Guidance for Hydrographic Offices
IHO Publication C-17

Annex 1

Syllabus for Educational and Training Programmes for Marine Spatial Data Infrastructures

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Preface

The concept of Marine Spatial Data Infrastructures (MSDI) is gaining wider appreciation. MSDI is the combination of a variety of data types, for efficient analysis by a wide range of disciplines, such as maritime spatial planning, environmental management and emergency response. This requires the data to be held in a generic way, rather than for a particular product for a limited user group or for a specific purpose.

MSDI require data, technology, standards, and policies to work together for the common good. There is a tendency to focus on ICT and data, without sufficient focus on standards and people issues. It is also a common mistake to think that existing products fulfill data requirements. But for effective exploitation of the true value of the data, it cannot be restricted by the intentions of the product compiler or editor. MSDI are not collections of hydrographic products, but infrastructures that promote interoperability.

Many countries have already established National Spatial Data Infrastructures, or have initiatives to do so. The marine element is often less well developed and there is a tendency to start building SDI on spatial products rather than spatial data. This is a good start, but there is considerable scope for improvement.

The development of the IHO Universal Hydrographic Data Model (S-100) is a strong enabler of enhanced data sharing across multi-disciplinary groups. A declared intention of S-100 is that it will make the use of hydrographic data easier. It will extend the use of hydrographic data beyond the focus on navigation, going beyond ENCs to include imagery, dynamic data, and high-density bathymetry. Being based on ISO19100, S-100 has international and multidisciplinary recognition, such as with the Open Geospatial Consortium (OGC).

Given the scope of MSDI, e-navigation and e-maritime and no doubt other initiatives, Hydrographic Offices (HO) need to consider the extent of their domain and influence, and how this might need to change to address future expectation. At present most HOs work in a relatively restricted domain, mostly due to their government status, tightly defined responsibilities and funding arrangements. This limits their opportunities to reach their full potential as data custodians rather than product producers. Authorities who define the role of HOs need to be challenged to encourage them to support the wider potential of hydrographic data.

The potential for HOs to contribute to national and regional spatial data infrastructures is becoming more realistic. This requires serious consideration in terms of the consequences to how data is managed. It is therefore important to use a data centric approach, holding unique features such that they are stored once but used many times and to use S-100 internally and consider and promote wider use of data.

This syllabus should be seen as a tool to establish the fundamental knowledge about MSDI.

Comments arising from the experience gained should be addressed to the Chairman of the Marine Spatial Data Infrastructure working group.

This document is published periodically. Please check with IHO for the latest edition, including current amendments.

Definitions

TBA

The aim of the syllabus

The syllabus is about making sure decision makers and employers have the skills, knowledge and understanding to approach the different elements of MSDI.

It is not intended to set out exactly what the instructor should do.

The MSDI syllabus is a tool for communicating what should be the minimum content of a MSDI course. It acts as a "road map" for the MSDI courses and puts the students on the same path as the instructor. By setting the tone and describing the course structure, the syllabus is critical in implementing effective learning.

Learning outcomes

The syllabus sets out the learning outcomes that as a minimum must be achieved. It is important that components and elements from national and regional perspectives are also considered and added to the MSDI training course, in order to achieve the right skills, knowledge and understanding that is needed from a national perspective

In making sure these learning outcomes are achieved, the instructor should be able to:

- identify areas where the students are failing to demonstrate competence
- help the students to understand the barriers that are stopping them from demonstrating competence

Syllabus outline

The syllabus is divided in four, one MSDI orientation and 3 more detailed MSDI courses:

1. Provides a general introduction to MSDI.

2. Is a Syllabus for Fundamentals of a Marine Spatial Data Infrastructure (MSDI)

3. Is a Syllabus for Database Design, Data Management and MSDI for Practitioners (i.e. Hydrographic Surveyors, Cartographers, Oceanographers, IT specialists)

4. Is a Syllabus for Marine Spatial Data Infrastructure (MSDI) for Senior Managers (i.e. Directors, Hydrographers, Human Resource Managers)

Target audiences are provided at the top of each course.

Recommendations

All MSDI training courses should have basic information such as:

- Course Description
- Course Date(s) and Times
- Instructor Contact Information (if applicable)
- Course Objectives / Goals
- Learning Objectives to meet the Course Objectives/Goals
- Course Completion Requirements
- Requirement(s) for Text and or Other Materials
- Any Technology Requirements (if applicable)
- Technical support (if applicable)

It is important that the instructor also has the right skills and knowledge about SDI and MSDI therefore the MSDIWG recommends that instructors from organisations, private companies and universities that participate in the MSDIWG primarily be chosen. Participating in the MSDIWG meetings is expected to give these organisations the knowledge and skills needed. An updated list is available in this document and on the IHO MSDIWG webpage.

Annex 1.1: Syllabus for MSDI orientation

Target Audience:	Decision makers (e.g. National Hydrographers, Oceanographers, Investors, Planners, Asset Managers, Scientists)
Description:	MSDI Awareness Briefing
Expected duration:	2 to 4 hour Briefing Session
Objectives:	To provide a basic awareness and appreciation of the importance of MSDI in hydrographic and oceanographic management decision making
Required Material:	None
Technical Requirements/ Support:	None/Laptop computer, Audio-Visual projector,

Subject	Description	Content	Outcome
1.1	**Introduction**	• Welcome and introductions • Programme • Aims and objectives of the day	
1.2	**Spatial Data Infrastructure**	• What it is SDI • Policy and Governance (People) • Technical Standards (Standards) • Information Systems / Services (ICT) • Geographic Content (Data)	Have a basic understanding of spatial data infrastructures (SDI) and the important marine components (MSDI)
1.3	**Wider uses and applications of HO data**	• The future role of Hydrographic Offices • Supporting "The Blue Economy" • The role of HOs within a SDI (hydrography is much more than charting!) • The business case for MSDI?	Understand the strengths, weaknesses, opportunities and threats facing HO's and how HO's can contribute to the wider economy
1.4	**MSDI - Obstacles to progress?**	• People as individuals and as part of teams • Organisational culture • Organisational structures • Making change happen • Sustainable change	Understand why "change" is mission critical to achieving best practise and delivering MSDI and why without the support of people, success is far from guaranteed!

Annex 1.2: Syllabus for Fundamentals of a Marine Spatial Data Infrastructure (MSDI)

Target Audience:	All Practitioners and Middle Managers (i.e. Hydrographic Surveyors, Cartographers, Oceanographers, IT specialists)
Description:	A "Fundamentals of Data Management Best Practice and MSDI" Briefing Session
Expected duration:	1 Day Briefing Session
Objectives:	Provide a basic understanding of MSDI and its importance to Hydrography and Oceanography
Required Material:	A prior knowledge of the content of IHO Publication C-17
Technical Requirements/ Support: (optional)	Computer hardware, Audio-Visual projector, web access

Subject	Description	Content	Outcome
2.1	**Introduction**	• Welcome and introductions • Programme • Aims and objectives of the day	
2.2	**Spatial Data Infrastructure**	• What it is SDI • Policy and Governance (People) • Technical Standards (Standards) • Information Systems / Services (ICT) • Geographic Content (Data)	Have a basic understanding of spatial data infrastructures (SDI) and the important marine components (MSDI)
2.3	**Wider uses and applications of HO data**	• The future role of Hydrographic Offices • Supporting "The Blue Economy" • The role of HO's within a SDI (hydrography is much more than charting!)	Understand the strengths, weaknesses, opportunities and threats facing HO's and how HO's can contribute to the wider economy
2.4	**Data Sharing and Efficiencies**	• Achieving best practise • Data sharing • Delivering operational efficiencies	Have the knowledge and understanding of how other organisations are tackling SDI development at the national or regional level
2.5	**Data Management**	• Data policies and principles • Data management systems and	Gain an understanding of the fundamentals of effective data

	and Data Base Development	design • Metadata • Sources of data • Structure, attribution and relationships • Versioning and data outputs	management, database design structure and implementation and why metadata is as important as data itself!
2.6	**Technical Standards**	The importance and role of data standards including the IHO S-100: The Geospatial Standard for Hydrographic Data and extending S-100 for other products and services	Gain a basic knowledge of standards employed in the geospatial world; the implications of S-100 for the HO community and the opportunities to extend the S-1XX specifications in a common manner
2.7	**Introduction to Data Publishing in the Electronic Age**	The work of the Open Geospatial Consortium (OGC); Data Sharing and Network Services (Discover, View and Download)	Have an understanding of what publishing means using a variety of media and how web services are developing to assist the user to access metadata and data for onward use (including experience in Europe with INSPIRE)
2.8	**MSDI - Obstacles to progress?**	• People as individuals and as part of teams • Organisational culture • Organisational structures • Making change happen • Sustainable change • The business case for change?	Understand why "change" is mission critical to achieving best practise and delivering MSDI and why without the support of people, success is far from guaranteed!
2.9	**Factors that hinder development of MSDI**	Factors that hinder development, how these can be overcome by understanding, careful design, sympathetic communication with stakeholders and an understanding and appreciation of the value and benefit that change brings over time	Have the confidence and knowledge to manage and / or contribute to the change process and identify the benefits and opportunities of MSDI and the role HO's should play in NSDI
2.10	**Evaluation**	• Review Key Points and Messages • Has the briefing met your expectations? • How can you deliver MSDI and best practise? • What will success look like? • What are the next steps?	Reinforce key messages learnt so that attendees have a knowledge and understanding and of the fundamentals of MSDI and how people, organisations and processes influence outcomes

Annex 1.3: Syllabus for Database Design, Data Management and MSDI for Practitioners

Target Audience:	Practitioners (i.e. Hydrographic Surveyors, Cartographers, Oceanographers, IT specialists)
Description:	A basic theoretical and practical course on Data Management, Database Design, Data Publishing and MSDI
Expected duration:	5 Day Session
Objectives:	To provide a fundamental operational appreciation and understanding of MSDI and how it enables hydrographic and oceanographic operational efficiencies
Required Material:	Prior awareness and understanding of subject areas to be covered and awareness of practical applications and GIS
Technical Requirements/ Support:	Computer software and hardware, database access, Audio-Visual projector, web access

Day 1

Subject	Description	Content	Outcome
3.1.1	**Introduction**	• Welcome and introductions • Programme • Aims and objectives of the course • Opening remarks by course sponsor	Presentations and round table introductions by students and instructors to get to know each other and understand course requirements
PART 1: THEORETICAL SESSION FRAMEWORK			
3.1.2	**Spatial Data Infrastructure**	The basic concepts of SDI: • What it is and what it is not! • Policy and Governance (People) • Technical Standards (Standards) • Information Systems / Services (ICT) • Geographic Content (Data)	Students gain an understanding of spatial data infrastructures (SDI) including the importance and role of data management and databases
3.1.3	**General presentation of SDI**	Introducing the conceptual design of SDI, the challenges and obstacles faced to achieve its implementation, and the role of the HO community in its development	Students will gain knowledge of how other countries are tackling SDI development and will confirm their understanding of the topic
3.1.4	**Perspectives on SDI**	The benefits and opportunities of SDI and the factors that hinder	Each student gains a good understanding of SDI and the role

		development, and how these can be overcome by careful design and sympathetic communication with stakeholders	the HO can play in NSDI
3.1.5	**Effective Data Management**	A theoretical and practical introduction to data management • Data policies and principles • Data management systems • Database design • Conceptual and logical design • Physical implementation	A theoretical and practical appreciation of data management, modelling, database design and implementation.
3.1.6	**Database Development**	The design of a simple data management solution including: • Sources of data • Structure and attribution • Relationships between features • Versioning and data outputs	Each student/group to deliver a simple design structure for a database comprising Hydrographic and /or Oceanographic content.
3.1.7	**Introduction to Metadata**	The value and benefit of good metadata. • Data audit and inventory • Purpose • Metadata standards • Creation and management • Publication and use in data discovery	Students gain a good understanding of metadata, its use and its importance
3.1.8	**Metadata Creation**	To create international standard compliant metadata for a bathymetry dataset. Demonstration of metadata	Students complete a simple exercise to create metadata for bathymetry
3.1.9	**Review**	Key messages and learning points from day	Students understand the main aspects of the day's lessons

Day 2

Subject	Description	Content	Outcome
3.2.1	**Technical Standards**	The importance and role of data standards. • Categories • Description • Importance • Selection	Students gain a basic understanding of data standards
3.2.2	**IHO S-100:**	The Geospatial Standard for Hydrographic Data. The implications of S-100 for the HO community	Understanding the value and benefit of a holistic standard for hydrographic geospatial information

3.2.3	**Data Specifications**	The importance and role of data specifications. • What is a data specification? • The importance of data specifications • Description of data specifications in MSDI • The extensions to S-100 (e.g. S-101 for Electronic Navigational Charts)	Students gain a basic understanding of data specifications
3.2.4	**Data Modelling and Specifications development**	The creation of a data model and specification for a non-navigational application of hydrographic data based on S-100. Topic area to be decided by students	Students work in groups to define different components of a new S-10X specification which includes source data management and data modelling using appropriate data themes as an example identifying the issues and challenges to be resolved
3.2.5	**Review of Data Specifications**	Introduction to data specifications	The student to gain knowledge, understanding and importance of Data Specifications
3.2.6	**Data Publishing**	Presentations on product specifications and the work of the Open Geospatial Consortium (OGC) Presentation on Data Exchange and Sharing; Network Services (View and Download) - including experience in Europe	Students understand what is meant by publishing. The student to gain an overview of the effectiveness and efficiencies gained by a joined-up approach through SDI
3.2.7	**Review**	Key messages and learning points from day	Students understand the main aspects of the day's lessons

Day 3

Subject	Description	Content	Outcome
3.3.1	**What are the obstacles to progress?**	"change" issues	Students present their findings.
3.3.2	**Cultural and Organisational change**	How to manage the process of change	Understanding of why "people" issues are so important in the development of MSDI? Ways to engage in the process of Change
3.3.3	**Ownership of the process**	How to reinforce the message and how to take ownership of the process of change	Students have the confidence and knowledge to contribute to the Change process

3.3.4	**Sustainable Change in the Hydrographic Community**	How to identify the key things to ensure change is sustainable	Students appreciate the value and benefit of change over time
3.3.5	**Review of PART 1 of the course**	What has been communicated so far, questions and answers	Students have a good level of understanding of the theoretical elements of the course
PART 2: PRACTICAL SESSION FRAMEWORK			
3.3.6	**Technology supporting SDI**:	• Relational Database Management Systems (RDBMS) • Interoperability to form data themes in Marine Spatial Data Infrastructures	Students gain a basic overview of Data Management and Database Design
3.3.7	**Data Model and workflow**	• Client/Server architecture • Data Model for elevation data (bathymetry and terrestrial): - Grids and Point Clouds - PostgreSQL and Oracle • Data model for marine cartographic data: - Feature and Spatial Objects - Oracle RDBMS • User access control	Students to gain a basic understanding and hands-on of different data models used for high-resolution data and cartographic vector data through demonstrations and practical exercises
3.3.8	**Working with Elevation Data**	• Database organization for elevation data (bathymetry and terrestrial): - Elevation objects • Importing data into existing models • Managing survey products • Metadata • Interoperability	Students to have hands-on experience managing elevation data and starting the process leading to a final product Students to have concepts of metadata (both standards compliant and organisation specific) reinforced through exercises configuring marine spatial databases
3.3.9	**Review**	Key messages and learning points from day	Students understand the main aspects of the day's lessons

Day 4

Subject	Description	Content	Outcome
3.4.1	**Working with Elevation Data**	Continuation of session 3.3.8	
3.4.2	**Data Organisation and Design**	• Usages: - Thematic and non-thematic	Students to have concepts of database design (e.g. scale

		- Scaled and un-scaled • Metadata - Project • Source and products • Data portrayal • Importing data into existing models	independent data) and the importance of metadata (both standards compliant and organisation specific) reinforced through exercises configuring marine spatial databases
3.4.3	**Project Management and editing**	• Traceability - Certification - History • Metadata • Data integrity	Students to have concepts reinforced on the importance of metadata (both standards compliant and organisation specific)
3.4.4	**Product Creation**	• Standards and Product Specifications • Data and metadata exchange	Students will complete the exercises leading to creating a final product and gain the experience leading to data publication and information exchange
3.4.5	**Sharing and Interoperability**	• Discovery • Open Geospatial Consortium (OGC) Services and Web Mapping	Students to have additional hands-on experience in the practical application of data standards, data publishing and information exchange in MSDI
3.4.6	**Review**	Key messages and learning points from day	Students understand the main aspects of the day's lessons

Day 5

Subject	Description	Content	Outcome
3.5.1	**Sharing and Interoperability**	Continuation of session 3.4.5	
3.5.2	**Review of main content of the Training Course**	Written assessment exercise to ascertain level of knowledge and understanding	Students to individually complete a questionnaire
3.5.3	**Course Wash-Up**	• Review assessment results • Review of Aims and Objectives • Review Key Points and Messages • Group Discussion – has the course met your expectations? • Feedback Forms completed by students	Students to have a basis theoretical and practical understanding and knowledge of the fundamentals of SDI; database design, data management and data publishing
3.5.4	**Closing Session**	• Certificates distributed to successful students • Closing remarks by course sponsor	

Annex 1.4: Syllabus for Marine Spatial Data Infrastructure (MSDI) for Managers

Target Audience:	Senior Managers (i.e. Directors, Hydrographers, Oceanographers, Human Resource Managers)
Description:	Data Management and MSDI "Best Practice" Awareness Course
Expected duration:	2 day Session
Objectives:	To provide a basic level of understanding of the value and benefits to be derived from data management and MSDI
Required Material:	Prior knowledge of IHO Publication C-17 and its content
Technical Requirements/ Support:	Computer hardware, Audio-Visual projector, web access (optional)

DAY 1			
Subject	**Description**	**Content**	**Outcome**
4.1.1	**Introduction**	• Welcome and introductions • Programme • Aims and objectives of the course	
4.1.2	**Spatial Data Infrastructure**	• What it is SDI • Policy and Governance (People) • Technical Standards (Standards) • Information Systems / Services (ICT) • Geographic Content (Data)	Attendees will gain an understanding of spatial data infrastructures (SDI) including the importance and role of data management and databases
4.1.3	**General presentation of SDI**	Introducing attendees to the conceptual design of SDI, the challenges and obstacles faced to achieve its implementation, and the MS within a SDI	Attendees will gain knowledge and understanding of how other organisations are tackling SDI development at the national or regional level
4.1.4	**Perspectives on SDI**	Discussing the factors that hinder development, and how these can be overcome by careful design and sympathetic communication with stakeholders	Attendees are able to identify the benefits and opportunities of SDI and the role HO can play in NSDI
4.1.5	**Data Management**	A theoretical understanding and appreciation of "best practise" • Data policies and principles	Attendees gain an understanding of the fundamentals of effective data management, database

		• Data management systems • Database design • Conceptual and logical design • Physical implementation • Metadata	design and implementation
4.1.5	**Database Development**	To design a simple data management solution including: • Sources of data • Structure and attribution • Relationships between features • Versioning and data outputs	Attendees are able to understand a simple design structure for a database comprising hydrographic and /or oceanographic content
1.6	**Introduction to Metadata**	The value and benefit of good metadata • Data audit and inventory • Metadata standards • Creation and management • Publication and use in data discovery	An understanding of why metadata is as important as data itself
4.1.7	**Review**	Key messages and learning points from day	To understand the main aspects of the day's lessons

DAY 2

Subject	Description	Content	Outcome
4.2.1	**Technical Standards explained**	The importance and role of data standards • Categories • Description • Importance • Selection	A basic knowledge of international standards employed in the geospatial world
4.2.2	**The Geospatial Standard for Hydrographic Data**	The implications of S-100 for the HO community	Understanding of why S-100 is important to the MS and how it can facilitate product and service developments in future
4.2.3	**Data Specifications explained**	The importance and role of data specifications • What is a data specification? • The Importance of data specifications • Description of data specifications in MSDI	An understanding of what data specifications are and how they underpin MSDI
4.2.4	**S-1XX based product/service specifications**	The extensions to S-100 (e.g. S-101 for Electronic Navigational Charts)	Knowledge of the opportunities that exist to extend the S-1XX

			family of products and services in a common
4.2.5	**Introduction to Data Publishing**	Product specifications and the work of the Open Geospatial Consortium (OGC)	Gaining an understanding of what is meant by publishing using a variety of media to do so
4.2.6	**Data Publishing in the Electronic Age**	Data Exchange and Sharing; Network Services (Discover, View and Download	Understand in what way web services are developing to assist the user to access metadata and data for onward use including experience in Europe with INSPIRE.
4.2.7	**MSDI - Obstacles to progress?**	Cultural and Organisational "change" issues • People as individuals and as part of teams • Organisational culture • Organisational structures	Understanding why "change" is mission critical to achieving best practise and delivering MSDI and why without the support of people, success is far from guaranteed!
4.2.8	**Achieving Sustainable Change in the Hydrographic Office**	Identifying the key things to ensure change is sustainable • Ownership of the process of change • Making Change sustainable • Making the business case for MSDI	Gaining the confidence and knowledge to contribute to the Change process and understanding and appreciating the value and benefit of change over time
4.2.9	**Course Wash-Up**	Group Discussion – has the course met your expectations? • Review of Aims and Objectives • Review Key Points and Messages • Feedback Forms completed	Attendees have a basis understanding and knowledge of the fundamentals of SDI; database design, data management and data publishing and how people and organisations influence outcomes

List of Expert Contributors attending the MSDIWG meetings

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