Institute for Climate Change and Sustainable Development

Annual Report 2013-2014

University of Malta
L-Università ta' Malta

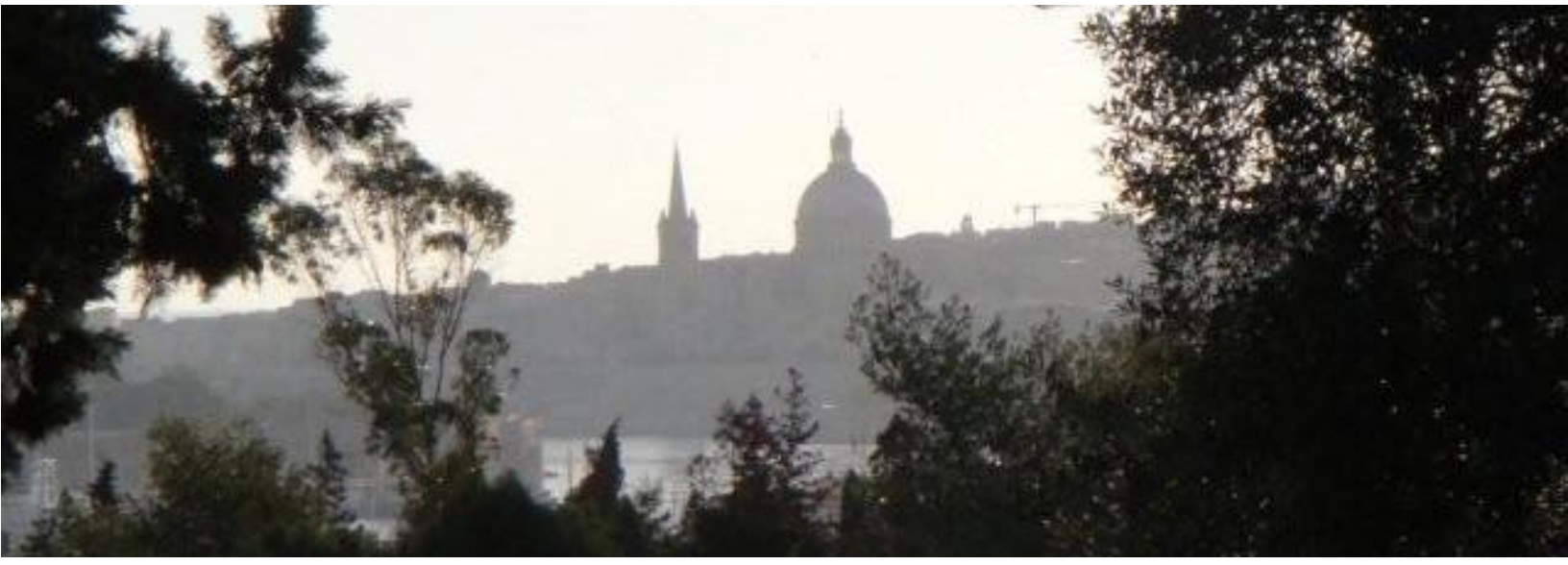
Foreword

From time to time, people remind me about the role of the Institute within the University as well as outside. There is value in doing interdisciplinary research and focusing our efforts on the local challenges. This has reflected in much of the work of the Institute during the period under review. Apart from continuing our educational efforts and contribution to the University's profile, we have also participated and contributed to a number of local and international events, as well as obtained funding related to very specific but pressing concerns which the islands are facing today. This report will highlight in detail the outreach that the Institute has continued to do in order to raise awareness and publicize the results of research. It will list the contributions made in events, conferences and fora in which academic, government and industry partners were present. This exposure has elevated the profile of the Institute, so much that we are now carrying out important research activity for a number of Government entities, including the recent award of funding by the European Commission Representation in Malta. This is their first such commission and we are very proud to be considered for such a task. We have continued to apply for funding in an attempt to grow our fields of expertise and capabilities further. To this end the Institute now houses ten individuals between administrative, academic and research staff. This is an incredible achievement for such a small institute, however it shows the dedication to research and scholarship.

I take the opportunity to thank our supporters, being the staff at the Institute, industry partners, government and the academic staff that have formally accepted to collaborate with us from the various University departments and international institutions.

Professor Maria Attard

Director, Institute for Climate Change and Sustainable Development



Introduction

The Institute for Climate Change and Sustainable Development was established in 2009. During 2013-2014 the Institute strengthened its research areas and continued with its research efforts to promote interdisciplinarity.

The Board of the Institute met regularly during this year where a number of key decision were taken with respect to the work of the Institute and the development of programmes, projects and events.

This report outlines the work and achievements of the Institute for Climate Change and Sustainable Development during the period October 2013 and September 2014.

THE BOARD OF THE INSTITUTE 2013-2014

Chairman **Prof. Simone Borg**

Vice-Chair and Director **Prof. Maria Attard**

Members:

Prof. Richard Muscat
Mr Godfrey Vella
Dr Gordon Cordina
Dr Kenneth Scerri
Prof. Alex Torpiano
Dr Sandro Lanfranco
Prof. Adrian Muscat
Prof. John A. Schembri
Ms Thérèse Bajada
Ms Margaret Camilleri Fenech
Dr Anton Bartolo

Aims of the Institute

(a) to perform and promote interdisciplinary research on issues related to sustainable development, social sustainability, and climate change including mitigation and adaptation strategies;

(b) to provide consultancy, advice and assistance on sustainable development and climate change including mitigation and adaptation strategies;

(c) to provide continuous education, undergraduate, and postgraduate courses within the scope of the Institute subject to the Statutes and Regulations of the University;

(d) to act as host institution for scholars, professors and chairs of international repute, as well as programmes, networks and fora, that aim to enhance the profile of the Institute within the regional and European research area, in areas related to sustainable development and climate change including mitigation and adaptation strategies;

(e) to use telemetry, IT tools, intelligent systems, and modelling for monitoring, research, decision support and strategic planning;

(f) to engage in knowledge transfer and awareness raising initiatives on sustainable development and climate change with companies, organisations and other institutions outside the University to promote best-practice (e.g. to promote the uptake of cleaner technologies; to mitigate and adapt to impacts of climate change on business operations and markets);

(g) to network and liaise with similar or complementary, university institutions and centres for sustainable development or climate change; and

(h) to disseminate acquired knowledge through online media, publications, seminars, conferences and teaching programmes.

The University of Malta Institute for Climate Change and Sustainable Development

The Administrative Office

During 2013-2014 the Institute was located in Regional Business Centre Triq Achille Ferris Msida. This office housed the administrative as well as the academic staff, whilst also offering space for interns, students and project work which the Institute maintained and ran throughout the year.

The Institute's Human Resources

During this academic year the Institute also engaged a number of Research Support Officers to work on numerous projects funded through local and international funds. **Ms Deborah Mifsud**, **Ms Nicolette Formosa** and **Ing. Luana Chetcuti Zammit** continued to support the STREETS Project. **Carlos Canas Sanz** and **Jeremy Azzopardi** joined the Institute throughout this academic year to work on a number of projects. **Mr Iago Gomez** also served as an intern at the Institute working on a number of GIS related projects.

Ms Thérèse Bajada, Assistant Lecturer and **Ms Margaret Camilleri Fenech**, Assistant Lecturer (TR4) have continued to pursue their PhD studies, as well as supporting the growth in the Institute's projects, teaching and administration.

Mr Raphael Mizzi has continued to work on the Green Travel Plan as well as pursuing his Master's research with the Institute.

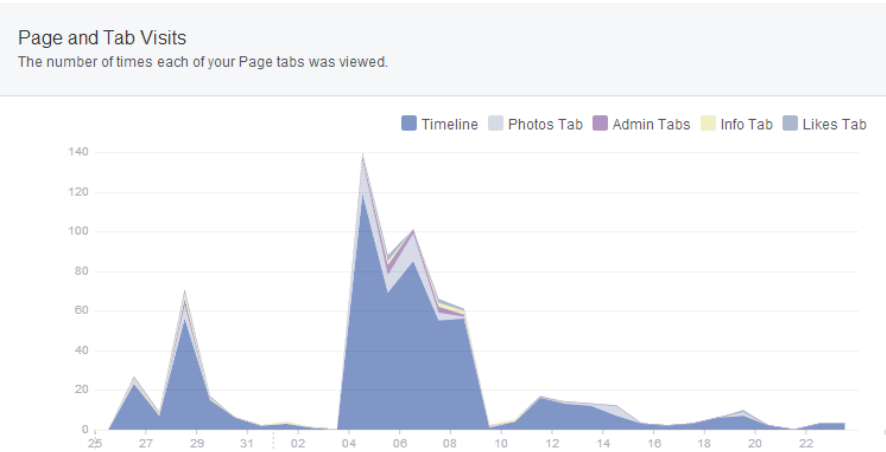
Ms Boglarka Toth supported the institute's EU funded projects including STREETS and SIMIT.

Community Outreach

The Institute on the WWW

The Institute website has continued to act as a medium for communication with the University community and the general public. The Institute's website contains reference to almost all the work that the Institute engaged in since its opening in 2009. Throughout this year, the structure of the website has been changed to reflect the structure and themes of research at the Institute.

In 2014, the Institute also launched its facebook page. A very good response was received from the public, and use of the Institute facebook page remained active throughout with some evident peaks during particular events and uploads.



The Institute in the Media

di-ve.com

Custom Travel Information for University users

The University Green Travel Plan Coordinator launches the new Custom Travel Information website for University

22/10/2013

Times of Malta

University travel website launched

Custom Travel Information is a new website providing University students and staff customised information on how to reach its Msida campus using different means of transport based on the origin of their journey. The site may be accessed at www.um.edu.mt/iccsd/greentravel/cti


Sunday, October 27, 2013, 00:01

University travel website launched

The University is encouraging students and staff to cycle to the Msida campus.

Times of Malta

Transport policy that works Opinion article by Prof. Maria Attard, Director ICCSD

http://www.timesofmalta.com/articles/view/20131031/opinion/Transport-policy-that-works.492642#.UoxqSBhwbIX

31/10/2013

Gozo News.com

STREETS Project launched to improve accessibility to Malta and Sicily

07/11/2013


Gozo News.Com

Over 100 currencies, Great FREE Buy Back Guarantee, No Comm

Home Gozo News Malta News EU News Financial News Letters & Opinions

Malta News

Be the first to comment!

STREETS Project launched to improve accessibility to Malta and Sicily

BY GOZO NEWS · NOVEMBER 7, 2013

Email item Print item

Times of Malta

Project to improve Malta and Sicily's accessibility

10/11/2013

Times of Malta

University appoints Cycling Ambassadors

Six University students and staff have been officially appointed by the Bicycle Advocacy Group (BAG) as its cycling ambassadors at the University of Malta, as part of the Green Travel Plan.

17/11/2013

Sunday, November 17, 2013, 00:01

University appoints cycling ambassadors

The Bicycle Advocacy Group stand at last week's Discover University.

Times of Malta

The Fear of Handling Cars Opinion article by Prof. Maria Attard, Director ICCSD

http://www.timesofmalta.com/articles/view/20131206/opinion/The-fear-of-handling-cars.497780#.UqGb1LmA3IU

06/12/2013

Times of Malta

When elderly miss the bus Research article by Deborah Mifsud, Research Support Officer ICCSD

http://www.timesofmalta.com/articles/view/20131219/opinion/When-elderly-miss-the-bus.499620#.UrK3LZBFDIU

19/12/2013

Times of Malta

Students urged to bike it to University Article promoting the Green Travel Plan efforts to promote cycling as a green mode of transport amongst students and staff.

30/12/2013

Times of Malta

Transport problems, experts and discourse Opinion article by Prof. Maria Attard, Director ICCSD

http://www.timesofmalta.com/articles/view/20140128/opinion/Transport-problems-experts-and-discourse.504464

28/01/2014

Times of Malta

Coming unstuck An interview with Prof. Adrian Muscat discussing the work on Shared Demand Responsive Transport Systems

03/07/2014

tvm.com.mt

Jaqdef u jnizzel il-postijiet kulturali fil-gzejjer Maltin

Feature narrating the task of Jeremy Azzopardi, Research Support Officer with the Institute, engaged to map cultural infrastructure as part of the V18 Cultural Mapping Project.

8/07/2014

Times of Malta

Gendered mobility: what future? Research article by Prof. Maria Attard and Dr Frank Bezzina

The authors share results from a paper presented at the International Conference on Women's Issues in Transportation, in Paris.

28/07/2014

Participation in conferences and events

4th September 2013 ESRI Malta Conference, SmartCity Malta Kalkara

Staff from the Institute attended the ESRI Conference organised by GEOSYS Ltd, supported by ESRI (Europe).

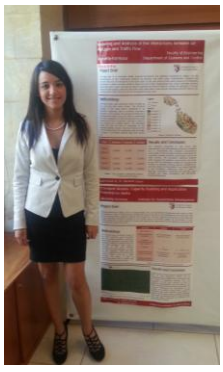
13th September 2013 Modelling on the Move 4: Social theory, transport and energy modelling, London, UK

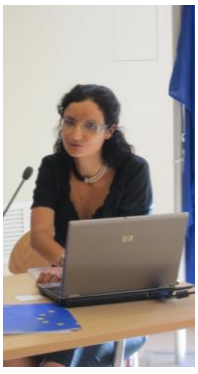
Ms Thérèse Bajada attended this seminar as part of the ESRC Seminar Series. These are a series of events bringing together researchers and practitioners to discuss innovative ways of responding to pressing policy problems in transport. Discussions particularly referred to three interlinked energy problems: climate change, obesity, and oil depletion.

23rd September 2013 National Workshop The Eco-Sustainable aspects of the Country-Specific Recommendations for Malta, Ewropa House, Valletta

During this event the Institute was represented by its own researchers and academics who presented their work to the general public. Some of these included:

- Prof. Adrian Muscat, Prof. Maria Attard, Dr Kenneth Scerri presented *A comparative study on a Dial-A-Ride Taxi System for Malta*
- Deborah Mifsud presented *The Role of Public Transport in addressing sustainable mobility for the Elderly Population in Malta*
- *Margaret Camilleri Fenech* presented *The Management of Waste and other research initiatives*
- Ms Rosalie Camilleri presented *The spatial distribution of nitrogen dioxide in the local atmosphere: an analysis*
- Ing. Luana Chetcuti Zammit, Dr Kenneth Scerri presented *Looking back to change track*
- Nicolette Formosa presented two posters entitled *Modelling and Analysis of the Interactions between Air Pollution and Traffic Flow* and *Transport Models: Capacity building and potential in Malta*

6th - 9th October 2013 The 16th International Conference on Intelligent Transport Systems – Intelligent Transportation Systems for All Transport Modes, The Hague, The Netherlands

Ms Luana Checuti Zammit gave a presentation entitled, Bayesian hierarchical modelling of traffic flow - with application to Malta's road network. The work was co-authored with Dr Kenneth Scerri and Prof. Maria Attard.

30th October 2013 GIS and the Geography of War, King's College, London

Ms Thérèse Bajada attended this seminar during her studies in London.

13th November 2013 Horizon2020, UCL, London

Ms Thérèse Bajada attended a talk by Dr Marcel Rommerts Head of Unit - Transport Research, European Commission, Innovation and Networks Executive Agency during her studies in London.

25th November 2013 Launch of National Strategy Policy for Active Ageing, Auberge de Castille, Valletta

In view of the research carried out in the field of the elderly Deborah Mifsud, Research Support Officer within the Institute and Prof. Maria Attard were invited to attend the launch of the National Strategic Policy.

29th November 2013 Electromobility Islands Port PVEV Project Conference, St Julian's, Malta

Prof. Maria Attard delivered a presentation entitled Car ownership, mode choice and the future of electric mobility in island states. The conference was organized by Transport Malta, Project Leaders of the Port PVEV Project funded by the EU Italia-Malta Programme.

3rd December 2013 Sustainable transport through engineering techniques, University of Malta

Prof. Maria Attard delivered a presentation entitled Sustainable Transport: How do we achieve it? at the UESA (University Engineering Student Association) Transport Seminar.

10th December 2013 Sustainable Built Environment (SBE) Malta: Kindergartens for Children: Drawing on Education and Child Development Perspectives. Ministry of Education Conference Hall, Floriana

Ms Margaret Camilleri Fenech attended the conference. The conference included a number of keynote speakers that delivered presentations related to architecture, early education, child and environmental psychology, history and pedagogy.

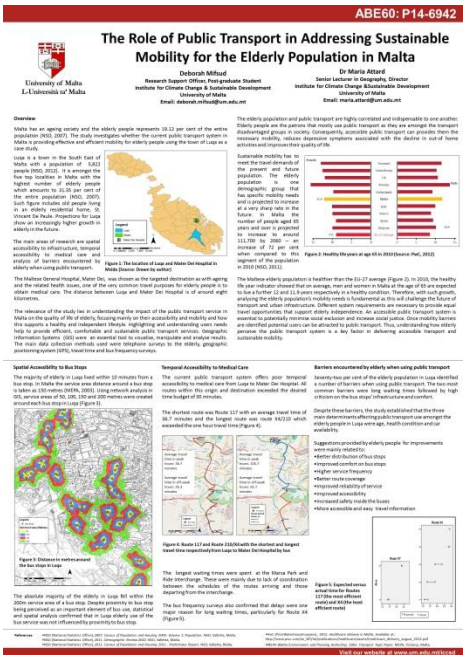
12th – 16th January 2014 Transportation Research Board 93rd Annual Conference, Washington D.C., USA

Prof. Maria Attard attended the Annual Conference and presented three posters showcasing her research with various collaborators.

- Attard, M., Macharis, C. Demographic characteristics of modal choice: a comparative analysis of accessibility trends in two European urban areas.

- Deborah, M., Attard, M. The role of public transport in addressing sustainable mobility for the elderly population.

- Attard, M. Evaluating the future of Road Pricing in Valletta, Malta: The role of politics and institutions.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The Role of Public Transport in Addressing Sustainable Mobility for the Elderly Population in Malta

Deborah Mifsud
Research Support Officer, Post-graduate Student
Institute for Climate Change & Sustainable Development
University of Malta
Email: deborah.mifsud@um.edu.mt

Dr Maria Attard
Senior Lecturer in Geography, Director
Institute for Climate Change &Sustainable Development
University of Malta
Email: maria.attard@um.edu.mt

30th January 2014 Briefing session on the Waste Management Plan 2014 – 2020. Ministry for Sustainable Development, the Environment and Climate Change, Excelsior Hotel, Floriana.

Ms Margaret Camilleri Fenech attended the presentation of the final report of the Government's Waste Management Plan for 2014-2020.

20th February 2014 Present Around the World (PATW) Institution of Engineering and Technology

Ms Nicolette Formosa, Research Support Officer at the Institute presented her Masters research with the aim to provide an interpolative method to overcome limitations in spatio-temporal modelling.

14th – 16th April 2014 WIiT Paris 2014: Women's Issues in Transportation 5th International Conference on Women's Issues in Transportation - Bridging the Gap, held in Paris, France

Prof. Maria Attard presented a poster entitled Gendered mobility in Malta: Influencing factors on travel choices. The work was co-authored with Dr Frank Bezzina from the Department of Management, Faculty of Economics, Management and Accountancy of the University of Malta.

14th – 15th April 2014 Royal Geographical Society Post-graduate Mid-Term Conference, Loughborough University, UK

Ms Thérèse Bajada presented her PhD studies with a presentation entitled Planning bus service reforms that meet people's needs at this mid-term post-graduate conference.

30th April – 1st May 2014 NECTAR 2014 Joint Cluster Meeting Cluster 2 Policy and Environment - Cluster 7 Transport Security and Vulnerability jointly with WCTR SIG 14 entitled Evolving Perspectives on Sustainability and Security in Transport. Shamoon College of Engineering, Beer Sheva, Israel

Prof. Maria Attard delivered a presentation entitled Visioning sustainable transport futures: the role of gender and age in achieving modal shift. The work was co-authored with Dr Philip Von Brockdorff and Dr Frank Bezzina, both from the Faculty of Economics, Management and Accountancy.

9th May 2014 Food and the Environment, Cleaner Technology Centre, University Residence, Lija.

Ms Margaret Camilleri Fenech gave a presentation entitled Food Miles – of concern to the environment as part of a seminar on Food and the Environment.

15th -17th May 2014 EUROGEO Conference: The Power of Geography and the Role of Spatial Information, University of Malta, Valletta Campus

- Deborah Mifsud attended the EUROGEO Conference with a paper entitled The Role of Public Transport in Addressing Sustainable Mobility for the Elderly Population in Malta. She also presented a poster entitled The use of GIS in studies in Transport Geography.
- Ms Thérèse Bajada presented on-going research work entitled *A Comparative Analysis of Two Public Transport Reforms: The Cases of Transantiago and Arriva Malta*.

The Department of Geography, Faculty of Arts of the University of Malta hosted the 2014 EUROGEO Conference. Prof. Maria Attard was a member of the Conference Scientific Committee and chaired the Local Organizer Committee.

16th June 2014 Life Transitions and Travel Behaviour, Department of Transport, London

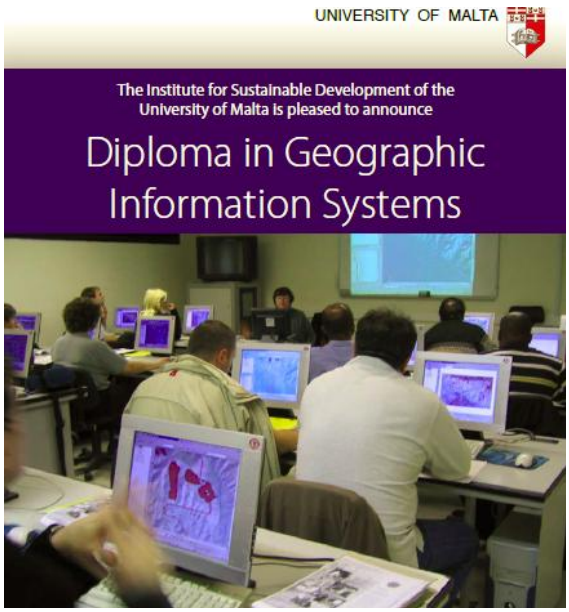
Ms Thérèse Bajada attended a seminar at the UK Department for Transport with presentations from a study team of the University of West England, University of Essex and the Department of Transport (http://travelbehaviour.com/)

27th – 29th August 2014 Royal Geographical Society (with IBG) Annual International Conference, London, UK

Prof. Maria Attard delivered a presentation entitled Bridging the gap between policy makers and transport geography.

The Institute's Study Programmes

The Diploma in Geographic Information Systems



The Diploma in Geographic Information Systems is the first opportunity for formal training for those interested in developing skills in this very specialised discipline. This is a part-time (evening) course over six semesters and falls under the Get Qualified funding scheme where students get financial support to undertake their studies.

YEAR ONE
ISD1100 Basic Skills in Geographic Information Systems (Lab Practicals) 6 ECTS
ISD1101 Basic Concepts of Geographic Information Systems 4 ECTS
ISD1102 Introduction to Geographic Information 4 ECTS
ISD1103 Introduction to Geographic Analysis 4 ECTS
ISD1104 Introduction to Database Management Systems for GIS 4 ECTS
ISD1105 Remote Sensing and Applications 4 ECTS
ISD1106 Mobile Geographic Information Systems 4 ECTS

YEAR TWO
ISD1203 Intermediate Skills in Geographic Information Systems (Lab Practicals) 6 ECTS
CRM1001 Geographic Information Systems and Crime Mapping 4 ECTS
ISD1200 Geovisualisation 4 ECTS
ISD1201 Programmable Aspects of Geographic Information Systems 4 ECTS
ISD1202 Cartography and Digital Mapping 4 ECTS
ISD1204 Geographic Information Systems and Geodemographics 4 ECTS
ISD2205 Geographic Information Systems and Databases 4 ECTS

YEAR THREE
ISD2000 Long Essay 8 ECTS
ISD2305 Advanced Skills in Geographic Information Systems (Lab Practicals) 6 ECTS
ISD2301 Web Mapping 4 ECTS
ISD2302 Geographic Information Systems in Transportation 4 ECTS
ISD2303 Managing Geographic Information Systems 4 ECTS
ISD2304 Advanced Geographic Analysis and Mapping 4 ECTS

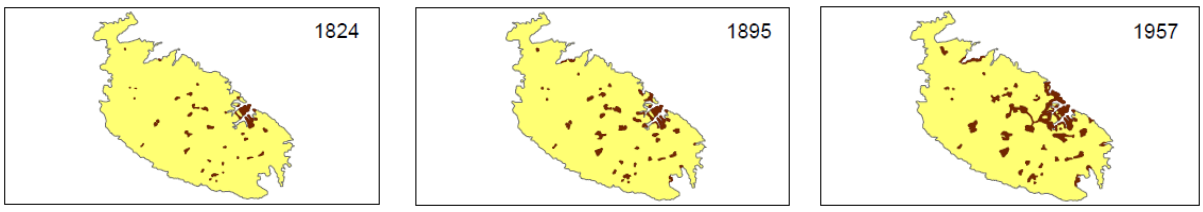
The Diploma in Sustainable Land and Real Estate Management

The Diploma in Sustainable Land and Real Estate Management is an interdisciplinary study programme bringing together the main aspects related to land and estate management. The study programme is designed in such a manner as to effectively develop skills and knowledge required by land managers to understand the complexities of rural and urban management and development. The study programme includes a number of study units aimed at the teaching of basic concepts of economics, law, geography, environment, finance, planning, management, architecture, marketing, ICT tools and statistics. This is a part-time (evening) over six semesters.

YEAR ONE
CVL110 Law of Ownership and Property Law Relating to Sustainable Estate Management 4 ECTS
MGT1013 Fundamentals of Management 4 ECTS
ISD1110 Principles of Sustainability 6 ECTS
ECN1003 Introductory Economics for Land and Real Estate Management 4 ECTS
GEO1042 Socio-geographic Aspects of Land Management 4 ECTS
ISD1108 Geographic Information Systems for Land Management 4 ECTS
ISD1109 Quantitative Techniques for Land Management 4 ECTS

YEAR TWO
CVL1109 Legal Anthropological Perspectives on Land, Property and the Environment 4 ECTS
GEO1041 Urban and Rural Geography 4 ECTS
RFS1400 Rural Policy and Land Use Management 6 ECTS
EMP1201 Impact Assessment and Monitoring 4 ECTS
LIN1063 Academic Reading and Writing in English 2 ECTS
MRK1011 Introduction to the Marketing Concepts 6 ECTS
SPI1011 Development and Spatial Planning 4 ECTS

YEAR THREE
BKF2200 Real Estate Finance 4 ECTS
CIS1043 Information Systems for Land Management 4 ECTS
CNM1041 Property Valuation 4 ECTS
ERL1000 Principles of Environmental and Development Planning Law in relation to Estate Management 4 ECTS
MGT1052 Leadership and People Management 4 ECTS
ISD1205 Project 10 ECTS

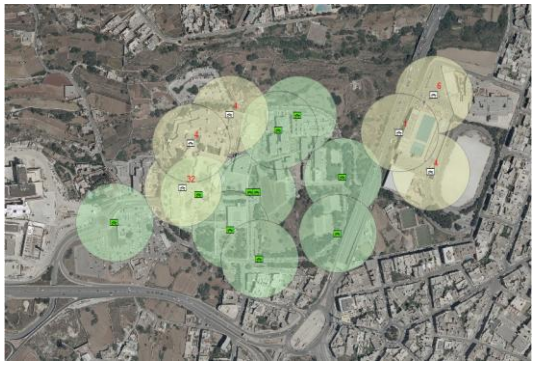


The Postgraduate Certificate in Geographic Information Systems

The Postgraduate Certificate in Geographic Information Systems covers the principles of the Geographic Information Science, such as spatial databases, programming, remote sensing and digital cartography and the technology supporting Geographic Information Systems such as principles, management and applications. It is a part-time (evening) course over two semesters.

YEAR ONE

ISD5001 Principles of Geographic Information Systems 5 ECTS
ISD5002 GIS and Databases 5 ECTS
ISD5003 Applying GIS (Lab Practicals) 5 ECTS
ISD5004 Geographic Information, Remote Sensing and Digital Cartography 5 ECTS
ISD5005 Managing Geographic Information Systems 5 ECTS
ISD5006 Programming in GIS 5 ECTS



The Master of Science by Research (Sustainable Development)

The Master of Science (Sustainable Development) is a research programme enabling researchers to focus on a variety of topics to be studied in depth through full-time or part-time study. The study programme is over three semesters or equivalent in part-time.

Research conducted by MSc students is outlined in Annex 1.

YEAR ONE
ISD5100 Dissertation 80ECTS
ISD5101 Research Methods 5ECTS
ISD5102 Principles of Sustainability 5ECTS

Student Intake 2013-2014

Student	**Dissertation Title**
Mr Jonathan Caruana (Full-time)	Social Sustainability, Urban Regeneration and Postmodern Development Approaches for Strait Street, Valletta Supervisor: Prof. Maria Attard

Cultural Mapping Project Data for Valletta and the Harbour Area

New Research Activity

The Institute has continued to work on the projects awarded in the previous year. It has also succeeded to submit and participate in project proposals, both locally and abroad. Table 1 shows the projects which were developed by the Institute and its partners and the outcome of the funding applications.

Funding Programme	**Title of Project**	**Project Partners**	**Outcome and Value**
UOM R&I	Assessing the impact of transport measures on sustainable mobility	Prof. Maria Attard, Institute for Climate Change and Sustainable Development	EUR 500
HORIZON2020	SOFTURBILITY	TDU (DK), Lund (SE), ITS Leeds (UK), ETH Zurich (CH), TU Delft (NL), POLITO (IT), Valencia (ES), **UOM (MT)**, Aegean (GR), ATU Bucharest (RO), Krakow (PT), Technion (IL)	NOT AWARDED
HORIZON2020	Lots of Parking	Loughborough (UK), **UOM (MT),** Radboud (NL), KTH (SE), Trinity College Dublin (IE), European Parking Association (EPA)	NOT AWARDED
National Electro Mobility Platform Transport Malta	2014 European Mobility Week SUMP Award Application	Prof. Maria Attard, Institute for Climate Change and Sustainable Development for the Valletta Local Council	EUR 802
European Commission Representation in Malta	Study on the impacts of congestion in Malta	Prof. Maria Attard, Institute for Climate Change and Sustainable Development Dr Philip Von Brockdorff FEMA (Economics) Dr Frank Bezzina FEMA (Management)	EUR 13,200
Malta Resources Authority (Climate Change Group)	Support for the writing of Malta's 6th National Communication to the UNFCCC	Prof. Maria Attard, Institute for Climate Change and Sustainable Development; Prof. Simone Borg, Faculty of Law Dr Noel Aquilina, Faculty of Science; Prof. Paul Pace, Faculty of Education	EUR 10,266
Malta Resources Authority (Climate Change Group)	Assessing landuse classification from the Corine landcover 1996, 2000, 2006	Prof. Maria Attard and Mr Carlos Canas Sanz, Institute for Climate Change and Sustainable Development	EUR 1,575

On-Going Projects

STREETS (STRatEgia IntEgrata per un Trasporto Sostenibile Italia-Malta) is a 3-year project partly financed by the EU under the Operational Programme Italia-Malta 2007-2013. The project aims to contribute to the improvement of the transport and to enhance the integration of multi-modal transport between Sicily and Malta, in support of the TEN-T corridor 5. This will be developed through a joint mapping of the transport network, aiming at an improved internal/external accessibility, while overcoming the current bottlenecks identified between the two islands. The project aims to develop a web-GIS platform by collecting geo-referenced data about the transport system, while making it available to the Public Administration of the involved territories. This will in turn enhance the quality and safety standards and the communication with citizens and stakeholders.

STREETS involves six partners, with the leading partner being the Dipartimento Regionale Delle Infrastrutture, della Mobilità e dei Trasporti di Sicilia, together with Collegio Universitario ARCES, Vittoria Local Council, Catania Port Authority, University of Malta (coordinated by Dr Maria Attard) and Transport Malta.

The University of Malta represented by the Institute for Climate Change and Sustainable Development is responsible for the joint mapping of the transport system between Malta and Sicily, amongst other tasks.

The University is leading the team to draw up a detailed analysis to investigate the urban road access to the port of Malta and its traffic flows in and out of the port area of Catania and Malta. A map will be developed to provide efficient connections between the ports, land and air transport, superimposed on a topographic map of the Maltese Islands. An analysis of the road supply-demand relationship within the traffic network between the two islands will also be analysed and will serve as a unified strategy between Catania and Malta.

A detailed analysis will be carried out to determine current territorial problems, any economic and social issues, or critical infrastructures or strategies currently in action. Guidelines will be established for efficient flow of origin-destination passengers and goods within a certain time schedule.

Intermodal means of transport connecting Malta and Sicily will be identified while keeping in mind the short-medium and long-term infrastructures and services currently available to provide an integrated logistics platform within the Sicilian-Maltese environment.

An analysis of what data is required to efficiently capture the flow of passengers and goods between Malta and Sicily will be investigated. This will also incorporate analysis of the data available from local operators or surveys to be distributed to passengers, to capture the flow of passengers and goods between the two islands.

To enhance the working progress between all project partners, several meetings are planned to take place. The first Steering Committee meeting took place in Palermo on the 7 - 8 March 2013, with the Institute for Climate Change and Sustainable Development being represented by Prof. Maria Attard, Project Coordinator, Ms Boglarka Toth, Project Administrator and Ms Deborah Mifsud, Research Support Officer. During the meeting, the project partners were introduced and presentations were made about the project's strategic activities.

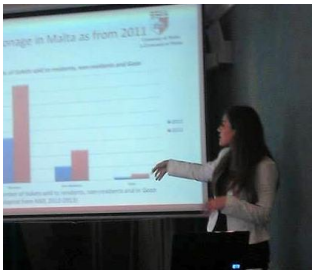
Project co-financed by the European Union – European Regional Development Fund

Project Events

10-11 October 2013 STREETS Project Launch Conference in Vittoria, Sicily

All project partners discussed progress of works. At the conference Prof. Attard presented the work with regard to the development of a digital map of the Maltese transport network and survey results on the flow of passengers between Malta and Sicily.

15 April 2014 STREETS Thematic Table on Public Transport in Agrigento, Sicily



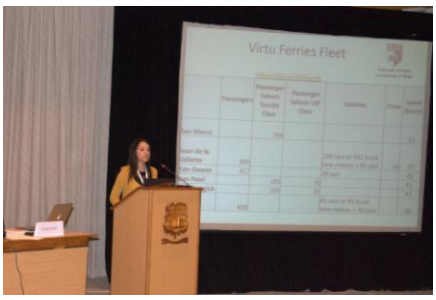
Deborah Mifsud delivered a presentation entitled “Passengers Data Analysis between Malta and Sicily”. Flow of passengers and accessibility between the two islands were discussed in terms of sea and air transport. An overview of the public transport system in Malta was also given by an explanation of bus patronage throughout the years and the main routes connecting the Airport, Valletta and other touristic cities with the rest of the islands.

22 May 2014 STREETS Steering Committee Meeting, ICCSD Office, Msida, Malta

23 May 2014 STREETS Thematic Table on Maritime Transport in Valletta, Valletta Campus, Valletta, Malta

The Institute for Climate Change and Sustainable Development organised a one-day thematic table on maritime transport at the University Campus in Valletta. Different presentations by different stakeholders were presented. Prof. Maria Attard chaired the conference; Nicolette Formosa delivered a presentation entitled “Sea Passengers Data” whilst Deborah Mifsud presented a

presentation entitled “The Road Topology” showing the progress of the Maltese road network topology.



16-17 June 2014 STREETS Expert Meeting, ICCSD, Msida, Malta

Prof. Maria Attard discussing the structure for the Strategic Plan with Prof. Giuseppe Salvo.

3 July 2014 STREETS Thematic Table on Air Transport in Trapani, Sicily

Deborah Mifsud delivered a presentation entitled "Air Transport between Malta and Sicily". An overview of the air transport development in Malta throughout the years, the busiest routes in the Maltese airport, and the passenger flow to the Sicilian airports of Catania, Trapani and Palermo was given.

Assessment of key success indicators for the Public Transport Reform in Malta

Following the agreement reached between the Institute for Climate Change and Sustainable Development and Transport Malta in 2010, work has continued on this project. The project aims to collect information about success indicators for public transport and analyse their progress over a period of five years. Key indicators include emissions, travel time, bus journey time and reliability and customer perception of the bus service. This project will see the Institute carry out surveys throughout the five-year period (2011-2016) and produce reports analysing the data and comparing them temporally. This project is also being complemented with student research and publications.

European Mobility Week Sustainable Urban Mobility Plan (SUMP) Awards

Prof. Maria Attard was engaged by the Valletta Local Council to prepare the Council's application for the SUMP Awards. The application was submitted in September 2014 presenting in total 15 project proposals for the Valletta Local Council, aimed at promoting Sustainable Mobility in and around Valletta.

SIMIT Integrated System for Trans-boundary Italo-Maltese Civil Protection

The SIMIT Project aims at developing an integrated civil protection network between the Sicilian and Maltese bodies involved in the risk forecast, prevention and mitigation processes, and moreover in the planning and management of emergencies, to be further extended to the cross border countries.

The project aims at structuring an integrated system of interventions, targeting the identification and prevention of seismic, volcanic, hydro-geological, as well as risks and issues related to the vulnerability of the cross-border territory.

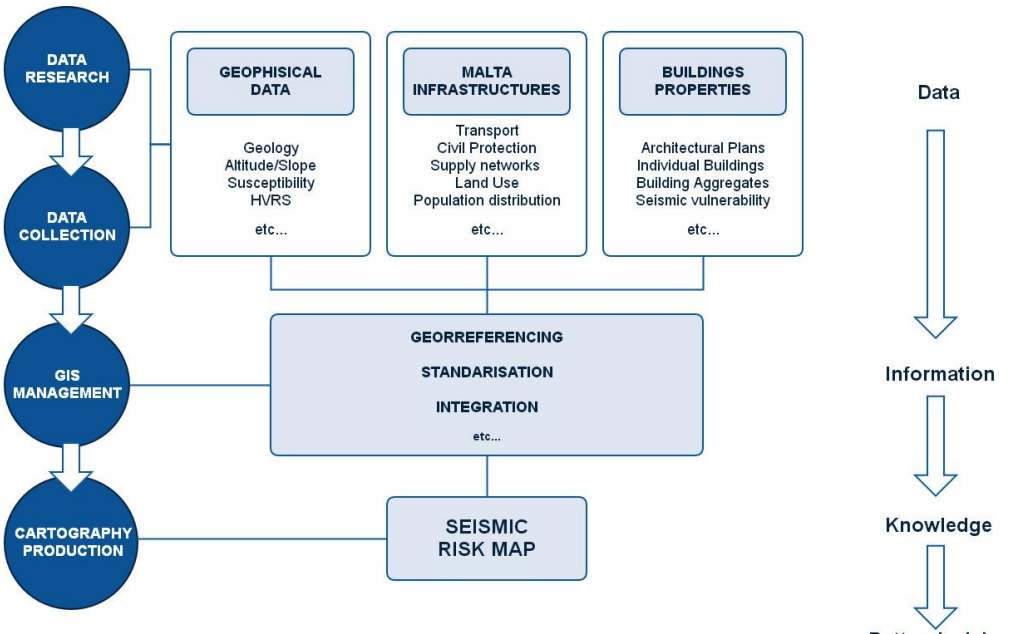
These objectives are pursued with the creation of an institutional network between parties involved and consulted outside a portal that could be checked from outside, facilitating the exchange of information on its functional use.

Within the project SIMIT Project, the ICCSD is in the process of compiling, standardising and geo referencing all data generated as the results of the research by the different departments involved in the project.

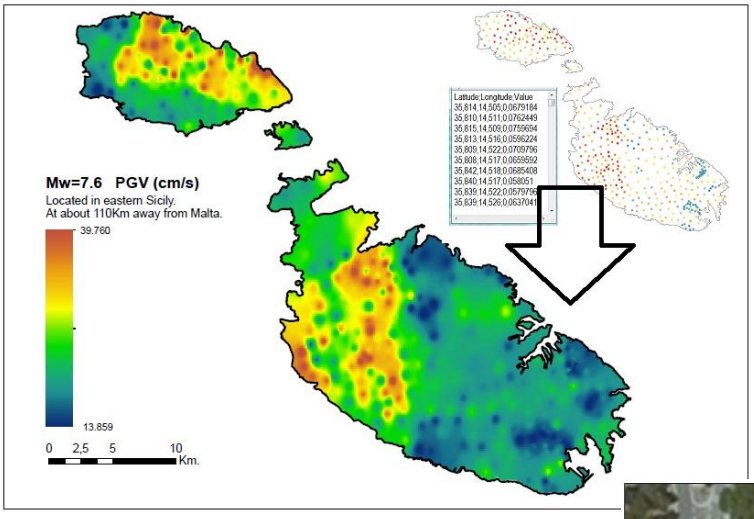
Furthermore, such information will be incorporated into a Geographic Information System, allowing the visualization of the results for all the research in a thematic cartography that integrates all the information within the whole project. This process gives an entirely new perspective to data analysis and visualization that cannot be seen in a table or list format.

As a result of the project, the ICCSD will develop a geo-data base within a Geographic Information System whose data will be visualised through a Seismic Risk Map.

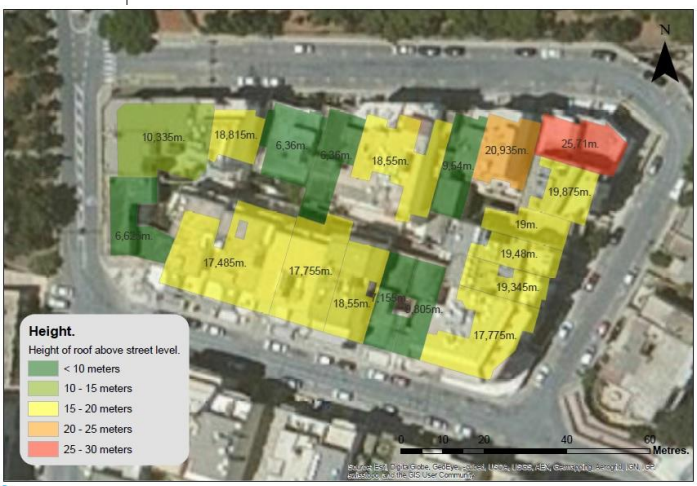
More is available at http://simitriskmap.weebly.com



The importance of the Seismic Risk Map lies in its ability to combine a wide variety of data to create a spatial picture that is far more useful than the old system of linear comparison. It provides a real image of the current situation and it can be used as a powerful tool for decision making in case of seismic activity.



SIMIT Project Output Maps



Carlos Canas Sanz presenting the work of the Institute at a project meeting.

Looking beyond the entertainment aspects of festivals. A delve into their environmental impacts.

Powered by Island Festivals Project

by Margaret Camilleri Fenech, Assistant Lecturer, Institute for Climate Change and Sustainable Development

Festivals are attractive crowd pulling activities often associated with culture and free spirited music. But festivals can cause extensive environmental impact that goes beyond cutting flowers to put them in hair. Oxford University researchers who analysed the environmental impact of 500 UK festivals found that, combined, they emit around 84,000 tonnes of CO2 a year. This excludes waste generation, traffic congestion and noise and light pollution. A growing environmental concern has made various festival organisers investigate these impacts in order to minimising them and simultaneously improve the festival image.

The first step to do this is to set a clear environmental policy. This is of considerable importance both for the festival's image and also as part of the strategy for stakeholder management. Therefore a triple bottom line (TBL) approach which provides a concern that goes beyond the environmental, to include social and economic considerations is necessary. The decision to green the event must be communicated both to primary (i.e. employees, volunteers, sponsors, suppliers etc.) and secondary (i.e. the host community, media, businesses etc.) stakeholders in order for them to understand that environmental stewardship is a core value of the festival.

Next are operational issues. These relate both to the event itself together with location, inputs and outputs and include public transport, waste management and possibilities to use green power. Other areas include the type and quantity of materials used, logistics and marketing.

Accessibility to reliable public transport is a crucial factor. Festivals which choose to have the environment as part of their policy must discourage the use of private cars. A drastic step is to refrain from providing parking facilities or make it difficult to obtain parking passes in order to encourage people to use mass transit. Carpooling is another consideration. Other initiatives include rewarding people who choose public transport through vouchers that, for example, give discounts for food stalls and official festival merchandise.

Waste management is next topic. When events cater for a large number of people a clear and concise waste management plan is crucial. Ideally a waste audit should be conducted before, during or after an event to get a better understanding of the different waste generated and the management requirements. Disposal facilities and their availability will affect how the waste collection system operates. Contracts with stallholders should include the responsibility to manage waste properly (with penalties for non-compliance) and the prohibition of certain materials e.g. polystyrene and disposable items e.g. sachet portions together with the requirement to use correct packaging materials that can be recycled or composted. Waste is highly visible, particularly when it takes the form of littering and therefore it can be used as one of the main tools to promote the greening of the festival!

Food can also serve as a means to deliver a green message. Purchasing exact quantities to avoid wasting both food and money cannot be emphasized enough. Recent years saw the growth of the Slow Food concept which sees food not just as a question of nutrition, but as part of a broader lifestyle statement therefore offering the possibility to combine the local culture and environmental awareness under one umbrella.

Beverages are also a source of high waste generation. The utilisation of reusable containers together with local sourcing are noteworthy steps. Other initiatives include the use of Fair Trade product. Readily available Fair Trade products like tea, coffee, hot chocolate and sugar can be sold as standard. Similarly to when sourcing sustainable food, fair trade standards should be communicated and celebrated.

Water has always been the world's most popular drink. Free water dispensing units have made available in a number of festivals. Other initiatives include setting a target to be a plastic bottle free event by banning the sale of bottled water and asking festival goers to bring their own refillable bottle, whilst making refill stations available for free. Refillable water bottles can also be sold on site.

CO_2 emissions must also be examined. Events often involve the use of generators powered by diesel or petrol. Additionally, cars traveling to events and guests and artists flying add to carbon emissions. Similarly to waste, auditing to calculate carbon emissions should be a first step to understand the emissions impact. These emissions should then be (ideally) reduced at source. Julie`s Bicycle (www.juliesbicycle.com), a cross music industry initiative on climate change, came up with the `Powerful Thinking` campaign which brings together festivals and suppliers to explore new ways of working to reduce costs and carbon through increased efficiency, and share findings to promote lower carbon energy supply. The aim is to drive a market for renewable energy supply at festivals, understanding and accounting for the business and cost restraints. It also supports smaller renewable providers by raising their profile amongst promoters and suppliers that are using multiple power sources to strengthen their low carbon offer in a changing market place. Finally, it works with established suppliers and festivals to increase the efficiencies of existing relationships.

The innovative Nabro (Neigh) bridge placed in Viby Rengvej as part of the 2010 Neighbours Festival (Aarhus Festival, Denmark). The bridge can be used both by pedestrians and bikers to facilitate passage to a nearby school and to date is still in place and used regularly by students.

The research was financed by the Province of Fryslan and analysed the various environmental impacts caused by festivals. The main focus of the research were Aarhus festival, Northside festival and Spot festival all organised in Aarhus, Denmark together with the Evenings on Campus festival organised at the University of Malta. The article gives an overview of the main environmental impacts caused by festivals and possible solutions.

Cultural Mapping Project

Description and Aims

Launched in October 2013, the Cultural Mapping exercise aims to gather and input data related to the islands' cultural infrastructure. This data was collected and entered into a Geographic Information System, and will include spaces used for a variety of activities of different categories. This exercise will thus generate information related to cultural use of public spaces and cultural venues and sites in all localities of Malta.

Allocation of Human Resources

A call for the position of Research Support Officer I was issued by the University of Malta for one year commencing on December 1st 2013 and ending on December 1st 2014. Along with the Research Support Officer, two members of staff from the ICCSD also supported the efforts of fieldwork and digitisation in a number of localities.

Methodology

The project methodology was agreed in December 2013 alongside a pilot serving to inform the partners involved. The localities of Siġġiewi and Msida were chosen because of their diverse characteristics.

Siggiewi	**Msida**
Old Village Core	Mainly urban environment
Newly built areas around the car	Access to coastal facility
Rural areas with varied uses	Harbour area
Areas of ecological importance (e.g. Buskett)	

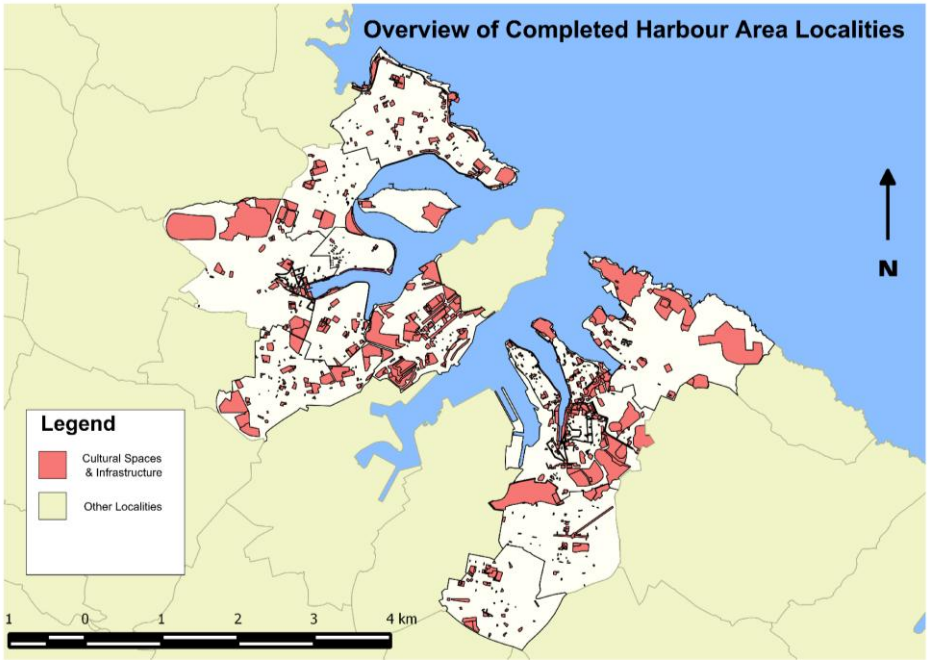
Progress meetings were held regularly to update the V18 team to discuss relevant issues and confirm or make changes to the methodology, which included:

- The selection of built-up areas within the locality.
- Creation of a map to be use for fieldwork, using open source and free web map services.
- Fieldwork, which consists of walking or cycling through built-up areas and collecting data on paper. Where feasible, a GPS unit is also used to facilitate digitisation. However, this is not always useful, since older villages with narrow streets lead to very inaccurate and imprecise readings which hinder, rather than assist, digitisation.
- Digitisation was carried out using open-source GIS software (Q-GIS).
- Desktop Research.
- Where deemed necessary, meetings with local council members were held.

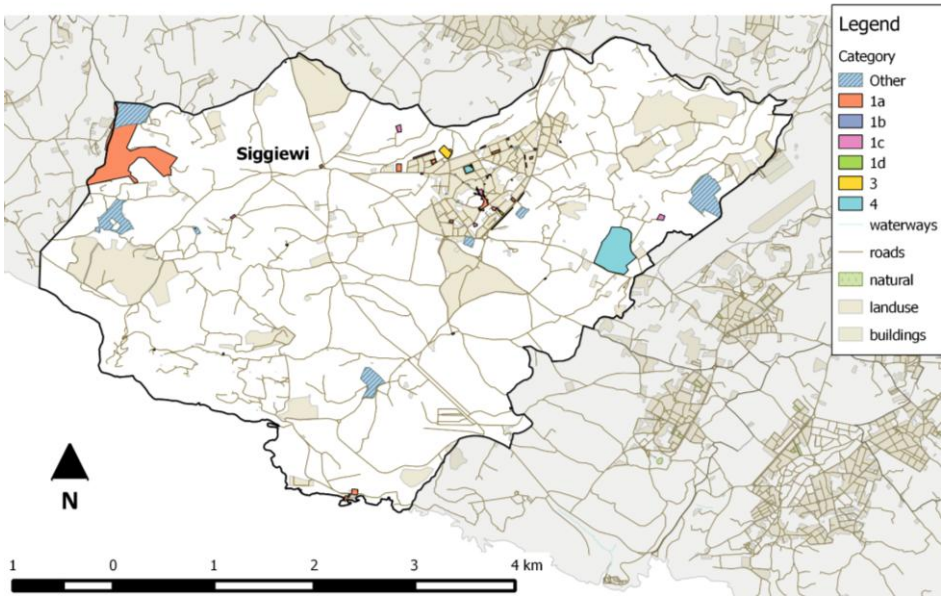
A series of consultation meetings were planned for the month of October 2014, in order to obtain general public and stakeholder feedback.

Current Results

As of August 2014, the Cultural Mapping effort has yielded several thousand cultural features. Around 80% of fieldwork has been completed, and 65% of all localities digitised. The Cultural Mapping exercise has also been mentioned in a short item on TVM News (http://www.tvm.com.mt/news/jaqdef-u-jnizzel-il-postijiet-kulturali-fil-gzejjer-malti)



Pilot Study - Siġġiewi



The European Commission Representation in Malta - A study on the impacts of congestion

Following the European Commission 2013 Country Specific Recommendations, Malta is required to tackle emissions from energy and transport. To this end the European Commission Representation in Malta approached Prof. Maria Attard in order to commission a study specific to the impact of congestion in Malta. The study is being coordinated by Prof. Attard, with Dr Philip Von Brockdorff and Dr Frank Bezzina from the Faculty of Economics. Ms Deborah Mifsud, Research Support Officer at the Institute is providing the necessary support.

Malta Resources Authority, Climate Change Group – Malta's National Communication to the United Nations Convention on Climate Change (UNFCC) and the National Green House Gas Inventory

The Climate Change Group at the Malta Resources Authority commissioned a number of contracts to support their efforts in drafting and submitting Malta's 6th National Communication to the United Nations Framework Convention on Climate Change (UNFCC). The Institute contracted Prof. Maria Attard, Prof. Simone Borg, Dr Noel Aquilina, Prof. Paul Pace to assist in the task.

Following on this the Institute was requested to assess the land use classification through the use of map layering techniques from the Corine Land Cover maps of 1996, 2000 and 2006. Prof. Maria Attard coordinated the project whilst Mr Carlos Canas Sanz was engaged to carry out the assessment. This work contributed to the review of the National Green House Gas Inventory which maintains the national inventory used to report Malta's progress to the UNFCC.

Travelling Smart – The Green Travel Plan Committee at the University of Malta

Following last year, Prof. Maria Attard continues to chair the Green Travel Plan (GTP) Committee which aims to implement the University Green Travel Plan approved in 2012. Mr Raphael Mizzi, the GTP Coordinator, is currently following an MSc by research (Sustainable Development) with the Institute for Climate Change and Sustainable Development. The focus of his research is in transport area. He still administrates the GTP work as well as act as secretary to the GTP Committee.

The GTP Committee for 2013-14 was made up of:
Prof. Maria Attard (Chair)
Ms Thérèse Bajada (Travel Plan Expert, ICCSD)
Mr Gayle Lynn Callus (President, KSU)
Mr Joseph Camilleri (Precincts Officer)
Ms Amanda Ciantar (Office of Human Resources)
Ms Nathalie Cauchi (UHM)
Mr Raphael Mizzi (Secretary)
Prof. Luciano Mulé Stagno (UMASA)
Perit Christopher Spiteri (Director Estate & Works)

During 2013/2014 a number of initiatives were undertaken by the GTP Committee and the GTP Coordinator in order to improve travel to the University.

Cycling

With respect to cycling, new bicycle racks were installed around UoM campus. Some of the old bicycle racks were relocated and new locations were identified to improve access for students and staff who make use of this transport mode. One of the new bicycle racks was installed in a sheltered area in the new ICT building underground parking. The other four new bicycle racks were installed in various locations around UoM campus.

Cycling promotional posters given by the Bicycle Advocacy Group (BAG) were frequently attached to noticeboards inside campus to increase safety awareness. Stickers, portraying safety messages were also attached to bicycles parked within campus.

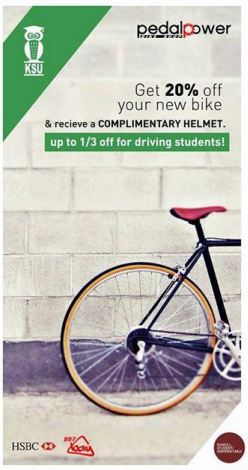


University of Malta Cycling Ambassadors

In October 2013, a call for Cycling Ambassadors was issued by the Green Travel Plan Coordinator within the Institute for Climate Change and Sustainable Development. Six students and staff of the University of Malta (UoM) applied and became officially recognized UoM Cycling Ambassadors.

Mr Mizzi, the GTP Coordinator at the UoM organised a meeting at the Institute for Climate Change and Sustainable Development. Present at the meeting were Jim Wightman (BAG PRO), Saviour Sam Agius (BAG President), together with the new UoM Cycling Ambassadors, Edward Mazzacano D'Amato, Holger Mitterer, James Mifsud, Mike Rosner, Martinique Vella Baldacchino and Michelle Vella Wood. BAG's vision is that the UoM will, over time, develop their individually tailored cycling policies with the collaboration of the UoM Cycling Ambassadors who will support the University's efforts to implement Green Travel and help reduce the number of cars driving to and from the University, with the ultimate aim of reducing the CO2 footprint of the University. Official BAG Cycling Ambassador T-shirts were handed to each ambassador to be worn while cycling to University.

KSU Bicycle Purchase Scheme



On 14 April 2014 KSU launched a bicycle purchasing scheme in collaboration with Pedal Power. Students were asked to fill out an online form in order to receive a 20% discount on the purchase of a new bicycle, including also a complimentary helmet. Driving students were eligible up to 1/3 off the original purchasing price.

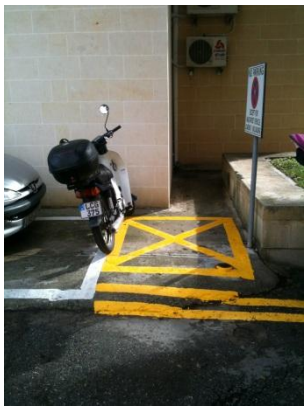
Purchase of an Adult Bicycle & Cycling Equipment from the WRF (Work Resources Fund)

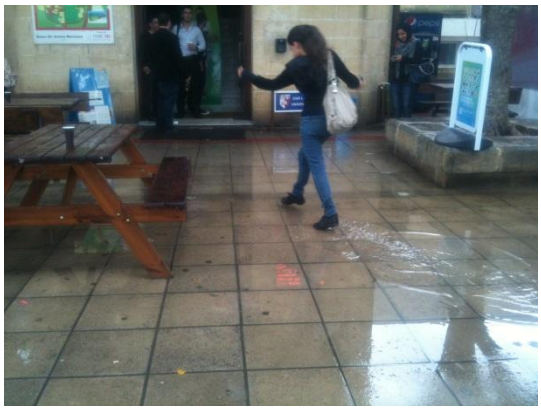
Following the bicycle purchasing scheme incentive for support staff at UoM, the GTP Committee asked the WRF (Work Resources Fund) Committee the number of applicants for the 'Purchase of an Adult Bicycle & Cycling Equipment'. In 2013 there were five approved applications for the purchase of an adult bicycle. In 2014, till August, the WRF Committee has received and approved eight applications for the purchase of a bicycle and three applications for the purchase of cycling equipment.

Pedestrian Safety

Pedestrian Obstruction

The GTP Coordinator together with Estate and Works Department ensure that pedestrian passageways within UoM are well maintained and cleared from any obstruction. Appropriate methods were applied in the designated areas.





Speed limit awareness

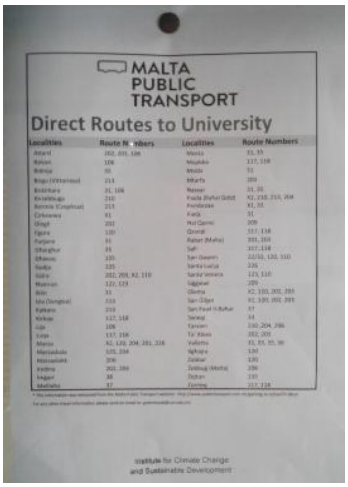
In order to increase awareness on speed limit within UoM on 29th July 2014 the following notice was sent to all UoM members through News on Campus from the Health and Safety Unit and the Precincts Office. Other pedestrian safety posters were attached to UoM notice boards throughout the year.

Public Transport

Promotion

A booklet with list of routes leading to/from UoM and a map indicating the location of bus stops in UoM boundaries was prepared by the GTP Coordinator with the support of Malta Public Transport.

In order to increase visibility of public transport information and delivering updated information, a number of promotional posters indicating the list of direct routes leading to/from UoM were distributed by the GTP coordinator to all institutes, centres, faculties and departments within campus to be attached to noticeboards.

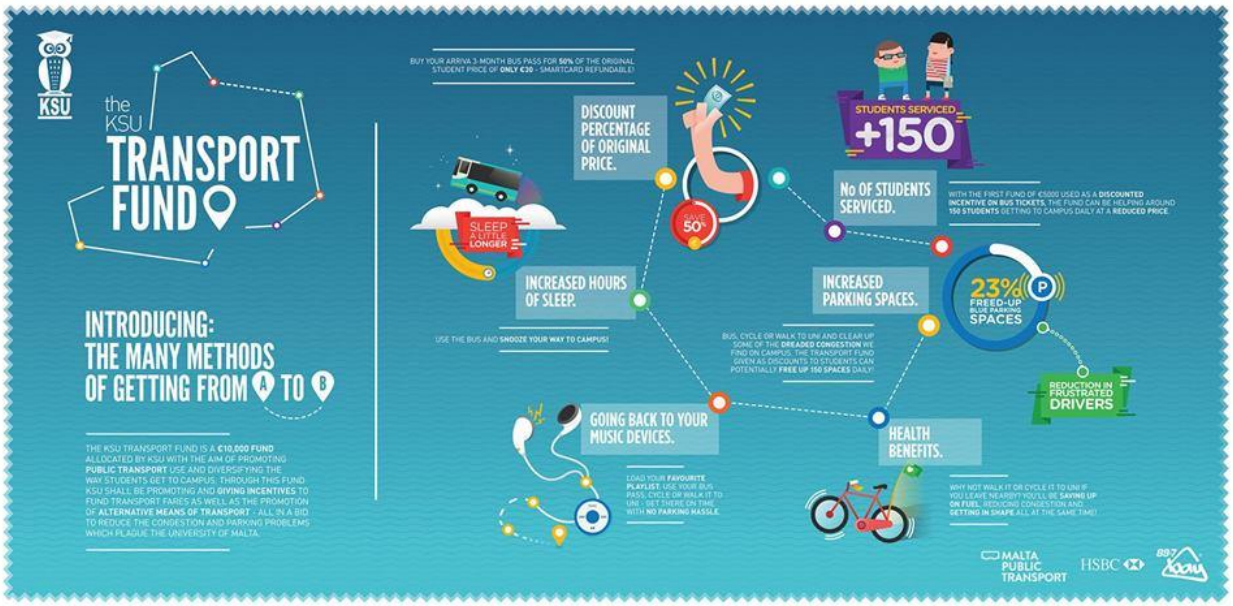


Bus Terminus Upgrade

The bus terminus situated at the west gate of the University Campus was upgraded by Transport Malta earlier this year. This upgrade is considered a major milestone in reaching the UoM GTP goals. A majority of the 2010 GTP questionnaire respondents had requested an upgrade of the bus shelters and seating at the University/Mater Dei interchange. This upgrade has improved significantly the outdoor facilities for those suing public transport. The GTP Coordinator is constantly monitoring the quality of such infrastructures around the University and requesting maintenance from the authorities if and when this is needed.

KSU-Malta Public Transport - Transport Fund 2014

On 20 March 2014, KSU invited all student drivers who usually commute to University by vehicle to apply for the KSU-Malta Public Transport Fund. €5,000 were dedicated to this fund with the aim of encouraging the use of alternative methods of transport to and from campus.



One of the initiatives launched as part of the fund will give students who have a parking permit the possibility to benefit from a 50 per cent discount on the 90-day student bus ticket. The aim is to encourage the use of public transport as a greener mode of transport to university. This means that the students would effectively be travelling for a whole semester at the price of one month.

Public Transport Assignment from James Madison University (US).

A small group of students together with their Professor Elise M. Barrella, Ph.D. from James Madison University (US) visited our University on May 2014. The visit saw the students engage in fieldwork on public transport at the UoM, and looking at the challenges of green travel. The fieldwork entailed direct observation on the bus system, collection of data and surveys of bus users. Prof. Maria Attard assisted the students by delivering a presentation about the public transport system in Malta followed by a tour around UoM campus by the GTP Coordinator, indicating the location of bus stages, terminus, and related efforts carried out by the GTP since its inception. More information on public transport in Malta and the GTP was delivered weekly during the months of May and June.

The students presented their results on the 13th June 2014 during a series of Transport and Energy sessions at the Sundown Court Hotel. The GTP Coordinator was present for the session and discussed outcomes of the results with the students.

Other GTP initiatives

GTP Survey and Questionnaire 2014

In order to monitor the traffic and pedestrian flows in and out of the Msida campus, surveys were carried out by the GTP Coordinator and other members of staff within ICCSD on December 2013. With the help of IT Services an online questionnaire was developed and was sent to all staff and students working and attending courses at the University. The questionnaire data was analysed using IBM SPSS Statistics. An email notification was sent on the 8 April 2014 inviting participants to follow the link to the questionnaire.

On the 28 February 2014 Transport Malta requested the GTP to carry out in-depth analysis of the surveys and questionnaires, and to compare the current situation with that of 2010. It is evident from the modal split comparison between 2010-2014 that whilst students have improved on the use of greener modes, staff have increased their use of the car as principal mode of transport. Further efforts are therefore required to engage staff and promote modal shift.

Figure 1: Student Transport Mode % Change 2010 - 2014

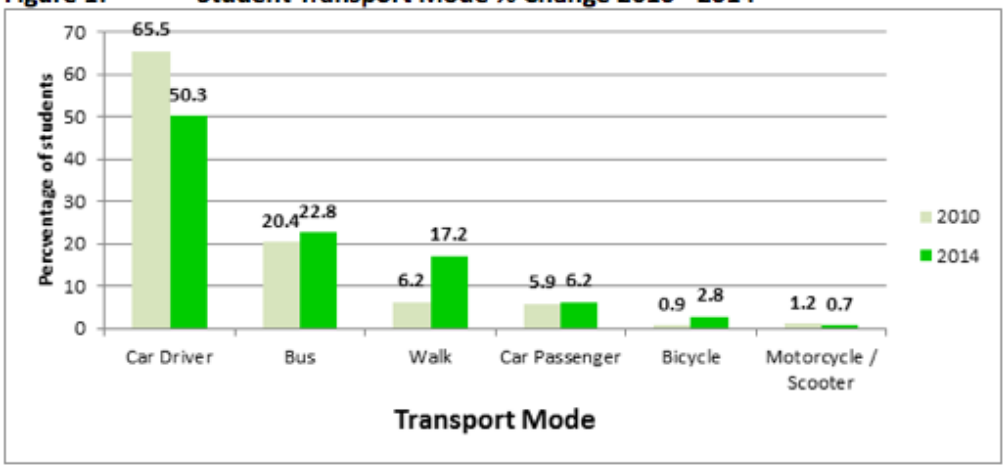


Figure 2: Academic Transport Mode % Change 2010 – 2014

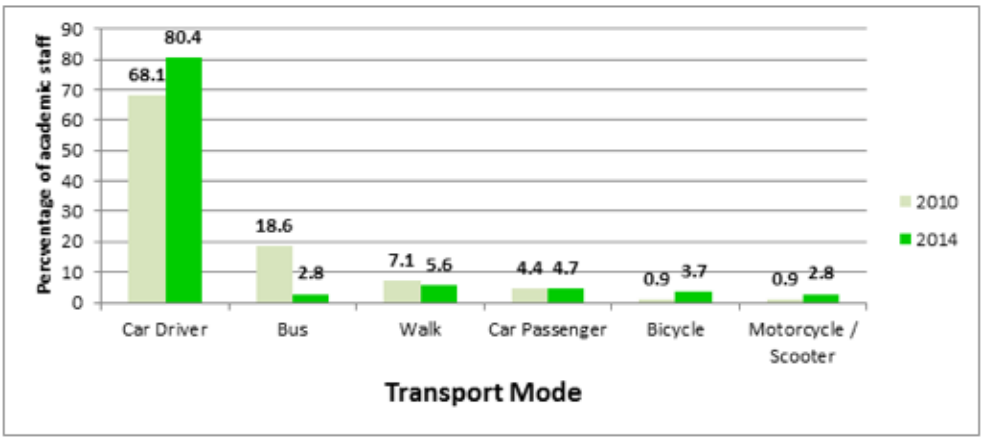
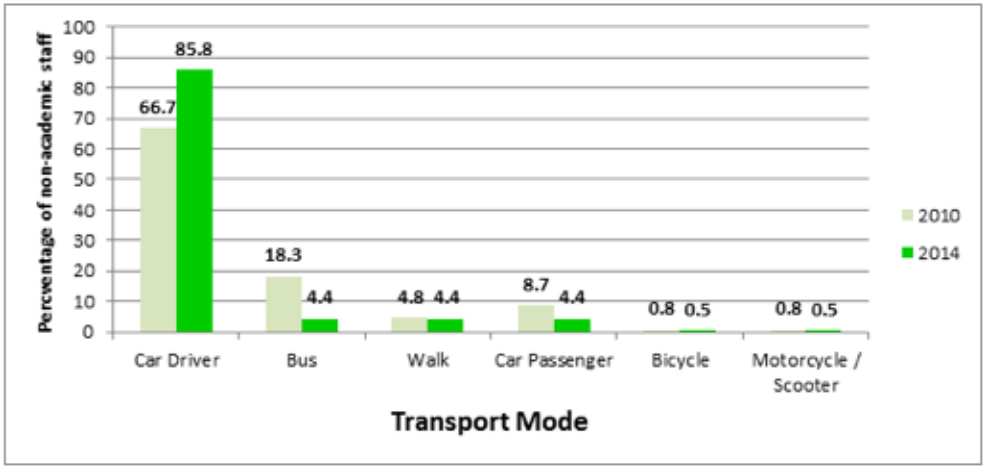


Figure 3: Non-academic Transport Mode % Change 2010 – 2014



GTP contribution to the D-Air Project

The ICCSD has been identified as a stakeholder in terms of the goals of the D-Air project and Mr Mizzi was invited to the second stakeholders' forum meeting on 14 May 2013.

On 16 July 2014, Mr Mizzi from the ICCSD was invited by Transport Malta to give a presentation entitled "Developing Green Travel Plans – The Case of UoM" at D-Air 3rd stakeholders' forum. This EU project aims at lowering the carbon emissions at airports. This year's presentation in Malta indicated how carpooling, the use of bus transport and cycling have been encouraged within the university campus and how these measures can be taken up by other local companies. Presentation was followed by a round table discussion where Mr Mizzi contributed by sharing his knowledge and experience.

Other conferences attended by the GTP Coordinator

- GIS User Conference – 4 September 2013
- Malta Resources Authority - Information session on Energy Efficiency in the Transport Sector – 13 September 2013
- MTI TM PORT-PVEV mid-term event - Electro mobility Islands – 29 November 2013
- The Institute for Sustainable Energy Annual Conference - 20 March 2014
- STREETS Thematic workshop on Maritime and Integrated Transport – 23 May 2014

GTP during Freshers' Week 2013

The GTP Coordinator collaborated with various entities involved in the organization of Freshers' week to ensure suitable and clear information is available to all the students and staff at the beginning of the academic year. ARRIVA were present on Campus disseminating bus route information and promoting and providing SaverCards to students using their SmartCard. Pedal Power was also present on Freshers' week with a variety of bicycles and e-bikes.

Outreach

In order to maintain communication lines open with the University community the Green Travel website is updated on a regular basis with useful information and links about green travel to and

from University. During Freshers' Week 2013, the GTP Coordinator launched the "Custom Travel Information" web page which provides various transport options to both students and staff on how to reach the University. Further useful links and information will be made available through this website and publicized from time to time internally within the University community.

The GTP website is found at http://www.um.edu.mt/iccsd/greentravel

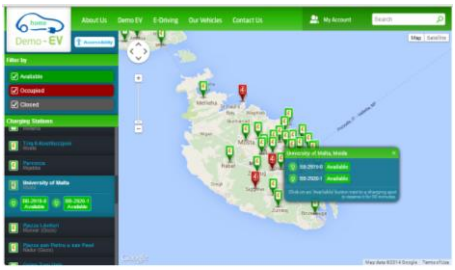
Custom Travel Information

Custom Travel Information is a new website which brings together, for the first time, information about the different means of transport to and from the University. This is the first ever such initiative that provides users with customized information on how to access the Msida Campus, based on the origin of their journey through http://www.um.edu.mt/iccsd/greentravel/cti

Bookmarks were distributed amongst staff and students to promote the launch of the new website.

Installation of Electric Vehicle charging point at the University of Malta

The GTP committee liaised with the Ministry for Resources and Rural Affairs to find a suitable location within UoM campus to install one of the 100 electric vehicle charging points situated around the Maltese Islands. The preferred location was Car Park 2 and two reserved parking spaces were allocated. On 6 May 2014, an electric vehicle was displayed on campus with officials from the ministry delivering information about e-mobility and the use of the charging points.



Support for UoM Students

In April 2013 a Postgraduate student from the Department of Spatial Planning and Infrastructure of the Faculty of the Built Environment requested GTP data for his study entitled 'Social Impact Assessment of the Public Transport Reform'.

In November 2013 a group of UoM students from the Institute of Earth Systems who were following a study unit on Sustainability (EMP2004) met up with the GTP Coordinator to seek information for their group assignment related to the University Green Travel Plan.

Participation in International Scientific Committees

Academic members of staff of the Institute have participated and contributed to a number of scientific committees and conferences during the period under review. Below is a list of contributions.

- Prof. Maria Attard continues to co-lead the NECTAR Research Cluster 2 on Policy and Environment. NECTAR is the European Transport Research Association

- Prof. Maria Attard continues to co-lead the Special Interest Group G3 on Urban Transport Planning and Policy in World Conference on Transport Research (WCTR). This year she launched the Call for Papers for the Malta Conference, planned for 2015.

- Prof. Maria Attard was invited to co-chair the Climate Change Committee of the Association for European Transport (AET). She will be automatically designated as part of the annual conference scientific committee.

- Prof. Maria Attard was invited to become a member of the Emerald Advisory Board of the Transport Sustainability Book Series, published by Emerald. Prof. Attard is currently co-editing a volume on Sustainable Urban Transport, with Prof. Yoram Shiftan (Technion).

- Prof. Maria Attard was the host (Local Organiser) and member of the Scientific Committee for the EUROGEO 2014 Annual Conference "The Power of Geography" organised by the European Association of Geographers (EUROGEO), Valletta (Malta), 15th – 16th May 2014.

- Prof. Maria Attard was member of the Scientific Committee for the NECTAR 2014 Joint Cluster Meeting "Evolving Perspectives on Sustainability and Security In Transport" organised by the Association of European Communications and Transport Activities Research (NECTAR), Shamoon College of Engineering, Beer Sheva (Israel), 30th April – 1st May 2014.

- Prof. Maria Attard chaired the Seminar on Renewable Energy organised by MEUSAC, Gzira, Malta - 24th January 2014.

During the period under review **Prof. Maria Attard** acted as paper reviewer to a number of academic journals including the Journal of Transport Geography (Elsevier), ICE (Institute of Civil Engineers) – Transport (ICE) and Transportation and Research Part A: Policy and Practice (Elsevier).

Other staff news

Ms Deborah Mifsud, Research Support Officer at the Institute was accepted as PhD candidate within the Department of Geography at the University of Malta. The dissertation is entitled *A Framework for Modelling Spatial Transport Vulnerabilities for the Elderly Population in Malta*.

Ms Luana Checuti Zammit placed second in the Present Around the World Competition (PATW 2014) Malta organised by the Malta Group of Professional Engineering Institutions (MGPEI). A 10 minute presentation entitled *Autonomicity…. is it the way forward?* was given at the Radisson Hotel on 20th February, 2014, presenting autonomicity concepts in road networks.

Ms Luana Checuti Zammit attended a two-day workshop entitled *Successful Proposal Writing for Horizon 2020* in September 2014. Lectures were presented by Dr Klotzbucher, physicist and chemist, with over 20 years experience in research funding projects and Mr Peter Wolfmeyer, consultant for EU Funding. The aim of this workshop is to familiarize staff and researchers with the pivotal points to consider when writing competitive proposals for Horizon 2020. Hands-on information will be covered.

Ms Thérèse Bajada also participated in the following events related to her Continued Professional Development

- 11th March 2014 Seminar organised by Emerald Publishing at University of Malta entitled *A guide to getting published*

- 18th June 2014 Workshop organised by the Research Communication Workshop at UCL entitled *Writing the News*

Other Initiatives

Participation in COST

In the period under review, **Prof. Maria Attard** continued to serve as member of the Transport and Urban Development Domain Committee within COST. Other members of the Institute or affiliated academics have participated in COST Actions and events.

Prof. Maria Attard continued to act as DC Rapporteur on the COST Action TU1102 Towards Autonomic Road Transport Support Systems (ARTS) (2011-15). **Dr Kenneth Scerri** and **Ing. Luana Chetcuti Zammit** (Faculty of Engineering) are the MC members on this Action. Both are represented in the TISTA research group at the University.

Prof. Maria Attard was assigned as DC Rapporteur on the COST Action TU1209 Transport Equity Analysis: assessment and integration of equity criteria in transportation planning (TEA). **Ms Thérèse Bajada** and **Ms Deborah Mifsud** (Institute for Climate Change and Sustainable Development) are the MC members of this Action.

Prof. Maria Attard and **Prof. Matthew Montebello** (Faculty of ICT) continued to participate in COST Action IC1203 ENERGIC (European Network Exploring Research into Geospatial Information Crowdsourcing): software and methodologies for harnessing geographic information from the crowd (2012-17).

Ms Thérèse Bajada and **Ms Deborah Mifsud**, both from the Institute for Climate Change and Sustainable Development, joined COST Action TU1209 Transport Equity Analysis (TEA) as MC members.

Bottom centre: Deborah Mifsud and Therese Bajada attending the TEA Action Meeting

Ms Luana Checuti Zammit attended a COST TU1004 Training School organized by TransITS and the University of Thessaly in Volos, Greece between the 5th-7th May. It was entitled *Modelling Public Transport Passenger Flows in the Era of Intelligent Transport Systems*. The training school presented theoretical and practical problems connected with public transport modelling, with lectures covering ITS technologies for public transport; discrete choice models, mode and route choice models; Input data strategies and information; schedule-based assignment; frequency-based and mixed case assignment.

Ms Thérèse Bajada and **Ms Deborah Mifsud** attend the COST TU1209 Transport Equity Analysis: Assessment and integration of equity criteria in transportation planning (TEA) Second TEA Management Committee Meeting and first Working Group Meetings in Madrid, Spain organised on the 16th-17th September 2013. Deborah Mifsud is a member of Working Group 2, which deals with Methods of integrating Equity Criteria in Assessment Practices. This combines knowledge of social justice, activity-based modelling with GIS mapping tools and social welfare to analyse equity implications of transport policies and investments. During the first working group in Spain, Ms Mifsud was the Rapporteur for Panel Group 3 which discussed different definitions of the term "equity in transport". Ms Thérèse Bajada also attended the meeting contributing primarily to Working Group 1.

During academic year 2013-2014 Prof. Attard attended several COST events including:

- COST Action TU1102 Autonomic Road Transportation Systems Prague MC Meeting 27-28 February 2014 (Rapporteur), Lisbon Portugal

- TUD Domain Committee Meeting and Annual Progress Conference, 9-12 April 2014 Paris, France

- COST Action TU1209 Transport Equity Analysis MC Meeting 14-15 April 2014 (Rapporteur), Paris, France

The Institute Visiting Lecturer

This year the Institute hosted Dr Marcus Enoch from the University of Loughborough in December 2013. Dr Enoch delivered a series of presentations and a public seminar.

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Dr Marcus Enoch, Loughborough University, UK
http://www.lboro.ac.uk/departments/cv/staff/profile/135.html

His background:
- BEng (Hons) in Civil Engineering, University of Nottingham, 1990-1993.
- MSc (Eng) in Transport Planning and Engineering, University of Leeds, 1993-1994.
- Ph.D, Bus-based best-practice and urban transport emissions, The Open University, 1994-1998.

Currently he is employed as a Senior Lecturer in Transport Studies, School of Civil and Building Engineering, Loughborough University. His research interests include: the design, financing, implementation, operation and monitoring of Sustainable Transport Systems. Transportation Demand Management and Mobility Management measures - e.g. travel plans, parking policies, road pricing, car free development, tax and transport, use of the land use planning system. Road based public transport systems - e.g. Buses, Demand Responsive Transport systems, car sharing, car clubs, vanpooling etc. Transport policy in small island developing states.

He will be delivering the following lectures:

Wednesday 18th December	10.00-12.00	***Mobility Management and Travel Plans***	LC120
Thursday 19th December	10.00-12.00	***Island Transport Systems***	OH113
Friday 20th December	14.00-15.00	***Transport Integration and the Future of Interchange***	LC120

PUBLIC SEMINAR

The Future of Local Passenger Transport
Friday 20th December 2013 1800hrs
Gateway Building Hall C

Attendance is free. Registration is necessary and can be done by sending an email with name, organisation and contact details to iccsd@um.edu.mt

Discussions with Dr Enoch were held on the possible research collaboration on Transport Demand Management projects, including a Horizon2020 proposal and Green Travel Planning.

Staff Publications for 2013-14

1. **Schembri, J.A., Attard, M.** (2014) The Foreigner Counts: a spatio-temporal analysis of occupiers, immigrants and expatriates in Malta. Arts & Humanitas: Journal of Arts and Humanities.

2. Von Brockdorff, P., **Mifsud D.,** (2014) *In press* Transport by the elderly: comparing use of private and public transport to access out-patient services at Mater Dei Hospital (Malta). Bank of Valletta Review, 49.

3. **Attard, M.** (2014) Book Review. Transition Towards Sustainable Mobility. The Role of Instruments, Individuals and Institutions, edited by Harry Geerlings, Yoram Shiftan, Dominic Stead. Surrey, UK, Ashgate, 2012. In Transport Reviews Vol. 34(2) pp 269-270.

4. **Mifsud, D., Attard, M.** (2013) The role of public transport in addressing sustainable mobility for the elderly population in Malta. Xjenza. Vol. 1(2) pp 47-54.

5. Ison, S.G., **Attard, M**. (2013) The Smeed Report and Road Pricing: the case of Valletta, Malta. Bank of Valletta Reviews. Vol. 47(Spring) pp 1-23.

Participation in Local and Community Events

22nd September 2013 Car Free Day, Mellieħa Local Council
Ms Margaret Camilleri Fenech attended a discussion on transport and its impact on the environment during Car Free Day organised by Mellieħa Local Council in the main square of the village.

15th October 2013 Environment Awards, organized by the Cleaner Technology Centre
Ms Margaret Camilleri Fenech acted as secretary to the Adjudication Committee attending meetings and site visits. Prof. Maria Attard was a member of the Adjudication Committee. Prof. Simone Borg chaired the Committee with Mr Anton Pizzuto coordinating the awards and logistics.

Annex 1

Assessing Participatory Geographic Information Systems for the eGozo Initiative
by Johann Attard B.A. Hons (Melit.)

The emergence of web mapping services like Google Earth and Yahoo Maps has driven public interest in geospatial technologies. These services present simple and interactive applications which facilitate the uploading of maps utilising free available application programming interfaces and data interoperability that ultimately enable the visualisation of citizen-generated geographic information.

Whereas in the past, only mapping agencies were responsible to create geographic information, nowadays anyone with a bit of knowledge can easily make a map and publish it online.

The free availability of geoweb editing tools has narrowed the gap between data providers and data consumers. Moreover, the rapid development of social networking is a clear example of how people are making use of the web. Taking full advantage of the progress in technology for the interests of the public is crucial especially when dealing with local planning issues which ultimately affect peoples' lives. Moreover, public participation supports decision-making processes as it improves the effectiveness of planning.

The eco-Gozo initiative provides a unique opportunity to pursue the long-term path to sustainable development in Gozo. Such a holistic project depends on citizen participation. Geographic information technology, for instance, is one tool that could contribute directly to the vision's objective by encouraging local participation and interest.

For such a collaboration to be effective, the appropriate frequency between decision makers and civil society has to be set. Engaging in a participatory process would first include methods to create local knowledge and educate the general public to make their voice heard. Thus, utilising public participation GIS in a local context through the eco-Gozo initiative represents a vital change from current top-down methods used by governmental institutions to bottom up approaches. However, to be effective, existing top hierarchies need to accept that the general users have valuable knowledge and experiences that aid to take sound decisions.

For the purpose of my research, specific geographic issues highlighted in the eco-Gozo action plan were chosen to be mapped by local people. The online participatory process was intended to yield

tangible results in the form of a public participation GIS where participants mapped a variety of land use concerns in Gozo. These concerns included the condition of major streets and secondary roads in Gozo, noise pollution, flooding hotspots, traffic, air quality and community perceptions about their localities.

This data together with multimedia of specific concerns were included in the designed GozoMap application to help visualise the severity of the perceived problems that will ultimately help to plan for the future. A number of map-based questions related to each topic were prepared, asking respondents to locate any potential local issues on the map. This was done in order to understand and visualise how participants spatially locate the well- known concerns, and to identify common themes that are essential in planning a sustainable vision for the island that depends on the locals' needs.

Results have clearly shown that public involvement through the use of a visual tool is effective as it can envisage a desired future environment. However, data must be presented in a way that all users can understand it. Moreover, there must be a mechanism to protect the voice of the minority in decision-making.

The GozoMap application was considered efficient and easy-to-use as it offered an opportunity to analyse the processes built in the system, focusing on the ability to democratise communities' decision-making. The contributions made during the participatory exercise also revealed that participants had a general grasp of the tool and were willing to explore the application. In addition, the fact that many users familiarised themselves with the tool by posting comments after locating a point and entering a rating corresponding to a particular theme shows the simplicity of the tool enables users to learn quickly and appreciate the concept of participatory mapping.

Overall, the concept of the tool was appreciated as the main themes discussed during the case study revealed a range of potential uses of the developed application, especially within the context of public consultations.

Information is priceless and invaluable and its value is characterised by timeliness, ease of access, and the ability of people to comprehend and use it. Nowadays, the internet is an exceptional platform for the dissemination of information. Indeed, it is also affecting ways of how human activities – including public participation GIS – are performed. Just as strategies and policies are continuously changing as a result of the advances of modern technology, geoweb applications will keep evolving according to public aspirations and societal demands.

Ultimately, the future of neogeography tools in decision-making processes and collaborative projects would depend on the choices people make regarding the use of the internet to create spatial information, the design used to develop these spatial technologies and the institutional arrangements to embed these tools in the future.

For more information visit www.gozomaptool.com.

Johan Attard completed his MSc research in 2014 under the supervision of Prof. Maria Attard

The research project was funded by the Strategic Educational Pathways Scholarship (STEPS) programme, which is part financed by the European Union – European Social Fund (ESF).

Research Article: Household Water Consumption in the Maltese Islands: An Analytical Study
by Annalise Grech B.A. Hons (Melit.)

Sustainable development, defined by the United Nations (UN) (1987) in the Brundtland Report as development which 'meets the needs of the present without compromising the ability of future generations to meet their own needs', is a fundamental objective of the European Union (EU) (p.37). Every country should therefore ensure that each decision taken regarding social, economic and environmental issues is made in such a way as to improve the quality of life of the present and future generations. With regard to the water agenda, this means that the extraction of fresh water from an ecosystem should not exceed its natural replacement rate. Since Malta is densely populated but has few freshwater resources and low annual rainfall, the country is faced with a major challenge in order to meet the high water demand while also protecting and conserving its resource base and environment (Food and Agricultural Organization (FAO) 2006).

Malta is committed to ensure sustainability regarding the scarce water resources in a holistic manner. This is attained through the Water Policy for the Maltese Islands in line with the EU Water Framework Directive (2000/60/EC). Malta's Water Policy aimed to address the sustainable management of water resources in the Maltese Islands by using these resources

> *in a manner that is environmentally and economically sustainable, providing the right amount of water for people, agriculture, commerce and industry, and an improved water-related environment whilst recognizing the effects of climate change* (Ministry for Resources and Rural Affairs (MRRA) 2012, p.1).

The Water Policy for the Maltese Islands proposed various measures to be taken by Government and the respective entities in order to encourage recycling and re-use of domestic water resources and to raise awareness on the consequences of water wastage. These included the increase in efficiency of domestic water use through improved water-saving technologies, management practices, public awareness campaigns and incentives for water-saving. Furthermore, the installation of smart water meters was an integral part of this policy. This included radio frequency apparatus on all household water meters, as well as monitoring, recording and collecting periodic water meter readings. Rainwater harvesting was another cause for concern since this practice has decreased in importance. As a result, Government committed itself to intensify efforts towards the practice of rainwater harvesting while increasing the available storage capacity (MRRA 2012).

The recent revision of potable water tariffs lead to more efficient water use since the domestic, industrial and agricultural sectors were found to alter their water consumption patterns in relation to price level adjustments. In this regard, Government aimed to introduce various measures, including rising block tariffs and eco-reductions, to encourage users to use water more efficiently (MRRA 2012). Such long term objectives aimed to eliminate water wastage and introduce the efficient use of this commodity, while emphasising water-saving practices. Eventually, such policies were aimed to lead towards achieving a reduction in household water consumption, while acknowledging the impact that such a reduction might have on future generations.

The major environmental issues of the Maltese Islands, namely those related to energy and transport, freshwater, marine and coastal environment, solid and liquid waste, biological diversity and land use, were analysed in a report submitted by the Government of Malta to the World Summit on Sustainable Development in 2002. The main objectives set by Government in this report pertaining to sustainable development in the water sector were:

- the attainment of internationally acceptable standards in drinking-water quality through the undertaking of the necessary improvements in the water production and distribution infrastructure;
- the need to identify, monitor and protect high-status sites and to introduce catchment management in line with the EU Water Framework Directive;
- the designation of the entire Maltese Islands as a nitrate-vulnerable zone in order to protect the quality of groundwater;
- the need to encourage further water conservation measures (including the use of cisterns);

- integrated water resources management coupled with further enforcement of regulatory measures (in particular with regard to illegal abstraction);
- the need to optimize the use of second-class water (Government of Malta 2002).

In 2006, the then National Commission for Sustainable Development (NCSD) had also proposed a Sustainable Development Strategy for the Maltese Islands in terms of Article 8 (7f) of the Environment Protection Act (Chapter 435 of the Laws of Malta). Covering the period 2007 – 2016, the main objectives of this strategy, with regard to the freshwater priority area, were the adoption of policy which aimed at

> *ensuring the utilisation of water resources in a manner that is environmentally and economically sustainable, while safeguarding the water needs of the population, and of the agricultural, commercial and industrial sectors, and achieve good quantitative status by 2015* (NCSD 2006, p.71).

These objectives were set since Malta's natural water resources are very scarce, mainly due to the limited amount and seasonality of rainfall.

Water consumption varies greatly from one region to the other. This is mainly due to the climatic, socio-economic and demographic characteristics of each country. Figure 1 indicates that in all regions except in Europe, the agricultural sector accounts for the majority of water consumption, followed by the domestic and industrial sectors, respectively. Since rainfall is very limited in most African countries, a high percentage of water has to be diverted to agricultural use in order to save the crops. Furthermore, Africa and South America depend mostly on agriculture since their industries are also based around agriculture. With regard to North and Central America, industrialisation plays a vital role. However, these countries still have large expanses of agricultural land. Asia, on the other hand, is comprised of highly industrialised countries like China and Japan, and other countries like India which are not industrialised. However, most of these countries are major producers of agricultural products. On the contrary, in Europe, the highest amount of water is consumed by the industrial sector since most of Europe is highly industrialised and does not depend much on agriculture. The domestic and agricultural sectors follow. Since rainfall is dominant in most of Europe, especially in the Northern countries, only a small percentage of water is used for agricultural purposes. This is due to the fact that fields in these countries are irrigated by rainfall. In Malta, water is also consumed by various sectors, namely agriculture, forestry and fishing, industry, and households. However, over the years, households always consumed the highest amounts of water in Malta (National Statistics Office (NSO) 2014, pers. Comm, 20 January). This was mainly caused by higher living standards (FAO 2006).

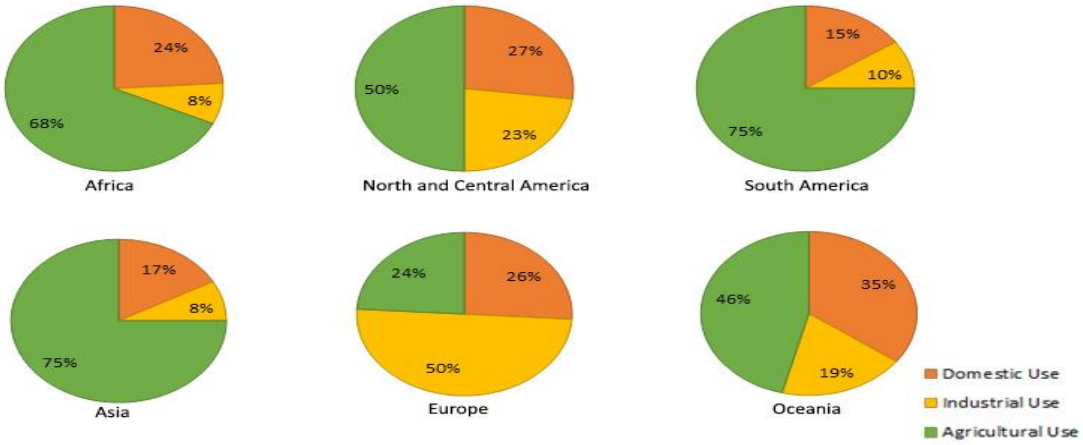

Fig. 1: Water Consumption Sectors around the World (adapted by author from Gleick et al. 2011)

This research therefore aimed to identify the amounts and main uses of water in Maltese households and the patterns of these uses. This study also recognised the difference between the perceived and actual amounts of household water consumption. Relationships between water consumption patterns and socio-economic and demographic characteristics of households were also analysed. Due to the limited time and resources, this study will serve as a test case to provide a framework from which a methodology on the calculation of household water consumption at a national scale can be developed. Consequently, it was essential to analyse whether the quantitative research methods used delivered reliable findings for household water consumption.

Data on household water consumption in the Maltese Islands is available, however, NSO data, published in the Environment Statistics (2006), and WSC figures only provide the total domestic water consumption of all households in the Maltese Islands. This research will therefore add value on existing NSO and WSC findings and reports, by categorizing consumption according to end-use and estimate average water consumption of each household. Being aware of such amounts, especially at end-use level, helps the country to manage and plan wisely domestic water policies in order to minimize the waste of water, promote the efficient use of water and introduce water-saving measures targeted at specific domestic water end-uses. This research will therefore provide the necessary background information for policy makers to direct measures, where necessary, and to start raising awareness and controlling the use of water in households.

For the purpose of this study, data was collected through the use of 432 self-completion questionnaire surveys and 30 time-use water diaries. These methods were chosen since Hall et al. (1988) stated that the amounts and patterns of household water consumption are 'best obtained by the metering of individual households, supplemented by questionnaire surveys and the completion of diaries for each major element of water use' (p.626). Since data loggers attached to each water end-use within every household were required, the metering of individual households was eliminated due to the high expense to supply all these meters to a representative sample of the population.

The questionnaires were set-up on Google Docs and targeted residents in Malta aged over 18 years, however, the use of household water by younger members of the family was also recorded by the individual filling in the questionnaire, who supplied information on behalf of all the family. The questionnaires aimed to establish socio-economic and demographic data and also obtain background information regarding household characteristics and water-using appliance ownership and use among a sample of Maltese households. Data regarding the perceived water-use habits of household water consumption in the Maltese Islands during the summer months, and respondents' water saving measures was also collected. Prospective respondents were emailed to request their participation in the online questionnaire, thus, a communication research method formed the basis of the questionnaire (Bryman 2012). These respondents also served as gatekeepers as they in turn invited and encouraged other respondents to participate, which consequently encouraged a snowball effect. A number of questionnaires were also distributed by hand amongst a number of people in order to balance the sampling bias produced by online populations. Moreover, the University of Malta sent the questionnaire to all University students attending at the time of the study, to minimize the non-random sampling error.

Actual household water consumption was collected through the use of time-use water diaries. According to Harriden (2013), diaries provide 'a simple, low-tech method to collect a rich body of data' that does not depend on the use of water meters or other technological devices (p.70). Time-use diaries are used when the researcher is 'interested in precise estimates of different kinds of behaviour' (Bryman 2012, p.239), in this case, the actual amounts and patterns of water consumption among the sampled Maltese households during summer. The participants were chosen on the basis that they needed to be committed and reliable to produce, as much as possible, precise estimates. Therefore, a purposive sampling strategy was used to select the participants. In order to improve accuracy of data collection, the diary was structured in a user-friendly tick-sheet together with slots for participants to fill in the day of the week and the time each water-use activity took place. The chosen participants were required to record the amount of time each family member engaged in water use activities throughout the day by ticking and noting every member's behaviour once it occurred for a one-week period. The time-use water diary followed a similar format to the questionnaire in order to ensure uniformity in the collection and analysis of data and also to facilitate the comparability of results. It was divided into nine sections which covered socio-economic and

demographic data of each household, and also the seven major water-using activities in households, namely toilet use, garden watering, shower and bath use, tap use, laundry, car washing, and dish washing. The last section of the diary consisted of questions exploring respondents' attitudes towards water saving measures.

IBM SPSS Statistics 20 was then used to analyse the data collected by the questionnaires and time-use water diaries. Questionnaire and diary data was analysed using frequency distribution tables showing the frequency and the percentage of cases corresponding to each variable. The Pearson Chi-Square test was then used to analyse, using crosstabs, whether there existed a significant association between variables.

The time-use water diaries showed that the average consumption for the sampled Maltese households in summer is around 239.7 litres per capita per day. When comparing this result to household water consumption amounts of other European countries, Malta's total consumption is high, and compares to the household water consumption in Slovenia, which was 242 litres per capita per day in 2004 (Genty et al. 2010). The only European countries with higher water consumption amounts than Malta are Cyprus (269 litres per capita per day), and Hungary (321 litres per capita per day) (Genty et al. 2010). On the other hand, if Malta's household water consumption is compared to countries like Canada and the United States, whose water consumption was 329 litres per capita per day and 380 litres per capita per day respectively in 2004 (Environment Canada (EC) 2013), it is marginally lower. The highest end use in Malta was found to be showering, with every person consuming 80.4 litres of water each day. This equates to 34 percent of the total usage. Dish washing follows, equating to 20 percent of total consumption, or 48.0 litres per capita per day. Laundry, tap use, and toilet flushing account for end use percentages of 18 percent (43.9 litres per capita per day), 15 percent (36.2 litres per capita per day) and 9 percent (21.0 litres per capita day), respectively. Garden watering and car washing make up a small component of water consumption, both making use of 5.1 litres of water per capita per day.

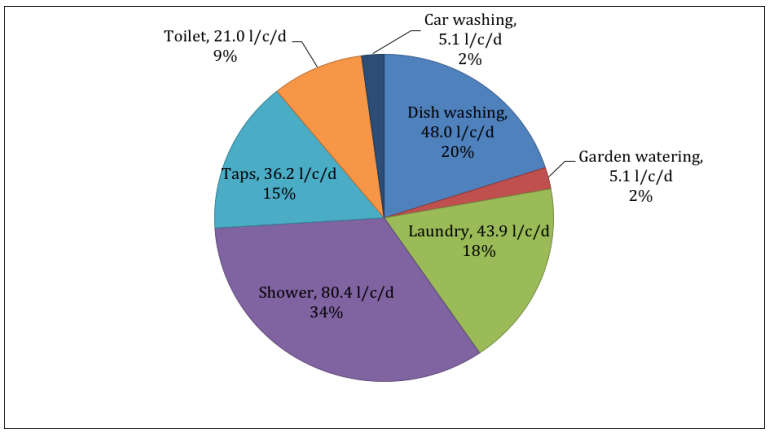

Fig. 2: Average Daily Per Capita Consumption in Maltese households (l/c/d): water diaries sample (n=30)

Water consumption varies from one household to the other due to a number of factors. Results of this study indicate that in Malta, the amounts of water consumed in households are influenced by the household's income, family size, level of education, type of house respondents live in, rainwater tank ownership and the district respondents live in. In analysing the impact of respondents' socio-economic and demographic characteristics on their household water consumption amounts, this study established that the greater the number of people living permanently in a household, the greater the number of toilet flushes and the more showers taken by the family in a week. Studies conducted by several researchers (Renwick and Archibald 1998; Mayer et al. 1999; Cavanagh et al. 2002; Jacobs and Haarhoff 2004; Cardona 2006; Perth's Water Corporation 2010; Barata et al. 2012) also found that household size has a positive effect on water consumption. In addition, in this study, no relationship was identified between the level of education of respondents and lower household water consumption levels. Instead, higher water conservation behaviours by the use of water saving measures were recognised in those households whose members had a higher level of education. This was also established by Flack and Greenberg (1987), Gilg and Barr (2006), Lam (2006), Barrett and

Wallace (2009), and Millock and Nauges (2010). This study also showed that higher income families consumed more water in terms of shower and bath use. Higher income families were also found to own more dishwashers and take on more water saving measures.

Household water consumption varies according to the time of day and the day of the week, especially when weekdays and weekends are compared. Water usage generally peaks in the morning when people wake up and get ready for work or school, in the afternoon when they return home, and in the evening before they go to sleep (Bowen et al. 1993; Gascon et al. 2004; Mead 2008). This study established that during weekdays, toilets, taps, showers and baths peak at around 06:00 and again as from 17:00 onwards, representing the people who are usually preparing for work or school and returning, respectively. On weekends, these uses peak at around 07:00, indicating that people probably wake up later during weekends. On the contrary, there was no noticeable difference for dish washing between weekdays and weekends. Laundry, on the other hand, showed a constant pattern on all days of the week except Saturday, where a higher increase in laundry activity was evident between 06:00 and 11:00. A standard pattern on all seven days of the week was also noticed for garden watering. Results showed that garden watering usually takes place at around 07:00 and at around 19:00, when the heat of the sun is not too intense. With regard to car washing, it emerged that this activity is always done either around 07:00 in the morning or after 17:00.

Various authors (Hamilton 1985; Gregory and Di Leo 2003; Corral-Verdugo and Frías-Armenta 2006; O'Toole et al. 2009; Millock and Nauges 2010; Beal et al. 2011; Beal and Stewart 2011; Barata et al. 2012) demonstrated that people's perceptions of their household water use generally differ from their actual water consumption. The results of the questionnaires and time-use water diaries of this study were compared in order to identify any differences between the perceived water consumption amounts, collected from the questionnaires, and the actual water consumption amounts, collected from the time-use water diaries. It was found that questionnaire respondents overestimated shower use, teeth brushing, and laundry, however, they underestimated the duration of bath use and shaving. These results therefore confirm the findings of other studies by showing that the perceived water consumption does not usually match with the actual water consumption.

Even though these results cannot be generalised for the whole Maltese population, there seems to be a significant trend towards the conservation of water and the reduction of water wastage in households. To reduce the waste of water in their households, the majority of questionnaire and water diary respondents claimed that their household mostly avoids small loads of laundry, uses greywater for toilet flushing and repairs dripping taps. Other popular measures included the use of water efficient showerheads and dual flushing systems, the use of tap aerators and flow control valves, and the use of cistern or well water. Questionnaire results also indicate that a number of respondents also take other measures to reduce the waste of water in their household, with the majority of respondents indicating that they use pool covers and also close taps when not in use. As a result, there seems to be a significant trend towards the conservation of water and the reduction of water wastage in households. The majority of respondents would consider changing their existing non-efficient showerheads to more efficient ones and also consider switching their single flush toilets to toilets that are equipped with dual flush systems. Most respondents would also be willing to change their present appliances and invest in more efficient ones. A high percentage of respondents would also consider recycling water at home if a subsidy in this regard existed.

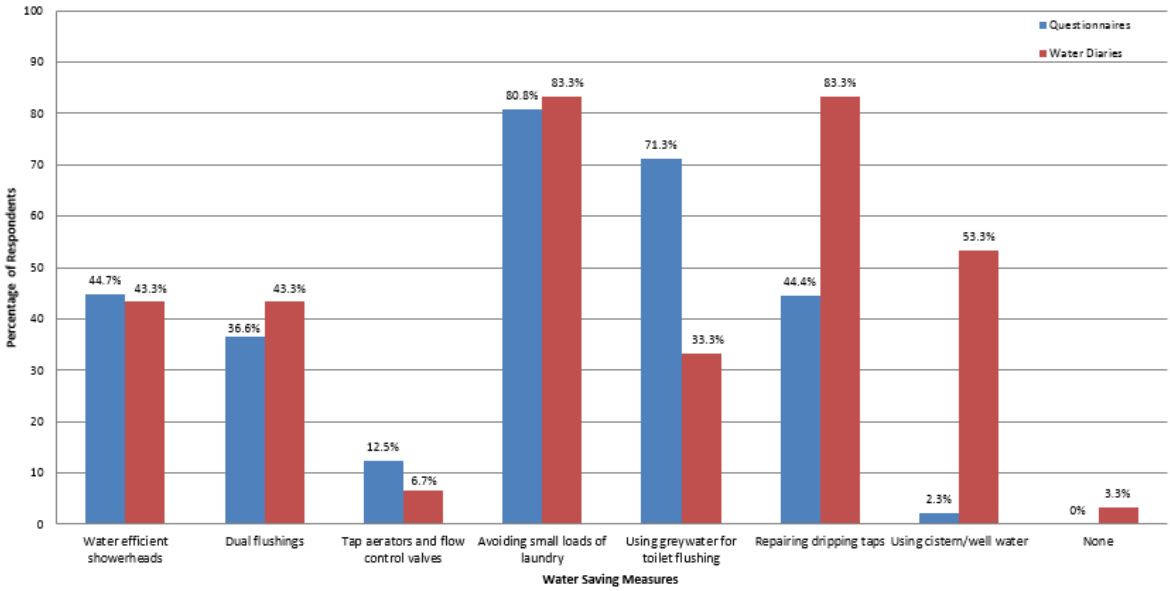

Figure 3: Measures taken by questionnaire and time-use water diary respondents to reduce the waste of water in their household

Due to the fact that this study made use of questionnaires and time-use water diaries to collect end use water consumption data, results may not be as accurate as when using data loggers attached to water meters. Furthermore, the period under review was during the summer months and consequently, this water consumption may not be representative for the whole year. Further studies should aim to establish household water consumption during the whole year to identify any seasonal differences and trends. The sample size of this study was relatively small when compared to the whole population of the Maltese Islands. It is recommended that other studies, such as a national water survey, are carried out in order to address a larger sample and obtain more generalisable results.

Identifying the drivers of water consumption can help in developing an affective policy to address household water consumption and promote its efficient use. In order to reduce household water consumption and eliminate waste, it is essential that a number of measures are taken in order to work towards sustainable development. Such measures include affective water pricing policies as an incentive for using water more efficiently, enforcement of legislation for the use of water cisterns and wells in households, and education campaigns focusing on water conservation in households combined with subsidies from Government towards the use of greywater, water efficient equipment and water-saving measures in households. Eventually, regular surveys about water consumption will be necessary to gauge the awareness of water conservation measures and to monitor the effect of policies. Such surveys can be included in the national Census of Population and Housing.

Annalise Grech completed her MSc research in 2014 under the supervision of Prof. Maria Attard

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VALLETTA: Towards the Strategic Re-Use of its Vacant Properties
by Perit Duncan Mifsud

Introduction

Drawing from the results of previous studies that document the extent of the problem of vacant properties in different western cities, the current study sought to make a detailed inventory of vacant properties within the Lower Part of Valletta (Map 1), which according to the Grand Harbour Local Plan is labelled as a "Housing Improvement Action Area". Moreover, the study aimed at proposing a sustainable strategy to guide the re-use of vacant properties in Valletta. The study area, also colloquially referred to as il-Baviera and its environs, covers a superficial area of approximately 50,000 square metres, and it is a good representation of a compact city comprising of dense living quarter. Currently, most of the properties available within the study area are abandoned and vacant. Hence, this area is ideal for this kind of study because it offers a challenging and academically stimulating environment to researchers (Kromer, 2000).

Perhaps the most fundamental aspect of Valletta is that this city was founded by the Sovereign Military Hospitaller Order of St John the Baptist (1530-1798). This fact has proved to be a vital element throughout the ages in any aspect of Valletta's urban history. It is the epitome of the city itself. This was followed by several historical events that contributed to the rich landscape of the city, which remained stable throughout the British colonial rule (1800-1964). However, over the years, especially after the end of World War II, the city of Valletta's demographics have changed considerably and the population density has been on the decline. This is attributable to aerial attacks on the city during the war, which forced residents to relocate to less-targeted areas. Consequently, this demographic shift brought an increase in the vacant and abandoned properties in Valletta, and it is estimated that over 30 per cent of the total properties within the city are vacant (National Statistics Office [NSO], 2012).

The reason for choosing this particular study area within the city is because it contains a number of housing units that are currently owned by the government. Moreover, the area has many structures with a historical importance and has a direct link to the coastal area through what is known as the Jews Sally Port and to the exposed inlet known as il-Fossa or St. Elmo's Bay. However, due to its derelict state, this same quarter has been previously earmarked for housing improvement initiatives. Basically, the research's main objectives were to:

- Determine the main factors that contributed to an exponential increase in vacant properties in Valletta.
- Determine how the re-use or rehabilitation of empty property in Valletta can be done in a sustainable manner for residential purposes.
- Determine the type of strategies that should be formulated for a sustainable property market in Valletta.

After analysing both primary and secondary data based on the methodology proposed by Vigar et al. (2005)'s study on the spatial strategies adopted for cities, the author observed that there was need for a long-term strategy that supports the realignment of proactive policies with long-term needs. For instance, the author noted that sustainable urban regeneration would provide ways of addressing the decline in population within the city of Valletta. Accordingly, the author proposed the strategy of land banking, which will be addressed in the following discussions together with the study's significance and its important outcomes.

The Importance of the Study

As noted earlier, the aim of the study was to make an inventory of all vacant properties located within the study area in order to propose a sustainable strategy for their re-use. This is very important considering that numerous projects have been initiated in the past with the sole purpose of rehabilitating the city, and none of these efforts has been able to address the vacancy residential problem. Hence, by providing a sound strategy on how to re-use the vacant properties in a

sustainable manner, the study will enable local property owners including the government to explore the full-range of benefits associated with bringing vacant properties back into use. Here, it is imperative to note that the re-use of vacant properties holds many financial as well as social and environmental advantages. For instance, the Torridge District Council (2012) argues that property owners stand a better chance of reaping from an outright sale or renting upon putting their properties back into the market. However, in most cases, property owners might find it difficult to obtain any outright financial benefits from their properties, particularly when they are not in a good condition. Under such circumstances, the author argues that it is important for property owners to consider re-using and regenerating them in order to inject life into the local housing market and businesses.

On the other hand, the author argues that the re-use of vacant properties contributes toward improved environmental conditions including air and urban quality. More specifically, when vacant properties are re-used, it means that the local communities will have the opportunity to enjoy the benefits of green field development targeting properties with signs of vacancy and deterioration. Moreover, revitalisation of vacant and deteriorated properties does not only promote the enhancement of environmental and urban conditions, but it also contributes to better public health conditions and reduced investment in new buildings, which would otherwise occupy new spaces, and in turn, increase the demand (Kromer, 2002). Hence, it is apparent that the overall advantage of reclaiming neglected assets entails improving the quality of life of thousands of local residents as well as offering financial returns to local authorities, property owners, and the government (Kromer, 2002; Mallach, 2006). Furthermore, experts have observed that the re-use of vacant properties is a sure way of reducing the amount of waste generated from the demolition of old properties and the construction of new structures. Moreover, the reclamation of vacant properties maintains the surrounding water quality because it does not entail the construction of new parking lots, roads, and other impervious surfaces (Rybczynski, Witold, and Linneman, 1999). Overall, it appears that the approach proposed in the study is more advantageous because it allows vacant properties to be re-used while safeguarding the local environmental and public health conditions.

Important Outcomes of the Study

In order to identify the factors contributing to the existence of vacant properties within the study area, the author examined historical maps of the city of Valletta besides gathering and analysing data related to the topography and urban morphology of the study area as well as the level of protection of buildings within the area, the different uses of property, the population statistics, and property ownership. The study findings show that the topography and urban morphology of the city of Valletta is negatively affecting the cost of reconstruction and redevelopment of vacant properties. More specifically, the study areas' topography consists of the Ghetto Valley and the Arsenal Valley, which hinder to an extent the development and re-use of vacant properties. Conversely, the urban morphology of the study area differs from the rest of Valletta considering that the latter has rectangular building blocks and the former consists of almost triangular blocks (Block 10 on Map 1). Furthermore, the study found out that most the buildings within the study area have a typical Valletta character, but some buildings have a modern look and do not blend in with the rest of the city (Ellul, 1995).

Buildings within the Maltese Islands fall under three categories namely; buildings with high architectural and historical value (Grade 1), buildings with considerable architectural and historical interest (Grade 2), and buildings with little or no architectural and historical value (Grade 3) (Ministry for Development of Infrastructure [MDI], 1990). Within the study area, there are seven buildings falling under Grade 1, one Grade 2 property, and the rest of the properties are Grade 3 (Map 2). On the other hand, the study findings show that the properties within the study area fall under different categories according to use, which include residential, public buildings, commercial, garages, stores, offices, and others. The most common uses of property within the study area were residential, storage, garage use, and few were for commercial use and government facilities.

After analysing the population statistics of the area under study, the author found out that there were about 5,784 people living in Valletta in 2011, and out of this number, approximately 925 people (or 16 per cent of Valletta's total population) were living within the study area, which occupies about

5.95 per cent of the total area of Valletta. The population density of the area was 18,500 people per square kilometre after excluding non-voters since the Local Council Electoral Register was used to calculate the population statistics. This shows that a large number of residents were living within small residential blocks. Furthermore, the population by sex of the area was 474 males (51.2 per cent) and 451 females (48.8 per cent), and out of these numbers, 13.5 per cent were aged 15-24 years, 15.5 per cent (25-34 years), 17.6 per cent (35-44 years), 16.0 per cent (45-54 years), 13.7 per cent (55-64 years), and 23.7 per cent (65 years and over) respectively.

Apart from the above-mentioned statistics, the study analysed the property ownership data, and found out that about 35.5 per cent of the total properties within the study area fell under the possession and use category while 33.4 per cent were government owned and 31.1 per cent were privately owned. Furthermore, the study found out that the number of vacant properties within the area was 230 properties, out of which 124 were government owned, 102 were privately owned, and four were held under the possession and use category. Moreover, out of the 230 vacant properties, there were 202 residential properties and 28 properties under non-residential use. Out of the 202 properties under residential use, 77 were apartments, 123 were maisonettes, and 2 were townhouses. Most of the vacant residential properties (52.5 per cent) were government owned while about 45.5 per cent were privately owned. The condition of the vacant properties was also assessed, and out of the 202 residential vacant properties, about 17 were in a good condition, 82 were satisfactory, and 103 properties were in a poor condition. Map 3 shows government-owned residential properties, which have been vacant for more than five years and are in a poor state of repair, whereas Map 4 shows the same properties but which are in poor/satisfactory state of repair.

The Concept of Land Banking

After looking at the characteristics of the vacant properties within the study area and Valletta in general, it is apparent that there is a good opportunity for the local government and other stakeholders to re-develop the abandoned properties and convert them into a variety of historical, modern, and functional buildings with enough spaces for recreation and cultural events (Dingli, 2013). This will in turn do away with the social and environmental problems that face the local populations residing within the study area. Within the confines of the nodal concept, the author proposed that a land bank will be most effective in addressing the problem of vacant properties in Valletta and in guiding the rehabilitation efforts. Basically, a land bank refers to, “a single-purpose public entity entrusted with the responsibility for the acquisition, management, and disposition of vacant and abandoned properties within the community [and] operates as a program within the formal structure of government” (Mallach, 2001).

In most cases, a land bank operates under local government budgets or through the management of tax-foreclosed properties (Whitaker et al., 2013). It is the most relevant approach to solving the problem of vacant properties because it holds a strong local incentive, which inspires the rehabilitation of abandoned or empty properties that have little or no expansion space and where neighbourhoods are burdened by the out-migration of local residents (Blakely and Bradshaw, 2002). Moreover, different studies have found out that the implementation of land banks with the intention of redeveloping vacant properties can dramatically change the landscape of both the local neighbourhoods and the city (Rosan, 2001; Mallach, 2001; Keating and Sjoquist, 2001; Tappendorf and Denzin, 2011). Moreover, a land bank as an approach to solving the problem of vacant properties has many advantages. First, a land bank can handle the problems associated with the redevelopment of properties co-owned by the government and other private entities. Secondly, a land bank is a good option when it comes to the redevelopment of properties owned by different heirs who have difficulties in selling or sharing the property. Finally, a land bank can easily deal with any issues arising from the acquisition and re-use of properties held under the legal title of ‘possession and use’. In conclusion, considering the characteristics of the vacant properties identified within the study area, it is apparent that a land bank is better suited in addressing most of the problems that may arise during the acquisition and re-use of the properties as well as in guiding the sustainable redevelopment of the area.

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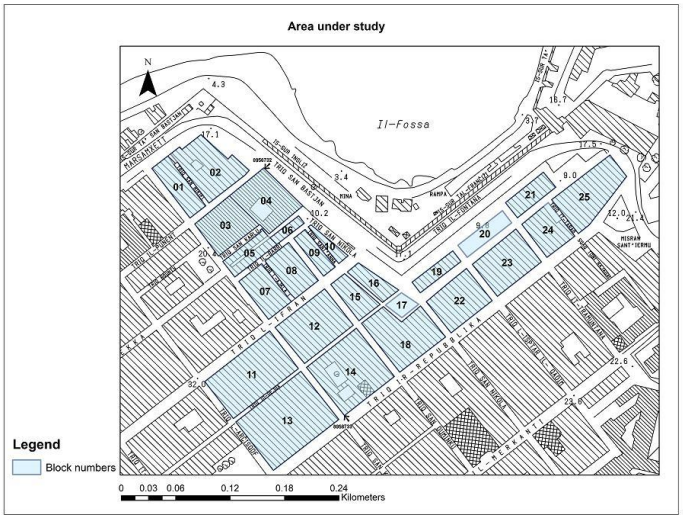
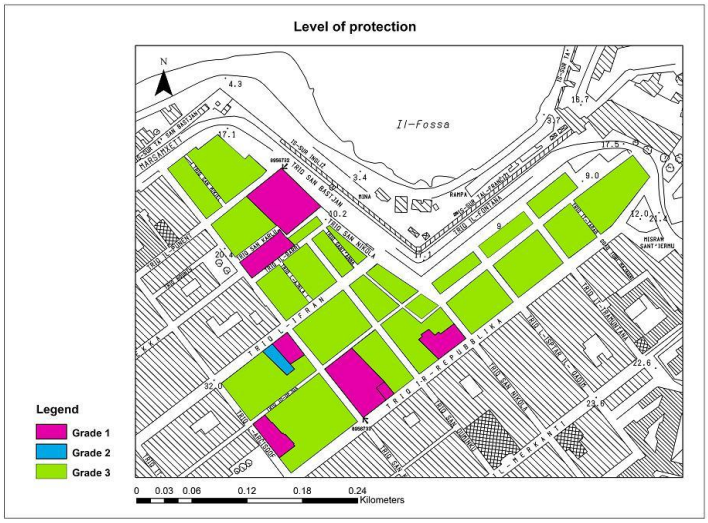
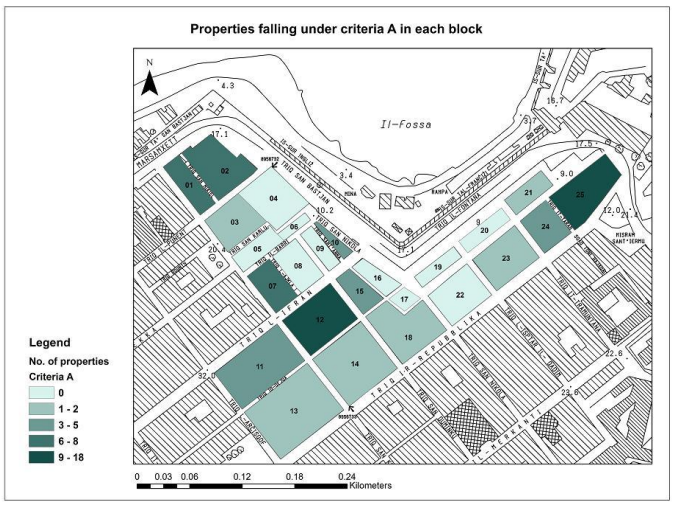


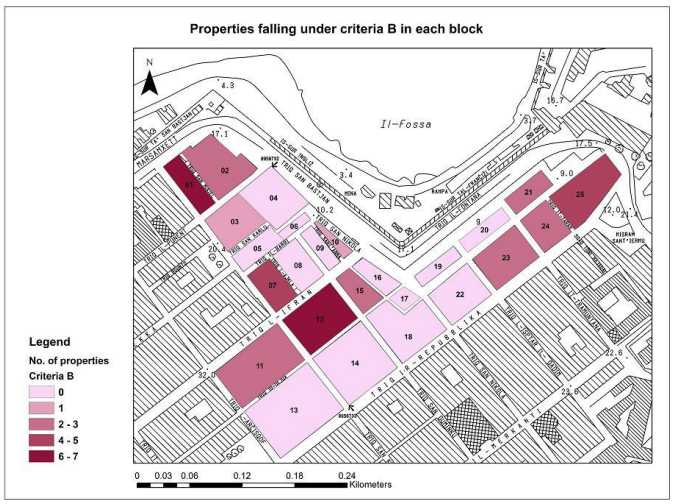
Map 1: Block Plan of Study Area, Valletta.



Map 2: Level of Protection of Buildings within the Study Area.



Map 3: Government-owned residential properties, which have been vacant for more than five years and are in poor state of repair.



Map 4: Government-owned residential properties, which have been vacant for more than five years and are in poor/ satisfactory state of repair.

A breath of fresh air: The use of Geographic Information Systems for the sustainable management of air quality in Malta

by Annalisa Farrugia B.A. Hons (Melit.)

Sustainable development entails the preservation of the environment for future generations (WCED 1987). While growing concern is mainly related to human health and environmental issues, it also has its economic implications. For instance, in China, the World Bank estimated death and disease from air pollution to contribute to annual losses of 2-3% of the Gross Domestic Product (Strebel and Lehmann 2013).

Both natural and anthropogenic sources are responsible for the emission of various air pollutants. However, air pollution involves very complex processes. Air quality is not only influenced by pollution sources, but involves a complex relationship between a number of factors. Among these are the geographical position, topography, meteorological conditions and land use in the sampled area. A combination of these factors has sometimes led to hazardous air pollution episodes. A case in point are the heavy industrialized Meuse Valley in Belgium (Boubel et al. 1994), Beijing in China (Strebel and Lehmann 2013), and Mexico City in Mexico (Collins and Scott 1993).

The case study of this dissertation is the island of Malta. With a population density of 1,566 persons per km2 (NSO 2012), air quality is a major concern especially in areas affected by heavy traffic. For instance, despite an overall decrease in sulphur dioxide and benzene levels for the period 2004 and 2010, the EU annual average limit values for these two air pollutants have been exceeded in a number of localities which are affected by heavy traffic. These include Fgura, Paola, Floriana, Marsa, Qormi and Ħamrun. In those localities known for their heavy traffic, exceedances to the EU annual average limit values for human health and environmental protection have also be registered for nitrogen dioxide and particulate matter. For the latter two air pollutants and ozone, an overall increase in the levels of these air pollutants has been registered for the period above mentioned (MEPA 2012b).

The geographical position of Malta makes it more vulnerable to trans-boundary sources of air pollution. For instance, a review of the literature has shown that in the Mediterranean, including Malta, winds from the south can lead to Saharan dust outbreaks. These are responsible for increasing particulate matter levels. Figure 1 clearly illustrates the entrainment of Saharan dust over Malta by strong south-westerly winds. These winds blow on 6.9% of the days in a year. Together with the south-south-westerly and southerly winds, these three winds affect Malta on 17.9% of the days in a year. Alternatively, north-westerly winds are responsible for the transportation of ash and gases emitted by the eruption of Mount Etna, in Sicily. These winds blow on 10.1% of the days in a year. Another factor influencing air quality in Malta is the latitudinal position which leads to Malta's mild climate. Increasing atmospheric temperatures trigger photochemical reactions such as the production of ozone from chemical reactions with nitrogen dioxide and nitrogen monoxide.

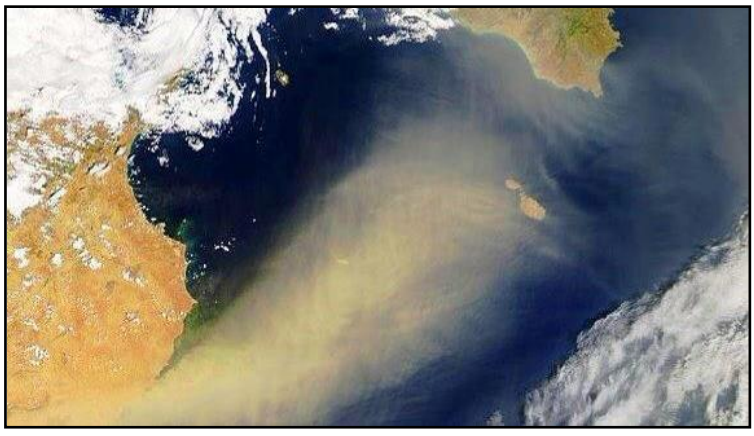


Fig. 1: Saharan dust blown over Malta by a strong south-westerly wind. (Times of Malta 2013)

In ‘A Sustainable Strategy for the Maltese Islands’, the energy and transport sectors have been identified as the main sources of air pollution in Malta (NCSD 2006). Of these, the fastest growing is road transport. Furthermore, particulate matter and ozone are considered as the main pollutants of concern. For these air pollutants the main sources are road traffic and Saharan dust outbreaks in the case of particulate matter, and photochemical reactions and transboundary sources for ozone. A dire need has also been identified for the mapping of air pollutants to predict and manage air quality in Malta (MEPA 2010).

For this purpose, 12-hour traffic counts (from 6.00 a.m. to 6.00 p.m.) in the location of the Attard, Kordin, Msida and Żejtun automatic real time air monitoring stations were carried out. Hourly average air pollutant levels from the four automatic real time air monitoring stations were also obtained. The Pearson Product Moment Correlation Coefficient and the Spearman Rank Order Correlation Coefficient were then used to assess the relationship between hourly average road traffic and air pollutant levels. When a strong relationship resulted between road traffic and these air pollutants, for each air pollutant, a linear regression equation was formulated. The linear regression equation is used to predict air pollutants’ levels based on road traffic. This road traffic data was obtained from Transport Malta. The reliability of the linear regression equation was compared and evaluated with the data obtained from the passive diffusion tube air monitoring network. Data from this network is also used to produce air pollution surfaces. For this purpose various spatial interpolation techniques were employed for predicting air quality in unsampled locations. More sophisticated techniques are indeed available, however, these are usually very data intensive and such data is difficult to obtain. Moreover, the whole process costs money and time. On the other hand, while spatial interpolation is more user-friendly, it requires a minimum input of data (and thus consumes less time and money) while being adequately reliable for decision-making.

In this study road traffic has been confirmed to be a main source of air pollution in Malta. However, from the evaluated relationships it was found out that other factors, namely meteorology, impinge (and so sometimes distort these relationships) on air quality in the sampled areas. For instance, in the four sampling areas an early morning peak (before the morning rush hour) was observed for carbon monoxide and nitrogen monoxide. Nonetheless, for both these air pollutants their relationship with road traffic resulted to be insignificant. Photochemical reactions during the day and temperature inversions at night are probably distorting the relationship between road traffic and these two air pollutants. At Msida a significant relationship with wind direction suggests sulphur dioxide to be transported from over the sea. Furthermore, solar radiation and surface temperature have been proven to trigger photochemical reactions that lead to ozone formation. Hourly ozone maxima could be observed late in the morning and in the early afternoon when these two weather variables are the highest.

As to the major pollutants of concern while road traffic was confirmed to be a primary source of particulate matter, in the case of ozone, it is a primary source of its precursors, nitrogen dioxide and volatile organic compounds (see Figure 2). Photochemical reactions are also responsible for the formation of nitrogen dioxide, its precursor being nitrogen monoxide. By evaluating the diurnal patterns for these air pollutants, nitrogen dioxide peaks were observed to occur some hours after the nitrogen monoxide maximums. For particulate matter peaks were observed during rush hour traffic. Nonetheless, it was found out that wind speed can distort the relationship between road traffic and particulate matter. This is especially the case for PM2.5.

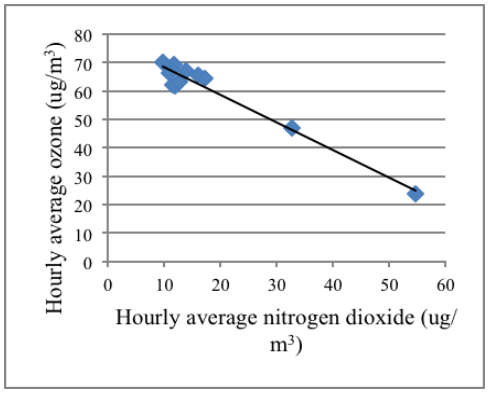


Fig. 2: The relationship between nitrogen dioxide and ozone at the Kordin automatic real time air monitoring station. (MEPA 2012a; Adapted by author)

The linear regression equation was used to predict air pollutant levels from hourly road traffic volumes obtained from Transport Malta. These equations resulted to be more effective for predicting the levels of primary pollutants of road traffic. Hence, where air pollution data is absent, these equations can be used to predict pollution levels for those air pollutants directly emitted by road traffic. To further assess the reliability of these equations, air pollution surfaces (using spatial interpolation) were also produced using the values calculated by the linear regression equations. These were then compared to the surfaces produced from the data collected by the passive diffusion tube air monitoring network (as it covers a wider area that could be compared to the traffic data collected by Transport Malta – see Figure 3). However, due to a lack of data these surfaces produced from hourly predicted values were compared to air pollution surfaces produced from monthly means. Nonetheless, these equations resulted to be good for indicating air pollution hot spots in general.

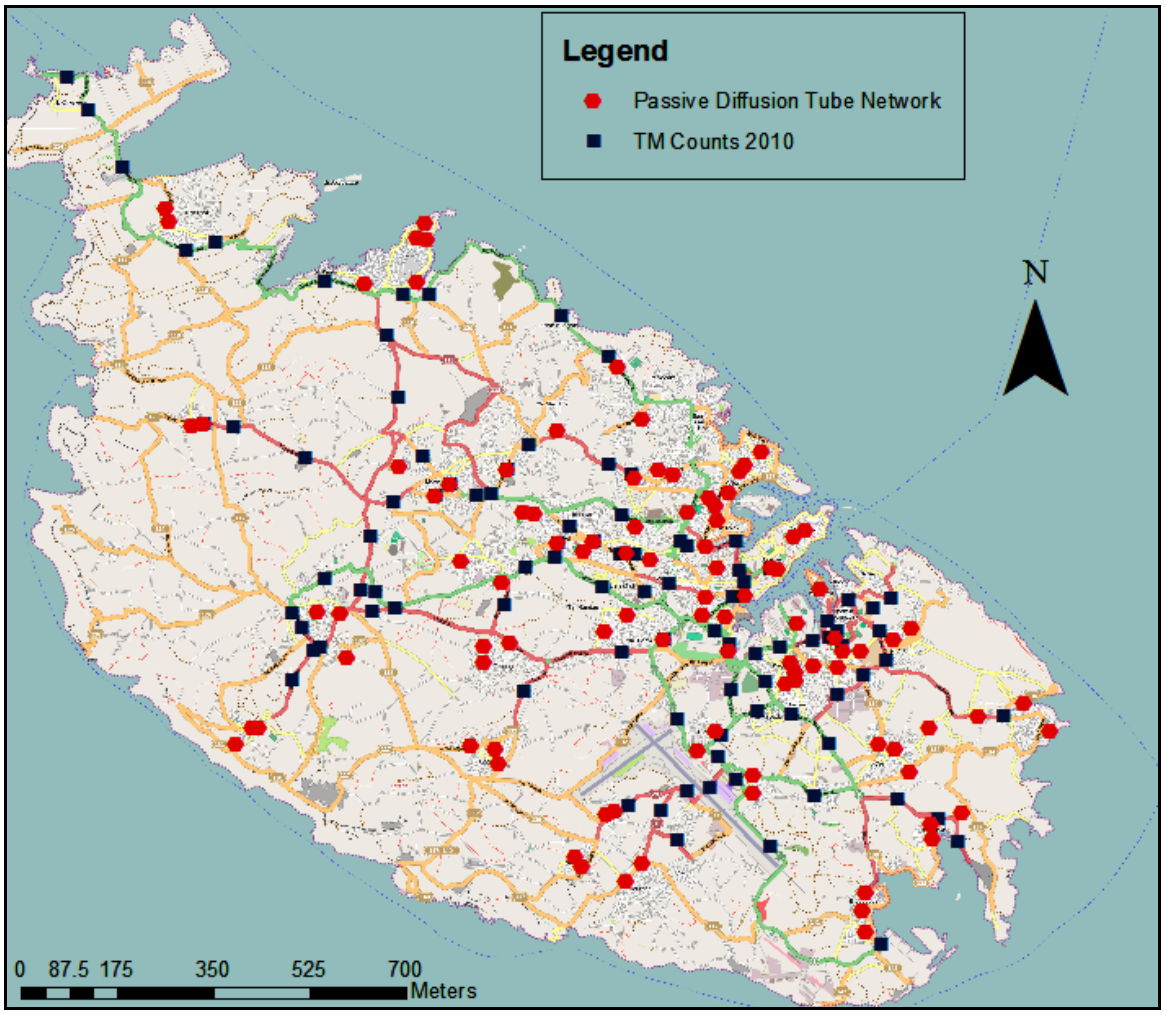


Fig. 3: The location of the passive diffusion tube stations and Transport Malta's counts. (www.openstreetmap.com; Adapted by author)

Seven spatial interpolation approaches were evaluated for predicting air pollution surfaces in Malta. Cross-validation was used to appraise the surfaces produced. The surfaces were compared on the basis of the mean error and RMSE values. For the data sets evaluated Universal Kriging resulted to be the best interpolator when it comes to efficiency in estimation. Lower mean errors (measure of accuracy) were achieved by Global Polynomial and Local Polynomial interpolations. Global Polynomial interpolation performed better for the annual mean data sets, while Local Polynomial interpolation achieved the lowest mean error values for the monthly mean data sets. This is probably due the

ability of Global polynomial and Local polynomial to perform better with data that varies over long and short distances, respectively (ESRI 2010). From a review of the literature, Kriging was expected to outperform deterministic approaches such as Inverse Distance Weighting, due to its ability to smooth irregularities.

When comparing the surfaces predicted by these three interpolation approaches the ones produced by Universal kriging are more suited to the aims of the current study. Apart from being aesthetically more pleasing, these surfaces are able to capture the trends and patterns underlined by the data. Pollution hot spots could also be identified. On the other hand, this is not the case for the surfaces predicted by both Global Polynomial and Local Polynomial interpolations. In these surfaces, both the air pollution hot spots and trends displayed by Universal kriging and the other interpolation approaches, were not fully captured. According to Philip and Watson (1986) Kriging is more suited to data which is irregular and known to contain error.

Eight data sets encompassing different air pollutants, temporal scales and data ranges were used to predict air pollution surfaces through spatial interpolation. Different parameters were also tested. According to Mühlenstädt and Kuhnt (2011) the choice of the spatial interpolation approach much depends on the data set in question. From the results obtained it is evident that the range of values within the data set has a greater influence on the root mean square error value (but it does not apply for the mean error value). As the range of values within the data set increases, the root mean square error value increases as well. This is congruent with the findings by Collins and Bolstad (1996); Ruelland et al. (2008); and Xie et al. (2011).

The current study has provided useful insight in the modelling and management of air quality in Malta. The relationships between air pollution and its various sources (mainly road traffic) and factors impinging on air quality have been analysed. However, the main focus of the current study has been on the development and evaluation of a reliable and user friendly model to manage air pollution in Malta. While studies such as Zammit (2000), Cutajar (2002), Axisa (2003) and Cohen (2004) have evaluated a range of models for modelling air pollution at the local scale, most of the time these require extensive data inputs which is either unavailable or too costly to obtain. As Joseph et al. (2003) stated, while reliable, spatial interpolation is quick and easy to use. Hence, the main advantage of spatial interpolation is that while adequate air pollution surfaces for decision-making are produced, resources need not be wasted (as on more sophisticated methods). Additionally, the reliability of the spatial interpolated surfaces has not only been proven by the root mean squared error value and mean error value results, but also by the capturing of trends that have already been identified in other studies. For instance, Nolle (2001) and Saliba (2004) argue that air pollution in Gozo is the result of a North-westerly transportation of air pollutants from Malta. As shown by Figure 4, this North-westerly trend has been fully captured by the produced spatially interpolated surfaces. Another North-easterly trend has also been observed. With this regard, further studies to the causes and impacts of these trends need to be carried out.

With regard to GIS, its user-friendliness and quick computation are its main strengths. With ArcGIS 10 various spatial interpolation techniques and parameters could be tested and evaluated. Additionally, ArcGIS 10's above mentioned strengths together with the identification of Universal Kriging as the most effective spatial interpolation approach, save money and time for future air pollution modelling in Malta. In the current study (due to limitations posed by the availability of data from MEPA) spatial interpolation surfaces could be only produced for nitrogen dioxide and ozone. Nonetheless, from the results of the current study, it resulted that more than the air pollutant, the root mean squared error value is mainly influenced by the range of values within the data set. Hence, the latter combined by the outperformance of Universal Kriging in 7 out of 8 of the data sets, means that if data is available, this spatial interpolation approach can be safely used to produce interpolated surfaces for other air pollutants (apart from nitrogen dioxide and ozone). Thus, saving money and time.

Annalisa Farrugia completed her MSc research in 2014 under the supervision of Prof. Maria Attard

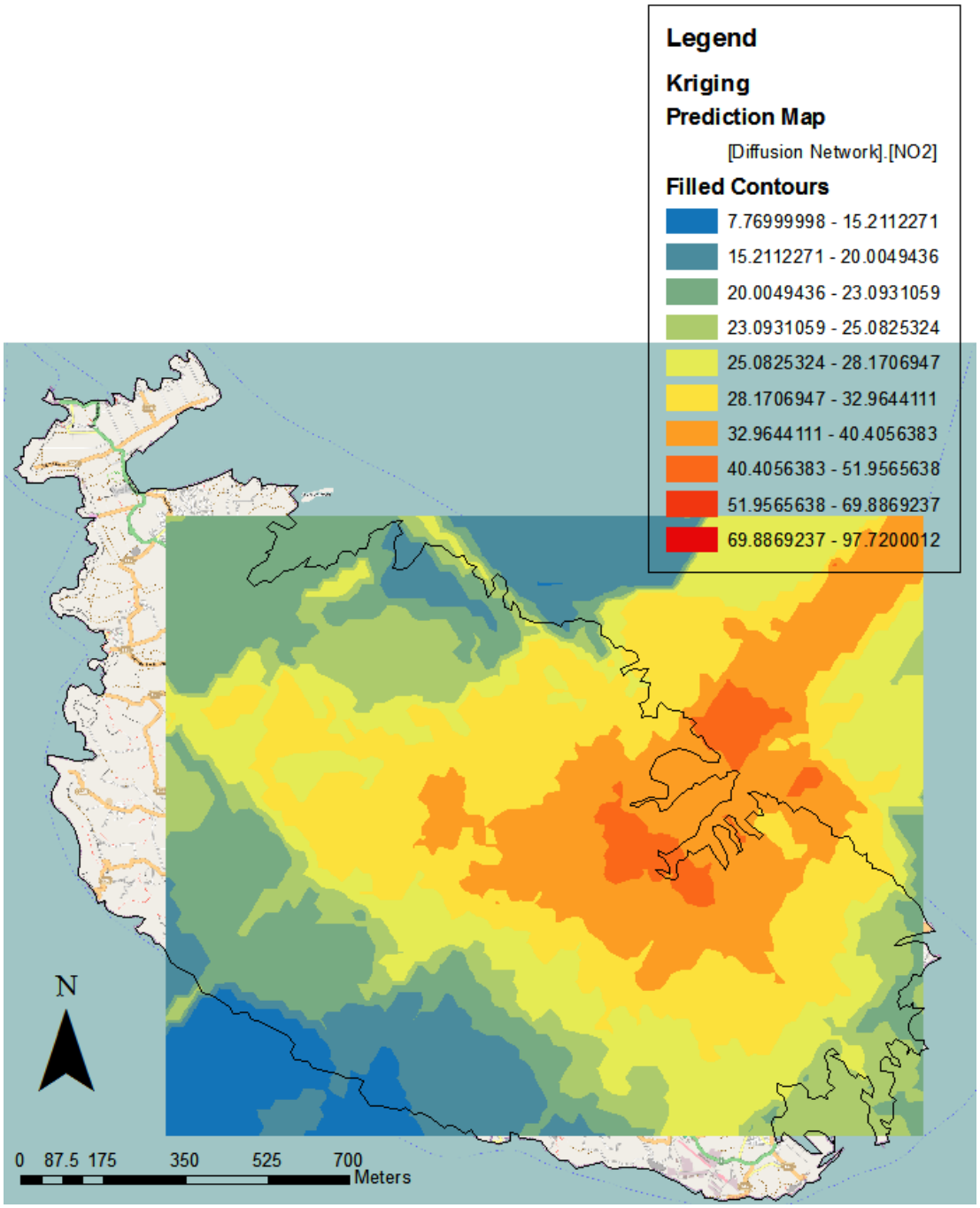


Fig. 4: Universal Kriging interpolation (with an Exponential kernel function and a Stable variogram) predicted nitrogen dioxide surface using the 2009 annual mean data set. (MEPA 2012b; Adapted by author)

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Analysis of Sustainable Development in Malta using a Multi-Criteria Analysis

by Ms Elaine Pace B.A.Hons (Melit.)

The structure of sustainable development developed between 1972 and 1992 through different international conferences and initiatives. The first meeting with a major international gathering was held in Stockholm in 1972 (UN, 2010). This meeting led to the creation of the United Nations Environment Programme (UNEP) and also the start of different environmental protection agencies at a national level. In 1987, the Bruntland Report which is also known as 'Our Common Future' was published. The report used the most common definition known about sustainability, that of "Development that meets the needs of current generation without compromising the ability of future generations to meet their own needs" (UN, 1987).

Sustainability indicators perform various functions, most of the times, sustainable indicators are used to measure progress towards sustainable development. These indicators can offer an important guide for decision making in different ways. They are capable of changing physical and social science knowledge into units of information that can help with the process of decision-making. Furthermore, they can also provide early advice in order to avoid damage to the environment, economy and society (DiSano, 2001). Indicators are important parameters which provide information about a phenomenon, environment or an area (OECD, 1993). In 1992, the United Nations Conference on Environment and Development, held in Rio de Janeiro, recognized the importance of sustainable indicators. Therefore, an action plan was adopted on Chapter 40 of Agenda 21. There was a call on countries to introduce a set of sustainability indicators.

The main idea of sustainability indicator framework is to provide a highly accessible information driven architecture, which is easily understood by members of society. The framework must cover an end-to-end process, which means it must monitor, assess and learn, decide and act. Furthermore, it must be transparent throughout (Hak, 2007).

In Malta, there have been various initiatives to introduce sustainability indicators at a national and regional level. The first attempt was made by the Planning Authority in 1997, as support to the development of land use planning policies. However, on December 1st of the year 2000, the Sustainability Indicators Malta Observatory (SI-MO) was established. The organization was represented by the Island and Small States Institute within the Foundation for International Studies at the University of Malta. The main objectives of the organization were to introduce and increase the skills for monitoring and reporting of the environmental parameters and sustainability indicators in Malta (Jari, 2011). In the new Sustainable Development Act of 2011, a number of indicators were chosen. These indicators help with decision-making processes and can be revised in accordance with on-going development. The Act came into force on the 10th July 2012 (Sustainable Development Act, 2010). Most of the data on indicators have been spread over a 10 year period. In order to complete the data the National Statistics Office (NSO) used a number of different sources both external and internal. The indicators are divided into the three pillars of sustainable development.

The evaluation of sustainability at macro level is now becoming a big problem for national governments, international organisations and the NGO's (OCED, 2002). Finally, Munda (1998) worked on the multi-criteria decision support method for measuring sustainable development performance (Shmelev et al., 2009). A multi-criteria analysis required a correlation of values of the socio-economic indexes with those of the environment. This allows us to know whether a location with a given socio-economic score is ranked in terms of environmental sustainability and vice-versa (Boggia et al., 2010). The main advantage of using a multi-criteria model is the fact that it can take into consideration a large datum, relationships and objectives which are normally visible in the real world. A multi-criteria model must offer a reliable framework which is aimed at aiding the structuring of the problem and the decision process. The decision makes in the end have to find a compromised solution, since when using a multi-criteria problem there cannot be one solution to optimize all the criteria. Therefore a multi-criteria evaluation cannot answer all the problems. They can however offer understanding about the nature of the conflicts and ways to compromise and reach a solution (Martinez-Alier, 1998).

A common problem found with multi-criteria analysis is the fact that it is challenging to develop weights without value judgment since the methods used need a stakeholder or a decision maker in order to identify the significance of each criteria. In order to ensure and develop a precise quantity of

sustainability for decision support, an objective method needs to be introduced based on the current understanding of sustainability. This is achieved by studying the interactions between different indicators and the impacts that they have on sustainability using correlations and comparisons in order to help create an integrated sustainability assessment. In order to improve a multi-criteria analysis as a decision support tool, it can be combined with GIS in order to be able to produce maps that can show ranking options (Carver, 1991; Crossland et al., 1995; Malczewski, 2006).

The aim of this study was to define an integrated approach to the assessment and monitoring of the integration of social, environmental and economic indicators. This was done to assess sustainability in different areas of Malta and Gozo and to rank them. It also helped to understand better, the specific technical and financial support that they need in order to grow sustainably. Furthermore, this study allowed spatial observations of the results as quantitative data obtained from different sources were mapped.

In all sixteen indicators were chosen in the study (Table 1). These were later divided into two groups, the socio-economic indicators and the environmental indicators. The reason behind such grouping was that the indicators sets were first tested separately and then were later correlated in order to see how sustainable each district is. Eventually, a visual representation of the results was given using the Geographic Information System.

Environmental Indicators	Socio-Economic Indicators
Pollution	Population Density
Artificial Surface Area	Unemployment Rate
Electricity consumption per household	Women's Unemployment Rate
Waste Separation	Work Related Accidents
Amount of water used	Higher Education
Bathing Water Quality	Tourist Establishments
Companies with ISO 14001 and hotels with ECO certification	Demographic Dependence
Ratio of people using public transport	Household disposable income

Table 1: Indicators used for this research

The aim of the sustainability analysis was to develop results obtained at the level of single indices which were integrated but not aggregated in order to identify homogenous districts in the Maltese Islands on the basis of the indicators used. The areas illustrated in Figure 1 show the results which were produced by correlating the environmental index class with the socio-economic index class.

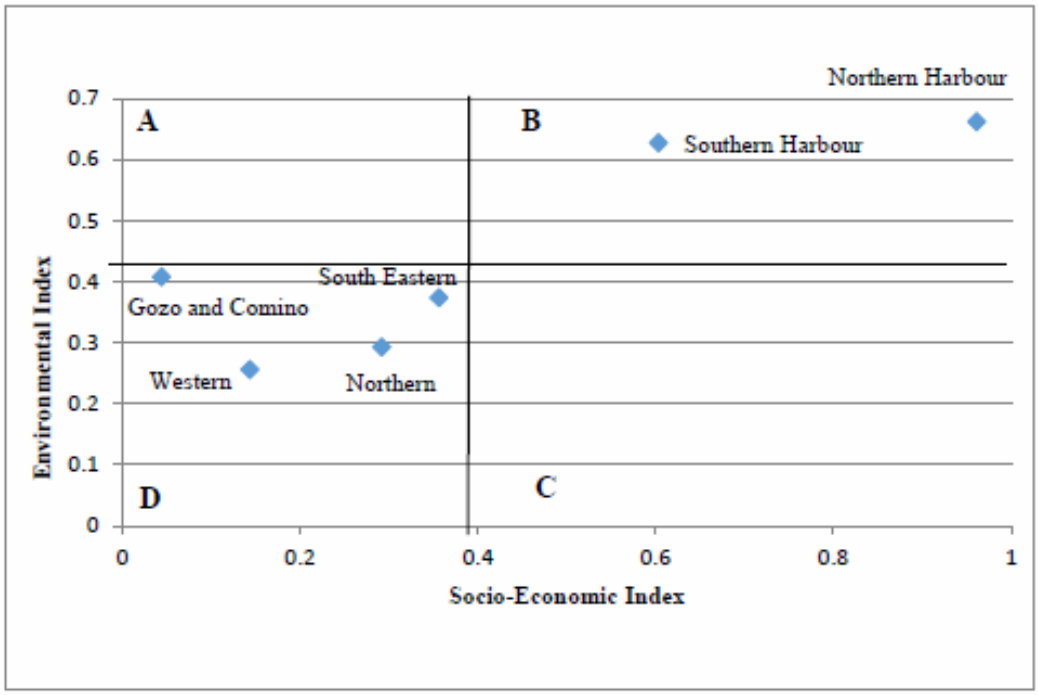
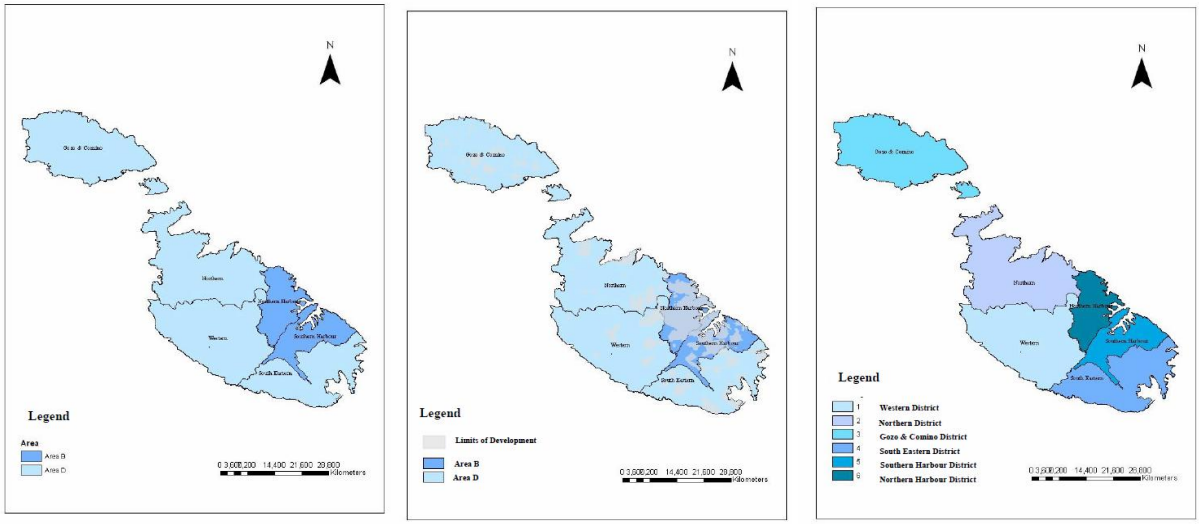


Figure 1: Crossing Environmental and Socio-Economic Indexes

The first evidence that can be seen from Figure 1 is the division of the Northern Harbour and Southern Harbour districts from the rest of the districts. The remarkable difference in sustainability levels between these districts is directly influenced by the set of indicators chosen, and from the surveys which were answered by different localities. The clear division of the districts can be seen in Figure 2, were a spatial representation of the results was given. This was further enhanced by a super-imposing the limits of development in Malta (Figure 3). From the super-imposition, it is evident that the limits of development and the districts with the highest level of sustainable development are correlated, since the areas with high development are also the areas with the best sustainability performance.

Figure 4 enable the six districts of the Maltese Islands to be situated according to a ranked distribution, were 1 represents the least sustainable area and 5 the most sustainable. This is defined by a system of different variables. Some critical aspects and different opportunities can also be identified by decision makers in different localities. The model used in this study is suitable to stimulate alternative scenarios in order to examine the effect that activities have on certain districts. It is aimed at improving environmental and socio-economic situations which are highlighted by the analysis of different indicators.



This study has shown that all three pillars of sustainability are important in planning and aspiring for sustainable development. An array of socio-economic and environmental indicators was chosen to ensure a balance. The results of this research could be the first 'warning sign' to society and stakeholders that sustainability is not just about environmental protections, it is also about finding a balance between sustainable economic and social development and the protection of the environment.

This research can be considered as the first step in understanding better how sustainable development can be implemented, and which environmental and socio-economic indicators might influence the performance of cities, regions and nations. Sustainable development is very important in today's world, and it is a multi-dimensional concept, since it integrates economy, environment and society. Policy makers must be aware of how sustainability is dependent on these three factors, before they design strategies.

This study presented a framework which can be updated with new data. Therefore, it can be more reliable and could eventually become useful in projecting future scenarios. It could also be applied to islands similar to Malta. The fact that indicators can be updated makes the model more dynamic and suitable for the use of temporal evaluation. It is still not known whether the change of indicators on the basis of one goal is preferred to a standard set of indicators which could be developed at European level (Boggia et al., 2010). A standard set would make the analysis less flexible however, it would enable the comparison of different situations in order to get a better allocation of resources in the framework of sustainable development policies. To carry this out, an effort is needed to make the assessment of sustainability more organized.

Elaine Pace completed her MSc research in 2014 under the supervision of Prof. Maria Attard

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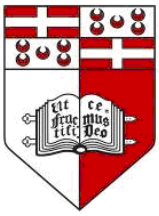

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