



International SDI Short Course

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7th GSDI Conference 2004-India
2-6 February, Bangalore, India

ABSTRACT

Spatial Data Infrastructure (SDI) is an evolving concept about facilitation and coordination of the exchange and sharing of spatial data between stakeholders from different jurisdictional levels in the spatial data community. In order to develop and maintain such an infrastructure, the international community needs to pay more attention to capacity building. In response to this need, an International SDI Short Course held by the Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne from 19-21 November 2003. The course was conducted as a result of Resolution 5 (Capacity Building) of the 16th United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP) and was further endorsed at the 9th Permanent Committee on GIS Infrastructures for Asia and the Pacific (PCGIAP) meeting in Okinawa, Japan, July 2003.

The focus of the course was on 'Developing Spatial Data Infrastructures'. It introduced the concept and hierarchical nature of SDIs as well as discussing some SDI applications, issues and challenges for future SDI initiatives. The structure over the three days was based on the book '*Developing Spatial Data Infrastructures: from concept to reality*', Taylor and Francis, UK.

The course provided an understanding of the concept and application of SDI, with a range of speakers giving different perspectives to the concept of SDIs. The practical sessions and discussions throughout the course allowed participants to share knowledge, and were a good opportunity to discover the other participants use and understanding of SDIs in their different jurisdictions and organisations.

The key issues that were highlighted concerned 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 were user driver, interoperable and integratable. The course finished with a group discussion on the future directions and the key challenges for SDI development.

This paper presents and discusses the contents, structure and the outcomes of the course as well as the issues and challenges for increasing awareness and capacity building in SDI.

INTRODUCTION AND OVERVIEW

From 19-21 November 2003 there was an international short course on Spatial Data Infrastructure (SDI) held by the Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne. The course was held following the recommendation of Resolution 5 (Capacity Building) of the 16th United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP) and was further endorsed at the 9th Permanent Committee on GIS Infrastructures for Asia and the Pacific (PCGIAP) meeting in Okinawa, Japan, July 2003. The course focus was on Developing SDIs: from concept to reality and it introduced the concept and hierarchical nature of SDIs as well as discussing some SDI applications, issues and challenges for future SDI initiatives. The structure over the three days was 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. The course was designed and coordinated by Dr Abbas Rajabifard and Prof Ian Williamson, the Deputy-Director and

Director of the Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne, and 24 people were attended from seven countries, who were both suppliers and users of spatial data.

The course began with an overview of the need for a broad understanding of the complexity and nature of SDIs presented by Professor Ian Williamson in which he explored some of the key drivers influencing SDI development. There is general recognition that SDIs are not just about data (or maps) but include standards, institutional arrangements, delivery or access mechanisms, as well as people. Therefore, in this session it was also discussed the importance of understanding the needs of society and social system in which an SDI operates and highlighted some SDI issues. Within the same session an introduction to the concept, nature and hierarchy of SDIs was presented by the course coordinator Dr Abbas Rajabifard. This lecture was fundamental to the course in which it was helped to build the current understanding about the importance of an infrastructure to support the interactions of the spatial data community and their partnerships as well as the concept and nature of SDIs.

There were then several lectures which examined the role of SDIs at all levels, recognising that SDIs are hierarchical, ranging from corporate and local through global initiatives, and are based on dynamic relationships, which are both inter-jurisdictional and intra-jurisdictional. Mr Peter Holland, the President of the Permanent Committee on GIS Infrastructures for Asia and the Pacific (PCGIAP) and General Manager, National Mapping Division, The Geoscience Australia, presented a lecture on Global and Regional SDIs and the relationships between these and other SDI levels in the hierarchy. The participants then formed groups in which they discussed the differences between implementing SDIs in developed and developing countries, and reported back the five main differences from their group. Dr Rajabifard and Prof Williamson then gave lectures in the afternoon session on National and State SDI initiatives and also on SDI capacity building. These lectures covered the concept and relationships of SDIs at these jurisdictional levels and the need for capacity building in SDI implementation using Australia as a case study. The first day finished by extending the case study of Australia with lectures from Mr Paul Kelly (Executive Director, the Australian and New Zealand Land Information Council-ANZLIC) on 'Implementing the Australian Spatial data Infrastructure' and from Dr John Busby, Manager, The Office of Spatial Data Management, Australian Federal Government on 'Mobilising Spatial Data to Underpin Government Policies and Programs'. These lectures provided examples of National SDI applications and some of the barriers to implementation in data access and use.

The Australian case study continued the next day with three lectures on State, Local, and Corporate and Organisational SDI initiatives. Mr Bruce Thompson, Director, Land Information Group, from Land Victoria, Australia discussed the current status of Victorian State SDI and the partnerships with this state level SDI and other National and State SDIs. Mr Duncan Kelly an IT Business Analyst from the Maribyrnong City Council in Victoria and Dr T.O. Chan, Manager Geographic Information from the Department of Sustainability and Environment in Victoria then looked at Local and Corporate SDI initiatives. Mr Duncan Kelly provided an example of a Local SDI initiative from his city council and discussed the financial and cultural barriers to implementing SDI at this level. Following this lecture then Dr T.O. Chan examined the role of Organizational SDI initiatives and discussed how these can support higher level SDIs through the role of local and corporate stakeholders.

For the rest of the day the participants formed groups and were give one level (global/regional, national, state or local) in the SDI hierarchy to research. Each group was provided with a list of relevant websites from which they could learn about SDI initiatives at that particular level. The main aim of the exercise was to provide an opportunity for participants to visit, search and learn more about SDI development at different levels of the hierarchy. In order to achieve this aim, the following dot points been considered as a start point and the framework for the research within each website.

STRUCTURE (Finding it)

- Terminology relevant to users
- Usability
- Ease of use
- Service type (data set/server, catalogue, application, etc.)
- Minimal levels
- Search Function
- Link to other sites
- Etc.

CONTENT (Using it)

- Users expect to find
- About Us (who they are)
- Strategies (where to)
- What are they doing now?
- What level they done
- Access to datasets
- Access mode and method of supply
- Policy for assessment of progress/success
- Etc.

OTHER POINTS

- SDI Concept and Model
- Underlying Process
- Principles or mechanism/approaches
- Driving forces
- Obstacles
- Benefits
- Etc.

In the last session of the exercise, each group made a presentation of their findings/observations and there was general discussion from all groups about that level of SDI research. This gave participants the opportunity to be an SDI 'user' instead of a supplier and to examine their own initiatives from this perspective. There was also the chance to compare their web facilities with other similar initiatives to see areas that could be improved.

On the last day of the course, there were three more sessions of lectures and discussions. The first session gave some more practical applications of SDI with Ms Mary-Ellen F. Feeney from the Centre for SDIs and Land Administration, discussing the benefits of SDI developments for decision-making in which she discussed the challenges and features of SDIs supporting decision environments, decision complexity and the variety of participants in the decision process. Mr Andrew Binns from the same Centre then looked at SDI for a marine environment and marine cadastre. Mr Binns identified and quantified the various themes driving the development of marine cadastre, as well as explaining the concept of a marine cadastre and its relationships with SDI. Prof Ian Williamson then discussed the importance of and methods for financing SDI initiatives through encouraging investment from government and donor agencies. 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. Therefore, this lecture highlighted the importance of financing SDI development and generating additional interest in the economic aspects of SDIs.

In the next session Mr Peter Ramm from Land Victoria demonstrated the importance of basing SDI on a single, well-defined geodetic datum in his lecture on 'Positional Framework for SDIs'. When spatial data sets are built of different data based on mixed datums, the situation is more complex for building any level of SDIs. With this in mind, this lecture also examined aspects of data quality that are critical for seamless data integration. This session also had a lecture by Mr Rob Atkinson from Social Change Online, and Australian based company, who focused on the technical aspects of developing and implementing an SDI and highlighted the key components of SDI such as policy and standards. Mr Atkinson discussed the need for the development of a framework enabling SDI to incorporate new applications for data use and access. This was achieved through the review and evaluation of existing access models, policies and standards for key components of SDIs, in relation to web-based and wireless applications that use spatial information.

In the last session of the SDI Course, Ms Jude Wallace a Senior Research Fellow from the Centre for SDIs and Land Administration gave a lecture on policy and privacy issues with the availability of data that may affect individuals through SDIs. In this lecture Ms Wallace examined how policies involved in designing, building and managing SDIs at all hierarchical levels. Then she discussed the 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.

The course concluded with a discussion on future directions for SDI development, which in particular recognised the breadth and diversity of contributions to the course and the continuing need to bring the private, public and academic sectors together. As part of this session, the participants returning to groups to discuss the future directions of SDIs, and a presentation from each group of the key challenges for future SDI development. As a result of these discussions, the following points have been highlighted as important challenges and issues for the future directions of SDI developments:

- Legal frameworks
- Business drivers (changing environments)
- Language appropriate to audience, participate and engagement with users
- Communication infrastructures
- Funding models and mechanisms
- SDI should be embedded “seamlessly into society”, therefore SDI require:
 - Ongoing maintenance as any other infrastructures
 - Collaborative partnerships formed and maintained
 - Continued enhancement of policy and standards (transfer, access, usability)
- Societal and cultural drivers
- Capacity – knowledge, infrastructures and people
- SDI hierarchy (development of different level dependant on funding available)
- Issues in developing countries
 - Data availability, accessibility and usability
 - Financial stability
 - Expertise and educations,
 - Government stability,
 - Coordination of spatial data activities and programs
- Etc.

In summery, the course provided a good understanding of the concept and application of SDI, with a range of speakers giving different perspectives to the concept of SDI. The practical sessions and discussions allowed participants to share knowledge, and were a good opportunity to discover the other participants use and understanding of SDIs in their organisation. The key issues that were mentioned many times in the lectures were of data availability, accessibility, and applicability, and then of ensuring SDIs were user driver, interoperable and integratable. It was interesting to hear how people were going to use what they had learnt from the course in their SDI initiatives.

The following sections will provide a short description of each topic and lecture provided during the SDI course.

COURSE CONTENT

Setting the Scene

This lecture aimed to address the need for a broad understanding of the complexity and nature of SDIs and explores some of the key drivers influencing SDI development. One of the challenging questions was the definition of SDI or 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. There is general recognition that SDIs are not just about data (or maps) but include standards, institutional arrangements, delivery or access mechanisms, as well as people. This lecture also discussed the importance of understanding the needs of society and social system in which an SDI operates and highlight some SDI issues. The conceptual framework recognises that SDIs are hierarchical, ranging from corporate through global initiatives, and are based on dynamic relationships, which are both inter-jurisdictional and intra-jurisdictional.

Global and Regional SDI Initiatives

This session discussed and demonstrated current Global initiatives such as Global SDI and Global Map and their relationships with each other as well as with other SDI initiatives. The lecture explored the growing role of the regional SDI level, the 'pivot' between the state/national SDI's and the possibilities of attaining the GSDI vision. The lecture also evaluated how the organisational models of global initiatives can maintain and strengthen current relationships with other national and multi-

national SDIs initiatives. Based on this evaluation, recommendations and future directions were suggested to facilitate SDI development (design, implementation, support, etc.) at a multi-national level and to define the influence of Global SDI on the other levels in the SDI hierarchy. The lecture then discussed and demonstrated current Regional SDI initiatives and provided a comparative analysis of the strategies, organisational models, progress, issues and relationships with other SDI initiatives. Based on this, recommendations and future directions also were suggested to facilitate SDI development at a regional level and to define the influence of Regional SDI on the other levels in the SDI hierarchy.

National SDI Initiatives

This lecture discussed the nature of National SDIs and their relationships between Local, State and inter-national SDIs initiatives. There is currently a diversity of National SDI initiatives around the world. These vary from organisational and strategic models. However, the issues and challenges faced by these initiatives and their roles within the SDI Hierarchy are similar. With this in mind, this lecture introduced two generations of SDI development by evaluating the similarities and differences between initiatives and will in particular discuss the organisational models supporting SDI development in each jurisdiction. Based on this evaluation, recommendations and future directions were suggested to facilitate SDI development at a national level and to define the influence of National SDI on the other levels in the SDI hierarchy.

State SDI Initiatives

Following the National SDI initiative, this lecture discussed the nature of State SDI initiatives and their relationships between Local and National SDIs. There is currently a diversity of SDI initiatives within state (province or county) jurisdictions. These vary from those organised around administrative or political jurisdictions or around particular resources. However, the strategies, organisational models, issues and relationships between these initiatives are similar. Therefore, this lecture evaluated the similarities and differences between initiatives and will in particular discussed the importance of partnerships supporting SDI development in each jurisdiction. Based on this evaluation, recommendations and future directions were suggested to facilitate SDI development at a state level and to define the influence of State SDI on the other levels in the SDI hierarchy.

Capacity Building and SDI

SDI is an evolving concept about facilitation and coordination of the exchange and sharing of spatial data between stakeholders from different jurisdictional levels in the spatial data community. In order to develop and maintain such an infrastructure, the international community needs to pay more attention to capacity building. Having said that, we had a lecture on this subject.

This lecture discussed the capacity building concept and looked at capacity assessment and capacity development as the two key components. Within capacity development it considered the levels and dimensions of capacity. The lecture then introduced the evolving SDI concept and explores how capacity building is essential in delivering an operational SDI. In order to resolve the difficulty of applying the complex and often unclear nature of capacity building to the evolving and similarly unclear nature of SDI, capacity building for SDI in Australia is used as a case study.

Case Study-Australia

Part 1: Australian National SDI Initiative

This case study demonstrated in-depth the current status of National SDI development in Australia and its relationships to Local, State and inter-national SDIs initiatives. The past years have seen efforts to consolidate spatial information at a national level. A key initiative was the launching in September 2001 of the Spatial Information Industry Action Agenda by the Federal Minister for Industry, Science and Resources in Parliament House Canberra. Other activity included the establishment of a Permanent Secretariat and the appointment of an Executive Officer for ANZLIC, as well as the incorporation of the PSMA. ASIBA was established, as well as the formation of a Spatial Sciences Coalition to amalgamate the key professional and learned societies representing spatial information

interests in Australia. At the same time the education and research institutions established the Australian Spatial Information Education and Research Association (ASIERA). All these changes support development of a strong spatial information industry in Australia.

Part 2: State and Local Perspectives

This part of case study demonstrated the view of state and local governments on the development, implementation of and contribution to the National SDI initiative. As part of this case study, the first lecture discussed the current status of Victorian SDI initiative (as a leading state) and its relationships with the national and other state SDI initiatives. This lecture then explored the growing role of partnerships in the development of Victorian SDI initiatives. It was also evaluated how the organisational model of the Victorian SDI initiative can maintain and strengthen relationships with the national and other State SDI initiatives. Recommendations to facilitate SDI development at a state level and integrating with other levels in the SDI hierarchy also been identified.

The second and third lectures in this session demonstrated the foundation elements that are required to support SDI at a local level. The role of local and corporate stakeholders in development of digital spatial data to support local administration and higher levels of an SDI Hierarchy has been discussed. The lecture also explored the importance of partnerships in the development of SDI that links corporate, local and state initiatives.

SDI and Decision-Support

A key motivation for SDIs development is to provide ready access to spatial data to support decision-making. With this in mind, the aim of this lecture was to discuss the challenges and features of SDIs supporting decision environments, decision complexity and the variety of participants in the decision process. Spatial data and tools are central to addressing Agenda 21 action items, because they can be used to understand and integrate social, economic and environmental perspectives, and they can address relationships among places at local, regional, national and global scales. Since the adoption of Agenda 21 in 1992 there has been an increased emphasis on building human and technological capacity to access and use available spatial data to support decision-making. Important techniques for unlocking the potential of SDIs were reviewed in relation to the growing importance of the SDI role in decision support. The lecture concluded with a discussion on how evaluation of decision-support capacity may guide future SDI development and strengthen related data, technological and people activities.

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 lecture highlighted the importance of financing SDI development and generating additional interest in the economic aspects of SDIs. This was achieved through the review of existing funding models and the customisation of the models for the economic and political environments of emerging nations. The lecture then identified possible options for financing an SDI development by evaluating the efficiency of financial tools, including business plans, which practitioners can use to encourage investment in SDI by politicians and donor agencies to invest in SDI.

SDI and Marine Cadastre

The marine cadastre is an important topic for research both internationally and locally. In the terrestrial environment, the cadastre and initiatives such as the creation of the Australian SDI for example, facilitate effective decision making for sustainable development. The success of these tools and initiatives in facilitating effective decision-making and spatial data access mechanisms within the marine environment has given rise to research into a marine cadastre. The cadastre aims to define, visualise and realise legally defined maritime boundaries and the rights, restrictions and responsibilities attached to them. This lecture identified and quantified the various themes driving the development of marine cadastre, as well as explaining the concept of a marine cadastre and its relationships with SDI.

Positional Framework for SDIs

An SDI needs to be built on a solid positional foundation. It is desirable if the data are both compatible and homogeneous to reduce duplication and uncertainty. Nationally, regionally and globally this condition is best underpinned by a uniform geodetic infrastructure built on a single, well-defined datum as a fundamental layer in a spatial data set. When spatial data sets are built of different data based on mixed datums, the situation is more complex. Having said that, this lecture examined aspects of data quality that are critical for seamless data integration. The lecture reviewed experience with the traditional use of Class and Order for geodetic accuracy and the trend to the use of Positional Uncertainty in metadata standards.

SDI Development-Technical Aspects

This lecture focused on a selection of the many technical issues associated with the development and implementation of SDIs. The lecture demonstrated 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, policies 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. Based on this evaluation, recommendations and future directions have been suggested to facilitate SDI development for all levels in the SDI hierarchy.

Policy and Privacy Issues

This lecture examined how policies involved in designing, building and managing, SDIs at all hierarchical levels, can be identified, selected, implemented and measured. 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, have been covered. Significant issues of verifiability, transparency, maintenance, open-access and privacy will be discussed in the context of initiatives for making data from private individuals, businesses, government and agency sources available through new technologies. Strategies for implementation of overriding policies, such as legislation protecting privacy and contracts protecting confidential commercial information, have been examined. The differences between codes, protocols, standards, contracts, and laws have also been highlighted in terms of their capacity to balance competing policies of access and privacy.

Practical Exercises

This exercise provided an opportunity for participants to visit, search and learn more about SDI development at different levels of the hierarchy. Participants formed different groups in which each group selected one level of the SDI hierarchy (global, regional, national, state and local) to study by visiting some of the relevant websites and finding out about the characteristics, uniqueness, and current status of their development and future directions. Each group discussed the results of their research (within their group) and prepare a short presentation to summarise the results. At the end of the practical session then each group presented their results to all course participants. Following each presentation, there was discussions about that particular level.

Future Direction

The course concluded with a discussion on future directions for SDI development, which in particular recognises the breadth and diversity of contributions to the course and the continuing need to bring the private, public and academic sectors together. This collaboration is fundamental to stimulate continuing debate and education about the dynamic nature of SDIs. The SDI community is multi-disciplinary and draws on a wide range of experiences from the geographic information systems, computer science, land administration, geography, surveying and mapping, legal and public administration disciplines.

International SDI Short Course Course Program

Day	Morning		Afternoon				
	9.00-10.30		11.00-12.30				
Wednesday 19 Nov. Day 1 Presenters	- Registration - Opening Setting the Scene Overview of the Course SDI Concept, Nature and SDI hierarchy Prof Ian Williamson Dr Abbas Rajabifard	Tea Break	From Global to Local SDIs Global and Regional SDI initiatives Discussion Mr Peter Holland	Lunch Break	From Global to Local SDIs National SDI Initiatives State SDI Initiatives Capacity Building for SDI Discussions Dr Abbas Rajabifard Prof Ian Williamson	Tea Break	Case Study- Australia National and Federal Perspectives Discussions Mr Paul Kelly Dr John Busby
Thursday 20 Nov. Day 2 Presenters	Case Study-Australia State and Local Perspectives Discussion Mr Bruce Thompson Mr Duncan Kelly Dr T O Chan	Tea Break	Practical Exercises Different Groups: Global Regional National (Federated and Non-Federated countries) State Local	Lunch Break	Practical Exercises Different Groups: Global Regional National (Federated and Non-Federated countries) State Local	Tea Break	Practical Exercises Presentations by Different Groups Discussions Coordinators: Dr Rajabifard Prof Williamson
Friday 21 Nov. Day 3 Presenters	SDI and Decision-Support Financing SDI Development SDI and Marine Cadastre Discussions Mrs Mary-Ellen F. Feeny Prof Williamson/Dr Rajabifard Mr Andrew Binns	Tea Break	Positional Framework for SDIs SDI Development-Technical Aspects Discussions Mr Peter Ramm Mr Rob Atkinson	Lunch Break	Policy and Privacy Issues Future Directions Discussions Mrs Jude Wallace Prof Williamson	Tea Break	Closing Session

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the support of the University of Melbourne, Land Victoria of the Victorian Government, the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), and the member of the Centre for Spatial Data Infrastructures and Land Administration at the Department of Geomatics, the University of Melbourne, in the design and execution of the International SDI Short Course.

BIOGRAPHICAL NOTES

Abbas Rajabifard is Deputy Director of the Centre for Spatial Data Infrastructures and Land Administration, and a Senior Research Fellow in the Department of Geomatics at the University of Melbourne. He holds BSurv (Tehran), Postgrad-Dipl (ITC), MSc (ITC), and has PhD from the University of Melbourne. He worked for the National Cartographic Centre (NCC), Iran (1990-98), where he was the head of the GIS Department, managing the National Topographic Database and National GIS in Iran. He has been an Executive Board member and National representative to Permanent Committee on GIS Infrastructure for Asia and the Pacific 1994-1999, and member of International Steering Committee for Global Mapping 1997-2001. His current research and interest are spatial data management, SDI development models and SDI capacity building.

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Ian Williamson is Head, Department of Geomatics, University of Melbourne, Australia, where he is Professor in Surveying and Land Information, and Director of the Centre for Spatial Data Infrastructures and Land Administration. He is Chair, Working Group 3 (Cadastre) of the United Nations sponsored Permanent Committee for GIS Infrastructure for Asia and Pacific (PCGIAP). He was Chairman of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors (FIG) 1994-98 and Director, United Nations Liaison 1998-2002. His teaching and research interests are concerned with designing, building and managing land administration, cadastral, and land and geographic information systems in both developed and developing countries. He has consulted and published widely within these areas. <http://www.geom.unimelb.edu.au/people/ipw.html>