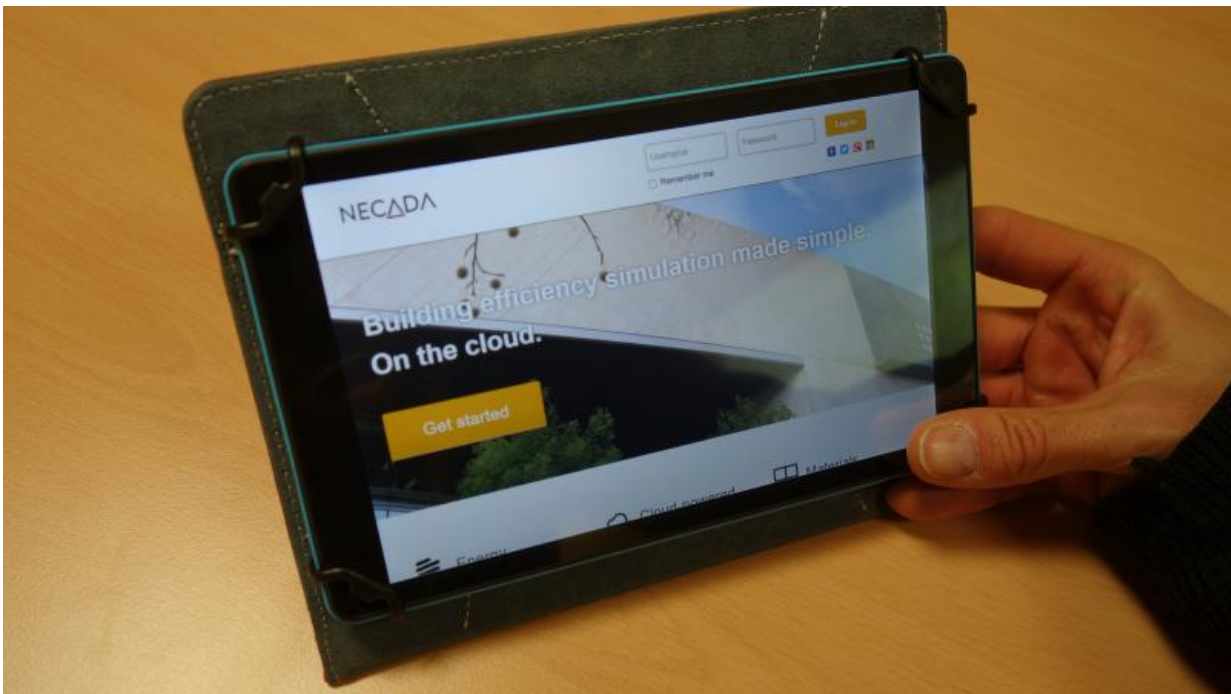


New software analyses the effect of climate change on buildings from the cloud

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The new software analyses the entire life cycle of a building, from its creation to the deconstruction process. Credit: UPC

Large Spanish construction companies have begun to use a simulation software package, developed by two researchers at the Polytechnic University of Catalonia, which analyses for the first time the entire life cycle of a building, from creation to deconstruction. The tool, which can be used in the cloud, includes aspects such as energy consumption,

materials and social repercussions. It also allows scenarios to be simulated, enabling the effect of global warming on constructions to be identified.

Brothers Pau and Antoni Fonseca, InLab FIB researchers from the Centre for Innovation and Technology at the Polytechnic University of Catalonia (CIT UPC) have developed the first-ever software to analyse the entire life of a building, or group of buildings, from the cloud. The tool, named NECADA, allows the entire construction cycle to be simulated, from creation to deconstruction, including aspects such as materials, design, orientation and energy consumption.

Certain details regarding the technology have been published in the journal *Advances in Engineering Software*. Even before its commercialization, Spanish construction groups such as Acciona and VIA had already used it in some of their projects.

Pau Fonseca, expert in statistics and operational research, explains to SINC: "Nowadays there are many IT solutions on the market that are capable of calculating [energy consumption](#), but they don't take into account key construction and design issues or deal with all the environmental and social consequences, which are fundamental to a sustainable system".

The social aspect of construction

Social aspects, omitted from other applications, are very much present in the new tool. "You can have a very ecological building, but in making it viable materials have been used which are not so ecological, or in whose chain of distribution and development, workers have been exploited. It is difficult to be sure that the chain is clean. Businesses and corporations' interests often make information unclear, but NECADA provides scenarios that enable this to be done properly."

Another of the software's most original features is the ability to simulate models to show how global warming may affect construction. The system considers different climactic scenarios, enabling the researchers to compare their effects and customise the primary factors that have an impact on buildings. "It is also possible to calculate how much CO₂ a building will emit," notes Fonseca.

Materials database



Brothers Pau and Antoni Fonseca, researchers InLab FIB Center for Innovation and Technology of the Polytechnic University of Catalonia. Credit: UPC

Furthermore, NECADA has an integrated database which can be used to improve construction and design buildings that are adapted to European legislation. The algorithms that are currently implemented in the system are some of the heuristic classics –such as hill-climbing, simulated annealing, NSGA-II, etc– which reduce calculation time to give a fast response to the problem posed," adds the expert.

Pau Fonseca indicates that the software consists of a core made up of a motor referred to as SDLPS that enables simulations to be carried out from complete representations of the models using languages such as SDL, DEVS and Petri Nets. "This core can be executed in a computer or be combined in a distributed way in a cluster, speeding up the extraction of results".

"We are currently uploading the system to the cloud so it can be managed remotely, enabling a user who is not familiar with simulation to customise the model and execute it in a distributed way," he adds.

Three dimensions

According to Fonseca, NECADA's selling point is its versatility. Starting with the shape and design of the building modelled in three dimensions with the open standard Building information modeling (BIM), "the system proposes different constructive solutions with regard to the materials that can be used. It also bears in mind the building's orientation and the area's climate," he stresses.

Furthermore, the software integrates "key factors such as the price of materials, and their transportation, assembly and disassembly so the construction company can calculate the total cost of the building."

Applications

With regard to its applications, the researcher believes NECADA could be useful in sectors outside of construction: "For example, businesses that manage a number of buildings, such as hotel chains or public bodies and local administrations, which could use it to completely evaluate the potential renovations they need to carry out on their buildings".

It could also be used for new builds for decision-making and for refurbishment. Taking a building or residential area's condition as a starting point, a number of alternatives to identify the best solution can be explored, the expert points out.

In the field of research, it could be used to test new materials, constructive solutions or climate analysis systems, enabling theoretical characteristics of the new element to be defined, and analysing the way it would fit in a specific building.

"Other possible uses would be for carrying out energy audits and designing scenarios to determine a building's optimal performance curve," concludes the researcher.

More information: "Formal simulation model to optimize building sustainability". *Advances in Engineering Software*. (2014). 69, 62–74. [DOI: 10.1016/j.advengsoft.2013.12.009](https://doi.org/10.1016/j.advengsoft.2013.12.009)

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