IT_CODE

1. NAME

IT_CODE
Per Christiansson, Aalborg University, supervisor

2. TITLE

"IT in Collaborative Design."

Analyses, demonstrations and requirements formulation on IT support in collaborative early design involving client, architects, engineers, and external product suppliers.

3. GOAL

It is well documented that lack of efficient and reliable information within the building industry leads to low end product quality and more serious failures. Information Technology, IT, tools must be further developed and adapted for reliable support in connection with communication within and between specialists, documentation of the building product during it's life time, and support of underlying processes from the program phase to operation and use of the building. The project will answer questions like; How can IT support collaborative work in the early design phases? How will individual working method change? How can competence collaboration be strengthened and how can the design process be documented to serve as an efficient project memory? The project will focus on, requirements formulation on IT-tools to support engineering architecture routine and creative collaboration, analyses of working methods in collaborative multidisciplinary design, demonstrator development to support the research process itself as well as capture, communicate, implement and evaluate ideas together with practitioners, development of a simple building process core model forming fundament for the common digital work space.

4. RELEVANS

The project focuses on central and not well understood problems in connection with IT-supported collaborative work in one of the most essential parts of the building process namely the early design and program phases. A holistic view is taken in order to better understand and map a complex process comprising issues like computer models for design team dynamic memory, meta language for communicating design intent between and within participating specialist groups, and product models to support work on shared work spaces partly independent of time and space.

5. PROJECT PLAN

Project start late spring 2001 with 3 years duration. The first 0.5 years will focus on analyses of existing tools and processes, followed by 1.5 years incremental prototyping of a demonstration system with continuos evaluation and usability tests. The final 1.0 year is devoted to results analyses and implementation of web based interactive demonstrator system.

6. RELATIONS TO OTHER CID-PROJECTS

- Komponentspecifikke IT modelleringsværttøjer (Kristian Agger), will contribute with product model components.
- 'Arkito' (Peter V Nielsen) will contribute with design review case within creative design
- Other projects will hopefully contribute with relevant design cases.

7. OTHER COLLABORATION PARTNERS

- Dr. Renate Fruchter Stanford University, on collaborative design
- Architect Poul Sorgenfri Ottosen, AAU on experiences of use of object oriented product models

- The project will require a reference group which should be integrated with a common CID reference group.

8. RESULTS MEDIATON

The project results are spread through work shops arrangements, publications in international journals, presentation at international conferences and as a publicly available interactive demonstrator on the WWW.

9. PROJECT DESCRIPTION

9.1 Background

The building sector is characterized by high complexity in its organization with a combination of industrialized supply industries to a very highly craftsmanship oriented process. This give raise to competing optimization demands from the different involved partners.

It is well documented that lack of *efficient and reliable information* within the building industry leads to low end product quality and more serious failures. Information Technology, IT, tools must be further developed and adapted for reliable support in

connection with communication within and between specialists, documentation of the building product during it's life time, and support of underlying processes from the program phase to operation and use of the building.

IT tools have been introduced in the building process since the end of the 1970s. Isolated digital islands have been created for design (2D/3D Cad, visualization, engineering calculations), construction (quantity take off, resource management), maintenance/use (hire administration, facility management), and recycling (components/material databases). To this we shall add access to external vendor product information, regulations, and community information.

The complex project organization of the building industry together with higher international involvement will take great advantage of the future advanced IT tools. The actual products will also themselves contain embedded and coordinated IT support. The building process will be more integrated, though often through redundant product/process models, and information produced during the whole process will to a higher degree support the maintenance and use of he final buildings and provide subsequent experience data.

We will through realistic simulations be able to get a much better support when we make important decisions in the very early requirements formulation phase of the design process. The multimedia and virtual reality properties of the interfaces to the computer models of the building process and products will improve all the building process participants way to communicate and collaborate less constrained by time and geographic position.

The Building Process is composed of sub processes that may be well formalized (for example in production lines) in the case of manufacturing of supply resources or building components. Practitioners of the future may in connection with 'industrialized individual building', develop a closer interaction between the more unique once in a lifetime building project and the dynamically linked supply processes (information and products on demand).

We believe that is important

- to try to recreate the old *building master* through efficient cooperation between different competencies (client, product suppliers, architects, engineers etc.),
- to introduce efficient IT tools to support *communication*, work *on shared digital work spaces* with access to personal and project data during team collaboration
- to provide adapted *time marked* building process documentation
- to provide access to building process models (geometrical and functional) with high degree of *realism*. That is to contribute to the build up of a *Virtual Building* which can be built and used during a whole simulated life cycle.

In order to facilitate the integration of building sub processes there is an urgent need to develop requirement formulations of the future Virtual Building models (Christiansson, 1999) which can be used during the whole life cycle of a building from idea to demolition. These requirements arise from

- requirements from design team activities as client briefing, design reviews, analyses and optimization, decision making, sketching, design comparisons.
- properties of multimedia access to design team shared work space
- underlying building process and product descriptions

9.2 Research focus

Some of the central research issues in this connection are

- formal descriptions and *meta languages* to facilitate communication between and within design/construction team and product suppliers (Christiansson, 1998), (aecXML)
- requirements on *multimedia* and virtual reality interfaces to support engineering architecture collaboration
- why and how formal *temporal* building process properties may be included in these descriptions to facilitate building sub processes integration
- influences of *meta level information models*, and dependencies between multimedia presentation and application model views
- development of a *demonstrator* involving practice participation and requirements formulation

The project will *focus* on,

- *requirements* formulation on IT-tools (multimedia and virtual reality interfaces as well as model handling and communication) to support engineering architecture routine and creative collaboration
- analyses of *working methods* in collaborative multidisciplinary design
- *demonstrator* development to support the research process itself as well as capture, communicate, implement and evaluate ideas together with practitioners
- development of a simple building *process core model* forming fundament for the common digital work space.

9.3 Methods and resources

We focus on the very important but less formalized initial design/sketch and client requirement formulation phases.

Methods and resources to carry through the research

- connection to a test house design and construction
- collaboration is intended to be established with Cad- and CSCW-system vendors as Archicad/Graphisoft for model implementation and team work partly using existing IT supported design tools
- incremental prototyping with end user participation (demonstrator development). The work will be a combination of incremental prototyping and continuous usability tests done in a distributed environment. It is our intent to use several different methodologies that can be used in combination e.g. Heuristic evaluation, (Nielsen & Mack , 1994) and Wizard of Oz prototyping (Beyer & Holzblatt , 1997)
- collaboration with Stanford University, Project Based Learning Laboratory, Civil and Environmental Engineering on new IT-tools to support and capture collaborative design

9.4 Research phases and schedule

Year 1:

- Analyses of existing IT tools and standards for communication (person to person, person to system, system to system)
  Properties of future enabling IT tools.
  Tools for work in shared work spaces
  Driving forces for development.

- Accounting and analyses of reported experiences from IT-supported collaborative work.
  Concurrent Engineering, CSCW Computer Supported Collaborative Working, models for design collaboration, decision support, negotiation support, support for creative thinking and idea generation, etc.

- Workshop on 'Collaborative Design Experiences'

Year 2:

- Set-up of demonstrator involving
  definition of test cases, one complex but limited in scope (deep), one large but with low degree of product complexity (broad with special regard to external support processes)
  creation of design/client team
  choose of product modeling platform(s), communication platform, design process modeling platform(s)

- Formulation of continuos evaluation and usability tests and experience documentation's. (See also methods above)
  Requirements and demonstrator implementation of long and short term external personal and team memories
  Description of design paradigms used in the study (routine, innovative or and/or creative design, (Gero & Maher. 1993)

- Special study on design intent propagation and realization between specialists and within specialist group.
  Translation of personal/team experiences to other participants
  Specification of team member 'checklist' support
  Documentation of routines for efficient collaboration and process documentation
  Test case: Innovative and creative use of IBI, Intelligent Building Installations, in connection with building function/form requirements formulation.

- Special study on design review and collaboration in distributed environments

- Workshop. Presentation of IT_CODE results together with industry Reference group.

Year 3:

- Analyses of results. Reporting. Requirements on underlying models, communication (meta) languages

- Adoption of prototype for common access from WWW, WEB_CODE. WEB_CODE provide a highly accessible demonstrator for transfer of research results to industry and educational environemnts.

9.5 Results

The main outcomes from the project are

- survey on building process models and IT-tools for work on shared building process/product models.
- demonstrator accessible to practitioners
- requirements on IT tools to support early design team work
- analyses and explanation of IT supported collaborative working methods
- coordination tools (sketch tools and model connections) to support early design team collaboration and sketch activities
- requirements on high level entity core model using IFC standard (the building component perspective) from collaborative early design work

9.6 Participants

- Prof Per Christiansson, Aalborg University (supervisor)
- PhD. student NN financed 50% by the project and 50% by Aalborg University Institute 6.
  Period: June 1 2001 - June 1 2004.
  Placement: Aalborg University, Sohngårdsholmsvej 57, Aalborg, and periodically at Aarhus School of Architecture.

- Dr. Kjeld Svidt, , Aalborg University (co-supervisor)
- Dr. Kristan Agger, Århus Architectural School (co-supervisor)
- Prof Peter V Nielsen, Aalborg University (co-supervisor)
- Dr. Poul Henning Kirkegaard, Aalborg University (co-supervisor)
- Dr. Hans Kiib, Aalborg University