IMEKO International Conference on
Metrology for Archaeology and Cultural Heritage
Torino, Italy, October 19-21, 2016

The CHeLabS System: sustaining Methodological and Technological Innovation in the Cultural Heritage domain

Paola Calicchia[1], Luca Pitolli[2], Paolo Salonia[3]

[1] *Institute of Acoustics and Sensors "O. M. Corbino", Via Fosso del Cavaliere 100 – 00133 Rome, paola.calicchia@idasc.cnr.it*
[2] *Institute of Complex Systems, Via dei Taurini 19 – 00185 Rome, luca.pitolli@isc.cnr.it*
[3] *Institute for Technologies Applied to Cultural Heritage, Via Salaria Km. 29,300 - C.P. 10 - 00015 Monterotondo St. (Rome), paolo.salonia@itabc.cnr.it*
URL: *chelabs.idasc.cnr.it*

***Abstract* – A territory, with its distinctive cultural patrimony effectively linked to the technological capabilities and grounded in the socio-economic context, constitutes a territorial system seemingly to a large-scale facility.**
This work illustrates the vision statement of a new model of territorial system recently launched, the Cultural Heritage Open Laboratory System (CHeLabS), aiming at the construction of this favorable context. The cultural asset (CH) is at the centre of this system, that addresses the challenge of a CH-driven development in science and technology. CHeLabS is thought as a scalable and distributed laboratory based on the Open Access and Sharing culture. The implementation of its current phase, consisting in a participated survey, is here described.
Keywords: Cultural Heritage Territorial System; Safeguard; Innovation Processes; Multidisciplinary; Open Access; Sharing.

I. INTRODUCTION

Although the specificity of any heritage object needs to be considered in preventive conservation, the correlation among different cases of problems/solutions amplifies the knowledge exchanges, and accelerates the experimentation, the validation and the adoption of innovative instruments.

The present work is focused on a system approach addressing the development, in the long-term, of new and sustainable tools for preventive conservation actions.

Today there is a growing attention of the heritage community to research infrastructures, within the vision of the ESFRI Strategy, as part of the most advanced policy in building systems [1]. Firstly the CHARISMA EU project, and presently the IPERION-CH EU project have strongly pushed the culture of the open access facilities among this community. Furthermore, a modern environmental planning and management approach for cultural heritage sites was developed in the CHERPLAN project, within the SEE program [2]. This approach provided a strong base for a synergy between conservation and socio-economic growth of the territory.

The novelty of the CHeLabS system resides in the combination of the open access policy, for strengthening innovation potential in the heritage science, with the recognition that the cultural asset, grounded in the territory, offers the scenario for a new territorial growth.

II. THE CHELABS SYSTEM

A. Vision

Sites and monuments, historical centres and collections are at the centre of this system, becoming the nodes and the places of a dynamic integration among people, different expertise and capabilities. This process is realized by implementing the access policies, the most advanced technologies, and the activities encompassing research, training and dissemination actions within the patrimony itself, as shown in Fig. 1.

The envisioned CHeLabS structure, as shown in Fig. 2, accounts for a Coordinating Team, a Sites Management composed of the Leaders of the Local Units, and these last involved in the management of each single site. An Advisory Board is appointed to give support for defining the goals and the policies, the harmonization of the sites, the best practices exchange, the standardization of methods, the quality assurance, and the data sharing validation. The system of sites, with their distinctive character, constitutes an Open Access Area accessible, for on-site investigations, to

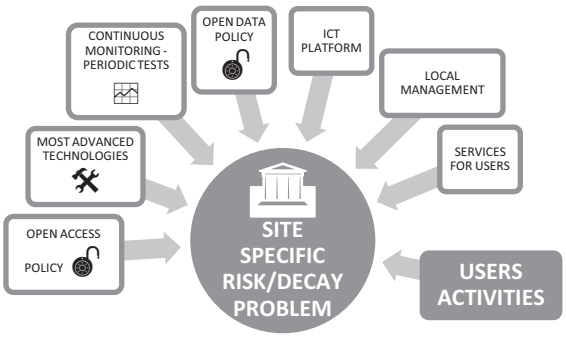

Fig. 1. Configuration of a site of heritage interest when is integrated into the CHeLabS system.

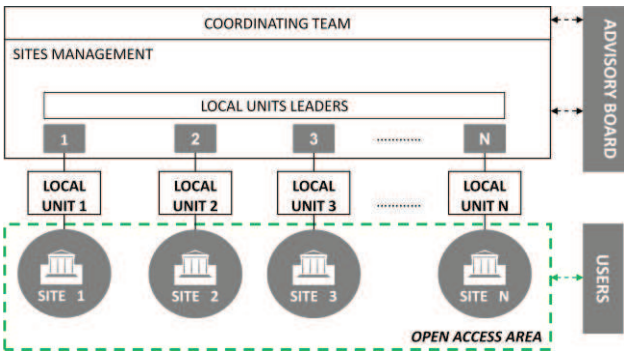

Fig. 2. Structure of the CHeLabS system.

the local units and the external users who propose their activities.

This system is a scalable and harmonized network involving different actors in a multidisciplinary context, stimulating those dynamics that trigger events favourable to creativity and innovation.

B. Inspiring principles

In many fields of science as in everyday life the comprehension of the dynamics of innovation is essential for facing challenges and exploring new solutions to open problems.

In our vision, the CHeLabS system observes the innovation dynamics based on knowledge creation as an essentially collective process. The characteristics of the environment may effectively orient this process. In the domain of social psychological science, also related to the economic science, complex dynamics of the relationships characterize the high performance working teams. Connectivity based on these complex dynamics, positively related to knowledge integration, is a key factor of this context [3 -5].

The heritage science domain has an added value in the multidisciplinary. Within CHeLabS, each subject of the community has an offer and a request/need. Any need, evidenced by one subject, can be satisfied by the offer brought by another subject. Any participant can share his offer and explicit his need in a peer process.

The access to data and previous knowledge, the experimentation facing open problems and also the meeting of stringent practical requirements lead the whole community towards innovative solutions. A shared space, where the interaction of the experts' community with these factors is supported, becomes a place where any new piece of knowledge opens up the opportunity to reach other regions of knowledge still unexplored. In the domain of complex systems science, mathematical models are purposely studied for predicting the dynamics of novelties both in social, biological and technological systems [6].

Finally, the above mentioned space is inside or around the object of heritage interest. Specifically the heritage object, when exposed to its characteristic decay process, is considered the observable system that can be monitored and analyzed in its natural evolution. When top-level assets are gathered in this system, a new scenario will be opened: the cultural assets become the space where methodological and technological innovation systematically occur.

C. How it works

What happens when a site of significant heritage interest becomes a node of the CHeLabS system?

Let us analyze a practical example where the implementation of the CHeLabS system is accomplished in an archaeological area. Let us assume that this area is located in the proximity of a lagoon, and is characterized by seismic hazard related to the geomorphology of the soil and by flooding. Furthermore, we can also assume that structural decay processes affect the built heritage localized in that area. This site may present a number of challenges in the comprehension of the geophysical characteristics of the territory, correlated to the accurate knowledge of the structural decay evolution in the buildings, and in the risk management; all these challenging issues require the development of innovative approaches as well as technologies for effective and preventive conservation actions.

The CHeLabS system intends to implement this approach in the site, through the following phases which are synthetically shown in Fig. 3:

PHASE 1 – Candidature of the site

The management involved in the safeguard of the archaeological area candidates the site to the CHeLabS system, and agrees to adopt an open access policy. The management identifies the specific requirements in order to define a proper framework for the possible users activities, such as:

Admitted activity – research studies; validation; comparison; training camp; dissemination events;

Annual availability – maximum six months per year;

Compatibility with visitors access and enjoyment;

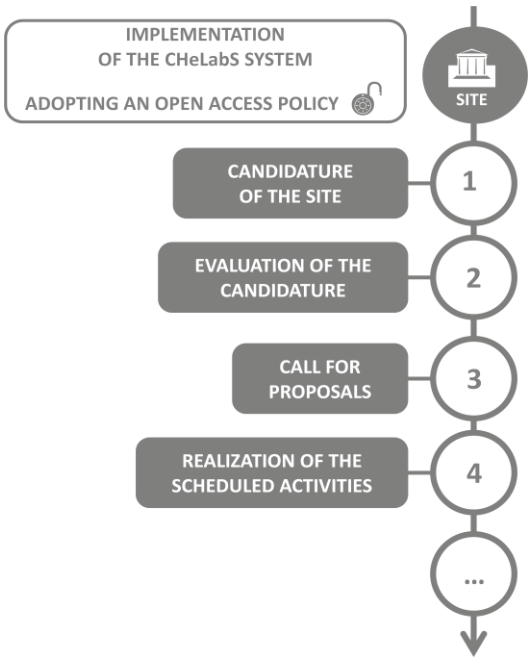

Fig. 3. Scheme of the CHeLabS implementation phases in a site of heritage interest.

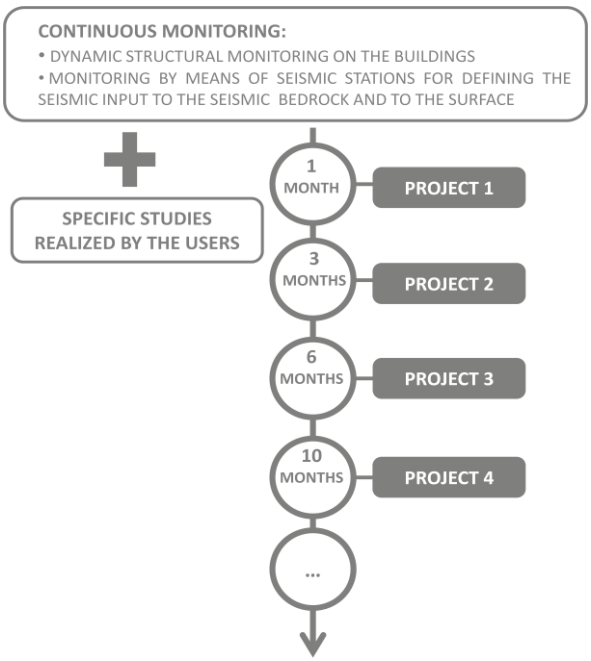

Fig. 4. Scheme showing an example of possible activities in the CHeLabS system.

Available additional spaces for storing external users' equipments;

Duration of open access policy – five years.

PHASE 2 – Evaluation of the candidature

The Advisory Board evaluates the application analyzing the representativeness of the site with respect to the risk/decay specificity, and identifies challenging issues that are strategic elements for the accomplishment of the CHeLabS objectives. All the practical aspects related to the authorization are preventively faced and solved at this stage; successively the equipment of the site can reach an operative state, disposing the site to become a node of the system. Advanced instrumentations are made available on the site:

Devices for constant monitoring - seismic sensors in borehole; wifi accelerometer arrays for the high-dynamics monitoring of the buildings; 3D laser scanner; systems for interferometric data.

Devices for specific studies – multichannel seismic antennas; systems for geophysical measurements of the subsoil; systems for structural tests for the static deformation parameters definition in buildings.

Data accessibility – open access to archives; data sharing.

Site accessibility services.

Management – local team creation.

PHASE 3 – Call for proposals

Calls for proposals are periodically launched to collect, evaluate and schedule the future users activities.

PHASE 4 – Performing the scheduled activities proposed by the users.

The site starts its full operation phase, as shown in Fig. 4, hosting the external users activity:

PROJECT 1 – integration of interferometric data, seismic data, and deformation data.

PROJECT 2 – digital modeling of monuments by 3D laser scanner and SFM systems (Structure From Motion).

PROJECT 3 – dynamic analysis of structural decay processes with respect to the maximum deformation of the soil.

PROJECT 4 – nonlinear dynamics analysis of the soil.

The effectiveness of the CHeLabS model does not depend on the state of the art technologies that, in a specific period of time, are available on the site. In this way the implementation of the system is continuously renewed with innovative technologies.

This example evidences that the adoption of the open access policy on the site, combined with accessible advanced technologies and data sharing, amplifies and accelerates the knowledge creation process.

The added value of this approach consists in building the proper context that naturally attracts the major experts who face the challenging issues. This triggers innovation processes in the long-term and the achievement of new solutions to still open problems, not necessarily predictable and planned in the

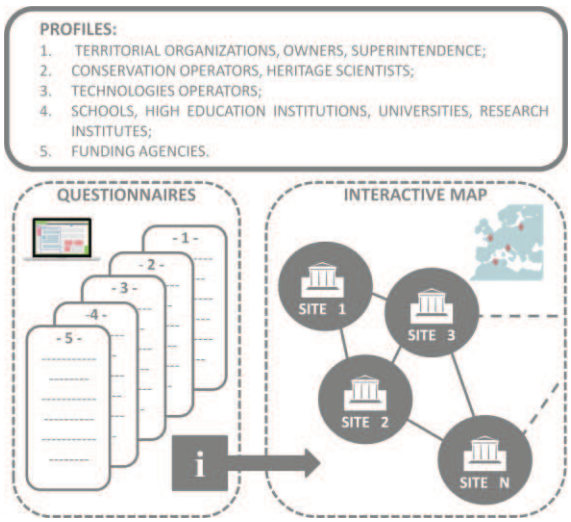

Fig. 5. Scheme of the CHeLabS survey, composed of questionnaires and an interactive map.

implementation phase. This aspect recalls the well known experience of all the large-scale facilities that, in few decades, have strengthen the growth in many research fields.

III. THE CHELABS SURVEY

Today the foundation of the CHeLabS system is set by means of a web based platform, where the wide CH community is invited to participate to an interactive survey, that aims at collecting and correlating the knowledge needs with the competencies and tools from all the other participants.

The survey is structured in questionnaires for five different profiles of participants: 1) territorial organizations, owners, superintendence; 2) conservation operators, heritage scientists; 3) technologies operators; 4) schools, high education institutions, universities, research institutes; 5) funding agencies. The participation also gives the opportunity to suggest representative heritage sites on an interactive map. Fig. 5 shows a scheme of the survey.

The questionnaires are composed of a section dedicated to specific profile information, and another section dedicated to the acquisition of common indications related to the knowledge needs and technological advancements. The information collected in this second section are transferred to the interactive map, in order to become shared and visible to the whole community as well as connected to the heritage sites suggested by the participants. On the map, the participants can express their interest for a site, which is considered particularly significant for fostering the new knowledge on still open problems, and they can add notes to the dossier of a site according to its specificity. Since this initial phase the CHeLabS map, built in this way and shown in Fig. 6, is intended to represent that shared space facilitating the connectivity among the users community.

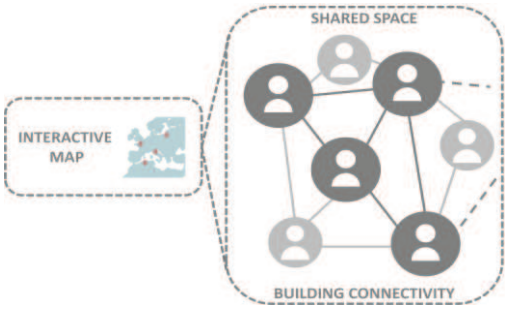

Fig. 6. The CHeLabS map.

IV. CONCLUSIONS

CHeLabS is intended to become a sort of distributed laboratory, attracting competencies and generating excellence, built on the Open Access and Sharing culture. Today, the bottom-up character of the participated survey is inspired by these same principles, inviting the heritage science community to configure a new scenario that will guide the CHeLabS system in its future operating phase.

The initial phase of the CHeLabS project has been funded within the Project SM@RTINFRA – SSHCH (C.N.R. – DSU; MIUR MD n. 973 of 25.11.2013).

REFERENCES

[1] ESFRI, “European Strategy Report on Research Infrastructures: Roadmap 2016”. ISBN: 978-0-9574402-4-1, Mar 2016.

[2] Enhancement of Cultural Heritage through Environmental Planning and Management: CHERPLAN (SEE/0041/4.3/X).

[3] M.Losada, “The complex dynamics of high performance teams”, Mathematical and Computational Modelling”, vol.30, 1999, pp.179-192, 10.1016/S0895-7177(99)00189-2.

[4] O.Caridi-Zahavi, A.Carmeli, and O.Arazy, “The influence of CEOs’ visionary innovation leadership on the performance of high-technology ventures: the mediating roles of connectivity and knowledge integration”, Journal of Product Innovation Management, vol.33, No.3, 2016, pp.356-376.

[5] A.Carmeli, P.B.Paulus, “CEO ideational facilitation leadership and team creativity: the mediating role of knowledge sharing”, The Journal of Creative Behavior, vol.49, No.1, 2014, pp. 53–75 10.1002/jocb.59.

[6] V.Loreto, “Unfolding the dynamics of creativity, novelties and innovation”, White paper of the Kreyon project, 2015.