Chapter 8
BIM and Interoperability for Cultural Heritage through ICT

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ABSTRACT

This chapter presents a methodology based on Building Information Modelling (BIM) and interoperability to convert existing buildings, even historical, into smart buildings. The chapter starts describing the main concepts of BIM and interoperability in the Architecture, Engineer and Construction (AEC) industry with special attention on integrating information from heterogeneous devices deployed in the building. Then, it details the SEEMPubS (Smart Energy Efficient Middleware for Public Buildings) middleware, which consists on three layers: (i) Integration Layer, (ii) Middleware Layer, and (iii) Application Layer. The validation of the most significant results is presented using both gamification and technical approaches involving different end-users. Finally, Apps for data management are introduced with a Community Portal and an Android Application for real-time data visualization. Future works introduce the integration of smart building into smart district context.

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INTRODUCTION

Working on a smart building requires the use of ICT to optimize design, construction and management. BIM provides an huge amount of information in its database and, theoretically, it is able to work with all kind of data sources using interoperability. However it is essential to define standards for both data contents and format exchange. In this way BIM and interoperability can play a key role to transform existing buildings into smart buildings.

In this paper the methodology and the results obtained with the Smart Energy Efficient Middleware for Public Spaces (SEEMPubS) project are described.

The SEEMPubS project, specifically addresses reduction in energy usage and CO₂ footprint in existing public buildings and spaces without significant construction works, by an intelligent ICT-based service, monitoring and managing the energy consumption. During the project special attention has been paid to historical buildings to avoid damage by extensive retrofitting. SEEMPubS provides control of appliances to effortlessly optimise energy efficiency usage without compromising comfort or convenience and offering decision makers strategies and tools needed to plan energy saving measures. SEEMPubS makes use of the LinkSmart middleware and uses its potential to create services and applications across heterogeneous devices to develop an integrated energy monitoring and control system. The project uses its real-time energy-awareness services for all users of the public space and combines awareness services with a community portal. This enables collective, community activity motivating positive competition in saving energy, complemented by courses towards the education on energy efficiency and sustainability.

The functionality of this system has been demonstrated on existing buildings at the Politecnico di Torino Campus, characterized by different representative typologies of buildings common in European cities, above all Valentino Castle in Turin, which has been built on XVI century. The validation of the most significant SEEMPubS results allows the elaboration of an energy efficient model for existing buildings and public spaces with a significant economic impact all over Europe. Indeed, this model could be replicated on many different existing buildings where old energy systems are already in place, avoiding expensive construction works and possible damages.

In order to optimize the data exchange among Architecture, Mechanical Electrical and Plumbing (MEP), energy simulations and Facility Management (FM), at the beginning of the project a building information model has been setup in order to contain the information that can be used in an interoperable way. Based on the results of the SEEMPubS project, it is very important to set correctly the contents of this model integrating architectural data (e.g. geometry and dimension) with energetic data (e.g. material, stratigraphy, colours and context) because interoperability between software (like Revit with Daysim and Radiance for lighting and Trnsys for heating and cooling) at present is not always perfect. This requires different formats (e.g. IFC and gbXML) and several test are often necessary.

As main result of the project, to guarantee a simplified access to all data, an APP for tablet and smartphone has been developed that leverages the SEEMPubS Middleware, which is a distributed event based Service Oriented infrastructure. It allows the end user to interact with the system in order to access heterogeneous building information available from multiple pervasive sources. It mixes structural information with fine grain energy and environmental data coming from heterogeneous devices both wireless and wired. It is worth noting that structural data information also comes from third-party software, such as Archibus FM, thanks to the Web Service approach. In addition, a Web Portal has been set up to guarantee a continuous interaction between the
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