Special Issue “GEORES: HBIM as part of a co-working GeoSpatial ecosystem”

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It is our pleasure to introduce this Applied Geomatics (AG) Special Issue on “GEORES (GEOmatics & pREServation): HBIM as part of a co-working GeoSpatial ecosystem”.

This Special Issue follows the successful edition of GEO-RES2019 2nd International Conference that took place at the Politecnico di Milano, with 165 full papers indexed publication and more than 250 participants. After a call launched to submit a new version of contributions, 11 papers have been selected following the peer review procedure. This Special Issue addresses Heritage Building Information Modeling potentials to the complexity, specificity and granularity of cultural heritage across space and time as part of a co-working virtual space.

Due to its complexity, cultural heritage often stimulates a dialogue between research and professionals offering new opportunities for developing strategies for the identification, preservation, interpretation, understanding, enhancement and transmission to the future of cultural heritage. Multidisciplinary research is a necessary condition for the complex mechanisms through which cultural heritage produces economic and social value. Cultural Heritage needs innovation and produces innovation.

The idea of an interdisciplinary documentation and preservation of cultural heritage is considered as a priority to all actions aimed at the conservation and enhancement of heritage: a smart use of 3D models, integrated with different historical, cultural sociological data has been widely recognised by the Horizon 2020 program.

A central theme is the development of open databases and the use of data models such as BIM (Building Information Modeling) to capture and preserve the knowledge of heritage. This includes materials and technologies for data management, considering all phases in the management of the conservation work. The issues related to representation, modeling and data management are a priority in the European agendas.

This Special Issue is the result of different researches that contribute to creating a multi-disciplinary cross-fertilization among the scientific communities of Geomatics and Preservation — to be intended in a wide meaning, involving Social Science and Humanities including museum operators, historians, users and citizens — addressing the Digitization of Cultural Heritage toward meaningful informative models, as in the specific case of Heritage Building Information Modeling (HBIM): HBIM can become part of a co-working geospatial ecosystem, where BIM-GIS data integration can create fruitful opportunities and new knowledge. Object Libraries in the form of linked objects can be connected and retrieved across space and temporal dimensions, supporting the comparison of different architectural components and construction technologies, the analysis of permanencies and mutations, capable to identify unexpected wires.

The contributions demonstrated that rigorous data acquisition coming from the integration of different technologies, including massive data acquisition, such as Mobile Mapping Systems, allows users to obtain cost-effective models. This however requires a validation process based on the precision and accuracy of data acquisition through entire data processing. Heritage domain experiences here documented can be scaled up to others' domain as the infrastructure domain

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for their renovation inheriting the HBIM methodological approach and results.

Starting from 3D dense point clouds and photogrammetric data, 3D informative models can be generated, circulated, re-used and shared using common data environment and platforms improving multidisciplinary cooperation facilitating the co-working among different operators: thus, they need to be validated not just on the surveying side but also on the processing side. This requires an advancement on the specifications in identifying the proper accuracy, scale and richness of details to decode, analyse and represent heritage complexity as a whole. At the same time, its components (from the structural elements, as vaulted systems, columns, walls, till decorations such as frescoes and mosaics) require proper procedures of controlled generative modeling, guarantying the interoperability among pure modelers and parametric modelers, can contribute to avoiding simplifications derived from not fully enable model, enhancing capacity building and upskilling. Levels of Geometry inherited from the BIM logic but tuned and adapted to the heritage preservation purposes and specificities have been suggested. The digitization process and the modelling of heritage complexity nowadays is not included within the BIM standards. Moreover, different Grades of Accuracy linked to the ‘model scale measurability’ referring to the richness of model details, precision and accuracy - in the data acquisition as well as in the model generation - have been proposed to shape the complexity. Different model scales—from the complex to the simplified ones—can be chosen and generated in the function of the different user needs. Tolerance and details characterize the surveying but also the modeling phases: they have been proposed to support the different needs by the operators in different contexts, from a high level of details to low level of details, guided in the adoption of the ‘proper scales’, as documented by the contributions.

A rich geometry obtained from orthoimages allows a multi-purpose driven holistic methodologic approach. It has been deemed necessary to be able to relate the different information: co-working platforms conceived as common spaces for sharing data and knowledge, as open CDE, represent a necessity toward new habits.

From such common virtual spaces users can access punctual information through HBIM nodes, but also perform queries based on geospatial semantics search, linking Object Libraries and single HBIM within the geospatial environment.

Avoiding dispersion of information, favouring aggregation of information coming from historical reports (including historical drawing), as well as connecting archives, library documentation, Open Data Assets, together with the results of the researches carry out by the different experts, is a crucial challenging issue to support preservation activities. The

logic of a high level of accuracy capable of managing the complexity through the adoption of the proper model scale can support to enhance the cultural heritage interpretation and knowledge creation. On the other side, the 3D model interoperability among different tools supports the sustainability of the process in terms of time and cost invested in the complex model generation.

It is mandatory to enhance the quality and methodology of co-working multi-disciplinary ecosystems to carry on and circulate analysis, assessment, design and planning, preservation projects and maintenance programmes such as planned conservation and preventive conservation. HBIM uses span from Finite Element Analysis purposes to energy efficiency BIM oriented, till to the Conservation Plans, and Construction Site management just to cite few of them addressing different Levels of Geometry in the function of the tools and requirements.

The integration of informative models within geospatial dimension can represent an added value to enhance heritage knowledge by connecting the two informative dimensions, the geographic system and HBIM. Boosting data transfer, coming from these informative models, for management and disseminating purposes can contribute to foster the knowledge gained on built heritage and sites by mean of eXtended Reality experiences toward an informed society, thanks to advanced VR/AR implementation.

The advent of new tools and new approaches, the evolution in expectations of the public, due to the change in perceptive habits, access to information and culture in the media society, where the fragmentation and dispersion of information contents predominate, have determined a series of changes in cultural communication. The forms of digital, interactive, immersive storytelling become an agile and powerful tool for communicating scientific content to the public and for re-aggregating the fragmented cultural experience within a framework of meaning that offers a key to interpreting the present. Among these modalities, the XR contains many of the contemporary peculiarities and expressive possibilities.

Climate change hazards and threats require a new harmonic vision connecting the built environment to informative object models and geographic ones. Moreover, the use of satellite data applied to heritage environmental site can be enriched by punctual informative object models within the workflow without continuity solutions. A new model for the economy must also include an interconnection between culture, ecology and society, conferring on this new model a highly transdisciplinary value. Particular attention and recognition should be given to the positive contribution of heritage to sustainable development as a strategic resource for smart growth, sustainable and inclusive and as a basis for promoting inclusive, innovative and reflective societies.

The papers in this Special Issue demonstrate once again that heritage preservation is a complex process, which requires new tools, protocols and standards to overcome gaps and barriers, as well as many efforts from everybody in the future being!

Our warmest regards

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(Assigned Editors)