CHAPTER 5

# Conceptualisation of the Design of an Environmental GIS System in Malta

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## Introduction

When Malta joined the European Union (EU) in 2004, it was obligatory to adhere to the Union's rigid environmental regulations. As a consequence, to date, most environmental data requires reporting in spatial formats, thus conventionally distinctive focus was given to the Geographic Information (GI) environmental aspect (EEA, 2014).

In 2002 the need for integration stemming from EU obligations resulted in the amalgamation of the then Environmental Protection Department (EPD) and Planning Authority (PA) to form the Malta Environment and Planning Authority (MEPA). Prior to this merger, the PA had its own Geographic Information System (GIS) whilst the EPD did not. Throughout the years to come the EPD as part of MEPA (now called the Environment Protection Directorate, bearing the same acronym [EPD]) sought a GIS system and constantly requested data thus consuming a considerable amount of time from the GIS professionals of the Authority.

In effect, the implementation of GIS structures within MEPA were located in two main departments:

- the Information Resources Unit (IRU), which caters for the thematic GI aspects of environmental and planning data, involved in various efforts to bring the environmental sector online (Farrugia, 2006; Formosa, 2010; Formosa, 2012); and
- the Mapping Unit (MU), which caters for the large-scale and small-scale topographic data and plotting services.

MEPA provided GIS reporting for both the EPD and the Planning Directorate (PD). Other main GI-related responsibilities of the Authority include the EU environmental reporting and the Environmental Impact Assessments (EIAs) collated from planning applications. Furthermore, the Government consulted with MEPA on GIS reports involving new national projects; case exercises, having been initiated in 2013, being land reclamation, wind farms and solar farms, (Government Property Department, 2013).

In March 2013 the Maltese Islands underwent a change in Government, with the Government aiming to and implementing a split of functions into two separate entities in line with the pre-election Manifesto (Labour Party, 2013). Due to its history of amalgamation as discussed above, albeit MEPA was externally perceived as one entity, EPD and PD structures were internally still relatively divided, with the PD remaining the main provider of IT related hardware and GI technical expertise to assist the EPD in their Information Technology (IT) / GI related needs.

Further to the above, data within the organisation was dispersed within several departments and servers. Moreover other governmental organisations hold their own GI data within their systems with third party entities not having access to such data. This data fragmentation results in difficulty to collect data, duplication and versioning control within different governmental organisations.

In summary, the following issues were faced with the above scenario, where this study chapter aims at conceptualising a centralised Shared Information System (SIS) where all environmental GIS data for government authorities are gathered and are accessible to all. All data needs to be in a central repository, in a standardised form, and on one platform; a situation brought to the fore in view that the split between the PD and EPD was under discussion, thus the new debate to which GIS as a core function is being studied. Thus this study also identifies the evaluation of synergies between the different GI environmental systems.

Such a case study will also assist GIS in Malta as such a proposal would result in a clear, centralised and sharable environmental GIS infrastructure. The main challenges comprise an SDI implementation, interoperability and system integration.

**Methodology**

The investigation of the potential SDI requirements resulting from the split of the Authority requires an analysis of what is entailed in the creation of an environmental SDI GI system for Malta. This was carried out through the understanding of the state of environmental information in Malta in terms of data lacunae, legislation, operational issues, structure, access and dissemination.

This posed questions on what and how the environmental GIS can be integrated within a strategic work frame based on EU Directives and through the examination of SDI systems implemented in other countries. A challenge of this study related to the functionality and design of the framework and the integration of feedback received from focus group interviews.

This process entailed an investigation of the methods best used in such a study, which focus on a triangulation method through the quantitative approach necessitated by the data gathering process, and the qualitative approach employing a focus group. Each of these are discussed in more detail below. Table 1 gives a description of both the qualitative and the quantitative approaches used.

Table 1 Qualitative and Quantitative Approaches and their outcomes

| *Qualitative Approach* | *Quantitative Approach* |
|---|---|
| To grasp knowledge of subject and underlying reasons about the subject. | To quantify and generalise results from samples taken. |
| To analyse the issue in discussion and formulate ideas, hypothesis. | To cross reference values and measure incidence of various views. |
| **Outcome:** Finding is not conclusive but assists in creating a course of action to further decision making. Assists in creating a current setup and provides a future theory in conceptualization of models. | **Outcome:** Results will lead to a planned course of action to assist decision making. |

**The Qualitative Approach**

A Qualitative Approach is a different method for the gathering of in-depth data about specific topics. Whilst researching a topic, qualitative approaches can assist in deriving extra topics which will assist the results of the study. This approach allows the flexibility to adopt unstructured interviews and content analysis whilst also permitting the collection of a variety of different opinions and ideas. Jung and Elwwod (2010) discuss new and extended qualitative approaches in GIS and stress that efforts are being pushed towards improving this type of approach. The latter is also considered as an explanatory approach, meaning that data gathered is analysed and theories are generated over the subject of study (Jung& Elwood, 2010).

A wide variety of innovative software solutions are available which assist in such an analysis. This approach has its limitations, such as those imposed by the level of knowledge and awareness of the subjects by the participants due to: low periods of time spent in GI-related work, (even if managing relevant units/teams); and limited choice of participants in a relatively-small organisation. Discussions between experts still define different views on the different approaches to adopt. Leszczynski (2009) describes the quantitative approach vs. the qualitative engagements in GIS as the diverse opinions between critical theorists and GI scientists. Taking the above into consideration, focus group interviews /

discussions with managerial staff in both Directorates within the Authority were carried out with fifteen experts over a period of four months. The aim of the focus group was to collect data and information on the current state and structure of the organisation, while the interviews with the Authority's Managers analysed the current interoperability between the different units, their views on the current structures, and the potential for an SDI implementation.

**The Quantitative Approach**

On the other hand the Quantitative Approach in GIS offers more numerical analytical techniques and numerical quantifications of values (Cope & Elwood,2009). A quantitative approach is the analysis of sociological data in numerical and statistical formats. By gathering numerical data, results can be illustrated in charts which can simplify a visual representation. A quantitative research is sometimes assisted with a qualitative research post quantitative results. Whilst delivering large volumes of objective data, the quantitative approach can be limited through various means such as the access to very specific datasets that are accessible to a few persons, issues related to nomenclature, non-clean datasets and dated data (Formosa et al., 2011). IBM (2012) SPSS statistics package is the tool used to derive such results from the quantitative data collected. It is mainly a predictive analytics software. For the data gathering and analysis of this study, the SPSS Data Collection package has been used to help generate frequencies. Other SPSS data collection capabilities are::

- Interviewing - tools for easy deployment, compiling and managing of surveys;
- Reporting - develop professional and interactive reports in online or desktop environments; and
- Authoring - facilitate the creation of surveys using intuitive interfaces comprising of sophisticated logic, to better completion rate and ensure good quality data.

Excel and SPSS assisted in cross-tabular analysis of the data gathered. This is the process to examine the relationship between two variables of data. Quantitative data was collected via questionnaires. The questionnaire was devised and constructed in such a way that results reflected the current knowledge on environmental spatial data use of GIS in Malta, and feedback on the proposal to conceptualise a design of an environmental GI System in Malta. Reja(2003) present the advantages and disadvantages for both open-ended and close-ended surveys. Open-ended questions promote a more spontaneous and freely deliberated reply, whilst the close-ended questions reduce the bias in reply by suggesting the choice or results (Reja., 2003). Reja (2003) also describe that open-ended questionnaires may be more difficult to analyse whilst close-ended replies might reduce the chance for theme experts and other interviewees to correct, or constructively adjust, the pre-given multiple choice answers.

Taking the above into consideration, the questionnaire utilised in this study was semi-structured, in that certain results were gathered online, whilst others were collected through a one-to-one meeting with key informants. Whereas the online version was a multiple choice with no open-ended questions, the one-to-one version used the same questions and allowed open-ended results and opinions. The choice for adopting such a method was to vary the results and to allow participants, in prime key positions, to express their opinion.

**The Triangulation Approach**

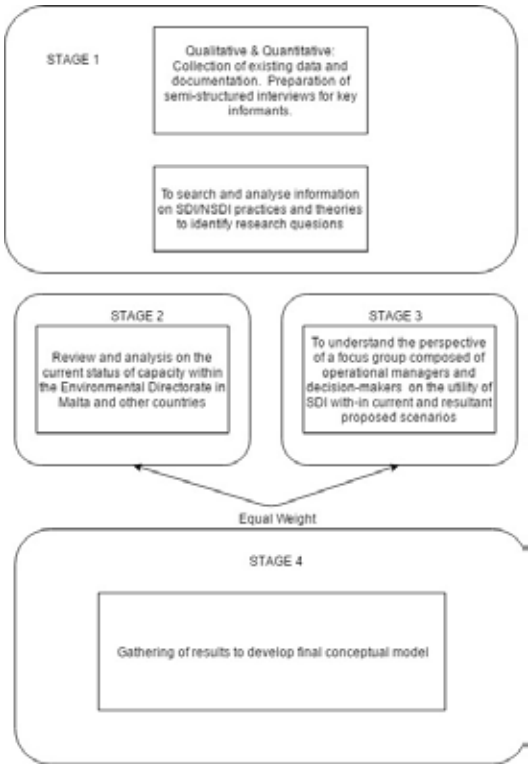
This study adopted a mixed-method approach, also called as a Triangulation Method. Tashakkori and Teddlie (2003) identify reasons that promote a mixed-method approach superior to the single-approach designs. A mixed-method approach can provide a more consolidated and better conclusion, whilst also providing the opportunity to gather information for wider and more diverse views and opinions. This research methodology was adopted since all interview experts formed part of the same organisation.

Table 2 describes the stages of how data collection was divided. Each stage does not reflect primary and secondary data but is in a chronological order for ease of data collection, resultant in the research methods and techniques as depicted in Figure 1. Figure 2 provides the mixed method design and implementation approach adopted.

Table 2 Individual description of the four stages in the research design

| | |
|---|---|
| *Stage 1* | Qualitative: Collection of existing data and documentation. Preparation of semi-structured interviews for key informants. |
| *Stage 2* | Review and analysis on the current status of capacity within the Environment Directorate ED in Malta and other countries. |
| *Stage 3* | To understand the perspective of a focus group composed of the operational managers and decision-makers on the utility of SDI within current and the resultant proposed scenarios. To research and analyse information on SDI/NSDI practices and theories to identify research questions. Quantitative: Design of questionnaires and structured interviews. Analysis of response from questionnaires and interviews. |
| *Stage 4* | Gathering of results to develop final model and acquire feedback from the experts on whether such a model is acceptable. |

Figure 1 Research Methods and Techniques




**Primary Data**

Primary data comprises of questionnaires and focus group interviews; presenting that an unstructured and a semi-structured approach has been adopted. The focus group follows a sequence of unstructured interviews with key elements that will allow the strengthening of results from questionnaires, thus having a triangulation of data in order to strengthen results.

The study's discussion was an open, semi-structured discussion highlighting the scope of this study aimed at gathering feedback and opinion. This was held at management level so as to gather key data on the responsibility of each unit and the way they operate. One of the major aims was to gather latest information, from top management, with regards to decisions on how the new environmental entity will operate, collecting information on new policies and environmental operations. Table 3 presents the approach adopted for the focus group interviews.

Figure 2 Mixed Method Design and Implementation Approach

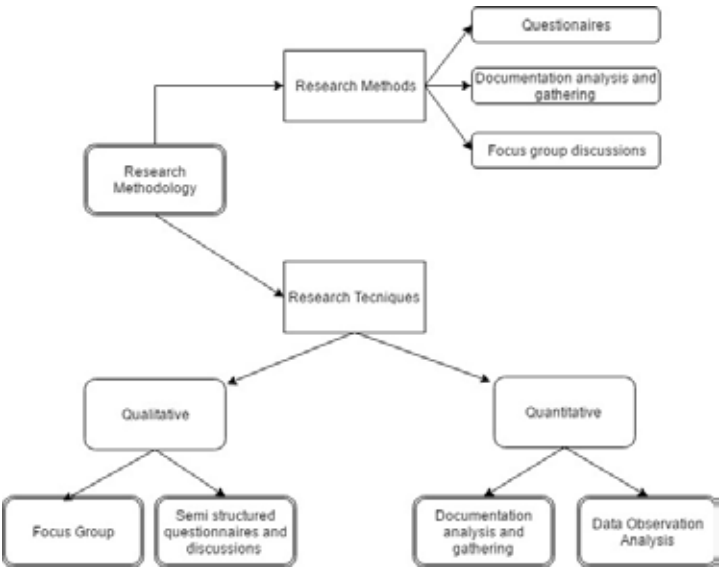



Table 3 Main focus of structured interviews

| | |
|---|---|
| ***Identifying key participants*** | **Gathering of information on all officers working in IRU, MU and environmental units that are directly related to GIS and the ERDF156 Project. Such information will be gathered from the Human Resources (HR) department and clearly stating ethical issues that the proposal is bound by.** |
| ***Formulating questions needed*** | **Preparation of a set of standard questions that are focused directly on the current setup and the participants' opinion on an ideal setup. Direct questions to higher management and direct sub-ordinates.** |
| ***Inputting data whilst interviewing*** | **All information is relevant for future analysis so that information that is not directly related to the questions will be recorded.** |
| ***Transcribing data*** | **Creation of a standard template on how to transcribe data. Data must be standardised in order to assist its analysis in table format.** |
| ***Preparing and organising focus group for discussion and data collection*** | **Organisation of extra sessions with Technicals directly responsible of data acquisition and to gather information on how a proposed system will assist in their work.** |

The second form of primary data collected was through the structured questionnaires, which data was later analysed. The key members were selected mutually with the consent of their respective managers during the focus group discussions. For every environmental theme (i.e. for every unit) one key expert was identified.

**Secondary Data**

The secondary data was collected from the IRU and the four environmental units forming the ED being: Environmental Permitting and Industry Unit (Unit A), the Environmental Assessment Unit (Unit B), the Ecosystems Management Unit (Unit C) and the Waste, Air, Radiation and Noise Unit (Unit D). Table 4 describes the secondary data sources used.

Table 4 Secondary sources of data

| *Within MEPA* | *External Organisations* |
|---|---|
| Data gathering from (SEIS) within the ERDF156 Project, MEPA (2009). This is currently on beta version and incomplete. | Data that is non-GI (non-spatial) from diverse agencies such as Malta Resources Authority (MRA), Ministry for Sustainable Development, the Environment and Climate Change (MSDEC, 2013). |
| | Data gathered from European entities. The European Commission 'EU Shared Information System – Implementation Outlook', (The European Commission, 2013). |
| | Information from the EEA, and the EIONET Central Data Repository (CDR) (The European Commission, 2013). |
| | Various Papers and Journals. |

Most of the secondary data sources were identified through the focus group interviews held with the unit heads and environmental experts, with an additional focus for those related to the 'Water' theme. Secondary data analysis was not restricted to data acquired by MEPA but also by other Maltese governmental authorities that house environmental data. Other sources of secondary data covered research and analysis of other European countries within the context of SDI, water theme, and data gathering and manipulation within the INSPIRE Directive.

**Results**

The following section will display results from the interviews held with various experts within the Authority. The aim of the first question was to cross reference how and who was conversant with spatial data. The response was that only a few respondents between

the age group of 35 and 44 years were not conversant. These were mainly persons who were the ones at decision level within the Environment Directorate. Their role in the entity does not entail them to be conversant with the data but simply to be presented with statistics and to take key decisions within the same Directorate.

A cross-variable analysis was carried out in order to identify whether the respondents who replied positively on SDIs knowledge, were also aware of metadata. Respondents, who had a very good knowledge of the structure, user and operation of SDI, exhibited very high awareness of metadata. In fact, 40% stated that they had 'Very High Awareness' and the rest stated 'High Awareness' (Figure 4). Those who answered that they had a 'Good Knowledge' were less aware of metadata (17% - very high) and there was an increase in less aware persons when they answered that they had a 'Fair Knowledge' (20% 'Low Awareness'). Another finding shows that they still considered themselves to have a high level of awareness.

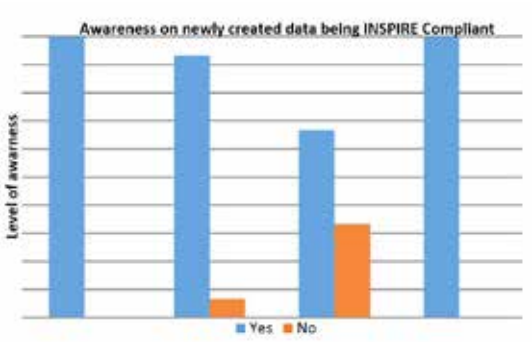
Figure 3 displays results of the cross reference between knowledge of metadata and the awareness that all new created datasets must adhere to the INSPIRE Directive. Results, clearly denote that 100% of the people who had knowledge of metadata, also had an awareness of INSPIRE compliance. 33% of respondents who were not aware of metadata, were also not aware that new datasets must adhere to the INSPIRE Directive. The same amount of respondents who answered 'No' had low knowledge. The respondents indicated that a centralised system is required where all data would have to be compliant in order to minimise the communication between diverse units, sections or ministerial departments. This is preferred by respondents, as it offers one strong hold of having one entity housing all environmental spatial datasets.

The desk study showed that GIS within the environmental sector of MEPA and ministerial departments was widely used, mainly for analysis (85%). Participants agreed with the consolidation of one entity housing all environmental data, as such analysis will be less troublesome. They indicated that all data will be available without interoperability issues between the units. An interesting fact is the low results in EU reporting. This was noted whilst commencing the open-ended questionnaire with the IRU, which as already stated is the National Focal Point (NFP), being responsible for the uploading of the content, after it is structured and prepared by the respective environmental experts.

The respondents argued that the process from the Environment Officer to the EEA is a long process of correspondence and approvals were required from different entities, further stating that such process is necessary to grant approvals from different institutions. The unit responsible for such a flow was the EU Affairs Team within MEPA. Figure 4

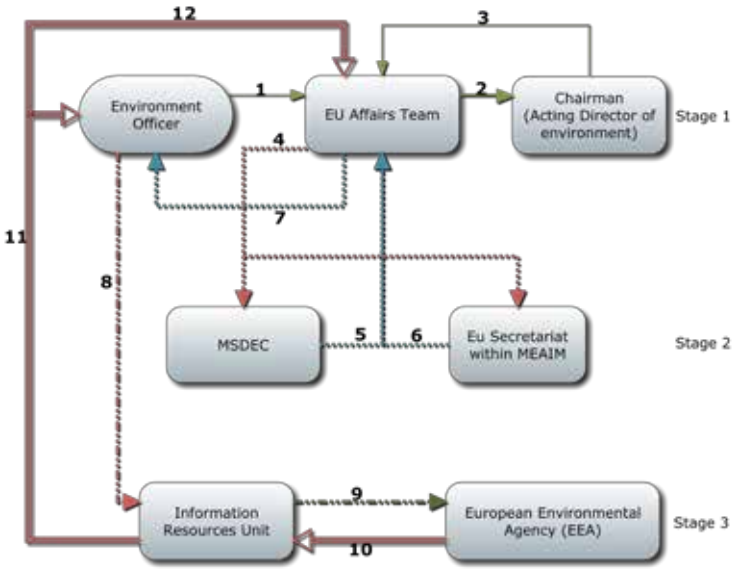
displays the dataflow diagram together with the appropriate step by step explanation of the data flow before it reaches the EEA.

Figure 3 Level of awareness on newly created datasets being INSPIRE compliant




The reporting workflow developed following discussion with the EU Affairs Team resultant from discussions with the respondents decsirbes the process adopted by the Authority in order to finalise any reporting before uploading to the EEA.

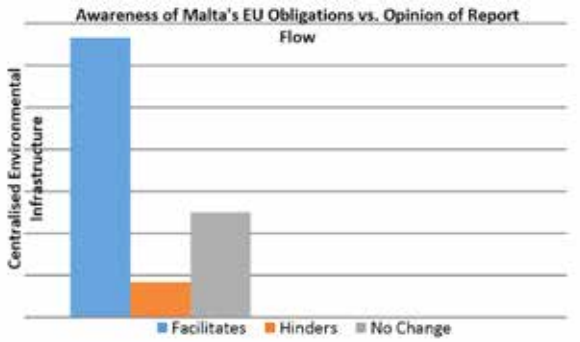
Figure 4 Dataflow between report originator to the EEA



1. The Environment Officer originates the data which after completion of report is sent to the EU Affairs Team;
2. The EU Affairs Team sends the report to the Environment Acting Director (currently MEPA Chairman) for the necessary approvals;
3. Once approved by the latter, the report is sent back to the EU Affairs Team;
4. The EU Affairs Team forwards the Environmental Director's approved reports to the (MSDEC) and to the Ministry for European Affairs and Implementation of the Manifesto (MEAIM), more specifically to the EU Secretariat, which coordinates matters and refers them to the Permanent Representation;
5. The MSDEC reports back to the EU Affairs Team;
6. The EU Secretariat also reports back to EU Affairs Team;
7. Reports from MSDEC and EU Secretariat are also forwarded back to the Environment Officer;
8. The Environment Officer forwards the approved reports to the IRU;
9. The IRU uploads the data on the EEA's portal being the European Environment Information and Observation Network (EIONET);
10. The EEA sends an automatic receipt of upload and any other relevant feedback to the IRU;
11. The IRU forwards any feedback to the responsible Environment Officer and the EU Affairs Team; and
12. The Environment Officer will then reply back to the EU Affairs Team.

As per discussions held with the IRU and the NFP, Malta must adhere to strict deadlines in uploading this data. 85% of the respondents who were aware of such obligations, also thought that a central environmental SDI will facilitate such reporting processes. Also, 4% thought that it will hinder such reporting. This is further explained in detail in Figure 5. The same percentage also illustrated that the theme experts who are in charge of preparing such reports had the perception that they will lose control of their data. The same respondents also thought that they will have to go through other individuals / entities to report data and also feared that the dataflow will be slowed down due to bureaucratic processes or political / operational indecisions. This was an ongoing concern, where dataflows had previously been slowed down at political / ministerial level and therefore data was always uploaded late. The IRU respondents stated that they had striven to reduce this problem through direct 'restricted-access' uploading to the EEA, which restrictions were then removed once the ministerial approval was gained.

Figure 5: Awareness of EU obligations and impact of centralised SDI on reporting



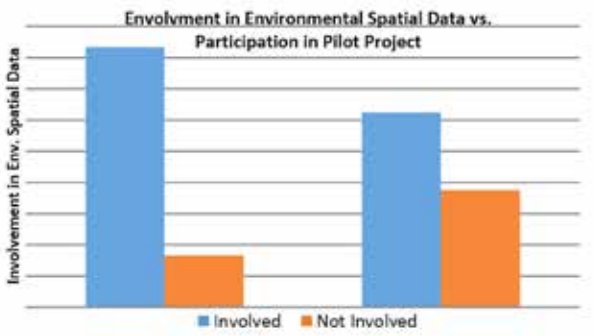

One interesting fact is that 25% of respondents thought that it will not make any difference in having a centralised system (Figure 8). The findings show that these respondents pertain to those who do not fully appreciate the GI work carried out. As demonstrated in Figure 6 with reference to the problems encountered by data share-ability between environmental departments within MEPA and other environmental entities throughout the governmental departments, all comments by respondents led to report a problem in this area. The results show that 38% of the respondents, who think that data sharing is a problem, still lacked the desire to participate in a pilot project for the conceptual model of a consolidated SDI, thus promoting data sharing between Governmental entities.

Figure 6: Data sharing vs. participation

The results show that when discussing lack of interest, it was noted that due to the fact that some employees have been employed for over 10 years with the organisation, their motivational drive has been reduced substantially. They stated that this was due to overloaded workloads, fear of unbalancing the status quo or a lack of willingness in striving against management and other governmental departments in their quest for new enhancements to the output.

Figure 7 depicts that a total of 23% of the respondents who are not involved in environmental spatial data, still showed interest in participating in a pilot project. On querying the reason for such a drive, younger participants and with recently acquired introductory knowledge of GI, showed more interest in learning more about SDIs and what is achievable with such consolidation of data. Once again, a large part of the respondents who were aware of environmental spatial data were still reluctant to participate in a pilot project, for the already mentioned reasons (63%).

Figure 7: Involvement in environmental spatial data vs. participation




Participants were also asked to give their opinion on the current GI environmental infrastructure, and their response was cross-referenced with the idea of a conceptual model for the environment entity (Figure 11). 56% considered GIS from an Information Communication Technology (ICT) perspective to be advanced but perceived having a centralised SDI to be highly essential in order to function better. Still, a very high percentage of those who thought that the system was adequate 'Passable', considered this to be 'Highly Essential' or 'Essential'. The respondents stated that whatever the current situation in environmental GI is, it is of essence to group all environmental data into one consolidated spatial infrastructure.

Participants were asked whether the idea of having a conceptual model of a centralised environmental SDI, was achievable. The response is a very positive one with 85% of the respondents confirming that it is achievable and that it will facilitate work within the new environmental authority, once it will be formally set up. 4% thought that a consolidated SDI might hinder, whilst 12% thought that it will not change the current situation. However, whilst investigating why such response was given, the same problem emerged, being that the respondents who have seen governmental changes and different reforms in the Authority still thought that at governmental level, there will be major barriers for the implementation. Respondents also highlighted that since this is a new proposal by a newly elected government, and was also part of the party's Electoral Manifesto, the change was more likely to happen now, thus the positive response.

**Results from the choice of one thematic area: Water**

Results from the 'Water' theme, show that respondents stated that each governmental entity is responsible for the collection of data that pertains to their respective department, which in turn is the data that MEPA has to try and gather for the compilation of the reports for the EEA. Table 5 describes the role of each governmental entity within the two directives as identified through this study.

Table 5 Relevant entities with respect to the WFD and MSFD Monitoring Programmes

| **Monitoring Programme** | **Entities** |
|---|---|
| Ground Water (GW) | Unit A (MEPA) – responsible for water quality analysis and reports. |
| | Environmental Health Directorate – must oversee the quality of GW within the Maltese Islands. |
| Inland Surface Waters (ISW) | Unit A (MEPA) – responsible for water quality analysis and reports. |
| | Unit C (MEPA) – responsible for Biodiversity. |
| | Environmental Health Directorate – must oversee the quality of GW within the Maltese Islands. |

| Monitoring Programme | Entities |
|---|---|
| Coastal and Transitional Waters | MEPA – responsible to link with the MSFD Directive. Must also oversee Bathing Water Quality and Transitional Areas. As per Figure 4.11, Transitional Area is that area that overlaps with the MSFD within the OSPAR Convention laws of the sea. |
| Bathing Water Data (BW) | Department of Health – sample beaches and Coastal Waters (CWs). |
| Non-Indigenous Species (NIS) | MEPA - monitoring within hotspots (e.g. Protected Areas, Harbours) and Action Plans. |
| | Transport Malta (TM) -shipping is one of the main vectors of non-indigenous species, Ballast Waters (Ballast Water Management Convention). |
| | Fisheries Department - aquaculture can be another source of NIS - Council Regulation EC 708/2007 concerning use of alien and locally absent species; Fisheries also have the opportunity to contribute to monitoring by the collection of specimens through the International bottom trawl survey in the Mediterranean (MEDITS). |
| Eutrophication | MEPA (E-PRTR – monitoring of nutrient input; WFD – monitoring status in the marine environment). |
| | Water Services Corporation (WSC) – Sewage Treatment. Plants (Urban Waste Water Treatment Directive) (UWWT). |
| | Agriculture – Nitrates Directive – Nitrates Action Programme. |
| Hydrological Changes | MEPA (link to development applications), TM (harbour development). |

| **Monitoring Programme** | **Entities** |
|---|---|
| Contaminants | MEPA (WFD: monitoring of input loads, monitoring of status).WSC (monitor contents of effluents). |
| | TM (oil spills, bilge waters, bunkering). |
| | Continental Shelf Department – oil drilling. |
| | Fisheries Department – contribute to monitoring of contaminants in biota. |
| Contaminants in seafood | Environmental Health Directorate – monitor contaminants in food (EC Regulation 1881/2006). |
| | MEPA and Fisheries Department – contribute to sampling of biota and assessment of contaminants in biota. |
| Litter | Cleansing Services Directorate – beach cleaning which can generate data on litter on the beaches. |
| | Malta Tourism Authority (MTA) – Blue Flag Beaches including criteria for monitoring beach litter. |
| | Fisheries Department – contribute to monitoring of litter on the seabed. |
| | TM – main source of litter is shipping and they can contribute to monitoring of litter on the surface. |
| | MEPA – Oversee monitoring programme and compiles report for EEA. |
| Energy, including Underwater Noise | MEPA – to include MSFD data requirements in EIA process. |
| | Continental Shelf Department - licensing of seismic surveys (one of the main source of impulsive underwater noise). |
| | TM – shipping lanes – main source of increase in ambient noise levels. |

| Monitoring Programme | Entities |
|---|---|
| Biodiversity - Birds | Wild Birds Regulation Unit – Birds Directive. |
| Biodiversity – Mammals and Reptiles | MEPA (Habitats Directive). |
| | Fisheries Department, TM, Armed of Forces of Malta can contribute to monitoring; Fisheries Department will be collecting data on by-catch of turtles. |
| Biodiversity – Fish and Cephalopods | Fisheries Department – collect data on fish and cephalopods – Common Fisheries Policy. |
| | MEPA – data analysis. |
| Biodiversity – Commercial fish and Shellfish | Fisheries - Common Fisheries Policy |
| | MEPA – data analysis. |
| Biodiversity – Seabed Habitats | MEPA. |
| | Pressures: Fishing Intensity (Fisheries); Anchoring & Bunkering (Transport Malta); Aquaculture; Waste Water. |
| Biodiversity – Water Column Habitats. | MEPA – data analysis. |

The mother directive, the WFD, is divided into two main programmes; the Inland Surface Waters (ISW) and the Coastal and Transitional Waters. Both have overlapping data, such as contaminants, eutrophication, hydrological changes, biodiversity seabed habitats and biodiversity in water column habitats. Each programme is responsible for the collection of data related to the underlying subsets.

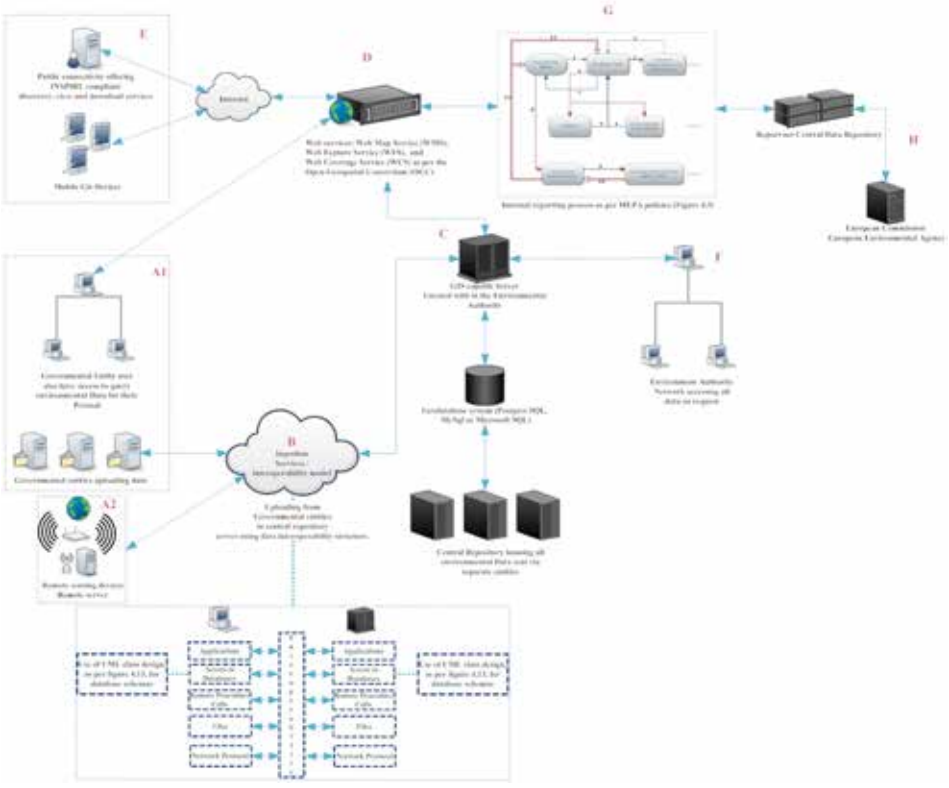
**The conceptual model**

The Conceptual Model (Figure 8) has been developed following an analysis of the qualitative and quantitative data presented above. The model was designed to facilitate communication and data gathering from different entities and to be able to be more productive in a better and more efficient way. As Tóth (2012) describes, providing a system with standardisation, will ease the interoperability between entities and also provide a base for a design of an environmental SDI (e-SDI) unified platform.

Figure 8 depicts the final conceptual technical model for an e-SDI resultant from the findings, which model was created post feedback on the current system and querying on whether the concept of a central repository would facilitate in the data collection, storage, reporting, ease of access, assistance in governmental decision making, and public dissemination.

The model provides the three main important features of an SDI, the core servers and respository, the dissemination services and finally the prodcedural data uploads and security. The scope is provide a solution capable of ingesting data from governmental entities directly into the system to disseminate to public thus reducing human interaction. The 'Results' section demonstrates positive feedback and depicts willingness in constructing such a system.

Figure 8 Conceptual Model for an environmental SDI



**Conclusion**

This study, in its strive to understand the status of environmental information in Malta, whilst initially reviewing the different environmental themes, focused on one main thematic aspect related to water as a case study. Findings showed that in terms of data lacunae, environmental themes suffer from the lack of spatially-structured information, legislation has been transposed (INSPIRE) but not every thematic expert is knowledgeable on this score. In terms of operational issues and structure, the findings show that there is a lack of interoperability between units, systems and information-sharing. This is highlighted even more through difficulties encountered in access to data and in being knowledgeable of dissemination modes of data.

The exercise to review, analyse and draft the process as well as to construct a conceptual model, which can be employed for an SDI's concept in Malta and findings show that the current ED does house knowledge and capabilities to convert a conceptual model into a full implementation. However there are issues that need to be tackled on various domains before such a system goes through to fruition. The process requires time and substantial finances but implementing the system in a staggered manner can assist the success of an SDI (Janssen & Dumortier, 2007). Throughout the process of data gathering, a number of concerns and issues have been highlighted, and these open new pathways for further investigations and studies.

The findings also show that the model is an achievable goal and its results are of great advantage to the authority that deploys it. The model covers new technologies and an independent upload system that will ease much of the work in digitising data. Furthermore, the system offers traceability, security and most importantly, data governance. Another important note is the enthusiasm shown by few, relatively new to the organisation, in implementing such a system, but also disappointingly, the large amount of people who are not willing to participate, mainly because of the years and numerous reforms MEPA went through. It is of vital interest to comprehend that such a system can simplify, and at the same time, build a robust architecture for the authority that is responsible for the care of the environment we live in. This is the scope of the conceptual model for the environmental SDI.

The main limitations of this study emanated from the state of flux that the change in the Authority's split brought about and as such, the experts interviewed could have been wary of the scope of this study, particularly due to a perceived fear that such a process may complicate / increase their work load or serve as the basis for additional functions. However, the experts were forthcoming, especially since the study was conducted prior to the actual launch of the change process.

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