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ICT-supported end user participation in creative and innovative building design

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ABSTRACT: In this paper we describe an ICT-supported method, VIC-MET, to support innovative and creative end user participation in the building design process. We also describe the actual process used in the development of VIC-MET. The method was developed in cooperation between university and two major engineering and architectural companies. Experiences from design of the two companies' new headquarters were used as input to method development and they have as well provided cases for method evaluations. The method supports user involvement in every phase of the design and construction process and with an individual setup depending on design context. VIC-MET has validated the need for enhanced methods to involve end-users of buildings in a collaborative/participative, creative and innovative building design process. The industry partners also appreciate the development, enhancement and extension of existing methods for user involvement in the building process.

1 INTRODUCTION

The latest decades of advances within Information and Communication Technologies (ICT) have paved the way for development of effective, efficient, and user-friendly building process support systems. We recognize introduction of object oriented parametric data modelling systems to house building models and advances in the Human Computer Interaction (HCI) domain to support collaboration and access to Building Information Modelling (BIM) models. The prerequisites for establishing a design environment, where early decisions and needs capture together with building end-users are at hand. We should now be able to put greater focus on optimisation of functional building systems, prioritization needs, requirements on the component building systems and evaluations of proposed solutions. In this paper we describe an ICT-supported method, VIC-MET, to support innovative and creative end user participation in the building design process. VIC-MET is a general method for user involvement in every phase of the construction process supporting an individual setup for each type of usage.

2 BACKGROUND

2.1 *User driven innovation*

If we do a Google search on the text "user-driven innovation" we achieve 1.8 million hits and with "innovation" 107 million hits.

There is a long list of methods and models, which can be said to support user driven innovation, see also (Von Hippel 2005), Beyer & Holtzblatt 1998), (Gero & Maher 1993), (Rogers 2003), Pittaway et al. 2004), and (Brandt et al. 2005).

A central issue in involving users is to uncover both known and not yet recognized user/client needs on functionality and form of new or refurbished buildings.

We here describe user driven innovation as a 'systematic approach to develop new products and services, building on investigation or adoption of users life, identity, praxis, and needs including unrevealed needs' (Christiansson et al. 2008).

2.2 *Participants*

The project User Involvement in Construction—Virtual Innovation in Construction, VIC, is financed

by the Danish Enterprise and Construction Authority and the Programme for User Driven Innovation. It started August 2007 and finishes in June 2010. Project participants are two major engineering and architecture companies in Denmark, Arkitema Architects and Ramboll A/S, together with Aalborg University, Department of Civil Engineering.

2.3 *Project goal*

The project goal is to create an ICT supported methodology VIC-MET to involve building end user in a creative innovation process together with building designers, to capture and formulate end-user needs and requirements on buildings and their functionality.

3 THE VIC METHODOLOGY

3.1 *Development of VIC-MET*

The VIC method (VIC-MET) was itself developed in an innovative/creative design process. The Contextual Design method (Beyer & Holtzblatt 1998) has given inspiration in the development of the VIC method.

The Confluence 'enterprise wiki' from Atlassian, http://www.atlassian.com/, was chosen to serve as a hosted project web also housing the VIC Public Space. VIC Confluence was mainly used as a dynamic content management system and also used to take real time notes during physical and virtual meetings.

3.2 *VIC-MET spaces*

The method supports user involvement in every phase of the construction process and with a unique setup depending on design context. Four spaces to support the innovative/creative design process are defined; The Contextual Inquiry Space, the Conceptual Modelling and Game Space, the Functional Building Systems and Consolidation Space, and the Solution Space. See Figure 1.

3.3 *Using VIC-MET*

The end-users can be more or less involved in the design. In VIC-MET we differentiate between User Involvement and Co-Creation. In the first case the users are typically presented alternative solutions to comment on and in the latter case they are deeply involved in the design activities.

The following activities in VIC-MET spaces can be distinguished:

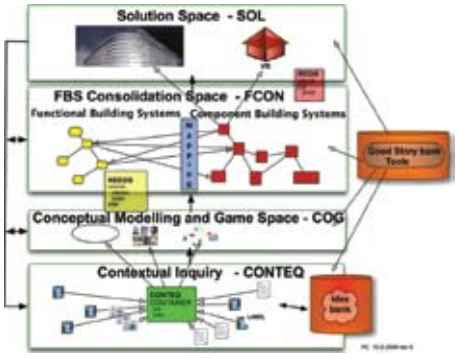

Figure 1. The four design spaces in the Virtual Innovation in design Method, VIC-MET. From (Christiansson et al. 2009a).

Activities in the *Contextual Inquiry* space (CONTEQ)

- Formulate Design/Innovation domain.
- Set up design team including proper end-users groups.
- Plan the whole design process.
- Identify/allocate resources such as Idea bank, Best practice, Contextual Inquiry Bank.
- Allocate tools from the ICT Tools Bank.
- Perform contextual inquiry including needs capture.

Activities in the *Conceptual Modelling and Gaming* space (COG)

- Develop conceptual models (e.g. using Contextual design methodology).
- Needs listing.
- Common values development.
- Functional Building Systems specification.
- Creative/Innovative design.
- Allocate tools from the ICT tools bank.

Activities in the *Functional Building Systems Consolidation* space (FCON)

- Needs consolidation, weighing and listing.
- Project vision formulation.
- Prioritizing needs.
- Mapping of Functional Building Systems (FBS) and Component Building Systems (CBS).
- Listing of requirements on Component Building systems.
- Component Building System modelling.
- Allocate tools from the ICT tools bank.

Activities in the *Solution* space (SOL)

- 3D virtual building modelling of (alternative) solutions.
- End user evaluation of solutions.
- Documentation of end user feed-back.

– Allocate tools from the ICT tools bank.
– Choose solution(s) or return to the FCON, COG or CONTEQ space.

3.4 *The VIC-MET tools box*

Many different ICT tools can support the VIC-MET activities described above. In the VIC-MET book (in Danish) the tools are categorized according to the ontology below:

Data collection and modelling
- Interviews and user investigations.
- Conceptual modelling.
- Scanning and surveying.
- 3D modelling.
- Registering and measurements.
- Analyses and prioritizing.

Communication and collaboration
- Communication.
- Information and knowledge sharing.
- Relationship and competence handling.

Visualization and interaction
- Still renderings.
- Animation.
- Interactive visualization.
- Virtual reality.
- Virtual 3D communities.
- Rapid prototyping.

Examples of tools within each main category are e.g. IHMC CmapTools for conceptual modelling (Novak et. Al, 2006), Atlassian Confluence for web-based collaboration, information and knowledge sharing, and Ramboll VR Wii for interactive visualization.

4 CASES FOR EVALUATION

VIC-MET was developed in parallel with design and construction of the new Ramboll Head Office (RHO) and the new Arkitema office (Mikado House), both situated in Copenhagen, Denmark. The RHO and Mikado House cases have contributed in assembling experiences input to the development of VIC-MET and served as a test bed for VIC-MET.

4.1 *The Ramboll Head Office case*

Three test cases were carried through in the RHO case.

1. Color selection
2. Placement of reception desk
3. Interiors of meeting spaces.

The end users involved in the process came from the interior and identity groups. The user participation was mainly of type User Involvement rather than Co-creation. The user took standings on principles of color distribution and range in the building, as well as general views on the artists color composition.

The following conclusions were drawn from the color selection case. The interior color selection process requires models on appropriate detailing level. In this case the artist found the original digital model too detailed to work with. It is also very important to do a proper calibration of the displays used in the coloring and evaluation process and keep in mind that lighting conditions in the model greatly influences the impressions.

In the 3D model the users could experience the size of the colored areas, distance color visibility, and color compositions. The first evaluation on high level took place in the Solution (SOL) space and the feed-back was introduced by the artist in the subsequent return to the Conceptual Modelling and Game (COG) space. Here the end users agreed on for example nice and ugly coloring, correlation with the personality of the building, and the amount of complement colors and contrasts. The user needs and views were included in a not very formal way to the FBSs and via color attributes of components in the CBSs, which were later realized in new solutions in the SOL space. See also Figure 2.

Another Rambøll case was—placement of reception in the entrance hall. The activities in the Contextual Inquiry (CONTEQ) space, invoked mainly the executive level in Rambøll. These end users expressed a lot of needs and requirements with at first glance contradictory functional and visual challenges. Four initial proposals were presented for the end-users in the solution (SOL) space, to support the following discussions in the Conceptual Modelling and Gaming (COG) space. It was for example discovered that there

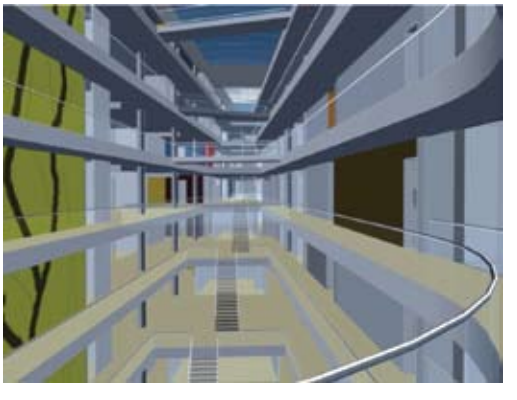

Figure 2. Coloring the new Ramboll Head Office.

were different requirements on placement of the reception depending on if it was watched from the entrance or from the inside of the entrance hall.

The function of the reception related to today and future expected functionality was further discussed in the Functional Building Systems Consolidation (FCON) space. Revised solutions were evaluated and discussed in the SOL space. See also Figures 3–4.

A special VR-Wii solution was developed at Rambøll providing the users a simple and cost efficient way to navigate in the virtual buildings solutions in the SOL space. See Figure 5.

A particular user group was early established to take care of end user needs in connection with interiors and facilities in meeting spaces and common locations. In this case VIC-MET was used late in the process involving a choice of specific furniture and their placements. Solutions were presented in both virtual and real settings in the existing office. The main activities took place in the FCON and SOL spaces. Special regards to possibilities for housing both social and more private meetings were studied in the café space. See Figure 6.

4.2 *The Arkitema headquarter case*

The Arkitema office project started in 2005. The kick-off procedure and early workshops from this work gave fruitful input to the VIC-MET development. An intentional focus in the office design was to keep the design activities on a high abstraction level with focus on common values, needs and functional building performance. User involvement procedures for the VIC-MET were set-up and evaluated for the office space design case.

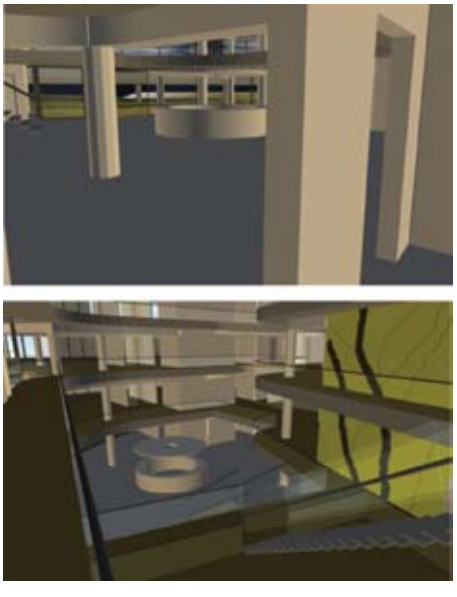

Figure 3. Entrance alternative 1 in the new Ramboll Head Office.

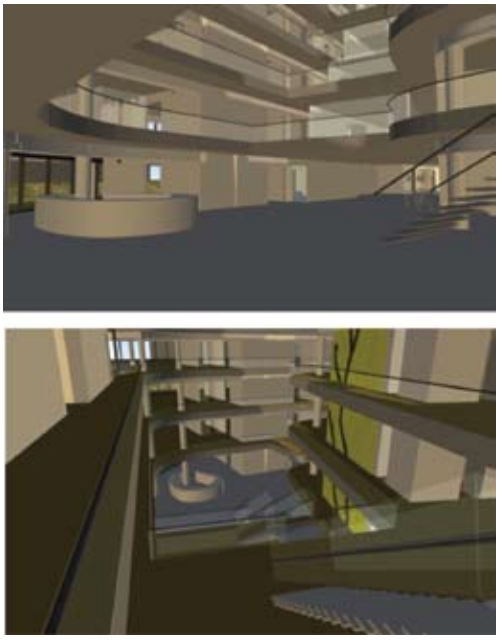

Figure 4. Entrance alternative 2 in the new Ramboll Head Office.

Figure 5. A special VR-Wii solution was developed at Ramboll.

Figure 6. The combined café and meeting space at the new Ramboll Head Office.

Figure 7. Video documentation of design, evaluation activities in the SOL space at the Panorama VRMediaLab Aalborg University.

Figure 8. Use of symbols in the virtual building office space to evaluate placements of privileged meeting places in the Panorama respectively Cave at the Aalborg University.

Alternative solutions were partly changed and evaluated in the Panorama and Cave at the VRMediaLab at Aalborg University. It was concluded that it was feasible to make real time changes, annotations, and to store different solutions. It was also concluded that is very important to work on a uniform abstraction level, dependent on design context and user skills. See Figures 7–8.

4.3 *Late Brain Injury Center case*

Finally VIC-MET was assessed in connection with design of a Late Brain Injury Center including patient housing, training facilities and Living Lab facilities for Aalborg University. See Figure 9. In this case the architect for a first alternative presentation compiled the end users needs and wishes. The architect leads the walk-through for a broad (15 persons) end-user representation of clients, patient relatives, AE design team, nurses, and university Living Lab researchers. Feed-back from

Figure 9. User Involvement in the design of The Late Brain Injury Center Frederikshavn Denmark. VIC-MET development support.

evaluations in the SOL space were used as input to the architect for further iteration and alternative evaluations.

5 CONCLUSIONS

The VIC-MET was developed to support user participation in innovative and creative building design. The method supports user involvement in every phase of the construction process and with a unique setup depending on design context.

VIC-MET has validated the need for enhanced methods to involve end-users in a collaborative/participative creative and innovative building design process. The industry partners also appreciate the development, enhancement and extension of existing methods for user involvement in the building process.

The VIC-MET will support a future more performance based design process and development of ontologies to better describe functional building systems. See also (Christianson et al. 2009b).

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