Building management and ICT learning in civil engineering education

Per Christiansson

Aalborg University
http://it.bt.aau.dk

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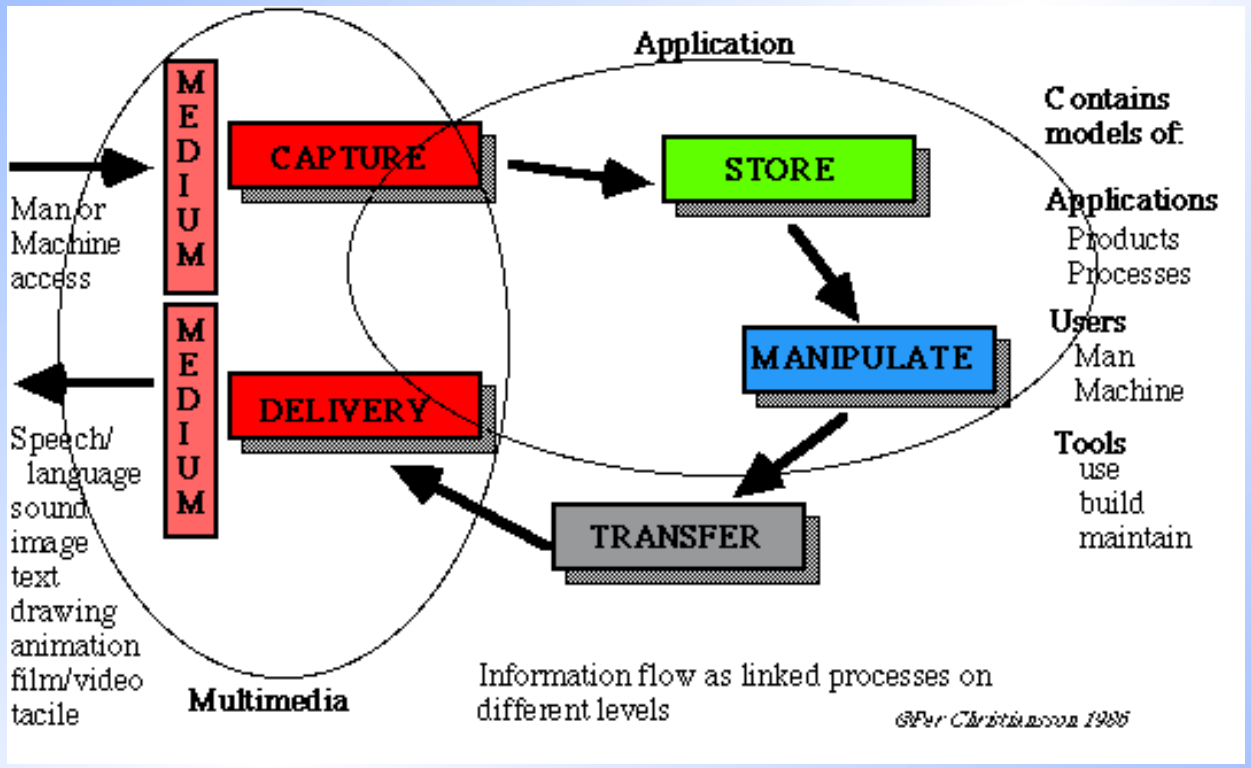
THE CHANGE PROCESS

A COMPLEX PROCESS

The implementation in the building process has been rather slow due to

- **the building process is one of the most *complex and less formalized* applied processes**
- **Building process actors using *different* ICT tools, languages and model formalisms with a rich spectrum of *user interfaces* with different characteristics**
- **A very *cross scientific* domain.**
- **Too little focus on building up it's *own ICT competences* (the out-sourcing trend increases the risk of loosen company business strategic knowledge).**
- **Low *client understanding* that ICT pays back (better early decisions in alternative solutions, higher quality and better documented end products.**

ICT and MODELS of REALITY



ICT (Information and Communication Technology) may be defined as the technologies to support capture, storage, manipulation, communication and delivery of information on different application levels (from macro to micro scale) and in different contexts such as technological, organisational, and cultural.

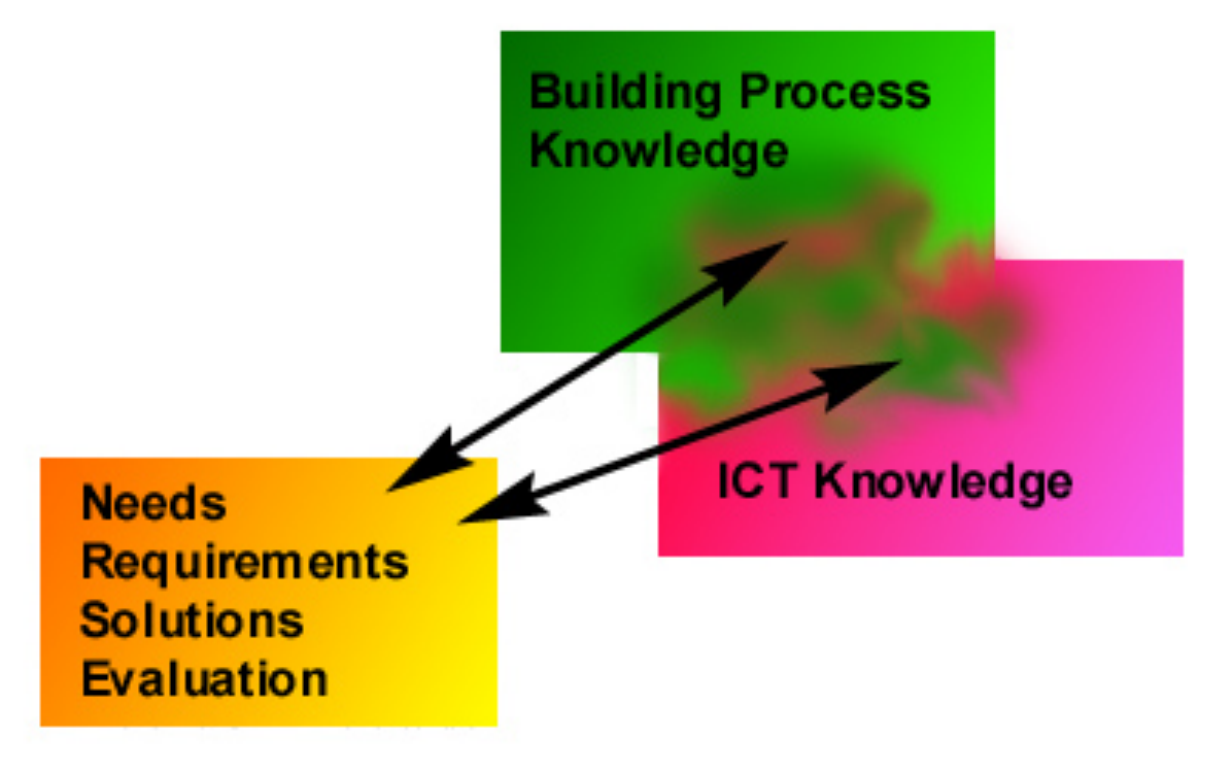
COMPETENCES NEEDS

COMPETENCES 1/2

There is at present and in the future building industry a great *need* for persons who can take active part in specification, design, implementation, and evaluation of *tomorrows* building process support systems.

A *broad* view and insight into the complex building process together with a broad and in some key areas *deep* knowledge into existing and coming ICT tools are required in combination.

COMPETENCES 2/2



Builders must process some ICT competences to be able to formulate needs, requirements, and perform usability evaluation as well as to actively participate in the (creative) design of tomorrows building process ICT tools.

LEARNING PARADIGM AND TOOLS

The LEARNING PROCESS

The learning process has not changed to any considerable degree during the latest centuries. A big shift came when the art of printing was introduced during the middle 1400 (Guthenberg).
The most important changes due to introduction of ICT in the learning process are

- Higher emphasis on *learning* (and learning to learn) than teaching
- The teacher becomes more of a *tutor* (coach, facilitator) than information disseminator
- Greater opportunities for distant learning in *virtual environments*
- Life *long learning* becomes an important issue (time and place independent learning).
- *Globalization* with cultural diversity and global market place development with greater possibilities to combine courses from different universities (*virtual universities*)
- Increased *modularization* of information containers with dynamic formation of higher level containers and inclusion of time marked data. The semantic web provides a first generation tools to relate disperse web based information containers
- Possibilities to adapt and/or develop *new pedagogical methods/learning styles* with respect to learning material, learning modes (exploration, discovery, problem based learning etc.), student competence and intelligence profile, improved collaboration, new teacher roles, and social contexts bearing in mind that IT in itself does *not* improve pedagogy and learning method.

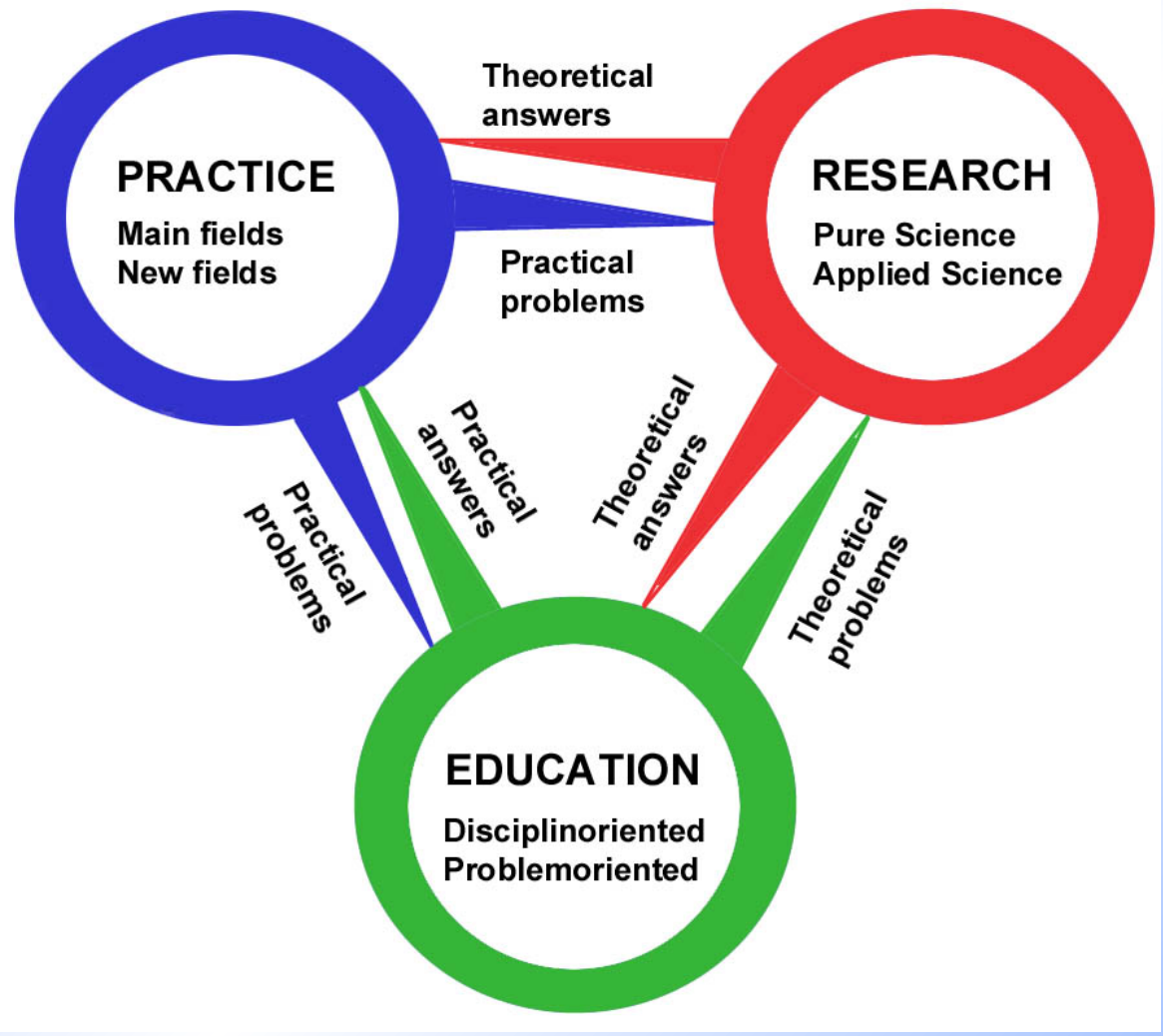
PPBL

The PPBL, Project Organized Problem Based Learning, methodology was introduced 1974 at Aalborg University.

The first year the freshmen learn to *work in project-groups*. The next two years in the undergraduate programs the project work is mainly *design-oriented*. The last two years in the graduate programs the project work is mainly *problem-oriented*

The duration of each project is one semester. In the program 50% of the time is distributed to the *project work*, 25% to *courses related to the project* and 25% to *courses related to the curriculum.*

RESEARCH -PRACTICE - EDUCATION

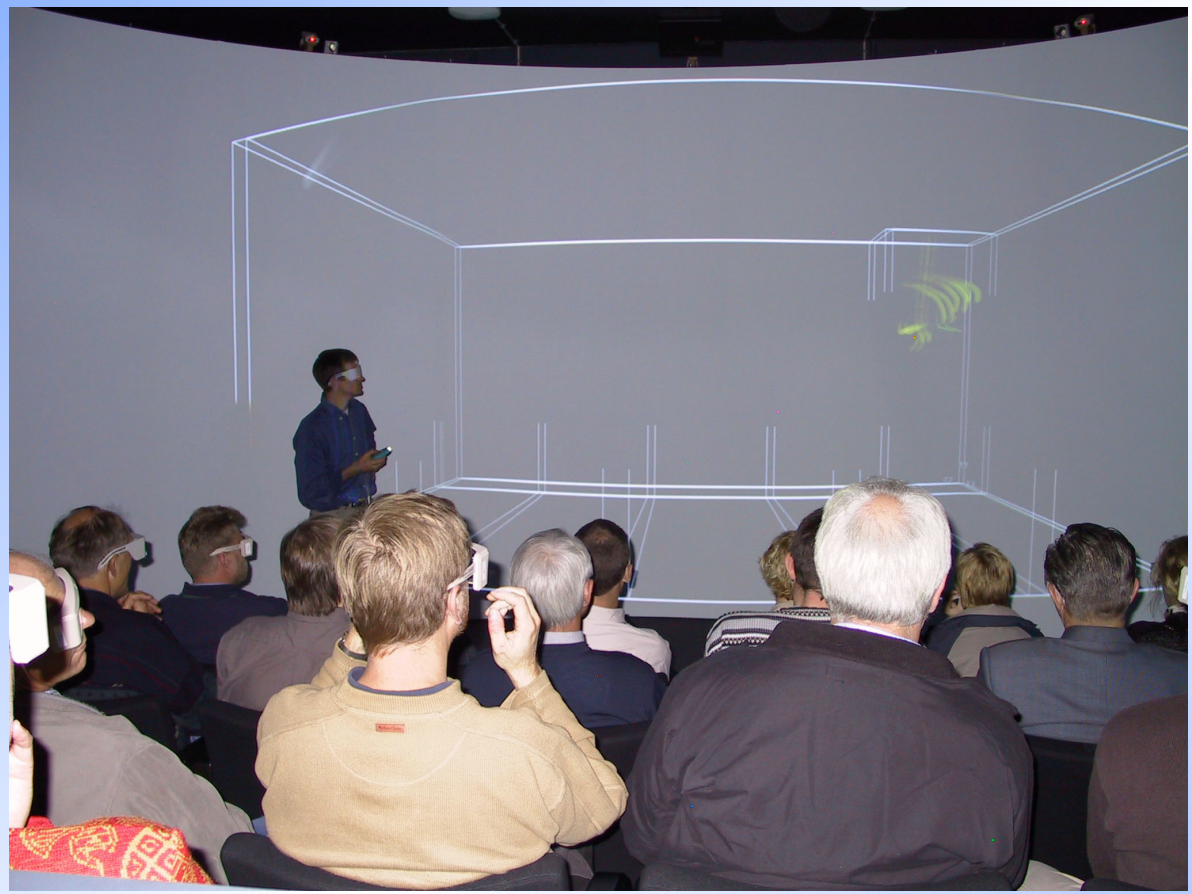


The dynamic model of the relationships between practice, research, and education

LEARNING SPACES & MATERIAL

"Distributed learning takes place in a *virtual learning space* that expands the conventional study chamber and classroom in time and room with regard to learning style and interaction modes as well as learning material and learning methods" (Christiansson, 1999)

3D panorama studio

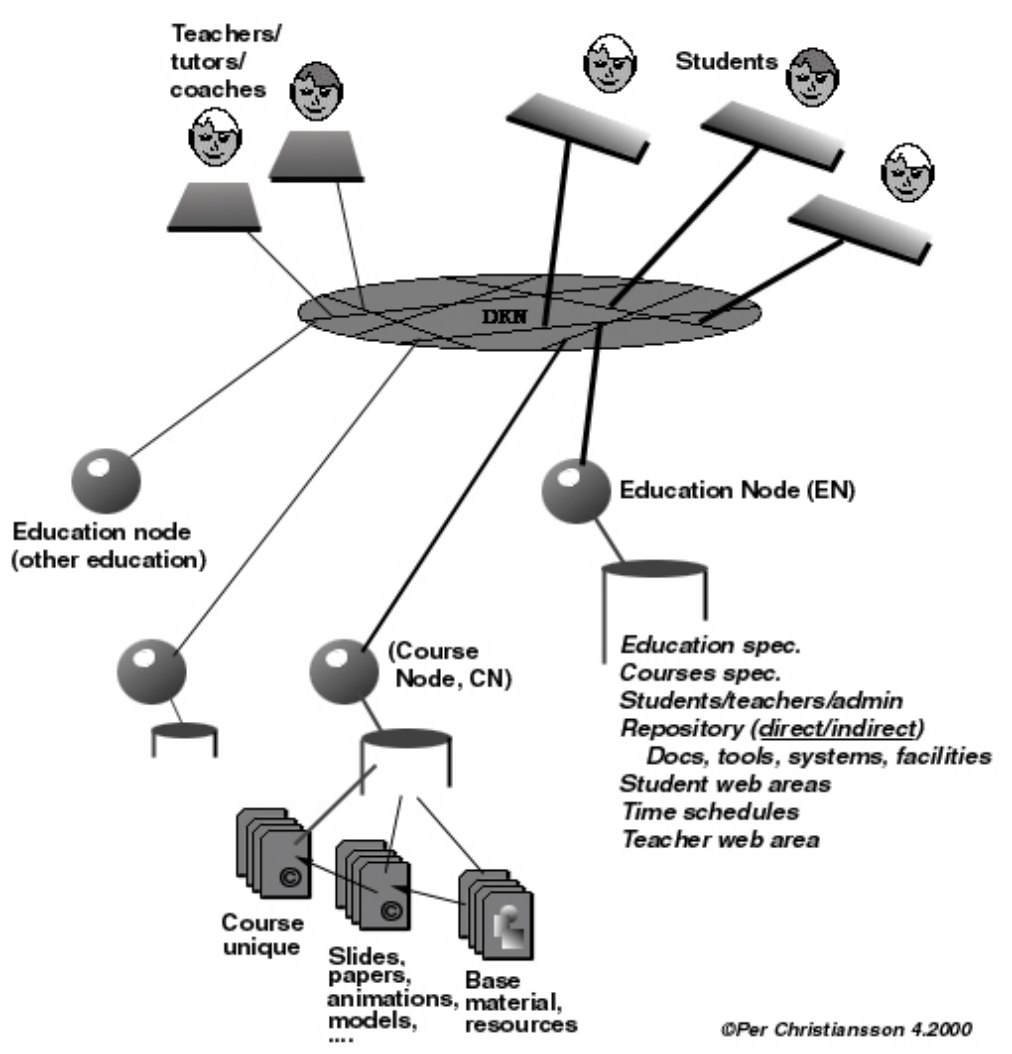


The Panorama studio provides wide screen (if necessary in stereo mode) interactive access to computer applications for 25 persons. The leftmost image shows 3D analyses of complex heated airflow in a ventilated room

CAVE

The 6 sided CAVE at the VR Media Lab at Aalborg University provides total visual and audio surrounding for small groups to experience and manipulate virtual worlds

WWW based learning material



MII students main education access is through the Education Node, EN. If all traffic is channelled through EN it is easier to create administrative data as 'who-is-on' and 'when', and 'who has accessed what'. This is though in conflict with direct student access to teacher produced locally stored material.

BUILDING INFORMATICS COURSES GOALS

OVERALL GOALS

- Students should understand *overall implications* of working with digital information (on personal, team, project, and company levels) and the properties of logic information containers properties and building product- and process models.

- understand the ongoing *change processes* caused by ICT introduction and be able to actively *participate* in the design of next generation digital building process environments and ICT tools

- acquire *deep knowledge* in how ICT can serve to integrate competences (also outside the engineering domain) and artefacts in the building process and how knowledge can be efficiently captured and transferred.

ICT in Construction Learning Domains

User Environment (UE) design

- User needs capture
- Requirements specs
- Contextual design
- Usability/evaluation

Knowledge Management (KM)

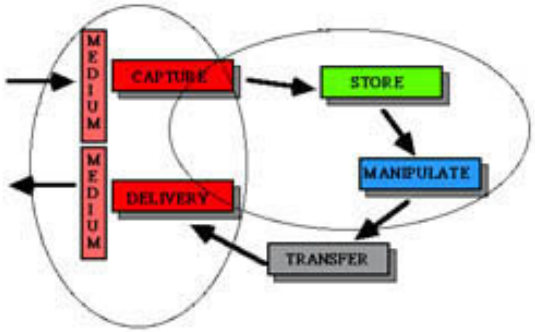
- Intranet/extranet specifications
- ICT and change strategy
- Knowledge and experiences discovery, capture, storage and transfer
- Information QA

Intelligent Buildings (IB)

- IB design
- Services and systems
- Networks
- Facility management
- Intelligent city

Computer Supported Collaborative Working (CSCW)

- Virtual workspaces
- Sync/async communication
- Distributed collaboration
- Storytelling



Building simulations

- Building systems simulations
- Building systems integration

Virtual Buildings (VB)

- CAD
- Product and process models and modelling
- Classification
- Conceptual modelling
- 3D geometric modelling

Human Computer Interaction/ Multimedia (HCI/MM)

- HCI design
- Multimodal interfaces
- MM formats
- Computer graphics
- Virtual Reality

Knowledge Representations (KR)

- Relational databases
- Object Oriented
- Logic
- HyperText
- XML
- Semantic Web

BUILDING MANAGEMENT ICT COURSES - AAU

OVERALL GOALS

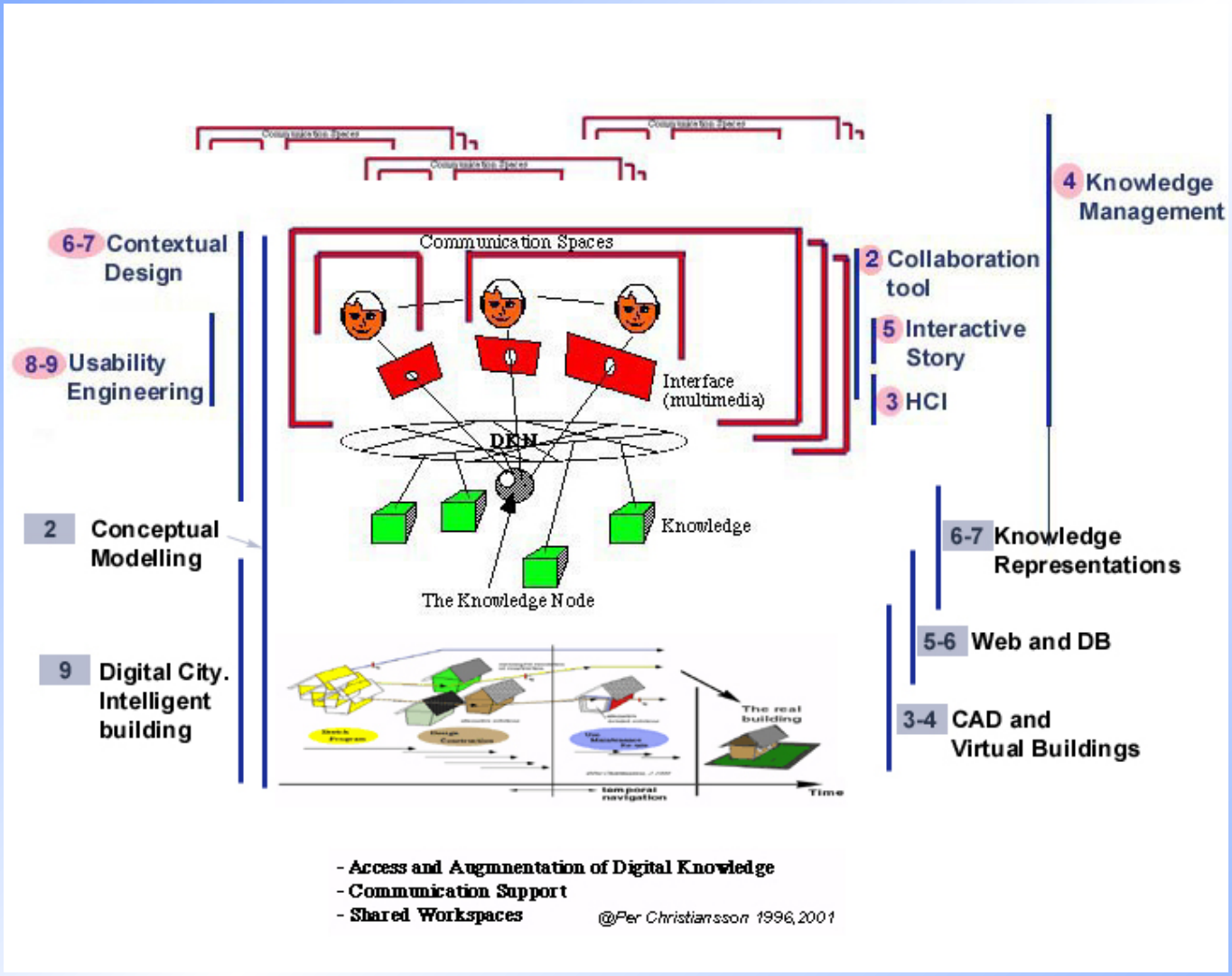
The *Building Management* education (BM) forms a *specialization* of the civil engineering education during the last 2 years (terms 6-9) (of 4.5 years total).

During earlier terms the students learn to model relational databases, integrated cad in praxis, 3d-modelling, and project web design.

Virtual Building course goal is - 'to mediate knowledge about fundamental concepts, technologies and methods to analyse and develop models which describe a building, the building process and the digital infrastructures from design to application as well as mediation of knowledge about how the future services, systems, and infrastructures for knowledge management can be built and integrated.'

Multimedia and Knowledge Management course goal is ' is to mediate understanding of principles, methods and technologies for design and evaluation of user environments for computer supported interaction and collaboration as well as team work and knowledge transfer'.

BM COURSES CONTENTS



Multimedia and Knowledge Management course.

Virtual Buildings course.

Building informatics courses at term 7 and 8 in the Building Management education.

Master in Industrial IT education

The MII education spans 3 years half time (from autumn 2004 compressed to 2 years) and is open for students with a Bachelor Engineering degree and at least 3 years of industry employment. The first year theme is 'Development of Internet-applications' and the second year theme 'Development and use of industrial IT systems'. The students follow 5 tracks of specializations.

- IT in Construction
- IT in Distributed Real-time Systems.
- IT in Industrial Production.
- IT in Process control.
- IT in System Administration

CONCLUSIONS

CONCLUSIONS

Needs to raise *competence* among civil engineers who also to a great extent will be responsible for the (creative) design of future industry ICT implementations, that will support communication, collaboration, knowledge transfer, as well as distributed building process information and model handling.

There is a lack of dedicated *learning material*.

Industry collaboration on both student and teacher levels are crucial for timely coordination of the ongoing technological, organisational, and work content change process.

Students must *not only acquire knowledge on how to use existing ICT tools* but gain deep insights in ICT tools used to support and build tomorrows building process support systems (such as semantic web and meta data based handling of distributed information containers, and building process models).

Teacher competences must be upgraded for efficient use of ICT tools for group and individual tutoring as well as operative knowledge on ICT supported working methods and learning material production and use in virtual learning spaces.

http://it.bt.aau.dk/education

END

INTRODUCTION

Changing paradigm **for information handling (information containers dynamically composed, everything stored in a wide range of formats).**

Separation of information *content* and *access* mechanisms.

Digital models **(virtual buildings, users/team, processes, ICT tools, production systems) of our reality and also non-physical objects are accessed from adapted and advanced *user environments* (UE).**

Web and html early 1990s. Now resources on the Internet, labelled by their *Uniform Resource Identifier* (URI), that can be described and reached through a common syntax and structure such as RDF (Resource Description Framework) and RDF Schema that give meaning to the web based information containers.

New *services* and new not yet designed *ICT tools*

Future ICT tools

Wireless networks with fibre based backbone

Portable/ubiquitous units (computers, service/communication units)

Many (flat panel/glasses/..) *communication units* (offices, building sites, homes)

Embedded intelligence (installation components etc.) with Internet connectivity

Peer-to-peer societies/interest-groups/'global' villages

Family/personal *servers* (personal storage of information/knowledge within physical reach)

Manifold of parallel personalised/team/project *market* and *service* places

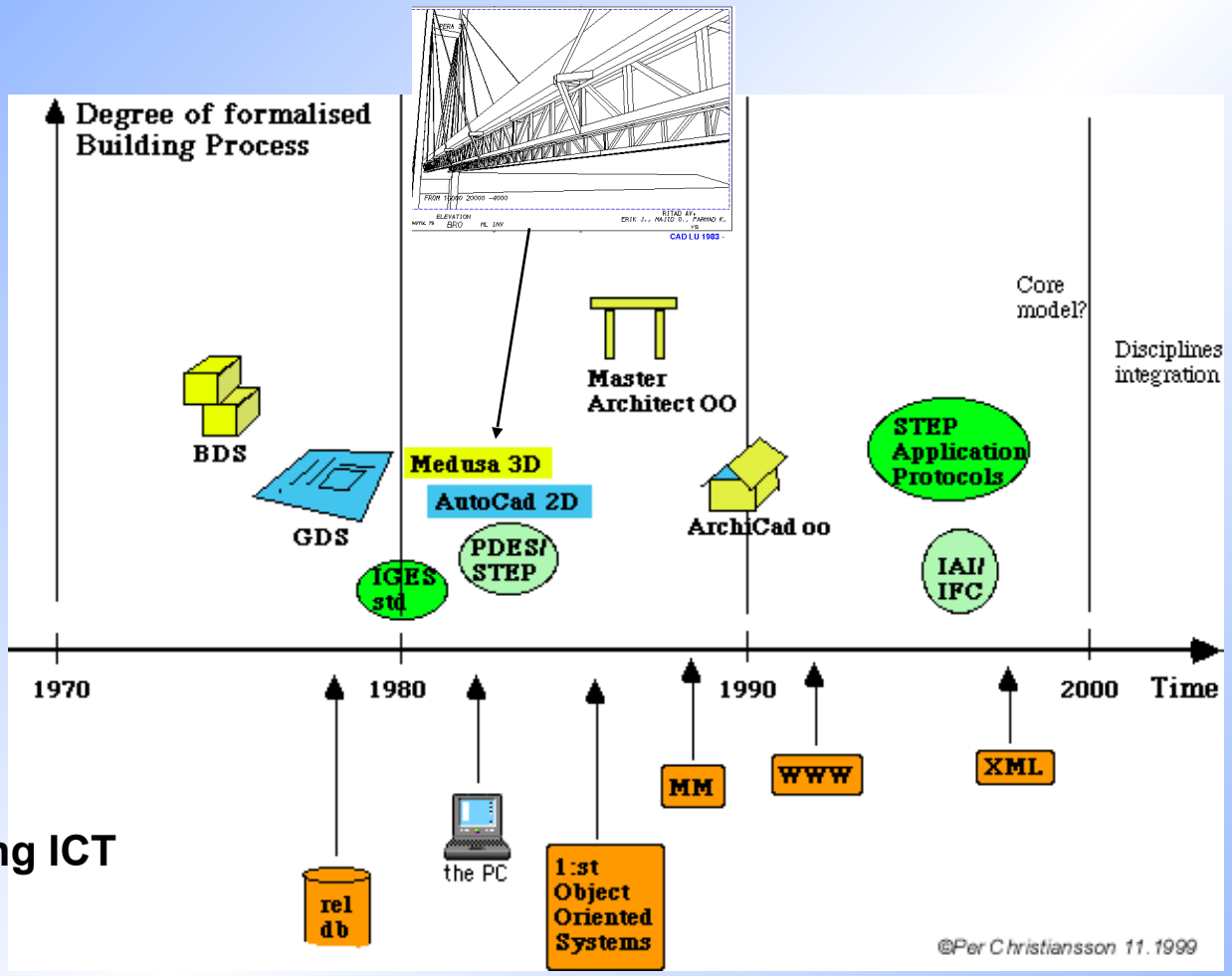
XML tagged communication standards and *Semantic Web*.

All information ('good' and 'bad') accessible through dynamic logical containers

Virtual spaces for communication and learning

Personal global *positioning* units

Building Process Oscillations



Supporting ICT

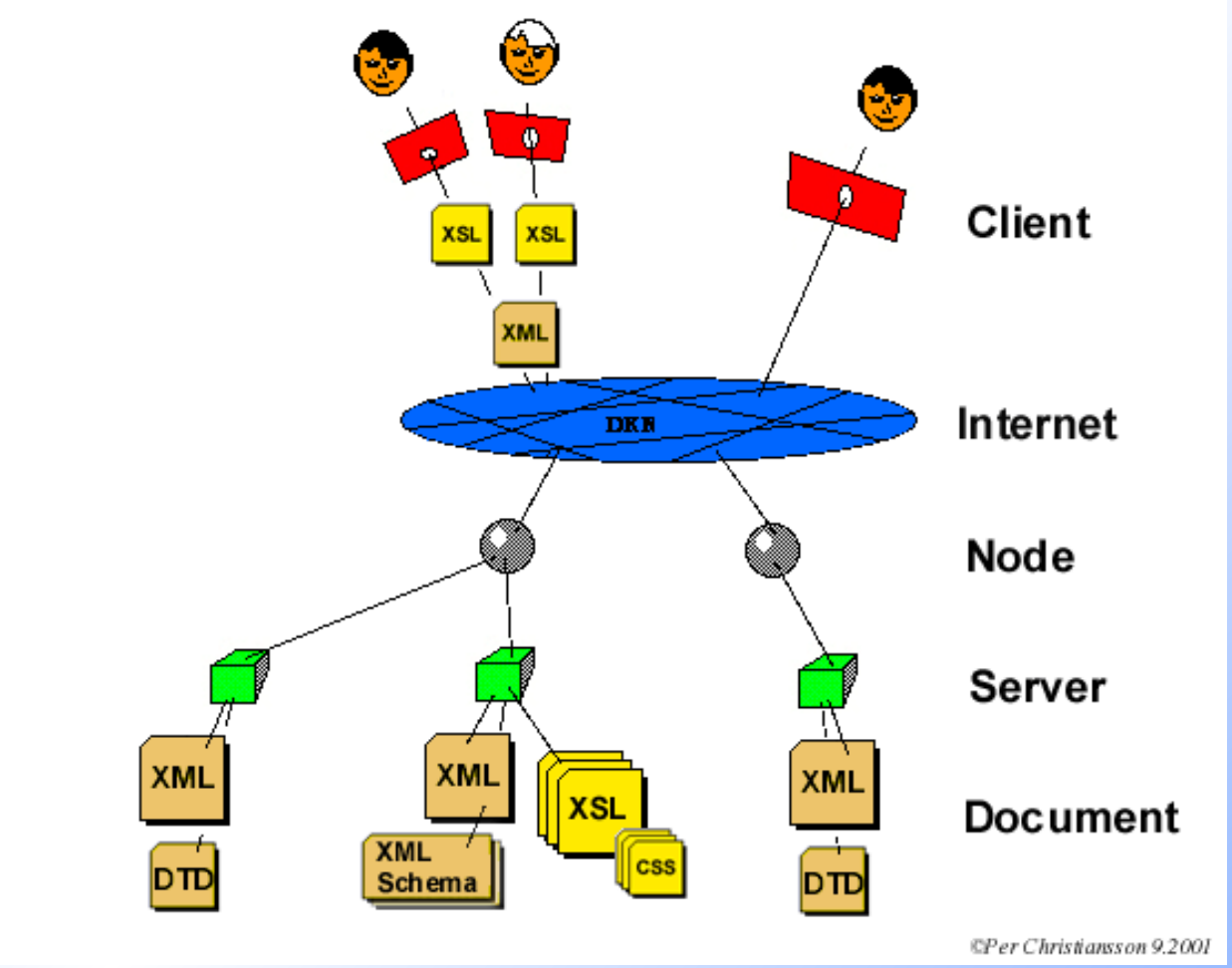
The Knowledge Node Concept

- ***Participants***; number of, type (persons, agents
- ***Collaboration subject/context & Form of interaction***; design, reviews, purchase, learning, brainstorm, negotiation, discussion,
- ***Communication content*** to support interaction; e.g. speech, sound, images, music, video, whisper, body language, 3D objects, control information;…..
- ***Meeting spaces*** and room definitions; physical, virtual, static, dynamic, mobile and combinations.
- ***Collaboration artefacts***; communication channels, user applications, and information containers

EMERGING ICT TOOLS

- **XML** (Extensible Markup Language)
- **TEMPORAL DATABASES**
- **The SEMANTIC WEB**
- **Virtual Workspaces**

XML Extensible Markup Language)



Separating content from presentation. Efficient communication and web-services.

TEMPORAL DATABASES

With temporal data introduced into the Virtual Building (VB) new opportunities arise:

- **we can store snapshots of different building processes (e.g. alternative designs) and *backtrack* to make a re-design or re-simulation with changed requirements (regeneration of the VB);**
- **it should be easier to document and retrieve *causal connections* over *time* and *space* in the VB;**
- **storage of *lines of reasoning* and possibilities for analyses of their relations;**
- **improved possibilities for efficient updating of VB model with *as-built data;***
- **effective use of the time parameters in the *life-time documentation* of building behaviour;**

Virtual Building Process

Tracks of alternative solutions. **Two time lines** -real time during collaboration and time points in the life cycle of a design artefact.

TEMPORAL DATABASES cont.

Temporal extension to traditional relational database systems enables us to handle queries like

'what resources have we used during different time periods of the conceptual design of the building?'

'who and what competencies were engaged during different time periods of the Virtual Building design?'

'how many resources have we used over different time periods at different building locations?'

The SEMANTIC WEB

Through the introduction of the RDF (Resource Description Framework) an emerging standard for handling *metadata* on the World Wide Web was introduced 1997.

RDF will provide a *framework* for metadata *interoperability* across different Internet based resource description communities with focus on semantics rather than meta data syntax and structure.

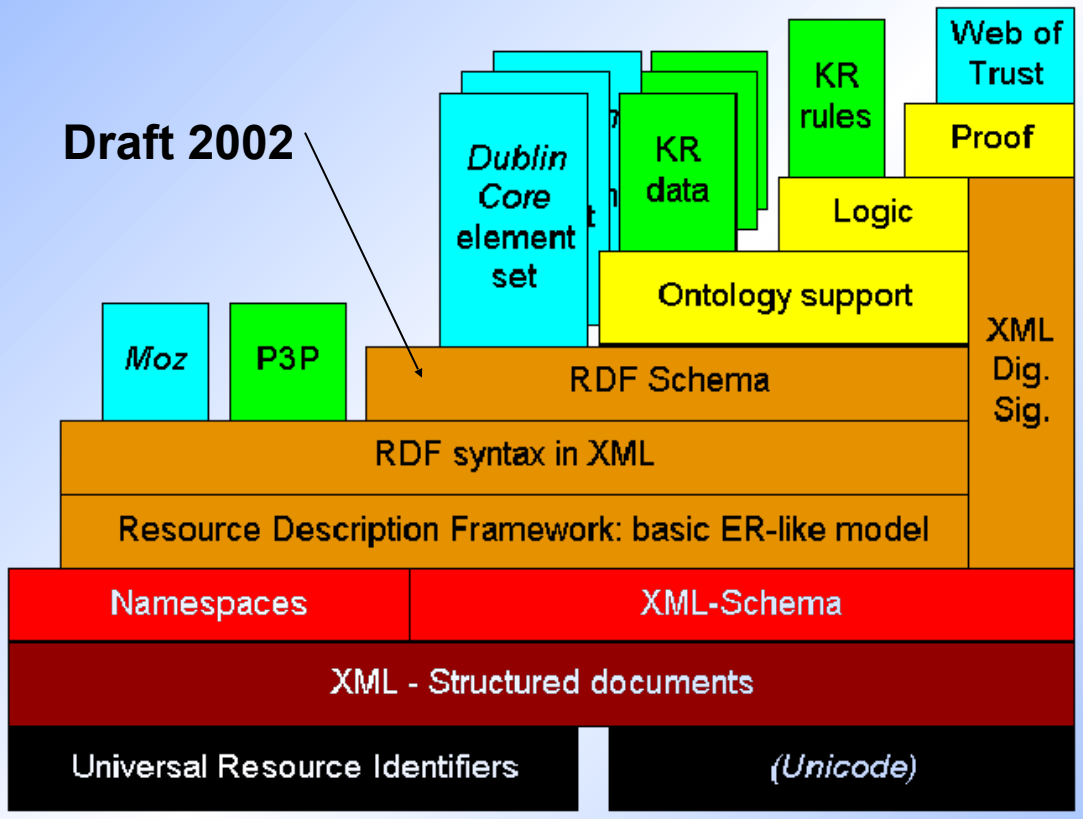
The semantic web will use *XML*, *RDF*, and *Ontologies* (with taxonomy and a set of inference rules) as basic building substances.

RDF is a way to express *relations between objects*, something XML does not allow you to do, "RDF provides a general model for describing resources. Resources in RDF are any objects that can be uniquely identified by a Uniform Resource Identifier (URI).

The RDF data model can be represented as a set of *triples*
{Property Type, Node/Resource, Node or Property Value} or
Attribute(Object,Value)

'RDF Vocabulary Description Language 1.0: *RDF Schema'* was presented as a W3C Working Draft 12 November 2002,

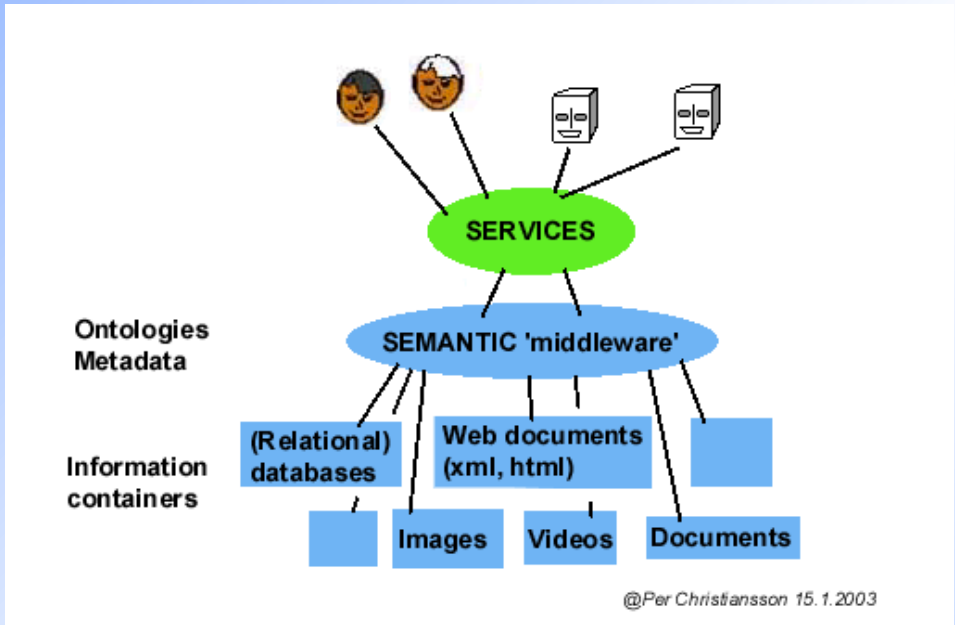
The Semantic Web



Tim Berners Lee, http://www.w3.org/2000/Talks/1206-xml2k-tbl/slide10-0.html

The next generation World Wide Web

The SEMANTIC WEB cont



The semantic web will allow us to introduce new *services* (e.g. for experience capture, early design collaboration) to handle unstructured and structured data accessed from the Internet such as

- link documents to other documents handling similar subjects/concepts;
- search specified and similar concepts in interaction with end user;
- annotate existing web contained documents;
- capture concepts in documents and create meta-content descriptions;
- translate a document to another 'language';
- combine low level concepts in different containers for idea generation.