M6.3 Façade Innovation Management

WP6. Innovation Management, T6.2

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1 Introduction

The improvement of the building envelope's performance plays an important role in the achievement of the energy saving target of the European Union [1] and the long-term goals set in the European Roadmap 2050 [2]. Thus, in recent years big attention is given to the improvement of the building envelope's performance through the development of new and innovative solution, beside the enhancement of traditional ones. In addition to that architectural trends influence the shapes and aspects of facades. All these developments led to a huge variety of façade systems, including several materials, components, construction principles, design typologies and installation solutions. In order to keep on developing innovative façade design solution, the broad knowledge about the existing ones is essential.

Within the FACEcamp project, the focus was given to the façade knowledge management as basis for façade innovation.

It is known that the acquisition, organization, structuring and communication of knowledge, has a central importance for innovation. In other words, innovation is a process that captures, acquires, manages and diffuses knowledge with the aim to create new knowledge that supports the development of new products and solutions.

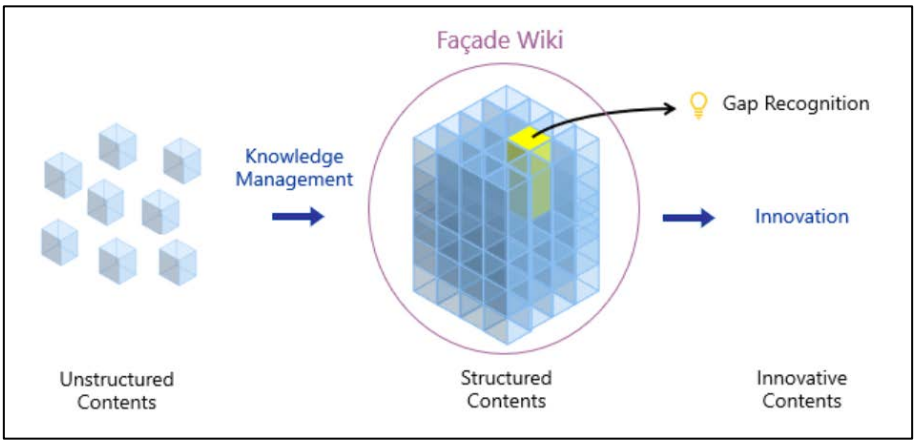

Figure 1: Façade knowledge management as basis for innovation

Figure 1 summarises the concept of the façade knowledge management as basis for innovation: lots of unstructured contents about façade technologies are collected and organized in a structured system (façade wiki). The recognition of gaps within the structured contents, as response to certain requirements and constraints, could lead to innovative solutions. It might also be that the gap is not filled due to low market or technology readiness level, but it is anyway a potential for innovation.

2 Analysis of innovation methods

Different innovation methods, like TRIZ AIDA, Axiomatic Design and the contradiction-oriented innovation strategy (WOIS), were examined and trained, in order to gain knowledge in innovation processes and get some ideas for a smart classification and clustering of façade technologies. All these methods have in common the segmentation of the general, more complex problem into smaller ones.

3 Semantic data model for the façade wiki

3.1 Conception

From the study of the innovation methods the necessity of concepting the façade wiki semantic data model with a holistic approach emerged. In this perspective, a vertical decomposition of the façade and its surroundings was done. As shown in figure 2, as superior system the building concepts were selected, followed at a lower hierarchical level first by the envelope systems and then by the façade systems that are of major interest in this work. The façade system is further subdivided into the façade sub-systems and the façade components.

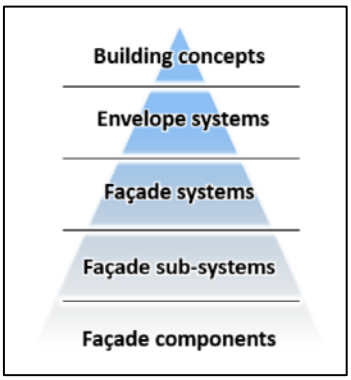

Figure 2: Vertical decomposition of the façade

In order to do a comprehensive classification of the façade systems, in a first step the customer needs were defined that specify the requirements of the customer and form the constraints of the design. These are translated into functional requirements that are fulfilled by specific design parameters.

3.2 Development

With the knowledge gained during the research of façade systems, components and materials, the described concept for the data model was applied to façade technologies to develop a semantic data model for the façade wiki that forms the classification system for façade technologies within the Façade Wiki.

As shown in figure 3, typical customer needs are security, privacy, thermal and visual comfort, outward view, etc. These needs can be translated into four main functional requirements: protection, load bearing, space enclosing and utility. Each one of them is decomposed into sub-requirements. For instance, the protection requirement is divided into the two main groups: protection against continuous and protection against extraordinary actions. This latter including, for example, fire protection, lightning protection, burglar protection, bullet protection, etc.

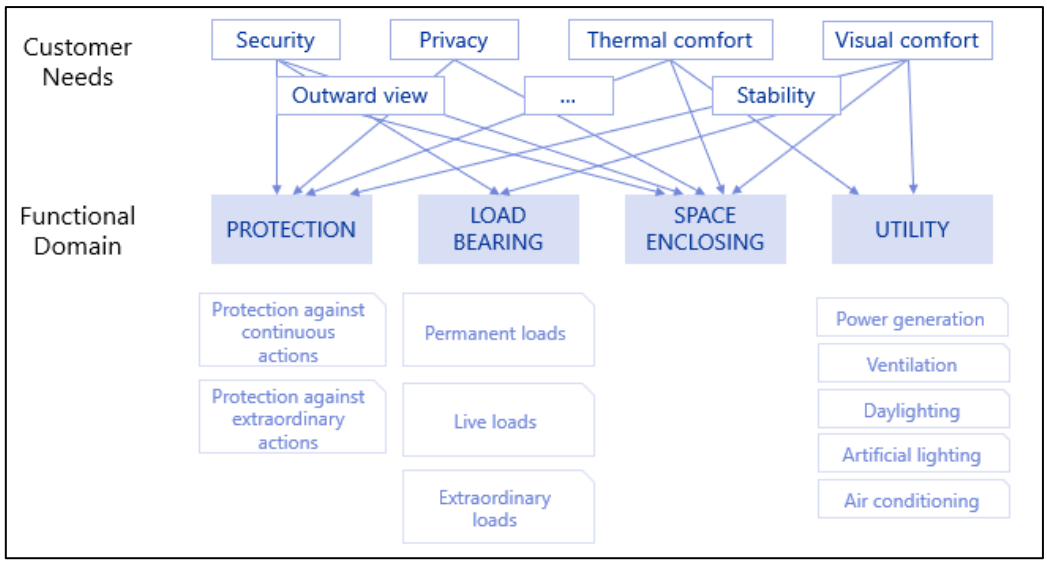

Figure 3: Semantic data model showing customer needs and functional requirements

In the same way as for the functional domain, the corresponding structure for the design domain was created. In particular, the design domain is formed by the following four groups: protection system, load bearing system, filling system and utility system. The several clusters of design parameters are decomposed until a specific technological solution is found. This decomposition is visible in figure 4, where the example of an active thermal power generation system is shown.

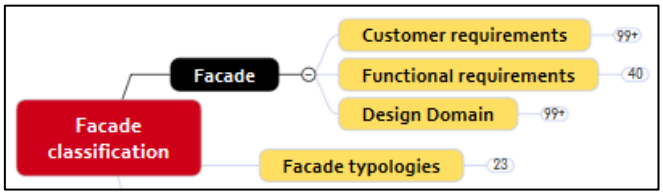

Figure 4a: Extract from the semantic data model of the façade wiki: overview

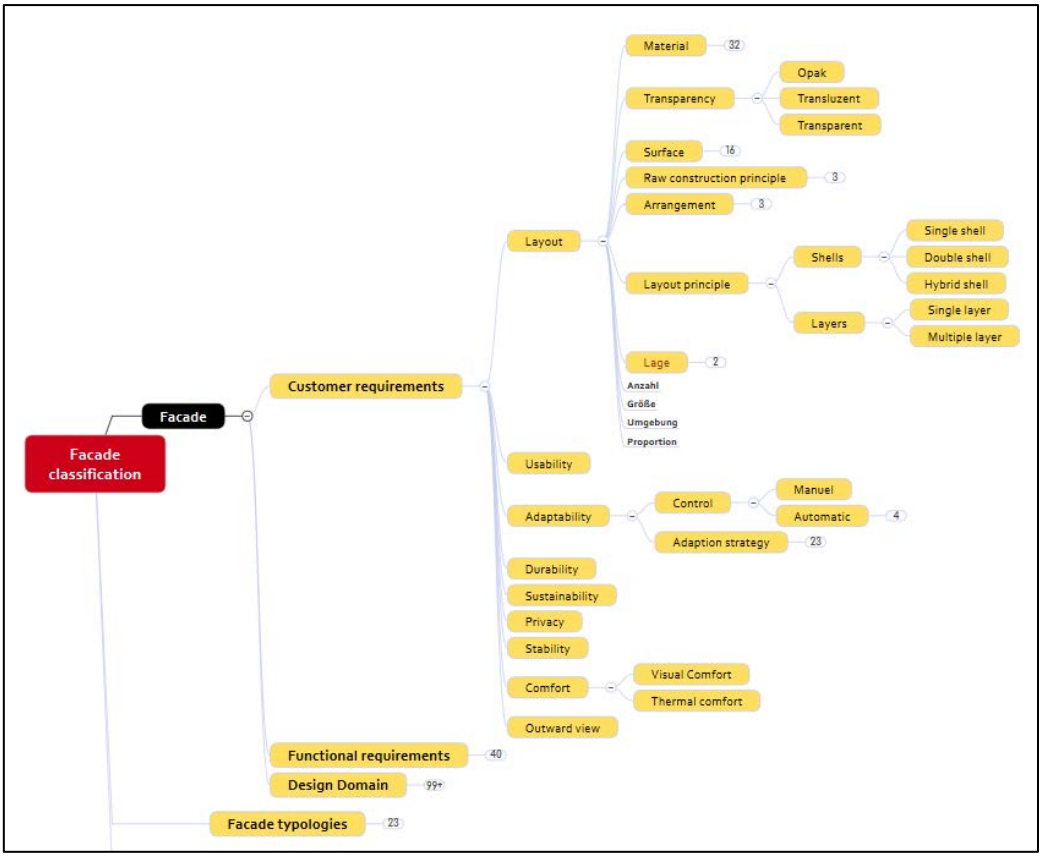

Figure 4b: Extract from the semantic data model of the façade wiki: customer requirements

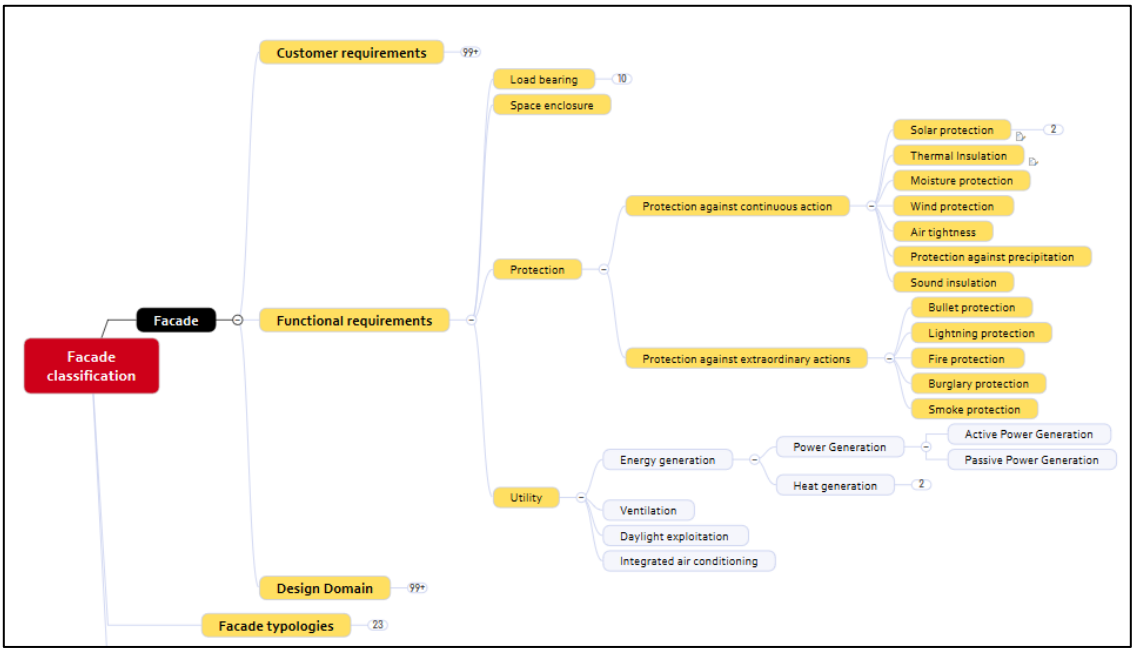

Figure 4c: Extract from the semantic data model of the façade wiki: functional requirements

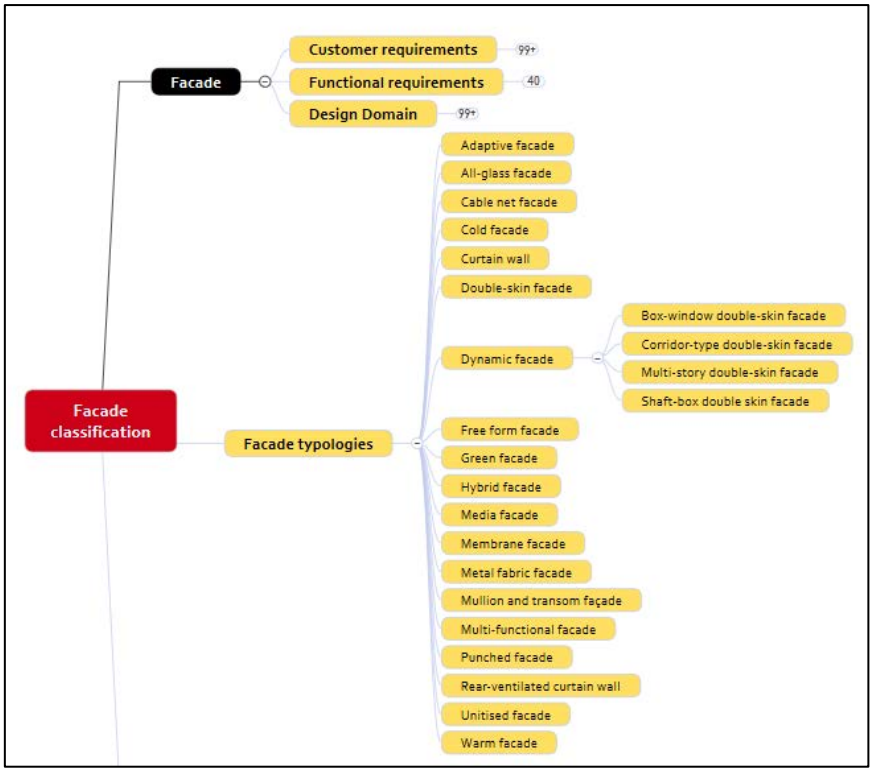

Figure 4d: Extract from the semantic data model of the façade wiki: façade typologies

If from a combination of functional requirements with the specific constraints of the customer, no design solutions are found, this means that there is a potential for innovation, of course considering the readiness level of the technology and the market and of course also the organization.

4 Digitalisation of the semantic data model

The semantic data model needs also a digital infrastructure that can be developed from scratch or rely on available knowledge management software (KMS). Therefore, an accurate research of available KMS was done. This resulted in a big variety of tools able to manage documents and contents and search among them.

Focusing on the search function, we can distinguish four main classes:

- Static search engines, like traditional DMS, based on the manual definition of metadata and a full text search over the contents;
- Semantic search tools with semantic processing of the contents, basic indexing and search functions, and manual definition of metadata;
- Advanced search and analysis tools with specific features related to semantics, like natural language recognition, entity extraction and partially automatic indexing and many search features;
- Self-learning tools based on Artificial Intelligence and Machine Learning that learn from the user behaviour and enhance the search; these tools require lots of users and big data.

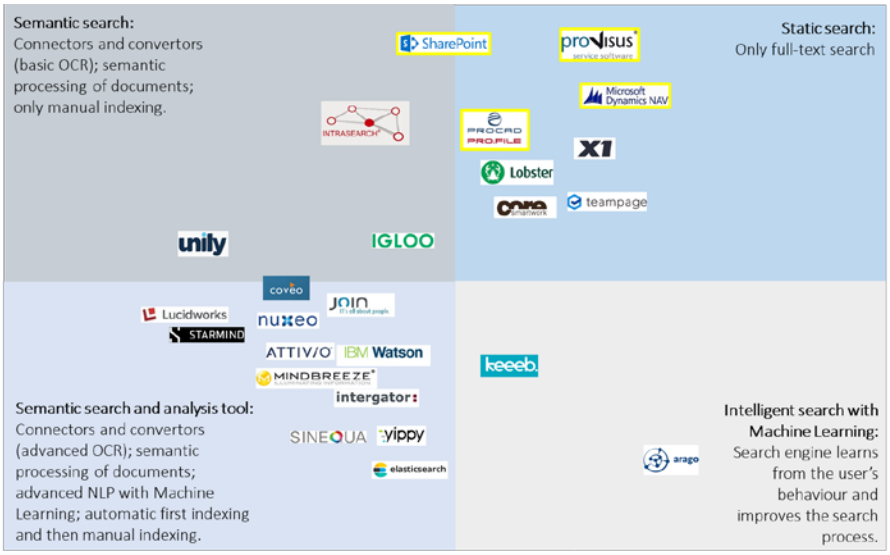

Figure 5: Classification of knowledge management tools

To quantitively evaluate the various tools, these main evaluation criteria were defined and weighted according to their importance:

- Database connection;
- Conversion of different file formats (i.a. CAD files);
- OCR functions;
- Indexing features;
- Natural language processing (NLP);
- Search enhancement (refinement, filter, ranking);
- User permissions;
- Interface;
- Usability;
- Company;

From this first analysis the advanced semantic search and analysis tools resulted to be the most appropriate for the façade knowledge management.

5 Business Model

A possible business model for the façade wiki could work in this way: manufacturers of the façade industry provide contents about façade technologies that are collected and organized in a façade wiki. For this, the manufacturer gets paid. The customer can access the wiki and searches for solutions paying a fee that might depend on the level of detail of the contents that the user needs.

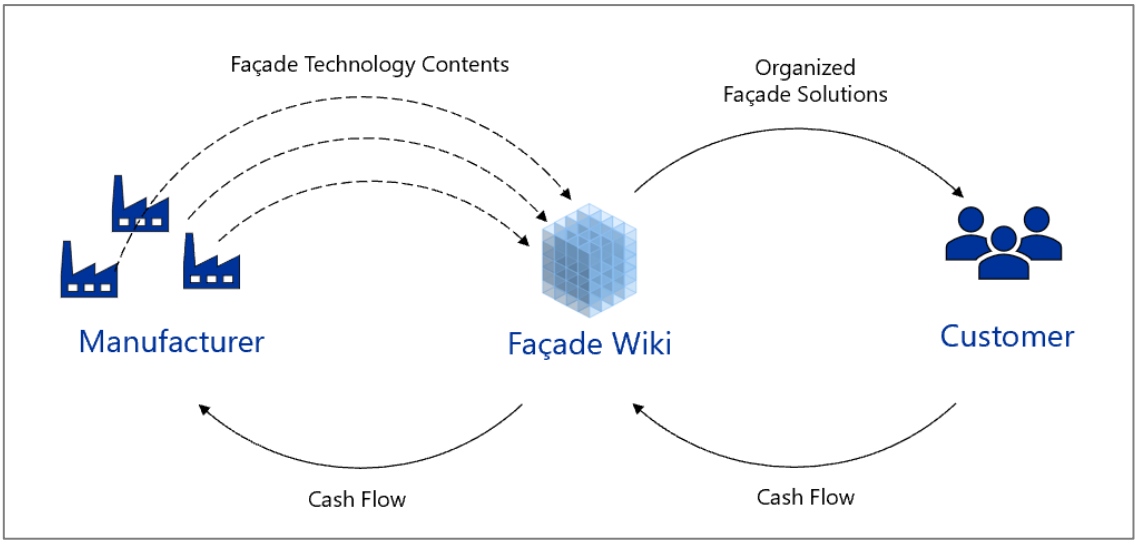

Figure 6: Business model for the façade wiki

6 References

[1] E. Parliament, “Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency," *Official Journal of the European Union*, pp. 1-56, 2012.

[2] E. Commission, “Communication from the Commission to the European Parliament, the Council, the European economic and social Committee and the Committee of the Regions, Energy Roadmap 2050," 2013.

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