Better way of Access, Use, Maintenance and Dissemination of Spatial Data

SDI Seminar

Design and Development of Spatial Data Infrastructure SDI

Tehran, Iran

Presented by

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Organised by

TAVANIR Co.

Information Technology Group

THE UNIVERSITY OF MELBOURNE

Introduction and Background

Advanced spatial information and visualization technologies1 have enabled new methods and tools for collecting, disseminating, sharing, integrating, and using spatial information. The access to such information as a primary input to planning and implementation of various projects, policies, and programs is the key prerequisite for its effective use. To address this need for easy access to accurate, consistent, and up-to-date spatial information resources spatial data infrastructures (SDI) are created globally as well as by many countries, international regions, and localities.

SDI is an evolving concept about facilitation and coordination of the exchange and sharing of spatial data between stakeholders from different departments, organisations and jurisdictional levels in the spatial data community. SDI becomes core infrastructure supporting economic development, environmental management and social stability in developed and developing countries alike. In order to develop and maintain such an infrastructure and an enabling platform, any organisation and community needs to pay more attention to capacity building. In response to this need, this Seminar has been designed and will be conducted for it.

The focus of the seminar is on 'Design and Development of Spatial Data Infrastructures'. The seminar introduces the concept and hierarchical nature of SDIs as well as discussing some SDI applications, issues and challenges for future SDI development. The structure is based on the book '*Developing Spatial Data Infrastructures: from concept to reality*', Taylor and Francis, UK, edited by Prof Ian Williamson, Dr Abbas Rajabifard and Mrs Mary-Ellen F. Feeney, all from the Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne. The SDI book aims to clarify the SDI concept by allowing practitioners and researchers from different backgrounds and jurisdictions to document their understanding of SDI and to share their experiences in building and analysing SDI.

The seminar aims to provide an understanding of the concept and application of SDIs, with a range of topics giving different perspectives to the concept of SDIs. The discussions throughout the seminar allow participants to share knowledge, and are a good opportunity to discover the other participants use and understanding of spatial data in their different departments and organisations.

The key issues are concerned with data availability, accessibility, and applicability as well as the importance of partnerships among of stakeholders and securing funding for the development, and of ensuring SDIs are user driver, interoperable and integratable.

The SDI seminar has been organised jointly by TAVANIR Co. and IT Group, Tehran and designed and presented by Dr Abbas Rajabifard, Deputy Director, Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne, Australia.

Program

Morning Sessions

Session 1 (9.00-10.30)

- Registration
- Opening and Introduction to the Seminar
- Setting the Scene
- Overview of the Program
- GIS and Spatial Data Technologies
- SDI Concept, Nature and SDI hierarchy

Discussion

Tea Break (10.30-11.00)

Session 2 (11.00-12.30)

- Global Initiatives
- Regional SDI initiatives
- National SDI Initiatives
- State and Local SDI Initiative

Discussion

Lunch Break 12.30-13.30

Afternoon Sessions

Session 3 (13.30-15.00)

- SDI and Decision-Support
- SDI Capacity Building
- Financing SDI Development
- SDI and Marine Administration
- SDI Development-Technical Aspects

Discussions

Tea Break (15.00-15.30)

Session 4 (15:30-16:30)

- Policy and Privacy Issues
- Future Directions

Discussions

Closing Session

Seminar Content

Introduction to the Seminar and Setting the Scene

The first part of the seminar aims to address the need for a broad understanding of the complexity and nature of spatial data, spatial data technologies (including GIS), SDIs and explores some of the key drivers influencing SDI development. One of the challenging questions is the definition of SDI or determining what constitutes SDI. The difficulty is that SDI is an evolving concept that sustains various perspectives or views depending on the user's interests and the role of the concept within the broader SDI hierarchy. This part will also discuss the importance of understanding the needs of society and the social system in which an SDI operates and will highlight some SDI issues.

SDI Concept and Nature and Components

This session aims to discuss the nature and concept of SDI, including the components which have helped to build the current understanding about the importance of an infrastructure to support the interactions of the spatial data community and their partnerships. Several examples of how SDIs have been described to date are offered to aid understanding of their complexity. The session introduces the concept of an SDI hierarchy followed by a review of hierarchical reasoning and its properties.

SDI Hierarchy

Global SDI
Regional SDI Initiatives
National SDI Initiatives
State and Local SDI Initiatives

SDI Capacity Building

This part discusses the capacity building concept and looks at capacity assessment and capacity development as the two key components. Within capacity development it considers the levels and dimensions of capacity. The lecture then introduces the evolving SDI concept and explores how capacity building is essential in delivering an operational SDI.

Financing SDI Development

SDI development is a long-term process. To secure success of this process, there is great need for understanding and developing funding models to guarantee ongoing SDI development and maintenance. This topic will highlight the importance of financing SDI development and generating additional interest in the economic aspects of SDIs.

SDI Development-Technical Aspects

This session focuses on a selection of the many technical issues associated with the development and implementation of SDIs. The lecture discusses the need for the development of a framework enabling SDI to incorporate new applications for data use and access. This is achieved through the review and evaluation of existing access models, polices and standards, and infrastructure requirements for key components of SDIs, data, access network, policies, standards and people, in relation to web-based and wireless applications that use spatial information.

Policy and Privacy Issues

Limitations and challenges faced by SDI developers, implementers and managers, especially issues created by collection, publication and merging of data affecting individuals and businesses, and the importance of considering the commercial and social dimensions of information, will be covered.

Future Direction

The seminar concludes with a discussion on future directions for SDI development and in particular Iranian National SDI development.

Discussion Sessions

During the course of the seminar there will be different discussions and possibly breakout sessions to provide opportunities for participants to discuss and share their experiences on different issues and topics related to data access and sharing.

SDI Seminar

Setting the Scene

1.1 INTRODUCTION

We live in an age of information with this information being essential to tackle the issues of today's society. Spatial information in particular is one of the most critical elements underpinning decision-making for many disciplines. In the past we used maps to show where people and objects were located. Today this has evolved into a complex digital environment with sophisticated spatial and related textual databases, satellite positioning, communication networks like the Internet as well as wireless applications.

It seems for decades that the spatial information industry has been endeavouring to raise the profile and importance of spatial information within the wider society, yet it is only in the last few years that the message is starting to be heard. The reasons are many and varied, but the result is the same – governments are starting to listen. Two recent examples in Australia are firstly the Prime Minister (Howard, 2002), in announcing the national research priorities, identified geo-informatics as an example of a frontier technology for building and transforming Australian industries, along with bio-technology and nano-technology. Secondly, the Minister for Science (McGauran, 2002) announced the awarding of a major research grant to support a joint industry, government and university Cooperative Research Centre for Spatial Information. This attention is placing the management of spatial information and Spatial Data Infrastructures (SDIs) under the spotlight. It follows earlier statements such as in the USA by President Bill Clinton (Executive Order, 1994) and Vice President Al Gore (1998).

SDIs, which are the focus of this seminar, are allowing spatial information to be integrated and accessible within a complex digital environment and in so doing are increasingly underpinning the relationship of humankind to land, and the management of natural resources and the marine environment by enabling spatial information to support planning and decision-making. SDI is an initiative intended to create an environment in which all stakeholders can co-operate with each other and interact with technology, to better achieve their objectives at different political and administrative levels. In simple terms SDIs facilitate the sharing of data. By avoiding duplication associated with generation and maintenance of data and integration with other datasets, and facilitating integration and development of innovative business applications, SDIs can produce significant human and resource savings and returns.

SDIs have thus become important in determining the way in which spatial data are used throughout an organization, a state, a nation, different regions and the world resulting in the consequent development of the SDI concept at different political and administrative levels and the development of the SDI hierarchy.

This structure and the content of this seminar builds on a number of previous initiatives which have focussed on the concept and development of SDIs and the sharing of development experiences. The latter has included an increasing number of conferences on SDIs, with the leading forums being the Global Spatial Data Infrastructure (GSDI) conferences, United Nations Regional Cartographic Conferences, the meetings of the UN-sponsored Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and such initiatives as the Digital Earth conference and the International Symposium on SDI. These forums form the basis of professional SDI development networks facilitating the exchange of experiences and the sharing of problems as well as opportunities, to look for solutions in the experiences of others in different jurisdictions.

To support the evolving concept and practitioner development, the SDI Cookbook (GSDI, 2000) was produced by the GSDI as an online resource drawing examples from a variety of national level developments, to give practitioners access to SDI development experiences. At the same time there have been a number of books written which deal with the evolving concept, such as "Framework for

the World" by Rhind (1997), "Governments and geographic information" by Masser (1998), "Geospatial Data Infrastructure – concepts, cases and good practice" by Groot and McLaughlin (2000) and the forthcoming book "World Spatial Metadata Standards" edited by Moellering et al., (2003) to be published by the International Cartographic Association (ICA).

All these and many conference papers, journal articles and book chapters are contributing to our understanding of the evolving SDI concept.

1.2 BUILDING SPATIAL DATA INFRASTRUCTURES

Our understanding of the evolving SDI concept is essential to the process of building SDIs. Building SDIs is a complex task not just because of the evolving nature of the SDI concept, but as much because of the social, political, cultural and technological context to which such development must respond. The latter is shaped by the need for spatial information to meet and support the objectives of sustainable development, land administration, a broadening spectrum of users and developers, not to mention the different challenges of developed and developing nations. This section will highlight some of these issues influencing the development of SDIs.

1.2.1 SPATIAL DATA IN DEVELOPED AND DEVELOPING COUNTRIES

Spatial data and spatial data products are becoming a consumer good in countries throughout the world, especially when connected to positioning technologies such as Global Positioning Systems (GPS) and when utilising a range of communications networks including the Internet, as well as wireless applications. The key driver in the commercialization and public use of spatial data is the ready availability of spatial datasets at medium to large scales, showing road networks, the land parcel framework, street addresses and topography. The use of these datasets for government, the private sector and recreational use is expanding rapidly as societies are becoming more spatially enabled - that is technology is available to assist in the use of spatial information to support decision-making and people are able to use the technology and access data to support their decisions.

Spatial data is considered a force multiplier in the military and provides a strategic advantage to many businesses. This use of spatial data and the rapid expansion of spatial data applications are driving the need for jurisdiction-wide policies surrounding the creation, maintenance, custodianship and use of spatial data – in other words the development of the SDI concept. As fast as information technology is changing, the SDI concept is evolving and adapting to capitalise on the new technologies and to meet the ever changing needs of society. One of the objectives of this book is to identify these changing needs and to explore the evolving SDI concept.

The reality is that every country is at a different point in the 'SDI development continuum'. The situation described above is most common in highly developed countries which may be considered to be positioned at the front end of the SDI development continuum. The situation however is very different in many developing countries, which are just starting SDI development, or those countries where adoption of the SDI concept is not even under consideration.

In developed countries the push towards a spatially enabled society and the need for jurisdiction-wide spatial data policies has resulted in major institutional changes. This is reflected by a world trend for spatial data and land related information activities to come together in one organization. This re-engineering of the institutional arrangements in developed countries has not been easy and has resulted in many political, administrative and professional challenges.

On the other hand, many developed countries still have fragmented institutional arrangements in the spatial data and land information area. It is not uncommon to find a range of different government departments, often in different ministries, responsible for different aspects of the management of spatial data. The result is that spatial data is held in independent silos with often little contact between them. Examples of different government agencies include those for land registration, cadastral surveying and cadastral mapping, planning, land valuation, administration of state lands, geodetic control and national mapping. The problem is often exacerbated by some functions being under the control of state governments, national governments and defence organizations. It is not surprising that moves to establish SDIs under these circumstances are problematic at best or non existent at worst.

The difficulties this places on developing countries moving to establish an information society, which is sensitive to sustainable development objectives, are huge.

Between these two extremes are the majority of countries which are positioned at different points on the SDI development continuum. However even the poorest and least developed country can still adopt SDI principles and implement strategies which can lead them to develop SDI in the future, such as the creation of a common base map and reforming institutional arrangements for spatial data.

1.2.2 SDIS AND THE "TRIPLE BOTTOM LINE"

While the growth of spatial datasets and the use of spatial data rapidly expanded in the latter part of the 21st Century, it was not until the creation of jurisdiction-wide spatial databases that Geographic Information System (GIS) functionality could be incorporated into mainstream decision-making and government administration, and could support mainstream private sector activities. The resulting government administrative structures supporting the establishment and maintenance of these jurisdiction-wide spatial databases promoted the growth of and need for the SDI concept.

In the meantime no country today can ignore the economic, social and environmental dimensions of sustainable development. In most cases the developed world has embraced the concepts more than most developing countries with the "Triple Bottom Line" (economic, social and environmental considerations) now driving a great deal of government policy.

The growing inter-dependency between sustainable development and SDIs has evolved over the last decade. The economic, social and environmental dimensions of sustainable development and the use of GIS initially had a project focus in the natural resources sector but have been gradually tied to the evolution of land administration systems and in turn the evolution of the SDI concept. This has been emphasised and highlighted in such international statements as the joint UN-FIG Bogor Declaration on Cadastral Reform (FIG, 1996), the UN-FIG Bathurst Declaration on Land Administration for Sustainable Development (FIG, 1999), FIG Agenda 21 (FIG, 2001), The Nairobi Statement on Spatial Information for Sustainable Development (FIG, 2002a), Land Information Management for Sustainable Development (FIG, 2002b) and resolutions of UN Regional Cartographic Conferences for Asia and the Pacific (UN, 2000) and the Americas (UN, 2001).

It was logical that governments recognised the important link and inter-dependency between achieving sustainable development objectives and establishing and maintaining SDIs as described above. In many countries SDIs are now being seen as a key component in delivering a jurisdiction's "Triple Bottom Line".

1.2.3 THE EVOLVING SDI CONCEPT

The evolution of the SDI concept has paralleled the development of complete digital spatial datasets in jurisdictions. As a result of the availability of jurisdictional-wide spatial data and the many opportunities this presents to both the government and private sectors, the institutional, legal and technical arrangements to support and facilitate the use of this spatial data have been re-engineered. One result highlighted over the last decade has been the evolution of the SDI concept.

Originally the focus of SDIs was on the type, the development of and access to the various spatial datasets. As the concept has evolved it has expanded to include a focus on people, access, policies and standards in relation to the data, as well as adopting a shift in emphasis from what can be called a "product-based" approach to a "process-based" approach in SDI development (Rajabifard et al, 2002).

Discussion of the SDI concept also initially focussed on nations as an entity, while the last few years have seen more attention given to understanding the SDI hierarchy, from local level, through to state, national, regional and global levels. In general the various levels in the SDI hierarchy are a function of scale with the local government and state level SDIs usually concerned with large (1:5,000) and medium (1:25,000) scale data, whereas National SDIs tend to be small scale (1:25,000-1:100,000) with regional and Global SDIs adopting the scale of the global map of the world (1:1,000,000).

With an improved understanding of the SDI hierarchy has come the challenge to improve the relationships between SDIs in different jurisdictions as well as between different spatial data initiatives. As identified throughout this book the key to building successful SDIs is in the

establishment of these relationships, especially through mutually beneficial partnerships, which are both inter- and intra-jurisdictional within the SDI hierarchy.

What is certain is that in the foreseeable future the SDI concept will continue to develop to a large degree in parallel with the evolution of information technology and the mainstreaming of sustainable development objectives in government polices.

1.2.4 SDIS AND LAND ADMINISTRATION

While the early focus of conferences and forums on SDIs was at a national level, and then in parallel with the growth of Regional SDIs such as the PCGIAP, the European initiatives and of late the Permanent Committee on GIS Infrastructure for the Americas (PC IDEA), one area of SDI development which has equivalent impact on society has not considered in depth. This is SDIs based on large scale data, such as those closely linked to land administration activities. These forms of SDI, which are linked to land administration activities such as the operation of land markets (land registration, cadastral surveying, land use planning, valuation, local government administration, administration of utilities and services) or natural resources management, have not received the same amount of attention internationally, yet could be considered to be more complex.

The key aspect about the form of SDI which is linked to land administration is that it is fuelled by people-relevant data – this data provides a richness to the SDI which distinguishes it from the typically small scale data in national, regional or Global SDIs. While the last decade has seen the evolving SDI concept focus on National SDIs, there is an expectation that the next decade will focus much more on large scale SDIs and particularly those related to land administration activities.

The very close relationship between land administration and SDIs in a large-scale context was the driving force behind the establishment of the Centre for SDIs and Land Administration in the Department of Geomatics at the University of Melbourne (University of Melbourne, 2003). This Centre receives significant funding from the State Government of Victoria, due to the need to better understand the complex issues surrounding the role of spatial data in an information society with a focus on the role of SDIs and land administration.

1.2.5 SDIS AND THE GOVERNMENT, PRIVATE AND ACADEMIC SECTORS

Another early focus on SDIs has been the emphasis on the role of government as having the primary or even sole responsibility for their development. As more jurisdiction-wide spatial datasets are completed, and increasingly in larger scales, so the role of the private sector has increased in the collection, maintenance and provision of spatial data within the context of SDIs. The private sector is now playing a greater role in both developed and developing countries in supporting the establishment and maintenance of SDIs.

The sector which has not had the same attention as the government and private sectors, is the academic sector, which is responsible for education, training and research in SDIs. While there are some excellent examples of commitment from the academic sector to SDI education and research, particularly in Western Europe, North America and countries like Australia, the attention is minor and in its infancy compared to the more traditional disciplines within the spatial data sector, such as GIS, positioning technologies (GPS), data collection and technologies such as remote sensing. What is certain is that the continued development of the SDI concept, like other areas within the spatial information discipline, is dependent on a close working and mutually beneficial relationship between the government, private and academic sectors.

It is hoped that this book will encourage a greater awareness of the need to pursue education, training and research in the development and maintenance of SDIs and to ensure that the academic sector plays an equivalent role to the government and private sectors by providing the capacity, and the research and development to ensure that the SDI concept will continue to evolve and be relevant to the users of spatial data.

1.2.6 SDIS AND USERS

The move into the digital environment has seen a very significant institutional change to the position where users are now the dominant driver in the establishment of spatial databases and the underpinning SDIs. While there is still a great deal of interest in international forums on investigating and better understanding SDIs, without a use or a business application an infrastructure such as SDI has no justification for its existence. A simple analogy is the road network, which is a classic example of an infrastructure. If there were no vehicles to travel along the roads then there is little justification for today's sophisticated road network.

Another reason why users are having far greater say than in the past on what spatial data is required and how it should be accessed is due to the rapid increase in the different forms of uses being found for spatial data. A good example is the increasing interest over the last couple of years on the need for improved emergency response, which can range from the provision of road networks and satellite positioning devices to support for police, fire and ambulance in an emergency, to a better understanding of the complex spatial requirements in mapping bushfires and responding to bushfire threats or other environmental disasters. As the wider community is learning to better use spatial data for making better decisions, then we are seeing the decision makers increasingly demanding more in the way of content, quality and ease of access to spatial data.

As a result, in very simple terms the future development of SDIs and the use of spatial data will be driven by the users. In many countries this will require a change in focus in the development of SDIs, away from government directives to listening to the needs of the wider community and non-government organizations to a far greater extent.

1.2.7 TECHNOLOGY AS AN SDI DRIVER

Technology has clearly been one of the most important, if not the most important, driver in influencing the evolving SDI concept. Ongoing changes and improvements in technology will ensure that the SDI concept continues to evolve for many years to come. To a large extent the SDI concept is tied to the development of jurisdiction-wide digital spatial databases, which in turn have promoted the need for SDIs. From a theoretical point of view, SDIs are not technology dependent; however, all the components of an SDI are influenced by technology with all the spatial technologies having an influence in one way or another on SDI development.

There is currently great optimism about the potential of information and communication technologies in revolutionising most applications that are dependent on spatial data. Communication technologies such as the Internet and wireless applications are revolutionising methods of maintaining, disseminating and accessing spatial data. The convergence of wireless communications, positioning technology and network computing is now capable of providing new facilities and new applications and as a result, new challenges for spatial data providers and users. To fully utilise these technologies there must be a clear understanding of how they impact on and assist in the development of an SDI.

1.3 CHALLENGES FACING SDI DEVELOPMENT

1.3.1 DEVELOPING AN SDI VISION

Even though good management practices demand the development of a vision prior to the determination of specific objectives and implementation strategies for managing projects, it is surprising how few jurisdictions have developed a simple vision for their SDI. Such a vision provides a road map and a way forward for the development of more detailed objectives and implementation strategies. Typically such a vision is part of a three to five year implementation strategy, although three years is preferable due to the continued evolution of the SDI concept and fast changing technology.

1.3.2 RAISING COMMUNITY AWARENESS OF SPATIAL DATA

The last couple of years have seen spatial data and associated technologies becoming mass consumer goods (such as the availability of low cost hand held GPS receivers having national street address

datasets), a scenario that was hard to imagine a decade ago. Today in most developed countries spatial data has permeated the wider community albeit in a transparent manner.

Unfortunately, one of the draw backs of such transparency is that the term "spatial" is still misunderstood by the wider community with many people believing it relates to activities or associated technologies in Space. While professionals in the discipline may refer to a community becoming 'spatially enabled', that community more often than not is not aware how spatial data and the associated technologies are supporting activities which identify street address, location and other everyday activities.

There is an argument that it is not necessary for the wider public to understand the role of spatial data and associated technologies in delivering emergency services or something as simple as ordering a taxicab, just in the same way that they do not have to know anything about information technology to be able to use a computer or the technology in a car in order to drive one. In the same way that much of the wider community still has difficulty in reading maps, it is likely there will continue to be a lack of understanding about spatial data and associated technologies in the years ahead.

On the other hand, just as some understanding of the operation of a computer or the operation of a motor vehicle allows the user or driver to gain greater benefit from the technology, so does a greater understanding of spatial data and associated technologies provide users with a greater ability to use the data to better serve their needs. Therefore, while it is unreasonable to expect the wider community to appreciate the detailed nature of spatial data and associated science and technologies, there is no doubt that appropriate education and training of the use of spatial data and associated technologies will improve both the spatial information industry and benefit the community at large.

Therefore, while governments and the private sector will continue to develop SDIs they will need to invest significant resources into explaining the use of spatial data and technologies to the wider community if the full potential of SDIs is to be realised.

1.3.3 THE MARINE DIMENSION OF SDIS

In the same way that land administration systems have traditionally only focussed on land and have stopped at High-Water Mark, SDIs have also typically only related to land. With the increasing focus on large to medium scale data in SDIs, the closer relationship with land administration systems, and the trend for rights, restrictions and responsibilities relating to land to move from the land into the marine environment, there is a trend for SDIs to cover both the land and marine environments depending on the responsibility of the specific jurisdiction. This is particularly relevant in the coastal zone.

If an SDI is seen as an infrastructure for a jurisdiction or nation, then that infrastructure should cover those areas which are the responsibility of the jurisdiction - for most countries this includes both land and marine environments – so it is inevitable that SDIs will include marine areas.

1.3.4 SDIS AND PRIVACY

There have always been issues in many countries with regard to restricted access to maps as a result of security and defence considerations. Unfortunately the laws and policies of these countries have not kept pace with technology whereby medium scale maps can now be produced of any country from high resolution satellite imagery. As a result, the historic restrictions on access to spatial data, at medium to small scales, is no longer valid.

This is not usually the case for large scale spatial data when it concerns land parcel data resulting from land administration systems, and where it is possible to identify the owner and/or occupier of a particular property. The use of spatial technologies for these purposes does raise significant issues of privacy which should be taken into consideration when designing those components dealing with large to medium scale data in SDIs. Similar arguments relate to spatial technologies used to identify the location of mobile phone users as another example.

Since the trend is for more large scale spatial data becoming available in SDIs, the issues surrounding privacy will increasingly require attention in the development and administration of future SDIs.

1.3.5 STRENGTHENING INSTITUTIONAL ARRANGEMENTS FOR SDI DEVELOPMENT

The emergence of a spatially-enabled information society as a result of the development of jurisdiction-wide digital spatial datasets has had a major effect on those institutions, both in government and in the professions, which support spatial information. For the past fifty or possibly a hundred years or so, the institutional arrangements for organizations in government responsible for surveying, mapping and land administration were relatively stable.

These government institutions were often led by a Surveyor-General or Chief Surveyor, supported by a surveying profession. They have had a long and well established history of over a hundred years in many countries. Historically the surveying profession was heavily influenced by the cadastral surveying or land boundary surveying segment of the profession, which was the largest sector of the profession.

The latter half of the 20th Century saw the growth of other professional bodies, such as cartography, and international bodies to represent the scientific interests of specialists in photogrammetry and geodesy. The last half of the 20th Century also saw the growth of associations concerned with the use of GIS technology such as the Urban & Regional Information Systems Association in North America (URISA).

While different countries and different regions of the world have had different interpretations or slightly different structures in accommodating these discipline areas, in general there was a similarity in the institutional arrangements, both in government and in the professions, supporting the spatial information industry (typically the surveying and mapping industry). Within this context the academic sector was represented primarily by schools of surveying which supported the surveying profession. Again there was great similarity between these academic programs around the world.

The impact of the spatial information revolution has significantly altered the historic institutional landscape in those countries which have moved heavily into information technology with their communities becoming spatially-enabled. This trend has also impacted on the manner in which the private sector organises itself to take advantage of the new opportunities presented by the new spatial information environment. Other chapters discuss this in greater depth but the result has been a continued re-evaluation of both government institutional structures and the professional organizations which support the industry.

What is clear from this brief overview is that if countries or jurisdictions are to take advantage of the spatial information revolution and the SDI concept, then major institutional changes are most probably required in government, in professional bodies, in higher education and in the private sector.

1.3.6 ENSURING CAPACITY FOR SDI DEVELOPMENT

An educated and trained workforce is an important component in building SDIs, a position which is usually not questioned. What is unclear is what form of education and training is required to produce this work force to support the growth of SDIs. For example the question could be asked where the professionals will be educated or trained who will have the educational background? The same question can also be asked for many other sections within the spatial information discipline, ranging from positioning technologies such as GPS to GIS, to data collection including photogrammetry and remote sensing, to measurement science through to land administration.

It is proposed in the medium term that a similar approach is taken as for the other sections of the spatial information discipline outlined above, and that is that specific courses on SDI be included in professional degrees in geographic or spatial information science, geomatic engineering, survey engineering, surveying and related disciplines. The SDI work force will be sourced from these programs and the graduates will have the knowledge and skills in geographic information science and technology as well as organizational, legal, institutional and sustainable development factors. In the short to medium term these formal courses can be supplemented by short courses run by organizations such as PCGIAP, GSDI, professional bodies or by universities which have the requisite expertise.

To complement this form of education it is expected there will be a continued expansion of educational initiatives concerned with SDI such as professional and research forums, text books, workshops and on-line facilities which are designed to enhance our understanding and development of the SDI concept and the potential of spatial information.

Just as the SDI concept will continue to evolve, so SDI education and training will need to evolve, recognising it will need to be a partnership between the educational institutions, the professional bodies and the government and private sectors.

1.3.7 SDI RESEARCH AND DEVELOPMENT

As in all technical disciplines, research and development is essential to the ongoing evolution of the technology and associated concepts. Research into SDIs is similarly essential if the concept is to grow and reach its full potential. At this point in time, international research in SDIs is in its infancy with only a handful of universities around the world actively pursuing SDI research. While much of the research which supports the development of SDIs can be considered as being undertaken under many related discipline areas in the spatial information area, such as in data collection, positioning, geographic information science etc., specific SDI related research could include:

- understanding, identifying and promoting the nature of SDI
- developing conceptual models of SDI within the SDI hierarchy
- comparing SDI initiatives to identify best practices
- investigating differences between the various levels in the SDI hierarchy
- investigating technical issues in support of SDI development and implementation including testing and evaluating prototypes
- technical issues concerned with interoperability and access
- data issues of privacy, intellectual property and security
- pricing policies and funding models
- statutory control of spatial data
- cultural and indigenous issues concerned with the establishment and maintenance of SDI
- establishment and integration of marine SDI within the SDI concept

While this is by no means a comprehensive coverage of the diverse range of challenges facing SDI development, it simply demonstrates some of the areas for research ranging from social and cultural dimensions, legal, policy and institutional considerations, through to technical issues and their intersection with the former. Nevertheless there is a whole range of issues which impact on the development of SDIs which need to be researched if the SDI concept is going to deliver its potential.

1.4 CONCLUSION

If we are going to design relevant SDIs we have to understand the spatial needs of society, the social system in which the SDI will operate, and the technical environment which the SDI will be required to support. We need a Global SDI vision which can facilitate the concept of Digital Earth and related initiatives. This latter concept is important for the future requirements of SDI and extends the concept of SDI further to incorporate a political, institutional and social dimension. It clearly shows the role that SDIs play in supporting good governance.

The concept being discussed in some jurisdictions is that government will enter into a contract with the community that all government decisions and policies would be based on data which is part of “The Virtual State” and is freely available to all citizens of the jurisdiction over the Internet. This promotes transparency in government decision-making. It is based on freely available data with the result that the wider community can review government policy decisions thereby promoting good governance and civil society. The importance of such a strategy is that all government spatial datasets need to be compliant with “The Virtual State” standards.

A vision such as “The Virtual State” raises issues of interoperability including data identification, data storage, data integration and accessibility of data. It also raises issues concerned with intellectual property and privacy of data. However, it is initiatives such as “The Virtual State” which will be one of the key driving forces for the development of future SDIs, recognising this will only be one of the many drivers influencing the development of SDIs. It is only a matter of time before the “The Virtual

State" concept manifests itself from local government all the way to a national level in many jurisdictions.

"The Virtual State" concept discussed above highlights that SDIs cannot be developed in isolation. They must be user-driven; otherwise they have no justification or purpose. The challenge for governments, the private sector, educators and researchers is to develop appropriate SDIs that can support the complex demands of society as described above and as explored throughout the course of this seminar.

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