euprha European Universities on Professionalization on Humanitarian Action

Laying the groundwork for Social and Physical Spatial Analysis in Post-Disaster Scenarios

Saviour Formosa*, University of Malta

Planning for post-disaster management is a major task that cannot be elicited from reactive action to the factual incidence per se but through proactive preparedness years in advance. Following an extensive six-year analysis of the requirements for spatial data enhancement in the physical, social and natural environments, the Maltese Islands have acquired a comprehensive set of data that will serve as a basis for cross-thematic research. Though initially targeted at the natural environmental themes, the exercise has widespread operational implications that go beyond these domains but spread into other far-reaching domains, including disaster-management, security and safety.

This is being made possible through the creation of fundamental datasets that will bring Maltese terrestrial and bathymetric baseline free information to the public domain. The motor driving this initiative centered on a €4.6 million project, entitled *Developing National Environmental Monitoring Infrastructure and Capacity*, which involves monitoring of air, water, soil, radiation and noise and 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*.

Of special interest to post-incident analysis and decision makers was that the project delivered terrestrial and bathymetric data at high resolutions suitable for detailed environmental modeling and for EU reporting purposes. A dearth of information is currently the status in both academia and in the industry, with situation hinders comprehensive land use planning, environmental monitoring and the resultant socio-security impacts. This is especially true due to a lack of high quality 3D spatial data, where the need was felt to commission such a project. The delivery, being launched mid-October 2013, also through a site www.seismalta.org, includes a high resolution 3D terrestrial data coverage for the Maltese Islands employing a combination of oblique aerial imagery (Figure 1a and 1b) and Light Detection and Ranging (LIDAR) data (Figure 2), as well as through a bathymetric survey of coastal waters within 1 nautical mile (nm) radius off the baseline coastline, using a combination of bathymetric LIDAR surveys, acoustic scans and a physical grab sampling survey (Figure 3). These outputs, together other fieldwork technologies as are handheld scanners and GIS handhelds, aim to aid researchers with a launching pad for the diverse physical, environmental and social studies that are undertaken in relation to the strengthening of social and environmental fabric as well as any resultant recovery process. The basis for the future analysis of the multi-thematic analysis was laid through the acquisition of various deliveries that include the following 5-point outputs by technology, delivery and area:

- LIDAR Scan: Terrestrial (Topographic Light Detection and Ranging (LiDAR))
  Digital Surface Model (DSM) and Digital Terrain Model (DTM) (316 km.sq)
- Bathymetric LIDAR aerial survey – depths of 0 m to 15m within 1 nautical mile from the Maltese coastline (38 km.sq)

- Bathymetric Scan: Acoustic (side scan sonar)
  Digital Surface Model and an acoustic information map of sea bed (361 km.sq)
- High resolution oblique aerial imagery and derived orthophoto mosaic and tiled imagery of the Maltese Islands (316 km.sq)
- Satellite imagery (GeoEye, RapidEye, Quickbird) (316 km.sq)

Malta's target to acquire LIDAR scans as well as a full bathymetric survey is being carried out for all the Maltese terrestrial areas and the coastal waters. Whilst various terrestrial exercises were carried out for development planning and environmental protection purposes, various bathymetric surveys were carried out for specific projects and research work, however, the latter were ad hoc and highly localized with rare attempts at a strategic methodology.

In terms of post-disaster scenarios, the project has laid the groundwork for the establishment of a structural de facto snapshot of the islands at 2012 which would be enhanced over the years in order to allow for instant change analysis should comparative studies by required post-incident. Side views of building (counts of compacted stories), material volume analysis (to calculate debris removal), network shifting (roads, bridges movements), landslide calculations, heat seekers for victim locations, flash-flood prediction, inundation viewsheds and other studies.

Figure 4 depicts initial outputs that depict the main areas which would require monitoring such as landfill (volume shifting analysis), access to health infrastructure, stability of urban development in village cores, security and safety in high-density development and in tourism areas, as well as the protection of archaeological and military sites.

Of special interest is the fact that having been structured around a number of international directives, the project will ensure the free delivery of all data to the general public. This is the result of an integrated exercise to adhere to the requirements as outlined by the Commission's Communication COM (2008) 46 Final "Towards a Shared Environmental Information System", the INSPIRE Directive (Directive 2007/2/EC) and the Aarhus Convention.

All data from this project will be made viewable and disseminated through a web portal known as a Shared Environmental Information System (SEIS), which will be launched in quarter 4 of 2013.

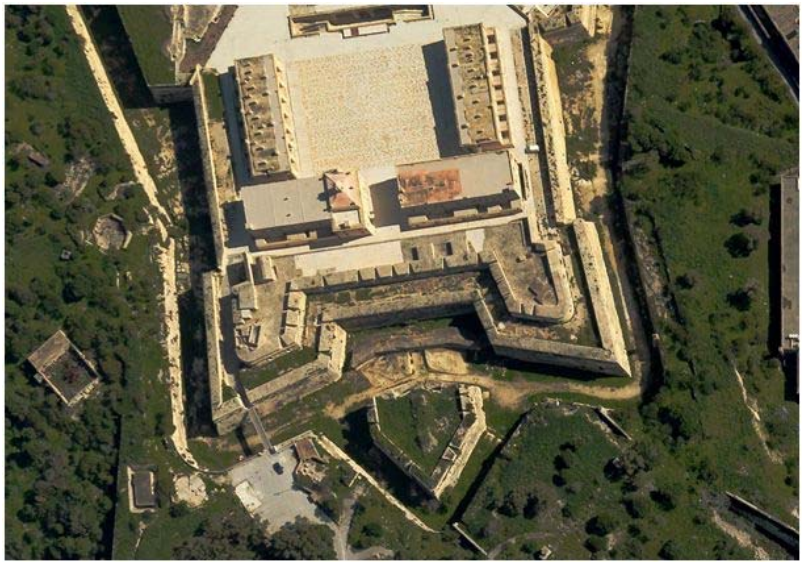

Figure 1a. Aerial image (orthoimage) depicting the fortifications of Manoel Island

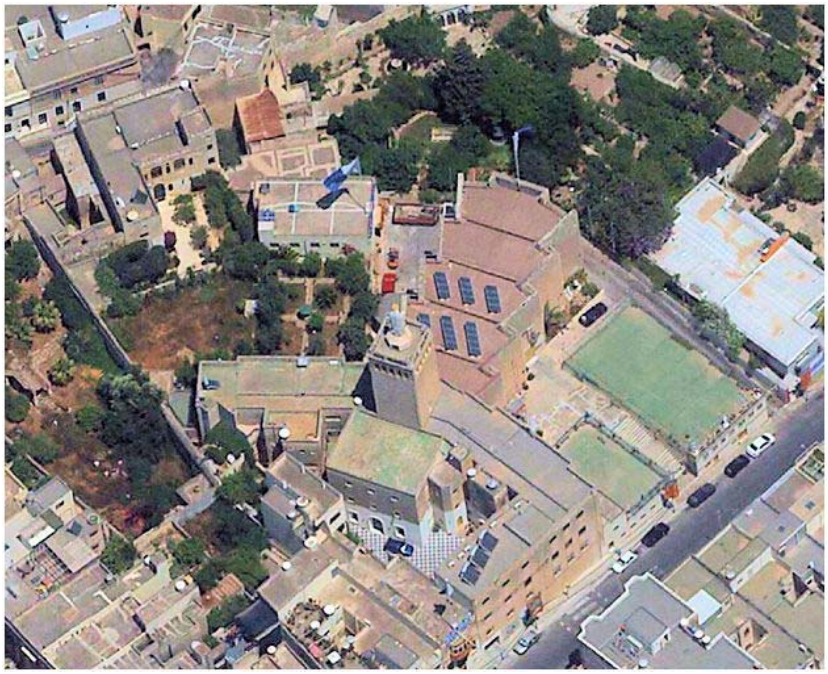

Figure 1b. Oblique (side) imagery of an urban area, allowing analysts to carry out comparative analysis pre and post-incident

Figure 2. Lidar Data: Lidar image depicting the Valletta peninsula in Malta depicting detailed urban infrastructure, street alignment and open spaces.

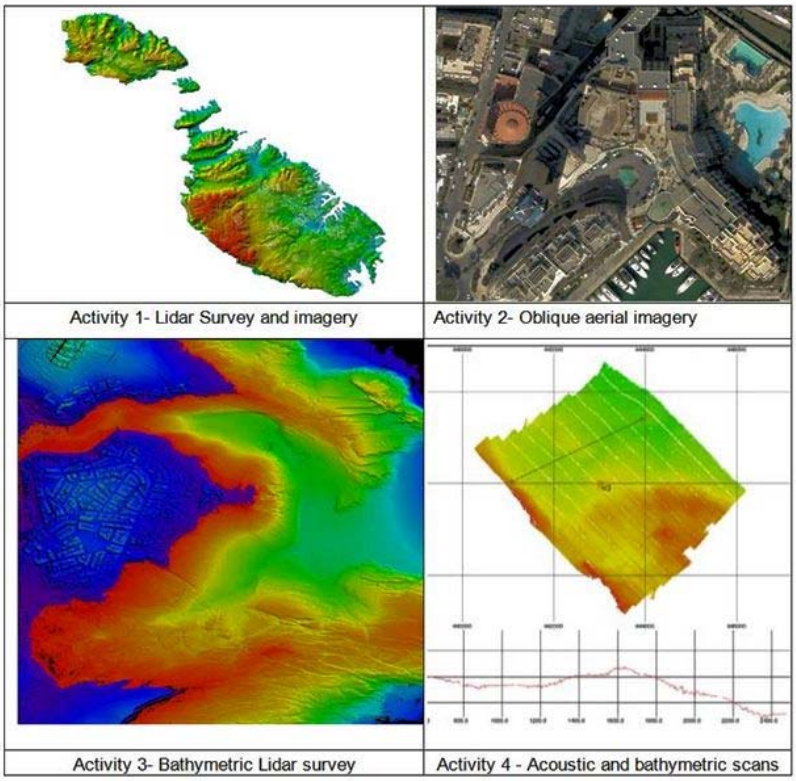

Figure 3. The 4 main data capture exercises

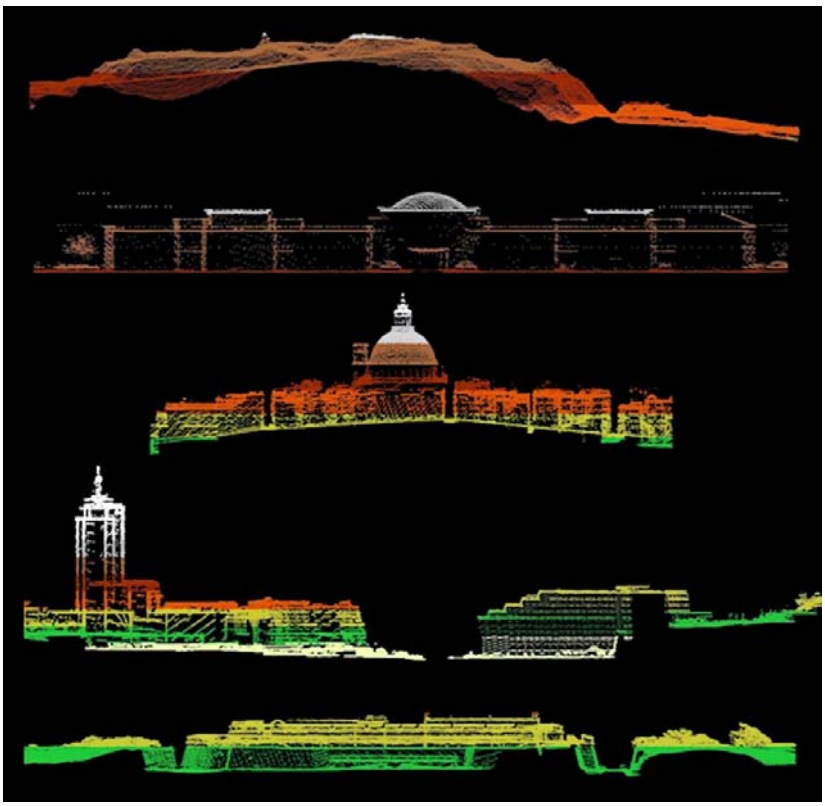

Figure 4. Initial cross-sectional analysis of urban development and environmental structures.

About the author:

Saviour Formosa is a Senior Lecturer at the University of Malta. His main area of research is in spatio-temporal analysis of crime and its social and physical relationships using spatial information systems. His main expertise lies in the implementation of cross-thematic approaches and uses to the data cycle and management with emphasis in the thematic and spatial data structures, visualisation, modelling, web-mapping, analysis and dataflow management and reporting. He has led projects on Aarhus,

INSPIRE, ERDF, ESF, ISEC, ESPON and serves as contact point for various international fora. Dr. Formosa has a Ph.D. in spatio-temporal environmental criminology (University of Huddersfield 2007), having acquired a MSc in GIS (University of Huddersfield 2000) and a BA (Hons) in Sociology (University of Malta, 1994).

Contact: Department of Criminology, Faculty for Social Wellbeing, University of Malta, Humanities A (Laws, Theology, Criminology), Msida MSD 2080, saviour.formosa@um.edu.mt

---

Bibliography

Formosa S., V., Magri, J., Neuschmid, & M., Schrenk, (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., Sciberras, E., and Formosa Pace J., (2012), Taking the Leap: From Disparate Data to a Fully Interactive SEIS for the Maltese Islands in Murgante B., Gervasi O., Misra S., Nedjah N., Rocha A.M., Taniar D., and Apduhan B.O., (Eds.), Computational Science and its Applications – ICCSA 2012, LNCS 7334, Springer, Heidelberg, ISBN 978-3-642-31074-4

Martirano G., Bonazountas M., Formosa S., Nolle M., Sciberras E., Vinci F., (2012), INSPIRE EF Data Specifications to develop the SEIS-Malta Geodatabase for the Air Quality data management, INSPIRE Conference June 2012, Istanbul, Turkey

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

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, (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

4 October 2013

This project has been funded with support from the European Commission.