The metrics database management for the development of the research project

A program of International cooperation Italy-Israel

The Masada project was developed as an on-going research collaboration between the Department of Interior Building and Environment Design of Shenkar College of Design and Engineering, the Department of Architecture of the University of Florence and the Department of Architecture and Civil Engineering of the University of Pavia. Beyond the research aspects, the project has didactic aspects as well. The project, consisting in a proposal for digital documentation of Masada cultural heritage sites.

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On cover: General view of the point cloud about Herod's Palace area.

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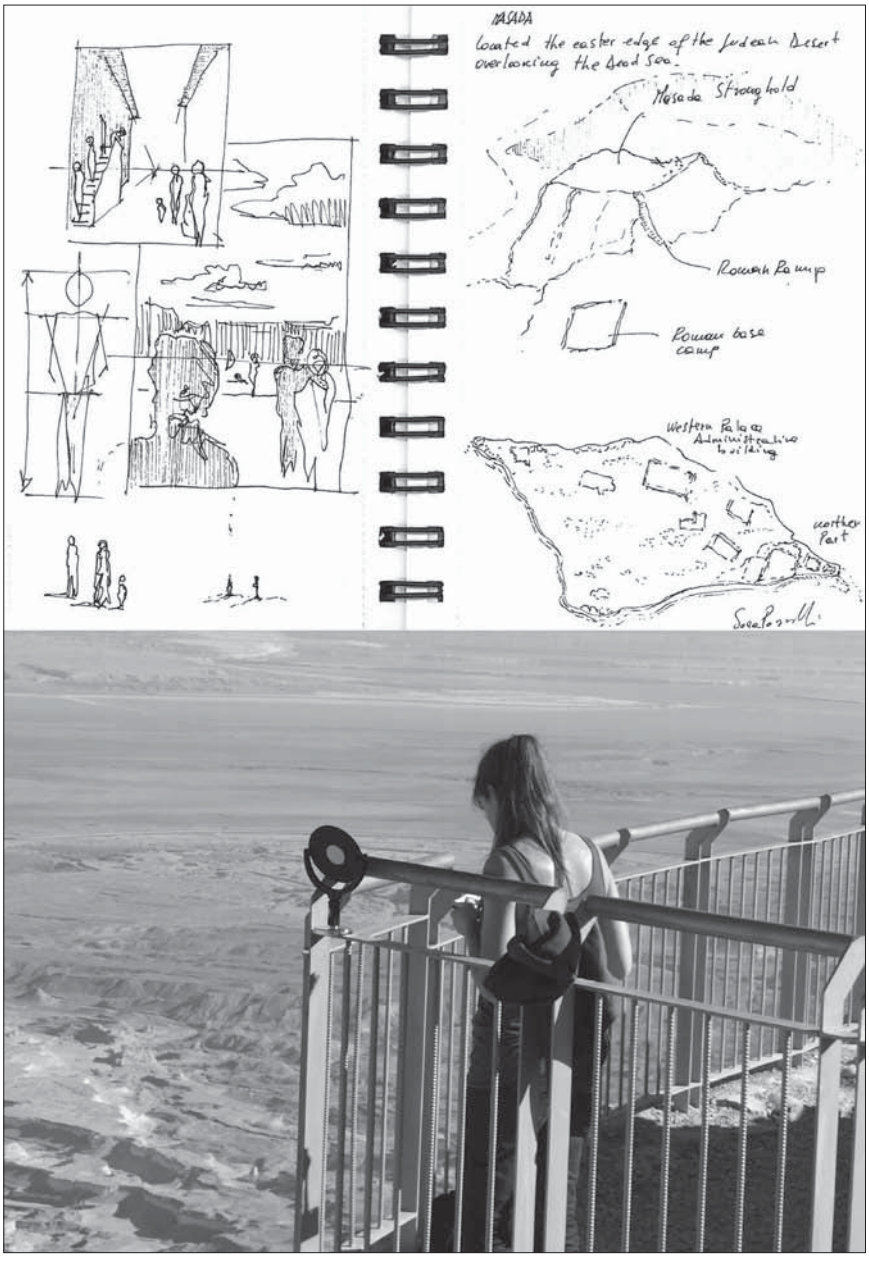

MASADA
located the easter edge of the Judean Desert
overlooking the Dead Sea.
Masada Stronghold
Roman Ramp
Roman base
camp
Western Palace
Administrative
building
northern
Part

The metric database management for the development of the research project

Sara Porzilli

Introduction to the survey activities

The preliminary draft programme of the activities: operators, methodologies and objectives

In the complexity of a survey project, it is necessary to plan in advance the general structure of the activities that are going to be performed on the work site. During an extensive survey activities we come into contact with different instrumentations and survey methodologies that, with different purposes, commonly involved in the acquisition of information by developing different contributions in relation to the quality of the data, to the different forms of information management, to the development of interpretive activities and organizational integration and data interpretation.

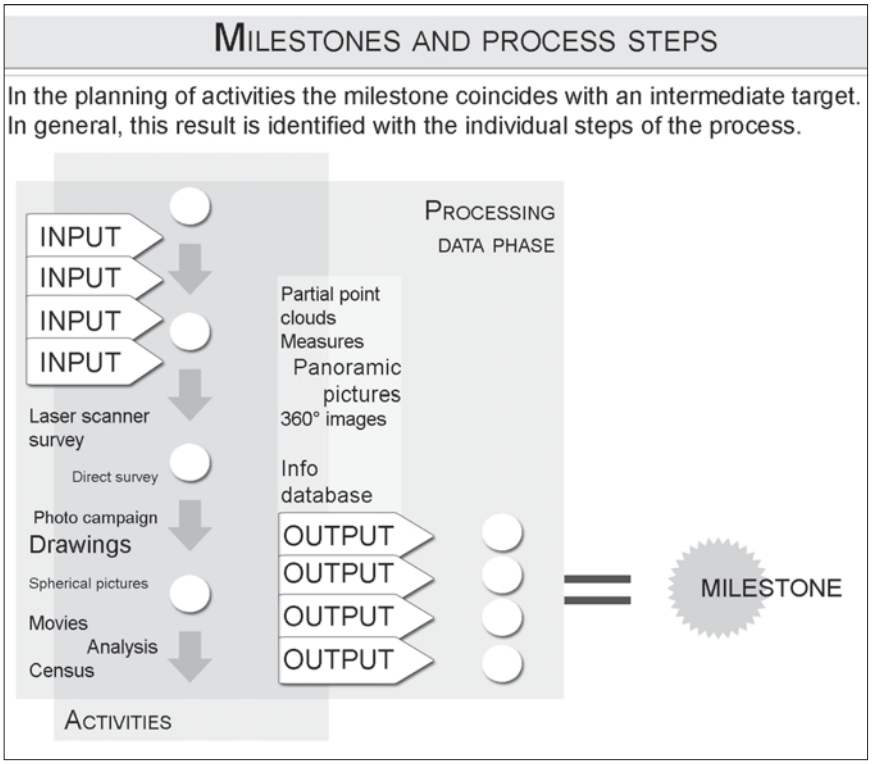
It is important to consider, since the preparatory phase of the research, what is necessary to actively participate, to develop cognitive maps and guidance systems on the complexity of the site, and at what time these different components come into action mutually influencing the ideal image of the context. Defining the type of contribution that each operator will provide to the work is needed to determine what will be the relations not only between the same parties involved, but also between other acquired data which will be organized afterwards and structured in a single model. Understanding the inputs and outputs of each phase or activity of work means to also

In a survey project the preliminary planning of the activities should be adapted and modified according to the suggestions and considerations made on the site. For this reason it is important that the operator uses his notebook to document and determine any changes to the planned activities and methodologies.

For organize, perform checks and then crossed implementations appears evident that the programming and preliminary definition of the complexity of the phases is essential, not only to a logical organization of the individual work groups, but also and especially for proper organization and storage of materials, information and data that each activity provides to the research itself.

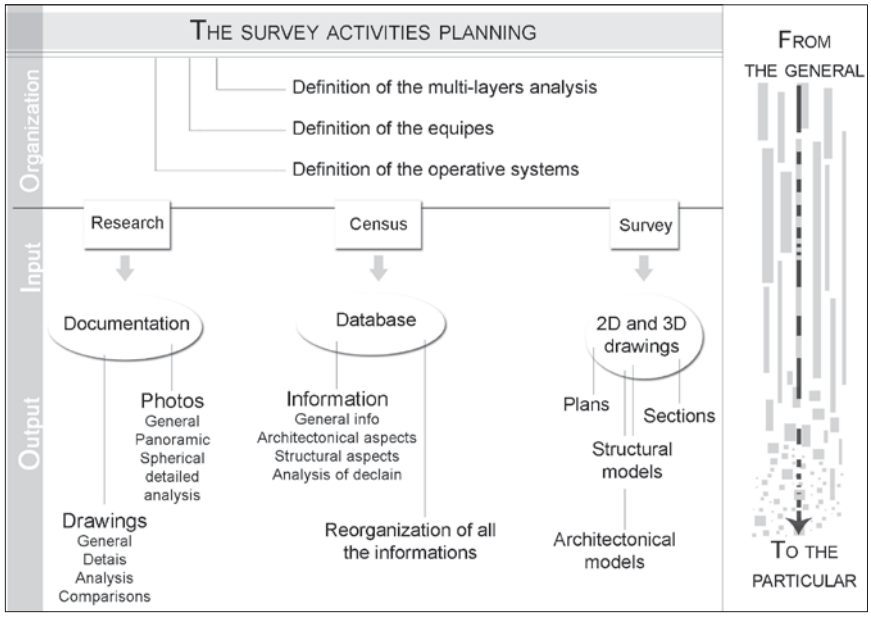
identify the main objectives that you want and can achieve with the material collected (milestones), thus allowing you to frame the subject of research with its variables and changes, streamlining processes and explaining the methods and the dynamics of labor.
In order to have a precise and punctual control of the activities performed and the material they provide, it is essential to work with drawings, diagrams and coding systems (such as activity/time, activities/achievements, etc.). defining the input and output of each stage, or rather defining the preconditions of each activity (instrumentation used, operators who execute the work, and goals) and the final result (giving

All survey operations contribute in the production of useful material to the definition of the documentation of the site. The incoming data defines an input that, after its elaboration, determines an output. The product of more processed data defines a partial but concluded result of the activity done, taking the name of "milestone".



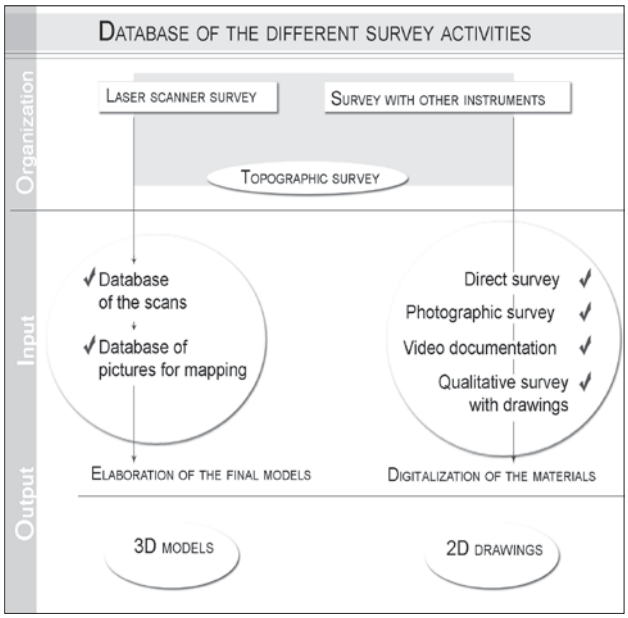
In the design of a complex survey project it is fundamental the identification of the proper instruments and tools available, the type of analysis you want to realize and the final results that you want to obtain. In this process that starts from the general and arrives to the detail it is important to understand what kind of information is collected into the metric database to understand how to manage and reprocess the data.

preliminary coarse result, understanding how they should be reworked and what would be the potential to integrate other data). The project management of all activities, that includes identification of staff, tools and results obtained, it is useful to define a series of explanatory diagrams capable of describing the work from the general to the particular, in such a way as to provide in the first instance to the general description of the activities and then to examine in depth into specifics analysis and considerations. After identifying the organization of activities it is useful to make a timetable functional for the identification of the individual timing necessary for the performance of the different phases in realizing to the total time budgeted for realize the survey activities.
This operation will be extremely useful to understand and verify activities, if each task can perform its work in accordance with the expected times and if it can



achieve the desired objectives. If not, thanks to the comparison with the timetable predesigned, it will be possible to make changes on the amount of work to be performed or on the level of detail provided.

Organization of data acquisition
In a survey project, when tools interact with different methodologies, it is necessary to define a general data storage system that is capable of organizing each area of intervention and, at the same time, able to define possible interchanges and contributions that each area of investigation can give to a another area. For this reason it is important to find a type of structure that would unify and categorize incoming information but also to be prepared to discuss, according to an interface, the early results the *raw* database. Also in this case, resorting with a prior design of the storage system through the use of diagrams, it si beneficial to



Each type of survey determines a different result and final graphic representation. Before starting the activity it is important to understand what kind of results you can expect to get even possible integration between different data.

The activity of post-production is a crucial assessment of the activities carried out on the side and test of the storage system pre-designed.

by having the security of a global management of the work and of the progressive results obtained during the activities.

To ensure that the data storage system is functional and consistent with the purposes and objectives of the research you need to run the operations of the pre-test using the system chosen. The verification and control of the first stages of working has a dual utility, on the one hand it allows to check the functionality of the method of storage, on the other hand it allows a check on the data acquired for the understanding of the object of study.

If the same survey project uses simultaneously different instruments, always in a pre-test phase, it's useful to make and useful to perform a cross-check of the various data collected to understand how different

data will be able to communicate and to be able to predict the level of detail and reliability of the work. The pre-test is essential because it also allows control over the correctness or otherwise of the data as it is acquired. There are in fact two types of errors that can occur during the survey operation activities: metric information not properly gathered or lost, creating a lack of information, and metric information transcribed incorrectly.
In both cases, the comparison with other types of information is fundamental to improve the output of the final result. If all the cross-checks are satisfactory then the work is correctly set up and planned in accordance with the predetermined requirements.
The method of storage is in line with the objectives to be pursued, verifying the correctness of data acquisition

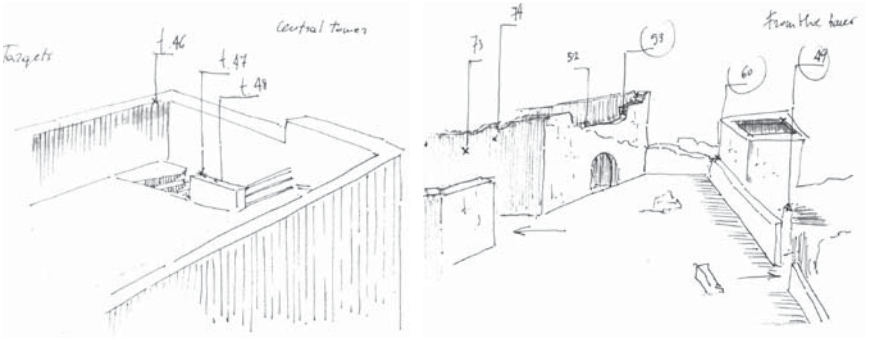
During the post-production phase it is essential to organize a teamwork group to have a simultaneous control of the partial results. This type of activity will also give the first checks on the quality of the data made collected.

during operation in the field so it's possible to proceed in the same manner throughout the whole period of the investigation.

Despite the use of sophisticated instruments and technology it is increasingly important the documentation through drawing and notes on notebook, for fixing the station of the laser scanner (or total station) and positioning of targets.

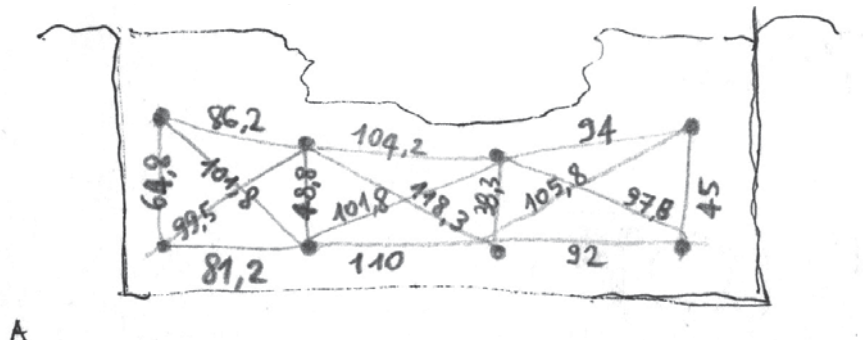
Survey activites for the devolopment of research projects

The documentation through the survey is closely linked to the type of object studied. When an object of research is quite complex or if the work is continues several years, it is important to support the laser scanner survey (or other types of survey like direct survey, photogrammetric survey, etc.) with a topographic survey or with detection systems like *GPS*, in order to have a reliable metric base, which progressively engages the results of the various activities. For the management of data from different sources it is necessary to verify the sources of data that are related through programs and software that are able to rework file formats with different extensions. The software are chosen according to two main requirements: ability to read and interact with different data, the need to perform rework and refunds on the material collected. For this reason it is necessary to have equipment such as workstations and hard disk support storage



powerful in such a manner as not to compromise the quality of the collected material.
The back-up system must be planned in such a manner as to be performed at regular intervals and fixed always on the same support.
The daily backup and rescue must be performed on a fixed workstation and preferably on a removable support like a hard disk, a server or on the cloud to eliminate the possibility of data loss because of malfunctioning of technological supports.

Activity on the site
The start of the survey on the site requires a first phase in which, on a planimetric support already available (or possibly on sketches processed on site to the plan representation of the areas under study) is going to define the macro-areas, assigning a sequential alphanumeric code that should never be changed.
Within each macro area, there are established sub-discipline analysis based on the level of detail that is necessary to be achieved. If it is open environments, the division will proceed with the identification of micro-areas. In case of interiors, the division will identify the limitations of the different rooms, spaces or other known boundaries. In the detailed survey, also a sin-



gle place may be subject to a subdivision, corresponding to the individual elements, the individual structural systems or architectural elements analyzed. The topographic survey performed on large sites, such as Masada has had the primary purpose of acquiring the spatial coordinates of specific points and substantial entire areas, in order to obtain a cloud of points containing all metrics coordinates, capable of defining precise areas, perimeters and significant openings. To document the succession of the different operations, it is important that one of the operators takes note of these points on a notebook or on a general plan and create a daily report of the activities carried out, the control over the material collected and in ordern to have the possibility to compare it with the objectives and the timetable established. At the same time, the phase of the topographic survey that was conducted during the first campaign of the documentation of the northern part of Masada, was according to the three main gradients present. During the phase of acquisition with a laser scanner, it is important to specify in plan where the instrument is located in order to verify if all objects of study were recognized and understood and what portions should be done by integrating different methodologies. In addition to the survey operations through the use of sophisticated instruments, such as total stations and laser scanners, it is possible to enrich the archive with other activities extremely useful, not only for the documentation of the work, but also as a supplement to the metric data for documentation, such as the creation of spherical/ panoramic photos and detailed photos around small to medium size elements for processing directly from the photographic material to the realization of three-dimensional models (this is called fast-survey type). Even for the spherical photos, editing is im-

portant to identify the precise points, from which monitoring shots to document the activity and have a constant control of incoming data in the database metrics. There is free software that allows processing the results of the spherical photos by interpolation of point clouds, similar to the results of a topographic survey. Panoramic photos, such as spherical photos, also contribute to the storage of high-resolution images useful for mapping 2D drawings or for texturing three-dimensional models in the post-production phase. For this reason, it is essential that the coding system and the layout of the floor plans is always the same for the different activities and checked daily by the operators that perform the activities. Pictures of details around small to medium sized objects exploit the use of innovative software that can directly from photo shoots process point clouds that are densely prepared for immediate meshing. In this case, the storage system must respect each detailed analysis of the overall system. This aspect is even more important if we consider that the operators running the survey may not necessarily be the same ones that will work in postproduction phase. It is useful to adopt an encoded storage system that aims to define a scheme of reorganization of the information that would be understandable by each operator who for the first time has to reprocess the information. An organization cascade-type allows you to have a unique code in which one can recognize the identification of the macro area, the micro-area or the room, and then locate the name of the specific space studied. Also in this case, the code to accompany a planimetric identification of where the object is located, can facilitate recognition and tracking of the same element in a more intuitive and easy way.

Storage activity and data management
In a survey project with a complex set of data as described above, it is clear that the use a single system of storing and managing the information gathered, is the only way to have a general check up and detail on all the activities and on the quality of their results. The design of the database is intended to organize the system of information coming from different activities. As information increases, each acquired data passes from being a simple static value to a dynamic element. That's because by entering a piece of information into the system of the database, it begins to relate to and engage with other data, becoming a dynamic element subject to cross-checks and evaluations between different levels of acquisition. For this reason, the testing phase of the storage system is essential: the ability to change the storage structure is inversely proportional to both the passage of time, the amount of data and information that are captured on a daily basis.

The post production process: data integration for the two-dimensional design and three-dimensional modelling

The new digital detection systems have revolutionized some of the fundamental aspects which were the basis of traditional systems of survey, to primarily direct one. Usually during a direct survey project, the operator performed technical operations for individuate the main measurements and information about the object studied. With the new technologies of laser scanning survey, and the development of acquisition methodologies from fast survey through the photography, the risk is to lose the control of information

entering into the database data management. It may happen that one might exceed in the acquisition of certain parts at the expense of others. For that reason, the outcome will not be covered by the right amount of measures. The data acquired is the element with which you start revising the description and representation of the object being analyzed. At this stage the computer database takes an active role, by dynamically changing: from becoming a static container collection in a real operational tool that is functional for the operator or for the group of operators involved in the rework. In the post-production stage the material is reprocessed at first in the same way it has been acquired: it is reprocessed as a topographic survey and operations that are performed during the registration of laser scanner survey (or rather the union of individual projects carried out), through the help of sketches and by studying the place through the consultation of stock photos. During the next phase, the operator needs to determine the metric scale used for the representation, to process the data in a manner consistent with the level of detail required. After performing the graphic base updates, it's possible to go deeper into the work, through a system of elaboration, which goes from the general to the particular, just as it has been coordinated and organized in the stages leading to the activities.