

INTRODUCTION

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Why Future Preparedness?

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Why Future Preparedness and why even attempt to look into the future at a stage where the state of the environment is in such a constant rate of flux? Trying to understand what may come to pass tomorrow only takes a form when we know our present and how today is affected by our yesterday. Society is in transition and at a very rapid pace too. We cannot embrace one without the others and preparedness has never been more crucial. From understanding the diverse and contrasting social realities and the interactions between the environment, human capital and landuse to fathoming out the implications of legislative and operational tools on social cohesion, society faces major challenges. Challenges that can be understood through a dichotomy of interlinking activities: those purely based on scientific research and those striving for the implementation of on-the-ground operational processes.

This publication seeks to help us understand such worlds and delves into a review of the past, describes the state of current knowledge whilst striving to help open for readers a window into future activities: through spatial descriptors. The publication is structured into three sections that help readers to understand the context within which such a publication is set: the first related to descriptors pertaining to the implementation of two major projects, the second section related to research that laid the groundwork for the present, whilst the final section looks forward on new societies and research challenges.

The Things that Came to Pass

The first section focuses on a documentary walkthrough of the implementation of the ERDF156 project entitled “*Developing National Environmental Monitoring Infrastructure and Capacity*”, and the Twinning project MT/06/IB/EN/01 entitled “*Further Institution Building in the Environment Sector*”. The former project involved the monitoring of air, water, noise, radiation, soil and the marine environment as well as 3D terrestrial and bathymetric surveys. This project was co-financed by the European Regional Development Fund, which provided 85% of the project’s funding and the Government of Malta, which financed the rest under Operational Programme 1 - Cohesion Policy 2007-2013 - Investing in Competitiveness for a Better Quality of Life.

The second project was aimed at supporting the Maltese Government in improving the implementation of the Aarhus Convention on *public access to environmental information, public participation in environmental decision making and access to justice in environmental matters*.

These activities saw the joint interaction of such entities as the partners as well as countless other entities, NGOs and individuals who came together to try and understand what was required from the nation both in terms of international obligations but also as a safeguard to mitigate for sustainability. The latter, though an overused word, has become one with the social psyche but needs to be taken to the next level where deeds towards sustainability outnumber the theoretical approaches: we need action on how to morph such concepts into action.

In Chapter 1, Ashley Hili tackles the process through a description of the project initiated in 2010 and concluded in 2014, the targets and outcomes as based on an initial 3 year review (2006-2009) of the environmental obligations required for Malta's adherence to environmental reporting. The project sought to ensure that should society undergo changes, the technologies would be in place to ensure the understanding of the resultant occurrences as well as enable continuous monitoring and reporting. The focus was on seven themes: six environmental (air, water, noise, radiation, soil and the marine environment), as well as focussing on the technologies required to deliver baseline and real-time parameter monitoring from remote and in-situ sources.

Nathalia Kisliakova in Chapter 2 details an overview of the thoughts and perceptions of a project that served as a precursor to the ERDF156. The Twinning project, entitled "*Further Institution Building in the Environment Sector*" aimed at supporting the Maltese Government in improving the implementation of the Aarhus Convention, was co-funded by the European Union and the Maltese Government under the 2006 Transition Facility Programme for Malta. The project was carried out by the Malta Environment & Planning Authority (MEPA) as Beneficiary Institution and the Austrian Environment Agency as Lead Member State Partner and consisted of four components: the assessment of the current situation and development of recommendations; the implementation of recommendations; the development of guidance documents and the training and awareness-raising processes. The author takes the reader through a description of the project and how it benefitted the Maltese society.

Setting the Scene for Understanding the Realities of Space

Interestingly, mainly research based, the second section of the publication looks at diverse initiatives, projects, research and implementation measures that helped enable the fulfilment of various datacycle components relevant to high-end research targeted for decision making processes. The topics are various and whilst covering widely-diverse

themes, such come together in their common target to provide information for a better future. Whilst some are resultant from the ERDF project or from the Twinning project, and others hail from other disciplines related to the spatial field. The meshing of the different topics is aimed at gaining an understanding of what is really going on in the environmental, social and landuse domains in the Maltese Islands and how change can be mitigated for future preparedness. Ranging from a full datacycle approach from design, through data gathering, input, cleaning, analysis and reporting, the original research papers have helped establish the current research activities that serve as a baseline for future studies.

In Chapter 3, Carol Agius and James Brearley argue that the manual collection of topographic map detail is traditionally collected via manual methods, most often photogrammetric capture. This method is laborious, work-intensive, lengthy and hence, costly. In addition because photogrammetric capture methods are often time-consuming, by the time the capture has been achieved the information source, that is the aerial photography, is out of date. As a result, National Mapping Agencies (NMAs) aspire to discover methods of data capture that are efficient, quick, and cost-effective while producing high quality outputs. Targeting Light Detection and Ranging (LiDAR) as a quick and economical method for obtaining cloud-point data which can be used for various applications, the paper explores whether building footprints extracted from LiDAR data can meet the quality and accuracy requirements of large and medium scale topographic mapping. Building footprints extracted from the LiDAR survey carried out for the ERDF156 project were compared with topographic data captured via traditional photogrammetric methods. These flow line and results were examined to determine whether the results meet the required specifications of topographic mapping. Sample extractions from urban, rural, and coastal areas were explored to determine if the outputs from this method can be used productively to update and maintain large to medium scale datasets on a national scale.

René Attard and Matthew explore the Malta Environment and Planning Authority's (MEPA) National Protective Inventory (NPI) and the Malta Scheduled Property Register and how the two have developed from basic tools when heritage protection and management in Malta was in its infancy to an effective part of the current planning system they are today. The NPI is a digital database comprised of data cards containing information on properties of cultural heritage significance. It has evolved into a readily-accessible digital system from its origins emanating from the cumbersome Inventory of the European Cultural Heritage (IECH) system of heritage protection. The NPI database is linked to the Malta Scheduled Property Register which utilises the information from the NPI database to provide heritage professionals and the general public alike with vital information on built heritage property. The paper describes the evolution of the NPI

and the MSPR, the changes carried out to both systems to make them more efficient and user friendly by making use solely of the limited tools available to the public sector. In conclusion the paper reviews what could have been done for the system to be used nationwide inclusive of legislation other than the requirements emanating from the Environment and Development Planning Act.

Chapter 5 focuses on an implementation approach to data dissemination, where Marc Bonazountas, Giacomo Martirano, Tim Camilleri and Anestis Trypitsidis investigate the process employed to enable a SEIS Geoportal technology development which delivers one of the first practical implementations of SEIS in the EU. It comprises of a set of Web and Desktop tools for monitoring, reporting and disseminating environmental data. It also supports the development of environmental policy according to the requirements of the EU as well as those of the government of Malta. The authors describe in detail the philosophy, concept and a set of high-level principles and workflow processes. Specifically, SEIS-Malta makes use of proprietary GIS and Geoportal Technologies combined with custom developed webservices providing the public and ERDF project partners with user-friendly interface. On a technical level, the paper focuses on data management/ingestion from the various monitoring stations and locations, on-line data editing, data export, metadata viewing, editing and managing, searching for metadata, automated reporting according to EEA requirements and reporting obligations. It also strives to enable the provision of environmental information to the public according to the Aarhus Directive as outlined by the Twinning Light project and the ERDF156.

Sandro Cutajar, in Chapter 6, highlights the issues inherent in the identifying the strategy and feasibility requirements partaking to the setting up of an integrated soil monitoring system for Malta. The issues pertain to structured soil information generation, the creation and updating of interoperable, INSPIRE-compliant digital mapping data and the comprehensive evaluation of measurable, time-bound and relevant issues. The author states that relatively recent activities in Malta have contributed to the consolidation of the Island's environmental protection credentials. The author points out that the ERDF156 enabled the investigation of further fundamental regulatory aspects as required to adequately monitor local soil protection efforts. This review shaped the identification of priority research pointers and data parameters required to adequately manage soil health in a sustainable manner. Multi-criteria modelling of Maltese soils, utilising past information generated through MALSIS, is one of the selected components of the project meant to establish sound environmental monitoring tools. Moreover, description and analysis of preliminary findings, emerging from implementation of a baseline survey, within the context of an emerging short and long-term information monitoring strategy, was also carried out with a view to achieve a robust evaluation of a pre-agreed set of indicators established for all degradation threats identified in the Soil Thematic Strategy.

This approach is expected to assist land managers and other stakeholders to better anticipate where more research is required so that a clear appreciation, of the state of degradation threats experienced in a standalone soil ecosystem setting, is appropriately mapped out. Consequently, the drawing up of suitable strategies, realistic measures and appropriately benchmarked targets, meant to protect this natural capital from complex land use competition occurring within this island Member State, is identified as crucial for adoption.

An innovative approach to agriculture-related scholarship is described in Chapter 7, where Charles Galdies, John C. Betts, Antonella Vassallo and Anton Micallef research a process to develop a high resolution agriculture land cover using aerial digital photography and GIS. This study demonstrated for the first time in Malta the collection of high precision farming statistics in relation to agriculture resource management. It makes use of a relatively cheap, digital aerial remote sensing and GIS mapping effort complemented with limited ground surveying data as part of the AGRISTAT Project. The generation of high resolution imagery in the region of 12-15 cm pixel resolution eliminated the need for extensive ground surveying. This project was aimed at the collection of spatial statistical data of the country's agriculture productivity. This study shows how a national comprehensive survey can be carried out using a combination of minimal ground surveys, aerial remote sensing and GIS. The project also shows how high resolution mapping can further push the Corinne Land Cover (CLC) nomenclature scheme by an additional two classification levels as a requirement of small scale, highly fragmented agricultural land cover that is typical of small islands.

The sea-going experts, Carlos A. Espinal and Shane Hunter review their ERDF156 input to deliver a first hi-detail bathymetry of the Maltese Islands in Chapter 8. Such was possible through a national-scale marine survey employing interferometric sonar. As part of the requirements to the implementation of the Water Framework Directive, a study of the marine zone bounding up to one nautical mile from the baseline coast. The authors describe the full-scale topographic and bathymetric baseline survey of the Maltese Islands was performed between 2012 and 2013, acquiring data from the highest elevation point in the archipelago, down to a depth of 200 metres within the Island's coastal territory. Whilst diverse technologies were employed in other parts of the project, inclusive of LiDAR-based topographic datasets, bathymetric LiDAR datasets, the authors were tasked with the role to collect wide-swath sonar-datasets, enabling Malta to create a full 3D model of the islands for future use in environmental monitoring, coastal management, archaeological research, navigation aids and marine infrastructure projects. This paper describes the planning, acquisition and delivery of bathymetric datasets of 415 square kilometres of Maltese seabed through the summers of 2012 and 2013 using interferometric wide-swath sonar along with a combination of licensed and open-source marine surveying and GIS

software packages. A description of the sensors, software used, survey planning and undertaking, data processing and digital reconstruction of the Maltese Islands by merging data from the three above-mentioned sensors is reported.

David Mallia takes the readers back to land through his dissertation on sustainability and urban conservation in Malta in Chapter 9, with some interesting concepts and flashbacks. He argues that the establishment of the Planning Authority for Malta in 1992 led to the writing and the implementation of a number of important policy documents which are still in force to date. The Structure Plan aimed to provide adequate tools for the effective regeneration and revitalisation of existing urban cores within the Maltese Islands. The author has analysed the number and quality of approved applications lodged with the authority over a number of years in order to build a statistical picture of the actual effectiveness of the development control process with regards to Urban Conservation Areas. The results indicate that not only has interest in UCAs grown over the years, but that this has resulted in the rehabilitation of a considerable number of properties, some of which were formerly derelict and abandoned. These indicate that new life has been injected into many UCAs and the relatively low number of approved demolitions would indicate that the environmental impact - especially in terms of the amount of waste rubble generated - has been relatively low. Furthermore, the reuse of existing buildings has led to a reduction in the take-up of new land. In this sense, the policies have encouraged the idea of “reduce, reuse and recycle” on an urban scale and this has resulted in a paradigm shift in which raising awareness about the characteristics of Maltese vernacular architecture and its value as an element have added to the definition of the national identity in an era of globalisation.

Through Chapter 10, Maria Refalo concludes this section through her study on the surrounding habitat of marine algae in Malta. The underlining aim of this analysis is aimed at understanding how algae live within parameters that are being imposed on them either through abiotic or biotic factors. These consisted of sea temperature, pH, dissolved oxygen, orientation, open/closed sea, light intensity, wind force, pollution, accessibility, distance from wading depth to shoreline, slope of shoreline, length of shoreline, turbidity, chlorophyll a, Phosphates, and Nitrates. The macro-algal species collected from the study sites during the summer season were 18, having *Jania rubens* and *Ulva sp.* as the most abundant species all along the whole season. *Jania rubens* and *Ulva sp.* were dominant in almost all the points of the study sites. While only 13 macro-algae species were identified during the winter season, *Enteromorpha* being the only macro-algal dominant species; this was the only macro-algal species present in almost all the points of the study sites. Sea temperatures and anthropogenic disturbances increased in summer, although the levels of chlorophyll a increased in winter. The turbidity readings were correlated with wind forces, while pH levels remained relatively constant throughout the whole study. Phosphates and

Nitrates tests gave opposing results; one decreased when the other increased. GIS mapping was used for each study site, in order to better visualise the presence of anthropogenic disturbance on the study sites through a buffer. An abundance of macro-algae species was present during the summer season, whereas the indicative factors fluctuated according to the weather, environmental and anthropogenic disturbances present at the time.

Conceptualising the Future

The final section builds on the previous in-depth studies and posits further ideas for future research and innovation, an output that was so highly achieved by the research from the previous sections. The past and present are being fulfilled by all the papers presented in this publication, with some experimental and theoretical emphasis being depicted in this section. These papers range from heritage appraisal toolkits, through policy-making ensconced in evidence, to conceptualisation of virtual worlds as research tools and neo-societies, where in addition, the final two papers ground readers back to real-world proposals for future research.

Malcolm Borg and Saviour Formosa, in Chapter 11 state that character appraisals are essential and vital in understanding an area through the drawing on urban conservation techniques and guidelines on how the use of a character appraisal toolkit may assist in developing sustainable plans and launching viable environmental management solutions. There have been various attempts to create and adapt character appraisal toolkits especially in the realm of urban conservation or cultural landscape management but also in real estate with the application of economic and environmental indicators. The understanding of space through the collation of data and evidence may not necessarily give a holistic picture. The better understanding of an area may only be achieved through an integrated approach. This is more significant in landscape appraisal. The multi-layering of data and specifications of a given area, site or heritage assets contribute directly to its character and value and the reading of the same. Moreover a given landscape or site may include a variety of complex systems with varying characteristics and dynamics determining value. This study delves into best practice guidelines in the realm of character assessment taking into consideration extant tools as in the case of; UNESCO criteria, ICOMOS Heritage@Risk assessment and the English Heritage approach. This paper considers the applications of Geographic Information Systems (GIS) as a tool to stimulate an integrated approach with reference to planning regimes and policy development mechanisms. This paper takes stock of various proposals developed in the past decade in the application of GIS for character appraisals and urban conservation and proposes a structure for an information model.

Marguerite Camilleri and Roberta Debono debate policymaking in Chapter 12. They describe policymaking through recent good practice that has highlighted the need

for evidence-based policy in all fields, including that of the environment. There is an ongoing need for reliable information that may feed into the policymaking process. In the environmental field, the putting into place of environmental monitoring processes and the regular publication of state of the environment reports have contributed significantly to providing a better evidence base for policy. The EU-funded ERDF project has played an important role in upgrading national environmental monitoring programmes. This paper puts forward possible next steps to be taken in order to improve the evidence base to support national policy-making processes, including the monitoring of existing policies, in the environmental field now that the data from the ERDF monitoring project is emerging. A key area where more information is required is the marine environmental field, where the significant costs involved are a challenge. The area of sustainable housing, where significant research and innovation will be required in the move towards zero-energy housing, is also crucial. A third area of importance is integrated assessments. These would need to highlight links between datasets such as environmental and health data, and economic and environmental data, for example in the context of green accounting and green jobs. Finally, on this basis, models will need to be developed that link environmental data to the socio-economic parameters that will enable the testing of various policy options.

Chapter 13 sees Saviour Formosa tackling spatial conceptualisation as a foundation for social interactionism in virtual worlds. He states that the acquisition of the concept of space is an essential requirement for immersive migration from the real to the virtual worlds. Knowledge of space and place posit a hard-to-acquire concept for the non technological person. The move from a techno-centric reality to a socio-technic one has aided the transposition of the non-technic disciplines to take up the virtual environments as the next level interactive domain. Initial activity would have come from the geographically-equipped disciplines, with eventual porting to the civil-protection-related disciplines and eventually to the social sciences and the arts. The resultant knowledge gain is yet to be fully established, as technology has outshone the actual transition, with most disciplines still struggling to understand the shift. This paper reviews the issue of knowledge of spaces, the efforts made to acquire a reality-to-virtual transition, as pushed through the establishment of a spatial information system. The paper highlights the initial work carried out to create an initial gaming environment for social interactionism to occur. The target is that based on available gaming engines and focuses on the process employed to establish the launching environment. The DIKA model is employed through its Data acquisition of real space, it being given a meaning through spatial information, its conversion to 2D environments and in turn to 3D space as a Knowledge markup and the final Action process employed to create the interactive space through the gaming engine.

Janice Formosa Pace, through Chapter 14, outlines the realities of new social

paradigms existent within a Neo-Society, where some people are bound to fall outside of social realities leading to the creation of a new poverty cycle. This situation shows that societies have rapidly morphed into complex entities that are creating both accessibility and new forms of neogeographic-poverty: that related to datacycles and information uptake in new forms. Those that have managed to partake to the opportunities provided by the web have new vistas to survive in, in contrast to the new poor who have limited or no access to information. This is a world that has been immersed in the world-wide-web (www) as far back as the early 1990s since the birth of the phenomenon. With the current university generation having been born in the early 1990s and the subsequent generation now in their secondary years, the access to spatial-knowledge should be wide-ranging, what with all the available online maps, New forms of data in spatial format are accessible to all, however few realise the implications of such a transitional change in wellbeing: whether entire societies or individuals. Whilst the www-parturition cohort (early 1990s – mid 2000s) live in-between worlds and have experienced the social-change phoenix that the web has become, the dichotomies of the older and the newer generations have no such luxuries. The older have lost out on the birthing pains and the rapid-turnover of knowledge required in the digital verse being thus lost in the physical domain, the newer ones have little idea of the realities in the physical world, being immersed in the digital domain.

Marine archaeologist Timmy Gambin partakes to an excellent process to take up side scan sonar as an essential tool for the management of underwater cultural heritage through his paper in Chapter 15. The author states that to date, the majority of shipwrecks discovered and documented in the Mediterranean are situated in waters shallower than the 50 meter contour. With an increase in technical diving and deep water exploration, this is a statistic that may change in the not too distant future. Given that the UNESCO convention on the protection of underwater cultural heritage puts emphasis on preservation of shipwrecks in-situ, it is imperative to look at ways in which such a directive can be implemented. This paper highlights the synergy between existing remote technologies and the management of underwater cultural heritage. Using examples from ongoing research projects, the author demonstrates how large-scale remote sensing surveys can make a major contribution to site management, which in turn facilitates decision-making.

Ines Sanchez, Francesca Tamburini and Ruth Debrincat dedicate Chapter 16 to undertake an assessment of the Maltese environmental matrix to define the future monitoring strategy as researched within ERDF156. Malta, as a member state of the European Union, is obliged to comply with specific environmental monitoring standards and respective reporting obligations. This paper describes the main aspects of the proposal and its design method based on the analysis of the existing Maltese network, the legislation framework and the baseline surveys results in all the components of the

environmental matrix. The baseline survey in coastal waters and inland waters brought about a reclassification of sites based on the water quality status. It allowed the localisation of points with higher water quality disturbance and the areas with low anthropogenic pressures, hence, a reduction in the number of monitoring stations where the water quality was classified as “high”. The local air monitoring network, consisting of four fixed stations, after one year of measurements indicated traffic as the most significant air pollution source in Malta. In the soil matrix, the seven threats to the European soil were analyzed. The knowledge acquired represents an important basis for the implementation of long term strategies in accordance with the specific context and targets of each environmental component. Nevertheless, additional steps will be needed to be carried out in the short term before establishing definitive long term strategies, such as performing additional base line surveys in the case of soil and inland waters or analysing future monitoring outputs in the rest of the environmental matrix. After doing so, Malta will be able to establish the final characteristics of its environmental monitoring network.

In Conclusion

In 2006, MEPA, as project leader, in coordination with the partners Malta Environment and Planning Authority, the University of Malta, the Malta Resources Authority, the National Statistics Office and the Environmental Health Directorate, embarked on a process to upgrade and enhance national environmental monitoring infrastructure and capacity as well as serve as a launching pad for hi-end spatial system in the Maltese Islands. At the time, it was deemed as a veritable cliff-hanger decision if not a potentially impossible-to-manage project. Perseverance and a drive to tackle the different themes and data sources in a holistic approach has resulted in the formulation of a monitoring strategy and a series of information systems, which deliver a new *modus operandi* for strategic and spatial analysis in the Maltese state. The project created effective tools for the monitoring of and reporting of environmental information in the air, water, noise, radiation, soil and the marine domains, which outputs have in turn ensured the creation of baseline studies for future trend analysis.

Between 2009 and 2014, the project and resultant studies provided a basemap from which various environmental studies could be carried out. These include studies as required by the INSPIRE Directive, the Aarhus Convention, the Corine Landcover Initiative, the Water Framework Directive and the Marine Strategy Framework Directive which are aimed to protect more effectively the territorial landmass and the marine environment and in turn effect the health of the region’s population. It will also serve as a tool for impact analysis of development planning, pollution and chemical prediction modelling, climate change monitoring as well as render recognition of features. It will also serve to aid enforcement officers to analyse the trends in security breaches and illegal development

as well as plan for potential health hazards. In addition, it will allow thematic experts to study, monitor, analyse and protect those areas that are vulnerable to degradation and exposure. Spin-offs from the results include updated nautical charts, viewshed analysis and cross-thematic studies in the physical, social and environmental domains.

The aim was to base the whole process on the integration of the requirements of the EEA (European Environment Agency) dataflow process, the INSPIRE Directive, the Aarhus Convention, the Freedom of Information Act and the Public Sector Information Directive. In addition, this project targeted the development of a Shared Environment Information System, currently available at www.seismalta.org.mt. Such a large project and the extensive collaboration between theme experts, scholars, researchers, implementation entities, policy-makers and decision-takers, called for a legacy publication that would do the process, strategies, research and deliverables justice, an endeavour now complete.

In 2014, the multi-domain thematic and spatial issues targeted through this publication served to place the Maltese Islands a step closer to the implementation of such a knowledge gain. The different themes investigated here serve both the environment and sustainability through their conceptualisation approaches and their stepped scientific approaches. Interestingly, from a concerted targeting of six environmental themes, the papers published herein range into wider arenas, once few would have attempted to bring about at the initiation of the exercise, but which proved the initiators right: leave an open space for research and the rest will come to pass. Such a state serves to depict the versatility of the research community in their drive to employ cross-discipline tools and technologies in order to understand their particular domain; whether past or present, theoretical or tangible, real or virtual.

Future Preparedness is a step closer to realisation