

**The Nairobi Statement
on Spatial Information
for Sustainable Development**

**2nd – 5th October 2001
Nairobi, Kenya**

**INTERNATIONAL FEDERATION OF SURVEYORS FIG
in co-operation with
THE UNITED NATIONS**

Foreword

The International Conference on Spatial Information for Sustainable Development, held in Nairobi, Kenya 2-5 October 2001, was organized by the Institution of Surveyors of Kenya, the International Federation of Surveyors (FIG) and the UN-Habitat.

The conference became a reality because of support and help from the main sponsors United Nations Environmental Program (UNEP), GEOMAPS Ltd. Surveying and Mapping and Institution of Quantity Surveyors of Kenya, the co-sponsors Metrocosmo Valuers Ltd, University of Nairobi, Intergraph Mapping and GIS Solutions and Swedesurvey AB and a number of companies and institutions who have contributed in one way or another. In addition the United Nations Economic Commission for Africa and United Nations Food and Agriculture Organization were active participants /C1/.

Spatial Data Infrastructure and Spatial Information Management is clearly in the focus for all surveyors and other stakeholders worldwide in their diverse tasks in development, planning and resource management and in their efforts at creating and supporting a Sustainable Development.

The conference offered the speakers as well as the participants the opportunity to focus on, discuss and share experiences on issues and topics related to Spatial Information for Sustainable Development in general and in Africa in particular.

The conference concentrated on the following sub-themes: i) Spatial Data Infrastructure and Spatial Information Management, ii) the role of Spatial Information in land tenure, land administration and spatial planning iii) low cost housing and iv) Spatial Information, education and best practices.

In total there were more than 80 presentations. Some were based on research and developing trends, others were based on projects and experiences. /10/

The outcome of the Conference is a number of recommendations on actions necessary for establishing a Spatial Data Infrastructure.

This publication, which includes the conference recommendations, is intended to support politicians, senior managers and professional organisations by providing greater understanding of the need for Spatial Data Infrastructures (SDI's) and how they can be used to support Sustainable Development. Even though the recommendations are based on African conditions they are easily transformed to general terms are therefore applicable to all regions of the world.

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The Nairobi Statement on Spatial Information for Sustainable Development

Executive Summary

The objectives of the Nairobi Conference on Spatial Information for Sustainable Development /10/ were to:

- Contribute to the international community's effort to advance the implementation of UN Agenda 21 (www.un.org/esa/sustdev) and the Habitat Agenda (www.unhabitat.org);
- Understand the role of the surveying community in implementing the Habitat Agenda;
- Urge governments and stakeholders to implement integrated land information management;
- Strengthen and promote the relevant information to support FIG Agenda 21.

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.

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.

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.

Special attention should be given to the following recommendations:

- African countries are encouraged to form National NSDI Steering Groups to formulate appropriate policy and institutional frameworks and facilitate co-operation amongst the stakeholders.
- African countries are encouraged to design solutions that start with realistic objectives and grow incrementally through political and market needs.
- African countries are recommended to establish regional co-operation through joint initiatives that require regional information management to support common interests.
- The Commission on Developing Information (CODI) proposal for UN-ECA to establish a Permanent Committee for NSDI in Africa is strongly supported.

1. Introduction

This publication, which includes the conference recommendations, is intended to support politicians, senior managers and professional organisations by providing greater understanding of the need for National Spatial Data Infrastructures (NSDI) so that Spatial Data and Information can support the implementation and maintenance of Sustainable Development effectively.

A major part of data and information necessary for Sustainable Development refers a particular geographical location somewhere on the Earth. Data and information with a reference to a specific location is called Spatial Data and Spatial Information respectively. Spatial Data and Information is strategically important to decision makers at all levels as it affects a major part of all human decision-making.

The information requirements for supporting Sustainable Development involve the integration of a number of different types of data from diverse sources, including: land administration, socio-economic, environment, and development. Through common spatial referencing standards enforced by NSDI, these data can be interchanged and integrated to encourage a more holistic approach to decision making involved in Sustainable Development.

The information requirements for managing Sustainable Development require datasets to be available locally, nationally, regionally as well as globally. There is therefore a need to create a 'vertical information highway' to allow transaction based information to be generated through administrative activities at the local level, e.g. land registration, to be aggregated through the local – national – regional and global levels. This approach to recycling information through different levels of Spatial Data Infrastructures will ensure that datasets are current and compatible. The Spatial Data Infrastructures can be the 'land information engine' to support this vertical information highway.

Mature NSDI's 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. The concept of Sustainable Development is much more than "protection of our environment". It has essential social and financial dimensions and the fundamental principle to secure decent conditions of life for the future generations must never be forgotten.

It is our duty to promote a Sustainable Development. We need to be considerate and we need to have a breadth of view. We can form a general view by monitoring the development and continuously analyse the results. Information technology is indispensable but Spatial Data, Information and Knowledge is a prerequisite.

Spatial Information and Knowledge Management will be in focus in the years to come. Spatial Information Managers and responsible politicians will become the main catalysts in the development, implementation and maintenance of the necessary Spatial Data Infrastructures.

Guidance to the reader: Chapters 3-6 provide an introduction to Sustainable Development, Spatial Data and Information, Spatial Data Infrastructure and some related international events. Further details about these topics are available in Appendix C. Chapter 7 contains the recommendations. References to literature and links are in Appendix A. The outcome of the Commission 3 Annual Meeting 2000 is in Appendix B.

1. Sustainable Development

Development is the managed process of change designed to improve the conditions of members of a society. Sustainable Development implies that this process should balance the exploitation of resources, the direction of investments and the advancement of technology in a manner that affords the same opportunity to future generations /C2/.

The sustainable exploitation of environmental resources requires

- Data to be available, up-to-date, reliable and usable indicating the quality, quantity and spatial location of the various resources and the size and spatial distribution of the population who depend on these resources;
- The availability of tools to support the transformation of data into understandable information for decision-makers, from national and international levels to grassroots levels;
- Rethinking of both inter-organisational and intra-organisational relations in order to improve the use of common data and the reuse of data.

Almost all objects like roads, lakes, rivers, settlements, pollutions, citizens, etc, in our environment have a reference to a specific location, called a *spatial reference*. In the same way every change in or influence on our environment has a reference to a specific location.

The spatial reference is a "main key" in the transformation of data into information. Often the lack of availability, quality and coherence, means that the standardization and accessibility of spatial data is a serious hindrance for this transformation, and in that way a barrier for the implementation of Sustainable Development.

2. Spatial Data and Spatial Information

Spatial Data is data with a direct or an indirect geographic reference to the surface of the earth. A co-ordinate and an address are examples of a direct reference whereas the relation between the discharge of polluted water and the location of the property where the source of pollution is situated could be an example of an indirect reference. Combining data from one or more different sources creates information. More than 80% of all information in society has a spatial reference. /C3/

Spatial Data and Information is an indispensable part of the basic infrastructure of an individual country, as are roads, hospitals and schools. Spatial Data and information is strategically important to decision-makers at all levels. Like other infrastructure elements the establishment and maintenance of data implies high costs and lengthy implementation time.

Unlike other resources, Spatial Data does not suffer any wear and tear from repeated use. Reusing of data increases the possibilities for improving the quality of the content of data

collections. The real benefit of investments in Spatial Data increases dramatically with the multiple use of data.

Provided that data are based on a common spatial reference system with Geographic Information Systems (GIS) it becomes possible to integrate, analyse, model and visualize spatial data from the different sources on the local as well on the national and international level.

Management of Spatial Data, Information and knowledge is a key element in the processes which lead to users of Spatial Data and 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. Consequently *Spatial Information and Knowledge Management* becomes an important discipline in both developed and developing countries and in countries in transition.

3. Spatial Data Infrastructure

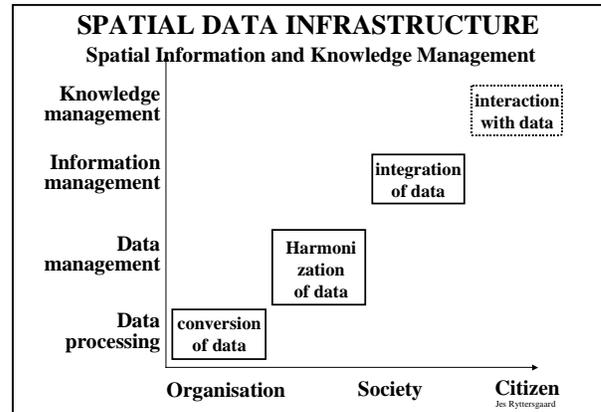
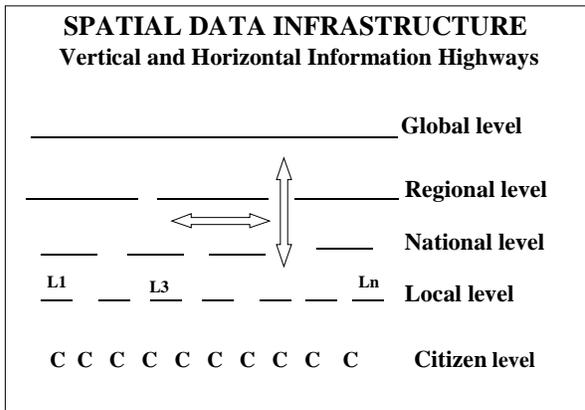
Regardless of the stage of development, there are innumerable very different applications for spatial information for instance:

- Transportation infrastructure in a region;
- Health-monitoring programmes;
- Cadastre and land management.

The variety of applications implies a need for co-operation between the primary user (the owner of the data) and other possible users on standards, common data models, object definitions, common keys, availability, copyright, pricing models, etc. There is a need for development and implementation of a *Spatial Data Infrastructure* based on a holistic approach comprising organisational, political and technical matters. /C4/

In 1994 the Federal Geographic Data Committee defined a National Spatial Data Infrastructure (NSDI) as: *the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geo-spatial data* /www.fgdc.gov/.

The information requirements for managing Sustainable Development require datasets to be available locally, nationally, regionally as well as globally. There is therefore a need to create a 'vertical information highway' to allow transaction based information to be generated through administrative activities at the local level, e.g. land registration, to be aggregated through the local – national – regional – global levels. This approach to recycling information through different levels of Spatial Data Infrastructures will ensure that datasets are current and compatible.



The development and implementation of a Spatial Data Infrastructure for a nation or a region is the prerequisite for a sustainable future where:

- Data collected and maintained by one administrative unit are available for other users;
- Data from different sources can be combined in seamless models without loss of information;
- Dissemination, modelling and visualization are based on international standards.

4. FIG Involvement

The member associations behind FIG as well as the individual surveyors are involved in activities being or becoming important for Sustainable Development in the different regions of the world. Therefore FIG is constantly engaged in the issue. /C5/

In 1999 the FIG Commission 7, in close cooperation with UN organisations and the World Bank, held the workshop on “*Land Tenure and Cadastral Infrastructures for Sustainable Development*” in Australia. The outcome of the workshop, “The Bathurst Declaration on Land Administration for Sustainable Development” /5/, is primarily devoted to issues relevant for the administration of land. The declaration points out the need for Spatial Data and Information, and the need for a land information infrastructure. A land information infrastructure is a subset of a Spatial Data Infrastructure.

In 2001 the FIG General Assembly adopted the proposal “FIG Agenda 21 – Agenda for implementing the concept for Sustainable Development in the activities of the International Federation of Surveyors and its member associations” /6/. The main findings call attention to the fact that promotion of Sustainable Development demands formulation of a Spatial Data Infrastructure.

5. United Nations Activities Related to Spatial Data

In 2001 the United Nations arranged two regional conferences addressing topics related to spatial information /C6/.

The Seventh United Nations Regional Cartographic Conference for the Americas was held in New York 22-26 January 2001 /7/ and /11/.

Spatial Data Infrastructure is mentioned in most of the 10 resolutions adopted by the conference. Resolution no 7 is explicit about “Implementation of National Spatial Data Infrastructures in the Americas”. The conference recommends:

- That the member states share experiences and address common needs and interests within the Americas and with other regions of the world, through the Permanent Committee on Spatial Data Infrastructure for the Americas (established in the year 2000);
- That all countries of the Americas embrace the concept of NSDIs and develop implementation strategies that support regional and global SDI initiatives while meeting national objects.

The Second Meeting of the Committee on Development Information (CODI-2) arranged by the United Nations Economic Commission for Africa (UN-ECA) was held in Addis Ababa 4-7 September 2001. /8/

The Development Services Division of UN-ECA had prepared a position paper: “The Future Orientation of Geoinformation Activities in Africa” /9/. The aim of the paper was “To raise awareness of African governments on the importance of geographic information...”. The paper, which contains very valuable information about and examples on topics related to Spatial Information was endorsed by the meeting.

The Committee on Development Information recommends:

- That the member states give priority to the establishment of Spatial Data Infrastructures;
- That mechanisms be immediately set in motion by African countries to develop the national GI policy as an integral part of the National Information and Communication Policies;
- That African countries should develop appropriate institutional, legal and technical framework to integrate land administration and topographic programmes within the context of a wider national strategy for Spatial Data Infrastructure;
- That African countries should follow, with appropriate adaptations, the model policy guidelines presented in ECA’s position paper on Future of GI activities in Africa;
- The establishment of a permanent committee on SDI’s for Africa to promote the coordinated establishment of SDIs in African countries and to facilitate the establishment of a regional Spatial Data Infrastructure and the African Regional Database;
- That regional SDIs should be established to meet the wish for regional applications.

7. Recommendations

In the light of the recommendations from international and regional conferences, workshops and task forces it was obvious to focus the outcome of the Nairobi Conference on how to implement Spatial Data Infrastructure on national and regional levels.

The recommendations are based on the different presentations, on the results from the discussions in plenary and on experiences from former Commission 3 activities /B/.

The recommendations are designed to provide a practical way forward to create a National Spatial Data Infrastructure to support Sustainable Development. In addition two FIG specific recommendations are formulated.

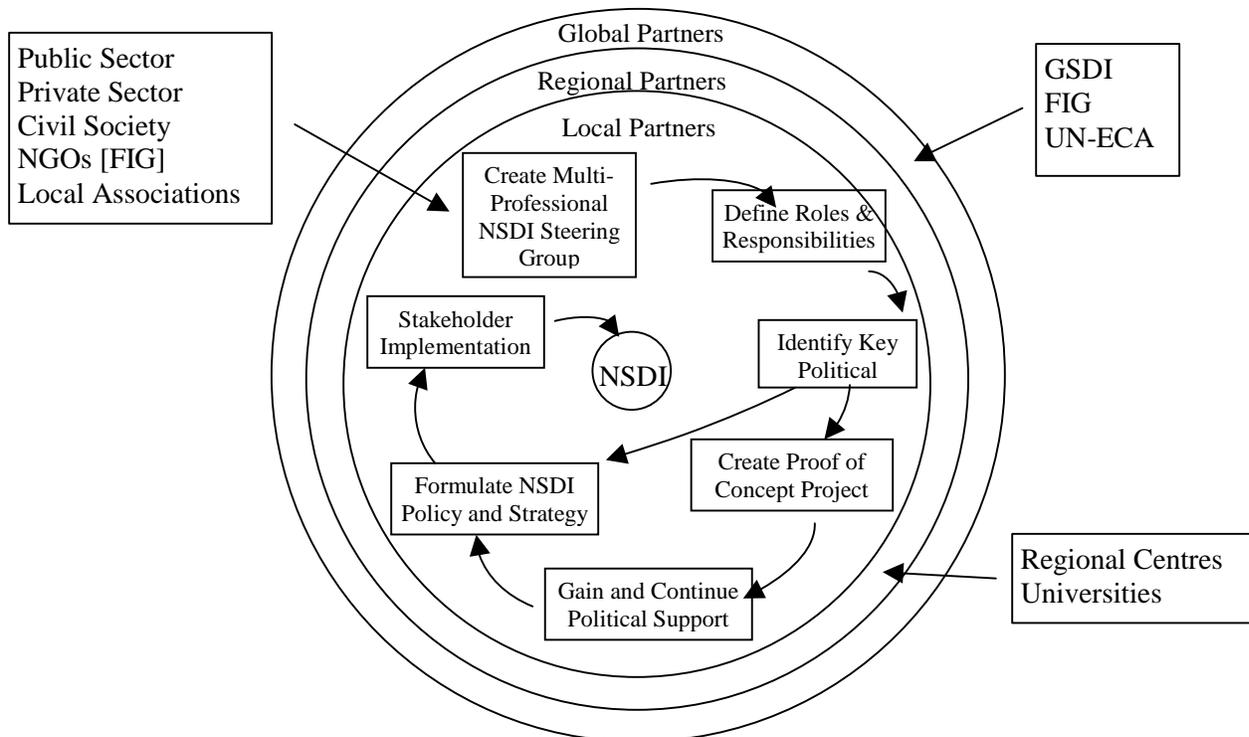
The recommendations on Spatial Data Infrastructure are split up in three groups:

- The National Perspective;
- The Regional Perspective;
- The Global Perspective.

The three groups are divided in subgroup as follows:

- The National Perspective:
 - National Organizations;
 - National Policies, Strategies and Implementation;
 - Legal Aspects;
 - Capacity Building.
- The Regional Perspective:
 - Regional Strategies and Activities;
- The Global Perspective:
 - UN-ECA (www.uneca.org) and African Countries;
 - Technology Transfer - The Role of the Vendors;

The inter-relationship between the recommendations is shown in the figure below.



7.1. The National Perspective

7.1.1. National Organisations

1. National Spatial Data Infrastructures (NSDIs) are underpinned by effective partnerships and co-operation amongst a wide variety of multi-disciplinary stakeholders in the public and private sectors and the end user communities.

African countries are encouraged to form National NSDI Steering Groups to formulate appropriate policy and institutional frameworks and facilitate co-operation amongst the stakeholders. These National Steering Groups should involve end user representation.

2. Experiences from those countries that have embarked on the NSDI process indicate that roles and responsibilities amongst the stakeholders are clarified at an early stage.

African countries are recommended to clarify the lead role and the responsibilities and roles amongst the other stakeholders – this will be an initial activity of the National NSDI Steering Group.

3. It is recognised that the rapid implementation of a NSDI must embrace all available resources within a country. This will be best achieved through partnerships between the public and private sectors.

Countries are encouraged to involve all sectors in implementing a NSDI and ensure that appropriate business models are agreed to support these partnerships at an early stage.

7.1.2. National Policies, Strategies and Implementation

4. It is recognised that every NSDI is different due to varying cultural, social and economic contexts within each country. However, there are a significant number of common elements that can be shared. Countries should avoid re-inventing these common elements.

5. It is recognised that complete policy and institutional frameworks do not have to be in place before implementation of a NSDI can begin.

6. It is recommended that a top down approach is combined with a pragmatic bottom up approach. Short term bottom up projects will provide valuable experience and through proof of benefits, convince further funding of NSDI.

7. It is recognised that a mature NSDI will be a complex solution involving a large number of stakeholders and user groups. From experience the most effective examples of NSDIs are those that have started with clear short term objectives with corresponding simple solutions.

African countries are encouraged to design solutions that start with realistic objectives and grow incrementally through political and market needs.

8. The success of a NSDI is dependent upon delivering products and services that are accepted and desired by the end users, both within Government and the private sector and citizens. This key objective will only be achieved if the requirements are clearly understood.

African countries are encouraged to provide for end user needs and ensure that appropriate products and services are provided.

9. It is recognised that a key success factor of implementing a NSDI is the management of information as an asset, as is the case with finance and human resources. Countries are encouraged to adopt information as an asset and manage it appropriately, e.g. only capture data that is needed and can be maintained.
10. A NSDI requires a culture of data sharing to exist within a country. Although data may be accessible for the common good, the organisations providing data must in return receive a benefit for their contribution.
It is recommended that countries research the benefits associated with data sharing to encourage wide participation.
11. It is recommended that all countries establish unambiguous naming conventions as a key component of their NSDI, following the guidelines produced by the UNGEGN.

7.1.3. Legal Aspect

12. Experience has shown that issues associated with national security, data privacy and associated liability are potential show stoppers for NSDI initiatives.
African countries are recommended to establish legal frameworks to address these crucial legal issues as early as possible.
13. Although there will be significant benefits for the data producers and service providers, it is recognised that one of the main beneficiaries should be the citizen.
African countries are encouraged to formulate appropriate legislation to facilitate access to NSDI information and services by the citizen.
14. It is recognised that the benefits of an NSDI are significantly increased if it supports both niche and mass markets.
African countries are encouraged to ensure that the appropriate legislative business frameworks are established to facilitate support of mass markets.

7.1.4. Capacity Building

15. National organisations, with the support of FIG and sister organisations, are encouraged to organise regular Regional workshops to raise awareness and knowledge sharing of Spatial Information Management for Sustainable Development issues and solutions. This will be a significant contribution to capacity building.
16. African countries are encouraged to provide continuous capacity building. If this is applied at the management level then this will be a significant contribution to institutional building.

7.2. The Regional Perspective

7.2.1. Regional Strategies and Activities

17. It is recommended that African countries establish regional co-operation through joint initiatives that require regional information management to support common interests. This will encourage knowledge sharing and ensure common standards are implemented.
18. It is recommended that existing regional centres of excellence in Spatial Information review their current services in the context of the NSDI agenda and ensure that appropriate services are provided to encourage the establishment and support of NSDIs.
19. Universities within Africa should be encouraged to work with the local survey associations in the provision of Continuing Professional Development.

7.3. The Global Perspective

7.3.1. UN-ECA and the African Countries

20. The Permanent Committee for NSDI in the Pacific and South-East Asia has been successful in promoting co-operation amongst the participating nations.
The Commission On Developing Information (CODI) proposal for UN-ECA to establish a *Permanent Committee for NSDI* in Africa is strongly supported.
21. It is recommended that a *Forum of Education and Training* is established as a sub-group under the Permanent Committee for NSDI in Africa focussed on the sharing of Education and Training resources and experiences.
22. Land administration in Africa faces specific, but common elements, e.g. variety of indigenous right, informal settlements, in relation to statutory tenure arrangements.
It is recommended that African countries share knowledge and experiences and develop guidelines within the framework of UN-ECA by the creation of a *Forum of Land Administration* as a sub-group of the Permanent Committee for NSDI for Africa.
23. Land administration systems provide important foundation data for NSDI.
The Forum of Land Administration is recommended to identify the institutional and operational conditions for successful land administration in Africa.
24. As land tenure in Africa is varied, a good understanding of the concepts of land tenure and its impact on registration is important.
The Forum of Land Administration is recommended to aim for a concerted research effort on this subject.
25. It is recognised that ISO (www.iso.org) and the Open GIS Consortium www.opengis.org produce data and interoperability standards that should be adopted by NSDI stakeholders.

It is recommended that UN-ECA produce best practice guidelines providing NSDI implementors with practical advice on how to effectively implement these essential standards.

7.3.2. Technology Transfer – The Role of the Vendors

26. It is recognised that the majority of NSDI implementors within Africa have limited opportunity to be exposed to the technical options available to build NSDI.

Vendors are encouraged to support a new approach to technology transfer in Africa.

27. It is recognised that many of the key infrastructure requirements of NSDI, e.g. pervasive, effective telecommunications and Internet access, are not widely available in Africa. This limits the applicability of leading edge NSDI technical solutions in Africa.

Vendors are encouraged to understand the needs of African countries and design and market appropriate technical solutions.

7.4. The FIG Perspective

7.4.1. FIG Specific Recommendations

28. There is a need for co-operation by FIG (www.fig.net) Ad hoc Commission on construction economic and management with other international and regional cost management associations, for research into cost management and community based driven organisational models for low cost housing and the publication of the results for dissemination.

29. There is a need for FIG to establish a Cross Commission Working Group to harmonise land management and planning issues with construction and cost management of low cost housing delivery with holistic requirements and within the framework of FIG Agenda 21.

Appendix A

A1. Literature

- /1/: Al Gore: The Digital Earth: Understanding our Planet in the 21st Century. Given at the California Science Center, Los Angeles, California, on January 31, 1998.
- /2/: The Longman Dictionary Of The English Language. Harlow, UK. Longman.
- /3/: Jes Ryttersgaard: Spatial Information Management Supporting Sustainable Development, Proceedings from Commission 3, The FIG Congress in Brighton, England. 1998.
- /4/: Jes Ryttersgaard and Stig Enemark: From GIS to Geographic Information Management, Organisational and Educational Impacts. GIS/LIS For Sustainable Development - GIS/LIS For The Future.FIG Commission 3 Seminar, 28 - 30 October 1996, Copenhagen, Denmark.
- /5/: The Bathurst Declaration on Land Administration for Sustainable Development. FIG Publication No 21, December 99. / www.fig.net /
- /6/: FIG AGENDA 21, FIG Publication No 23, February 2001. / www.fig.net /
- /7/: Seventh United Nations Regional Cartographic Conference for the Americas, New York, 22-26 January 2001. Report of the Conference (E/CONF.93/3)
- /8/: Report of the Sub-Committee on Geoinformation, Committee on Development Information, United Nations Economic Commission for Africa, 2001. /www.uneca.net/
- /9/: The Future Orientation on Geoinformation Activities in Africa, A position Paper. Development Information Services Division (DISD), United Nations Economic Commission for Africa, 2001. / www.uneca.net /
- /10/: International Conference on Spatial Information for Sustainable Development, Nairobi, Kenya, 2-5 October 2001. / www.fig.net /
- /11/: Spatial Information Management in the 21st Century, Robert Foster, Matt Higgins, Jes Ryttersgaard, FIG 2001 / www.fig.net /

A2. Links

- a) The SDI Cookbook, version 1.1 15 May 2001:
www.intl-interfaces.net/cookbook/WMS/
- b) Open GIS Consortium Web Mapping Testbed Public Page:
www.opengis.org/wmt/index.htm
- c) Open GIS Consortium Interoperability Program Page: ip.opengis.org
- d) Web Map Server Interfaces Implementation Specification Revision 1.0.0:
www.opengis.org/techno/specs/00-028.pdf

Appendix B

Spatial Information Management Experiences and Visions for the 21st Century Outcome of the Commission 3 – Annual Meeting and Workshop Athens, Greece, 4-7 October 2000

Experiences

- National Spatial Information Infrastructure (NSDI) is an Asset for all Nations in general. It should be considered as a key part of wider infrastructure assets such as roads, telecommunication networks etc.
- Establishing of a Spatial Information Infrastructure demands co-operation/partnership between the public and the private sectors and amongst the variety of professions involved.
- Given the complexity of existing institutional structures, one can expect conflicts when seeking co-operation in NSDI strategy formulation and implementation.
- NSDI can proceed even if a formal policy document [top down approach] does not exist. It is possible to proceed with certain operational level activities [bottom up approach] while the policy is being formulated. These activities can themselves drive and encourage policy.
- Every NSDI will be different, depending on cultural needs, social evolution, economic reality and national ambitions. The environmental framework and the market demand will shape the most appropriate SDI.
- NSDI policy must be flexible to address rapidly changing needs and wishes of the users and adapt to changing technologies.
- Varied applications and services through a project oriented approach will bring reality to the NSDI (GSDI). An over emphasis on data acquisition, without a market linked application, will not provide any momentum for further development.
- The potential values and benefits have to be demonstrated through large scale projects to encourage further investment.
- Currently, it is often difficult, or even impossible, for users to sensibly combine data from different sources.
- It is essential that users are involved in defining and testing the associated products and services.
- Visualisation, modelling and analysing activities will be the focus of value added services in the years to come.

Visions

- Cadastral, topographic and thematic datasets should adopt the same overarching philosophy and datamodel to achieve multi-purpose data integration, both vertically and horizontally.
- To be able to integrate and share data we need to focus on research to understand and resolve different semantics in data.
- To be able to offer the different users [institutional as well as private] the full potential of spatial information independent of space and time, the full range of spatial data, actual as well as historical, should be made accessible and available
- Alternative possibilities for the presentation and interpretations of spatial information, including integration of knowledge, should be considered.
- The commercial and contractual frameworks for co-operation and the associated business models will be key issues in the further development of NSDI.
- To be able to adapt to the e-market rethinking of pricing, rights and access to data is necessary.

Appendix C

C1. The History of and the Partners behind the International Conference on Spatial Information for Sustainable Development

The International Conference on Spatial Information for Sustainable Development, held in Nairobi, Kenya 2-5 October 2001, was organised by the Institution of Surveyors of Kenya, the International Federation of Surveyors (FIG) and the UN-Habitat.

In June 1999 the United Nations Economic Commission of Africa (UN-ECA) had its first meeting of the Committee on Development Information (CODI). A resolution from the sub-commission on Geo-Informatics recommended FIG, ICA, ISPRS and UN-ECA in co-operation to hold seminars in 2000-2001 in Anglophone and in Francophone Africa.

In October 1999 FIG Commission 3, Spatial Information Management, decided to fulfil the CODI-resolution by having its annual meeting and a seminar/conference in an Anglophone African country in 2001.

The conference became a reality because of support and help from the main sponsors United Nations Environmental Program (UNEP), GEOMAPS and Institution of Quantity Surveyors of Kenya, the co-sponsors Metrocosmo Valuers Ltd, University of Nairobi, Intergraph Mapping and GIS Solutions, Swedesurvey AB and a number of companies and institutions who have contributed in one way or another. In addition the United Nations Economic Commission for Africa and United Nations Food and Agriculture Organization were active participants.

C2. Sustainable Development

Development is the managed process of change designed to improve the conditions of members of a society. Sustainable Development implies that this process should balance the exploitation of resources, the direction of investments and the advancement of technology in a manner that affords the same opportunity to future generations.

The United Nations defines a sustainable society as one which: *meets the need of the present without sacrificing the ability of future generations to meet their own needs*, and Sustainable Development is *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (Brundtland 1992, 87).

The theme of the conference was strongly related to the international community's efforts to advance the implementation of the Habitat Agenda (paragraphs 76 and 114) as well as the implementation of important elements of Chapters 7,10 and 40 of the Agenda 21.

Habitat Agenda: Paragraph 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: Paragraph 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.

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.*

40.2. *While considerable data already exist, ..., more and different types of data need to be collected, at the local, provincial, national and international levels, indicating the status and trends of the planet's ecosystem, natural resource, pollution and socio-economic variables.*

The gap in the availability, quality, coherence, standardization and accessibility of data between the developed and the developing world has been increasing, seriously impairing the capacities of countries to make informed decisions concerning environment and development.

40.3. *There is a general lack of capacity, particularly in developing countries, and in many areas at the international level, for the collection and assessment of data, for their transformation into useful information and for their dissemination.*

40.5. *...To develop or strengthen local, provincial, national and international means of ensuring that planning for Sustainable Development in all sectors is based on timely, reliable and usable information and to make relevant information accessible in the form and at the time required to facilitate its use.*

40.9. *Relevant international organizations should develop practical recommendations for coordinated, harmonized collection and assessment of data at the national and international levels.*

40.17. *There already exists a wealth of data and information that could be used for the management of Sustainable Development. Finding the appropriate information at the required time and at the relevant scale of aggregation is a difficult task.*

40.18. *Information within many countries is not adequately managed, because of shortages of financial resources and trained manpower, lack of awareness of the value and availability of such information and other immediate or pressing problems, especially in developing countries. Even where information is available, it may not be easily accessible, either because of the lack of technology for effective access or because of associated costs, especially for information held outside the country and available commercially.*

40.22... *Mechanisms should be strengthened or established for transforming scientific and socio-economic assessments into information suitable for both planning and public information. Electronic and non-electronic formats should be used. Establishment of standards and methods for handling information*

Planning and implementation of Sustainable Development means that decision-makers on all levels in the public as well as the private sector should be able to evaluate risks and consequences of the possible solutions and scenarios. This demands the ability to access to all relevant information and subsequently the possibility to transform the available data into useful information. The relevant data and information need to be up-to-date, reliable and usable.

Promotion of Sustainable Development demands overview, experience and knowledge that can be related to events (what has happened and what will happen?), those involved (who was in involved or who will be affected?), time (when did it happen and when will it happen?) and a location (where did it or will it happen?).

In general "events" and "those involved" can be linked directly or indirectly to a specific geographic *location*. The location is the "main key" to data and information that is a condition for planning, development, implementation and administration of Sustainable Development.

C3. 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 "geo-referenced" – that is, it will refer to some specific place on the Earth's surface. The hard part of taking advantage of this flood of geo-spatial information will be making sense of it, -turning raw data into understandable information” /1/.

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)

With Geographic Information System (GIS) it becomes possible to integrate, analyze, 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 a resource on a par with employees, funds etc. Use of spatial information opens up the possibility to increase efficiency in the public and the private sector.

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.

Infrastructure is the basic structures and facilities necessary for a country or an organization to function efficiently. An infrastructure has the following characteristics:

Users are aware that ‘somebody’ maintains the infrastructure, but do not regard this maintainer as an owner. Users it to always be available, even if there is a fee or other consideration for its use.

The delivery or provision of the service is standardised to a large extent. As a result of the standardized delivery, users take it for granted because of the ease of use. Infrastructures are expensive to develop and maintain, and the returns from the investment are usually long term. /2/

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.

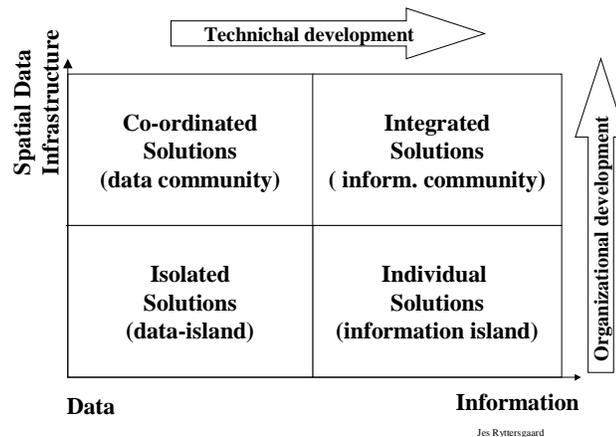
Spatial Information Management is based on the idea that data, people, software and hardware interact, and that it is practicable to obtain synergy by co-ordinating changes and development.

The concept covers different disciplines such as capture, storing, maintenance and upgrading of data and information, information technology, organisational issues and spatial data infrastructure.

Spatial Information Management is a discipline for the individual organisation, administration or enterprise, the micro level, and for society in general, the macro level. On the micro level there will be a technical approach whereas on the macro level political and organisational issues will be highlighted. /3/

Spatial Information Management is a dynamic concept. It changes in line with the technological possibilities and the political and organisational developments in society in general.

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 becomes an important discipline in both developed and developing countries and in countries in transition. *Spatial Information Management* as well as *Spatial Knowledge Management* is a growth field for surveyors.

C4. Spatial Data Infrastructure

Spatial Data or Information stored in traditional paper maps is static. Each map sheet represents a snapshot of selected objects at a given time, and “the owner” has an exclusive right to the map. In contrast a digital map or better a collection of spatial and spatial related data is dynamic with the time parameter as a part of the individual data collection.

In “the digital world” we have different owners of spatial data, many different users and an unknown number of applications for Spatial Information. The following are a few examples of some very different, areas of application:

- Transportation infrastructure in a region;
- Health monitoring programmes;
- Socio-economic issues;
- Cadastre projects;
- Land management;
- Natural resource management;
- Monitoring of environmental issues;
- Environmental impact assessment;
- Conservation projects.

The variety of applications implies a need for co-operation between the primary user and other possible users on standards, common data models, object definitions, common identification, keys, availability, copyright, pricing models, etc. There is a need for a well-documented *Spatial Data Infrastructure*.

In the early 1990’s much attention was focused on Geographic Information Systems (GIS) as a basis for Land information Systems. Soon it became obvious that the pure technical approach had to be replaced by a more holistic approach comprising organisational, political and technical matters. The concept of Spatial Data Infrastructure became a reality.

In 1990 the United States Federal Geographic Data Committee (FGDC) was established to promote the coordinated use, sharing, and dissemination of geospatial data on a national basis.

In 1994 FGDC defined National Spatial Data Infrastructure (NSDI) as: *the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geo-spatial data.* / www.fgdc.gov/

At the FIG Commission3 seminar in Copenhagen in October 1996 "GIS/LIS for Sustainable Development, GIS/LIS and the future" it was expressed in the following way:

"The design, establishment and continued extension of Land Information Systems are rather to be seen as organisational and political matters than purely technical. The point is to create organisational and technical infrastructures which make it possible to establish simple, clear and well-working data collections that at the same time can support the individual organisation and also be placed at the disposal for the society in general....". /4/

In 1997, at the second Global Spatial Data Infrastructure Conference, the first definition of Global Spatial Data Infrastructure (GSDI) was adopted. It was revised in May 2001.

The GSDI Steering Committee agrees to the definition for the GSDI as follows:
“The Global Spatial Data Infrastructure supports ready global access to geographic information. This is achieved through the coordinated actions of nations and organizations that promote awareness and implementation of complimentary policies, common standards and effective mechanisms for the development and availability of interoperable digital geographic data and technologies to support decision making at all scales for multiple purposes. These actions encompass the policies, organizational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the global and regional scale are not impeded in meeting their objectives” / www.gsdi.org /

C5. FIG Involvement

The member associations behind FIG as well as the individual surveyors are involved in activities that are or will become important for Sustainable Development in the different regions of the world. Therefore FIG is constantly engaged in the issue.

In 1999 the FIG Commission 7, in close cooperation with UN organisations and the World Bank held the workshop on *“Land Tenure and Cadastral Infrastructures for Sustainable Development”* in Australia. The outcome of the workshop is documented and published in *“the Bathurst Declaration on Land Administration for Sustainable Development”* /5/.

In 2001 the FIG General Assembly adopted the proposal *“FIG Agenda 21 – Agenda for implementing the concept for Sustainable Development in the activities of the International Federation of Surveyors and its member associations”*. /6/

The main findings call attention to the fact that promotion of Sustainable Development depends on demands for the formulation of a Spatial Data Infrastructure.

C5.1. The Bathurst Declaration

The Bathurst Workshop addressed the changing relationship of humankind to land. The Workshop then considered the relationship of land with Sustainable Development, and the consequent relationship of land tenure to land administration.

The Bathurst Declaration is primarily devoted to issues relevant for administration of land. The declaration calls attention to the need for Spatial Data and Information, and the need for a land information infrastructure.

A land information infrastructure is a subset of a Spatial Data Infrastructure.

Quotations from the workshop findings:

... If relevant and good decisions are to be made by public authorities, private resource users or community bodies, they must be based on sound information about the land and environment in order to contribute to Sustainable Development.

*These ambitious goals will not be achieved unless there is a commitment to designing and implementing effective **land administration infrastructures**. These may be described as the organisations, standards, processes, information and dissemination systems and technologies required to support the allocation, transfer, dealing and use of land.*

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

and one quotation from the recommendations:

Encourage the flow of information relating to land and property between different government agencies and between these agencies and the public. Whilst access to data, its collection, custody and updating should be facilitated at a local level, the overall land information infrastructure should be recognised as belonging to a national uniform service to promote sharing within and between nations.

C5.2. FIG Agenda 21

In the foreword to the publication “FIG Agenda 21” the President of FIG Robert W. Foster makes the following statement:

“Dealing with surveying, planning and management of land and water resources, laws and systems needed for access to land and security of tenure, and with geographic information in all its aspects, the surveying profession is deeply involved in issues of profound importance for Sustainable Development ...”

FIG Agenda 21 gives examples and directions on how surveyors can contribute to implement and support Sustainable Development in all regions of the world.

Chapter IV is dedicated to Spatial Information for Decision Making. After having underlined the importance of data as a basis for decision making, the attention is drawn to the fact that although data quite often exists, it is difficult to access and, is not standardized etc. Finally it is pointed out that the lack of infrastructure is a barrier for sharing, use and reuse of data.

Quotations from FIG Agenda 21 Chapter 6:

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.

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.

C6. United Nations Activities related to Spatial Data

In 2001 the United Nations arranged two regional conferences addressing topics related to spatial information.

1. The Seventh United Nations Regional Cartographic Conference for the Americas was held in New York 22-26 January 2001 /7/
2. The second meeting of the Committee on Development Information (CODI-2) arranged by the United Nations Economic Commission for Africa was held in Addis Ababa 4-7 September 2001. /8/

The outcome of the Conferences is recommendations calling attention to the need for Spatial Data Infrastructure.

C6.1. The Regional Cartographic Conference for the Americas

At the opening of the conference the following was highlighted:

“The concept and realization of the value of Spatial Data Infrastructure was increasing. There was increasing facilitation of access to a wide range of data, and the challenge was how to harness the capability. The barriers were not related to technology but, in order to restructure and focus on standards, various national mapping programs would be required.... In 2000, various governments in the Americas, in collaboration, created a Permanent Committee on Spatial Data Infrastructure of the Americas.....”

Spatial Data Infrastructure is mentioned in most of the 10 resolutions adopted by the conference. Resolution no 7 is about “Implementation of National Spatial Data infrastructures in the Americas”.

The conference recommends:

That the member states share experiences and address common needs and interests within the Americas and with other regions of the world, through the Permanent Committee on Spatial Data Infrastructure for the Americas;

That all countries of the Americas embrace the concept of national spatial data infrastructures and develop implementation strategies that support regional and global SDI initiatives while meeting national objects.

C6.2. Meeting of the Committee on Development Information

The Development Services Division of UN-ECA had prepared a position paper: “The Future Orientation of Geoinformation Activities in Africa”. The aim of the paper was “to raise awareness of African governments on the importance of geographic information.”

The conclusion of the position paper is:

It was established early in the paper that the future orientation of GIS does not lie in the technology itself, but in its use to process data to support spatial decisions and services.

Experience in some African countries suggests that emphasis on the technology might result in the acquisition of hardware, software and peripherals with no clear plans on how to use them. Others might go a step further and use the technology to digitise maps and simply automate map productions, creating large digital databases, which would be locked away for departmental use, with all the flaws of the present manual systems.

Following experience in other jurisdictions, emphasis should be placed on data management and dissemination. The vision is to ensure that spatial data permeates every aspect of society and that they are available to people who need them, when they need them, and in a form that they can use to make decisions with minimal pre-processing. Also the collected data sets should be put to the maximum possible uses by publicising their existence and making them easily available to the widest possible audience. The most efficient and effective way to achieve these two related objectives is to establish spatial data infrastructures, using GIS technology to maintain and exploit the SDI. The future orientation of GIS in Africa is therefore as a ubiquitous tool that is integrated into the SDI concept, rather than as an end in itself. /9/

The paper, strongly recommended to all interested in Spatial Data and Information, became endorsed by the meeting.

On the background of national reports, prepared contributions from invited speakers and a seminar on Spatial Data Infrastructure the Committee on Developing Information recommends:

- That the member states give priority to the establishment of SDI's;
- That regional SDI's should be established to meet the wish for regional applications;
- The establishment of a permanent committee on SDI's for Africa

The Committee recommends on Spatial Data Infrastructure (SDIs)

Member States give priority to establish their NSDIs with all the necessary components (national standards, metadata, clearing house, national database). The content of the core datasets should be defined by a collective effort of all GI stakeholders in the country;

For regional applications, Regional Spatial Data Infrastructure (RSDI) be established with an African Regional Database as a component, based on a unified African Reference System;

A permanent committee on Spatial Data Infrastructure for Africa be established to:

- *promote the coordinated establishment of SDIs in African countries,*
- *facilitate the establishment of RSDI and the African Regional Database.*

The permanent committee should follow the model of the Permanent Committees for the Americas (PC-IDEA) and for Asia and Pacific.

Member states to participate in the work of the proposed permanent committee and in the work of appropriate technical committees of the International Standards Organization, notably Technical Committee 211 (ISO/TC 211);

The Committee recommends on Policy:

Mechanisms be immediately set in motion by African countries to develop the national GI policy as an integral part of the National Information and Communication Policies;

African countries should develop appropriate institutional, legal and technical framework to integrate land administration and topographic programmes within the context of a wider national strategy for spatial data infrastructure;

African countries should follow, properly adapted, the model policy guidelines presented in ECA's position paper on Future of GI activities in Africa;

Further investigation be done on the regulatory conditions under which NMA's are eligible for competitive valued-added production and on the concept of cost recovery in various accounting and financial regime.

C7. FIG Commission 3 - Spatial Information Management

In 1998 the field of responsibility for Commission 3 was changed from Land Information System and GIS to Spatial Information Management. To day the term Spatial Information Management (or Geographic Information Management) has been adopted by several involved in the traditional GIS businesses.

The new field of responsibility found expression in the following “Terms of reference”:

- Management of land, property and hydrographic information and the related processes, procedures and resources
- Spatial Data Infrastructure – data models, standards, availability and legal aspects, management of spatial knowledge
- The impacts on organisational structure, business models, professional practice and administration
- Management of Spatial Information supporting Sustainable Development.

Against the terms of reference the Commission formulated the following mission statement:

“Towards a digital earth” - How to change raw data into understandable information.

C7.1. Work Plan 1998-2002

Commission 3 works through the Working Groups and by bringing people together. In 1998 three working groups were established:

- WG 3.1: Spatial Information Management: technical approaches
- WG 3.2: Spatial Data infrastructure
- WG 3.3: Facilitating Spatial Information and Knowledge Management for decision support: through appropriate organisational, political, business structure.

At working weeks, annual meetings and seminars the Commission offer people from different countries the possibility: to share experiences, to become members of a global network and to become friends.

The results of the Working Groups and the meetings are made available to the professional and political community in the form of reports and proceedings.

Information on the Commission and its activities and results is available on the Commission homepage on <http://fig3.boku.at>.