

Digitising building energy renovation

In a market where time, costs and disruption to people's lives are key drivers, the BERTIM project has looked to digital solutions and a prefabrication business model to help boost the market potential for energy-efficient renovation. Project coordinator Nagore Tellado explains how she hopes this approach will lead to greater innovation in the construction sector and, ultimately, more much-needed renovation of Europe's inefficient buildings



The EC has funded many projects supporting its policies designed to increase the energy efficiency of buildings through their renovation, with varying degrees of success. All aim to reduce Co2 emissions, increase energy efficiency, help make buildings less reliant on fossil fuel energy and benefit the environment overall - but while the policies are in place and the research is being generously funded, the market for this type of renovation is just not keeping up.

One of the main reasons for this is that the cost of energy is relatively cheap, while to renovate a building is very expensive and also very intrusive for those living or working in it. If we want to renovate buildings on a large scale to meet the EC's

ambitious targets and change this market situation, then we need cost-effective solutions available that are quick to install and keep to a minimum any intrusion on residents' lives.

BERTIM is a project that may well have a chance in this difficult market. Having just completed its four-year effort, which was coordinated by Tecnia, the project addressed these two essential elements the market is looking for. On the one hand it has developed a prefabricated solution which allows for cost-effective renovation that improves energy performance, air quality, aesthetics, comfort, and raises the value of the property while on the other hand, it ensures low intrusiveness during renovation works, while providing a clear indication of

any return on investment the improvements will deliver.

There are two elements to BERTIM's approach. The manufacturing element of the solution is included in a holistic methodology for the renovation process, from data collecting to installation. Meanwhile, there is a systemic methodology that is based on a digital data flow in BIM that has been implemented in a bespoke software named RenoBIM. This helps constructors reduce renovation operation time, allows for customised mass production, and lowers the financial risk for investors.

"Put simply, for BERTIM, cost-effective solutions for building renovation have two drivers," says project coordinator Nagore

"This systemic renovation methodology accurately models every aspect of renovation and provides the client with potential cost and energy savings and a potential return on investment before the work starts"



picture caption

Tellado from Tecnalía in Bilbao, Spain. “Firstly, we have digitised the whole process of renovation and secondly, we have developed a system of using mass-manufactured prefabricated modules that speed up the whole process and, through a franchise business model, are fully scalable.”

Tellado is, however, quick to concede that initial investment costs for BERTIM’s renovation package may still be a barrier to market. While compared to traditional renovation solutions, BERTIM reduces installation time by more than half, the prefabricated solution is still not cheaper than the traditional solution at the moment. “Our solution still requires a lot of man effort if done on a small scale,” she says. “But, if we are able to use these solutions in a large number of buildings, then an economy of scale will be reached and we will then start to see better returns on investment.”

The BERTIM solutions are designed for larger buildings that need to be renovated very quickly, like those in city centres where work cannot take months due to the disruption that would cause. “We have a demo site in France, where we renovated one building in two and a half days,” Tellado explains. “While the work in the factory making the prefabricated elements for the renovation takes longer than it does for traditional renovation, the BERTIM solution is very quick to install at the site itself – and digitisation is key to being able to achieve this.”

The project has developed its own platform named RenoBIM that effectively streamlines the whole renovation process for timber-based buildings using a complete flow of data for every stage of the process. This involves capturing real building data, using laser scanning or total station techniques, which is transferred to a 3D web environment for building information modelling (BIM). The BIM application is then used to define the building renovation requirements and communicate with CNC manufacturing machines.

The novel nature of this new RenoBIM tool is that it is comprised of three main blocks:

- **Data gathering and building model template:** from digital data acquisition or directly from parametric values, the 3D template of the building for renovation is

erected. This methodology provides added value to the companies currently working only in data acquisition.

- **Interoperability:** The renovation project will be defined in BIM. Any software used in the construction sector (thermal, structural, fluid, etc) and using BIM will be able to access the building model and so can carry out the required analysis. RenoBIM exports directly to Energy+ for energy assessment
- **Configuration of timber modules:** a pre-design and pre-dimensioning on the prefabricated modules can be carried out with the RenoBIM configurator. Once the project is accepted by the client this pre-design is exported to a CAD/CAM software.

“Key to the success of this tool is that it is able to provide calculations of energy efficiency and returns of investment and a first calculation of how many prefabricated modules are needed as well as how these calculations will be affected by the use of different renovation solutions,” says Tellado. “This is the very first platform to provide a rough design and calculations of energy, costs, aesthetic in the same platform that can then be exported to IFC to be used with any detailed design software.

The prefabricated renovation modules developed by BERTIM are not only façades that improve insulation and the aesthetic of a building, but also include other elements of the building’s services, like heating and cooling, lighting etc. “What we wanted to do was to be able to renovate all these services without having to disrupt those living in the building while the renovation work is carried out,” says Tellado.

“So we developed a system where the ventilation and the pipes for the heating and cooling go through the façade and into each dwelling in the building. This prevents problems associated with buildings that are hermetically sealed after renovation, where there are often problems with condensation and ventilation. The pipes and ducts are added to the façade, which reduces the amount of work needed inside each of the dwellings in the building.”

PROJECT INFORMATION

Project Title:

BERTIM: Building Energy Renovation through Timber prefabricated Modules

Project Objective:

BERTIM developed a prefabricated solution which provides the opportunity to renovate improving energy performance, air quality, aesthetics, comfort and property value at the same time, while ensuring low intrusiveness during renovation works.

Project Duration and Timing:

June 2015 - May 2019

Project Funding:

European Union’s Horizon2020 research and innovation programme

Project Partners:

TECNALIA, EGOIN, EMVS -Empresa Municipal de la Vivienda y Suelo de Madrid, S.A., Institut Technologique FCBA, POBI Industrie, Setra Trävaror AB, SP Technical Research Institute of Sweden, LULEA UNIVERSITY OF TECHNOLOGY, Oslo Kommune, Dietrich’s France, TUM Technische Universität München, Building Realisation and Robotics - br2, ASM-Market Research and Analysis Centre



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“In summary, this systemic renovation methodology, based on prefabricated timber modules, that accurately models every aspect of renovation and provides the client with a cost, energy savings and a potential return on investment before the work starts,” she continues. “It also provides details of the aesthetic of the building, how many modules will be required and their dimensions, as well as details of possible heating and cooling systems renovation to improve energy efficiency and the costs that will be saved. This is all done before the hard work of the detailed design is carried out as it is all



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digitised using one model, rather than each of the stakeholders involved in any renovation currently, who all use their own tools, models and calculations.”

By providing accurate models of the buildings, BERTIM is able to produce very accurate facades that can be applied to the building quickly. For example, the new facades are constructed with the new windows in place, which must be the same size and in the same place as the existing windows on the building. Once the new façade is in place, the old windows can be removed from the inside and this process minimises disruption to those living in the building.

BERTIM has been working with a French manufacturer called POBI, which is able to mass-produce the renovation modules and it is their intention to franchise the BERTIM process across the whole country. Tellado explains how this will work: “There will be companies all over France who are able to gather the building data, use the BERTIM platform to provide a rough estimation before speaking to the client to get agreement on what level of renovation will be carried out, how much that will cost and what returns on investment will be achievable through energy performance savings and how the building will look. Once that agreement is reached, the prefabricated renovation modules will then be produced by POBI at its central manufacturing site.”

Tellado believes there is a very clear business model for BERTIM now that the project has finished and she wants all stakeholders, from architects and constructors to building owners and investors, to see the clear opportunity that it provides in a market with such clear potential for growth.

“To be successful in the market we need to work with architects, developers, constructors and building owners,” she says. “They need to know that there is a timber renovation solution that can be applied very, very quickly. Working with the timber façade manufacturers, they will then be able to make the calculations needed to make a final decision that works for all. The timber façades can then be designed using any material enabling the architect to be able to design the final aesthetic.”

Of course, there are still many challenges ahead for BERTIM and, indeed, the whole energy-efficient renovation market, and Tellado sees the big challenge that needs to be managed is still one of cost. “The main challenge for BERTIM is still that the traditional way to renovate is cheaper, even though the quality may not be so high and the time needed to complete a renovation is much more,” she says. “So it will be difficult for those only considering saving money on the renovation to choose BERTIM. Those who want a very fast renovation where

long-term return on investment can be calculated, however, then BERTIM has a clear chance. “I believe that the construction sector in general is not very innovative,” she continues. “But looking at how the world is moving, those who engage with digitisation and industrialisation first will be the most successful.”

“This sector must incorporate these new technologies to become more efficient. It cannot continue to be so reliant on the manual workforce but must adopt new technologies to streamline and speed up processes, reduce errors on site and improve coordination. If most of the work is done off site to be simply installed on site, it is much more efficient in every respect, while also reducing disruption, noise, dust and risk on site.

“BERTIM does just that and is designed to increase the efficiency of the whole sector by digitising the process, making renovation faster, while also delivering better quality solutions.”★

MAIN CONTACT



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and Executive MBA (University of the Basque Country, 2013). She joined TECNALIA in 2001 as a researcher in urban sustainability. She currently holds the position of Project Manager specialized in International Projects related to energy efficiency in buildings and built environments and development of new products for energy efficiency in which advanced simulation, solution development and decision support tools are involved. She has participated in a large number of European 7th FP and H2020 projects, both as researcher and as project coordinator.

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