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Questa è la Versione finale referata (Post print/Accepted manuscript) della seguente pubblicazione:

Original Citation:

Cultural Heritage and Sustainable Valorization in the Governorate of Tartous with Reference to the Euromed IV Project: The Contribution of Geomatics / G. Tucci; F. Algostino; L. Bucalossi; A. Conti; A. Nobile. - STAMPA. - LNCS 6436:(2010), pp. 399-408. (Intervento presentato al convegno EuroMed 2010, 3rd International Euro-Mediterranean Conference "Digital Heritage" tenutosi a Limassol, Cyprus nel 8-13 novembre 2010).

Availability:

This version is available at: 2158/401644 since:

Publisher:

Springer-Verlag Berlin Heidelberg

Terms of use:

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IV Project: The Contribution of Geomatics

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Abstract. Six Mediterranean countries are participating in the “Mare Nostrum” project: “A Heritage Trail along the Phoenician maritime routes and through the historic port cities”; the goal of this project is to valorize the cultural heritage of the sites involved by promoting and supporting sustainable tourism. WP4 concentrates on the port cities of Tyre and Tartous, chosen as pilot sites. The on-site research was conducted in accordance with the WP4 objectives: on the one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; on the other hand an enormous amount of photographic and video documentation was collected for the 3D models that were produced in the first phase. The paper will describe how the disciplines involved in Geomatics can provide important contributions to all four phases of the Heritage and Development framework.

Keywords: Cultural Heritage, Laser scanning, Virtual Tour, Cultural Mapping

1 Cultural Heritage and Sustainable Valorization

Six Mediterranean countries (Syria, Lebanon, Greece, Italy, Malta and Turkey) are participating in the “Mare Nostrum” project: “A Heritage Trail along the Phoenician maritime routes and through the historic port cities”; the goal of this project is to valorize the cultural heritage of the sites involved by promoting and supporting sustainable tourism.

This goal is being achieved by: raising public awareness of the importance of serving and promoting sites; valorizing and promoting the Cultural Heritage of the different Mediterranean basin cultures in a more communicative way; preparing effective management plans to reduce the marginalization of archaeological sites; to enhance the centuries-old port-city relationship; defining management plans for the target sites that will promote sustainable tourism.

WP4 concentrates on Syria and Lebanon where the port cities of Tyre and Tartous (including the nearby Arwad Island which is already on the World Heritage Tentative List) have been chosen as pilot sites. In both cities WP4 has to

nean map that connects all the port cities involved in the project; place explanatory panels on site to provide information for tourists.

The concept of sustainability has a double meaning when it is applied to heritage management: in the physical sense it means that excessive concentration of tourists have to be avoided to ensure that the conservation of the cultural heritage is not compromised; in the economic sense it means limiting the cost-benefit ratio and thus increasing the capacity for promoting development. Conservation management planning and the model for sustainable valorization can be integrated to evolve a new model wherein heritage serves as the core of the development process. This process moves through four phases: *Awareness*- Development begins with the identification of resources which have to be documented and studied to have a potential use; *Appreciation*- Development emphasizes public participation in heritage activities; *Protection*- The tools of reference are heritage charters (laws, policies and practices) and conservation guidelines (technical standards); *Utilization*

2 The Contribution of Geomatics

The contribution of geomatics does not only consist in the application of information technology procedures but creates a new methodological behaviour in the data acquisition and management process. Geomatic techniques can play a key role because they provide innovative and more complete ways of describing the environment which, in their turn, allow approaches at different levels:

1. Geomatic techniques can manage enormous quantities of data relating to the geographic location but generated at different times;
2. Extra features can be added to the representation field during the research process using processing to reconstruct modifications that have taken place over time;
3. Georeferencing of data makes possible to link the existing relationships between cultural heritage objects;
4. The knowledge acquired can be widely disseminated on-line;
5. The information can also be transferred to external databases and web sites.

To sum up, the research for this project uses geomatic techniques to propose innovative ways of using case studies, allowing diverse analogous elements (the archaeological sites) linked to each other in the Phoenician commercial maritime routes system to be considered simultaneously. In this sense it is possible to propose hypotheses about the valorization of these heritage objects which take into account a series of conditions such as accessibility, current transformations within the area, relations between the different important monuments which profoundly effect their use. The use of these techniques on these objects should be seen as an opportunity for increasing our understanding of the past.

The disciplines involved in Geomatics provide important contributions to the four phases of the Heritage and Development framework: awareness, appreciation, protection and utilization.

other a powerful tool for communication. To provide the cultural heritage with a powerful system for learning, enriched by information technologies, is the first step towards a better understanding of the sites and an essential step towards their appropriate valorization.

3 Description of the Places

Tartous was founded in the 2nd millennium B.C. as a coastal settlement on an island belonging to Aradus (the present day Arwad), a small island 3 km away and one of the most important Phoenician city-states. It expanded as an independent city-state until Emperor Constantine and his son Costanzo II. The city was conquered by the Muslims in 636 and was of little importance until it was taken by Raymond de San Gili during the First Crusade. In the second quarter of the 12th Century the Cathedral of the Lady of Tortosa, one of the best preserved Crusader religious buildings, was built. This fortified structure makes it unique among the Latin churches of the Near East.

In 1152 Tartous became one of the main settlements of the Knights Templar. They built the Citadel in the north-west corner of the city. This Citadel was built with three concentric walls and a double moat. Although dwellings were later built within the walls, the concentric walls and a double moat. Although dwellings were later built

Fig. 1. Historical phases of the Citadel of Tartous. The numbers indicate the most recognizable examples of Crusader architecture that are still recognizable.

Tartous is currently the second most important city on the Syrian coast. It was the main centre of a network of important points of interest for culture and tourism. Its relationship with Arwad has now been reversed: the island is only a small part of the coast and depends mainly on local daily tourism. There are significant remains of the Phoenician Aradus on the island including the imposing remains of the walls facing the sea. The importance of Arwad during the Crusades is testified by the presence of several castles, one built by the Crusaders on the highest point of the island, the other by the Arabs by the sea.

There are other important archaeological remains 7 km from Tartous at Arwad. A temple known as Maabed, is a basin carved into the rock surrounded by a wall of stone with an altar in the centre, which holds water from a nearby spring. Near it there is a necropolis with underground tombs and two monuments called Meabed and Maabed.

There are also the remains of the docks of a port and a stadium from the Hellenistic period. Further from Tartous there are other important sites of cultural interest. One of the most interesting is the Hosn Suleiman archaeological area (the ancient city of Suleiman), a sanctuary dating from Phoenician times with a well preserved sacrosanct area and the remains of two temples dedicated to Zeus and Astarte. There are also several castles in the area which date back to the Crusades. The White Castle, the Al-Marqat Castle and the Krak des Chevaliers, the most famous and best preserved of the castles of the Crusade period, were all inspected during the mission.

4 Goals and Methodological Choices

During previous WPs, graphic, cartographic, iconographic and bibliographic information was gathered for pilot sites and so, after an inspection, it was possible to choose the area on which to concentrate the on-site research. Studies by G. A. Neghiz and Bouteflika were used as references for the urban analysis of Tartous and the surrounding area; the “Memorandum on Sustainable Urban Development in Syria” and the “Workshop on the preservation and development of the old city of Tartous” by GTZ and the Syrian Ministry of Local Administration and Environment, provided information on guiding principles and programmes in the important areas of urban policy and management.

The on site research was conducted in accordance with the WP4 objectives. On one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; this provided the necessary information for the archaeological analysis (chronological phases, construction techniques, state of preservation) required for preparing conservation guidelines; on the other hand an extensive amount of photographic and video documentation was collected for the 3D models that were produced in the first phase; this documentation is being used for the popularization and communication of the most interesting sites: architectural, urban landscape and archaeological sites.

In particular: integrated topographic and laser scanning techniques were used to provide a metric survey of the Knights' Chapel and the urban spaces of the Citadel; the most interesting parts of Tartous (the Citadel and the Cathedral).

4.1 Metric and Thematic Survey

The metric surveys and the studies of the materials and construction techniques were mainly carried out in the old city of Tartous. The urban fabric has a complex structure because of its pronounced vertical stratification. The Knights' Chapel and the vaulted galleries, both situated in the inner circle of the city walls, and a portion of the wall circle (Figure 1) were chosen because they have best preserved the peculiar characteristics of Crusader architecture. Three-dimensional metric surveys were carried out to obtain the disposition of masses on an urban scale as well as the detail required for analyzing wall textures. A topographical network with 7 vertices was defined in the urban fabric, 59 topographical targets which were necessary for the alignment and reference of the range maps acquired. An HDS6000 phase-based scanner was used for the metric survey. The shooting geometry and the scanning resolution were modulated to adapt them to the morphological characteristics of the spaces. Data was acquired from different view points to ensure uniform data coverage and to minimize any "shadow areas". Documenting the Chapel's morphometric characteristics, the techniques used, the extrados of the vaults, the fallen down parts and the texture of the walls was a complex business partly because it was difficult to obtain access to adjacent private spaces but also because it was difficult to transfer the reference points around the building. A total of 43 scans were carried out: 20 for the Knights' Chapel, 5 for the Ottoman galleries, 5 for the portion of the town walls and 11 to document the urban fabric in which these structures are inserted.

In the parts that have been studied it is possible to measure the size of the spaces, their shape, the workmanship involved and the construction criteria used. A variety of wall building techniques has been documented. As an example: the wall from the Chapel is made up of perfectly squared parallelepiped blocks; the wall for important buildings; portion of wall from the service galleries, is composed of small blocks of rather irregular shape in a homogeneously textured wall surface.

4.2 Image Recording

All the sites that are part of WP4 – the Cathedral/Museum of Tartous, the Cathedral of Amrit site and Arwad - have been documented using the most innovative digital techniques available to produce spherical panoramas, high resolution image montages and digital stereo images. More than 14.000 photos were taken to cover the different aspects of the mission: they show the places, the architecture, the landscapes, the residents and the local handicraft production as well as documenting the different stages of the work. A panoramic head, combined with a 15 mm fish-eye lens, was used for photographing complex or particularly wide spaces that could not be covered by a single photo and panoramas were elaborated using cylindrical equirectangular projection. The individual photos were mounted using software so they could be viewed as 2D files and explored as immersive environments. About 70 panoramas were mounted: each one was made up of an average of 21 photos and a maximum of 100 photos. Up to 3 stop bracketing was used for every single photo: these mul-

dynamic range) images.

5 Graphic Output

The total points model obtained after the alignment and referentiation of maps is an extremely versatile 3D database as it allows graphic output to be to meet specific requirements. Extracting information from the data gathered by scanning systems is a complex time-consuming post-processing operation that requires special software and skilled personnel. The following information contained in the range maps: plans, elevations and vertical sections; 2D image of a range map; 3D static and dynamic digital models. Further information can be obtained from the photographic archive: spherical panoramas; high resolution images; digital stereo images.

Table 1. Summary table of metric survey and image recording data

METRIC SURVEY DATA (Tartous Citadel)	
Tartous Citadel total area	about 31.000 mq
Survey area	about 6.900 mq
Surveyors	4
Topographic survey	
Total station	Leica TCR 303
Closed traverse	1
Open traverse	1
Vertices	7
Least-squares adjustment (stdev)	80 ^{cc} , 11 mm
Laser scanner survey	
Laser scanner	Leica HDS6000
Laser scanner stations	43
Acquired targets	59
Acquired spatial coordinates	185.018.130
Registration mean absolute error	0.006 m
IMAGE RECORDING DATA (Tartous and surroundings)	
Photographers	2
Cameras	Nikon D3, D90 and D700
Fixed lenses	15mm f/2.8, 24mm f/2.8, 50mm f/1.8
Zoom lenses	18-200mm f/3.5-5.6, 18-55mm f/2.8
Image resolution	D90: 4288x2848 - D3 and D700: 4256x2832
Photographed locations	16
Avg. number of photos in panoramas	21
Shots for each picture	3
Avg. panorama resolution	360°x80°: 6.000x3.200
Max panorama resolution	360°x40°: 72.000x3.600
Texture pictures	160
Camera and video shooting time	42'33"

nication potential: 3D digital modelling as a method for checking the reconstruction; 3D and kinetic digital modelling as a tool for understanding education and communication; 3D digital modelling for representing morphological transformations. The preliminary results of the surveying campaign undertaken in the Tartous area during WP4 of the Mare Nostrum project are presented below.

A. Plans, Elevation and Vertical Sections The following drawings have been produced:

- A plan (Figure 2) which was realized by integrating a previous survey of the Citadel with the survey undertaken by our working unit. This mixed plan was completed with an orthogonal image of the range maps of all the connecting areas (lanes and the main square) in order to show the extension of the on-site data acquisition.
- Vertical sections (Figure 3) to analyze the urban morphology and the relationship among the buildings.

B. Bidimensional Images Obtained from the Range Map. A precise digital model can simulate 2D images so well that the human eye cannot distinguish these images from perspective photographic representations. The 2D image shown in Figure 4 is an example of the remarkable levels of detail that can be obtained using scanning systems. Obviously, temporal information i.e. the condition of the object at the time it was surveyed, is collected along with the geometric information.

This peculiarity, intrinsic to laser scanner data, has many positive uses for the project (e.g. for search and for setting up multimedia instruments for popularizing, promoting and explaining the project to different user categories).

Fig. 2. Integration of the existing plan with the present situation and the plan extracted from the points cloud

Fig. 3. Transversal section BB' passing through the Knights' Chapel

interactivity, which allows users to extract information (2D and 3D), makes such models ideal instruments for setting up virtual museums which popularize and explain the museums' contents. But this is only one of their possible applications. As these models possess the fourth dimension, time, they introduce a dynamic element to both representation and comprehension. This factor is extremely important as it provides a means of checking historical reconstructions and for representing morphological transformations.

Fig. 4. 2D image of the total point cloud of the Knights' Chapel

D. Panoramic Images. The images were organized in a database managed by Adobe Lightroom 3. This software allows the images to be catalogued using metadata series of information connected to the files containing the images. Some information is memorized when the photo is taken, such as the date, the type of camera used, the lens focus, the time and the diaphragm. Other information can be added subsequently by designing a suitable thesaurus. About 60 keywords have been defined for cataloguing the images belonging to this project which means it is now possible to undertake detailed research within the database. This method of management has made over 30 GB of photographs accessible to the various members of the group and will also make it possible for researchers outside the WP4 group to find images. The position from which the photos were taken is also known thanks to the GPS system connected to the camera. This type of information, known as geotagging, facilitates the use of these images allowing them to be managed in various ways such as classifying them on the basis of geographic proximity. The spherical panoramas (Figure 5) can be used in various ways: to enable the use of interactive virtual spaces on the internet or on CDs; to integrate chromatic information into the point cloud; in pairs for photogrammetric restitution (spherical photogrammetry).

Fig. 5. Spherical panorama inside the vaulted galleries (Citadel of Tartous)

6 Towards a “Shared Cultural Mapping”

There has always been a direct relationship between tourism and cartography. Maps of travel routes and general information about the areas to visit are used in the destination and in planning travel and stay. Today cartography is numerically used on line. Geographically referred data can be questioned, cross-checked and it can be a valid tool for understanding and valorizing planning activities as informing and preparing visitors. Cultural mapping is a process of collecting, analyzing and synthesizing information in order to describe the cultural resources, works, links and usage patterns in a community. The technological revolution has had an enormous impact on the information content available on-line and has given rise to the phenomenon known as user-generated content (UGC). Photos, films, audio and text comments are placed on blogs, podcast guidebooks, social network sites, video content multimedia sites and Wiki at an uncontrollable rate, allowing an enormous audience to access contents that would not have previously been available. Virtual places described had been visited in person. This enormous amount of content leads to form opinions among internet users regarding tourist destinations and recommendations offered and in fact influences the choices made by future travelers. These technological innovations are opening the way for so-called virtual tourism which lets travelers anticipate their travel experience thereby stimulating their curiosity and increasing their interest in the areas visited.

Making a cultural mapping involves many different categories in a participatory approach: residents, administrators, schools, tourist operators, and general public from different perspectives and prepares the ground for effective cultural planning. A map has a greater potential than an inventory; it communicates a rapidly increasing amount of information and appreciation, it draws attention to the cultural area identifies previously unknown resources and activities, it provides the possibility of looking at the territory from different perspective thereby gaining objectivity and overview and identifies gaps, needs and overlaps. The work to be undertaken, in the EuroMed Marine Heritage project, will contribute to programming sustainable development by helping to transform tourism into an element that valorizes the environmental and cultural heritage of a given territory as well as consuming them. The future of the tourist industry depends on the conservation of the environment in which it takes place. The measures required are: to increase the awareness of the population regarding the cultural heritage of their own country, to sensitize visitors and to train tour operators. A series of innovative and experimental measures should also be taken in order to identify strategies and instruments for reducing the pressure of tourism on the environment and improving the quality of the environment in areas that will remain mass tourist destinations (for example the Island of Arwad where the visible degradation is caused by large numbers of visitors).

Michel Maqdisi and Dr. Bassam Jammous (Directorate General Of Antiquities Museums) and Dr. Maruan Hassan, Arch. Alaa Hammoud (DGAM Depa Tartous) for their support and cooperation in the project.

Special thanks to arch. Davide Guerra for the photographic campaign on

References

1. Bouteflika, M.: PhD thesis: Tartous, Syrie: lecture stratigraphique et restauration Tutor: Attilio Petruccioli. Polytechnic of Bari, 17th cycle (2004)
2. Neglia, G.A.: Digital Reconstruction as Part of Urban Renewal Projects: the Citadel of Tartous, Syria. In: Digital Media and its Applications in Cultural Heritage, pp. 161–175
3. Saidi, M.: PhD thesis: Les forms et le fonctionnement du paysage de Tartous modele de projetation. Tutor: Attilio Petruccioli. Polytechnic of Bari, 17th cycle (2004)
4. Coquais, J.P.R.: Arados et sa Pérée aux époques Grecque, Romaine et Byzantine (1974)
5. Deschamps, P.: Les châteaux des croisés en terre sainte. Paul Geuthner, Paris (1961)
6. Folda, J.: Crusader art in the Holy Land. Cambridge University Press, New York (1992)
7. Barber, D., Mills, J.: 3D Laser Scanning for Heritage. English Heritage Publishing (2003)
8. El-Hakim, S., Beraldin, J.-A., Picard, M.: Detailed 3D Reconstruction Of Monuments Using Multiple Techniques. In: Proceedings CIPA WG 6: International Workshop on Recording For Cultural Heritage Recording, Corfu, Greece, September 1-2, pp. 58–64
9. Guarnieri, A., Vettore, A., El-Hakim, S., Gonzo, L.: Digital photogrammetry scanning in cultural heritage survey. International Archives of Photogrammetry and Remote Sensing 35(5), 154–158 (2004)
10. Haggren, H., Junnilainen, H., Järvinen, J., Nuutinen, T., Laventob, M., Huotari, J.: use of panoramic images for 3D archaeological survey. International Archives of Photogrammetry and Remote Sensing 35(5), 958–963 (2004)
11. Reulke, R., Scheibe, K., Wehr, A.: Integration of digital panoramic camera and laser data. In: Proc. International Workshop on Recording, Modeling and Visualization of Cultural Heritage, Centro Stefano Franscini, Monte Verità, Ascona, Switzerland, pp. 27 (2005)
12. Torniai, C., Battle, S., Cayzer, S.: Sharing, Discovering and Browsing Geotags on the Web. HPL-2007-73 (2007), <http://www.hpl.hp.com/techreports/2007/HPL-2007-73.html> {19-08-2010}
13. Tucci, G., Bonora, V., Nobile, A.: Innovative survey methods for the digital documentation of vernacular architectural Heritage in Syria. In: 22nd CIPA Symposium, Milan, October 11-15 (2009)
14. Tucci, G., Bonora, V., Nobile, A., Tokmakidis, K.: Geomatic methods of surveying the Villages of Northern Syria. In: Mecca, S., Dipasquale, L. (eds.) An architectural Heritage shared by East and West - Earthen Domes and Habitats, pp. 157–162. ETS, Pisa (2009)