disaster Prevention, 2 other organizations
19	Philippines	Office of Civil Defense-National Disaster Coordinating Council (NDCC), 7 other organizations
20	Singapore	Centre for Remote Imaging, Sensing and Processing (CRISP) National University of Singapore
21	Sri Lanka	Survey Department of Sri Lanka, 1 other organization
22	Taiwan	National Applied Research Laboratories (NARL), 1 other organization
23	Thailand	Geo-Informatics and Space Technology Development Agency (GISTDA), 6 other organizations
24	Vietnam	Vietnamese Academy of Science and Technology (VAST), 4 other organizations
25	International Organization	Asian Institute of Technology (AIT), 10 other organizations

※ Sentinel Asia Membsrs https://sentinel.tksc.jaxa.jp/sentinel2/MB_HTML/JPTMember/JPTMember.htm

In view of these circumstances, the APRSAF proposed a new project called “"Sentinel Asia”" in 2004 to showcase the value and impact of earth observation technologies, combined with near real-time Internet dissemination methods and Web-GIS mapping tools for the disaster management support in the Asia-Pacific rims. Its aims are: to improve safety in society using ICT and space technology, to improve the speed and accuracy of

disaster prevention and early warning, to minimize victims and social/economic losses.

Main activities of Sentinel Asia are as follows: Emergency observation by earth observation satellite in case of major disasters, Acceptance of observation requests, Wildfire monitoring and Flood monitoring, Capacity building for utilization of satellite images for disaster management, Operations of Sentinel Asia have been commenced since October 2006 by opening its Web site. (http://dmss.tksc.jaxa.jp/sentinel)

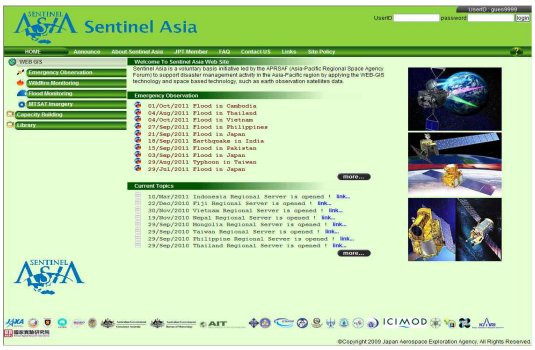


Fig 2: Sentinel Asia Homepage

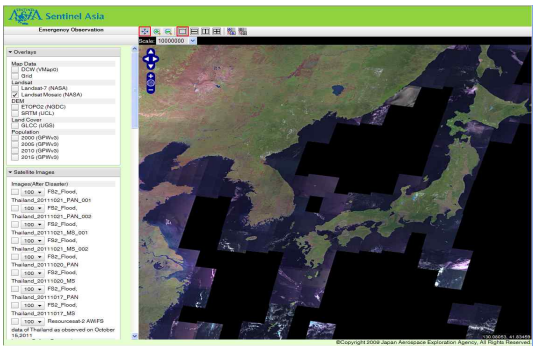
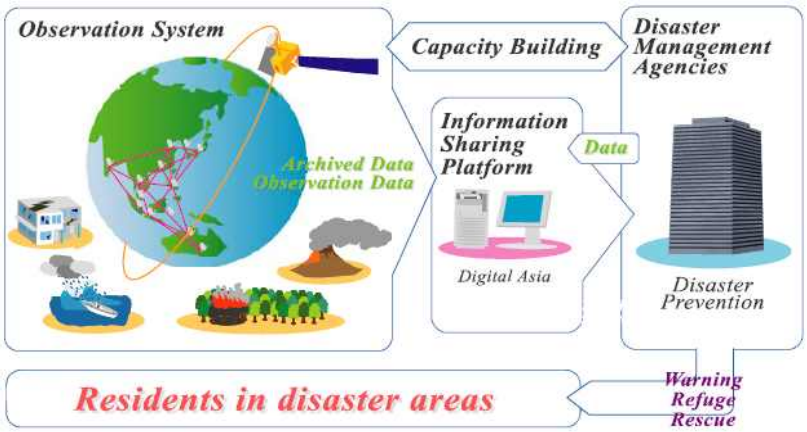


Fig 3: Emergency Observation

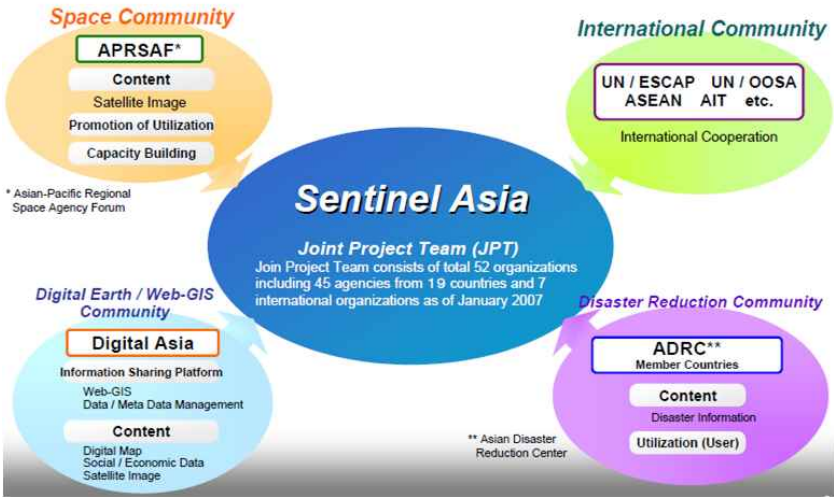
Sentinel-Asia is "voluntary organization" led by the APRSAF to share the disaster information in the Asia-Pacific rims to make the best use of earth observation satellite data for disaster management in the Asia-Pacific region by applying remote sensing technology, GIS technology, and ICT. The concept of Sentinel Asia is shown in <Fig 4>.

Fig 4: Concept of Sentinel Asia



Sentinel Asia is promoted under collaboration among the following four communities as shown in <Fig 5> (Space Community (APRSAF); International Community (UNESCAP, ASEAN and AIT etc.); Disaster Reduction Community (Asian Disaster Reduction Center and its member countries); and Digital Asia Community (Keio University etc.)). To support the implementation of the Sentinel Asia project, a "Joint Project Team (JPT)" was

Fig 5:: Framework of Sentinel Asia



Sentinel-Asia deals with only disaster-related data / images in the Asia-Pacific rims, which are wanted for participating organizations on best-efforts and voluntary basis from the viewpoint of contribution to disaster management in that region.

A millionth digital map stored in Digital Earth server in Keio Univ. provided by NGA (National Geospatial-Intelligence Agency), which covers the whole Asia area (as a default)

2.3 Collaborative Research Network in Korea

For building international collaborative network about Spatial information, Korea hold an international seminar related to production·management·research of spatial information. At this international seminar many korean researchers and international experts discussed and shared their knowledge of spatial information. For building international collaborative network about Spatial information, organize international seminar's related to spatial information research organized by KRIHS(Korea Research Institute for Human Settlements) since 1996. The theme of the 15th international seminar is 'International Collaboration for

Global Geospatial Information Society'. <Table 3> shows the history of 'GIS International Seminar'

Table 3: GIS International seminar history

Number	Theme	Field
1st(1996)	Strategies for NGIS Development	NGIS Development
2nd(1997)	GIS Applications in the Public Sector	GIS in Public Sector
3rd(1998)	GIS Development Strategies for the 21th Century	GIS Future View
4th(1999)	GIS in Local Government	GIS in Local Gov
5th(2000)	Toward a Knowledge-based Society: NGIS Policy and technological Development	NGIS Policy
6th(2001)	Present and Future of GIS Technologies	GIS Technologies
7th(2002)	GIS Workshop & Seminar	GIS Industry
8th(2003)	Envisioning Cyber-geospace and Spatially enables E-government	Cyber-GIS
9th(2004)	Emergency and Disaster Response with GIS	Disaster GIS
10th(2005)	NGIS Policy in Ubiquitous Computing Environment	Ubiquitous GIS
11th(2007)	Collaborative GIS toward the Geospatial Information Society	Collaborative GIS
12th(2008)	NSDI Policy for National Spatial Data Integration	NGIS Policy
13th(2009)	The World Geospatial: Trends and Prospects	GIS Industry and Technologies
14th(2010)	GI Application Strategies for Realizing SMART KOREA	Smart GIS
15th(2011)	International Collaboration for Global Geospatial Information Society	International Collaboration for GIS

3. Plan for Global Geospatial Information Collaborative Research Network

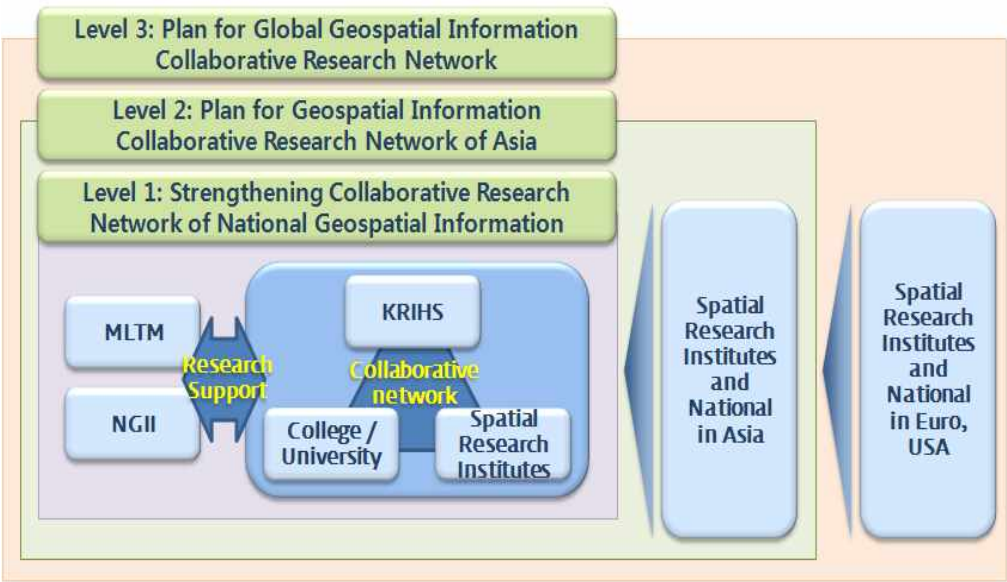
The global geospatial information collaborative research network previously implemented consisted of voluntary members and has helped to increase the global competitiveness by securing professionalism in geospatial information related fields.

But in Korea, that is hard to expect international experts participation in Korea geospatial research fields. Thus, before building a plan for global geospatial information collaborative research network, Korea needs to strengthen the collaboration of geospatial information related institution at the national level first. With this in mind, Korea should initiate international collaborative research projects, or hold continuous collaborative seminars with

national and international research institutions in order to improve national research standard and to enhance the international academic information sharing.

For a stable international collaborative research network, a stable managing system is needed. For Korea, Ministry of Land, Transport, and Maritime Affairs(MLTM), and National Geographic Information Institute(NGII)－institutions in charge of production and management of national geospatial information－as well as Korean Research Institute of Human Settlement(KRIHS)－institution in charge of research of national geographic information－should work together to come up with a national collaborative research network. In addition, over a long term period, a plan for international collaborative research network should be proposed.

Fig 6:: The establishment of a research collaborative network about spatial information



3.1 Strengthening Collaborative Research Network of National Geospatial Information

Before proposing a collaborative research network of geospatial information at the global level, strengthening of collaborative research network at the national level is needed. Currently, research institutions and universities are doing the geospatial information related researches led by the Korean government.

In order to strengthen the collaborative research network of national geospatial information, the related R&D businesses and companies should be supported, and all

research information should be shared through international seminars.

For such, MLTM, NGII, KRIHS, and other institutions with the right tools and information should collaborate to come up with a plan for managing the collaborative research network at the national level and to motivate voluntary participation of universities and enterprise affiliated institutions－which will lay the foundation for proposing a plan for international collaborative research network. Level 1 is shown in <Fig 6>.

3.2 Plan for Geospatial Information Collaborative Research Network of Asia

In order to come up with a global geospatial information collaborative research network, institutions that support national collaborative research network provided at level 1 as well as the network of Asian research institutions should work together.

Currently, research networking opportunities such as 'GIS International Seminar' and other agreements such as MOUs should be used to come up with the international collaborative research network institutionally. Geospatial information collaborative research network of Asia should promote active partnership between countries and research institutions under agreement. Level 2 is shown in <Fig 6>.

3.3 Plan for Global Geospatial Information Collaborative Research Network

In order to come up with the global geospatial information collaborative research network, the collaboration with geospatial information related research institutions of European countries, American countries, and other countries should be induced.

By organizing joint researches and international seminars with geospatial information related researching communities within Europe, North America, and other regions, the research network can be created. Through the institutional collaboration, the global geospatial information collaborative research network can be implemented. Level 3 is shown in <Fig 6>.

4. Conclusion

The competitiveness of national geospatial information is sharpened through the establishment of strong foundation of GIS technology by MLTM, NGII, KRIHS, and other related research institutions, and also, the basis of collaborative network is established by

holding more than ten years of international seminar.

For the global geospatial information collaborative research network, it is necessary to strengthen the collaborative research network at national level, and in five years the collaborative research network of Asia should be established. Once the level 2 is accomplished, the collaborative research network at global level by networking with European and North American countries should set sail. By 2020, the accomplishment of level 3 is projected. In order to come up with geospatial information collaborative research network at all levels, the sharing of technology and information is essential at institutional, national, and international levels.

Finally, it is necessary to point out that fields related to global issues—such as the environmental issues(sustainable development, green development, public safety and smart-city) and the new geospatial information related technological issues(platform technology and high-precision spatial information technology)—should be a part of the collaborative research.