"Realising the benefits of Spatial Data Infrastructures in the Hydrographic Community"

IHO MSDIWG Submission to IHC 2017

"Change is hard because people overestimate the value of what they have and underestimate the value of what they may gain by giving that up."

James Belasco and Ralph Stayer: Authors of the "Flight of the Buffalo"

The purpose of this paper

This draft paper has been produced for IRCC to discuss and report back to MSDIWG on its content prior to onward submission to conference of XIX IHC /Assembly in April 2017.

Overview

It is now ten years since the 4th EIHC held in April 2007 adopted the Resolution that the IHO implement a Marine Spatial Data Infrastructure (MSDI) Policy. A Spatial Data Infrastructure (SDI) is the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data[1].

This submission to XIX IHC /Assembly provides a resume of progress to date made by the MSDIWG, the role of the IHO in that time, external drivers to adoption of SDI and the expectations of Member States (MS) in adopting MSDI and data management best practise principles now and in the future. SDI is "the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data". *Ref: Global Spatial Data Infrastructure (GSDI) Cookbook*.

Conference is requested to consider this submission and to extend the mandate for this IHO policy for a further ten years.

1. The Current Situation

1.1. National HO's as providers of authoritative foundational marine information

Hydrographic Offices (HOs) have been providing navigational chart products and navigational services since the end of the 13th century! However, in the 21st century, whilst HOs find themselves ideally placed to be the de-facto provider of authoritative foundational marine/maritime information[2] such as bathymetry, coast line and maritime administrative areas to a wider marine user community, the community, with a few notable exceptions, remain unable to "get involved" in MSDI initiatives except in specific cases. HOs collect, ingest and manage authoritative data that is now much more widely sought by marine users to underpin decision support and asset management. The way such information is now being delivered is

[1] Ref: Global Spatial Data Infrastructure (GSDI) Cookbook.

[2] This means data that can be used by most users most of the time; sometimes called "core reference" data.

through the greater access to, sharing of and re-use of data at an enterprise, national or regional level.

1.2. The role of the IHO

The IHO strongly believes that its MS should be the "providers of choice" for authoritative foundational marine/maritime information through engagement and participation in MSDI in addition to their existing navigational role. It is actively strengthening its understanding and knowledge of the role of hydrography in MSDI through its outreach programmes with other SDI stakeholder groups (such as the European Commission, UN-GGIM, IOC-IODE), globally, and through the IHO MSDIWG across the HO community. The IHB is a great advocate of MSDI and the need for change stating, along with other stakeholders, that unless MS act quickly, others will provide the authoritative data and in doing potentially weaken the status of HO's.

However, the decision as to whether HO's might engage and / or contribute in MSDI sometimes rests outside the direct control of HO's in a higher level of national or state governments which means that HO's need themselves to "make the case" for MSDI. This process can be difficult if there is lack of understanding and interest at the higher level of government about the role and relevance of hydrography. In this respect, assistance in making the case for MSDI could be sought by HO's through the IHO MSDIWG.

1.2. The role of Regional Hydrographic Commissions (RHC's)

The fifteen RHC's, as the coordination and monitoring bodies that drive, communicate, encourage and promote the role of national HOs within their region of interest, have a responsibility to ensure that their Member States (MS) are equipped with the understanding, knowledge and mandate to take advantage of the support available to them through the IHO Capacity Building programme or by individual MS investing themselves in the necessary education, training and mentoring to meet new expectations for access to their data. RHC's are tasked with coordinating reports of progress of MS in their engaging in / or leading of efforts to develop and / or engage in MSDI initiatives by reporting such activities as a standing agenda item at RHC meetings. Whilst an element of reporting is now routinely happening at most, but not all RHC meetings, it has not resulted in the anticipated engagement in MSDI initiatives. Feedback from RHC's to the MSDIWG to enable it to assist and / or support MS is often limited of even missing. Much more could be done to encourage and coordinate the IHO approach.

1.3. The role of MSDIWG

As a result of Decision 13 on Proposal 13 at the 4th EIHC: April 2007, the Marine Spatial Data Infrastructure (MSDI) Policy resolution was adopted. To deliver the IHO policy objectives, the MSDIWG was set up, initially as a sub group of the Hydrographic Services and Standards Committee (HSSC); formerly known as the Committee on Hydrographic Requirements for Information Systems (CHRIS). In early 2015, the MSDIWG became a sub group of the Inter-Regional Coordination Committee (IRCC) reflecting its predominantly non-technical coordination

and support role working with the Regional Hydrographic Commissions (RHCs), to deliver its knowledge and wisdom to HO. Its terms of reference can be found on the IHO website.[3]

1.4. Some significant SDI Policy Drivers

There are now many policies driving requirements for greater access to authoritative geospatial data across the world. Here are a few of the ones that have far reaching remits:

1.4.1. Blue Growth

The "Blue Growth" long term strategy *supports sustainable growth in the European marine and maritime sectors* as a whole and the goals of the European economy 2020 strategy for smart, sustainable, inclusive and innovative growth of its seas and oceans. The European 'blue' economy currently represents roughly 5.4 million jobs and generates a gross added value of almost €500 billion a year. The MSDIWG is tracking this initiative and other similar ones across the World.

1.4.2. UN-GGIM

The United Nations initiative on Global Geospatial Information Management (UN-GGIM) is now playing a leading role in setting the agenda for *the development of global geospatial information and to promote its use to address key global challenges*. It provides a forum to liaise and coordinate among Member States, and between Member States and international organizations. The IHO has observer status at UN-GGIM the future role of its MS will be crucial to enabling the wider reach and use of HO data as part of the UN-GGIM framework of activities which includes the development of the global geodetic reference frame; adoption and implementation of standards by the global geospatial information community; determining fundamental data sets; developing a shared statement of principles on the management of geospatial information and setting up legal and policy frameworks related to authoritative data.

1.4.3. G8 Open Data Charter

In June 2013, the G8 Group of major economic nations signed the *Open Data Charter*. We are witnessing the growth of a global movement facilitated by technology and social media and fuelled by information; with enormous potential to create more accountable, efficient, responsive and effective governments and businesses, and economic growth. The G8 principles have at their heart, the foundation for access to, and the release and re-use of data namely: open data by default[4], improved data quality and quantity; data re-use by all and the release of data for improved governance and innovation.

1.4.4. Emergency Planning and Response

The urgent need to develop and provide improved plans for responding to disasters and emergencies in the world's sea space has been highlighted by several high profile events in

[3] http://www.iho.int/mtg_docs/com_wg/TOR/MSDIWG-ToR.pdf

[4] Open does not always mean free-of-charge

the last 5 years including: BP oil spill in Gulf of Mexico in Sep 2010; the Japanese earthquake and tsunami in March 2011; the Korean ferry disaster in April 2014 and the loss of Malaysia Airlines flight MH370 in 2015. Reaction to each of these, and numerous other events, requires a multi-disciplinary approach including emergency response, environmental protection and longer term regional planning. Efforts are already underway to create an SDI framework for more effective Oil Spill Response with MSDIWG members working with stakeholders to enable this.

2. Challenges Hydrographic Offices face in engaging in MSDI

2.1. The current focus on products supporting a single customer group

All HOs depend on data, but operate in terms of products based approach (e.g. paper charts, sailing directions, tide tables) supplied to a specific navigational user community. The creation of ENCs requires chart information to be decomposed into features and attributes, but the output is still a generalized product, provided as data sets delivered on a cell-by-cell basis and characterized by scale. They are therefore restricted by design in their onward use. With the driving force aimed at navigational safety, any additional use is seen as an opportunistic spin-off. The opportunity to service a wider user community (outside of navigation) of potentially 5 million users has been overlooked in the past but now needs to be actively considered.

2.2. Aversion to Risk

HOs operate in a core market where the pace of change is slow and deliberate, due in part to the Safety of Life at Sea (SOLAS) regulatory process at the IMO; the demographic profile of its core customer and also the pace of change in the HO community. Navigation is all about safety where the risk of things going wrong could ultimately, if its charts and publications are proven to be in error or missing vital information as a result of an incident, burden the government with unlimited costs. As a result there is a natural aversion to taking business or operational risks.

Adapting to new opportunities often presents a very significant challenge to the HO as it considers ways in which it might engage with a new and much larger user community. The fairly recent demand for access to marine and maritime geospatial data from commerce, government, academia and the citizen requires far less “warranty” in the HO data and information supplied so should present a less complex proposition. However, processes may not be in place to enable this, such as a lack of a policy for re-use, provision of licences or its ability to receive money in return for data delivered. Without support and encouragement from the IHO, the argument for HO’s to move forward cannot always be easily made. However, MSDI can and will provide most of the information for charting in the future!

2.3. Innovation

As witnessed during capacity building training courses that MSDIWG expert contributors provide, it is both surprising and heartening at how well, with a little persuasion and nurturing, students display inventiveness in thinking about products, services and systems that are clever, interesting, practical and potentially profitable. Yet difficulties are often cited by students that they cannot influence “change” due to the governance arrangements in place at their HO. But the HO is not alone in this respect; while people can be good at innovating, few organisations have track

records when it comes to implementing its own innovations. The paradox is that while we can systematise innovation up to a point, it is difficult to systematise the adoption of innovations. Add to this the fact that innovation is not a priority to HOs still predominantly based on the paper charts and ENC products. However, HO's do need to start innovating to keep abreast of changes in the way data is handled and published, the speed at which technology is developing and in the evolution in corporate governance models.

2.4. Perpetuating a fractured HO Governance Model

HO core business has remained unchanged for many years until now. There is now a new imperative to modernise and overhaul production processes and workflows in spatial and business data management. Functional MSDI requires willingness and practical co-operation between the various organisations that create share and use information to implement the overall policy. There should also be a clearly defined governance structure, transparency in decision-making and reporting, to foster a shared sense of working towards a common goal.

In an organisation that has a culture of trust, transparent communication, involved and engaged employees and positive interpersonal relationships; resistance to change is easy to see and therefore much more likely to happen. Employees feel free to tell their line manager what they think and have open exchanges with managers. When a change is introduced in this environment, with discussion and employee involvement, resistance to doing things differently is minimized especially where there is a wide-spread belief that the change is needed and beneficial.

With the emergence of highly skilled, IT literate, motivated and questioning workforces that are keen to see innovation and change happen, HO's are at risk of not providing a platform whereby new ideas can be discussed, listened to and implemented. This is evident in the basic understanding and appreciation of the opportunities presented by data management best practise and MSDI. In all HO's, staff should be armed with the knowledge, training and skills to enable them to engage and participate in MSDI.

2.5. Learning from Organisations and Coordinating Bodies that have succeeded!

There are several global organisations that already share and exchange data and / or submit their data to an SDI. Here are few examples that HOs should know about or may already work with:

2.5.1. IOC-IODE [5]

The programme International Oceanographic Data and Information Exchange (IODE) of the Intergovernmental Oceanographic Commission (IOC) of UNESCO was established in 1961. Its purpose is to enhance marine research, exploitation and development, by facilitating the exchange of oceanographic data and information between participating Member States, and by meeting the needs of users for data and information products. During the past 50 years, IOC Member States have established over 80 oceanographic data centres. This network has been able to collect, control the quality of, and archive millions of ocean observations, and makes these available to Member States. With the advance of oceanography from a science

[5] http://www.iode.org/index.php?option=com_content&view=featured&Itemid=89

dealing mostly with local processes to one that is also studying ocean basin and global processes, researchers depend critically on the availability of an international exchange system to provide data and information from all available sources. Additionally, scientists studying local processes benefit substantially from access to data collected by other Member States in their area of interest. The economic benefit of obtaining data by exchange as opposed to collecting it oneself is huge.

2.5.2. WMO[6]

The World Meteorological Organisation (WMO) is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. WMO has a membership of 191 Member States and Territories (on 1 January 2013). It originated from the International Meteorological Organization (IMO), which was founded in 1873. Established in 1950, WMO became the specialized agency of the United Nations in 1951 for meteorology (weather and climate), operational hydrology and related geophysical sciences. As weather, climate and the water cycle know no national boundaries, international cooperation at a global scale is essential for the development of meteorology and operational hydrology as well as to reap the benefits from their application. WMO provides the framework for such international cooperation.

2.5.3. The WDC for Geophysics and Marine Geology[7]

The World Data Centre (WDC) for Geophysics and Marine Geology, in Boulder USA, is operated by, and collocated with, the National Geophysical Data Centre (NGDC) and manages all types of data from the ocean floor. These include descriptions and analyses of seafloor samples, deep drilling data, underway geophysical measurements, and derived gridded data sets including total sediment thickness of the world oceans. Other data types include coastlines and plate boundaries.

Geophysical data include bathymetry, gravity, and magnetics, and single-channel and multi-channel sub-bottom profiles collected on more than 4,000 oceanographic surveys covering millions of kilometres of the world's oceans. Geological data are available for over one hundred thousand cores, grabs, dredges, and drill samples covering most of the world's oceans. Data are contributed by sources from around the world and were originally collected for a variety of purposes, including academic research, international and interdisciplinary scientific projects, commercial mineral resource evaluations, defence, and government environmental baseline studies.

3. Making MSDI a Reality

Since 2007, the work of the MSDIWG has been focused on building a body of knowledge[8] about MSDI and how HO's can make the journey of change in the way it manages data, information,

[6] https://www.wmo.int/pages/about/index_en.html

[7] http://www.ukssdc.ac.uk/wdc/usa/mgg.html

[8] http://www.iho.int/mtg_docs/com_wg/MSDIWG/MSDIWG_Misc/MSDIWG-BOK.html

workflows and its people. Ten years on, with progress slower than expected; the need to adapt has become more acute. HO's need to develop a greater understanding of the importance of data and information provision, sharing and publishing as well as how that data and information can be used in an MSDI.

It is a well-known fact that investment in hydrography is reducing across the world and this trend is likely to continue as long as HO's fail to respond to the needs of government, commerce and even the citizen. There is a real risk that budgets could potentially be re-directed to other government bodies in-country for them to provide the data and information services the wider user community require. This situation could also happen in the HO core navigation market where real time inertial systems, coupled with e-navigation services that just might supersede the role provided by charts.

Engagement in MSDI is one important approach to being able to meet the challenges emerging at this time so HOs need to create innovative ways to address the challenges and secure their futures. Developing the will "to succeed" in supplying authoritative foundational marine data and information management is absolutely vital, given a backdrop of uncertainty in the HO community and in the geospatial world globally. So how might HOs adapt?

3.1. Realise that HO data is a National and Global asset

Data are the second most important asset in an organisation after the people it employs! Data is now often referred to as the "new oil" or the "new electricity" and as such has tremendous intrinsic value not only to the organisation that captures and holds it but to other potential users as well. It therefore needs to be treated as an enterprise wide, national and even global asset. In the maritime sector, we have been promoting the term "collect once, use many times" for many years in respect of the wider value and utility of, for example, bathymetry data. But there are other important data held by the HO that also have additional or residual value once used to support the core business of charting. This is not often recognised by Governments and States and as such, HO's need to promote its importance, and that of its data holdings, more vigorously to national stakeholders and politicians.

3.2. Become Data Centric

The principle of data being the foundation of knowledge is well known. In essence, knowledge is only of value if conveyed from a broad base of data delivering a smaller volume of knowledge. The conversion of detailed bathymetric surveys into charts with sparse soundings, is a good example of this. A large amount of data is collected, and although it presents a lot of information to a chart compiler, only a small amount; enough to permit safe navigation; of the knowledge is passed on to the recipient of the charting product. Thus, knowledge transfer is only a small part of the potential of the original data. Holding data wrapped in products does not allow such freedom, as well as being more expensive to backward and / or re-engineer.

MSDI is the combination of a variety of data types at different resolution data, allowing efficient analyses 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. Managing data as close to its "source" manner as possible in a "data centric" way provides a greater opportunity for it to be re-purposed for greater re-use.

3.3. Engage with other relevant stakeholders in the geospatial world

3.3.1. Other Data Providers

HOs should not act in isolation, but interact with other bodies providing geospatial data. A good example is the role of National Land Survey and Mapping Agencies (NMAs), responsible for mapping the terrestrial world to the Mean High Water Line (MHWL) and below that where land generated structures extend into the littoral zone. The provision of interoperable data provided jointly by the NMA and HO across this space in the form of a seamless digital elevation models would be of significant value to coastal planners, engineers and surveyors.

Other important data providers are National Geological Agencies. HOs collect bathymetry data, the depth values of which are critical to core business. However, most modern survey instruments provide "backscatter" data; a "by-product" that defines the seabed form and texture. Whilst of limited interest and value to HOs for charting purposes, it is of great value to geologists and geophysicists.

3.3.2. Standards Bodies [OGC; ISO; IHO]

A key pillar of MSDI is standards. Standards are an agreed, repeatable way of doing something and are used consistently as a rule, guideline, or definition. Standards make life simpler, increasing the reliability and the effectiveness of many products and services we use. Standards are designed for voluntary use and do not impose any regulations. We cannot operate without them, whether they are there to provide a framework for hydrographic data collection (IHO S-44); metadata (ISO19115) or the IHO Universal Hydrographic Data Model (S-100) enabler for data sharing across multi-disciplinary groups making the use of hydrographic data easier. The Open Geospatial Consortia (OGC), with whom IHO interacts, develops de-facto standards that are tested in the real world and adopted by consensus by users often becoming de-jure in nature through adoption by the International Standards Organisation (ISO).

3.3.3.Users

Engagement in MSDI should involve users; government, commerce, academia and the citizen) to whom HO's will ultimately be supplying data. By understanding their needs, HO's will be better able to deliver fit-for-purpose data either directly or through a MSDI nationally or regionally.

3.4. Education and Training

Education, training, mentoring and coaching (including capacity building training) is available to better enable HOs to understand data management challenges and also to ensure they are able to implement significant and sometimes difficult changes. The IHO through the MSDIWG provides syllabi for a selection of training courses on subjects such as Data Management "Best Practise"

and MSDI; Fundamentals of MSDI, Data Management Awareness to practitioners, middle managers, directors and senior executives. Ranging from half-day briefing sessions; one-day courses on data management policy and strategic objectives to five-day courses on MSDI and data management which include practical exercises about making MSDI a reality; such training is available to all RHC's not just those that qualify for capacity building funds. They are also available to individual HO's willing to sponsor such training independently of CBSC funding.

4. Celebrating HO successes in NSDI and / or MSDI

Despite the challenges facing the HO community, there have been some notable successes made by HO's in supporting NSDI and / or developing national and regional MSDI capability:

4.1 Danish MSDI

The establishment of a MSDI involving the maritime authorities will ensure that selected marine geographic data is readily available, can be brought together and shared between the maritime authorities for various purposes. In a longer term, selected marine geographic data should also be shared between relevant countries and sectors. In addition, the MSDI should provide information about the data (metadata) such as when the data was last updated, how the data was collected, and how different organisations can get access to data, financial aspects and the quality of the selected data. The Danish MSDI can be divided into four main components:

A. Contractual framework (governances)
B. Financial model
C. Technical infrastructure
D. Data to be included in the MSDI.

MSDI-forum membership comprises: DMI, Danish Energy Agency, Defence Command Denmark, Danish Geodata Agency, Danish Agency for Culture, Danish Coastal Authority, Danish Environmental Protection Agency, Danish AgriFish Agency, Danish Nature Agency, Danish Police and Danish Maritime Authority. The Chairman for the MSDI-forum is at the Deputy Director level and will be undertaken by the Danish Geodata Agency. Other members of the forum are at the Head of Department level. The MSDI-forum is administrated by a secretariat, established in the Danish Geodata Agency DGA.

The following services will be provided:

- WEB-services
- Dataset and download
- MSDI (Communication platform)
- Shared visualisation platform
- Metadata for dataset and services
- Monitoring of INSPIRE services (option)
- Notifications related to new data (option)
- Service maintenance and support

4.2 Brazil NSDI

National Spatial Data Infrastructure (NSDI) of Brazil was instigated in response to a Presidential Decree 6666/2008. Information can be found at http://www.inde.gov.br/
The NSDI principles for policies of data access and use are to:

- Maximize the availability of public information for its use and reuse, emphasizing transparency and good governance;
- Promote public information access, data reuse conditions, expanding information access, use, integration and sharing it;
- Improve access to information and disseminate its content electronically and over the internet.

NSDI management is provided by the Brazilian Institute of Geography and Statistics (IBGE). Stakeholders include Armed Forces (Brazilian Navy, Air Force and Army); Federal Agencies (National e.g. Water Agency); Federal Government Ministries (e.g. Ministry of Transport, Ministry of Finance, Ministry of the Environment and Ministry of Planning, Budget and Management); National Geological Service; National Institute for Space Research; Universities and the private sector.

The Geoservices Catalogue (http://www.geoservicos.inde.gov.br/geoserver/web/) has web services based on OGC Standards such as WMS (Web Map Service); WFS (Web Feature Service) and WCS (Web Coverage Service).

The Brazillian HO (DHN) is contributing to the NSDI in the provision of a Raster Nautical Charts free download service (http://www.mar.mil.br/dhn/chm/box) as well as access to its paper charts (http://www.cartasnauticasbrasil.com.br/).

In the near future, DHN will make its nautical chart catalogue available along with information about its tide gauge network, meteorological stations and buoys. It will also use Caris Spatial Fusion Enterprise (SFE) to connect to its Bathy DataBase (BDB) with the purpose of publishing and sharing data on the web.

The challenges faced include difficulties establishing data exchange policies and training enough staff with the expertise in NSDI and MSDI. *This strengthens the argument for more MSDI capacity building to enable an acceleration involvement of HO's in NSDI.*

Being able to contribute to NSDI has confirmed the importance of having both a discovery metadata and geo-service catalogue in order to reduce work being repeated. Also SDI is a great way to discover and exchange data!

4.3. Japan's Marine Cadastre - Integration of marine spatial data

The driver for developing a marine cadastre in Japan rests within its first Oceans Policy, operational from 2008-2012. It stated that integration of marine-related information was hampered by it being publicized separately by respective agencies for their own purposes. It

argued that it was troublesome to search necessary information on specific marine zones or of specific types. Therefore a system was established to comprehensively manage and provide the pieces of information previously scattered in respective government agencies. In the process, measures were put in place to utilize the efforts made so far by agencies such as the Japan Oceanographic Data Center (JODC) which was established in 1965 as part of the Hydrographic Department of the Japanese Coast Guard (JCG).

In 2010, Japan established its meta-data search system through a "Marine Information Clearing House". In 2012 it established the WEB-GIS system for the marine spatial information, which is managed by JCG and called the "Marine Cadastre". http://www.kaiyoudaichou.go.jp/

Over 100 items are searchable and downloadable through the Marine Cadastre portal such as:

- Social activity information such as marine traffic volume, historic sites, natural treasures, fishery rights area, traffic routes, fishery port areas, national park areas.
- Infrastructure information such as thermal power stations, seabed pipes, cables, lights, Coast Guard offices
- Marine environmental information such as sunken vessels, obstructions, birds habitats, turtles spawn area, beach, coastal shoreline sensitivity
- Oceanographic data such as bathymetry, temperature, salinity and currents.

Marine Cadastre forms a key piece of the second Basic Plan on Ocean Policy (2013 - present). It states that:

- Measures should be taken to improve and strengthen the Marine Information Clearing House and the Marine Cadastre and develop systems for analysing and visualizing data in order to further increase use of marine information.
- It should facilitate the use of marine renewable energy, take initiatives to improve Marine Cadastre and strengthen their functions.
- It should offer encouragement to share marine related information and improve the Marine Cadastre, in which marine related information is visualized, selected and merged on geographic maps, and thereby enhance its functions.

For the future, there are plans for further improvements and utilization of the Marine Cadastre with discussions around a greater realization of Maritime Domain Awareness (MDA) : a concept originally developed for maritime security in the USA for the utilization of satellite data and a greater focus on real-time information.

MDA means "an effective understanding of marine-related situations and circumstances through the efficient collection and sharing of a variety of marine-related information conducive to Japan's maritime security, marine safety, natural disaster countermeasures, the marine environment conservation, the promotion of marine industries, and the development of science and technology, while paying attention to the handling thereof."

5. Some Successes of the MSDIWG

5.1. Building a Body of Knowledge

The IHO has developed a significant body of knowledge about SDI, MSDI and data management best practise from around the world over the last ten years. This body of knowledge resides on the IHO website[9].

A new IHO special publication C-17 entitled Spatial Data Infrastructures - "The Marine Dimension" (Guidance for Hydrographic Offices) was published in 2008 and subsequently revised in 2011. This document has recently been significantly revised to ensure its messages remain current and relevant to in MSDI developments across the world. It is available as a published document as well as being available in a web format. MSDIWG Expert Contributors, co-authored a White Paper in 2010 entitled: "The Hydrographic and Oceanographic Dimension to Marine Spatial Data Infrastructure - developing the capability". This document has been widely circulated at training events, conferences and RHCs. A new White Paper was published during 2016 thus providing a refreshed promotional view of MSDI to the reader.

Material has been uploaded to the MSDIWG website detailing the syllabi for Data Management and MSDI training and capacity building courses ranging from half-day short briefings to one-week intensive courses including practical applications. E-Learning is now being developed to allow MS to learn remotely from material available on the key elements of MSDI and its constituent parts.

The body of knowledge plus web-links is a good way of placing MSDI information before HOs and wider stakeholder communities to enable them to identify the steps necessary and the benefits and the wider opportunities to be derived from MSDI. There are links to case study examples for existing or emergent SDI initiatives in the MSDIWG part of the IHO website.

5.2. Global engagement

IHO and the MSDIWG interact with the European Commission (EC) DG Mare and EMODnet to monitor the implications of EC Directives (such as the recent Marine Spatial Planning Directive of 2014) on the work of HO's. It also has discussions with the EC Joint Research Centre (JRC) to monitor, and provide inputs to, the Infrastructure for Spatial Information in Europe (INSPIRE) Directive. It is important the European MS comply fully with its implementation by 2019.

IHO MSDIWG meets annually and has hosted meetings in Monaco (2008 and 2009); Copenhagen; Denmark (2013), Silver Spring, Maryland, USA (2014); London, UK (2015) and Tokyo, Japan (2016).

WG meetings since 2014 have been preceded by a one-day Open Forum, to which invited in-country and visiting government, academic and commercial experts share their experiences about SDI and related topics. In a further development, the Japanese Coast Guard (JCG), our hosts in 2016, facilitated a Demonstration workshop at which expert contributors to the MSDIWG were able to demonstrate software, workflow efficiency tools, data management and

[9] http://www.iho.int/mtg_docs/com_wg/MSDIWG/MSDIWG_Misc/MSDIWG-BOK.html

training services provided to assist MS. Both events were well attended, with over 130 people and were deemed a great success.

IHO is currently an observer at UN-GGIM but it is expected that its status will be heightened as the "marine and maritime" domain comes under the global spotlight in 2017-18. IHB provides briefs to the MSDIWG on activities of interest.

5.3. Standards Management

The MSDIWG has invited representatives from the OGC to its last three working group meetings. OGC, through its Maritime Ad-hoc group convened in March 2016, OGC is now working with the MSDIWG to develop a candidate specification for MSDI. As a result a DWG is likely to be set up to develop this specification. This would bring together a family of best practise standards relevant to the IHO role within an MSDI.

5.4. Regional Communication and Co-operation Across Borders

In the last three years, the MSDIWG has witnessed, through a combination of RHC sponsored capacity building training courses, and the debate and discussion taking place in MSDIWG annual meetings, offline communications and through access to its body of knowledge; that HO's in some RHCs are now beginning to discuss the opportunities to engage in MSDI at the enterprise and national level. It is now apparent that some nations are now actively discussing cross-border cooperation in the provision of data as part of regional initiatives. Whilst still very new, these are encouraging signs with HOs willing and able to share their experiences in open fora.

5.5. Capacity Building Training and Mentoring

RHCs, through the CBSC, has delivered 5-day Capacity Building training courses to practitioners and managers in Data Management and MSDI with over 100 students successfully completing the courses between 2010 and 2016. Each course covers the four main pillars of MSDI namely, ICT, Content, Standards and Policy/Governance. All students complete an end-of-course assessment with the results passed to the sponsoring RHC and IHB. Additionally, MSDIWG Expert Contributors delivered half day Data Management and MSDI Awareness courses as part of RHC meetings in Mexico (as part of MACHC in 2014) and Tanzania (as part of SAIHC in 2015).

Through investment in such training, we are now seeing the benefits realised with emergent MSDI capability in East Asia and Indian Ocean regions being coordinated or managed by ex-students! We have to realise that not all RHCs are yet taking advantage of such training despite an opportunity for them do so! CBSC has sponsored courses in six RHC's to date. It is timely for all RHC's to either consider applying for funding to CBSC to enable MSDI training to take place or simply sponsor a course themselves in their own HO.

6. The proposal to XIX IHC /Assembly

The IHO MSDIWG proposal requests that XIX IHC /Assembly recommits to an updated roadmap that acknowledges progress made to date by IHO MSDIWG and RHC's and looks forward to the next 10 years whilst acknowledging the changing landscape in which HO's are likely to be operating.

6.1. The IHO should continue to support Member States in the identification, development and implementation of an appropriate role in national and / or regional Spatial Data Infrastructure (SDI) and MSDI initiatives. This will be achieved through:

6.1.1.1. Providing an updated version of IHO Special Publication C-17 procedural guide to reflect progress made since 2008, whilst identifying ongoing challenges and providing a clear pathway to successful engagement of the national hydrographic authority in MSDI.

6.1.1.2. Developing further the MSDI capacity building framework comprising knowledge transfer, training and mentoring noting the need for all Member States to be sufficiently educated in MSDI whilst energizing the latest generation workforce to support, and potentially lead this process.

6.1.1.3. Preparing a revised MSDI White Paper that illustrates the value and benefit of MSDI and providing relevant best practice case studies.

6.1.1.4. Managing the IHO MSDI web-based facility and growing its body of knowledge to stimulate knowledge transfer, development of best practice workflows and data management through the provision of online guidance and training material.

6.2. Strengthening existing whilst identifying new relationships between IHO and SDI stakeholder groups globally and, through active participation in these groups, grow further the understanding and knowledge of the role of hydrography in MSDI to Government and politicians.

6.3. Continuing to support the work of the IHO MDSIWG

7. Recommendation

XIX IHC /Assembly is requested to support this revised action plan and in doing so, endorse the IHO stance in promoting and facilitating the modernisation and adaption of HO's; their active engagement and involvement in NSDI and MSDI to ensure the community as a whole remains fit for purpose and relevant, not only in charting, but to a wider marine and maritime community.

Annex 1

Decision 13, Proposal 13 from the 4th EIHC: April 2007

The 4th EIHC adopted the proposed Resolution as follows:

A1.xx Marine Spatial Data Infrastructure (MSDI) Policy

1. The IHO will support Member States in the identification, development and implementation of an appropriate role in national Spatial Data Infrastructure (SDI) and MSDI initiatives. This will be achieved through:
    a. The development and maintenance of a Special Publication that will provide a definitive procedural guide to establishing the role of the national hydrographic authority in MSDI.
    b. Developing an MSDI capacity building plan comprising knowledge transfer and training to Member States.
    c. Developing and managing a web-based facility to encourage knowledge transfer, best practice and provision of online guidance and training material.
    d. Formalising relations between IHO and other SDI stakeholder groups and through actively participating in these groups to strengthen understanding and knowledge of the role of hydrography in MSDI.
2. IHO Regional Hydrographic Commissions are encouraged to monitor and report progress in Member States' MSDI engagement and development as a means of benchmarking the role of the national hydrographic authority in MSDI.