FIG-President Univ. Prof. Dr. Holger Magel

## "Spatial Information Management for Sustainable Development"

Public lecture: The Jamaica Conference on 30th October 2003 in Kingston, Jamaica

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## 1. Why this SIM- and SDI-Boom?

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Why do we have this inspiring Spatial Information Management (SIM)-, Spatial Data Infrastructure (SDI)- and Geoinformation System (GIS)-Boom?

Because of global drivers

➢ like an increased need of better information for all kinds of politics and policies, planning and decision-making, management and implementation on global, regional and local level

➢ like enhanced technologies and a better networking as well as interdisciplinary cooperation of various stakeholder

➢ like strong pushing SIM, SDI and GIS – Philosophy by visionary politicians (like Al Gore), professionals (like FIG) and disciplines (like surveyors)

**Conclusion:** Society is moving on into a
**"Knowledge and Information Society"**

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## Spatial Data and Spatial Information

In the paper „The Digital Earth: Understanding our Planet in the 21st Century", written by the former American Vice President Al Gore you can find the following:

„A new wave of technological innovation is allowing us to capture, store, process and display an unprecedented amount of information about our planet and a wide variety of environmental and cultural phenomena. Much of this information will be „georeferenced" – that is, it will refer to some specific place on the Earth's surface. **The hard part of taking advantage of this flood of geospatial information will be making sense of it, turning raw data into understandable information"**

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## Sustainable Development

in the sense of Rio, Istanbul, Johannesburg Declaration and according to the Millennium Development Goals especially aims at

➢ the just balance of economic, ecological and social development on the basis of a "comprehensive planning and decision process"

➢ more democracy, decentralisation and deregulation, more participation and transparency etc. according to the "good governance principles"

➢ improving or sustaining quality of life of **all** living species and at efficient and sustainable use and managing of natural resources, especially of our more and more scarce land

➢ more awareness of people about our endangered world ("Our world is a village": increasing globalisation of environment impacts)

**Conclusion:** To implement sustainable development goals and to come to a more overall and special knowledge each state, authority and people need more and better data and comprehensive information.

## Habitat Agenda: § 76 (Action)

To ensure an adequate supply of serviceable land, Governments at the appropriate levels and in accordance with their legal framework should: **Develop and implement land information systems and practices for managing land**, including land value assessment, and seek to **ensure that such information is readily available**.

## Habitat Agenda: § 114 (Action)

To develop and support improved and integrated land management, Governments at the appropriate levels, including local authorities, should: Develop integrated land information and mapping systems.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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## Plan of Implementation

38. ...

(b) Develop and implement **integrated land management** and water-use plans that are based on sustainable use of renewable resources and on integrated assessments of socio-economic and environmental potentials, and strengthen the capacity of Governments, local authorities and communities to monitor and manage the quantity and quality of land and water resources;

…

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

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## United Nations Sustainable Development, Agenda 21 – Chapter 40: Information for Decision-Making

**40.1.** In Sustainable Development, everyone is a user and provider of information considered in the broad sense. That includes data, information, appropriately packaged experience and knowledge. The need for information arises at all levels, from that of senior decision makers at the national and international levels to the grass-roots and individual levels.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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## Plan of Implementation

104. Assist developing countries, through international cooperation, in enhancing their capacity in their efforts to address issues pertaining to **environmental protection** including in their formulation and implementation of policies for environmental management and protection, including through urgent actions at all levels to:

…

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

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## Plan of Implementation

104. …

(a) Improve their use of science and technology for environmental monitoring, assessment models, accurate databases and **integrated information systems**;

…

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

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## Plan of Implementation

104. ...

(b) Promote and, where appropriate, improve their use of satellite technologies for quality data collection, verification and updating, and further improvement of aerial and ground-based observations, in support of their efforts to collect quality, accurate, long-term, consistent and reliable data;

…

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

## Quotation from FIG Agenda 21 Chapter 6

**FIG**

Good decisions for Sustainable Development depend on access to reliable and relevant information and to a very large extent on information that is geographically referenced. The need for geographic information arises at all levels of government, from senior decision-makers to the grass roots and individual levels.

Considerable data exist, but access to data is often hampered by lack of standardisation, coherence and adequate services for data retrieval, including information about what data exist and where data are kept.

…

FIG Agenda 21, FIG Publication No 23, 2001

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## Plan of Implementation

**FIG**

119. septies ...

(b)    Develop information systems that make the sharing of valuable data possible, including the active exchange of Earth observation data;

(c)    Encourage initiatives and partnerships for global mapping.

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

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## Plan of Implementation

**FIG**

119.octies    Support    countries,    particularly developing countries, in their national efforts to:

(a) Collect data that are accurate, long-term, consistent and reliable;

(b) Use satellite and remote-sensing technologies for data collection and further improvement of ground-based observations;

(c) Access, explore and use geographic information by utilizing the technologies of satellite remote sensing, satellite global positioning, mapping and **geographic information systems**.

Source: Plan of Implementation, World Summit on Sustainable Development, Johannesburg, September 2002

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**FIG**

## 2. At the edge of the map – Facing the new world and the new technology

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**FIG**



Source: Prof. Stig Enemark, Head of School of Surveying and Planning Aalborg University, Denmark, Intergeo, Hamburg, 12 September 2003

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**FIG**



Source: Prof. Stig Enemark, Head of School of Surveying and Planning Aalborg University, Denmark, Intergeo, Hamburg, 12 September 2003

## Who needs access to coordinated geographic information?

- Land Records Adjudication
- Disaster Response
- Transportation Management
- Water, gas & electric planning
- Public Protection
- Defense
- Natural Resource Management
- Telecommunications Infrastructure
- Economic Development
- …

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003

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## A Global Land Administration Perspective
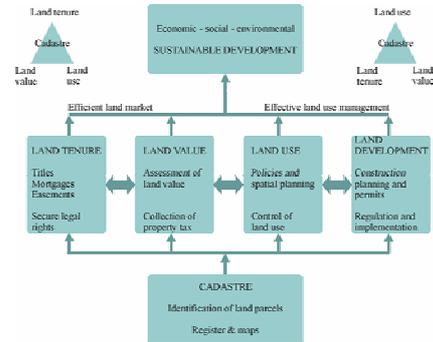


Source: Prof. Stig Enemark, Head of School of Surveying and Planning Aalborg University, Denmark, Intergeo, Hamburg, 12 September 2003

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## Land Information Management

The modern land administration system is concerned with detailed information at the individual land parcel level. As such it should service the needs of both the individual and the community at large. Benefits arise through its application to e.g.:

- guarantee of ownership and security of tenure and credit;
- facilitate efficient land transfers and land markets;
- support management of assets;
- and provide basics information in processes of physical planning, land development and environmental control.

The system, this way, acts as a kind of backbone in society.

Stig Enemark: Underpinning Sustainable Land Administration Systems
16 th UN Regional Cartographic Conference for Asia and the Pacific, Okinawa, Japan, 14 – 18 July 2003

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## Land Information Management
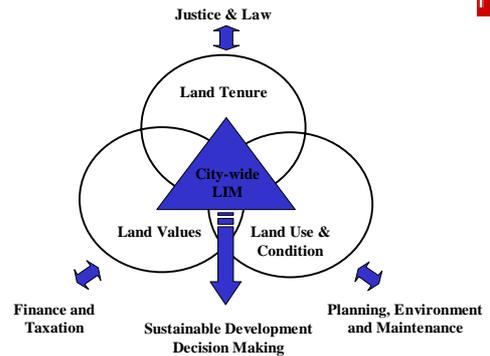


Land Information Management for Sustainable Development of Cities. Best Practice Guidelines in City-wide Land Information Management. FIG Publication No 31, 2002

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## Land Information Management

These ambitious goals will not be achieved unless there is a commitment to designing and implementing effective land administration infrastructures.

Information technology will play an increasingly important role both in constructing the necessary infrastructure and in providing effective citizen access to information. Also, there must be a total commitment to the maintenance and upgrading of the land administration infrastructure.

Stig Enemark: Underpinning Sustainable Land Administration Systems
16 th UN Regional Cartographic Conference for Asia and the Pacific, Okinawa, Japan, 14 – 18 July 2003

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## 3. The Nairobi Statement on Spatial Information for Sustainable Development
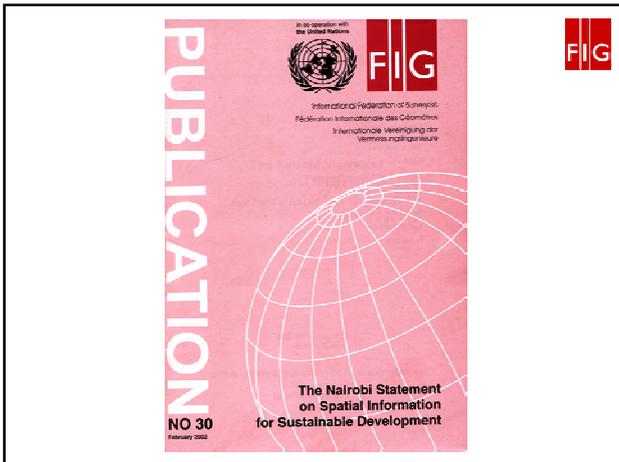
**The Nairobi Statement on spatial Information for Sustainable Development: Executive Summary**

The conference recognized, against a background of presentations and discussions and the outcome from other international conferences, workshops and taskforces, that development and implementation of a National Spatial Data Infrastructure is a prerequisite for promoting Sustainable Development.

The conference also recognized that although every National Spatial Data Infrastructure (NSDI) is different due to a variety of cultural, social and economic factors unique within each country, there are a significant number of common elements that can be shared.

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The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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**The Nairobi Statement on spatial Information for Sustainable Development: Executive Summary**

It is recognized that a key success factor of implementing NSDI is the management of information as an asset, as in the case with finance and human resources. Mature NSDIs are complex solutions involving a number of stakeholders. However, those who have a NSDI have started with clear short-term objectives and corresponding simple solutions. The use of Spatial Information to support Sustainable Development will only be achieved if solutions start with realistic objectives and grow incrementally through political and market needs.

Many of the key infrastructure requirements of NSDI, e.g. pervasive telecommunications and internet access are not widely available in some countries, this limits the applicability of leading edge NSDI technical solutions. Vendors are encouraged to understand the needs of developing countries and design and market appropriate technical solutions.

…

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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**The Nairobi Statement on spatial Information for Sustainable Development: Executive Summary**

NSDIs are underpinned by effective partnerships and co-operation amongst a wide variety of multi-disciplinary stakeholders in public and private sectors and the end user communities.

Countries are encouraged to form appropriate policy and institutional frameworks and facilitate co-operation amongst stakeholders. The creation of a 'proof of concept application' can be used to gain and continue political support whilst feeding into the formulation of NSDI policy and strategy.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002.

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**4. From Spatial Data to Decision Making and Makers**

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**Spatial Data and Spatial Information**

With Geography Information System (GIS) it becomes possible to integrate, analyse, model and visualize spatial data from different sources on the local as well as the national and international level, provided that data from the different sources have common „keys". Spatial Data and Information have the spatial component as the common key. With GIS it becomes possible to create overview and knowledge in up to now unseen combinations.

**Spatial Data is an indispensable part of the basic infrastructure in the individual country**, in line with roads, hospitals, schools etc. **Spatial Data is strategically important to decision makers** at all levels.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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## Spatial Data, Spatial Information and Spatial Information Management

**FIG**

Within FIG normally the term **Spatial Data** is used for „georeferenced data". Combining data creates information. **Spatial Information** is information with a reference to a specific location (coordinate, an address, a property number, a cadastral number etc.)
**Spatial Information Management** concerns organizing and accessing Spatial Information.
Geographical Spatial Information Management guarantees organizing and accessing Spatial Information by **geographic characteristics**.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002
Stefan Neumeier, TUM, Centre of Land Management and Land Tenure, 2003
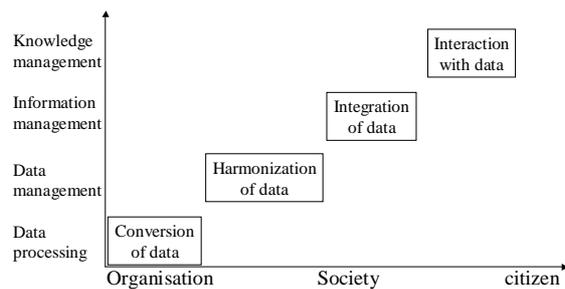
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## Spatial Information Management

**FIG**

Management of Spatial Data and Information is a key element in the processes which leads to users of Spatial Information having a better overview of both simple and complex problems and which give users the possibility to create comprehensible and thus acceptable solutions and/or compromises.

Spatial Information Management is also about human resources and organisational changes. **Being involved in Spatial Information Management means to be in the focal-point between man and technology.**

Spatial Information Management as well as Spatial Knowledge Management is a growth field for surveyors and for many other professions as well.

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002

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## Spatial Information and Knowledge Management as a Key Factor for Government, economy and society

**FIG**

Knowledge management
Information management
Data management
Data processing

Organisation — Society — citizen

- Interaction with data
- Integration of data
- Harmonization of data
- Conversion of data

The Nairobi Statement on spatial Information for Sustainable Development. FIG Publication No 30, 2002
(slightly changed by Prof. Magel)

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**FIG**

A powerful and sustainable Spatial Information Management needs an effective

**Spatial Data Infrastructure (SDI)**

A SDI is a more and more important part of the infrastructure of a country and in some countries already a central player in eGovernment (electronic Government).

© Holger Magel, 2003

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## What is a Spatial Data Infrastructure (SDI)?

**FIG**

"The SDI provides a basis for spatial data *discovery, evolution, and application* for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general."

*The SDI Cookbook*

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003

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## Why build an SDI?

**FIG**

- Build data once and use it many times for many applications
- Integrate distributed providers of data: Cooperative governance
- "Place-based management"
- Share costs of data creation and maintenance
- Support sustainable economic, social, and environmental development

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003

## Components of a Spatial Data Infrastructure (SDI)

➢ Technology (hardware, software, networks, databases, interoperability, technical implementation plans)

➢ Policies & Institutional Arrangements and Strategies (governance, data privacy & security, data sharing and dissemination, cost recovery)

➢ People (human resources, training, professional development, cooperation, outreach)

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003
Stefan Neumeier, TUM, Centre of Land Management and Land Tenure, 2003)

## Spatial Data Infrastructures

Spatial data infrastructures in a land management framework provide mechanisms for sharing georeferenced information. These mechanisms are conceptual, political and economic, and they are of course interrelated. Key elements include adoption and implementation of technical standards, adoption of access policies and cost recovery policies, and design of co-operative relationships between governmental levels and between the public and private sector.

Stig Enemark: Underpinning Sustainable Land Administration Systems
16 th UN Regional Cartographic Conference for Asia and the Pacific, Okinawa, Japan, 14 – 18 July 2003

## Spatial Data Infrastructures

- Conceptual mechanisms include design of organisational concepts for data sharing and custodianship, e.g. a centralised or a decentralised approach.

- Political mechanisms include provision of an effective institutional framework and the distribution of power between the governmental levels.

- Economic mechanisms include cost recovery policies as well as strategies for distribution and maintenance. The key issue here is provision of an universally accepted policy for access to data.

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## Challenges to SDI-Implementation

➢ **right** message about the **right** use of the **right** SDI to the **right** political and senior ministerial decision makers (for what and how much?)

➢ different technical standards

➢ interoperability, cooperation

➢ legal/institutional framework

➢ costs and pricing

➢ private-public-partnership

➢ university education

➢ capacity building of professionals

Open GIS Consortium (OGC) was established to improve or reach a better interoperability of the different systems and services by formulating "open" interfaces etc.

## Quotation from FIG Agenda 21 Chapter 6

The rapid development of technologies and methods in surveying and mapping, such as integrated geographic information systems, remote sensing, satellite positioning systems and digital networks for sharing and disseminating of data, provides a strong and important tool for decision making for Sustainable Development. Accessible and relevant geographic information will play an important role in planning, executing and monitoring development. Developing countries have embarked on **implementing spatial infrastructures for the optimal sharing and use of geographic data in digital form**.

However, the majority of developing countries lack the capacity to utilise the emerging technologies and methods.

FIG Agenda 21, FIG Publication No 30, 2002

## The European SDI-Approach

The most comprehensive and up to date formulation of critical objectives of any SDI has been developed within the EU's project INSPIRE (INfrastructure for SPatial Information in Europe). These objectives are listed below:

➢ Data should be collected once and maintained at the level where this can be done most effectively

➢ It should be possible to combine seamlessly spatial information from different sources across Europe and share it between many users and application

➢ It should be possible for information collected at one level to be shared between all the different levels, detailed for detailed investigations, general for strategic purposes

➢ Geographic information needed for good governance at all levels should be abundant under conditions that do not refrain its extensive use

➢ It should be easy to discover which geographic information is available, fits the needs for a particular use and under which conditions it can be acquired and used

➢ Geographic data should become easy to understand and interpret because it can be visualized within the appropriate context selected in a user-friendly way

Source: Bogdan Ney, Andrzej Sambura: It developments enabling customer-oriented cadastre. 2nd CADASTRAL CONGRESS, Krakow, 2003

## If an SDI were developed

➤ Improved decisions ... Providing decision makers what they really need – indicators, models, trends, patterns

➤ Adoption of existing spatial data standards

➤ Core data available, in the public domain, via a clearinghouse

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003

## Spatial Data Infrastructures

By creating an infrastructure and the relevant linkages positive results will emerge. Clear responsibility for data maintenance and upgrade will establish, duplication will be reduced and analysis improved. Sound decision-making processes are developed for governments at all levels, and valuable information is created for academic institutions, the private sector and the community.

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## Decision-maker Awareness

➔ **Successful implementation** of an effective GII increasingly **depends upon** senior **government officials** and **key decision-makers** in the political arena.

➔ Since **not technology but geospatial solutions are the crucial issues for communication with decision makers**, the following is essential: The key to creating awareness amongst key decision-makers is to deliver business solutions, particularly in the context of political problems/ opportunities, rather than focusing on and over-communicating technical capabilities of the Internet and databases.

Lemmens, M.: Considerations and Issues beyond Technology. Establishing Geo-information Infrastructure. In: GIM  International.
Volume 17. Sep. 2003. P. 61 .

## Decision-maker Awareness

"One of the **main problems hindering the rapid development** of national and regional geospatial infrastructures today is the **reluctance to learn from others**, supported by national (or even state) pride and the deeply rooted belief of facing a very special situation.

However, the relevant economic and technological evolution is pretty much the same for large parts of the world. And there are much better ways to preserve cultural diversity than through a plethora of arcane data formats and monolithic system architectures."

Lemmens, M.: Considerations and Issues beyond Technology. Establishing Geo-information Infrastructure. In: GIM  International.
Volume 17. Sep. 2003. P. 61 .

## Creating the motivation

➤ Development of an SDI should be a voluntary and have long-term vision

➤ Government roles may require both incentives and directives

➤ Commercial and non-commercial participants should find SDI appealing as a market

➤ The correct solution for SDI must be defined by your circumstances

Ottichilo, W. K.: Spatial Data Infrastructure: Concepts and Components.
URL: http://kism.iconnect.co.ke/JICAWorkshop/pdf/Ottichilo.pdf. 06.10.2003

## The Institutional Challenges

A fundamental institutional challenge in this regard is related to understanding the value of developing appropriate institutional, legal and technical processes to integrate land administration and topographic mapping programs within the context of a wider national strategy for spatial data infrastructure.

The issue will be the key focus of a UN, FIG, PC IDEA **Workshop on "Building Land Information Policies"** (Politicas para la gestion de la tierra) to be held in **Aguascalientes, Mexico, October 2004**.

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## The Institutional Challenges

Another institutional challenge is about establishing a suitable balance between national policy-making and local decision-making. This challenge relates to good governance and to the issue of decentralisation with regard to the delegation being made between governmental levels. Decentralisation of land-use planning and decision-making immediately raise the question of suitable local institutions and organisations for managing these tasks. Such local institutions and organisations must be able to handle conflicts in a very concrete and direct sense. In the context of sustainability, the conflict between immediate gains and needs on one hand, and the concern of future generations on the other, is of course crucial.

## The capacity building challenges

Capacity building is increasingly seen as a key component of land administration projects in developing and transition countries such as World Bank projects. However, the capacity building concept is often used in a very narrow meaning such as focusing on staff development through formal education and training programmes to meet the deficit of qualified personnel in the actual project in the short term. Where a donor project is established to create land administration infrastructures in developing or transition countries, it is critical that capacity building is a main steam component that is addressed up front, not as an add-on. In fact, such projects should be dealt with as capacity building projects in themselves.

## The capacity building challenges

For example if a country such as Indonesia wished to have a land administration system supported by a land title and cadastral surveying system similar to Denmark or Australia, this could possibly require 40.000 professional land surveyors and 30 or more university programs educating professional surveyors. Clearly this is not realistic even in a medium term perspective. As a result, there is a need to develop appropriate solutions matching the stage of development and specific characteristics and requirements of individual country.

## 5. SIM and SDI are not all, but with out them nearly all is nothing

Jack Dangermond: "Geography and GIS are necessary tools if we are willing to sustain our world."

**But nevertheless** keep in your mind: It is for ever human being who decides on our future and on our well being.

Therefore we need a stronger UN and much more commitment of all nations and civil society to the Millennium Development goals. And finally - we everywhere need not only excellent leadership and excellent education at schools and universities but also a broad opening and development of our hearts and values.

FIG President Prof. Magel
Oct. 2003