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Un nuovo approccio di analisi, gestione e controllo del processo edilizio sul patrimonio storico

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ABSTRACT

Abstract

The theme of the recovery of historical buildings is current, especially in a period in which, for known economic, financial, social and political reasons, interventions of new constructions and investment have declined dramatically and investments, although contained, are diverted to energy rehabilitation and functional recovery and restoration of existing buildings. Our country has a housing stock that, if properly managed and developed, can turn into an asset by potential priceless. Often, however, customers, designers and contractors are not ready for action in addressing the demanding projects on historical buildings, losing opportunities for development and economic growth. Just think, for example, to the considerable funds that the EU allocates periodically to facilitate the recovery of historic buildings and that often our country is not able to find or spend. The most common causes of these inefficiencies are attributable to the reluctance - in the fields of engineering and architecture - to the planning, management of enterprise-resource, teamwork, updated, the industrialization of construction site, quality control and so on.

This PhD research is aimed to study, from the theoretical point of view and from the study of the state of the art, the efficiency - in terms of productivity and quality of work - of a new approach for analysis, management and control of the building process, through the use of the methodology of building information modeling using two case studies of reference: the assessment of the applicability of the BIM Surveying to the historical buildings and the possible benefits of the latter compared to the use of traditional survey methods.

Building information modeling, already widely used successfully in other countries as part of interventions of new construction, it is a 'way of working' relatively young and little known in many advanced counties, including Italy. It is configured as a holistic and coordinated method to assist architects, engineers, customers, decision makers, maintenance staff and all those involved in the building project. In the current traditional practice, the life cycle of a building - from design, to construction management, from supply management to the maintenance work in the year - remains fragmented and based on a continuous and not-organized exchange of information between the various actors involved in the construction process. Errors, omissions or inaccuracies contained in these documents (paper or digital) are often due to unexpected costs, delays in the design and execution of the work, of legal actions between clients and companies or designers.

Studies implemented in the United States in the early 2000s show that the low interoperability between the various actors of the construction process generates huge economic damage to the construction industry. These considerations have led the most advanced nations in the adoption of BIM methodology in AEC (Architecture, Engineering and Construction), or rather the design and shared management of the building, based on a three-dimensional computer model 'smart' building (called building information model) containing all information of geometrical, mechanical, energy, computational and Maintenance. This will intensely reduce the errors due to the absence of protocol design, to misunderstandings in reading the charts, to inaccuracies due to lack of communication between the various actors.

The objectives of this PhD thesis is the evaluation of the applicability of the BIM Surveying at historic building heritage, the comparison - in terms of quality and quantity of data and information - between the traditional methods of survey and graphics and the most advanced (technologically and methodologically) survey laser-scanner and modeling in BIM environment and, finally, the proposal of a 'cultural heritage smart catalouging' of the historical heritage always available for questioning, implemented and, above all, used for the design of interventions restoration.

The research on the parametric design and integrated applications of BIM Surveying on the historical buildings have led to a series of considerations about the building information modeling. From a careful study of the relevant literature on the topic and the organization regulations of some countries - especially the Anglo-Saxons - related to the construction industry, showed that the near future of the management of the building process during the entire lifecycle It is going towards the adoption of new working methods and new and more advanced tools. An analysis of case studies of BIM and the comparison with others using a traditional management of orders for medium-large size, it was found that the lack of interoperability between actors generates, inevitably, a slowness in implementation times the work and the misuse of financial resources. Building information modeling, created to meet these and other needs of process optimization, it is setting up as a good management approach, before design and technology. Countries that already endeavor (United Kingdom, Scandinavia, the United States of America, United Arab Emirates, to name a few) have found significant benefits in all phases of the construction process, when the many different people involved need to communicate with a clear and unambiguous language, limiting misunderstandings and redundant processing.

The most innovative aspect of the first attempts of application of BIM to the historical buildings concerns interaction between the parametric design and data from laser-scanner surveying. Laser-scanner, in fact, allows to obtain a three-dimensional point cloud much detail that can be used as a 'guide' to infographic modeling of all those not attributable to the standardized forms in the libraries of BIM software. BIM Surveying involves a necessary collaboration between specialists in modeling in BIM environment and competent professionals in the use of instruments of acquisition and, especially, in data. Through detection laser-scanner and subsequent parametric modeling of two historical artifacts chosen as case studies (the Military Pavilion 'Sacchi' in Caserta and the Castle of Francolise, in the province of Caserta), this thesis has wanted to highlight that, thanks to BIM Surveying, it is possible extend the scope of the BIM methodology to historical buildings.

It was conducted a specific comparison between the application of BIM Surveying and methodology of survey using approaches and tools of traditional type. The first methodology was the best both in terms of productivity and quality of work and economic. Another issue to consider is the amount of information from the 'output' products. If the traditional process is achieved only a limited number of two-dimensional CAD elaborate, the final product of BIM Surveying, instead, is represented by a building information model, that is, by a three-dimensional model characterized by a large quantity of information, a real prototype infographic of the building.

The potential offered by a bim model are numerous: obtain elevations and sections (horizontal and vertical) at any level, material schedules and environments, material quantity, characterization of building elements, preliminary analysis on the energy conditions, and so on. Finally, applications conducted on parametric modeling of historical buildings has been possible to identify certain limitations. If the buildings are geometrically complex and rich in details, the result could require the implementation of more specific procedures. One limitation, however, that currently prevents the full definition of a BIM model of a historic building is the absence, within the software dedicated, to a specific module for structural modeling of masonry.

Downstream of these considerations can be delineated some possible developments in research concerning both aspects strictly related to information technologies of BIM, which aspects of the methodology. To speed parametric modeling of architectural elements that characterize the historic building (ornamental bases, capitals, trusses, frames and portals, to name a few), a possible solution would be the implementation of object libraries bim with families of elements specially created and edited in size, shapes, and physical and mechanical properties. Further progress could be made, in terms of computer programming, thinking of integrate specific modules dedicated to masonry.

A further consideration is the BIM Surveying. Applied to the building heritage could become a valuable tool in the hands of the Public Administrations for the formation of a 'cultural heritage smart cataloguing'. The cataloging of the historical heritage, namely the creation of a database of bim models of buildings, facilitate the issuance of call for design by reducing the time, interference and risk of failure. Consider, in this regard, the amount of European structural funds that each year the public administration are not able to spend - about half - because of the inefficiency of the entire chain.

In any case, the most important challenge undoubtedly affects the awareness of those involved on the topics covered.

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