CHAPTER 16

Would Spatial Planners Benefit from Better Familiarity with Integrated ICT Based Technologies?

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Introduction

In contrast to popular notion, spatial planning does not belong solely within the privileged realm of spatial planners. Spatial planners constitute just one link in a chain of stakeholders who may use the tools provided by the planners with a view to achieve sustainable development objectives (Karlenzig, 2012). The success or otherwise of spatially oriented plans and policies greatly depends on each link within this imaginary chain.

Properly executed spatial planning processes can potentially reap many benefits. Some of the benefits include:

- An overall functional and cost-effective infrastructure;
- Allocation of sufficient space for appropriately sited social and community facilities;
- Resolution of conflicts especially those arising from juxtaposed functions and competition for spatial resources;
- Areasonably good supply of territory available for a spectrum of envisaged uses and activities;
- A healthy provision of open space and the allocation of sufficient space for formal and informal recreation;
- Sufficient designation of areas intended for primary industry (including agricultural areas);
- Statutory protection of areas of cultural and natural value; and
- The creation and maintenance of an enjoyable urban, peri-urban, rural and coastal environment set within an overall attractive landscape

The general publicmay downplay the benefits of spatial planning. There are various reasons that contribute. One reason may be due to the fact that the tangible benefits of are often not readily perceived. Malta's particular situation of limited territorial

extent coupled with a high population density does not lend itself to alleviate matters. Moreover there are many reasons why planning results may not necessarily match public and/or individualexpectations. When planning does not leave the desired results, the consequences tend to be widely perceived and generally are of a rather permanent nature. There are many other reasons that may contribute to less desirable planning consequences and these often include socio-economic factors. Examples of contributors could include short term considerations prevailing over longer term ones or the adoption of certain priorities over others at the various decision making or decision taking stages.

Additionally, planning interventions build upon a previous context and any shortcomings in the preceding context are often carried along with the newer interventions. It is often ratherchallenging to satisfactorily address previous adverse situations and indeed sometimes situations which are conducive to exacerbate an existing situation can develop. Furthermore, planning policies are often a combination of technical advice coupled with other socio-economic considerations. Again this could lead to spatial policies which may aggravate rather than remedy a previously existing situation. Other complicating factors include the application and interpretation of planning policies in the development planning permit process. This process may also be adversely affected by policy vacua, inappropriate policies, outdated policies, misinterpretation of policies or consideration of matters which go beyondplanning policies. There is also the enforcement aspect that plays a role in the translation of policies aspect. Therefore what happens on the ground may not necessarily always reflect the policy thrust.

Good policy formulation is dependent on good quality, reliable and up to date information that can be ultimately assimilated into datasets which would ultimately inform the spatial planning formulation process. The evidence based approach to policy formulation should be coupled with the application of sound planning principles. This involves all the processes that lead to the drafting of the plan and the effective communication of the outputs to key stakeholders and the public. A well executed process increases the likelihood of the formulation of a successful spatial plan. ICT based technology can play a very determinant role in the collation, analysis, formulation, communication and execution of the relevant spatial plan (PEARL, 2015).

This paper mainly focuses on the relevance of certain aspects of ICT (Information and Communication Technology) to spatial plan and policy formulation processes and the spatial planners who draft them (Caperna, 2016). The main emphasis is on the spatial planning and policy formulation aspects. It must be pointed out that there are other extremely important spatial planning activities such as planning permitting, enforcement, monitoring and legal aspects (Huang, 2012). However these are only cursorily referred to.

The current legal basis for the development of planning policy

The various development planning related aspects in Malta are mainly regulated through ACT VII of 2016 (GoM, 2016). This Act is also known as the Development Planning Act of 2016 and supersedes Act X of 2010 (GoM, 2010). On the policy formulation front, the Act also stipulates that a number of procedural steps areadhered to when formulating planning policy. The Act also stipulates that a number of statutory public consultation stages are conducted in association with policy formulation processes.

The Development Planning Act of 2016 contemplates a number of planning tools which form the planning framework upon which the rest of the planning functions are based (GoM, 2016). The overarching strategic framework is the Spatial Strategy for Environment and Development, known by its acronym SPED (GoM, 2015). Subsidiary policies are based on this overarching document. Subsidiary plans and policies include Subject Plans, Local Plans, Action/Management plans, Development Briefs and other policies and guidelines.

Planning policy formulation or revocation can be initiated either by government or by the Planning Authority and in all cases except for strategic policy, endorsement lies at a ministerial level. Strategic policies such as the SPED would be require to be approved through a parliamentary resolution.

Public consultation is envisaged in various stages of policy formulation. The rationale for the statutory consultation processes is for the planning process to benefit from the wider knowledge present within the community as well as to include a measure of transparency which is essential in a modern democratic society. It is crucial to encourage meaningful and widespread public participation as the policy formulation process may positively benefit from such interventions (MNCPPC, 2015).

The Development Planning Act - 2016 also provides for the protection of immovable natural and cultural heritage through Scheduling and Conservation Orders as contemplated in Article 57 of the said Act (GoM, 2016).

The role of ICT based Technology in the Policy Formulation process

The Maltese spatial plan and policy formulation process together with Scheduling of property of Cultural and Natural importance and Conservation Orders rely heavily on ICT based inputs (MEPA, 2015). Two very important components of the plan and policy formulation processesinclude the data management function and the information exchange function.

The data management component includes database design and database updating, upgrading and management. Given the spatial nature of the planning function, databases are increasingly coupled with Geographical Information Systems (GIS) attributes in order to facilitate 2D, 3D or 4D representation which greatly enhances the assimilation of complex information sets. Additionally, these spatiotemporal oriented databases are increasingly being updated under near real-time conditions, thus facilitating simultaneous access by the wider community through electronic means. These databases are indispensable in generating the necessary evidence based numerical underpinnings, statistics and graphic representations necessary at all stages of the plan and policy formulation processes.

More recently, GIS referenced real, virtual or processed imagery is increasingly being used to better depict projected outcomes so that decision makers and decision takers are in a better position to undertake their respective roles. Moreover, a participatory wider audience is empowered to better understand possible future implications, assess potential benefits and gauge possible risks. Thus the spatial planning process is rendered more transparent and in turn is rendered more accountable to the wider public (Nunes Silva, 2011). Satellite, aerial (including drone imagery) and processing of considerable amounts of acquired sensor data (IR, Radar, Lidar, Sonar etc.) render 3D imagery much easier to produce and quicker to distribute. Thus superimposed or virtual depictions which may include projections of envisaged interventions may be viewed from any chosen point and these points are not limited to terrain based observation platforms. Moreover, various software packages enable the addition or removal of tagged objects to facilitate a "what if" visualisation of a potential situation.

Irrespective of how well databases are designed, the use of a database would be rather restricted if wider dissemination is precluded. This is especially relevant in a situation of a regulator like the Maltese Planning Authority. Here internal and external consultation as well as statutory requirements relating to freedom of information, dissemination of planning related information and accountability feature very prominently. Thus the design of the databases should also consider the information exchange function. This is to ensure that datasets may be disseminated to nodes which can read to and/or write mutually comprehensible information. Such exchanges need to be subjected to the necessary electronic security safeguards. In such cases it is paramount to ensure that simultaneous data exchanges do not slow down data exchanges to unreasonable speeds and that unauthorised data access, tampering or malicious disruption does not occur. This dissemination may rely on a variety of networks which are either land-line or wireless based. Increased use of wireless network s greatly facilitates access especially to people on the move who would otherwise be required to access data from a fixed point. The positive aspect of modern technology is that data exchanges (especially web based ones)

are not spatially limited by borders. In the last few decades it has become possible to almost instantaneously exchange information with any point on earth connected with the right equipment, software and access authorisation (if relevant) to the germane network.

Well designed databases and specialised image manipulation software also assist the planners with presentation to various audiences which can range from internal presentations to colleagues, to decision takers, professional representatives, constituted bodies and the wider community.

Background to ICT based technology use in spatial planning in Malta

When the Maltese Planning Authority (PA) was established in 1992, most of the information available that led to the approval of the Structure Plan for the Maltese Islands - (approved by Parliament in 1992) - was paper based (GoM, 1992). At that time, the web was locally practically unknown and even electronic mail was still in its infancy in Malta. However, even at that time there were endeavours to introduce computerisation to the various planning processes in order to render them less laborious and thus more efficient.

Earlier initiatives included the digitisation of cartographic maps, the slow but steady introduction of electronic mapping, the setting up of a Mapping Unit and an Information Technology (IT) Unit and the equipping of plan and policy formulation teams with training and equipment. This would eventually lead to the production of digital base maps and plans. Although planning permit and enforcement related databases are not directly related to the planning formulation process, they proved to be useful tools in extracting statistics and other information which contributed to eventual plan and policy formulation process. Later on there was a degree of linkage between these predominantly alphanumeric databases with a GIS system (Formosa, 2014a).

Around the turn of the century, the Planning Authority had embarked to undertake the review of the Structure Plan for the Maltese Islands. Various studies had been compiled using IT platforms and these were started to be electronic means available at the time. Naturally the penetration of internet at that time was not as extensive but still the potential was already being perceived. Various studies undertaken by PA staff coupled with input from external consultants. At approximately the same time, a number of geo-referenced data collation exercises were undertaken to build the PA's heritage protection inventory. A number of subject studies developed on the said studies were thus disseminated through the Malta Environment and Planning Authority (MEPA) website, these being intended to be the basis for the replacement Strategic Plan. The MEPA website quickly gained popularity and in 2002 it was awarded the "best overall website" and the "best public sector website" through the Datastream awards (MEPA, 2002).

These innovations eventually also culminated in generation of 7 Local Plans which were approved in August of 2006 and published in DVD-rom format as well as being simultaneously available on the MEPA website (MEPA, 2006). In terms of graphics and textual information, to date (mid-2016) this remains the most extensive compilation of data published by the PA as one collective exercise. This development permitted a much wider reach at a fraction of the cost of printing hundreds of pages of plans and text in full colour (especially the maps which were required to be in A3 format).

Digitisation presented a number of opportunities which included:

- Faster data assembly, superimposition and assimilation;
- Improved querying opportunities and extraction of meaningful data in various formats;
- Better opportunities for presentation;
- Faster and better opportunities for updates and amendments;
- Superior and faster quantification and scaling of the various planning parameters;
- Very cost effective solutions when compared to paper based options;
- Creativity only limited by the software capabilities, the training of the various operators and imagination;
- Near real-time updating of information;
- Faster dissemination of information with potential for simultaneous distribution; and
- Enhanced opportunities for involvement, co-ordination and participation.

Further in the 2010s, there were other innovations such as the introduction of electronic aerial imagery (most notably colour orthophotos), the availability of a web based GIS on the MEPA website (MEPA MAPSERVER), the undertaking of a Lidar survey in 2012 and other similar initiatives (including visualisation tools) through the ERDF156 project, all of which contributed towards the compilation of studies intended for the revision of subsidiary plans (MEPA, 2013). At this point it needs to be mentioned that in order to achieve reliable results, one must avoid the pitfalls of expecting too much from tools which may have limited capabilities. Moreover, the experience with GIS tools suggested that there was scope to improve upon:

- Well planned and integrated databases coupled with a similarly organised GIS database;
- A more organisation-wide structured approach to dataset collation (especially in terms of co-ordination, extraction, lineage recording, error minimisation techniques and so forth);

- More advanced training in GIS being given to a larger staff cross section and upgraded from time to time;
- The availability of more capable and faster GIS software and associated hardware (including processing and display facilities);
- Better database networking between the various sections within the organisation;
- Better exchange compatibility with a direct access to reliable externally based GIS sources of information;
- Greater reliance on GIS oriented sensors for automatic or quasi-automatic dataset generation;
- Better quality control;
- Improved security measures and intervention recording and accountability; and
- Future Resilience.

These requirements led to plans to procure more advanced technologies coupled with training initiatives. In the meantime the MEPA demerger process was concluded in 2016 through the creation of two separate authorities namely the Planning Authority (PA) and the Environment Resources Authority (ERA). This necessitated further data restructuring as well as updated of existing ICT and GIS related technologies in order to meet current and foreseeable requirements and to better meet the new organisations' statutory obligations.

The legislative changes in ACT VII of 2016 stipulate a greater degree of consultation and participation. Modern society has greater expectations from modern regulators to be informed, updated and presented with user friendly evidence based information in an efficient and equitable manner. Transparency also thus features heavily.

The Implementation aspect of Spatial Plans and Policies

Spatially oriented plan and policy formulation processes were guided for a considerable period through the strategic direction provided by the Structure Plan for the Maltese Islands (MDI, 1990). Other subsidiary policies had supplemented this guidance until the approval of all the Local Plans in 2006. Experience has suggested that a section of the Maltese public and development related professions preferred a deterministic situation,where the plans have sufficient spatial resolution and the associated policies clear-cut. Thus the development attributes of a property could be determined without recurring to a considerable degree of ad hoc interpretation. Conversely, there were many instances where other sectors within society and the same development related professions advocated the requirement for a higher degree of flexibility so that development proposals could satisfactorily address the prevailing and envisaged dynamic socio-economic challenges. These conflicting "requirements" have led to plans and policies sometimes leaning to the more deterministic approach, and some time later leaning to the more flexible approach (Flexibility.co.uk, 2016).

Both the deterministic and the flexible approaches have their advantages and shortcomings. The deterministic approach introduces a greater degree of security and stability and thus may foster a greater peace of mind. However it may introduce unnecessary constraints which may stifle innovation or changes to development patterns which ensue in a dynamic economy. Conversely, the flexible approach introduces possibilities for novel interventions which are better suited for changing market needs but may introduce a considerable degree of uncertainty and a degree of suspicion in the operation of the various planning processes.

Is it possible to integrate the two approaches? The answer is possibly in the affirmative but much depends on the substantiating data (clear, unambiguous and scientifically based data) which underpins the plans and policies, the development of options on which planning scenarios are based and a clear and transparent justification for the selection of the favoured scenarios. Moreover, the plans and policies have to be designed in such a manner as to limit flexibility on overriding considerations but extend it where this is not critical. Of course such is easier said than done but this is believed to be possible. Additionally, there must be a clear and transparent linkage between the actual policies and their interpretation through the consideration of development planning applications. In the past such deviations have not always been satisfactorily justified and even when possibly justified, the justifications were rarely sufficiently evidence based to initiate policy amendment to address an unsatisfactorily operating plan or policy. Critical to be addressed is the time required to amend a policy as too much time to undertake the exercise is often detrimental to the rational for changing the plan or policy.

On the participation front, it can be readily inferred that spatial plans and policies which included site specific graphics tended to generate more reaction than proposals which had the absence of such graphics. To a lesser extent, plans and policies which were thematic in nature tended to attract more public reaction than policies which were general in scope.

One of the main Achilles' heels of plans and policies was a significant discounting of a number of socio-economic realities. Past experience suggests that in some cases,less than satisfactory policy performance was predicted by some long before the actual policy was approved. Existing and envisaged socio-economic realities should feature very prominently in policy formulation. The planner should keep in mind that one of the main aims of the plans and policies is to improve the overall socio-economic milieu of the country.

Trials on Graphic Depiction through integration of existing databases with GIS software

The PA has a number of datasets which are GIS coupled. Most of these are made available to the public free of charge through the Mapserver of the PA website. During preparatory processes required for a number of subsidiary planning exercises, possibilities that went beyond what was available in 2014-2015 were explored. The rationale was to radically revise database classification, organisation and setup and proper lineage recording was in place in order to facilitate future analyses, presentation, extraction of meaningful data and monitoring.

A number of tests were conducted to probe the capabilities of available data sets coupled with freely available software. This set the stage to explore other hardware and software possibilities so that future coupling of GIS oriented data sets with spatial planning requirements would be more readily understood. During the same period, additional work was undertaken to examine technologies that couple intelligent sensors intended to regularly and quasi-automatically update existing and future databases (Formosa, 2014).

Most of the tests depicted in this paper are based on Lidar data which was generated through a EU funded project entitled Developing National Environmental Monitoring Infrastructure and Capacity, awarded to MEPA in 2009 (MEPA, 2013). The main aim of the tests was to evaluate depiction capabilities of the various GIS tools - i.e. the presentation aspect. Some tests were undertaken to explore the analytic potential of existing datasets which coupled to a GIS framework. Examples of these trials are indicated in Figures 1 to . These results are encouraging in the sense that they clearly show that when properly depicted, GIS data can convey much more information than graphic data presented as a distribution of symbols or polygons on a map. The psychology of visual perception needs to feature prominently in the generation of these representations. Modern technology also facilitates the use of graphic depiction to better understand either the evolution of a situation over time or the three dimensional aspects of a stretch of territory and interventions thereon. This requires software which depicts dynamic imagery (eg. videos of flythroughs, virtual time lapses and so forth).

The spatial planner is one of the key persons that needs to have a good grasp of the evolving complex interactions between a number of agents and actions over time. ICT based tools can assist with the assimilation of this understanding, the development of sound proposals and to better prospects for more successful conveyance of the said proposals to the rest of the stakeholders.

Figure 1: Test converting LIDAR data into relative surface altimetry to directly estimate building number of floors. Ground verification indicated very good degree of correspondence between the relative altimetric height and the envisaged number of floors. Grey depictions either low structures or trees - test could not distinguish between the two. Construction tower cranes feature as short straight lines. Location - Sliema peninsula. Based on MEPA Lidar data 2012

Figure 2: Test depicting topographical feature extraction from LIDAR data. Steep cliffs, rubble walls, cultural features and other built structures are easily identifyable. Map very useful to understand topography, feature inter-relationships and interaction between topography and history. White cut-outs are built structures. Location - Xrobb l-Ghagin Penisula and il-Hofriet. Based on MEPA Lidar data 2012

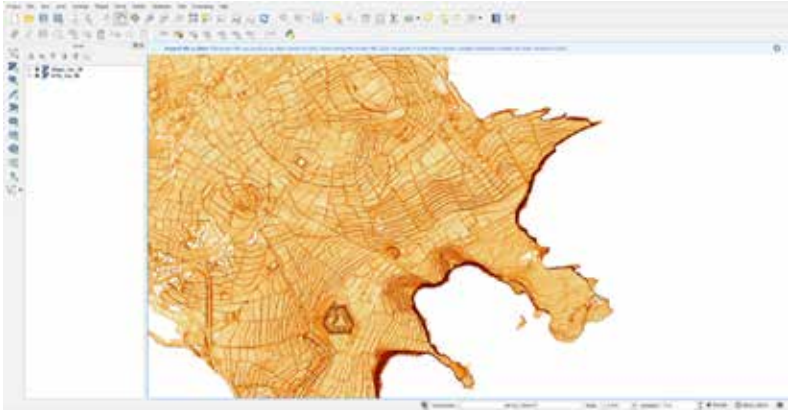


Figure 3 : Test using aspect to extract the 3D-nature of the terrain without using photographic imagery. Natural and mad-made features are often easily distinguishable. White cutouts are built structures. Location - Gharb / Ghasri / San Lawrenz area with L-Gholja tal-Ghammar at the centre of the image. Based on MEPA Lidar data 2012

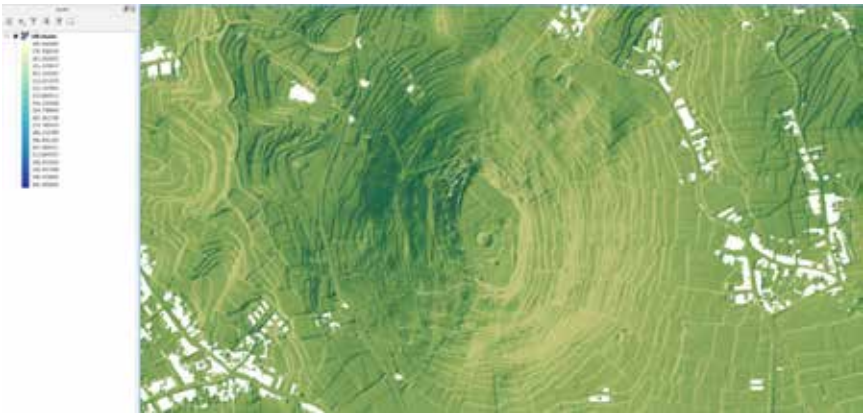


Figure 4 : Test depicting higher resolution altimetric map showing significant sloping terrain. V-shaped valleys and the cliff dominated coastline can also be readily inferred from this image. White cut-outs depict buildings, built structures and the larger trees. Location - Wied Babu area - Zurrieq. Based on MEPA Lidar data 2012

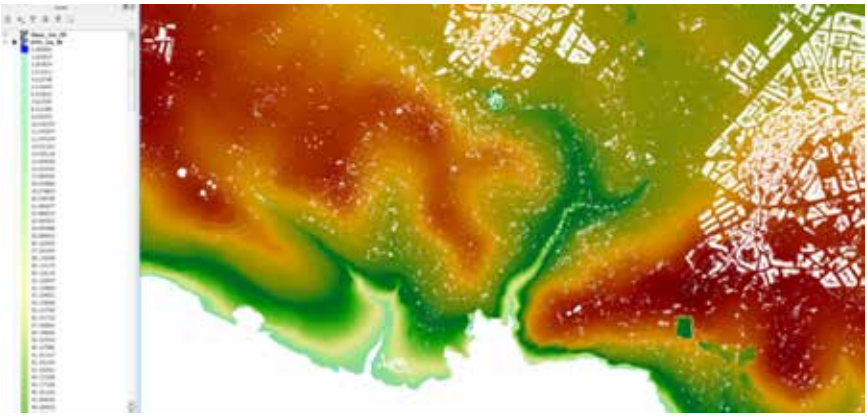


Figure 5 :Test showing a higher resolution altimetric map clearly suggesting the rationale for a number of man-made features (including roads and fortifications). Such maps may also assist in the identification of areas subject to wave action and localized pluvial flooding. White cut-outs include higher stuctures such as buildings and higher trees. Location - Valletta and surrounding areas. Based on MEPA Lidar data 2012

Figure 6: Test depicting the Hill shade function used to highlight the intervention of man-made terraces on the natural landscape. Location - Wied Migra l-Ferha area due SW of Mtahleb. Based on MEPA Lidar data 2012

Figure 7: Test indicating how careful choice of slope parameters and corresponding chromatic depiction can greatly facilitate identification of structures such as the more imposing fortifications. Location - Valletta and surrounding areas. Based on MEPA Lidar data 2012

Figure 8: Test showing slope mapping applied on a monochromatic basis. White features are the built up areas or significant structures, grey areas represent relatively flat terrain whilst black areas represent steep slopes. Excavations, steep sided mounds and V-shaped valleys thus feature prominently in this map. Location - Area around the Malta International Airport. Based on MEPA Lidar data 2012

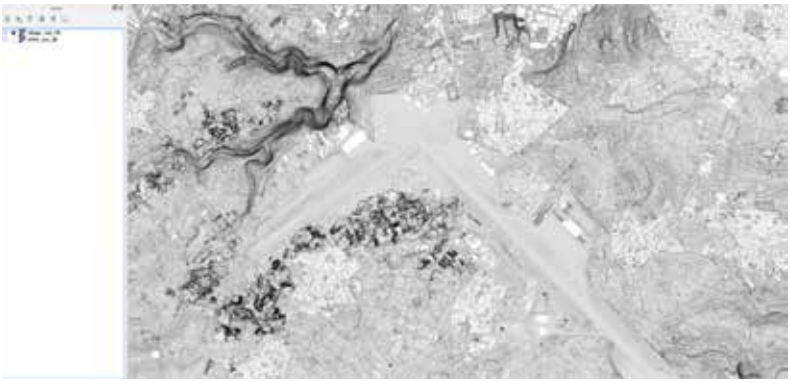
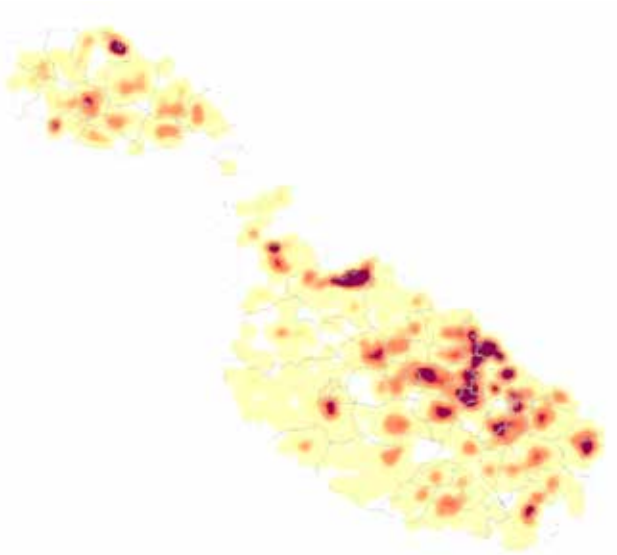


Figure 9: Test showing heat map depicting distribution of vacant dwellings in 2011. The darker colours indicate higher concentrations of vacant dwellings. The heat map suggests a greater percentage of vacant dwellings in the area around the inner Harbour area and Tourism oriented areas. The level of resolution is however too low to permit a deeper analysis. Based on aggregated data of water and electricity meterage registering zero consumption



Relevance of newer ICT based technology to future Spatial Planning

There is always scope to support spatial plans and policies with better evidence based information which is as user friendly as possible. Although there is much greater potential in modern technology, it is often complex to use and requires considerable technical skill to operate. Equipment and software are expensive and need specialised personnel to maintain, troubleshoot and periodically upgrade. Moreover, if not diligently employed,ICT based technology may complicate rather than facilitate the understanding of spatial planning situations. Additionally, the participatory nature of modern planning implies that the planners need to have better administrative, managerial, leadership, communications and presentation skills in order to fully convey the underpinnings of their proposals. Technology based on ICT/GIS related platforms, if well understood and judiciously employed, can assistwith the better conduct of the above functions.

So in which areas can new ICT based technology be relevant? Given that spatial planning has a spatio-temporal aspect, it is important that the hardware and software used to assimilate, analyze, model and depict data is versatile enough to process informationin quasi real-time.Moreover the information has to be as up to date as possible and organisedin formats that are amenable to be used by the planners and associated expertise. The same information should also be easily converted into electronic formats which are readily accessible in formats that are familiar to other key stakeholders and the general public.

Therefore the following are considered to be the main areas for improvement deemed possible through new ICT based (especially GIS) technologies and the associated expertise:

- More organised and better networked data collection processes;
- Improved data validation tools and quality control;
- Superior cross-platform and interagency collation, organisation, assimilation and analysis of data;
- Enhanced data exchange and handshaking through faster networks (fixed and wireless);
- Improved generation of evidence based statistical and other quantified data;
- Better depiction and presentation of significantly larger quantities of data;
- Greater use of image manipulation and dynamic imaging software (e.g. fly throughs) to enhance depiction flexibility (in space and in time);
- Better opportunities to develop scenarios based on available and projected information;
- Opportunities to upgrade and update data at much more frequent intervals to update,maintain and upgrade relevant datasets. This would greatly enhance the planning related monitoring processes and the prospects of updating plans on the basis of the most recent data. There is ample scope for automation on some datasets;
- Permit the increased direct input of various intelligent sensors which are coupled to automatically generate meaningful data in lieu of time consuming and less reliable manual data collation. More advanced real time data acquisition and monitoring delivered through a range of smart networked sensors would thus be achieved;
- Marked improvements in security and error protection facilities in software to keep track of and tabs on all interventions in the various planning processes with the required access and updating security protocols in place;
- Enhanced integration and exchange of information between public and private agencies; and

- Improved prospects of having dynamic plans whereby certain policies would be future resilient by being designed to operate according to predesigned triggers which are subsequently acquired from monitoring data (i.e. changing policy provisions according to monitoring outputs - i.e. if this happens, then an appropriate policy provision would be applicable).

In order to achieve better communication with ICT/GIS specialists, other stakeholders in the planning process, the key decision takers and the public at large, it is important that at least some spatial planners are equipped with ICT/GIS skills to facilitate dialogue and networking with the specialists in these fields. This would essentially translate into better multi-disciplinary handshaking and easier translation of planning ideas into outputs that can subsequently not only inform the planners but the rest of the players involved in the processes leading to the adoption of the respective spatial plans and policies. It is therefore deemed beneficial that the average planner has at least a basic understanding of modern GIS based and related data management and analysis software.

Familiarity with visual simulation, data (including GIS) querying, media presentation and image manipulation software would also be useful assets. Although spatial planners may not always be required to generate plans which include maps, associated imagery and graphics which can be comprehended by the widest possible spectrum within society often help with the participatory and consultation processes.

Conclusion

It is clear that ICT based technology can go a long way to render the various spatial planning processes more efficient, available to a wider audience and more comprehensible. Like every other tool, ICT based technologies are only as good as the intentions, knowhow and diligence in application of their use. Moreover, these technologies require considerable investment to secure the hardware and software which can efficiently process, exchange and effectively display huge amounts of data. Staff using the technology would require to be well versed in the capabilities and limitation of the said technologies and thus training is a must in order to promote the best possible use of the relevant tools.

To date, most spatial planners tended to have limited technical competence in the use of the various ICT based technologies. This paper is proposing that greater familiarity with these tools may open opportunities in terms of better exploitation of the as yet untapped potential and better communication with other experts in the field leading to superior deliverables and better externalisation of the processes and results.

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References

Caperna, A. (2016). *Information Communication Technology to support Sustainable Urban Planning* Available at: http://www.slideshare.net/antcap/ict-and-urban-planning (Accessed June 2016)

Flexibility.co.uk, (2016). *Planning in the Information Age* Available at: http://www.flexibility.co.uk/issues/modgov/planning.htm (Accessed June 2016)

Formosa, S. (ed), (2014). *Future Preparedness: Thematic and Spatial Issues for the Environment and Sustainability* University of Malta, Malta

Formosa, S. (2014a), Neogeography and Preparedness for Real-to-Virtual World Knowledge Transfer: Conceptual Steps to Minecraft Malta, *Future Internet* 08/2014, 6(3), 542-555; doi: 10.3390/fi6030542,

GoM - Government of Malta , (1992). *Structure Plan for the Maltese Islands - Draft Final Written Statement and Key Diagram* Planning Services Division, Ministry for Development of Infrastructure, Malta

GoM - Government of Malta , (2010). *ACT No. X of 2010 - Environment and Development Planning Act 2010* Dept. of Information, Malta

GoM - Government of Malta , (2015). *Strategic Plan for Environment and Development (SPED)* - Approved Document - July 2015 Available at: http://www.mepa.org.mt/Documents/FinalVersion.pdf (accessed in June 2016)

GoM - Government of Malta , (2016). *ACT No. VII of 2016 - Development Planning Act 2016* Dept. Of Information, Malta

Huang, W.J, (2012). ICT Oriented Urban Strategies- A Case Study of Taipei City, Taiwan *Journal of Urban Technology;* Volume 19; Issue 3, 2012

Karlenzig, W , (2012). *Shanghai Manual - A Guide for Sustainable Urban Development in the 21st Century* - Chapter 8 - Using Information and Communication Technologies For Smart and Connected Cities Available at: http://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/shanghaimanual/Introduction.pdf (accessed in June 2016)

MDI – *Ministry for Development of Infrastructure,* (1990 December), Planning Services Division, Floriana

MEPA - Malta Environment and Planning Authority, (2002). *A few kilobytes on Malta's Best* Website Available at: https://www.mepa.org.mt/news-details?id=337 (accessed in June 2016)

MEPA - Malta Environment and Planning Authority, (2006). *Local Plans - Malta, Gozo & Comino* Available at: http://www.pa.org.mt/LPLegislationPolicyDocslpin?topic=none&doctype=Local%20Plans%20&doctypeid=INLP&docname=none (accessed in June 2016)
MEPA- Malta Environment and Planning Authority, (2013), *ERDF 156 data: Developing National Environmental Monitoring Infrastructure and Capacity*, Malta Environment and Planning Authority, Floriana, Malta
MEPA - *Malta Environment and Planning Authority* , (2015). Development Control Design Policy - Guidance and Standards 2015 Mepa, Malta - also available from www.pa.org.mt
MNCPPC - *Maryland National Capital Park and Planning Commission,* (2015). Bethesda *Downtown Plan - Staff* draft May 2015 Available at : http://www.montgomeryplanning.org/community/bethesda_downtown/documents/BDPStaffDraft_051415_FINAL_sm.pdf (Accessed June 2016)
Nunes Silva, C, (2011). *Handbook of Research on E-Planning:* ICTs for Urban Planning and Monitoring Igi Global, USA
PEARL, (2015). *ICT in Urban Services - Compendium of good Global Practices* Available at: http://citynet-ap.org/wp-content/uploads/2015/05/GP-GL1-ICT.pdf (accessed in June 2016)
Talvitie, J, (2004). *Incorporating the impact of ICT into Urban and Regional planning Available at: http://www.nordregio.se/Global/EJSD/Refereed%20articles/refereed10.pdf (accessed in June 2016)*
UN Habitat, (2014). The Role of ICT in the proposed Urban Sustainable Development Goal and the new Urban Agenda Available at: https://www.ericsson.com/jo/res/docs/2014/the-role-of-ict-in-the-new-urban-agenda.pdf (accessed in June 2016)
Williamson, I. (2010). *Land administration for Sustainable development* Available at : https://www.fig.net/resources/proceedings/fig_proceedings/fig2010/papers/ts03a/ts03a_williamson_enemark_et_al_4103.pdf (Accessed June 2016)