Development of a Design Support Tool for an Innovative BICPV Façade System

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Background

Lumiduct is an innovative building-integrated concentrating PV (BICPV) façade system, developed by the company Wellsun, which provides shading control and energy harvesting to glazed building façades (Fig.1). The system consists of a double-skin façade with an array of movable panels located in its cavity, which track the sun during the day. This optical system treats the diffuse and direct part of solar irradiation in a different manner. The diffuse component freely passes the modules and reaches the room as soft daylight. The direct part, on the other hand, is concentrated onto tiny, ultra-high-efficiency III-V solar cells to generate electricity. Lumiduct provides many functions to a glazed façade. It reduces solar gains, protects against glare, generates electricity, lets daylight in, and allows for a view to the outside.

Figure 1. Artist impression of a full-scale building integration of Lumiduct.

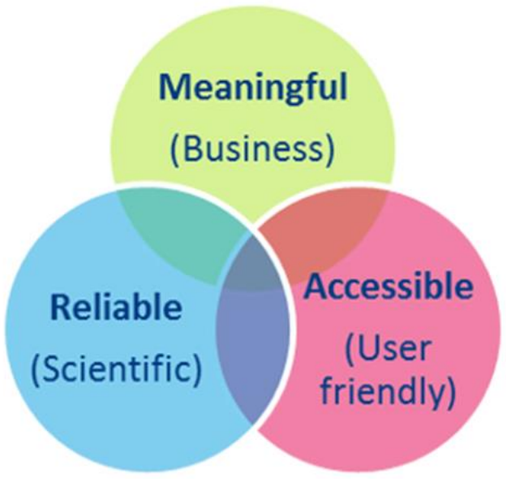
One of the main limitations that Wellsun is facing when trying to attract potential clients for Lumiduct is the lack of information about the expected performance of the façade system. Besides being a complex technology, active in multiple physical domains, Lumiduct entails a higher investment than common façades or shading systems. The potential benefits, related to electricity production, indoor environmental quality and energy efficiency, are difficult to appreciate by clients without means to quantitatively assess the performance of the system. This high uncertainty detracts their interest in this façade system, as they are not willing to take the risk.

Aim of the Project

The objective of this project is to develop a blueprint of a **design support tool (DST)** that provides a straightforward way for analysing the performance of the façade system in different environments. This blueprint will serve as a detailed plan to design this tool, based on insights obtained from literature, analysis of the potential users and stakeholders and other available design support tools.

Approach

Analyze the literature for existing alternatives, barriers for solar façade integration, potential users and stakeholders to find the best solution for a DST that supports the integration of Lumiduct into the market.



Calibrate the existing simulation models developed by a PhD candidate at TU/e with thermal and daylight comfort experiments of a full-scale demonstrator of the technology.

Adapt the current electrical, thermal and daylight models into a user-friendly DST, valid for non-specialized audiences.

Figure 2. Main concepts of the Design Support Tool.

Design Solution

The environment of the DST, including the parties involved in the development of the tool and its different audiences, is represented in Fig.3.

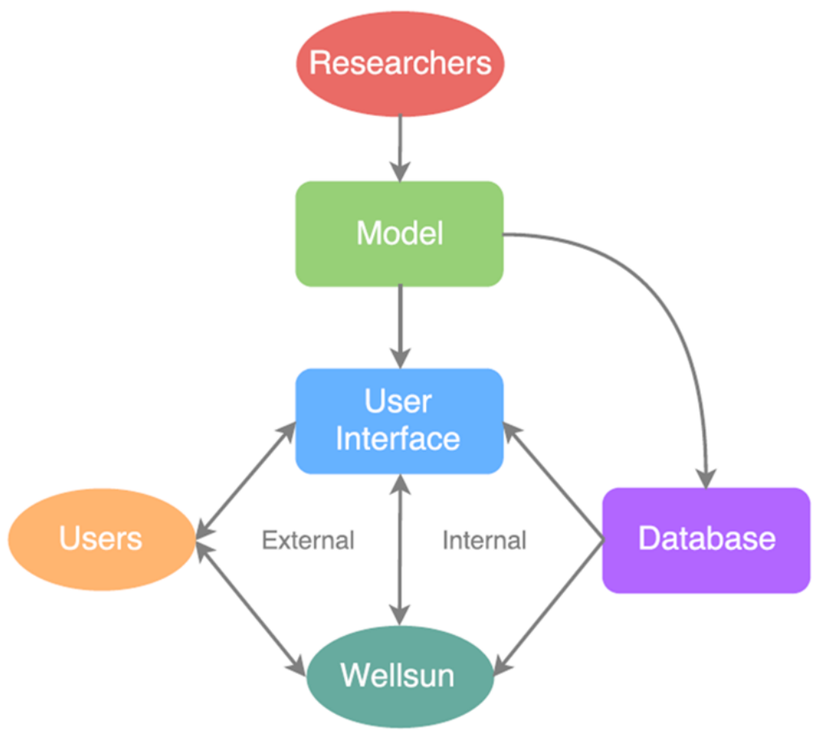


Figure 3. Environment of the Design Support Tool.