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BIM4Ren: Barriers to BIM Implementation in Renovation Processes in the Italian Market [†]

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Abstract: As a part of BIM4REN (Building Information Modelling based tools & technologies for fast and efficient RENovation of residential buildings) H2020 project, the analysis of the barriers to the use of BIM tools in renovation processes, as well as the necessary requirements to ensure a successful digital workflow is presented. This paper focuses on the Italian market where surveys, interviews and a workshop are carried out. The full study provides information by type of stakeholder, type of renovation work and the phase of the process, to instruct the development of the BIM platform in subsequent steps of BIM4REN project.

Keywords: BIM; renovation process; digitalization; H2020; barriers; stakeholders

1. Introduction

The EU climate plan is to achieve by 2030 the 40–32–32.5 targets [1]. Energy retrofitting is one of the main tools to achieve them as buildings represent 40% of overall energy consumption and 36% of generated greenhouse gases [2]. Moreover, about 70% of European building stock was built before the 70's. Therefore, innovation is needed to support Europe in pursuing the building retrofitting rate target of 3% versus the current 1.2% [3].

To boost the renovation rate, digitalization is part of the solution, it increases the cost efficiency, time saving, collaboration and process quality, moreover, Building Information Models (BIM) are used to store and share the existing building information data which helps to avoid the uncertainties and support the decision-making process. According to a recent report by the world Economic Forum, full-scale digitalization in non-residential construction would, within 10 years, lead to an annual global cost savings of \$0.7–1.2 trillion (13–21%) on E&C and \$0.3–0.5 trillion (10–17%) in the Operations phase [4]. Collecting data through the design, construction and operational phases would allow for further analysis of these data, generating new insights and simulations to identify clashes and interdependencies, moreover, creating new methods of data visualization using visual and mixed reality which improves communication and provide on-site information. However, the efficiency improvement, time and cost reduction due to using BIM depends on typologies of renovation works, the dimension of the construction site and the number of stakeholders involved.

2. Methodology

The project BIM4REN adopts an open innovation approach, focused on Living Labs, that enables feedback from the pilots' agents, key stakeholders and targeted beneficiaries throughout the project duration to optimize all project developments and fit them to their real needs and requirements of

digital tools users. In this way, the requirements for the BIM tools will be driven through the active end user's participation and involvement in the Living Labs.

The paper reports the results of the starting activities of Living Labs to define the state of the art of the use of BIM technologies for building renovation and to highlight the main barriers to uptake of BIM tools in renovation processes. The analysis was carried out in three steps to gather, test and validate information.

The first stage of the consultation was carried out by an extensive online survey to gather information about the common practices and the main concerns of the stakeholders involved in the whole renovation value chain. It was subdivided into three main parts:

- A. General information about the responding organisation
- B. Identification of the barriers in the renovation process
- C. Potential to overcome the barriers in renovation process through digital tools.

The survey was designed to reach different agents of the construction sector, with varied levels of expertise in Digital Technologies (or even any expertise) and varied links with renovation process.

The second step consisted in detailed interviews with closest stakeholders linked to the renovation field, the early adopters of BIM technologies. The main goal of the interviews was to collect direct and specific information from key stakeholders with a relevant role in one (or more) renovation typology (use case). Each interview analysed a renovation action, planned, ongoing or delivered, to describe: the sequence of actions, the actors involved, and the type of documentation exchanged. Existing case studies were chosen regardless of BIM use during the process, but the role of digital tools, as well as constraints and opportunities that they would bring were discussed.

Finally, workshops validated results in group discussions with stakeholders concerned with the project Pilot sites, but not necessarily BIM users. Workshops enabled to receive feedback from the end-users and targeted beneficiaries. They will be repeated along the duration of the project.

Two main topics are tackled in the workshops:

- Barriers in the renovation process, requirements of the stakeholders, and potential of BIM
- Workflows of different renovation use cases, renovation typologies, including the main activities developed by stakeholders as well as the information exchanged.

The discussion between project partners directly related to a pilot, and other experts, with different roles in the value chain and called to provide their informed opinion, allowed the integration of different insights about unique use cases.

Despite the full analysis was carried out in three countries, France, Italy, and Spain, in this paper the authors refer to Italy only, planning to extend the analysis to the European context in a further work.

3. Results

3.1. Online Questionnaire

The target group of the BIM4Ren questionnaire are the members of the Architectural Engineering and Construction sector (AEC), working on Large, Medium and Small enterprises and self-employees. Referring to the classification of the project stakeholder's community, the survey was able to reach the BIM4Ren Pilots Stakeholders, Early Adopters, and the BIM4Ren Extended Community.

A total number of 143 surveys have been answered in the Italian market, 76 of them were completed.

In Section A, the questionnaires covered all the agents of the value chain of the renovation sector, but Architects and Contractors types stood out from the all respondents. In relation to the number of employees in the organizations, quite a balanced representation of companies was appreciated among three different sizes: small, medium and large enterprises. However, the highest number of respondents is represented by small companies. This fact reinforces the value of the answers to the

purpose of the BIM4Ren project, because the SME in the construction sector are the main recipients of the project's findings. Half of the respondents declared to have participated in a project with a BIM collaborative process, whereas only a fifth of respondent are software users. The majority stated that is willing to invest in the BIM implementation whether as training or software or hardware or all.

The analysis of barriers carried out among the questions of Section B in relations to the role in the value chain of the respondents, showed that the phase where more difficulties arise is the construction work phase. Several problems related mainly to this phase, as the delay in supplying of materials or the material bad organization on site, represent a negative impact in the renovation project, and one of the points where a better digital organization of information and flows would be beneficial.

The analysis of the level of digitalisation by the different agents carried out in Section C demonstrated that the digitalisation and the use of BIM is an opportunity for improving the renovation sector. Nowadays BIM is hardly implemented and limited mainly to the data gathering phase. The use of platforms and digital interoperable tools in BIM environment could help to overcome some key barriers in renovation works. Issues are specially related to the accuracy of the information on the existing buildings, as well as the related unforeseen actions. It results in a critical factor for the renovation project and for construction work. If the initial information is accurate and complete and can be entirely integrated in the BIM model of the project, it will avoid the need for extra time and resources during the construction works, which are more expensive as far as the phases of the project progress.

3.2. Interviews

The interviews have been performed by project partners linked to the construction sector. The authors carried out the interviews for the Italian and Spanish context, however the current paper is focused on the results of the Italian approach. Several requests were made to large and small construction businesses as well as to individual professionals. The choice of the type of stakeholders was dictated by the local characteristic of the construction services supply market, particularly, the variability of sizes of the construction firms and design offices in Italy. Four interviews were completed, the interviewees are stakeholders of the construction sector, some of them particularly connected to the renovation process: a project manager from a large technical design team; a contractor and two free-lance architects. Interviews highlighted some factors to considered in the design of BIM tools for renovation.

In large complex renovation works the interviewees cover a short part of the renovation process, normally just construction phase, whereas in smaller sites, free-lance professionals support all steps from concept design to hand over.

The renovation process is not always a linear path from survey to construction but, because it addresses an existing building, not all information is available from the beginning and not all of them can be gathered from documentation and on field surveys. The initial demolition steps often reveal unpredictable issues that require to go back to diagnosis and design once the construction phase has already started. BIM tools can be strongly beneficial to speed up design edits and update of information about the building, simplifying the management and the exchange of information among the agents involved in the project.

Finally, overall the lack of interoperable BIM tools, their cost, and of skills and competences of some agents of the renovation process, mainly builders, are perceived as major barriers to the use of BIM tools.

3.3. Workshop

In Italy the workshop was held to the pilot site of the University Dormitory at Complesso Santa Marta, in Venice on the 1 April 2019. The activities were subdivided in 2 main parts: an initial session of presentations and a second session of visit, demonstration and discussion around the Italian pilot site.

To the purpose of the paper, the round table post-it session about barriers and opportunities in the use of digital technologies in the specific Italian pilot case was highly relevant. The construction process did not include the use of digital tools and it was highly relevant hearing diverging opinions on the suitability and usefulness of BIM for these specific renovation works.

Barriers were analysed per typology of stakeholder addressing them, classified into six categories:

- Public clients/owners seem to be concerned with the use of BIM only to comply with the law but don't seem to appreciate the long-term benefits of these processes (e.g. easy management of the building). Private clients/owners: the need for BIM tools is generally dictated by urgent works and lack of 2D drawings and previous projects. Sharing the model on a common platform may open privacy issues related to data of public buildings and users.
- The Site supervisor is the less keen to use the BIM process because it sees it as increase of complexity on information and data flow, time consuming during setting up and in the continuous update.
- Main contractors highlight that BIM software are conceived for the design phase, less attention is dedicated to the construction and to the information that the building firm needs to collect and transfer to the model.
- Industrial contractors (subcontractors)'s major difficulty is the continuous update of the model according to the decisions taken on site.
- Suppliers need specific legal agreements to share data on BIM platform and guidelines to define the information to describe objects in the BIM families.
- Architectural and engineering firms highlight that it is not easy to start using BIM, if never used, because training and education is expensive and time-consuming. There is a problem of acknowledgment of BIM roles, not only for the BIM manager. The process requires an initial coordination phase to manage the interaction between data, software and disciplines.

4. Conclusions

The first months of BIM4REN project aimed at understanding the level of BIM use in the market with a focus on renovation works. Stakeholders of the BIM4REN community were involved in a 3 steps process via an online survey, one-to-one interviews and a workshop. The picture is that of a scarce use of BIM tools for renovation purposes above all among SME. The consultation phase highlighted various barriers that can be summarized as follow.

Cost barriers are perceived by smaller organizations both building firms and professional offices: purchase of BIM software licences as well as training sessions are expensive and time consuming. These results confirm the market demand for open access, easy to use digital solutions as those under development in BIM4REN project.

BIM is well developed for concept and design phases of the building process, but it needs to be optimized for constructions and management ones, in order to be suitable for the renovation processes. A major flexibility of use and easy input of data and documents shall be guaranteed together with the interoperability of tools, and large dataset about materials and products shall be integrated to populate the information on building models.

Nowadays, in public works BIM it is used to comply with in force Code for public tender and the added value it is not recognized and therefore not rewarded adequately. Roles and responsibilities of BIM user in the process shall be clarified.

Potentialities of BIM use in renovations processes are not yet fully understood by all agents: straightforward and low-cost tools are needed as well as a big effort in terms of dissemination, awareness raising and training for professionals involved in the renovation process, in order to enhance the transformation and innovation of the building sector that the digitalization is able to bring about.

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