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# Building Renovation Process Map in Private and Public Works to Improve Communication and Data Exchange

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**Abstract.** Along the building process the cooperation among several stakeholders and the integration of information during the whole project life cycle, whether it is a new project or a renovation intervention, are two key essential factors. In fact, in AEC sector the loss of information, the lack of data and the improper or repetitive exchange of information are common issues that may cause delays and cost increase. To enhance communication and data transfer, an appropriate rationalization of information flows is necessary. Starting from the outcomes of BIM4EEB, an ongoing Horizon2020 project, the paper analyses the workflow processes to understand how to optimise information workflows among different actors and along different stages by the use of ICT and BIM-based tools. Particular attention was paid to individualise the differences between public and private works in order to provide methods and apply the BIM4EEB approach to renovation process in both cases.

## 1. Introduction

Among the objectives of 2030 Agenda, there are a 40% reduction in GHG emissions, a rate of 32% for renewable energy and at least an increase of energy efficiency by 32,5% [1]. According to a BPIE analysis on EPC data, about 97% of building stock, currently not in A level, must be upgraded to achieve 2030 decarbonisation objectives [2]. If we consider that buildings are the biggest energy consumers – they consume about 40% of energy and they are responsible for 36% of CO<sub>2</sub> [3] – hence they are strategic to reach the set of environmental goals. Furthermore, the condition of the environment where a person lives is very important if we think that generally people spent 90% of time indoors and that indoor air quality (CO<sub>2</sub>, PM2.5, PM10, VOC) impacts on our health [4]. Consequently, renovating the building stock means also to give a better life quality to inhabitants.

Ideally, buildings are subjected to renovation and refurbishment during their lifecycle according to a specific schedule: the owner should guarantee proper and good building conditions thanks to professionals' surveys, but also to planned and executed maintenance activities. However, the renovation process is slowed down by other factors such as: not understanding a long-term plan and its importance; no interest in thinking about the building in long term but preference to have short-term savings; buildings technical complexity due to their age and state of deterioration; the non- or semi-professional ownership of the residential buildings; disturbing inhabitants by noise caused by renovation or by leaving their apartments; the alternating of several and different actors during the whole renovation process (from maintenance professionals to managers). Then, renovation needs a precise procedure to take into account contemporarily several aspects such as costs of the renovation interventions, performances to be reached (e.g. indoor thermal comfort levels, CO<sub>2</sub> emissions, energy,



safety), national building regulations that could vary among different Countries, building specific information and end user's needs.

Within this context, the BIM4EEB project, an ongoing Horizon2020 project founded by European Union, wants to face these issues by producing a BIM model that is enriched of fundamental information of the building and that could be considered the basis for the cost-efficient renovation planning, implementation and future renovation phases [5][6].

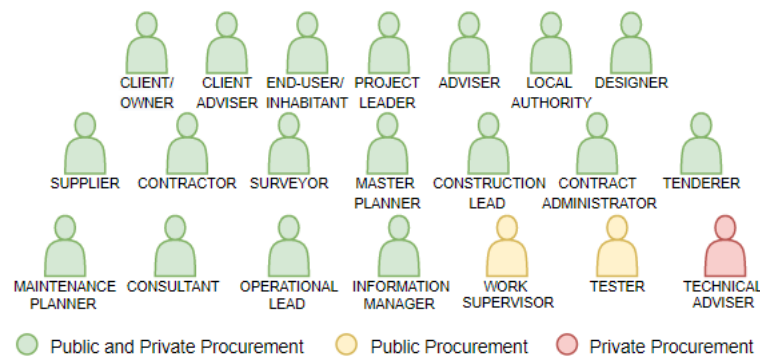
A specific task of the project deeply analysed the renovation process focusing on several information workflows for the directly or indirectly involved actors and outlining a complete process map in case of renovation. Designers, construction companies, facility managers, energy service companies, owners and inhabitants have then been assumed as main users of the BIM management system, highlighting which activity they do and point out their specific information needs and requirements. Attention has been paid also to when the activity is performed focusing on the stages of the building process. Finally, an integration of these single elements was made, showing up the differences in activities and actors if public or private works were taken into consideration.

## 2. The renovation process map development

BIM4EEB serves the purpose of developing and testing in real environment a BIM toolkit for renovation interventions of existing residential buildings in Europe. As mentioned, part of the initial effort was intended to analyse each step of the renovation building process with the focus on information workflow for each actor in order to make it replicable using the BIM management system, finding possible shortcuts in data exchange but also understanding how the building process could become more efficient by exploiting the BIM4EEB toolset.

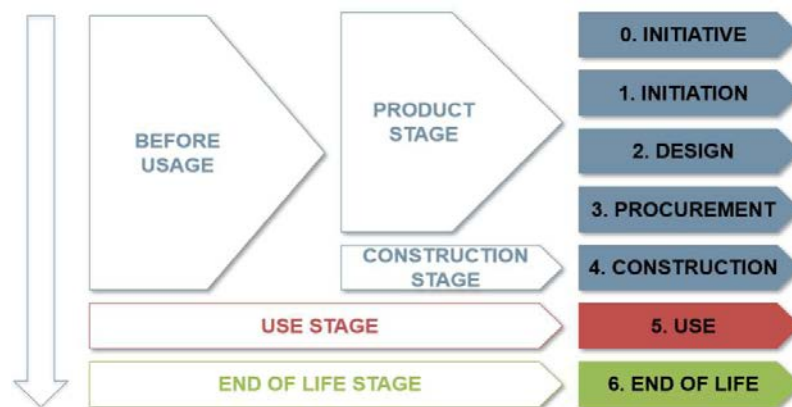
The study is characterised by six steps:

1. Individualizing the involved stakeholders in the renovation process. The experience of Consortium partners and a literature review based on the analysis of California Commissioning Collaborative, Global Buildings Performance Network and RIBA works lead to a list of the main stakeholders with their relative definition [7][8][9];



**Figure 1.** Main stakeholders involved in renovation process, considering the division between public and private works.

2. Outlining the undertaken activities;
3. Describing the outputs of each specific activity;
4. Outlining the stages when the activities occur according to the structure of EN 16310: 2013 [10];



**Figure 2.** Stages in the building asset lifecycle according to EN 16310.

5. Finding out possible differences among different Countries;
6. Identifying possible optimisation alternatives.

To collect these data, two spreadsheets were created, one for public works and the other one for private works. These analytical spreadsheets have been later converted into a comprehensive flowchart, a process map that takes into account both of them.

### 3. Process analysis in private and public works

The renovation process has some distinctions between private and public works. In case of private works the owner is a private person, a group of people, a private company or some private companies. In public works, the owner is a public administration.

Activities are very similar, but sometimes objectives and procedures change, the subject of the action also could be impersonated by a different actor (Figure 3, Figure 4).

#### 3.1. Private works and public works: main differences

Private works are generally profit-oriented and the client/owner leads the works with the final goal to obtain an economic benefit and he/she decides whether to undertake certain work after having made analysis about cost-benefit and available funds. Among these objectives there is also the improvement of building performances and the enhancement of inhabitants/end-users' conditions and comfort. Public works are managed by governmental bodies/authorities and they focus on public interest, trying to provide social and economic benefits. The improvement of building performance and the enhancement of inhabitants/end-users' conditions and comfort are objectives taken into consideration too.

Within the private works context, the budget is provided by the client/owner through personal private funds or banks and/or private investor groups, also named party financier. In detail, in the so-called initiation phase, the Client Adviser prepares a detailed business case that can be used for finding financing from third parties, and later the bank or the third party financier assesses it and the feasibility of project by own cost assessments and audits from external consultants to determine if the investment is safe. If the assessment is successful and the bank/third party financier agrees to finance the project, the next step for the client/owner is to negotiating financing terms (e.g. percentage of project financed, how money will be delivered over the project, interest rate, time frame and payments schedule, etc). Finally, both parties sign the financing contract. The funds in the case of public works arise from public funds such as tax revenue, duties, and fees. The client/owner must approve the preliminary design and spending plan before moving to the design phase.

Another significant moment is characterized by private bidding. The project leader undertakes the tender action converting the project design into a set of pre-contract documents and a set of tender requirements. The client/owner can decide to choose one contractor rather than another one according to the fulfilment of the previous requirements and not necessarily on the basis of the best economic offer. On the other hand, in public sector the bidding is a more competitive process and characterised

by more transparency, open to the public. The contract is awarded to the lowest bidder to guarantee the responsible use of money.

The procurement strategy selection is another point that public and private works face differently. Private works generally have a faster procurement process since there is not publicly subsidised, in addition the Project Leader can chose the supplier/subcontractors he/she prefers as long as they are in the budget. Similarly, private projects may, where required, procure the necessary materials and services.

In the case of public works, however, this procedure is not so rapid because it is constrained by local, regional, national or international legislations. Procurement practices must be approved by governmental bodies, suppliers/subcontractors can carry out inspections in order to qualify to bid and in this way the process is slowed down. “European Union Procurement”, with the purpose to open up public procurement within the EU, guaranteeing the free movement of supplies, works and service, defines and established the public procurement rules that are applied to any public purchases. Although the directive “European Union Procurement” defines public procurement rules, there are differences among countries. Therefore, especially in renovation interventions, the workflow process could vary according to the Country.

Considering actors in private and public works, a limited number of people are involved in private works, with owner and project leader having key roles. Instead public works have a major number of users since the number of activities is higher too.

WHO	MAKES	WHAT	WHEN	SHORTCUT
Project leader	Defines	the project organizational structure and range of consultants and others to be engaged for the project, including definition of responsibilities	Initiation	
Project leader	Defines	possible procurement strategy	Initiation	

**Figure 3.** Extract of a renovation workflow: activities of a renovation process in case of private works – Initiation phase.

WHO	MAKES	WHAT	WHEN	SHORTCUT
Project leader	Defines	the project organizational structure and range of consultants and others to be engaged for the project, including definition of responsibilities	Initiation	
Project leader	Evaluates	if it is necessary to appoint an external professional	Initiation	if the owner has an employee with the expertise to be appointed as site surveyor
Client/Owner	Appoints	designers to be engaged for the project (such as structural, mechanical, electrical, HVAC, geotechnical, fire security, acoustics, lighting, etc.)	Initiation	
Project leader	Defines	possible procurement strategy	Initiation	

**Figure 4.** Extract of a renovation workflow: activities of a renovation process in case of public works – Initiation phase.

### 3.2. Public works: regulations

BIM4EEB project involves partners from different Countries (Italy, Finland, Spain, Sweden, Ireland, Cyprus, Germany, Belgium, and Poland) and the BIM toolkit will be developed and then applied to three residential buildings respectively in Italy, Poland and Finland. Due to this fact, national differences in the procurement regulations were analysed.

The public works process is ruled by specific European directives that are transposed into local national laws:

- Directive 2014/24/EU on public procurement [11];
- Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors [12];
- Directive 2014/23/EU on the award of concession contracts [13].

The main principles of these directives are transparency, equal treatment, open competition and the possibility for EU companies to access to fast and efficient review. For putting public funds to good use, it is fundamental to reach a competitive, open, and well-regulated procurement market [14].

Concerning Italy, the regulation for public works is contained within the document “Italian public contract code - Legislative decree No. 50, April 18, 2016” [15] that outlines rules about all phases of the project from the planning to the award, also covering testing and verification of compliance and relates to other specific regulations (e.g. Italian Code for the construction design and Legislative Decree No. 42 of 22 January 2004 which contains the Code of Cultural Heritage and Landscape).

In Poland public works follow the “Public Procurement law”: it defines the rules and procedures for awarding public contracts, legal protection measures, control of the award and the competent authorities [16]. Even “Construction Law” and “The technical conditions which should be met by buildings and their location” are considered in regard for public and private works in this Country [17]. Finnish legislation on public procurement is instead governed by the “Act on Public procurement and concession contracts”, the “Act on procurement and concession contracts of entities operating in the water, energy supply, transport and postal services sector”, and the “Public defence and security procurement act” [18][19][20]. Other areas of national laws relevant to public procurement include the Act of the openness of government activities and the Act on the Contractor’s Obligations and Liability when work is contracted out [21][22]. The first document refers to the phase when tender offers and other documents about public procurement are to enter the public domain and the extent of parties’ right to access to information; the second one instead requires, when work is contracted out, that the party responsible for the project have guarantees that subcontractors will fulfil their various obligations.

## 4. Conclusion

The inefficiencies due to incorrect or redundant information are typical issues in construction sector, hence the need to precisely track the process map and find shortcuts.

The paper has been developed in the context of the EU founded project BIM4EEB. It proposes the methodology adopted to analyse and optimize the information workflow within a renovation process outlining the differences between private and public works.

Among the main differences, there are: from one hand profit-minded concept in private works and on the other public concerns and social, economic and/or aesthetic benefits in public works; different sources of funding and different criteria for selection of procurement strategies; regulation limitations to be followed in public works.

Starting from these activities, it is possible to map their outputs in a traditional process and in BIM-based processes and to assess when each activity is undertaken and its expected outputs. Finally, to define how ICT and BIM can support the rationalisation of information flows, a synoptic flowchart that shows the complete process map has been developed.

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only and the Commission is not responsible for any use that may be made of the information it contains.

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