

ARCHITECTURE HERITAGE and DESIGN

Carmine Gambardella

XVI INTERNATIONAL FORUM

Le Vie dei
Mercanti



WORLD HERITAGE and KNOWLEDGE

Representation | Restoration | Redesign | Resilience

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**WORLD HERITAGE and KNOWLEDGE
Representation, Restoration, Redesign, Resilience**

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Peer review

Scholars has been invited to submit researches on theoretical and methodological aspects related to Smart Design, Planning and Technologies, and show real applications and experiences carried out on this themes. Based on blind peer review, abstracts has been accepted, conditionally accepted, or rejected. Authors of accepted and conditionally accepted papers has been invited to submit full papers. These has been again peer-reviewed and selected for the oral session and publication, or only for the publication in the conference proceedings.

Conference report

300 abstracts and 650 authors from 36 countries:

Albania, Australia, Benin, Belgium, Bosnia and Herzegovina, Brasil, Bulgaria, California, Chile, China, Cipro, Cuba, Egypt, France, Germany, Italy, Japan, Jordan, Kosovo, Malta, Massachusetts, Michigan, Montserrat, New Jersey, New York, New Zealand, Poland, Portugal, Russia, Slovakia, Spain, Switzerland, Texas, Tunisia, Turkey, United Kingdom.

160 papers published after double blind review by the International Scientific Committee

Preface

In the present era, technologies are becoming increasingly important in helping and supporting man in research, knowledge and production activities, almost as if they were smart prostheses. With the theme of the XVI Forum "World Heritage and Knowledge", I propose to the International Scientific Community to debate and establish a comparison of knowledge carriers to communicate methodologies of good practices adopted and experiences in the use in the protection, conservation and safeguarding of cultural heritage and landscape as well as in the design of the "new, "that, adopting in the building processes and building construction Innovative Building Modelling, can realise a non-contemporaneity of what has the same date (Giulio Carlo Argan) respectful of the values of the pre-existing, legitimate because it participated ex ante and monitored becoming all its ethical, aesthetic and performance connotations.

With the Internet of things, for example, sensors that are used to produce data autonomously that widen the processes of knowledge on all levels, from the territory with its infrastructures, to the environment, to the artefacts entering into the body itself of their physicality, or, in the case of the new, building the project as a prediction throughout physical consistency.

Nevertheless, the use of new technologies allows for economies of scale, both temporal and economical, not only for the surveying and representation of the built and the territory in the analysis phase but above all for the management of the resulting data that makes the design activity of the restoration of the historical heritage and landscape or of the newly constructed in a single process no longer divided into steps but also unitary in concrete constructions and the realisation of the works, in the intermediate checks, in the testing, in the monitoring and in the programmed maintenance.

In conclusion, it is indispensable for the scientific community to highlight how technologies, without a responsible attitude that commit man's choices and knowledge in dealing with and planning appropriate responses to the issues and needs of the collective, can create a deception that unfortunately materialises with the subtle persuasion of uncontrolled astonishment that overwhelms the imagination.

Carmine Gambardella

President and Founder of the Forum



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Increasing resilience of Cultural Heritage Assets: the “BIMtoB Academy” project

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Abstract

Cultural Heritage is increasingly threatened with destruction not only by traumatic events, but also by rapidly changing social and economic scenarios, which consider the reuse of existing buildings in the same way as building preservation. Thanks to both the technological maturity and increased accessibility of ICT tools, the current digitalization of the building sector has brought about a way to increase the resilience capacity of cultural heritage. Moreover, the interoperability of systems and the new ways of sharing competences, among all the players involved, has led to awareness of existing cultural heritage assets and risk factors related to transformation processes in the built environment. Consequently, it is possible to identify sustainable maintenance and enhancement strategies to make the preservation effective.

The current “BIMtoB Academy” research project focuses on an impact assessment of BIM-based digitization in the construction sector for existing building project management. The study is based on the application of Integrated Project Delivery Methods (IPD) in order to define, among the Universities, enterprises, real estate asset managers and Public Administrations involved, tailor-made information with different levels of detail and representation according to the type of intervention. Diagnostic analysis, safety, maintenance and an inclusive approach for the project are certainly emerging as key findings in order to drive more effective results.

Keywords: Digital documentation, Construction management, Cultural Heritage, Resilience

1. Introduction

If they are properly managed and integrated, the increasingly available ICT tools can support the resilience capability of cultural heritage, supporting more effective decision-making processes, by forecasting rather than managing risks related to the construction process.

The historic built environment is the result of long-term continuous processes and adaptation, both of individual and collective actions, to climatic, social, economic and cultural challenges. While in the past slow adaptation processes, except for traumatic events, characterized that scenario, the phenomenon has recently become increasingly quicker due to frequently changing social and economic aspects. Obviously, the recognition of the heritage value of a built environment, and its intangible attributes, is the first action, which leads to a preservation and valorization project. Moreover, recognizing, preserving and enhancing cultural heritage assets is an integrated and complex process for the improvement not only of tools and technical applications but also for sharing knowledge, which can lead to prevention awareness.

The paper looks at resilience in terms of the result of a technology transfer process, between Academia and Industry, in order to support cost-effective results in terms of existing building management.

The project “BIMtoB Academy – Integrated competencies for a BIM-based existing buildings project management” funded within the “Regional high competencies Work Programme for research, technology transfer and entrepreneurship” (European Social Fund, 2014/2020, topic 10) aims to

evaluate the impact of the digitization of the construction process in order to optimize integrated data acquisition and diagnostics analysis in relation to project complexity. [1].

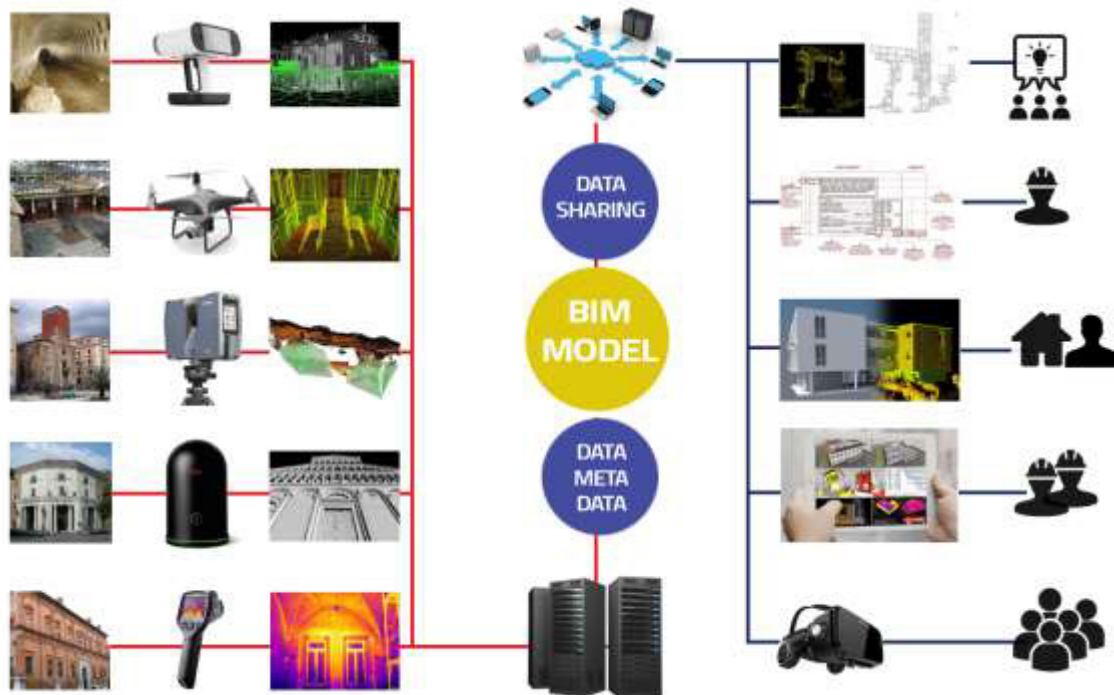


Fig. 1: Integrated survey and diagnostics methodologies applied to existing building management: 3D time of flight laser; scanner survey; topographic survey; spectrophotometric survey. It is possible to obtain CAD representations, solid models by 3D printer, structural analysis and conservative specifications for specific purposes, according with different level of detail and representation for each user.

2. State of the art

The restoration project and both the renovation and reuse projects involve several phases in order to perform on-site data acquisition, data processing and data outputs, which are as complex as the building typology, the building technologies and the project scope. Managing this scenario is less effective and efficient if we refer to the widespread traditional construction process, which is still manual or paper-based.

Nowadays the wide range of devices and technologies available makes the digitization of the construction process more effective, from cradle to grave, and allows all the phases of the traditional project cycle to be redefined from a preventive risk management point of view.

Increasingly, it is possible to make some changes effective, in a similar way to other production chains, such as the transition from preventive or corrective maintenance, based on repairs, to predictive maintenance based on automation and data management decision making. In fact, predictive maintenance is based on techniques that help to determine the condition of in-service equipment in order to predict when maintenance, as well as conservative actions or restoration projects, should be performed [2].

The fact is that the impact of digital solutions for the construction industry is closely related to both the construction phase and the in-use phase too [3]. The introduction of digital tools, such as Building Information Modeling tools, can allow:

- Automatic schedule updating, among all the players involved, through real-time modifications managed by mobile devices;
- Identification, tracking and supply of materials reducing waste, time and errors;
- Remote site inspections;
- Real-time information for predictive maintenance.

However, some gaps in the procedure of integration of diagnostic and survey data still occur due to the lack of interoperable ICT solutions between the BIM tools and ICT tools in use at organizations. Moreover, this scenario is strictly linked to the lack of optimized procedures and methodologies of integrating data models from existing buildings, with reference to project complexity and aims. [4]

The “BIMtoB Academy” will provide designers, industries, Public Administrations and Real Estate owners and managers with optimized data acquisition and processing procedures for existing building management.

3. The project methodology: applying the technology transfer method

Starting from the state-of-the-art concerning BIM software and tools, laws and recommendations related to the digitization of the construction process, such as the New Italian Procurement Code, Legislative Decree no. 50 of 18 April 2016, main surveys and diagnostic technologies available and the digital skills of professionals, the project will develop procedures for an adequate level of detailed digital representation. Based on on-site and off-site case studies, the study aims to make integrated ICT information systems effective, in order to manage existing building project and facility management.

This objective will be achieved by:

- Enhancing data management integration through system interoperability;
- Developing strategies for adequate assessment surveys and diagnostics, related to project conditions, cultural heritage and existing buildings based on data analysis and real-time monitoring;
- Identifying cost-effective strategies for 3D digital surveys and integrated diagnostic analysis.

In order to maximize the impact, the project will adopt a broad Stakeholder Panel within, first of all, the Emilia-Romagna High Technology Network in order to provide a significant relationship between Academia and Industry, both of the construction and ICT markets, and the effective sharing of good practices among all the players involved.

The members of the Stakeholders Panel are involved in:

- Identifying more relevant on-site and off-site case studies in order to provide research with better and transferable results;
- Defining quality evaluation criteria and both qualitative and quantitative indicators to assess the most effective digital strategies and automated data output in H-BIM and e-BIM (existing Building Information Modeling) environments;
- Evaluating research results in relation to the availability of technologies and organization capability.

Moreover, the project moves from the results of the 2nd level master *eBIM: existing Building Information Modeling for construction management*, which involves both architects and engineers [5]. In fact, as results of all the traineeships carried out by students in public as well as private organizations, it is possible to highlight the need for current ICT tools, adopted by the organizations themselves, integrated with a new BIM-based process.

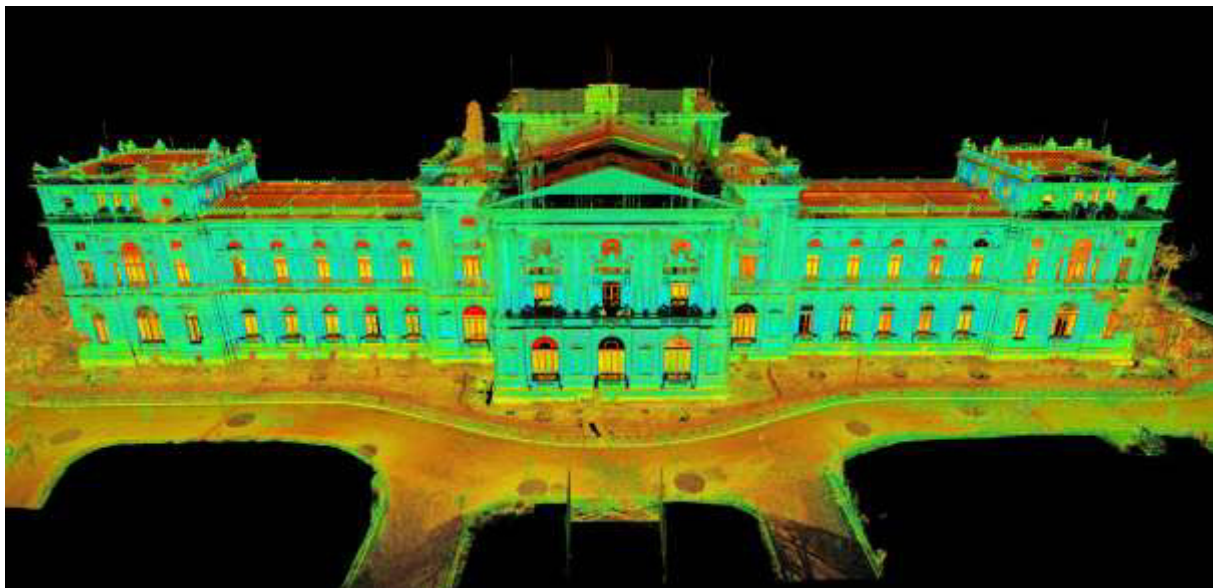


Fig. 2: 3D visualization of the database of the existing state of the Paulista Museum, “Museu do Ipiranga”, Sao Paulo, Brazil. DIAPReM, University of Ferrara, in collaboration with Universidade de São Paulo (São Paulo, Brasile), Leica Geosystem Brazil, Consorzio Futuro in Ricerca. Scientific Responsible: Marcello Balzani.

4. Competencies and new skills for the digitization of Cultural Heritage assets

To ensure that new opportunities for the management of Cultural Heritage assets and existing buildings support effective data-based decision making processes, the introduction of ICT technologies is not sufficient.

Despite the increasing demand for digitized processes, the sector is among the least digitized [6]. The reason for this is not only the lack of digitization competencies and skills among the professionals and technicians involved, but also the poor digitization among all the users involved [7]. As a result, this phenomenon threatens to prevent the conservation of both Cultural Heritage and existing building assets, since more value is attributed to ICT tools rather than to their function [8].

In order to maximize the impact, the research is based on the application of *Quality Function Deployment* (QFD), a user-centered design methodology, which allows the most effective engagement strategies to be identified in relation to the behavior of the end users involved.

Consequently, the higher the value acquired by data processing and management, the higher the value obtained by the representation of the project, with reference to all the end users involved.

The case study of the regional social housing management, as part of the project consortium, highlights the opportunity to make the digitization process effective. While in the past important ICT investments were made in order to adopt a common data environment, current integration with BIM tools is not immediately feasible. This is firstly because of the lack of aggregation of the big data available. Secondly, no criteria have been chosen in order to process all the available data. Certainly, no specific criteria have been identified in relation to technicians, employees, customers and end users.

In fact, real-time monitoring and sensors offer new possibilities to engage all the players in a feedback process, from a “pull-manufacturing” point of view, so that the application of integrated ICT systems provides assets managers with new predictive risk assessment tools.

Consequently, it has become urgent to verify how responsive the solutions identified are in order to:

- Apply integrated mobile solutions;
- Define the adequate information level of details, according with target user;
- Develop interactive maps to make comparing different scenarios effective;
- Address data security.



Fig. 3: Building Information Modeling for existing buildings project management. Integrated data management, processing and visualization. Example of mobile devices adoption in the workplace.

5. Results and long term fallout: tools and methods for the BIM-based project

The introduction of digitization tools and methods could represent a great opportunity for improving the productivity of the construction sector. However, to make the digitization of the process effective more efforts have to be made, despite the availability and accessibility of the BIM software and tools [9].

Definitely, the main issue is still providing owners, Public Authorities and asset managers with case-studies in order to effectively evaluate the interoperability between BIM software and systems and applications adopted by each organization.

The “BIMtoB Academy” will contribute defining this issue through integrated research and educational activities such as:

- 1 II Level Master eBIM: existing Building Information Modeling for existing buildings construction management;
- 1 research activity (WP1) “BIM standards for Public Procurement”;
- 1 research activity (WP2) “Optimized surveys for BIM as-built”;
- 1 research activity (WP3) “Optimizing integrated survey and diagnosis activities for the BIM-based project”;
- 1 research activity (WP4) “BIM for SMEs. Methods and criteria to improve the usability and the accessibility of both Building Information Modeling (process) and Building Information Model (product).”

Starting from a variety of case studies and from the results of a nearly ten years research activities, the field of experimentation takes into account the integrated, interdisciplinary research efforts in order to define new visualization and communication ways to make effectively the communication in the project management [10].

As a result, a comprehensive and integrated approach to the restoration project as well as to the reuse one can be put into practice [11]. All the phases of the project cycle are taken into account as a whole such as: concept, detailed project, building technology criteria, construction phase, testing, monitoring and predictive maintenance.

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