PROPOSAL FOR THE ESTABLISHMENT OF AN INTEGRATED NATIONAL SPATIAL AND MAPPING SERVICE FOR THE MALTESE ISLANDS

A phased approach for the setting up of an implementation structure of spatial information to serve all governmental and related entities with a free information function

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Glossary of terms and acronyms used

AARHUS	Convention on Access to Information, Public Participation in Decision making and Access to Justice in Envoronmental Matters
CDDA	Common Database on Designated Areas
Copernicus	Peviously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation.
CPD	Civil Protection Department
DTM	Digital Topographic Map or Digital Terrain Model
DGenv	Director General Environment
ERDF	European Regional Development Fund
EEA	European Environment Agency
ESPON	European Spatial Planning Observatory Network
EUROSTAT	European Commission Directorate-General with responsibilities to provide statistical information
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security
INSPIRE	European Commission Directive establishing an infrastructure for spatial information in Europe
IRM	Integrated Resource Management
LSTM	Large-scale Topographic Map
MEPA	Malta Environment and Planning Authority
MoU	Memorandum of Understanding
MRA	Malta Resources Authority
NSDI	National Spatial Data Infrastructure
NSO	National Statistics Office
SEIS	Shared Environmental Information System
UNIGIS	UNIGIS UK Universities - Leading provider of online distance learning education in GIS
UoM	University of Malta

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RAISON D'ETRE FOR THIS PROPOSAL

1. **Concept:** As most mapping data processing requires updated or near real time information, which is governed by concepts and technologies that evolve rapidly, it is imperative that a solid foundation is laid to ensure Malta's readiness in all areas that deal with base and thematic mapping. Currently the state of affairs depends on dated basemaps, inter-agency charging systems, inconsistent approach to the data-cycle process, dispersed expertise, various software and isolated non-networked systems.

   Malta needs to bring together these entities to ensure the setting up of a central organisation that serves all the country's needs, the creation of base and thematic spatial information system, a regularly updated and enhanced information structure that serves all entities, and the integration of expertise.

   This structure should ensure compliance with national and European/International legislation and commitments, simplification of procedures, free dissemination of information and inter-agency collaboration. Such a structure serves both for current requirements such as development monitoring, transport monitoring, infrastructural inventorisation, utilities' flows as well as deployment for foresight such as the realtime deployment of information in cases of emergencies. Only through an integrated information system can such be brought to a peak of excellence.

   This proposal seeks approval to develop a conceptual model and implementation process for the sourcing of EU ERDF funds aimed at creating the spatial entity, sourcing and integrating the players, creating information systems, acquiring in-situ and remote data harvesters, analysing the scenarios and implementing realtime and foresight contingency plans through scenario testing and disseminating the raw and processed information.

2. **Technical:** Spatial Data (or geapographical information system) refers to those information streams that deal with location: data as it is related to a point in space. These are generally known as graphical information systems that allow one to view data in the form of a map or as online interactive systems. Systems in place include the MEPA mapserver, MEPA's SEIS (Shared Environmental Information System), GoogleMaps and other similar systems. Since everything happens somewhere, the requirement for authoritative reference geospatial data is vital for all branches of central government. This necessitates the need for an increased awareness of the value of 'place' and 'location' as vital components in effective decision making and for linking public-sector information together. It is important to distinguish between levels of reference maps:- while free or web-based mapping are sufficient in locating the nearest restaurant, central government dealing with national and societal interests, and in some cases life-critical

situations like disaster management, requires authoritative and quality-assured geospatial data at a national level.

3. **Legacy:** Malta is one of the forerunner countries that have attempted to gather, analyse and disseminate spatial (or geographical information) that cover the entire nation. The country's size is an aiding factor, however, Malta has the same relative human and material resource capacity as other states.

4. **International Requirements:** Malta's entry into the European Union has pushed the requirement to create these information structures towards locational analysis and reporting in over 70% of the Acquis. There has been an exponential growth in the use and proliferation of geospatial and location information in the past decade. More importantly this trend is expected to increase in the next five to ten years as technology-driven trends will impact geospatial data capture methods, making location information even more ubiquitous.

5. **EU Legislation:** Malta is party to the Aarhus Convention, the INSPIRE Directive (EU Directive establishing an infrastructure for spatial information) and the SEIS initiative. All data reporting streams go through the EC (European Commission) and the EEA (European Environment Agency) and Malta has to report in spatial formats to these agencies.

6. **Maltese Legislation:** The production and maintenance of the national geographic database of Malta is defined as one of the functions and legal obligations of the Malta Environment & Planning Authority laid out in Act No X of 2010, Article 8, Sub-article 2(e): "*the carrying out of national mapping, including carrying out land surveys of specific areas and keeping up to date the national geographical database …"*

7. **Current Functionality:** MEPA's mapping unit is tasked with carrying out the national mapping function. The unit's core objective is to produce and maintain accurate, detailed, authoritative reference maps of the Maltese Islands, known as the large-scale topographic map (LSTM). This is composed of different layers that represent a collection of real-world features (such as buildings, roads, pavements), and abstract objects such as cartographic text. It includes a topography layer, an elevation layer, a Digital Terrain Model (DTM) layer, a geographic text layer, and the orthophoto map layer.

   The national mapping function is a specialist function which benefits MEPA since the base map is intrinsically linked with several of the authority's business processes, such as forward planning, plotting, development control, environment and enforcement. However the LSTM is also the *de facto* national spatial reference data, a strategic dataset that is indispensable to the wider national requirements comprising utilities, civil protection, transport, communication, emergency services, agriculture and health, to name a few. Government is thus a major stakeholder in the need for accurate, detailed and up-to-date authoritative geospatial data which act as the basic reference layer over which many other government entities can overlay their own specific geospatial themes and layers of interest. The LSTM is thus the basic reference layer that underpins the national Geographic Information System (GIS), otherwise known as a National Spatial Data Infrastructure (NSDI).

   This NSDI is the vehicle through which geospatial information and public sector information can be shared in a standardised and cost effective manner

by central and local government, public entities and indeed the general public. In turn a national GIS maximises the investment in information, ensuring that data are captured, maintained and managed once and shared by many. However a key element of an effective GIS is an authoritative and up-to-date reference database which brings together all the themes and layers of all the stakeholders in a standard, harmonised and interoperable platform.

The LSTM has a lengthy and specialist production process that requires the use of specialist suppliers, dedicated software and hardware, and specialist knowledge and skills. Topographic mapping represents the real world which is always changing. Therefore the challenge is to reflect the real world by constantly maintaining and updating the large-scale topographic map.

8. **Issues at Stake:** The technology and methods to produce and maintain digital geospatial data have undergone drastic changes in the last two decades since the Mapping Unit was initially set up in 1988. However, there has been no significant investment to upgrade the national mapping function in over a decade. The investment required to update and maintain the authoritative datasets and to upgrade the technology to exploit the new location-driven technology and trends is in the region of €1.5 - €2 million. This investment would entail a mixture of out-sourcing and in-house supply, data capture and quality control. While it is advantageous to outsource certain elements of the data-capture and production process of the base map, total divestment of the entire undertaking is not recommended since commercial interests may undermine the authoritative nature and trust of the reference datasets which are critical to the national interest and security.

9. **Free Access:** An emerging trend in other European states is that as part of their eGovernment strategy, free access to high quality reference authoritative data is being granted to the public. Reference authoritative data in such cases could include: geo-spatial businesses information, addresses, real properties, land tenure, and digital map data. This is viewed as a driver for efficiency and interoperability in the public sector, a stimulant for economic growth, and an opportunity for the creation of innovative digital services in the private sector. Free access has already been made available through the establishment of the Aarhus requirements and through the SEIS system which MEPA launched on the 18th October 2013. The concept of 'gather-once and use-many' should enable all entities in Malta to create information and distribute it for free to all entities and the public due to its base funding mechanism that ensure tax-payer's monies are returned in kind without the need to double charge for data that has already been paid for by the same citizens.

10. **Recommendation:** The above exposition, supported by and expounded further in the attached paper, are the main reasons for the urgency to establish a national Spatial Information Structure and Cabinet is requested to approve in principal the establishment of a national GIS function and authorise MEPA to set such a system in place. Cabinet is also requested to entrust the structure to investigate the best *modus operandi* for the setting up of a functional entity, explore the funding mechanisms for setup and implementation as well as ensure the delivery of the data to all interested parties and the public.

11. **ERDF Funding:** In addition, Cabinet is requested to approve that this process be implemented through the uptake of 2014-2020 funding with a specific mention in the proposal to this project as it entails a multitude of hardware, software and data gathering to enable its fulfilment.

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1. INTRODUCTION

1.1 In a rapidly developing world where the introduction of massive online information systems has enabled both the scientist and the general public to interact with remotely-located data from across the globe, the reality of access to data and eventually to information is slowly bringing forth the realisation that decades-old barriers to access to data still need to be overcome. Whilst the massive volumes of data at hand can easily lead one to acquire a perception that there is everything one could require at the touch of a button, reality speaks otherwise. Although the data is there, the issue of reliability and free access speaks otherwise. The fundamentals of research lie in the availability of reliable data, a phenomenon that has left disciplines struggling with issues of repeatability of scientific outcomes. Whilst technology and legislative measures have caught up with the realities facing researchers, access to that data through interactive interfaces is still limited.

1.2 Data availability suffers from a plethora of scourges that have left entire countries with a dearth of reliable baseline information, particularly small states which have limited human capacity to manage the whole datacycle in the physical, social and environmental domains. The main limitations include the fact that there are few homogeneous structures in operation. Other limitations included a governance situation where data is not made available or is charged at unsustainable rates. The latter has been tackled through the Aarhus Convention and the Freedom of Information Act, whilst others require initiatives that generate tools which gather, analyse and disseminate the data for free, an exercise sought in the European Regional Development Fund (ERDF) described herein.

1.3 Other more technical issues include the fact that there are too many standards to follow, data is not dynamic (gathered ad hoc as a one-off and not real-time), data is not quality assured/controlled, queries are not organised and recorded, data is not secured – ('illegal' use of storage on personal storage devices and other digital media) and that versioning is not practiced.

1.4 In addition, even where the data is available, there is an upsurge in requests for access to such data which has increased drastically since Tim Berners-Lee's 1989 world wide web (WWW) proposal changed society as never before. The WWW changed a medium that was at best techno-centric to one that is now essentially socio-technic. Increasing requirements for bandwidth has resulted in a need for a reanalysis of Dahrendorff's (1990) access issue in contemporary worlds, both real

and virtual, where not all society has access to the information through on-line services. This lack of access is leading to a situation where a new type of poverty is being created, specifically that related to information drought, with users lacking internet-access losing out on progress in the various socio-economic themes. This is already being seen in the North-South divide across European countries in terms of access to the medium that transports this data, where internet access disparities range from 33% in Greece to 88% in Iceland (NSO, 2009).

1.5 The other most important issue relates to the access to standardised processes for information-creation which is being tackled through various legislative instruments such as the Data Protection Act (OJ, 1995), the Åarhus Convention (OJ, 2003a; OJ 2003b), the Freedom of Information Act (OJ, 2003c) and the INSPIRE Directive (OJ, 2007), as well as other guidance documents that are targeted to enable the smooth and free flow of effective information.

2. STATUS REVIEW

2.1 There is no doubt that the ability to store, process and analyze information is considered as being one of the most powerful tools helping management in its many decision making processes. When the amount of information is large this can only be achieved through the fast, timely and effective use of such information, in the form of electronic data. Moreover, if this data could be made readily available to all those who are involved in the planning, control and decision making process, then this should lead to an even more integrated, unified and rational approach and the attainment of better results. Thus, it would be in the interests of all and of great benefit to the country, if the data which is already available on an individual basis, is centralised and made readily available and accessible to all. This data would be more valid if it is represented on a Geographic Information System (GIS).

2.2 In its simplest form a GIS can be regarded as the high-tech equivalent of the traditional map. An individual map contains a lot of information which is used in different ways by different individuals and organisations. It can, not only represent the means of locating ourselves in relation to the world around us but may be used in diverse applications, from locating telephone wires and sewer mains under our streets, to displaying the extent of coastal erosion, vegetation distribution and population migration.

2.3 The map has been in existence in much the same form for thousand of years. In the traditional form it suffers from a number of problems. Firstly maps are static and therefore difficult and expensive to keep up to date. This relates to a second problem, in that because they are static they lose flexibility; for example maps exist as discrete sheets and inevitably your area of interest lies on the corner of four adjacent sheets. In addition maps are often very complex and may require an expert to extract the particular data which are of interest.

2.4 GIS provides the facility to extract the different sets of information from a map (roads, rain fall distribution, vegetation, etc.) and use these as required. This provides great flexibility, allowing a paper map to be

quickly produced which exactly meets the needs of the user. However, GIS goes further. Since the data is stored on a computer in digital format, analysis and modelling become possible. For example, one might point at two buildings, request the computer to describe each from an attached database (much more information than could be displayed on a paper map) and then to calculate the best route between these.

3. WHAT IS A GIS

3.1 Although it is called a Spatial information System, better known as a Geographic Information System (GIS) as against a simple isolated information system, GIS is an entire technology. It is the technology of digital processing of geographic spatial data. Since the traditional repository for geographic spatial information has always been the map, GIS has sometimes (mistakenly) been described as "automated mapping" or "desktop mapping". The utility of GIS is however not in its ability to make maps, but in its ability to analyze the spatial information contained on maps.

3.2 The definition of a GIS varies depending on specific applications, but generally it is described as a computer-based system with the ability to assemble, store, retrieve, modify, analyze, manipulate and display data which contains physical locations (geographic co-ordinates) of features and information about those features (attribute data).

3.3 Essentially a GIS would consist of a collection of data under two main but closely linked and related forms :-

- a BASE MAP which is essentially a detailed map of Malta and Gozo in digitised form. This base map is basically a representation and record of the street layout, with street names, showing the built and unbuilt environment within the urban area and the rural landscape in rural areas.

- DATA LAYERS which are electronic layers containing information and data which are collected, owned and kept updated by the service providers or other data collectors and owners and plotted against the base map. Examples of service providers are Enemalta, the Roads Directorate at Transport Malta, the Drainage Directorate at WSC, the private communication providers such as GO, Vodafone, Melita etc., while examples of other data collectors and owners would be the Civil Protection Department, the Civil Registration Department, the Department of Health, the Electoral Commission, the Meteorological Office, the Maritime Authority, the Local Councils Department, the National Statistics Office, the University of Malta, Transport Malta and MEPA.

3.4 In practice a superimposition of one, two or more data layers on the base map would give varying information. Thus the superimposition of the layer kept by the Drainage Directorate say, would indicate the position of manholes in a certain locality or street. This could perhaps not be sufficient enough information for a public utility organisation or contractor who is planning to carry out trenching works in that particular street. So the switching on of the data layers held by Enemalta, Water Services Corporation, the Roads Directorate and Melita Cable

Television, besides others, and their superimposition on the base map together with the Drainage Directorate data layer would be required. This would effectively give the user an instant plan of that street or area indicating all drainage manholes and sewer pipes, all electrical power cables, all main water pipes, all telephone junction boxes and cables and all cable television services lying beneath the surface of the street. This can be achieved within 60-90 seconds on the screen and within 3-4 minutes made available in printed form in full colour.

3.5 The usefulness and utility of the system depends on the amount of appropriate, relevant and accurate data held. The possibilities are enormous and perhaps endless. In the example given above would it not be meaningful and very relevant if information indicating that at a particular residence in the street under consideration, or for that purpose in an adjoining street being served by the same water services main, lives a patient who is connected to a dialysis machine and that a suspension of the water service to that household for more than three hours would be detrimental to that patient!

3.6 The system does not however stop here. A GIS can be useful for relating mapped features and their attributes in two other ways. First, the actual feature from a map, a sewer manhole for example, displayed on a computer screen may be pointed at electronically and used to access and display all of its attributes. Thus the Drainage Maintenance Engineer would be able to know at the click of a button the year the manhole and its accompanying pipes were installed, their material, diameter and capacity of pipe, etc. Moreover, the database itself can be queried to display only those features selected in a way which may give it meaning. An example of this is choosing all parcels of land belonging to Government which have an area of, say, between 1,500 to 2,000 square metres and which are served by public transport. The possibilities are endless.

3.7 Moreover, the data held can in certain instances be used for modelling purposes. Thus for example, the data held by the Drainage Directorate or by other Directorates of the WSC can be exported to a modelling package and mathematical models giving different scenarios of flow characteristics can be built up and analysed. This is a very useful tool in the planning of infrastructural services. The same data can be employed by the Planning Directorate at MEPA to implement and test scenarios for waterflows prior to approving a development.

3.8 GIS may also serve as a useful tool for the planning and execution of services to the public such as for household waste collection, postman rounds, public transport routes, etc.

3.9 One other crucial point concerns that of predictive modelling, where the analysts can create scenarios for policy and decision-makers based on the spatial information created by MEPA's mapping function and the other datasets created by the other entities. An example would be the prediction of person-migration following a disaster, requiring information from all the public and private entities for feeding into the Civil Protection Department (CPD). A case in point would be information from Roads on infrastructure stability, water flows from environment and the utilities,

population structures from the National Statistics Office (NSO), amongst others.

4. THE NEED FOR A GIS

4.1 It is hoped that the above has amply demonstrated the need, which is, moreover, considered urgent, for establishing a project aimed at the implementation of a unified and strong GIS base within Government. The current scenario where an *adhoc* and sporadic framework exists is untenable, even more so when Malta is required to establish its requirements based on the INSPIRE Directive and Malta's subsequent transposition of the same Directive. GIS technology is very useful, allowing many different departments and the public access to the same basemaps and database. This means that each department does not have to keep separate versions of other departments' maps and data in order to use them for their own needs. Features or attributes need to be modified and updated on only one basemap and database and then be shared by everyone. By creating a shared database departments benefit from the work of each other. Data is collected once and used many times. Departments can portray mapped information at whatever scale they require, using the colours or symbols they want and accompany the maps with text and reports tailored to meet their needs.

4.2 Many foreign governments and their agencies are utilizing GIS technology because it offers a way of understanding and dealing with complex spatial problems by organising the data, viewing their spatial associations, performing multiple analyses, and synthesizing results into maps and reports. This has now become a prerequisite for international collaboration and data integration, such as the EU's activities to ensure data harmonisation; one such example being the creation of the Corine Land Cover across all the EU states and neighbouring countries. Other works relate to ESPON[1], CDDA[2], bathymetric and terrestrial data gathering through GMES[3], GEO[4], GEOSS[5], Copernicus[6] and other initiatives.

4.3 The planning, execution, commissioning and maintenance of infrastructural services are complex and require a strong organisation and a high level of expertise to manage and sustain. The introduction of Information Technology (IT) tools will help maximise the potential of the decision makers, the planners and those executing the works. IT will assist in providing better data sharing through the concept of "owners of data" and allow better analysis, planning and co-ordination and should in the end help in reducing and avoiding waste.

4.4 Although not well realised or practised, but surely of significant importance, is the need to start thinking seriously at the requirement of embodying concepts of Integrated Resource Management (IRM) into

[1] ESPON – European Spatial Planning Observatory Network
[2] CDDA – Common Database on Designated Areas
[3] GMES – Global Monitoring for Environment and Security
[4] GEO – Group on Earth Observations
[5] GEOSS – Global Earth Observation System on Systems
[6] Copernicus – Previously known as GMES, is the European Programme for the establishment of a European capacity for Earth Observation

current national development modes. This requires a number of commitments on the part of all actors in the policy-making process. A major contributing factor to the success of IRM entails the setting up of a national data bank which pools together a very wide spectrum of the nation's resources. Effectively IRM depends on the state-of-the-art technology and a GIS provides an excellent tool for such resource evaluation. Various organisations are already using these technologies for their own needs. However, the management of resources has been left within the hands of different and sometimes autonomous bodies who deal with the subject matter in an isolated and fragmented manner, devising their own solutions and strategies. Information on problems and resources is not always readily available trans-sectorially and the individual approaches adopted within these working environments are not necessarily the best solutions and strategies for the nation as a whole. The development of a unified and operational framework for IRM for Malta would be most welcome and the setting up of a project to establish a GIS on a national level should be a first step towards this aim.

5. PRESENT POSITION ON DATA COLLECTION AND AVAILABILITY

5.1 As already stated above a number of GIS systems already exist in some form or another among Government organisations. Apart from all the GI systems created for EU reporting through MEPA, the Agriculture Department and the utilities (mainly WSC), one advanced system was developed by the Local Councils Support Group for use by the Local Councils.

5.2 This Local Councils' system established a comprehensive structure of node points for the whole of Malta and Gozo and data was collected utilising these points as reference. The data that was collected may basically be termed and referred to as a Roads Inventory and consisted of the following main items of data:

- Street Furniture:
  - Post Collection Boxes; Public Telephone Boxes;
  - Public Conveniences; Bus Shelters;
  - Traffic Signs; Street Name Plaques; Communication Signs; Street Lights;
  - Litter Bins;
  - Safety Fences.
- Highways Features:
  - Footways; Carriageways; Verges; Kerbs;
  - Exits from Garages and Fields; Boundary Walls;
  - Bridges;
  - Obstructions such as Benches, Steps, Litter Bins, Ramps, Bollards, Trees, Poles.
- Utilities:
  - Manholes; Service Boxes;
  - Culverts; Cellar gratings; Gullies.

It is not known whether the data collected initially has been updated periodically or whether any other additional data has been included.

5.3 A number of Government Departments and entities make use of the base map owned by MEPA although their GIS operating architecture differs from one to another:

- The Agriculture Department has its own GIS system containing data on agricultural land and its produce.
- The Fisheries Department also created a similar system.
- The Land Registry has a GIS system and all property which is registered there is recorded on such a system. The system gives the geographical location for each property and records a number of attributes pertaining to that property.
- EneMalta Corporation have also invested in a GIS system. While this is commendable it is, however, understood that the system acquired might not be compatible with the system as already available in other areas of Government.
- Malta Resources Authority has also invested in such a system.
- MITA, which is entrusted with the INSPIRE implementation has its own system.
- Transport Malta created their road network and the maritime areas inclusive of underwater bathymetric data on an *adhoc* basis.
- MEPA's Environmental and Planning Directorates created their own systems for national and international consumption. Amongst these one finds data on:
  - Land Use / land cover.
  - Quarries.
  - Development planning inclusive of applications, constrains, enforcement.
  - Environmental datasets inclusive of species maps, CDDA – protection zones.
  - Terrestrial and bathymetric data as gathered through ERDF156 on air, water, noise, radiation and soil.
  - A series of height and depth points. This data which is intended for national consumption and is thus disseminated for free was part of the ERDF156 initiative.
  - Datasets created for different agencies such as the Health Department, NSO, MRA, the University and all entities that are involved in both national debate/consultancies as well as those involved in EU projects that employ GIS.

5.4 As part of the agreement with the Italian Government the Civil Protection Department acquired a GIS which serves as a base for plotting and recording areas which are of themselves either a potential source of danger or of a security liability and hazard to the country from a civil protection point of view. This GIS should be useful in calculating emergency response time in the event of a natural disaster as well as to be able to access all the other datasets in real-time should an emergency require same. The latter requires that the new structure is

equipped with a disaster management system that is used by the different entities in such situations.

5.5 A GIS Laboratory is available to students at the University. This laboratory is fully equipped and serves as a useful tool in research and a valuable aid in introducing students to GIS applications and possibilities. The Lab runs courses in association with London University and the proposed new entity should explore further the possibility of expanding this network through the UNIGIS UK[7] universities to ensure the tapping of international expertise for each of its system components and themes.

5.6 It is thus important, and this is one of the prime aims of this paper, that it is assured that in any future development there is full compatibility between the different systems which are developed and commissioned. In effect, there should be only one standard between the different users. Definitely this should be the maxim between all Government Departments, Parastatal organisations, Authorities and Corporations. Private enterprise, if interested in using the data available within Government, should follow suit and adopt the same standards. The INSPIRE Directive already provides the framework for this structure but the NSDI (National Spatial Data Infrastructure) would ensure this system. The SEIS (Shared Environmental Information System) which was proposed by the EEA, EC, EUROSTAT and DGEnv is at an initial stage although MEPA through the ERDF156 initiative has only recently, as already indicated above, launched its system.

5.7 Besides the organisations referred to above there are also a number of other Departments, Corporations and Authorities who own data in one form or another which is of vital importance to the nation. This is held under such forms as maps, spread sheets, tables, etc. The consolidation of all this data into one controlled form is considered to be of vital and national importance.

6. BASE MAP

6.1 As already indicated above, a base map already exists and this is available at the MEPA's Mapping Unit which is also responsible for its upkeep. Pioneering work in this respect was initiated early in 1989 by the then Mapping Unit within the Planning Services Division of the former Works Department. With the establishment of the Planning Authority and the transfer of the Planning Services Division to the Planning Authority the Mapping Unit moved also to that Authority. Together with this, the Land Surveying Unit, which was then also a unit within the Works organisation, was also transferred to the Planning Authority.

6.2 Thematic spatial information that uses the basemap and creates the next level of data for use by the agencies and international reporting is managed by MEPA's Information Resources function, which function serves as the interface for cross-thematic and inter-organisational

[7] UNIGIS UK universities is a leading provider of online distance learning education on GIS

informational flows. The latter function caters for high-end modelling that is required as the *modus operandi* for the new structure.

6.3 The work that was carried out and is still being carried out by MEPA is commendable. Like other organisations, MEPA, and eventually when the split of the latter takes place, both the Environment Authority and the Planning Authority will have full access to the current GIS system and will be responsible for the establishment and upkeep of their own data layer(s). It is envisaged that should the proposed structure be set up with the relative ERDF funding, this system will encompass all the government and parastatal agencies as well as the related agencies/entities within the private and public arenas that use spatial information.

6.4 At present any Government Department, entity or organisation wishing to invest in a GIS and thus requiring a copy of the Base Map has to procure this from MEPA at a one time cost and an annual updating service fee.

6.5 The entities making use of this service are the Enemalta Corporation, Water Services Corporation, Transport Malta, Government Property Division, Lands Department, Malta Resources Authority, ex-MRRA (Paying Agency), Malta Tourism Authority, Malta Industrial Parks, Ministry for Gozo, Malta Security Services and the Lotteries & Gaming Authority. The yearly fee collected by MEPA for such a service amounts to approximately €120,000.

7. DEVELOPMENT OF A SPATIAL STRUCTURE

7.1 It is not the purpose of this paper to give a full and comprehensive list of all the data that can and may be collected. In fact it would be both presumptuous and imprudent at this stage to do so. As pointed out earlier the possibilities are vast and perhaps endless.

7.2 It would, however, be useful to see how a GIS for the Maltese Islands can be developed and indicate some examples of the information that can be collected. Thus the following list should only serve as the basis of preliminary discussions and in formulating the way forward:

7.2.1 Every household in Malta and Gozo should have a unique identifier to which would be appended information relating to that household. The information that can be collected and appended to the address are innumerable and the range is vast and varied. Thus for example, information relating to:

- the street name and door number;
- the personal information of the individuals living in that household (names, I.D. numbers, age, etc);
- identification number of the Enemalta and of the WSC service meters at that address;

can all form part of the data set.

7.2.2 All service providers, departments and organisations have their own particular requirements and data sets. This data for example,

without mentioning the attribute data that can be collected for each item, may be classified very broadly under:

- Drainage Directorate
  - Main trunk mains and surface sewers;
  - Pumping Stations & Rising Mains;
  - Treatment Plants and Outfalls.
- Water Services Corporation
  - Main trunk mains;
  - Water Reservoirs;
  - Reverse Osmosis Plants.
- EneMalta
  - Power Stations;
  - Main Distribution Network and Sub-stations;
  - Secondary Distribution Network.
- Communication providers
  - Telephone Exchanges;
  - Main feeder lines.
- Transport Malta
  - Roads Directorate
    - Arterial and Distributor Roads;
    - Local Access Roads;
    - Water Culverts & Reservoirs (second class water).
  - Martime Networks
- Government Property Division and the Joint Office
  - all rural and urban property.
- NSO
  - All population, housing and economic data
- Agriculture and fisheries
  - Farms
- Malta Resources Authority
  - Boreholes, streams, dams, tunnels, valley network, etc.

7.3 As stated earlier the list given above is by no means exhaustive nor is it expanded to include all details that can be collected. Each system has its own set of detailed parameters which would be gathered also as metadata in line with the requirements of the INSPIRE Directive.

8. LEGISLATIVE BASIS

8.1 In recent years GI data requirements have called for the setting up of various data management functions which were based on a three-pronged approach: the data-function, the GI-function, and the research function. The data function included the setting up of a series of data and information processes that sought to lay the foundation for dissemination protocols inclusive of data protection, which were followed by the integration of standards for data management. This process included the integration of the physical sciences data together with the socio-related data thereby ensuring data interactivity and synergies through the integration of both tabular and spatial processes. In turn, the functionality could integrate such processes as the

Geographical Information (GI) function which took the data to a new level, mainly that employing visualisation methodology. This data resulted in the setting up of a series of information systems that allowed for spatial and geo statistical analysis through an integrative function targeted at ensuring scientific analytical functionality and reporting streamlining. It was only when Malta became an EU member state, and more specifically a member of the European Environment Agency (EEA), that the structures began to take form. Thus, the impetus to create such structures resulted from the need to submit data to the EEA and the EU which data required the necessity to conform to international standards on such issues as metadata, common protocols, common projections and calibration methodologies. Something that unfortunately is not yet structured for social data.

8.2 The process was enabled through a number of organizational setups and legislative tools that helped initiate the process to deliver data at the national level and also at the international level. In effect this was due to the membership/collaboration of Malta in the EEA, EUROSTAT, Joint Research Centre and the various EU Directorates General as well as being signatory to a number of UN Conventions. Legislative tools such as the Data Protection Act, the Freedom of Information Act, the Aarhus Convention, and the INSPIRE Directive were essential for the resultant preparedness. Whilst the first three have had a major impact on how one can access information through formal procedures and thus have a heavier socio-technic outcome, the INSPIRE Directive took up a more techno-centric role, directing the countries to implement a series of protocols to ensure that data is created in a homogenous manner that allows for analysis across the different states. Such protocols, called implementation rules, have resulted in the setting up of a smoother process to disseminate data in both visual and tabular formats. Data can now be created following a structure enabling analysis across the different disciplines. This said, INSPIRE caters for spatial data but being a small country, Malta has taken up the initiative to use the metadata forms both for spatial and non-spatial data, thus ensuring that for the first time social, economic and other non physical and environmental data can be structured through the same process as the spatial one. The relatively low expert capacity has led these few experts to effectively create the metadata reports for both spatial and non-spatial without major requirements for organisational and business restructuring. Dissemination has also been helped through the implementation of the Aarhus Convention which requires the free dissemination of data related to the environment to users, which in effect has broken the data hoarding and access-limitation that had been imposed on an *ad hoc* basis by the respective agencies.

8.3 The contents of Appendix I describe the input that the different international processes had on the access to data and creation of the tools in the Maltese Islands serving as the building blocks for spatial analysis.

9. DATA MANAGEMENT STRATEGY

9.1 The underlying strategy for the management of data should be based on a ‘gather-once / use-many’ approach, which ensures that data is gathered once but used by all without incurring further costs, access

and implementation bottlenecks. This proposal looks at the setting up of an organisation through a two-phased approach:

9.1.1 Phase I: initially an entity is tasked with implementing the short-term targets, those of creating a base-data layer for all entities, such as the LSTM, currently held by MEPA;

9.1.2 Phase II: the long-term strategy looks at the setting up of a GI-dedicted entity that will be tasked with the integration of all these systems into one entity with dedicated thematic expertise across the diverse GI-enabled agencies.

9.2 Phase I should ensure the migration from the current isolated-entities system to one where the datasets are harmonised, aligned and prepared for the eventual integration that would be required in Phase II. The Phase I concept envisages a scenario where the setup would be similar to the current system of individual-entity ownership where the entities are defined as “owners of data” meaning that each Department, Authority, Corporation or organisation is responsible for collecting, maintaining and managing data relevant for the running of its activities and operations. This data will be shared with other Departments, Authorities, Corporations or organisations in a ‘read-only’ mode. The advantages lie in the fact that:

a) the data is maintained by the owner of the information;

b) updating of the system is done in an “informed” or more professional manner rather than straight forward data entry;

c) the organisation itself and its officials maintaining the information are made responsible and accountable for the data;

d) this system also allows the other entities to create their value-added data on to the same datasets which the ‘guardian’ entity can then decide to implement as part of that dataset;

e) each dataset has to comply with INSPIRE implementation rules, even for those that do not fall under the diverse Directive Annexes.

9.3 It is very important that the data inputted in the system, once the necessary data collection exercise is carried out, will be almost completely error free. This is very important as the data, once input into the system is available to all those who need it for planning purposes. Any inaccurate data will definitely result in causing wrong decisions to be taken. Such occurrences would defeat the whole scope of the project.

9.4 Thus, it is of the utmost importance, that the project is set in the right perspective and that there are clear guidelines and standards to which all participants within the system would have to abide by. It is thus important that a proper set up is established which will have the authority not only to oversee the whole development, make the necessary guidelines and standards and see to their enforcement but be responsible also for the periodic auditing of the data in respect of its validity and accuracy.

10. A SEIS for National GI

10.1 It is felt essential that the data and information is made available to the public in a controlled manner. Thus it is important that an integral part of this process and indeed of the success of the project is the setting up of a link with the general public through a Customer Service Desk, either in a physical or virtual domain, such being the nature of current and tomorrow's social structures. This should take the form of a one-stop shop where the public would be allowed a 'hands free' approach to the system and be able to extract and get relevant information online and in printed form as has been established through MEPA's ERDF156 project and its SEIS (Shared Environmental Information System) that allows viewing, searching and downloading of the relevant datasets. This is compliant with the requirements of the INSPIRE, Aarhus and other relative legislation.

11. ESTABLISHMENT OF THE GIS PROJECT

11.1 Authority is hereby requested for the setting up of a Government wide corporate project for the establishment of a GIS. This project will be addressed at and involve all Government Departments as well as all Corporations, Authorities and Parastatal Companies and organisations. It is, however, not excluded that any Non Government Organisations (NGOs) and private individuals and companies who wish to participate in this project and supply the necessary data will be encouraged to do so, as has already been the case in the ERDF156 project with MEPA. NSO, Health, MRA, UoM, through the establishement of MoUs and implementation tools.

11.2 Authority is hereby also requested that MEPA be nominated as the sole central co-ordinating organisation for this project with the authority to:

a) implement Phase I and Phase II as further defined in sections 13 and 14;

b) set guidelines and standards for data collection;

c) effect an audit function on any data forming part of the system;

d) establish and connect on an integrated system, with MEPA as the focal point, all data owners and users.

12. ACTION PLAN

12.1 As soon as the necessary approvals, as requested in paras 11.1 and 11.2 above are confirmed, a Project Manager will be identified and a project team established.

12.2 The Project Team will have as its main responsibility that of developing a strategic approach and establishing a plan for the successful implementation of both Phases of the project. In this respect the Project Team will have among its key tasks those of:

a) Sourcing the best-technical expertise in Malta and international scenario to be tasked with providing input to the process;

b) Developing an NSDI (National Spatial Data Infrastructure) Strategy for the Maltese Islands;

c) Developing and establishing an Implementation Plan for the introduction of an integrated GIS;

d) Co-ordinating with other arms of Government in developing a data collection system and organising and monitoring such data collection in accordance with agreed priorities;

e) Setting up and carrying out a pilot collection project, monitoring, reviewing and amending policies as and where necessary;

f) Identifying and training staff;

g) Identifying, purchasing and installing the required software and hardware in order to enable the development of a GIS in an incremental and logical basis with the final aim of connecting all data owners and users onto a distributed system;

h) Developing and agreeing the appropriate interfaces with agencies involved in GIS-based activities;

i) Acquiring approval and sourcing ERDF funding for the major Phase II project;

j) Drafting of the ERDF Tenders and implementation processes;

k) Ensuring the roll-out of the diverse outputs and bringing on aboard all the entities to employ the systems;

l) Disseminating the information to the entities and the public.

13. PROJECT TIME FRAME AND FUNDING: Phase I

13.1 It is calculated that the Phase I of the project requires at three (3) years to be implemented. This period is required because of the amount of data to be collected and the infrastructure to be put in place. During this phase the LSTM would be implemented to serve as the basemap for the nation. This phase will require an investment of €2 million which will update the current basemap and which will be distributed to all entities without charge, since the scope of this Phase is to acquire approval for cost-sharing across all entities for Phase I. This output will ensure free dissemination which the only running costs related to the maintenance of the system, an issue that would be tackled in Phase II.

13.2 It is recommended that all Departments, Corporations and Authorities would be required to fund their own initial data collection (new data over and above the current legacy) and upkeep and the required investment in hardware and software. It is however felt that the required investment to be made in the establishment of the central data centre should be funded separately on an ad-hoc basis and here the possibility of tapping EU funds is not excluded as idenitified in Phase II which will be employed concurrently with Phase I.

14. PROJECT TIME FRAME AND FUNDING: Phase II

14.1 In the meantime that Phase I is being implemented, the new Planning Authority that would have been set up by then, will initiate work to

prepare for the setting up of a revamped and more focused unit that will take up the core activities of the diverse entities. This unit will both serve as the main core of expertise and implementation of the data cycles as well as to bring together all the agencies, information and experts for preparedness work, particularly in cases of emergency uptake.

14.2 This phase will entail the development of a conceptual model and implementation process for the sourcing of EU ERDF funds aimed at creating the spatial entity, sourcing and integrating the players, creating information systems, acquiring in-situ and remote data harvesters, analysing the scenarios and implementing realtime and foresight contingency plans through scenario testing and disseminating the raw and processed information. This phase is very costly and only through ERDF funding can it be implemented, which output will ensure data and information delivery across all the entities, high level computing power and the availability of technologhies to serve government and any related GI entity. This will ensure that Malta is competitive on various grounds especially in its readiness for economic, social and infrastructural restructuring.

14.3 Phase II timing is envisaged to take up 6-7 years in line with the 2014-2020 funding starting in Q4 of Year 1 of the project following the employment of specific project leader and managers. This will ensure that Malta will be the first country to have an entire state-wide spatial information system. The first year will be dedicated to drafting the ERDF proposal, with the second year taken up by implementation and tender issuance. The next 4 years will entail the setting-up, implementation and dissemination of the systems and information.

14.4 It is envisaged that setting up this entity will require a minimum of €10million ERDF funds, whilst should government approve the scanning of the seabed of all the national waters, such would require a further €48million under another project theme. The scale of the project is such that approval by Cabinet is requested, which proposal requires a direct mention in the 2014-2020 OP as a major project.

15. CONCLUSION

15.1 The recommendation to invest in this two phased approach for an integrated GFIS-based National Spatial and Mapping service is strongly justified not only taking into consideration the complexity and extent of the infrastructural network to be developed and managed but also considering that this is vital in the development and effective management of the nation's resources. This will require a considerable amount of effort to develop and should be considered as a project of strategic importance to the country. The two-phased approach will ensure that Malta caters for its immediate and long-term needs in order to implement its strategy.

APPENDIX I

The conveyor: EIONET [8]

The European Environment Agency's EIONET (expert network) has managed to bring together experts in the different countries (EU member states and other neighbouring countries) through the setting up of National Focal Points, European Topic Centres, National Reference Centres, and Main Component Elements. The EIONET resulted in the setting up of an excellence network that discussed datacycles and dataflows which eventually laid the ground for quicker take-up of the main Aarhus Directives and the implementation of the INSPIRE Directive, apart from ensuring that all data is sent on a yearly basis to the CDR (Common Data Repository) which served and still serves as the repository for all countries, but which benefitted the small states such as Malta and Cyprus in that there was no need to replicate the CDR on a local CIRCA [9] server and thus compliance for such state was quicker than for those who decided to install their own networks, hardware and software systems as well as dataflow methodologies.

The main impact that the EEA had on the Maltese dataflow process was through the identification and reporting of data for priority data flows on an annual basis. The process enabled the experts to ensure that the hoarding is longer the case, that data is sourced and gaps identified, that formats are identified and that information is updated and validated, something that was not necessarily the case due to the lack of protocols on calibration and validation. Finally the EEA required the data to be consolidated and eventually submitted respecting target dates and deadlines, the latter especially imposing a regime that ensures data dissemination to the EEA and through its website to the general public.

The main impetus in this international process was the setting up of an expert network that enabled data to flow to a common source for easy download by users as well as ensuring a timely delivery of the relevant datasets. This resulted in the setting up of a network of geographical and social scientists who had access to knowledge streams.

The instrument: Åarhus Convention [10]

Malta is party to the Århus Convention with its requirements for Access to information, Access to justice and Public participation. The Convention's Article 4 covers Access to Environmental Information which relates to how public authorities must make information available in the form requested unless such requests are unreasonable or where the information already exists in another form. The Convention also mentions specific deadlines for submission of such information emphasizing that data must be submitted by one month and two if such data request comprises a complex issue.

What is very interesting in the requirements of the Århus Convention is the fact that it outlines the cases where refusal is recommended, striving to limit the cases of refusal which should be only entertained if the requested information not held, it is manifestly unreasonable or too general and that it concerns material that has yet to be finalized and also that information relating to internal communications.

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[8] http://www.eea.europa.eu

[9] Country based server system

[10] http://www.unece.org/env/pp/

In terms of collection and dissemination of information, the Convention (Article 5) states that public authorities need to create and update environmental information relevant to their function as well as establish systems that ensure the smooth flow of information about existing and proposed activities relating to the environment and also to inform the public in case of imminent threats.

Finally, the main impact that the Convention had on Maltese data processes concerned the requirement to ensure that each country needs to make its information accessible through free information lists in a transparent manner employing electronic databases.

The main impetus emanating from the Århus Convention was the setting up of a requirement for free data which could be disseminated using the EIONET CDR conveyor. The second component was established.

The techno-centic protocol: INSPIRE [11]

The need was subsequently felt for a technical instrument that would enable GIS users to create their data in a standardized structure for cross-tematic analysis. The INSPIRE Directive is the most robust Directive that has enabled data processing to be taken to a higher level as it encompasses the networks of the EIONET and the dissemination issues of the Århus Convention with the added function of creating a technical base for the data ensuring that it conforms to standardization and that any spatial data can be compared across the different themes.

The main tenets of the INSPIRE Directive include the requirement for member states' public authorities to provide datasets and services that can be used for policy making, reporting and eventual monitoring. Though requiring only public bodies to comply, in actual fact this will result in a ripple effect since most private entities engage in work with the public sector and any creation, analysis and subsequent transfer of data needs to comply with the public authorities structures, thus in effect ensuring that all sectors comply with the legislation.

In terms of access, datasets need to be made accessible through readily-accessible interfaces that would be capable of being discovered, viewed, and downloaded. Another requirement is related to the need to create metadata (data about data which allows users to acquire knowledge of what datasets exist and what they hold prior to acquiring such datasets). Malta is highly advanced in the implementation of the metadata process through its employments of a two-pronged approach based on an Excel-based input tools and the use of the JRC online editor [12] that creates an xml-based tool.

The main impetus of INSPIRE is set at removing obstacles to access as well as making data that is currently available only to a few GI specialists, available to the general public. In fact this process was hastened with such developments as Google Map and the related services that have pushed such data in the hands of the public even to the extent that it is transmitted in real-time should a researcher own a dedicated GPS handheld or even a smartphone.

The disseminator: SEIS [13]

The set up of a high-level group entitled G4 as composed by the EEA, JRC, DG-Env and EUROSTAT, took over the initiative to consolidate the diverse information-related activities in order to enable the setting-up of a common information system. This was called the Shared Environment Information

[11] http://www.unece.org/env/pp/

[12] http://www.inspire-geoportal.eu/inspireEditor.htm

[13] http://ec.europa.eu/environment/seis/

System (SEIS). Though not legislation, such a process enabled the groups to bring together the various datacycle initiatives and tools in order to propose the best way forward for the reduction of redundancy and multiple-reporting, employing the gather-once/use-many dictum.

The G4 calls for the need for certified standards, the need for data-exchange, the need for an expertise audit of data, the take-up of the Århus EU-wide access standards and the integration of the INSPIRE as the integrative tool for SEIS implementation.

The SEIS initiative led to an integrated framework that has been expanded to the wider geographical, environmental, physical, social and economic data enabling a reliable base for data analysis across the different thematic disciplines.

The socio-technic tool: ERDF for spatial and social sciences [14]

Whilst Malta has experienced various access hiccups and limitations to data creation and access to data, the above four international activities have enabled it to set-up legislative and implementation procedures that ensure that data is reliable, consistently produced, validated and disseminated.

The resultant step was to integrate the requirements of the international activities and prepare a physical structure for data collection, input, storage, analysis and dissemination. Such was created through and ERDF project entitled “Developing National Environmental Monitoring Infrastructure and Capacity”, which initiative complies with the requirements of EEA dataflows due to its remit to establish monitoring networks in line with EIONET requirements. This process ensures the free dissemination to the public inclusive of spatial, environmental and physical data through Århus requirements, builds its structures through the Implementation Rules of the INSPIRE Directive and creates its own shared information systems. The initiative was based on the concept that the thematic disciplines would have available a comprehensive infrastructure that enables NGOs, academia and the general public to upload thematic data and carry out cross-thematic analysis without the need to create their own systems.

[14] http://www.mepa.org.mt/news-details?id=603

APPENDIX II

Sources:

Beyer, C., and Wasserburger, W., 2009, Plan4all Deliverable 2.2, Analysis of innovative challenges, Available online: http://www.plan4all.eu/extractor/fileReader.php?file=d2-2-analysis-of-innovative-challenges.pdf (accessed on 10 October 2012)

Clarke K. (1995). Analytical and Computer Cartography. Prentice Hall, Englewood Cliffs, N.J.

European Environment Agency, Priority Dataflows. Available online:

http://www.eionet.europa.eu/dataflows/pdf2011 (accessed on 29 February 2012)

Formosa S., Formosa Pace J., and Sciberras E., (accepted and to be published in Q3 2013), Spatial Information Preparedness for Environmental Enforcement in the Maltese Islands, International Journal of Agricultural and Environmental Information Systems (IJAEIS), Vol 4(3), DOI: 10.4018/IJAEIS, ISSN: 1947-3192, EISSN: 1947-3206

Formosa S., Briguglio L., Calleja E., Formosa Pace J., and Moncada J., (2013), One Small State's Preparation for Climate Change: Building an Integrated Socio-Technic Informational Infrastructure, International Journal of Geoinformatics, Vol 9(1), 11-18, ISSN: 1686-6576

Formosa S., (2013), Maltese Building Blocks for Geographical and Crime Sciences, Journal of Geography and Geology, Vol. 5, No. 1, 19-29, ISSN 1916-9779 (Print) ISSN 1916-9787 (Online), DOI: 10.5539/jgg.v5n1p19

Formosa S., Magri V., Neuschmid J., and Schrenk M., (2011), Sharing integrated spatial and thematic data: the CRISOLA case for Malta and the European project Plan4all process, Future Internet 2011, 3(4), 344-361; doi:10.3390/fi3040344, ISSN 1999-5903

Formosa S., (2010), Access to data in a small island state: The case for Malta, Islands And Small States Institute, University Of Malta, Tal-Qroqq, Occasional Papers On Islands And Small States, Vol 5 – 2010, ISSN: 1024 6282

Goodchild, M.F., Steyaert, L.T., Parks, B.O., Johnston, C., Maidment, D., Crane, M., and Glendinning, S., 1996, GIS and Environmental Modeling: Progress and Research Issues, John Wiley & Sons, 1996

Haining R. (1987). Spatial Modelling and the Statistical Analysis of Spatial Data in Human Geography. Matematiques et Sciences Humaines, 25(Fall). 5-25

Malta Environment & Planning Authority, MEPA mapserver, 2000, Available online: http://www.mepa.org.mt/mepa-mapserver (accessed on 9 October 2012)

Malta Environment & Planning Authority, 2003, Sea-Level Rise, MEPA, Floriana, Malta

Malta Environment & Planning Authority, 2009, Developing National Environmental Monitoring Infrastructure and Capacity, MEPA, Floriana, Malta

Official Journal of the European Union (24 October 1995). Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, L 281 , 23/11/1995

Official Journal of the European Union (28 January 2003a). Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public

access to environmental information and repealing Council Directive 90/313/EEC, L 041 , 14/02/2003

Official Journal of the European Union (26 May 2003b). Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC - Statement by the Commission, L 156 , 25/06/2003

Official Journal of the European Union (17 November 2003c). Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, L 345 , 31/12/2003

Official Journal of the European Union (25 April 2007). Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). L108, Volume 50

Sauer, C.O. (1925). The Morphology of Landscape, University of California Press