NEXT GENERATION KNOWLEDGE MANAGEMENT SYSTEMS FOR THE CONSTRUCTION INDUSTRY

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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

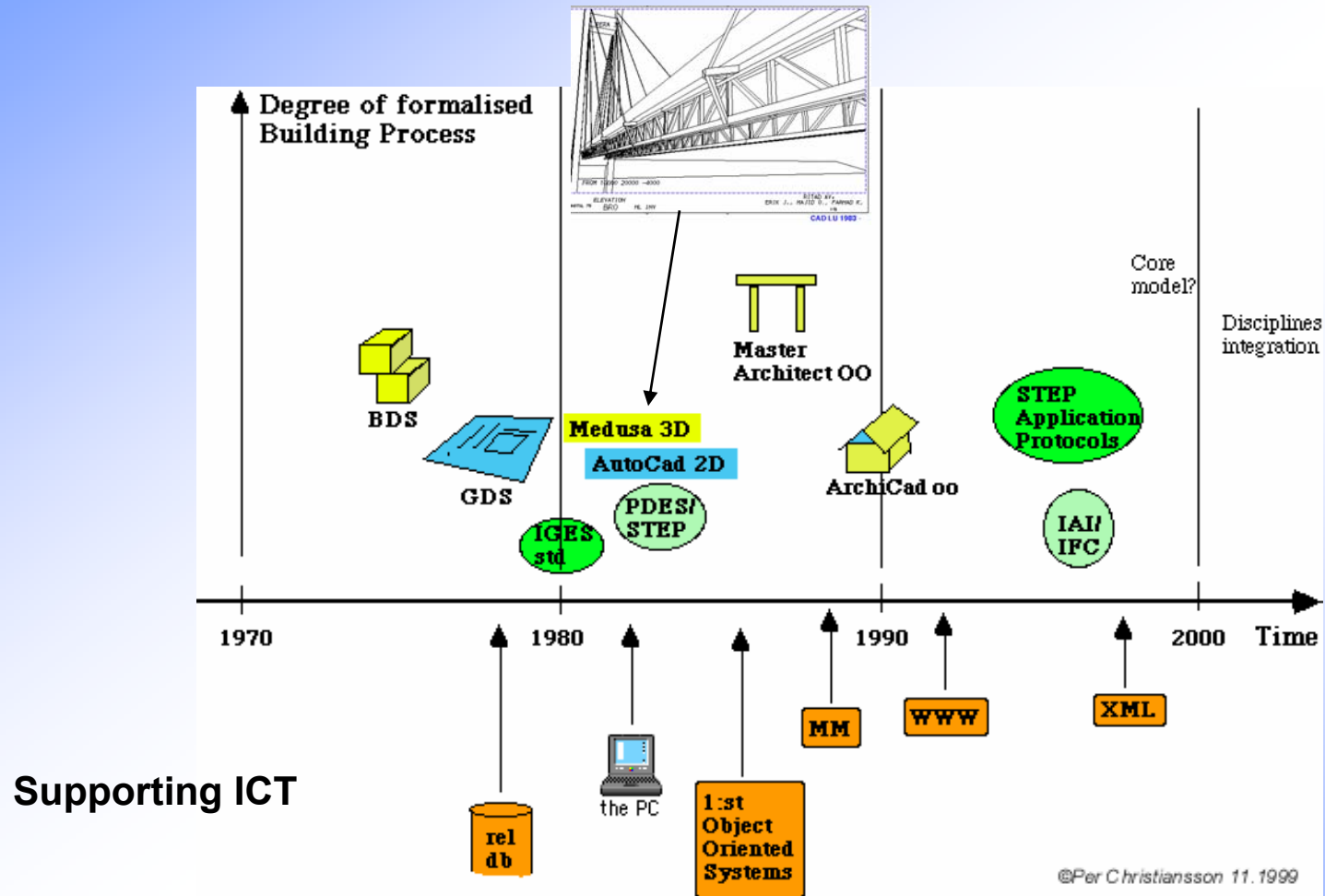XML tagged communication standards and *Semantic Web*.

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

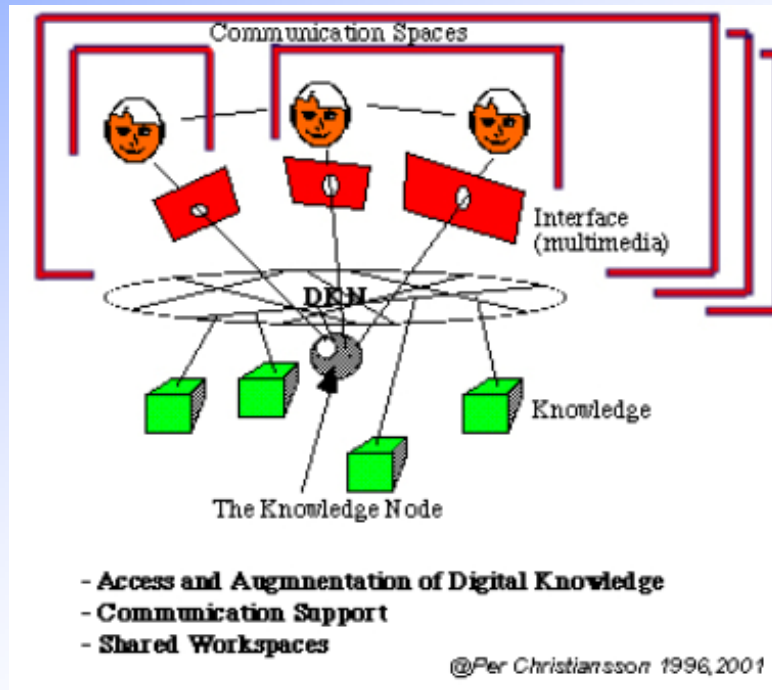*Virtual spaces* for communication and learning

Personal global *positioning* units

Building Process Oscillations

The Knowledge Node Concept

Communication Spaces

Interface (multimedia)

DKN

Knowledge

The Knowledge Node

- Access and Augmentation of Digital Knowledge
- Communication Support
- Shared Workspaces

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- *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.
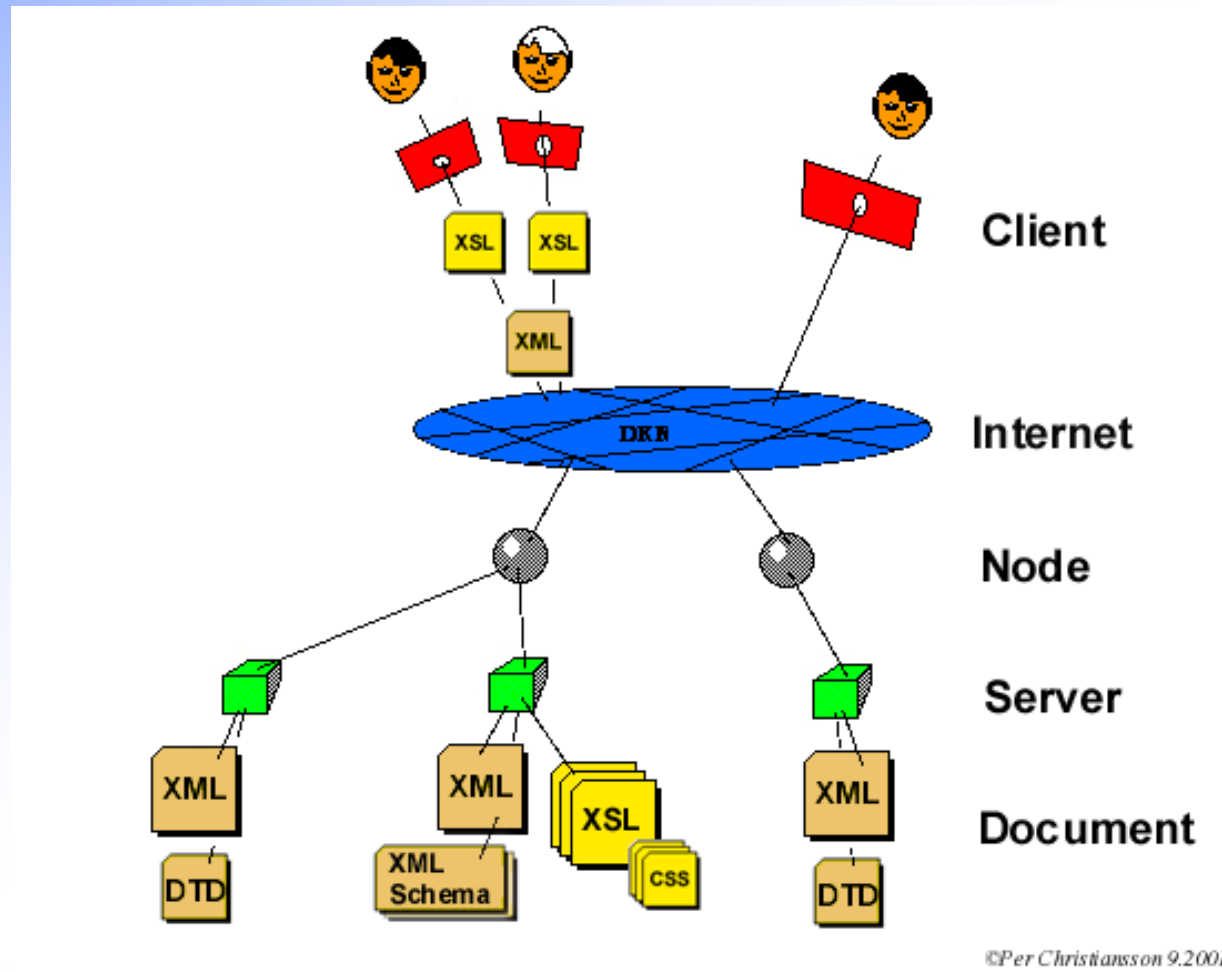- *Collaboration artefacts*; communication channels, user applications, and information containers

EMERGING ICT TOOLS

- **XML** (Extensible Markup Language)

- **TEMPORAL DATABASES**

- The **SEMANTIC WEB**

- **Virtual Workspaces**

XML Extensible Markup Language)

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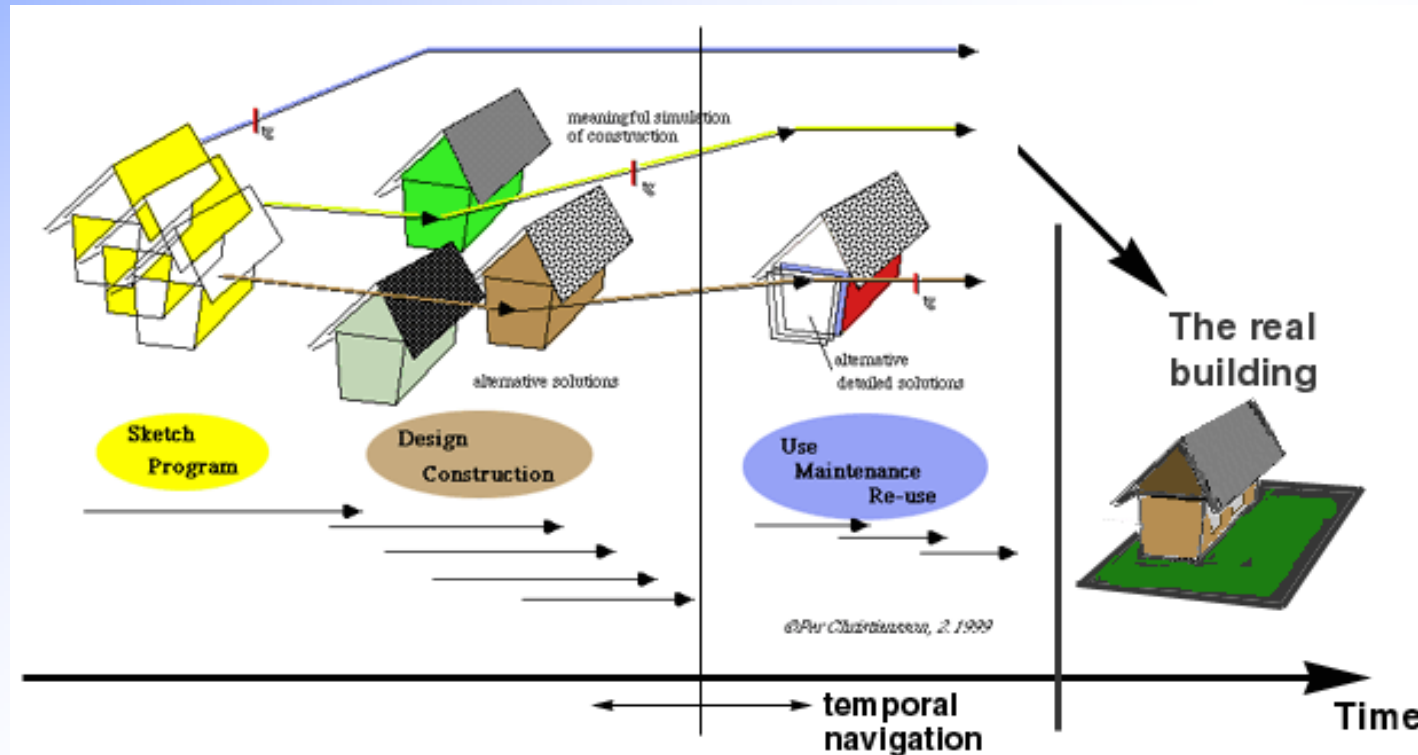
TEMPORAL DATABASES

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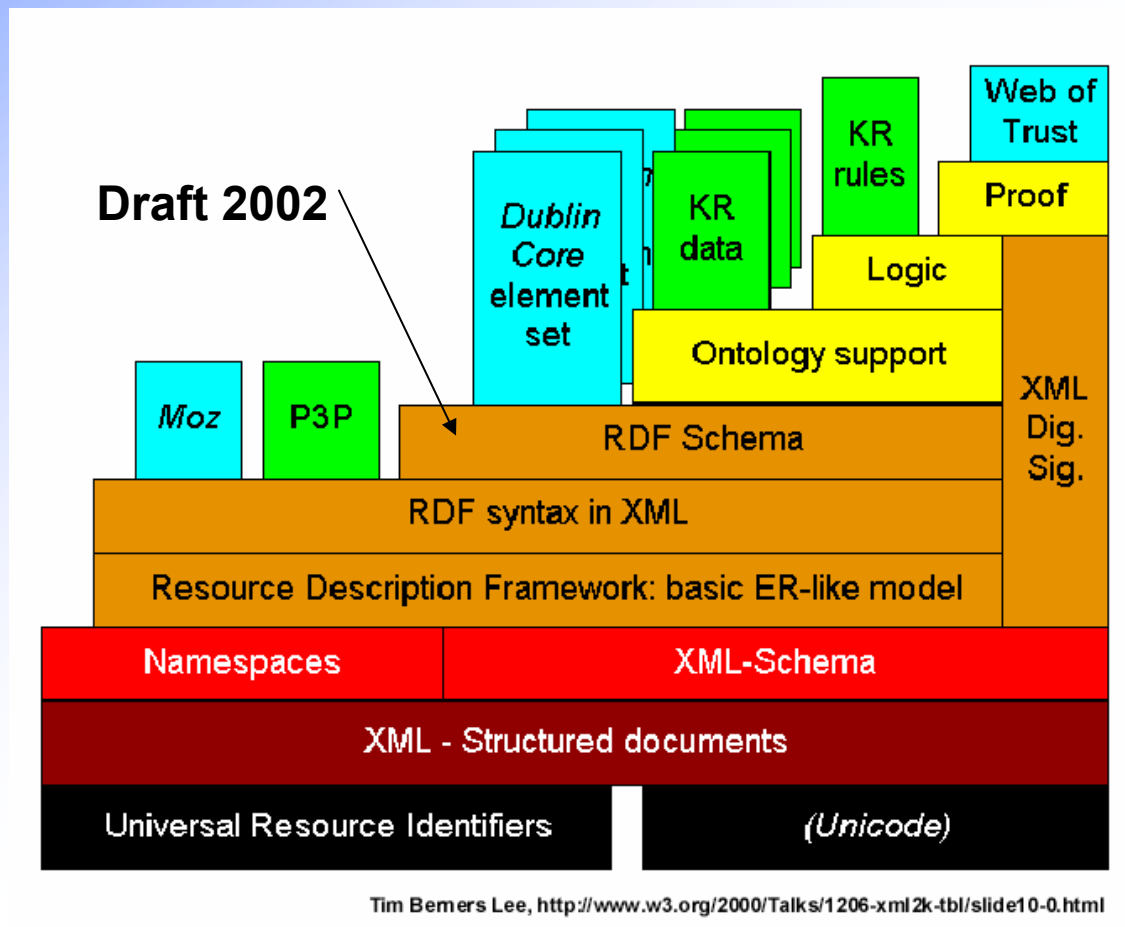
RDF is a way to express *relations between objects*, something XML does not allow you to do, "RDF provides a general model for describing resources. Resources in RDF are any objects that can be uniquely identified by a Uniform Resource Identifier (URI).

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

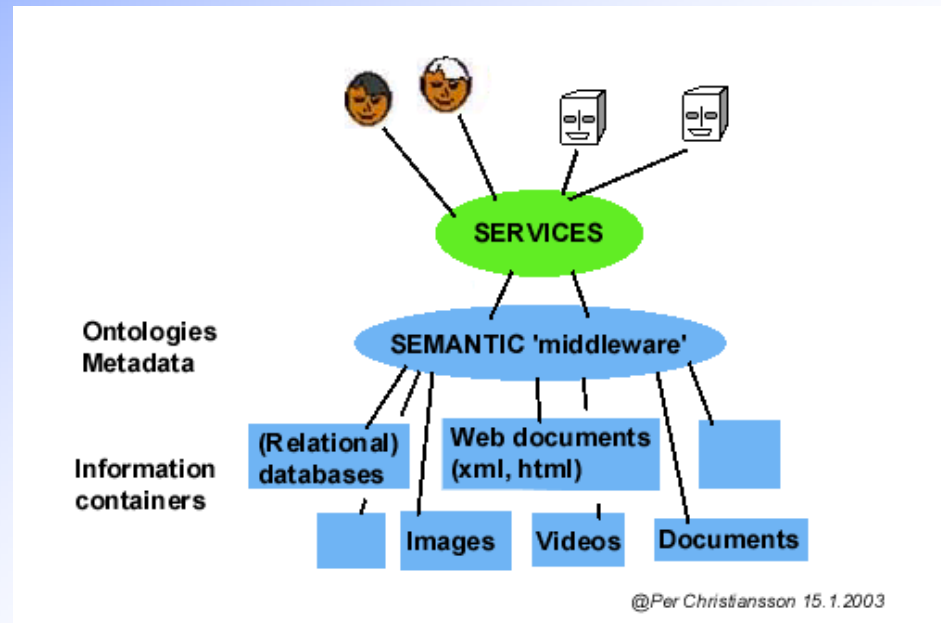'RDF Vocabulary Description Language 1.0: *RDF Schema'* was presented as a W3C Working Draft 12 November 2002,

The Semantic Web

Draft 2002

Web of Trust
KR rules
Proof
Dublin Core element set
KR data
Logic
Ontology support
XML Dig. Sig.
Moz
P3P
RDF Schema
RDF syntax in XML
Resource Description Framework: basic ER-like model
Namespaces
XML-Schema
XML - Structured documents
Universal Resource Identifiers
(Unicode)

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

@Per Christiansson 15.1.2003

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.

Collaborative Work

In the COOCOM project (Co-operation and Communication in the Building Process), 1993, industry participants (SKANSKA, FFNS Architects, and LKF facility managers) performed local and distributed ICT supported collaboration (local joint document editing, remote screen sharing using ISDN connection with support group at SKANSKA, and structured discussions). Walk-throughs of the design object were also available using the Virtus Walk-through system. (Modin, 1995)
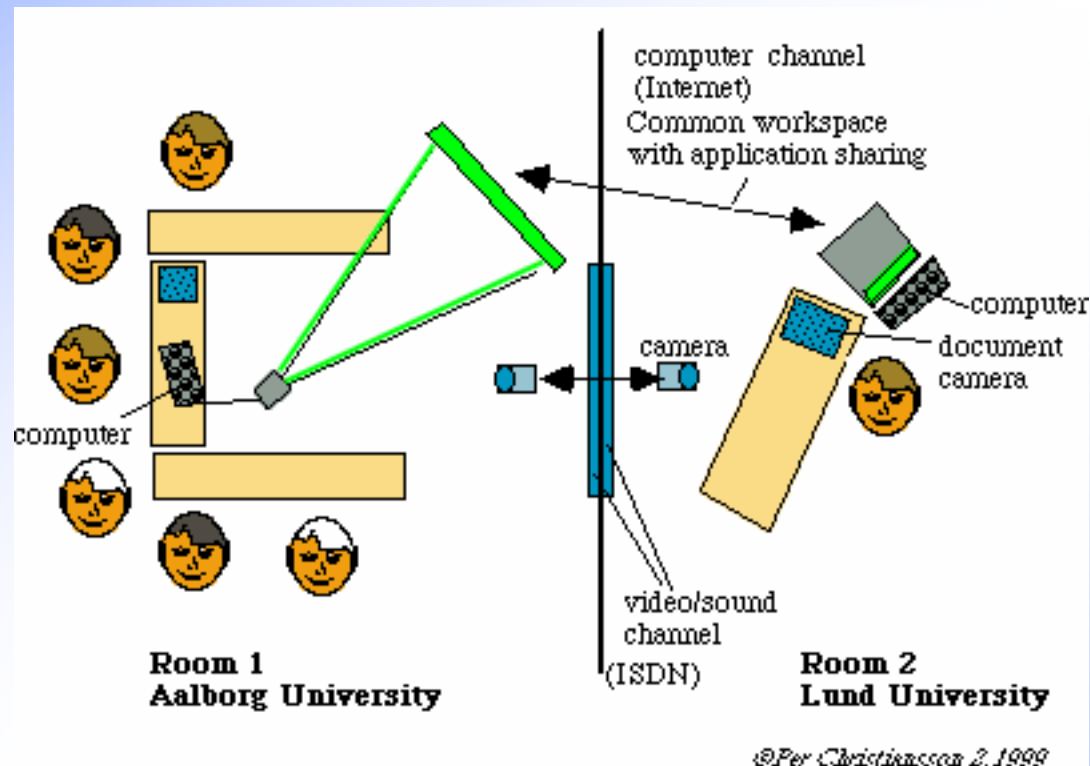
Distributed learning   1/2

Remote lecture and application sharing between Aalborg and Lund Universities 1999 in teacher/secretary course (parallel ISDN based video communication and Internet based application

Distributed learning   2/2

Parallel communication over ISDN (video conference) and Internet (application sharing).
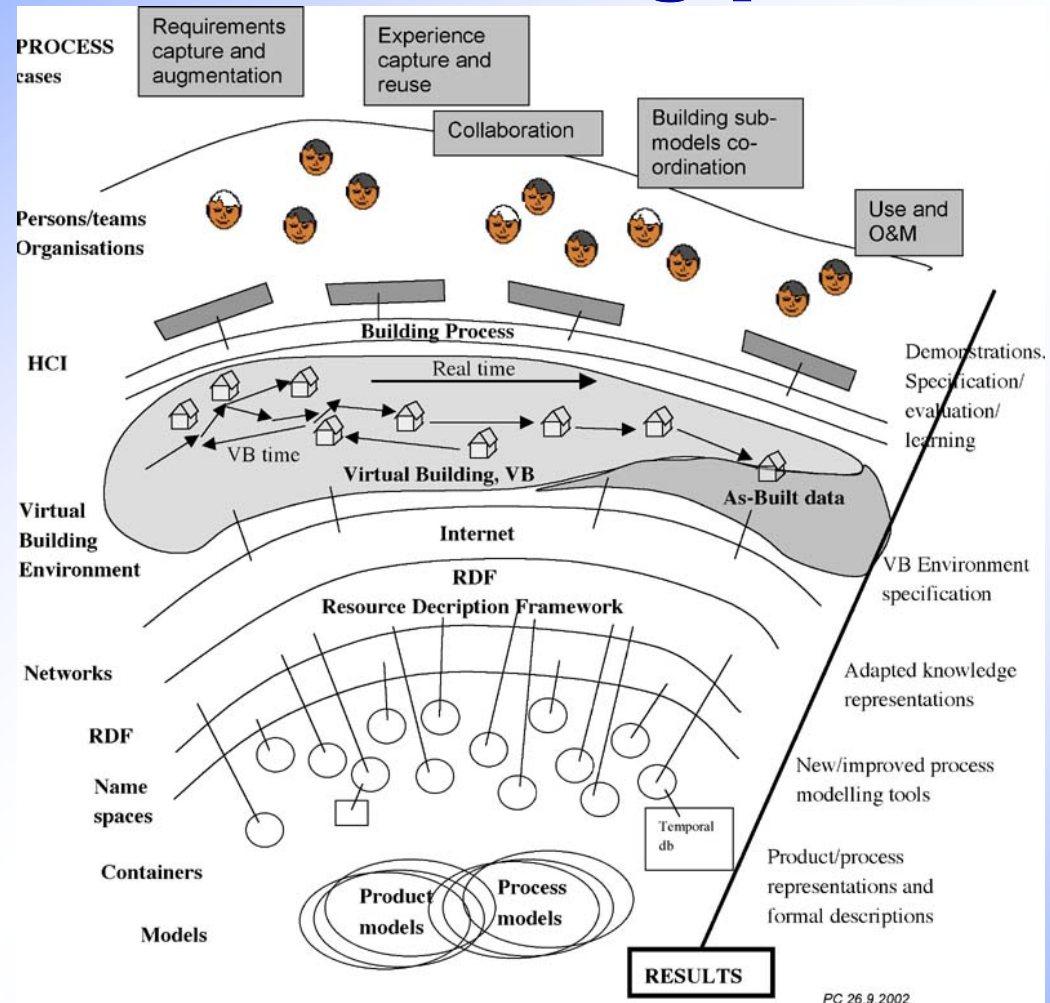
VIRTUAL WORKSPACES

The DIVERCITY framework supporting client briefing, early design and construction in a virtual collaboration environment. (Distributed Virtual Workspace for enhancing Communication within the Construction Industry. EU IST-1999-13365)
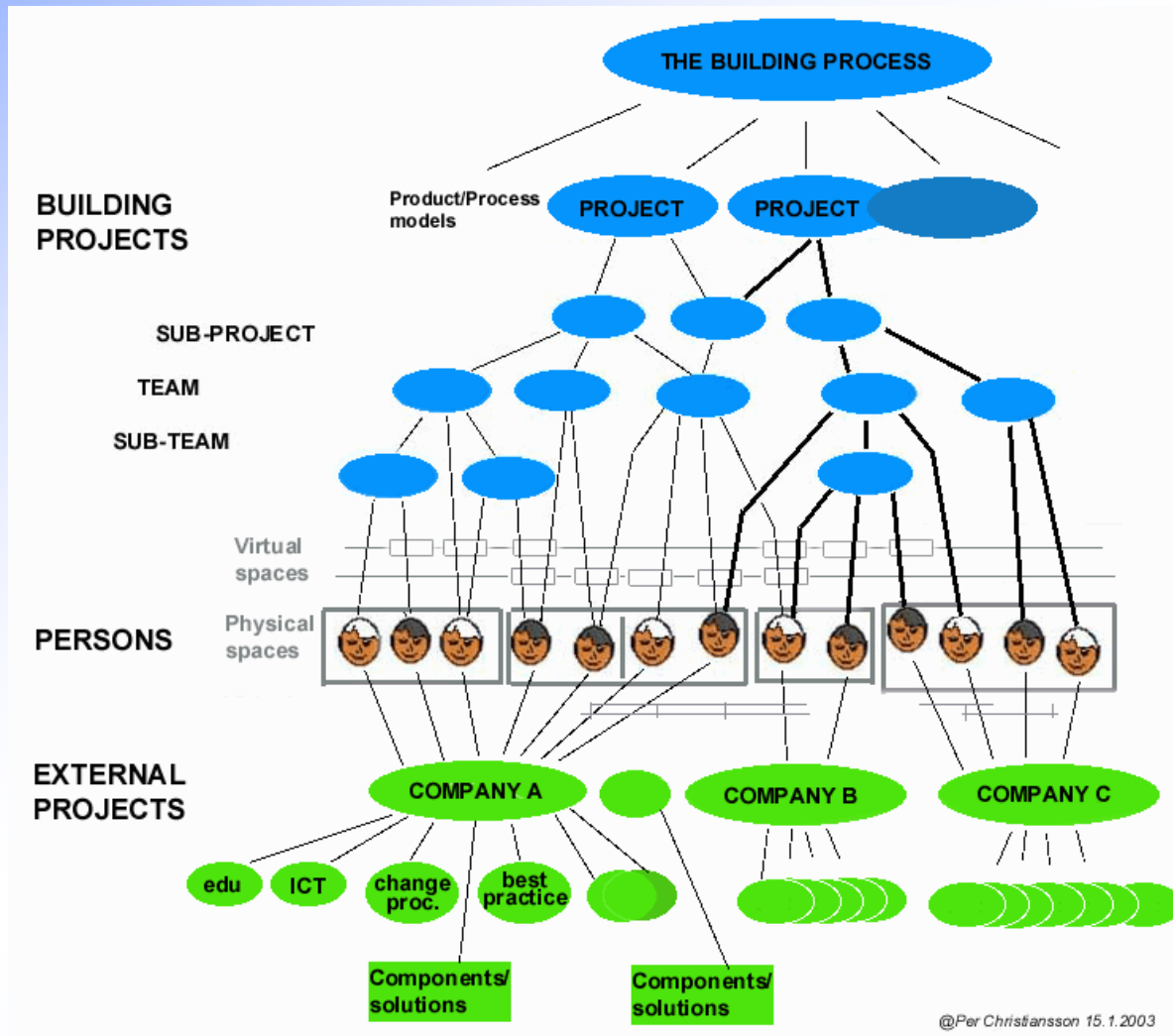
ICT IN THE
BUILDING PROCESS

ICT in the building process

Formalised processes will more efficiently handle flexible user environments (UE) and project information containers accommodating partly redundant information.

Organisational Impact

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

Organisational impact   cont.

- Mix of *physical and virtual workspaces* (80/20 to 20/80, physical meetings will *remain* very important especially during non-routine activities).
- New procedures (new companies?) to provide *knowledge management support* (e.g. long-term project information storage end experience transfer, company/building project education services).
- Greater possibilities to back-up digital knowledge resources in the companies due to *efficient capture and re-use of experiences* and ideas.
- Efficient handling of *unstructured and partly redundant information*. (The building process will for a foreseeable future contain semi-structured data together with information containers with highly formalised non-redundant data models).
- *Meta data* in models containing non-redundant data on high abstraction levels will glue together domain specific more specialised application models.
- Disconnection of *building application semantics* from underlying information containers will facilitate system interoperability and build-up of user specific search in and interrogation of underlying information containers.
- Higher flexibility in *creating project teams* composed of persons from different companies (the old 'building master').
- Flexible *collaboration* patterns between and within teams.

RECOMMENDATIONS FOR HANDLING CHANGE PROCESS

Model development

The formulation and refinement of digital models of the building process must be *driven by the end users*. Models describing

- Building project processes and company specific processes.

- Building project products such as buildings (and all systems built into the building), virtual buildings (VB), and building components.

- Production systems.

- ICT tools.

- User/team ('languages', competencies, human computer interaction styles etc.).

Key issues

Some crucial aspects in connection with development of next generation knowledge management systems for the construction industry are listed

- *Participatory* design (industry - university) of new tools and services that in many cases are not yet defined, see also.
- Development of *scenarios* (from idea to demolition of building) encompassing credible ICT tools.
- *Deep understanding* of ICT influence on organisation, work methods, user environments, and information handling.
- Agreements on *vocabularies* and *concepts* within and between stakeholders starting with meta project level and more detailed team and component supplier specifications.
- Introduction and use of tools for semi-automatic *capture* of vocabularies and concepts.
- Active *propagation* of captured and harmonised vocabularies to meta level project name-spaces.
- Conscious formalisation and automation of design tasks to *reduce risk of formalisation into non-flexible solutions*.

END