Future Integrated Design environments

CIB-W78 25th International Conference on Information Technology in Construction.

Santiago de Chile, July 15-17 2008

Per Christiansson, Aalborg University, Denmark
Kjeld Svidt, Aalborg University, Denmark
Kristian Birch Sørensen, Aalborg University/Rambøll, Denmark

CONTENT

- Today's context
- Historic development and enabling ICT
- Scenario and vision
- Needs analyses
- Integrated Design Systems development
- Conclusions

TODAY'S CONTEXT

We are facing a probable *great change* in the way we carry through building design in future ICT supported environments.

Driving forces - *digitalization* of information, *storage* and *access* media are separated, building process and product systems are *formalized* in digital models, *user environments* are provided with rich multimedia access to virtual models, *virtual collaboration rooms* established, and *new* efficient and effective ICT tools defined and implemented.

Barriers - missing *ontologies*, poor *user involvement* in needs and requirements formulations on new ICT tools, low *competence* levels, *complex* 'society'.

System development approach for IBDS needed.

HISTORIC DEVELOPMENT ENABLING ICT 1/6

1950 - 1960 *large* computers, *batch* processing, line-printers, *document* classification

1970 *building models* with abstraction hierarchies, calculations on 3D models, *relational databases*, CAD/CAM, time-sharing, minicomputers.

1980s personal computers, *object-oriented* building models, knowledge-based systems, *PDES/STEP*, hypermedia, WWW

1990 *application sharing*, *video communication* (1968) on Internet, mixed reality

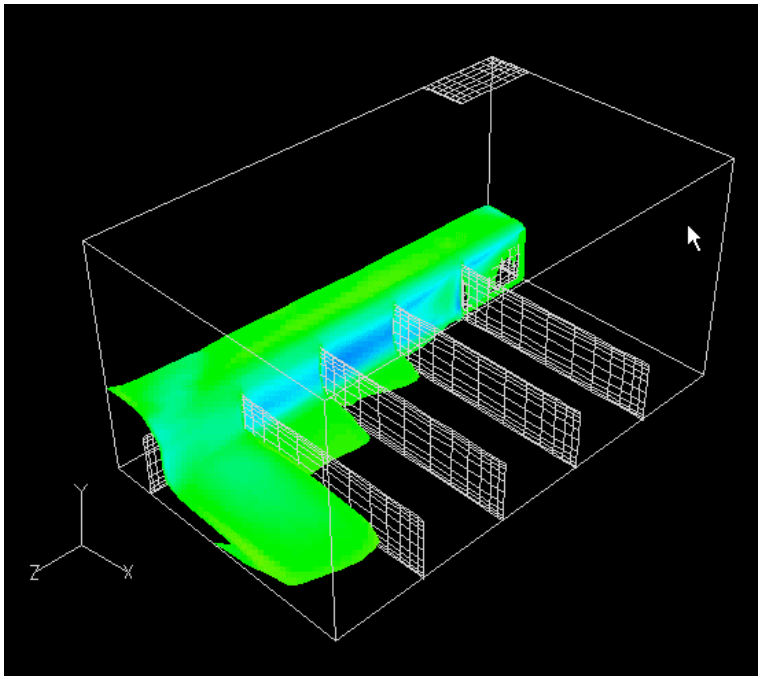
2000 virtual workspaces, *semantic web*, …

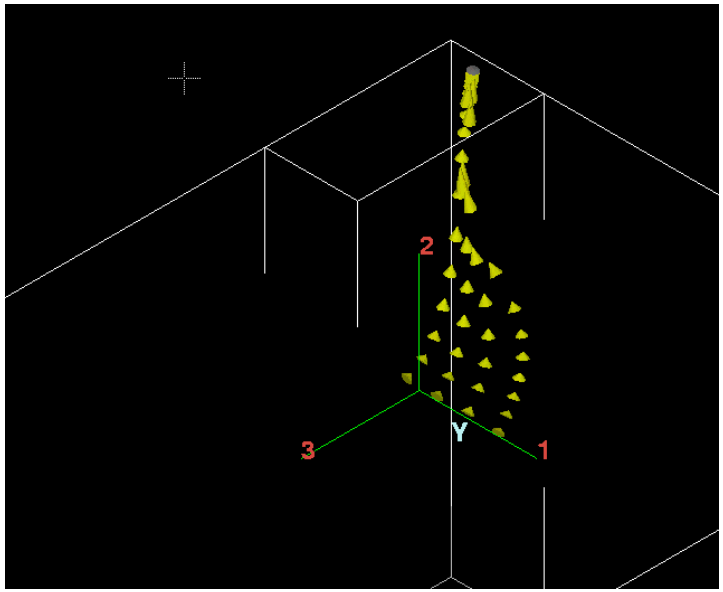
HISTORIC DEVELOPMENT ENABLING ICT

Hypermedia workstation developed 1988 at KBS-Media Lab, Lund University, with video display and browse of images and films stored on video disk.

Experimental set-up at KBS-Media Lab, Lund University, 1991, with video communication and screen sharing

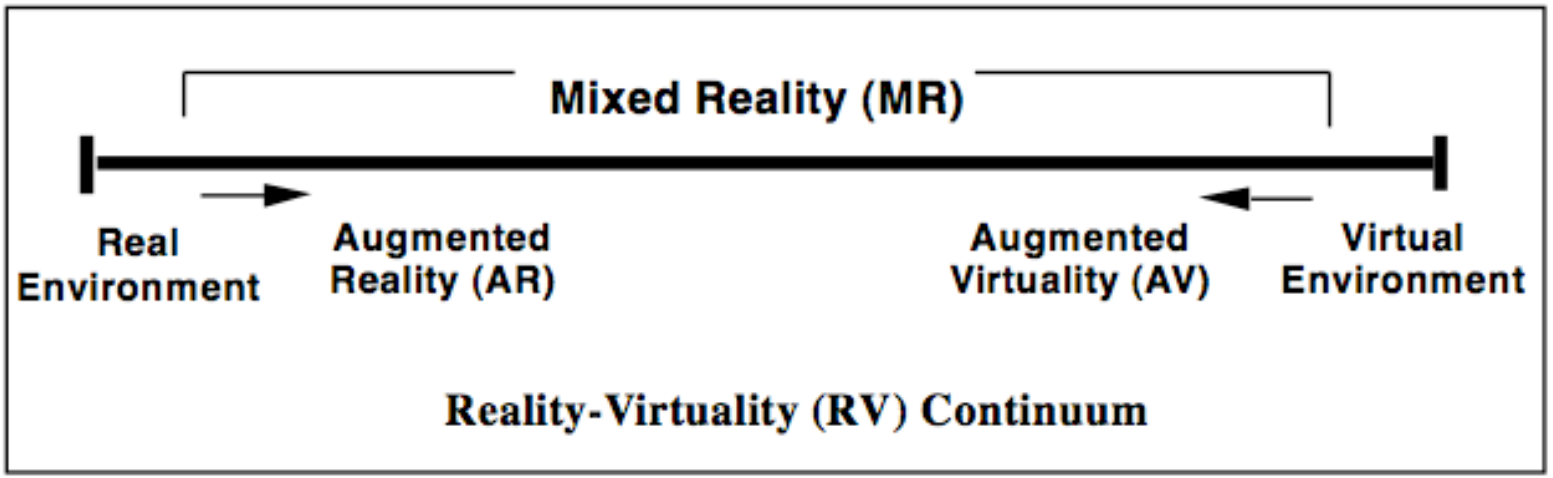
HISTORIC DEVELOPMENT ENABLING ICT





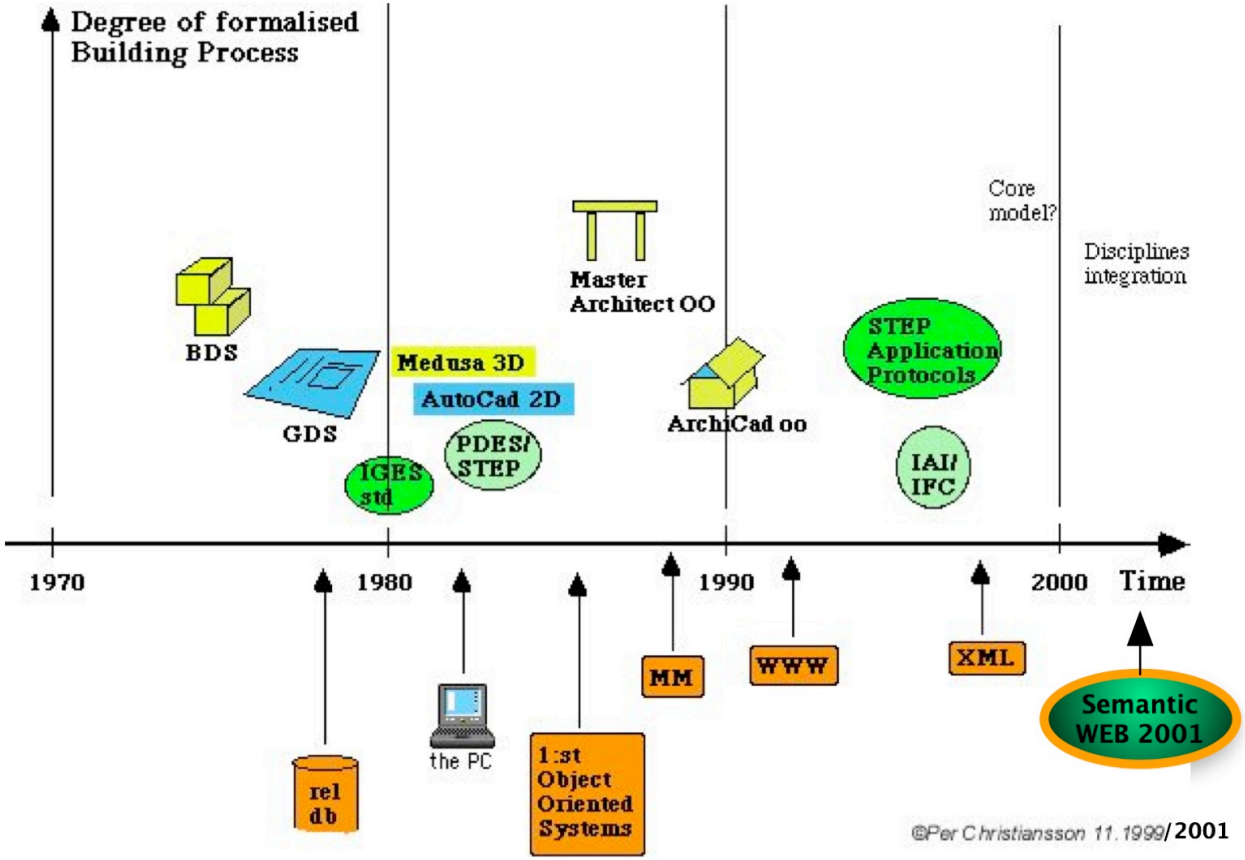
Dynamic interactive 3D visualization, in 6 sided CAVE, of airflow in a livestock building, Aalborg University 2001.

HISTORIC DEVELOPMENT ENABLING ICT



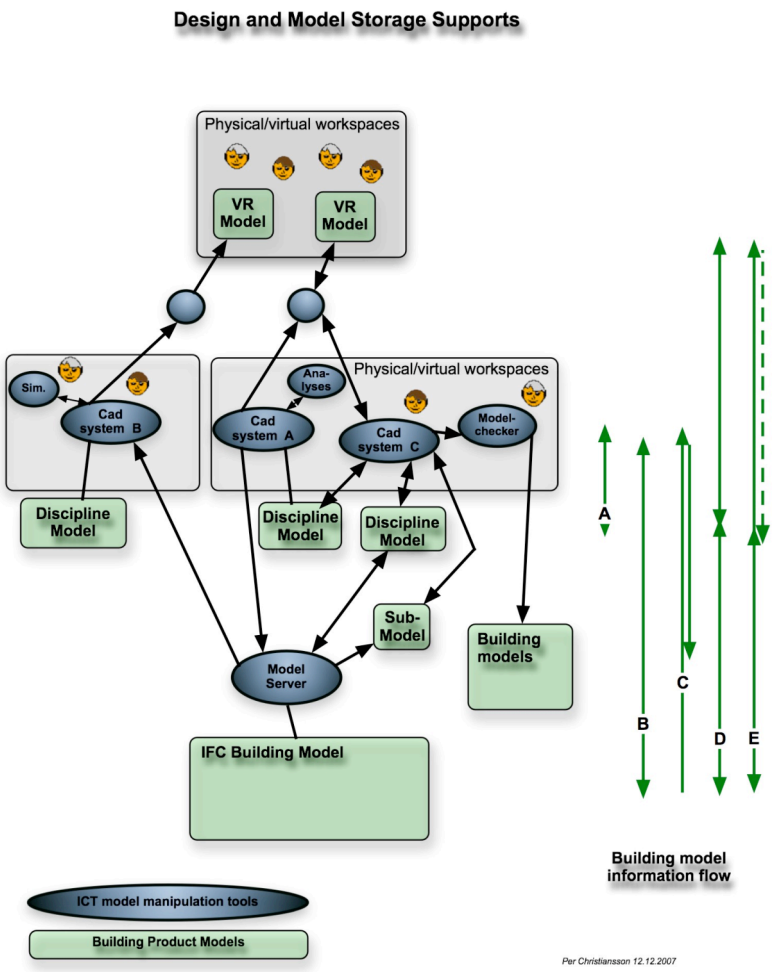
"Simplified representation of a RV Continuum." (Milgram et.al., 1994)

HISTORIC DEVELOPMENT ENABLING ICT



Building Product models development have during the latest decades had periodic focus on achieving a highly formalized non-redundant building product model (i.e. Virtual Building, VB)

HISTORIC DEVELOPMENT ENABLING ICT



Design Support Interoperability

A) Today's storage in Cad systems

B) The ideal case where discipline models can be merged into the common IFC Building Model either direct (simultaneous work on he building model) or via model file transfer

C) Realistic situation today where building sub-models are extracted from the model server, checked and stored locally by e.g. Solibri modelchecker,

D) A rare situation where even changes on simplified VR-models (often surface models) can be transferred back to discipline models in Cad systems and further to the IFC Model server for merging,

E) same as D) but updates has to be manually transferred from VR-model to discipline models

SCENARIO AND VISION

A client involves a group of building end-user representatives in an *early user-driven creative design process*. He also includes the contractor in the early decision process to secure constructability.

Alternative building solutions, expressed as Component Building Systems (CBS) and Functional Building Models (FBS), are evaluated by end users against *needs* and external *requirements*.

Functional building systems may be improved through *embedded ICT-systems* to help in making the building more intelligent and responsive to end user needs, usage context and surrounding constraints.

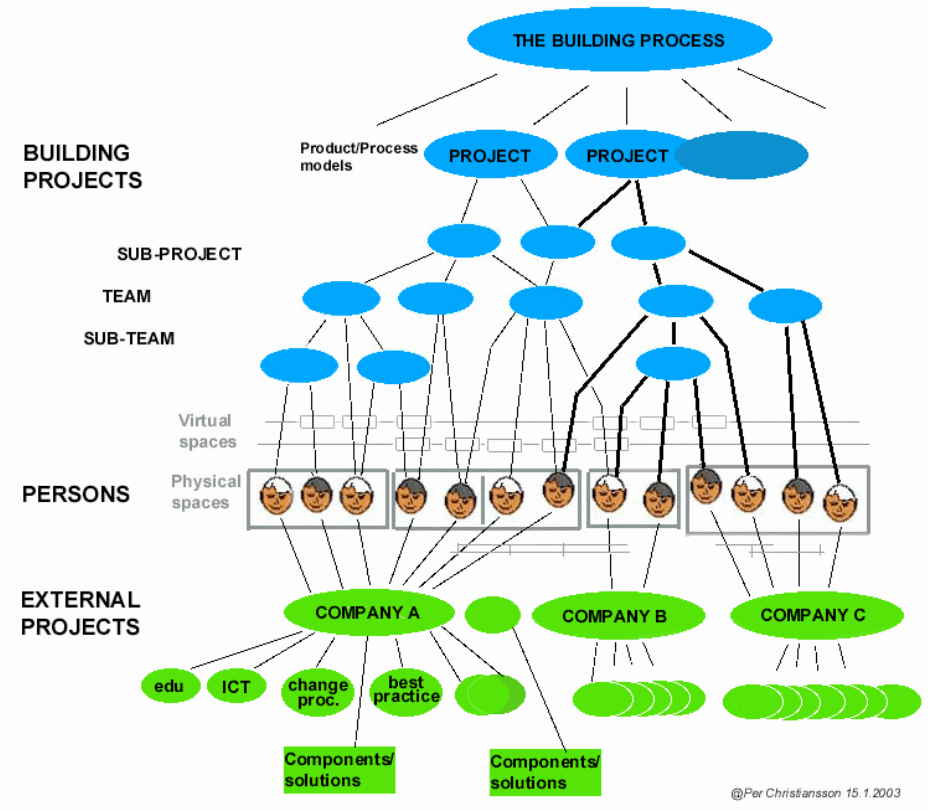
The design process is then partly carried through in *virtual spaces* with access to the building product model on different detailing levels (volume, space, building element etc.) and can be browsed in geometric and time coordinates (4D).

The *client early specifies* representation, content and functionality of the building model to be delivered after construction is completed.

NEEDS ANALYSES on Integrated Building Design Environments IBDE

What important **development trends** can we observe today?

- Local business is becoming *global local-like business*.
- *Business models* are changing. We have today business models very much based on locally optimizing value chains.

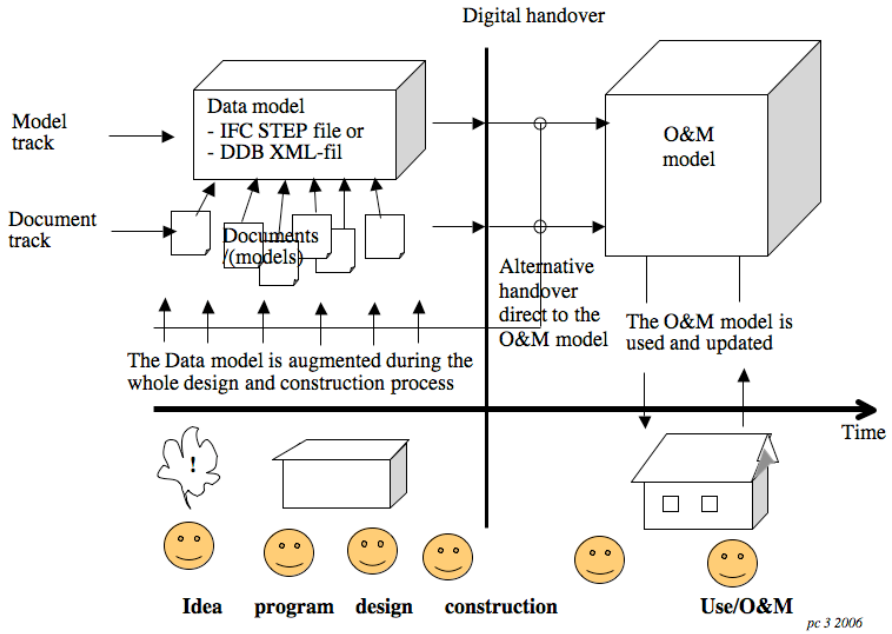


Organisational view on internal and external building project actors, activities and attached information containers.

NEEDS ANALYSES 2/4

What important **development trends** can we observe today?

- *Innovation* in construction is a *challenge* (fax and mobile phones were real hitters).
- *Virtual Organizations* is more often brought into play.
- *Moore's law* will be valid for at least another 20 years (memory, speed, ubiquitous computing).
- Extended development and use of *meta-data marked www-accessible information* (e.g. semantic web based solutions).
- *Clients* get instruments to formulate better *requirements* on buildings



Organisational view on internal and external building project actors, activities and attached information containers.

NEEDS ANALYSES 3/4

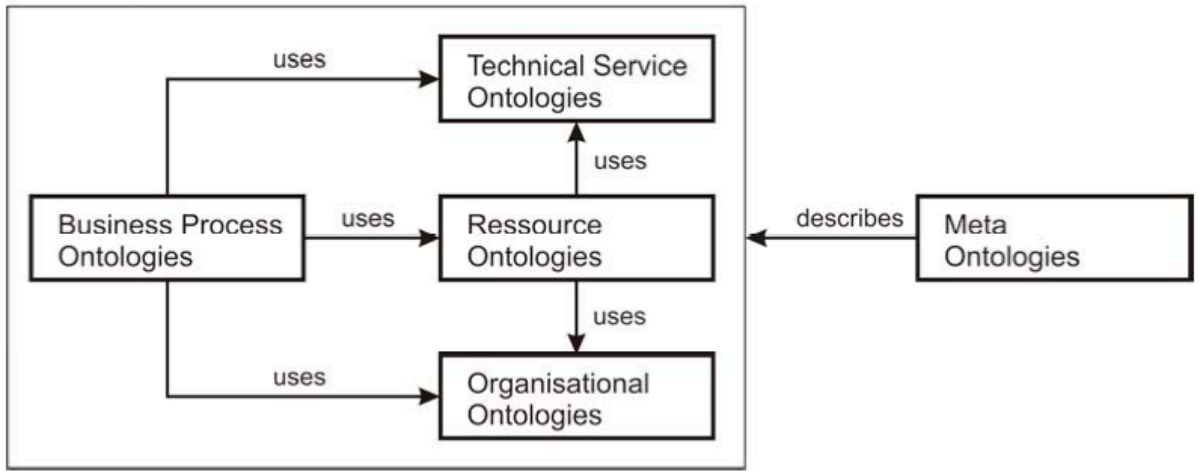
What important **development trends** can we observe today?

- We are introducing, also in practice, the *time dimension* (4D) in Virtual Building models
- *Virtual building (VB) models* access is getting more *standardized* through use of the IFC standard.
- Efforts are under way to create International Framework for *Dictionaries* (and *Ontologies*) (IFD).
- *Intelligent products and buildings* with embedded sensors and actuators are again in focus.
- *Energy optimization* and ecological building is gaining importance.
- We *should* be in a continuing *reflective* development process aiming at moving goals.

NEEDS ANALYSES

Needs list (that could and should be revised and extended)

- Better *Quality Assurance* (QA) on building process to minimize errors in the final product.
- Important *decisions* to be taken *early* in the process.
- Better *interactive process models* for simulations with automatic update possibilities of VB.
- More *user-friendly design tools* also supporting use of thin flexible screens, haptic feed-back, and ubiquitous access.
- Efficient *distributed collaboration* on Virtual Building models in virtual spaces.
- Common *ontologies* at least on business meta level.

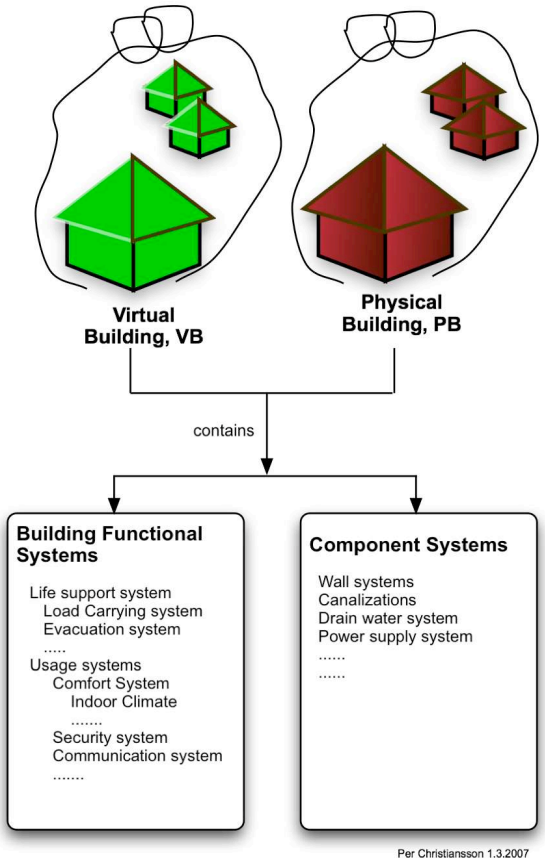


Overview of meta building ontology domains and their relations

NEEDS ANALYSES 5/4

Needs list (that could and should be revised and extended)

- *Ontologies* for functional building systems (*FBS*) such as comfort and personal security systems.



The virtual building can be used as interactive documentation of the ready building to support different services such as O&M activities, location of resources and persons in the building, and for simulation and design of new services and user environments.

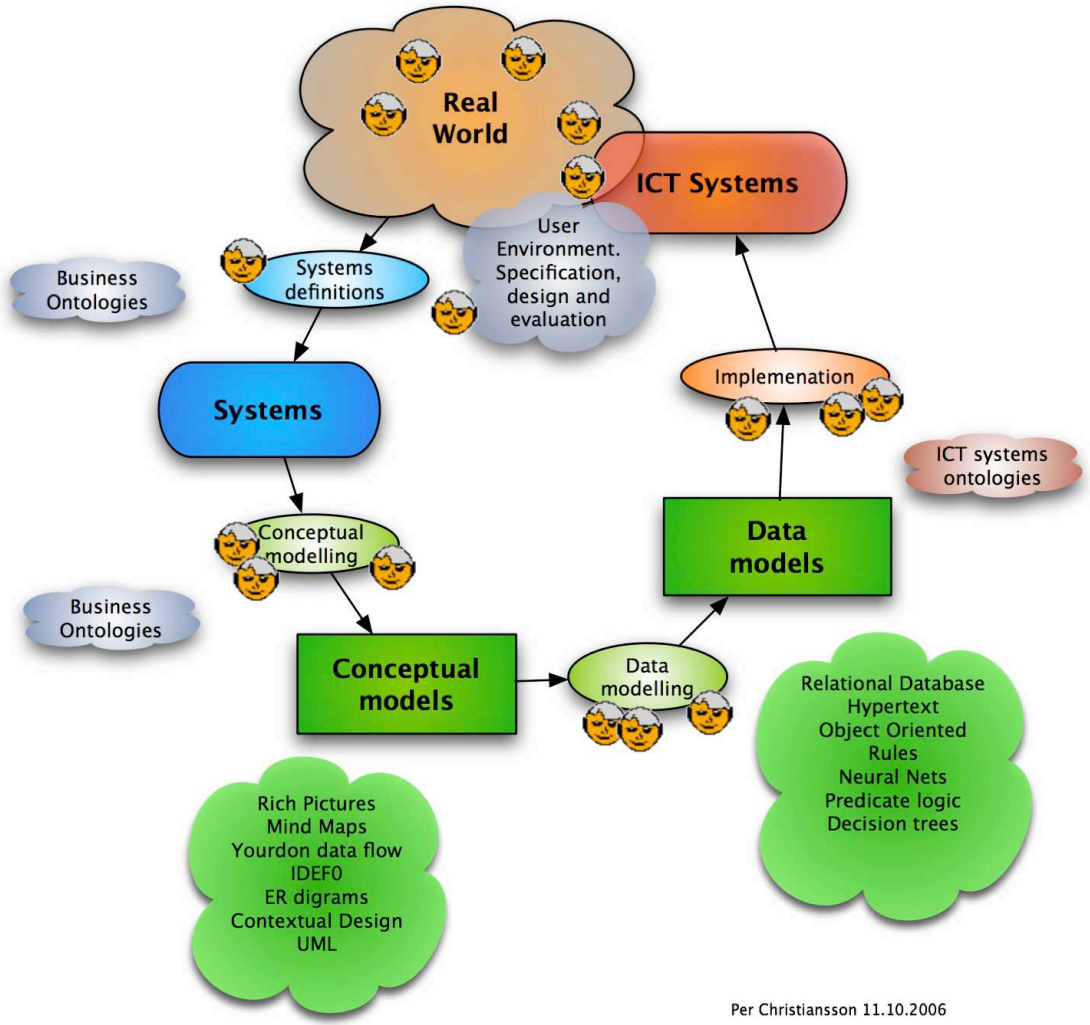
The building is more or less functionally integrated with other buildings, city areas, and optional global 'neighbourhoods'.

NEEDS ANALYSES 4/4

Needs list (that could and should be revised and extended)

- *Landmarks* (on high business and ICT levels) to aim at during long-term research, development, and organizational and work method change.
- *Increase* in general *competence* level and preparedness for organizational and work change due to global paradigm shift, going from the art of writing via art of printing to the art of communication.
- Increased possibilities for *user driven innovation* and co-creation in the design process.
- *Motivations* and *tools* for *open* ontologies and open business models *development*.
- More building informatics related *education* on university level and ICT supported learning.

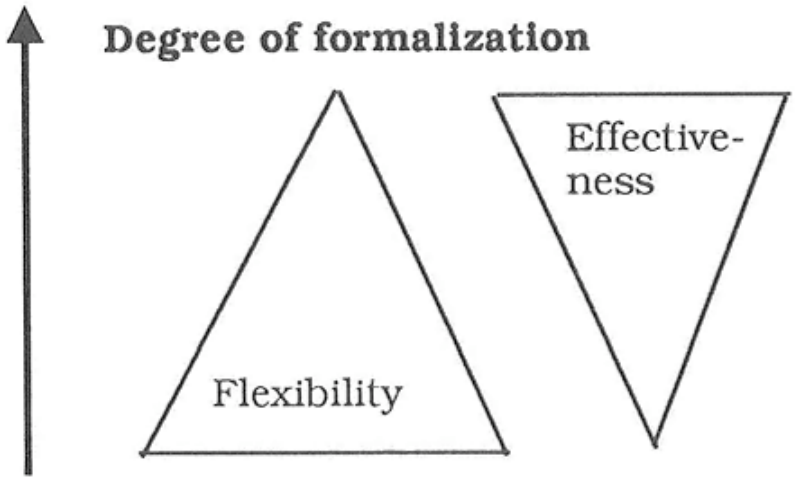
SYSTEM DEVELOPMENT



In the *real world* we identify activities, things, processes, context, and persons.

The real world can be described as (interrelated) *systems* (no de-facto structure is available today) to accomplish different *functions* e.g. a comfort system to provide personal living and working quality, personal transport system, load carrying building system, escape system, and communication systems (collaboration, knowledge transfer, mediation, virtual meeting).

SYSTEM DEVELOPMENT 2/4

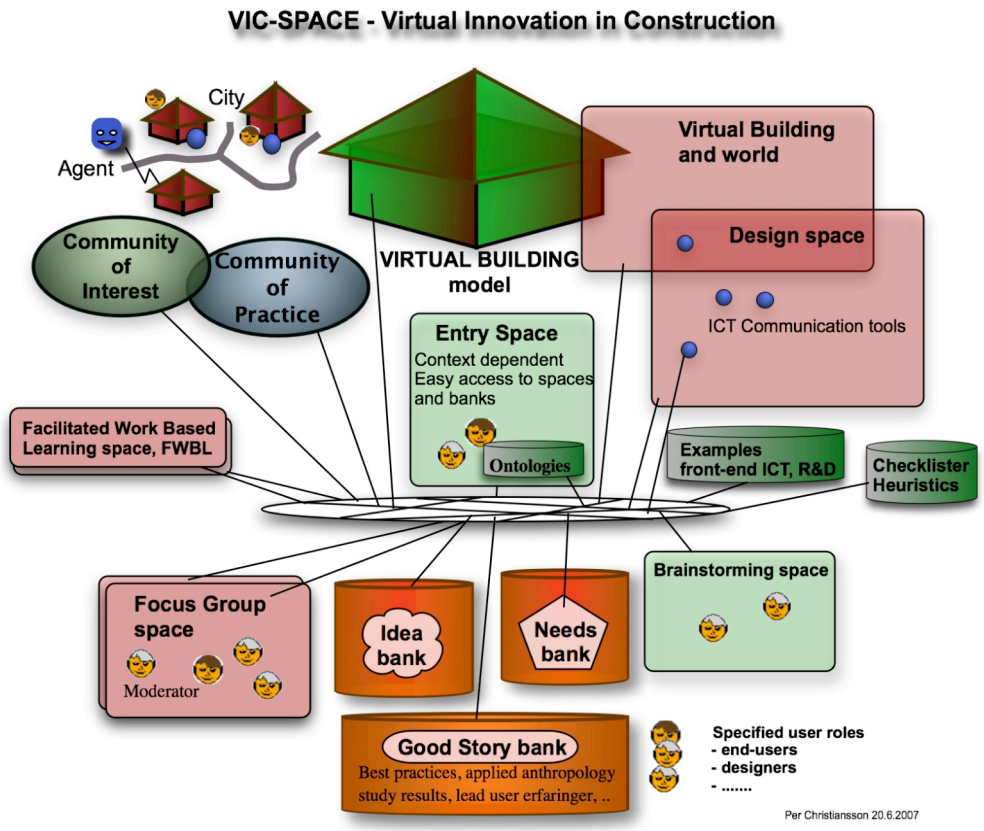


The higher the degree of formalization the more effective and efficient the computerized models of building product and processes will be and less flexible to changes. It is of course a question about *optimizing in a set of constraints*.

These constraints may be dictated from *external needs* and *access to resources* (such as workforce, material, money resources) and *available time* as well as *type* of building product.

During the 1960s there was (probably) another set of constraints than today.

USER DRIVEN INNOVATION



Virtual Innovation in Construction -VIC

Basic layout for a user driven innovation and design system, VICMET, under development by the two main engineering and architecture companies in Denmark , Rambøll A/S and Arkitema A/S, and Aalborg University, Civil Engineering department

An open dynamic innovation space VIC SPACE is created with access from WWW.

CONCLUSIONS

We are in the middle of a *great change process* concerning development of Integrated Building Design Environments.

We are in fact accomplishing an *innovative creative design* of future *design tools* and *buildings*, requiring significant end-user involvement and usability engineering.

Ontologies and dictionaries have to be further developed especially on *business* and *meta* levels to secure effective systems interoperability, and information handling.

Functional Building Systems have to be categorized and the client needs capture and requirements formulation and modeling be further advanced.

There is a great need for *increased efforts* within *building informatics education* to secure needed competences for leading and carrying through the future research, development and innovation activities.

END

http://it.civil.aau.dk