Virtuelle Bygningsmodeler og distribueret samarbejde.
DIVERCITY projektet

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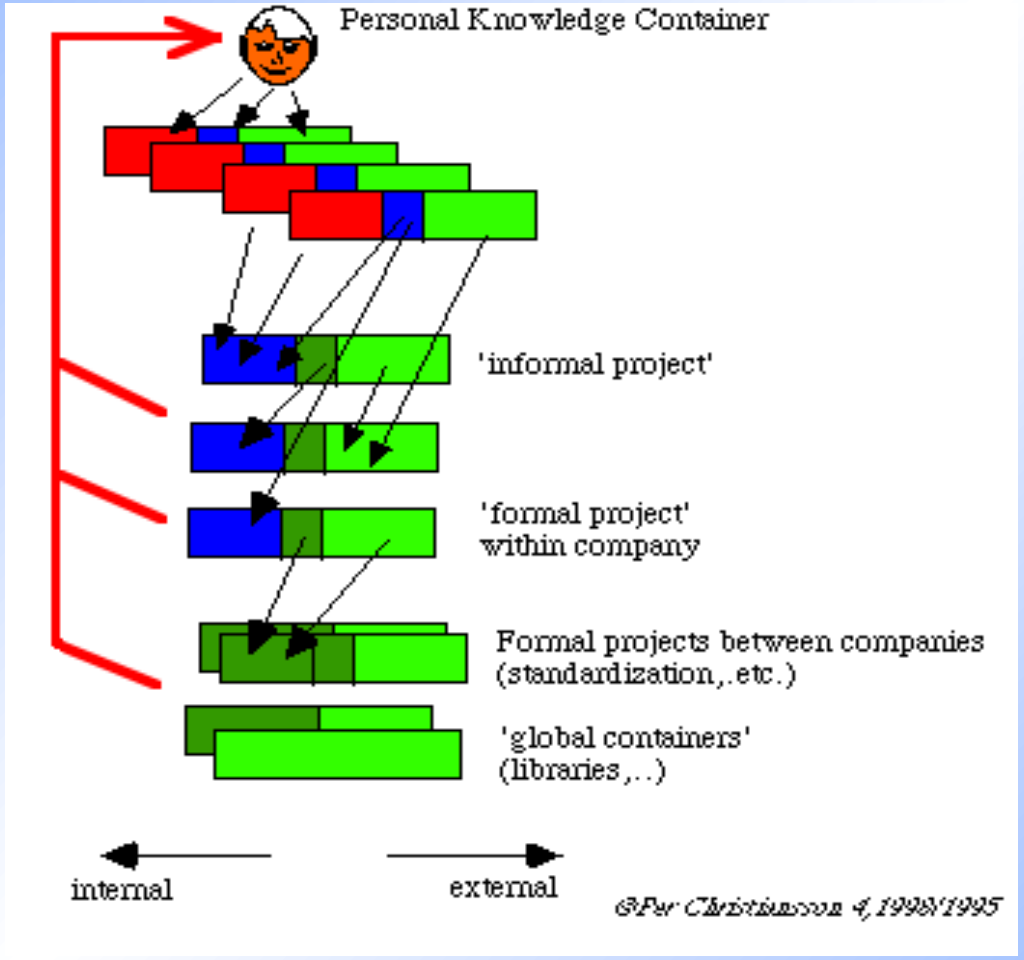
- Netværket for 3D GeoInformation -
Netværksmøde om ’3D byggeri’.
Onsdag den 11 december 2002
COWI A/S, Aalborg.

CONTENT

- SHIFTING PARADIGM
- IMPROVED MODELS (VB, Process)
- The DIVERCITY example

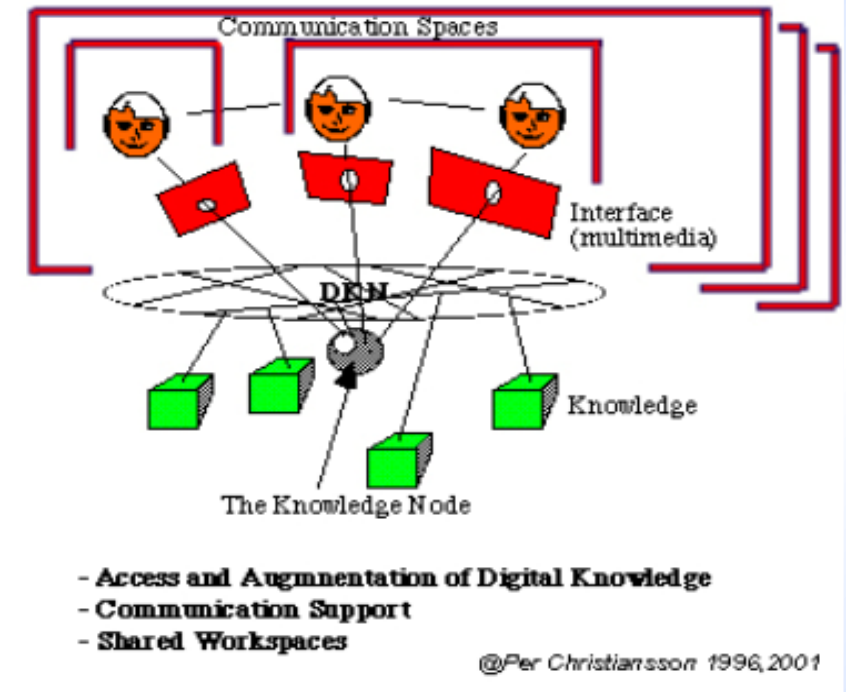
SHIFTING PARADIGM
(takes time)

Knwowledge Communication



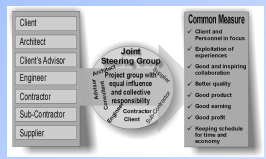
Knowledge is communicated between knowledge containers covering different subjects and time domains

The Knowledge Node Concept

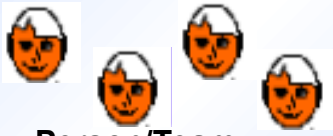


- ***Participants***; number of, type (persons, agents
- ***Collaboration subject/context & Form of interaction***; design, reviews, purchase, learning, brainstorm, negotiation, discussion,
- ***Communication content*** to support interaction; e.g. speech, sound, images, music, video, whisper, body language, 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

BUILDING PROCESS CHANGE?

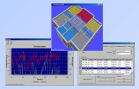


Organisation

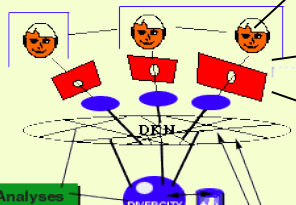


Person/Team

Collaboration environment



Analyses/simulation tools

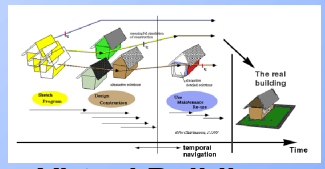


The DIVERCITY Framework

Models access

Framework

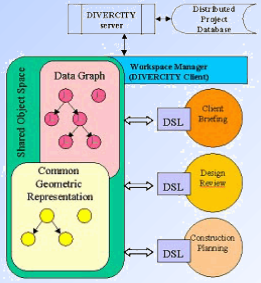
Information container



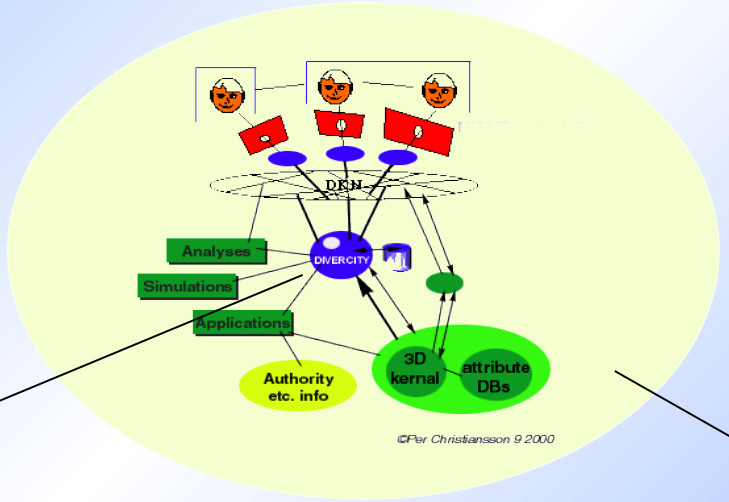
Virtual Building

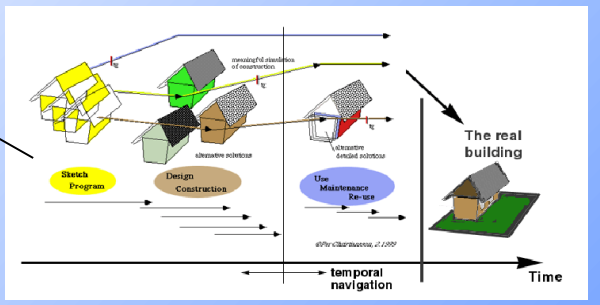
Virtual Building

- *Virtual Building* environment. Product and process models with spatial *temporal* properties, partly redundant information, early decision support, ….



Framework

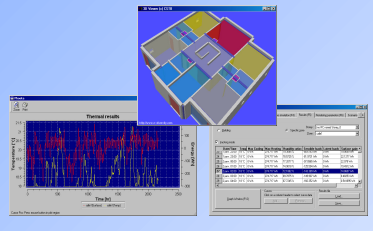




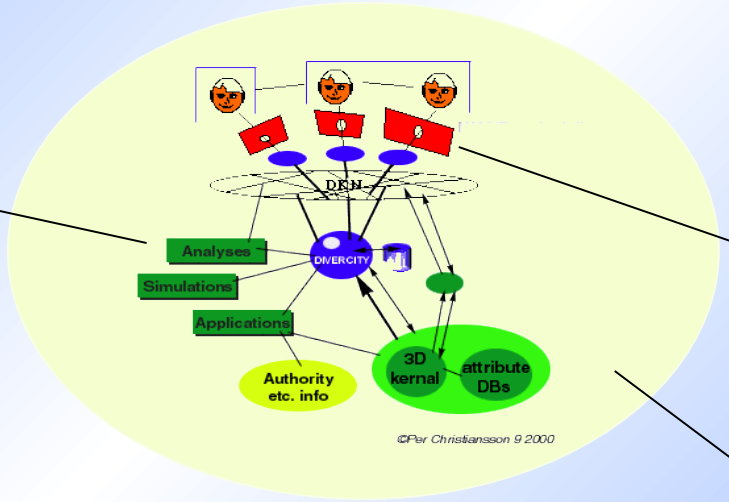
Virtual Building

Advanced Interface to Models

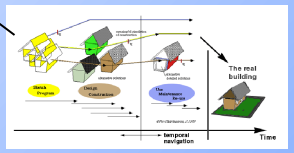
- Higher *realism* in interaction with underlying models (VR, simulation tools, adapted views, cost/accessibility,...)



Analyses/simulation tools

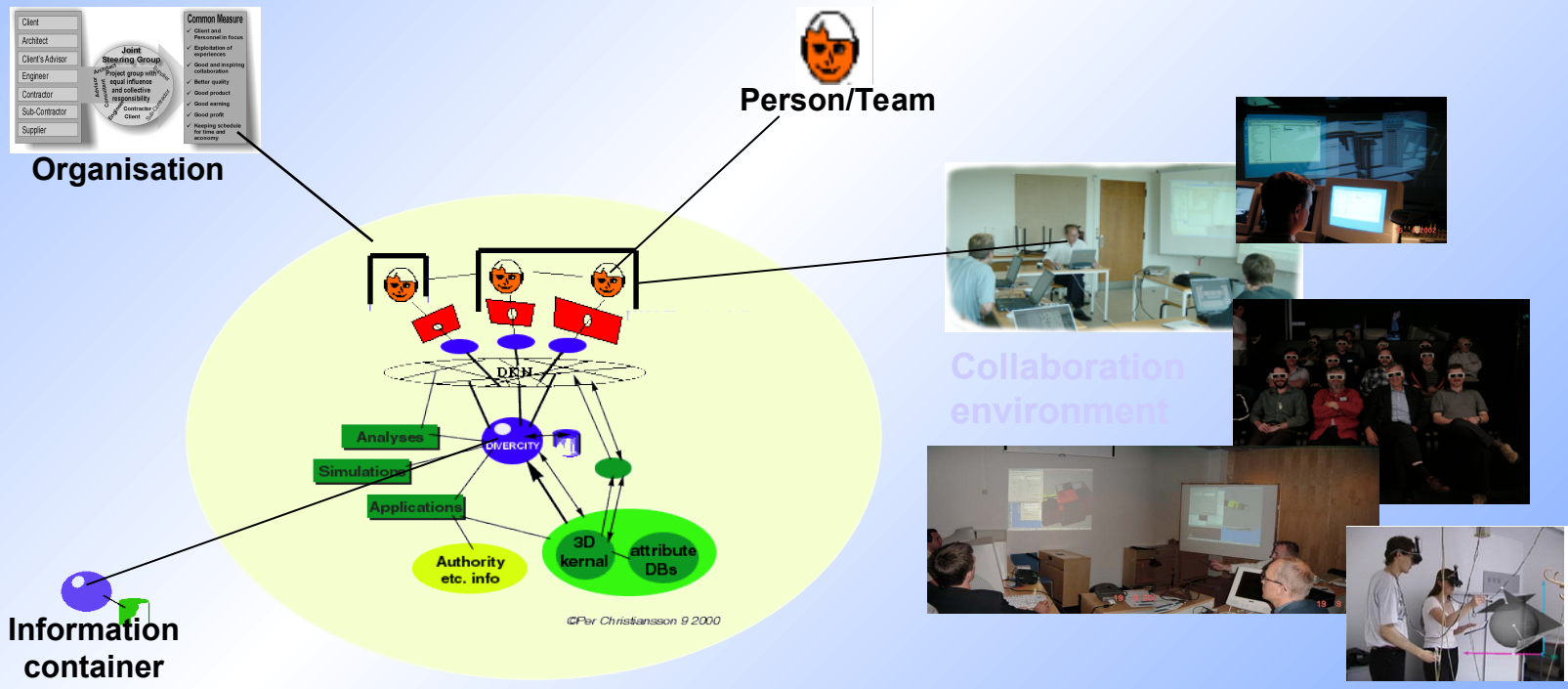


Models access



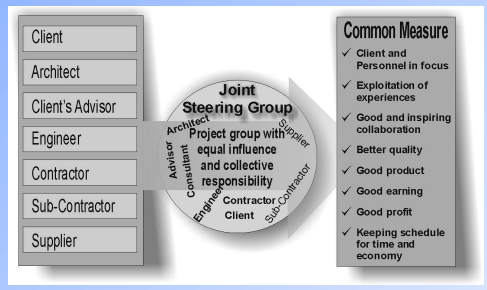
Virtual Building

New Workspace Properties

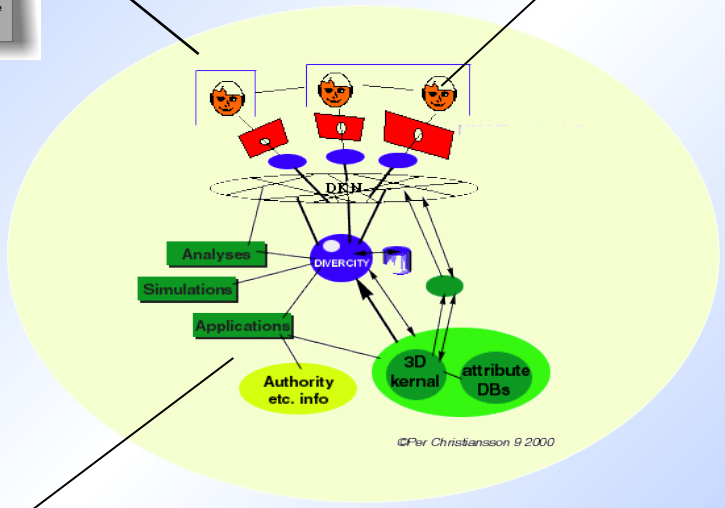


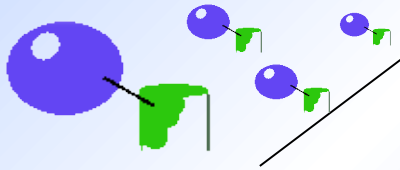
- Physical *workspaces* with new dimension ('virtual', augmented, immersive) and new collaboration tools.
- Advanced *administration tools* (artefacts) for secure distributed personal, team, and project information repositories

Competence Collaboration



Organisation





Information container

- *Competence* collaboration in projects enabled (adopted communication, access to knowledge containers with experiences etc.)

PARADIGMSHIFT TAKES TIME

- Early 80s - how can we invoice CAD(rawing) work?
  (Clients saw the qualitative effects of studying alternative)

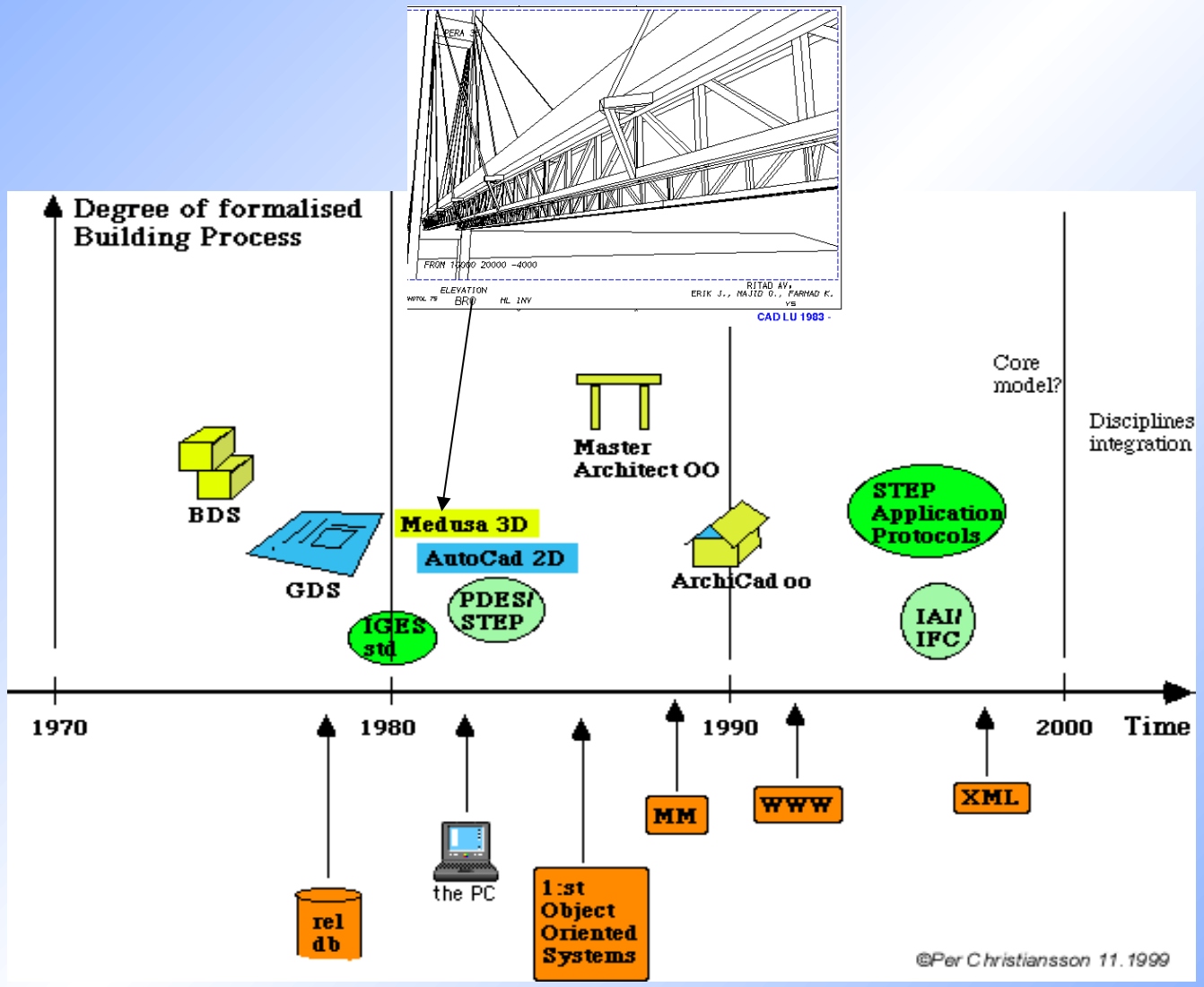
- Mid 80s - 3D (affordable solid modelling tools) will now be commonly used!!
  (early design needs, parametric models and degrees of formalisation, level of detailing, drawing to model thinking,….)

- Mid 80s - 4th generation 'db systems' and object orientation introduced.
  (organisational and work change, formalisation needs to integrate company functions

- Late 80s - large scale integration of hypertext information containers in Internet

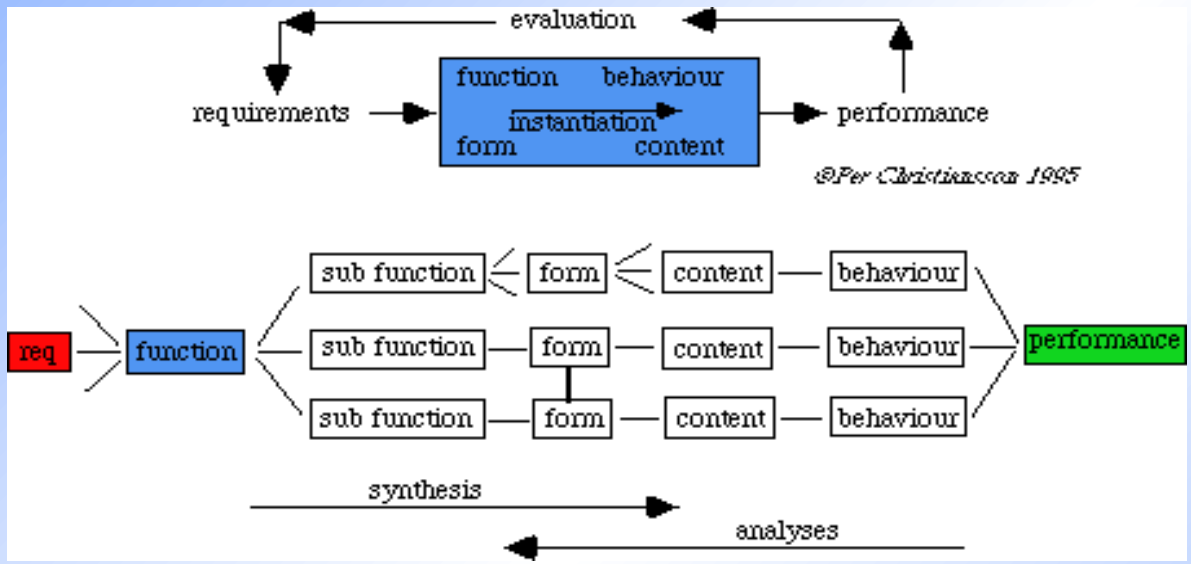
- Late 90s - 1 Internet year = 5 ordinary years.
  (ICT competence needs increases, out-sourcing back lash)

Building Process Oscillations



IMPROVED VIRTUAL BUILDINGS and BUILDING PROCESS MODELS

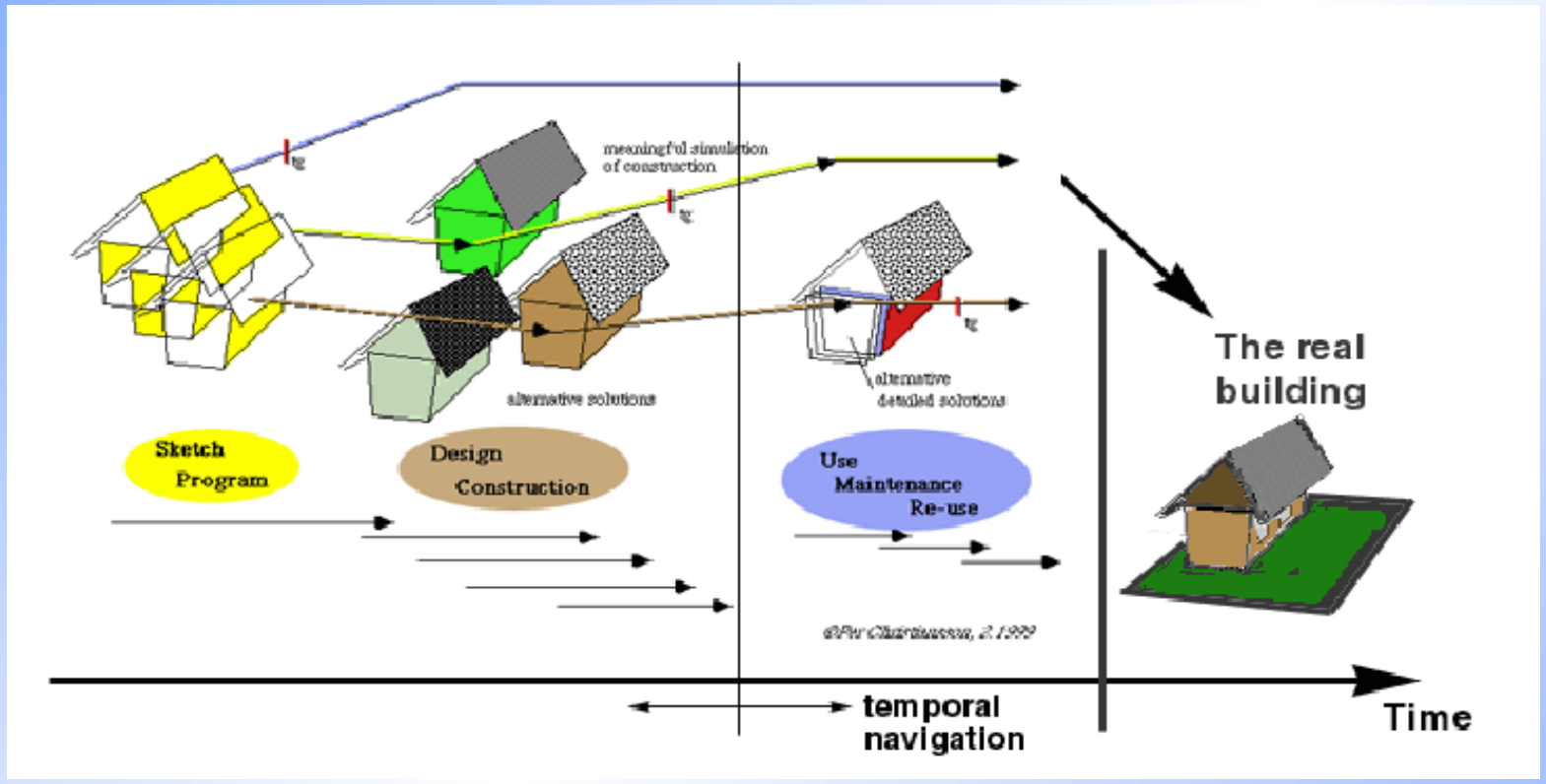
From Product idea to use, re-use



Requirements are translated to functional requirements

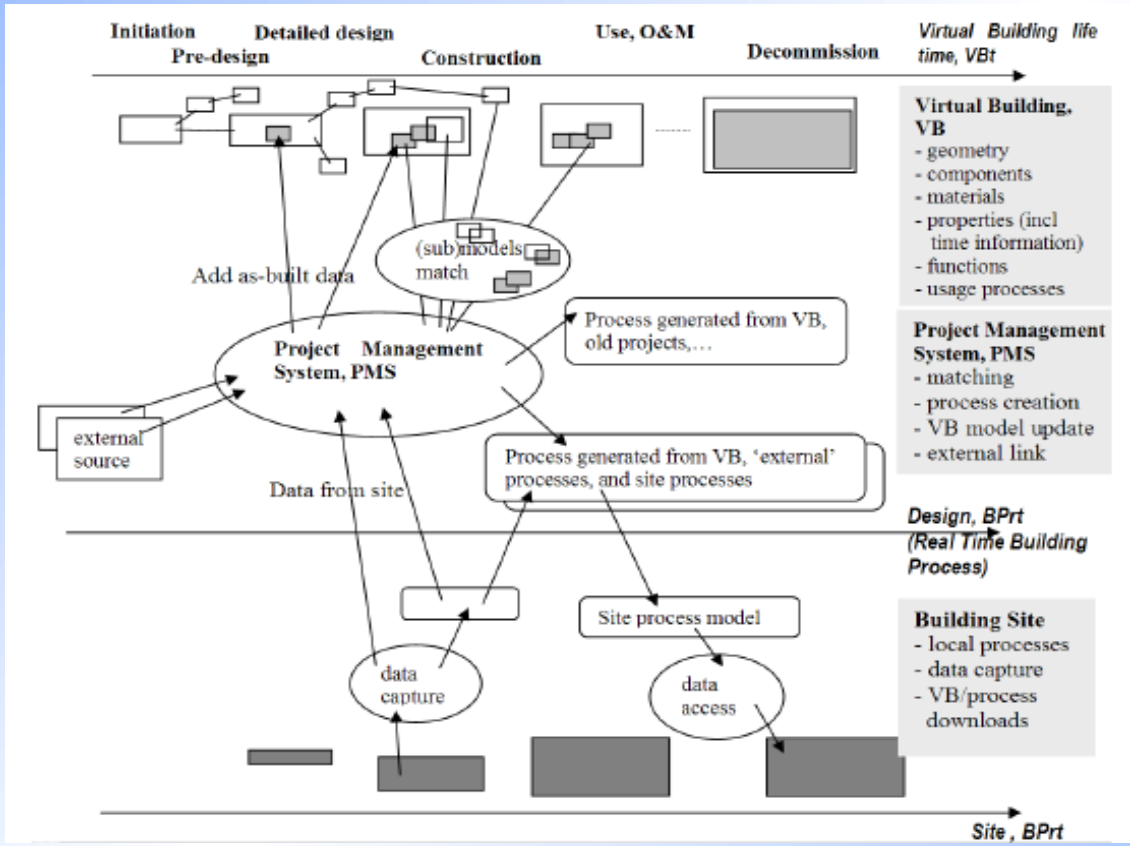
- **which in the design process leads to instantiated design parameters**
- **which leads to new functional requirements etc.**
- **Complex time dependent functional couplings will arise**
- **The same VB must also be able to support different design paradigms (creative, innovative or routine)**

The Virtual Building Model



The virtual building contains all documentation of the building including drawings, models, documents etc. It will normally contain redundant information and temporal information describing discipline models and sub models of the building over time. Tracks of alternative solutions. Two time lines -real time during collaboration and time points in the life cycle of a design artefact.

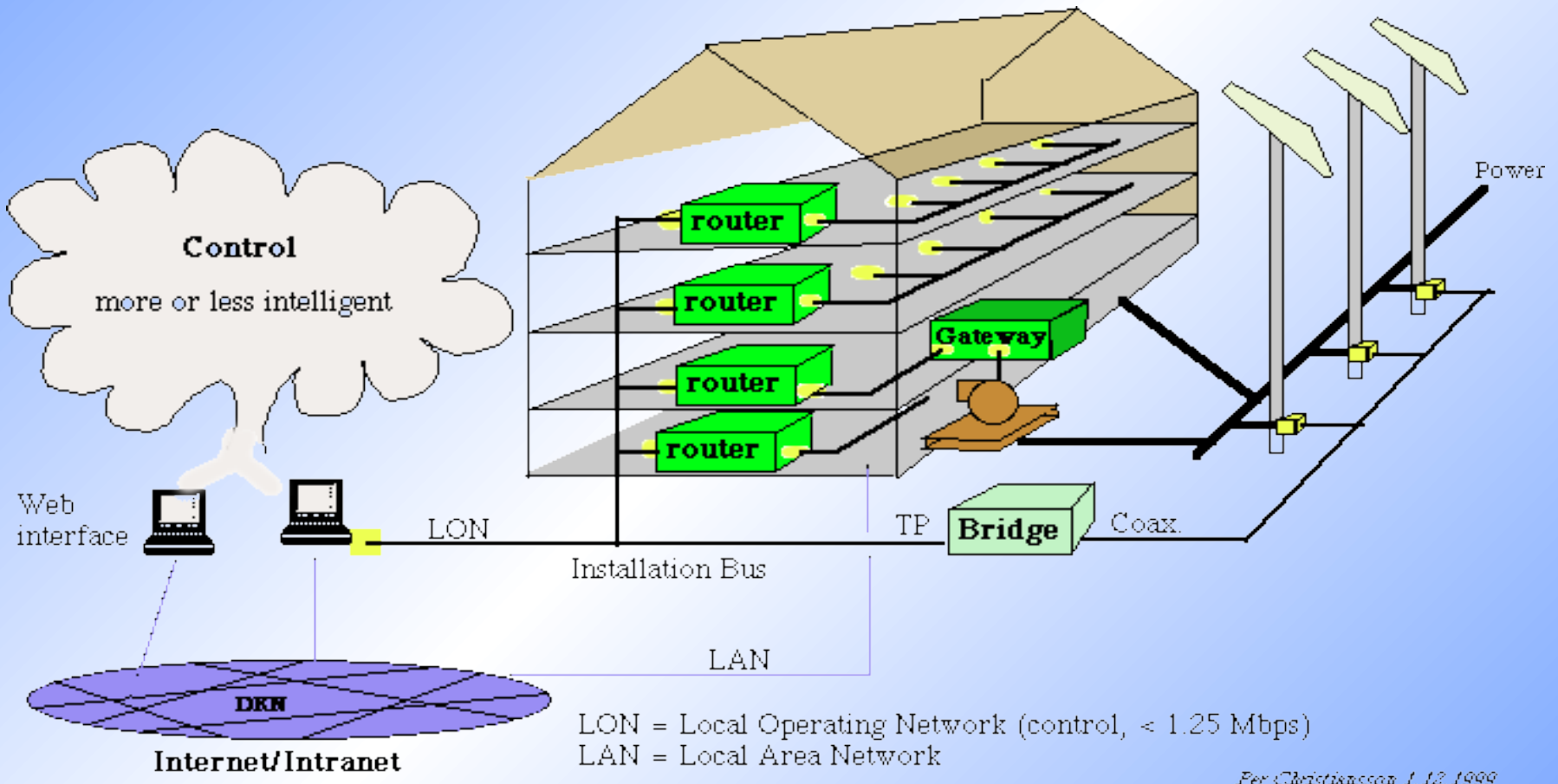
The PMS in context



The Project Management System (PMS) will integrate Virtual Building models, Site Process models, and external information containers. It will also manage matching and updating of the VB sub models as well co-ordination with building site activities. BPrt = Building Process real time, VBt = Virtual Building time to describe time points in life of Virtual Building (sub)models.

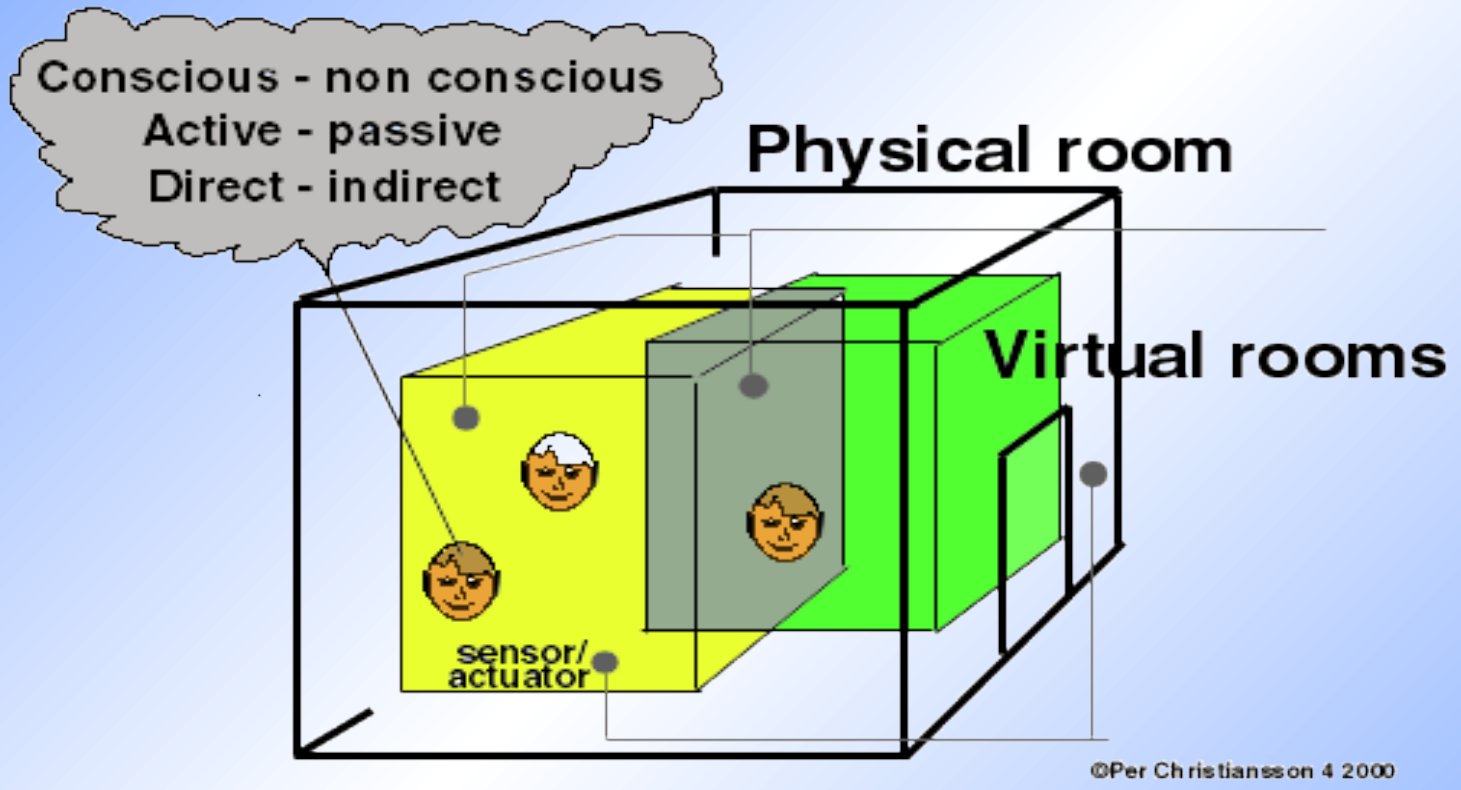
(from Christiansson P., Dawood N. N., Svidt K, 2002, "Virtual Buildings (VB) and Tools to Manage Construction Process Operations".

The Intelligent and Responsive Building



The building can also itself house ICT tools to support required functionalities/systems/processes

Virtual Rooms

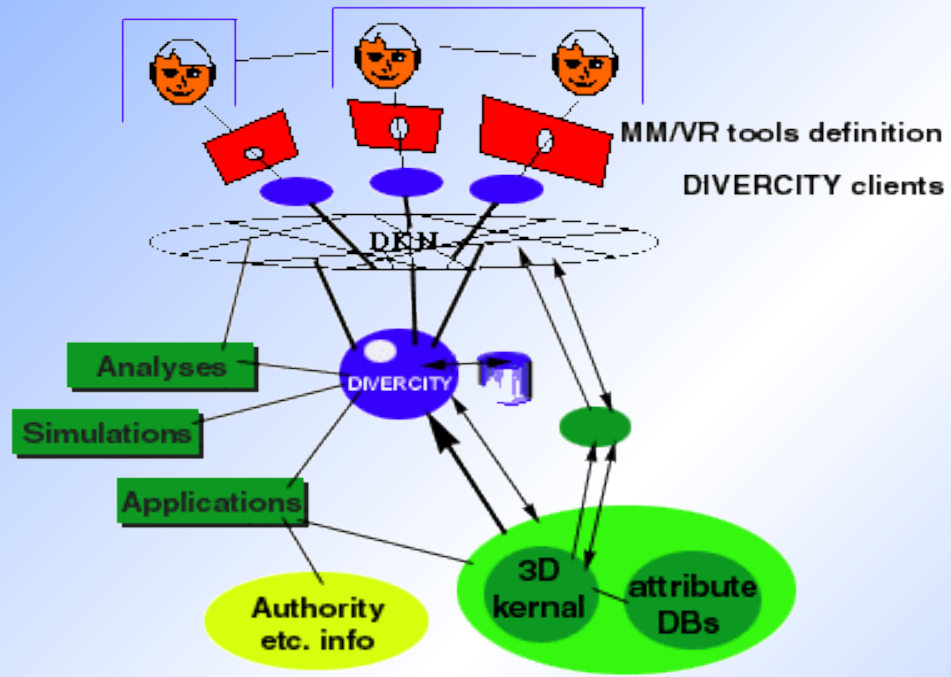


- The IBI should be responsive to the user needs and easily be ***re-programmable***.
- We may have to ***define virtual rooms*** to house different activities at different times and even occupying different spaces (for learning, creativity, virtual meetings, thinking, relaxation, sleeping, etc.) in the buildings.
- The building shall ***support communication*** in all respects also the communication directly involving it's users.

The physical form and functionality of the rooms will be more tightly related to the underlying IBI systems.

DIVERCITY - Distributed Virtual Workspace for enhancing Communication within the Construction Industry

EU IST-1999-13365 http://www.e-divercity.com/



DIVERCITY supports
- communication between persons
- multiple building product/process information access
- building process activites

The objective of the project is to produce a prototype virtual workspace that will enable the three key phases (client briefing, design review, construction) to be visualized and manipulated, and to *produce a set of VR tools that aid the construction design and planning process*.

PARTNERS

- **Distributed Virtual Workspace for enhancing Communication within the Construction Industry - DIVERCITY**

DIVERCITY project data

- - Shared cost RTD project - Key Action II.2.2
- (New Methods of Work / Workplace Design / Team Work)
- - Started in March 2000 - Expected duration: 30 months
- - Total cost: 4 M Euro (app.) - Commission funding: 2 M Euro
- - Consortium (10 partners - 5 countries):
- - Objective : Design & Develop a Distributed Virtual Workspace adapted for the Construction Industry

Contstruct IT (Coordinator)

University of Salford

CSTB
CS SI
SPIE

Aalborg University

COWI

CRS4

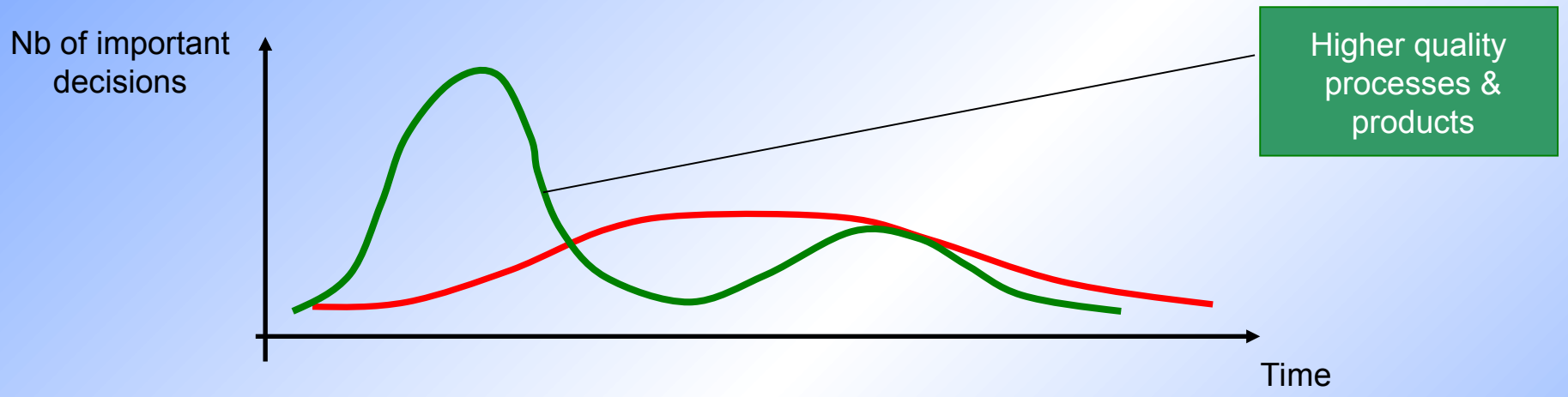
VTT
EVATA

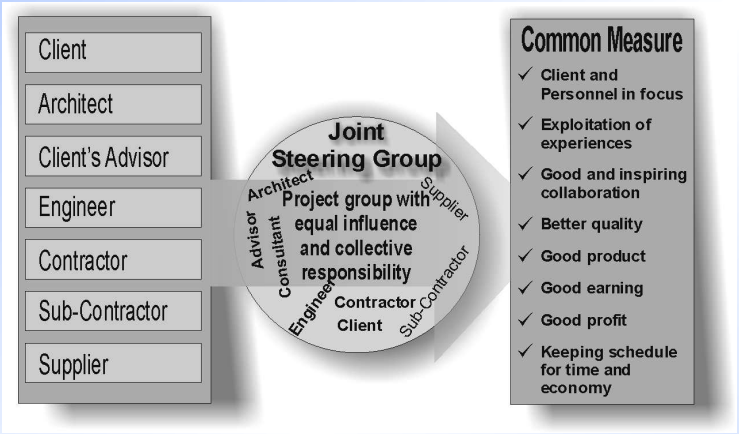
Developer

User

DIVERCITY project infrastructure

Changes in Process Organisation





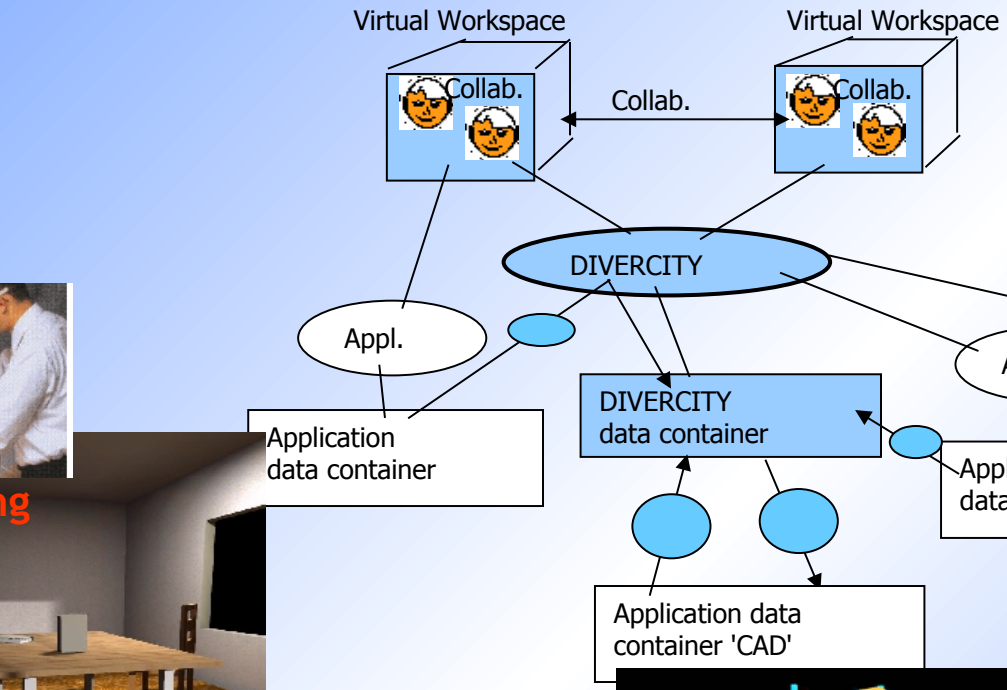
Dramatic changes in procurement philosophies, as a result of the internet (partnering model). Partnering model showing the stakeholders joining a common project group with mutual goals (COWI A/S Denmark)

Virtual Workspace Definition

- 'The Virtual Workspace, VW, is the new design room designed to fit new and existing design routines. VW may well be a mixed reality environment. The VW will host all design partners from project start with different access and visibility (for persons and groups) in space and time to the project, and will promote building up shared values in projects. The VW thus acts as a communication space with project information support in adapted appearances. VW gives access to general and specific IT-tools '

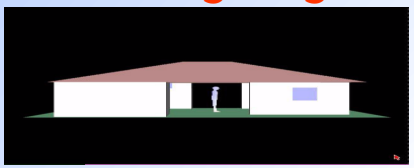
DIVERCITY - Virtual Workspace

DIVERCITY function, form, content, behaviour

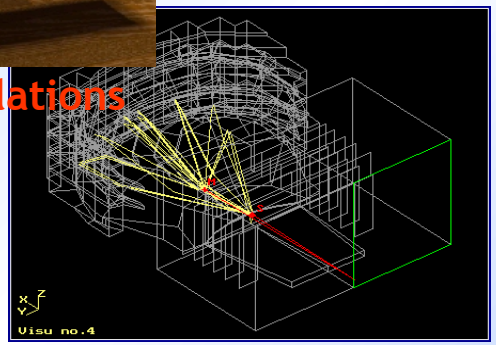


Client briefing

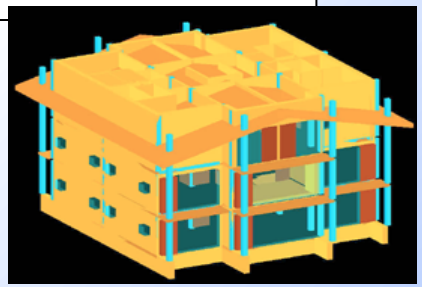
Lighting Simulations



Thermal Analysis



Acoustics

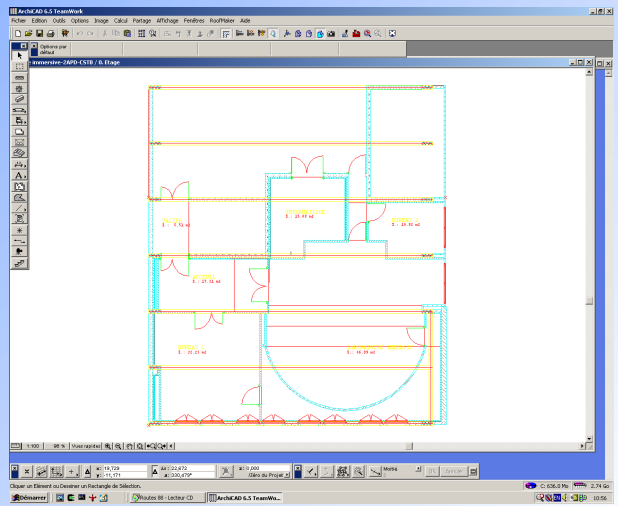


Building Model

(IFC,...)

4D building site

Import Product of Model to Application

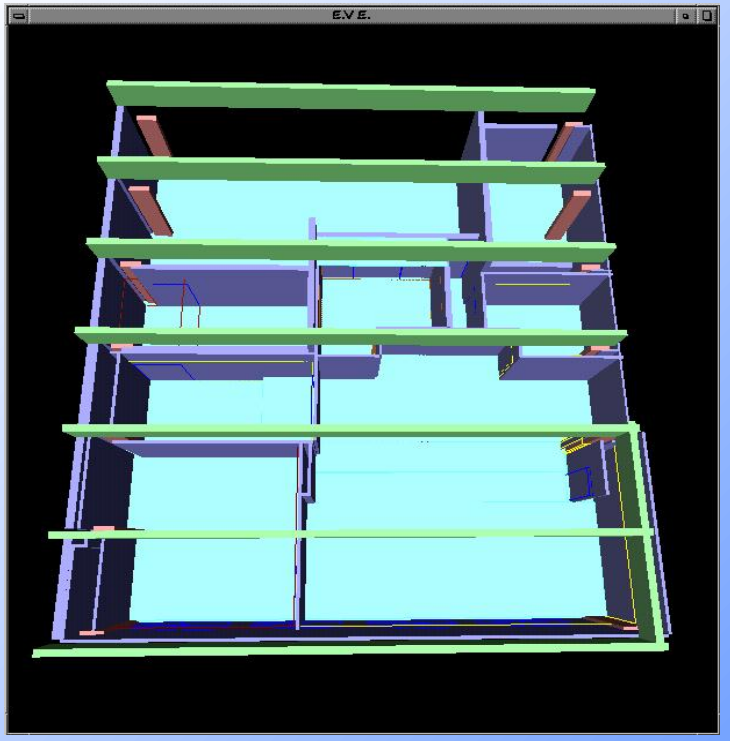


CAD-Tool (ArchiCad)

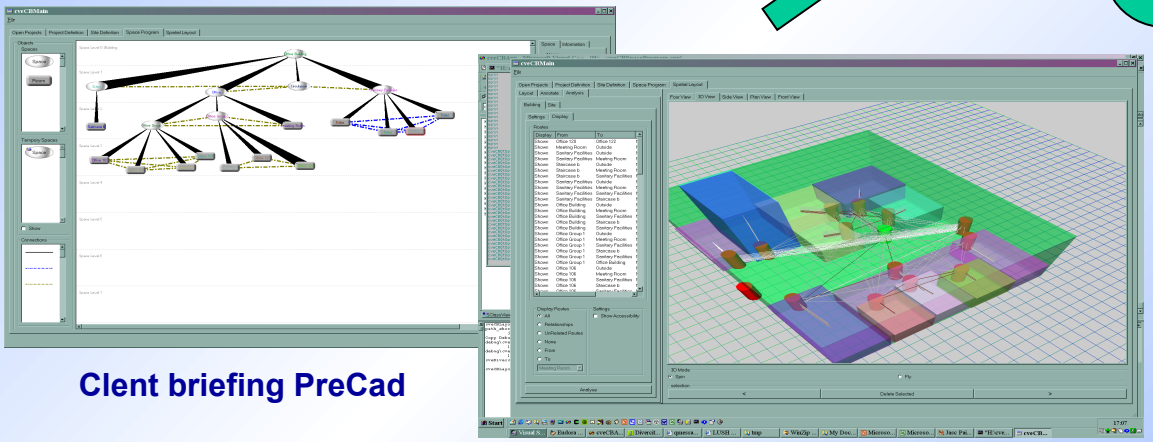
IFC C++ generator

SPF file

C++ classes

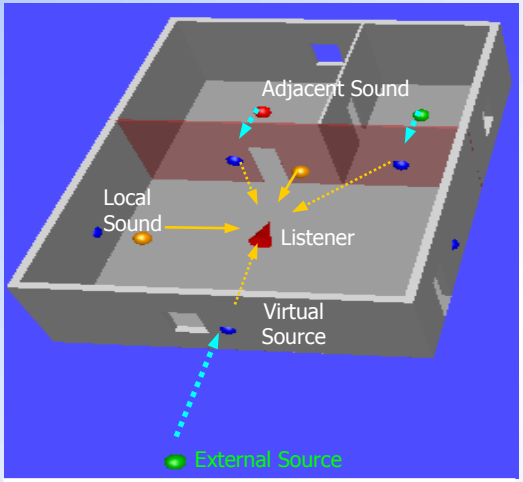


Divercity

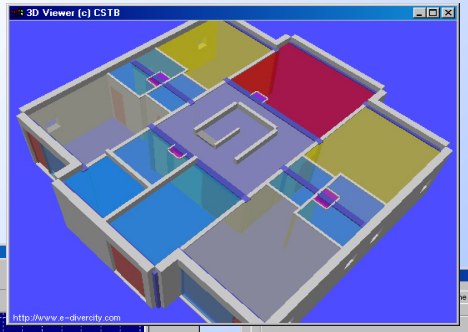


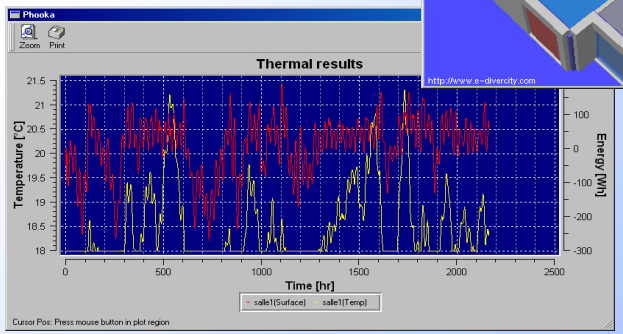
Clent briefing PreCad

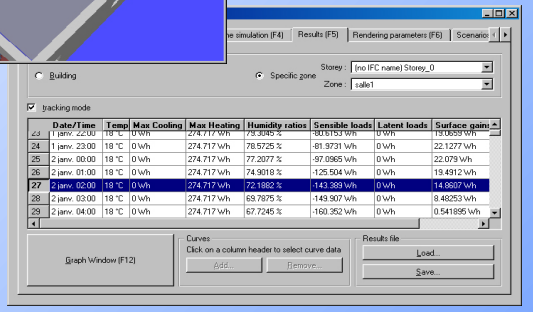
DESIGN REVIEW APPLICATIONS (more PRODUCTS)



Acoustic module





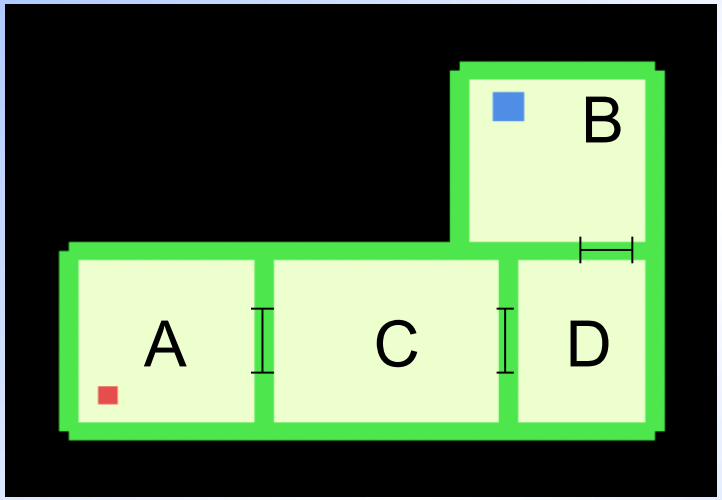


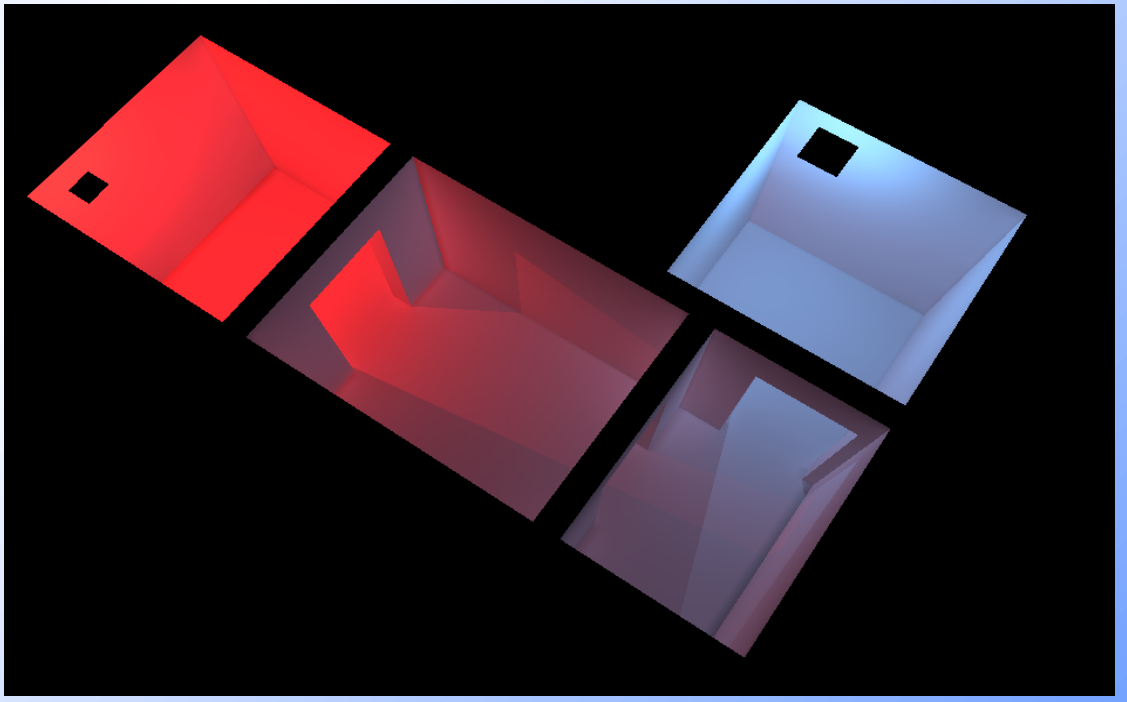
Thermal analysis module

Lighting module

DIVERCITY Design Review Lighting example

- - Interactive Radiosity
- - Visibility Graph subdivision associated with light transfer links
- - High shadows quality and optimised subdivision for real-time exploration (synchronous) (including object motion)





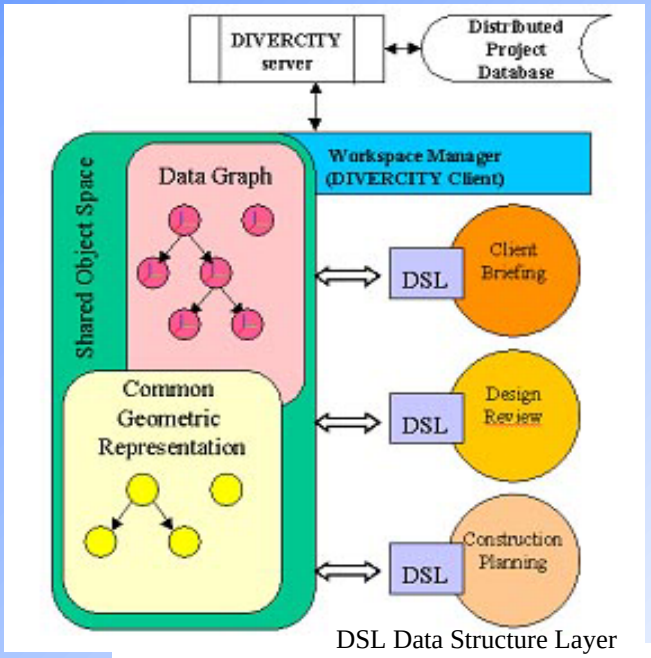
DIVERCITY Construction Planning

- - VR based tools to organise and optimise the Construction site in 4D (Space and Time)

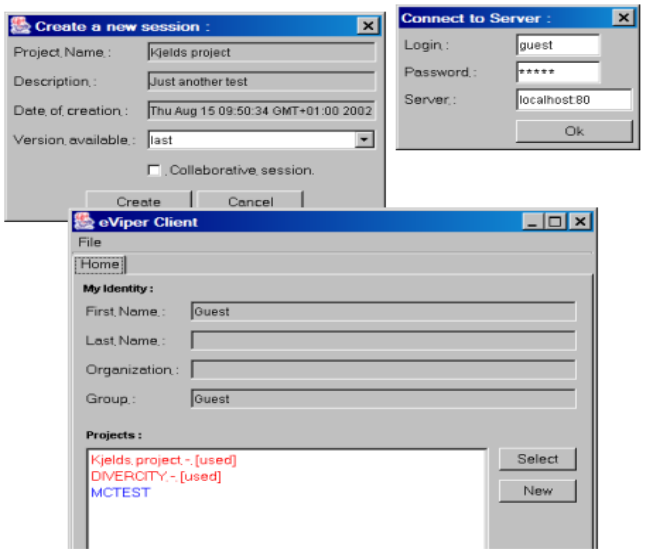
Project Model

DIVERCITY Framework

Laurent da Daldo



DSL Data Structure Layer



E-viper client handles access to the workspaces and proj

The Central eViper Server

Source control stores different versions and keeps an history of all that happens on a project

User profiling allows the server to identify people connected to, or trying to, connect to it and manage user access rights on projects.

Security and integrity of information is permanently controlled by the server.

Messages management is one of the most important feature of eViper. It controls information exchanged between users and manages priorities. Thanks to this feature, developers using eViper can build not only distributed but also collaborative applications. This is an open mechanism allowing any third party to use data controlled by the server (as long as they are authorised).

The Distribution Manager

The distribution manager is the ***client*** **(user) side of the communication layer of DIVERCITY**. It can be *included* in an application (it in the case of Phooka, the DIVERCITY client application) or can be a *stand alone* application, controlling data exchange between the client and the central server. The distribution manager has been released in JAVA and C++ and it is platform-independent. In this way, developers will be able to work in their own environment. This interface provides all necessary entries to send and receive message from the server. It also provides a simple way to plug any third party application to the central server of eViper. (SOAP, Simple Object Access Protocol used).

Indystry Foundation Classes - IFC

http://iaiweb.lbl.gov/
http://cig.bre.co.uk/iai_uk/
http://cic.vtt.fi/niai/

International Alliance for Interoperability (IAI)

An industry group created a series of prototype software applications that were demonstrated at the A/E/C Systems `95 show in Atlanta, Georgia.

With this successful public demonstration, the original twelve companies opened up participation in this effort in September 1995 to AEC/FM companies worldwide.

IFC2.x2 current wersion

Contact

http://it.civil.auc.dk

R&D and EDU collaboration within

- **Building process and product models**
- **Meta classification**
- **Knowledge Management**
- **Collaboration and Virtual Reality**
- **Multimedia/User Environment design**
- **Collaborative work on specification and design of next generation systems (Industry/University)**

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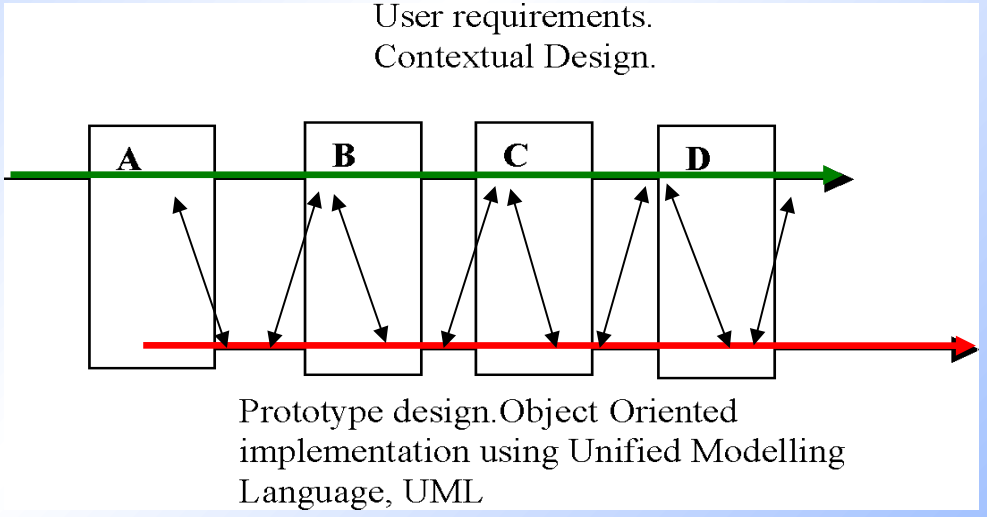
END

COLLABORATION IN PROJECT

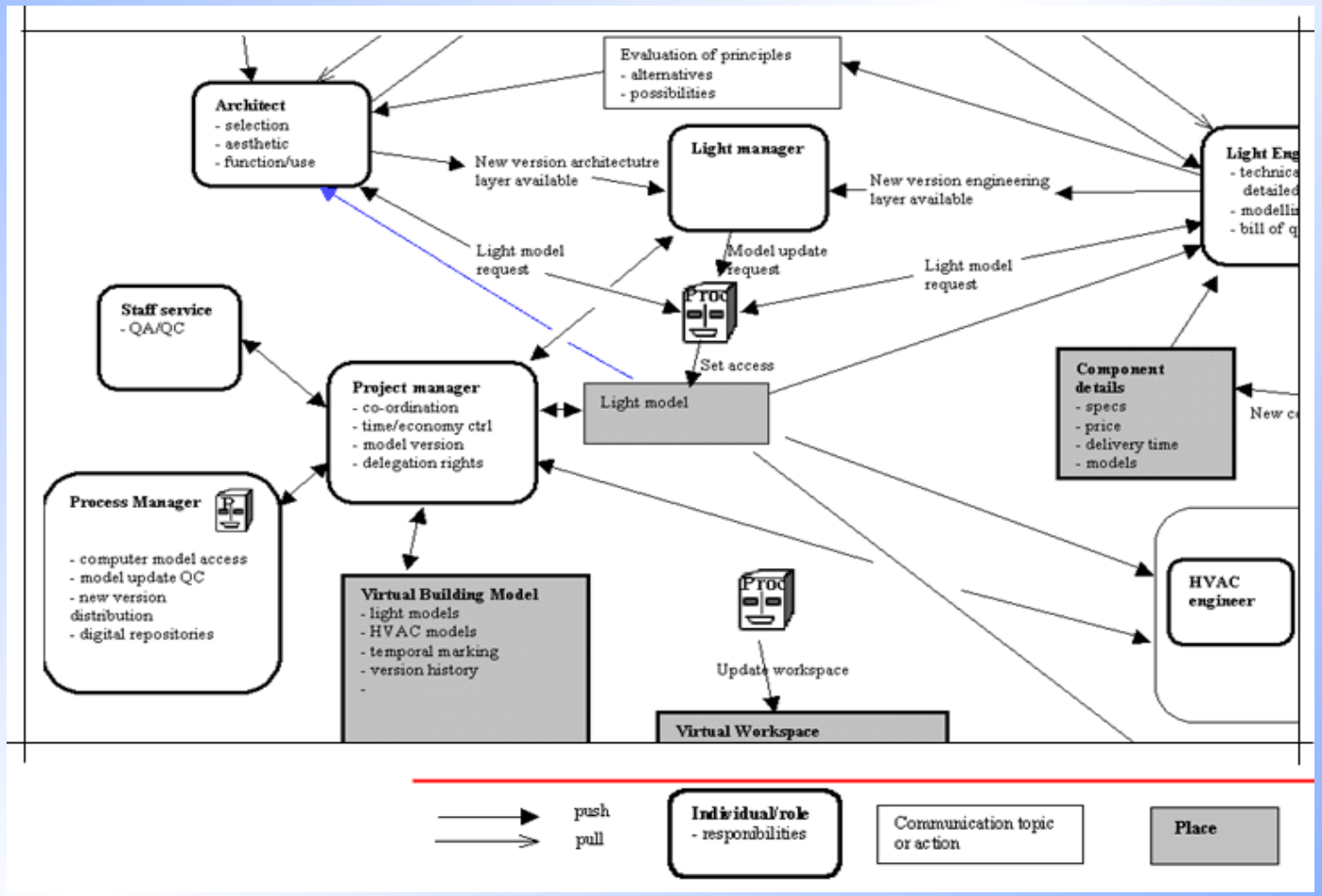
A) user requirements capture, user environment design and early prototyping;
B) implementation of DIVERCITY and end user alpha test (done within the DIVERCITY consortium) of basic functionality of the DIVERCITY products (applications);
C) continued implementation and end user beta tests/evaluations of basic functionality of integrated framework and DIVERCITY products;
D) final end user evaluation of DIVERCITY, and prototype refinement.

We have methodology for efficient user requirements capture, user environment modelling and system development

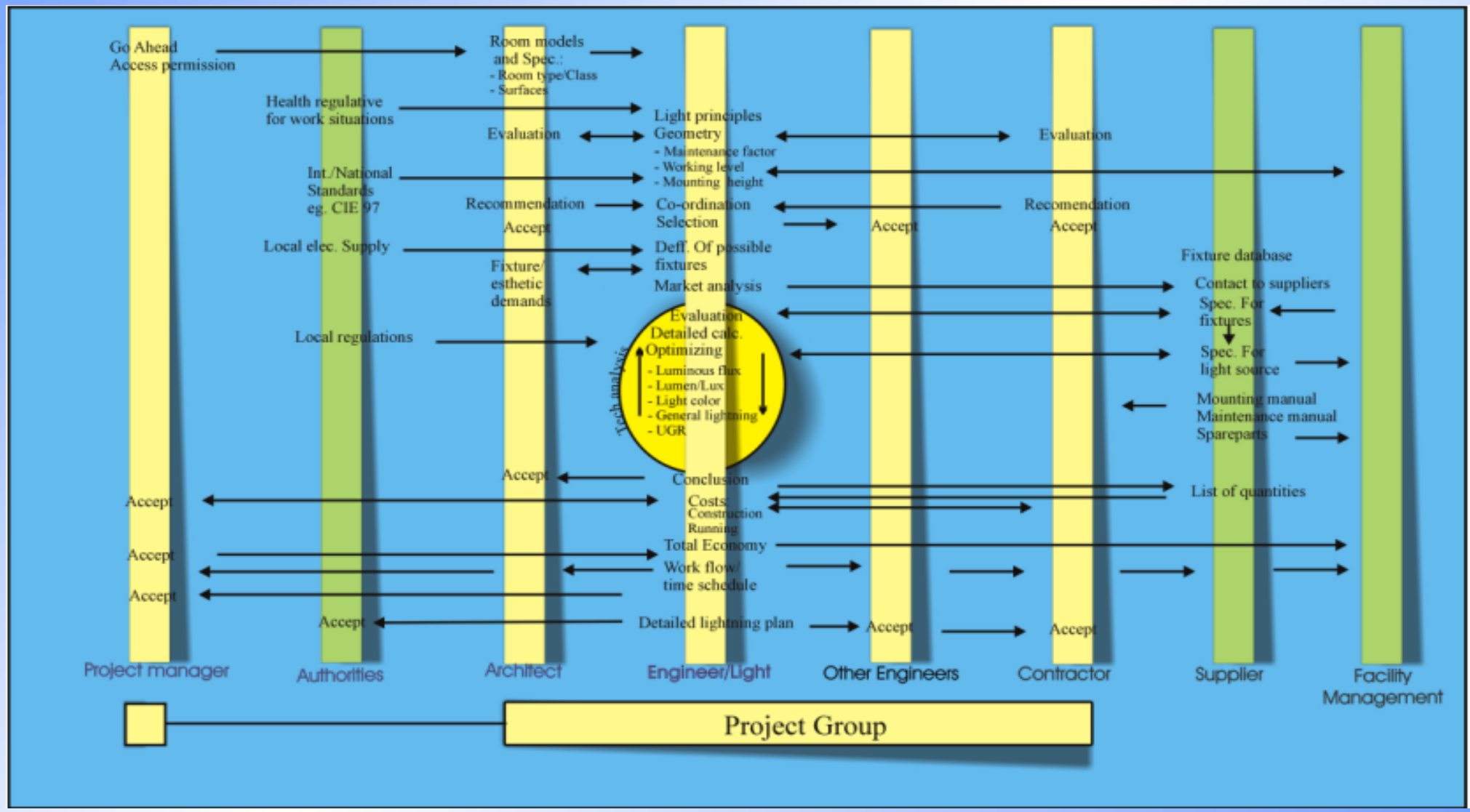


Socially very good environment

Work Flow Model. Conextual Design



Sequence Model. Contextual Design



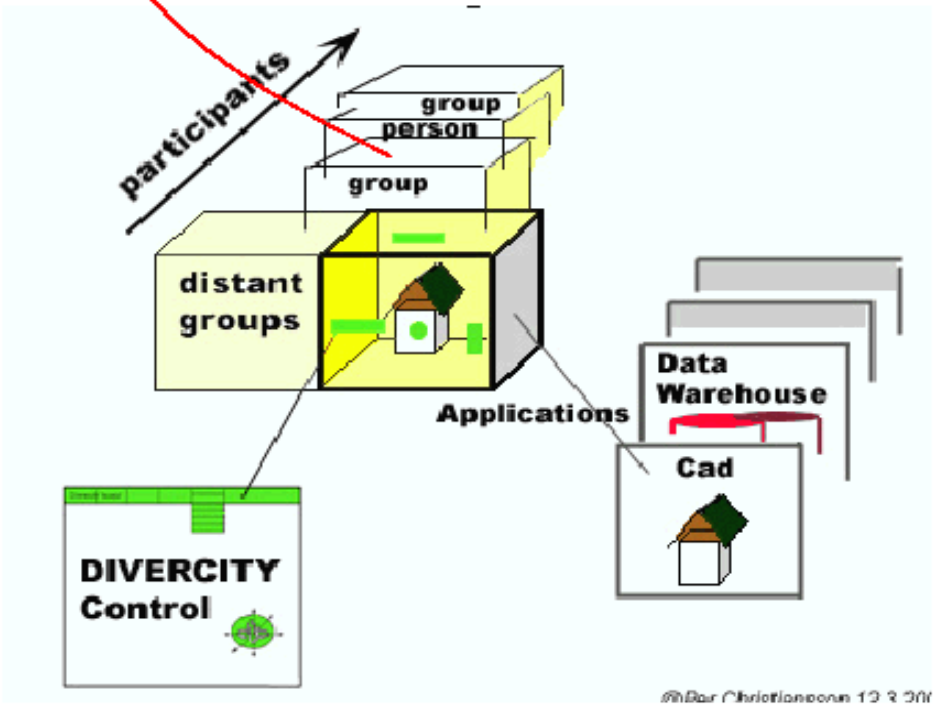
Scene 6- Light Simulation

•Page 1

Enter workspace

Load relevant parts of the model

Lock relevant parts to avoid changes by other stakeholders



Form of interaction/ communication

Internet/intranets/extranets
Dom ain (spaces, persons,..)
Content (text, video, 3Dmodels,..)
Interaction form, context (consultation,search, negotiation,presentation, design, documentation, sketching, 'e -business'

Requirements

client
external (regulations,..)
supplier constra ints
LOADS

Stakeholders

Roles (functions)
'partners'
participants in ….
process manager
…

xxx
xx
person

Spaces

space list
space state and content

review
'conventional me eting room'
design
personal
construction
…

Process

sub processes

lightning design
…

Process Manager alert

err 10876

Build spaces

external access
participants

Help

Explanations
tutorials
work models example

contact process managerr

Scene 6- Light Simulation

• Page 2

The main issues for the light engineer are to analyse the needs for light, the influence from outdoor light, the internal distribution of light and maintenance factors.

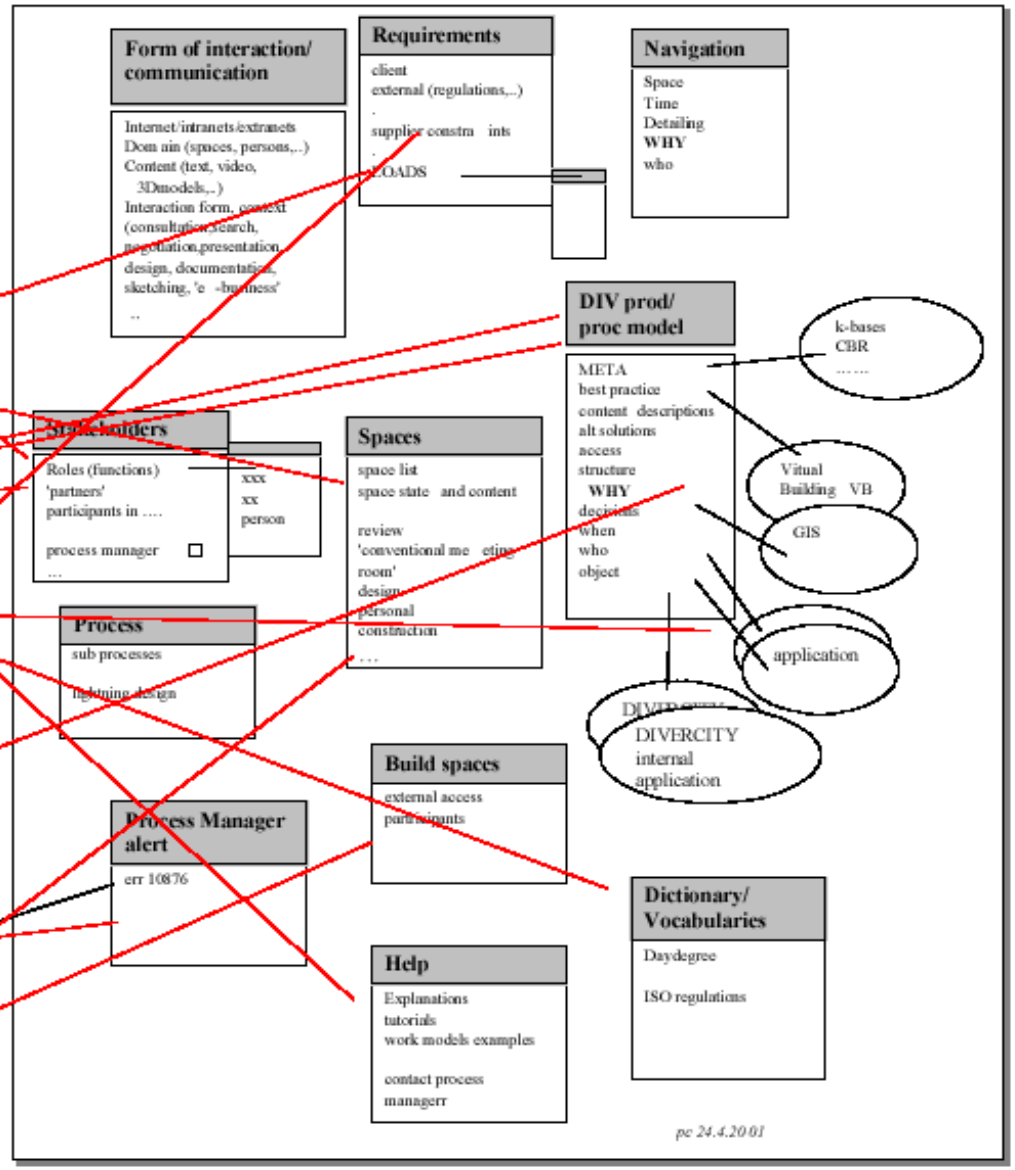
Basic information retrieval
- Room and Building information, Geometry, surfaces, concealed light from outside (windows)
- Legal requirements and regulations (national and local)

Analyse needs for light
- Check best practice and previous projects in the knowledge base
- Define light principles and get accept for these
- Import light components (fixtures and sources by types)
- Calculate
  - export data to external application
  - perform calculations
- Check regulations

Light simulation
- Import light components (fixtures and sources by BRANDS)
- Light simulation based on distribution, intensity factor per room
- Modelling mounting heights, light sources, fixture design
- Simulation of light distribution between rooms
- Simulation of influence of light from outside

Generate light model
- Mounting scheme
- Co-ordination with other design disciplines (thermal, acoustics...)
- Collision control

Process output
- List of quantities
- List of possible suppliers
- Standard e-requisition and tender documentation
- Work plan co-ordinated with other disciplines
- QA/QC-plan
- Price and cost calculations



Detailed Storyboard

The light engineer seeks information from external as well as from internal sources:

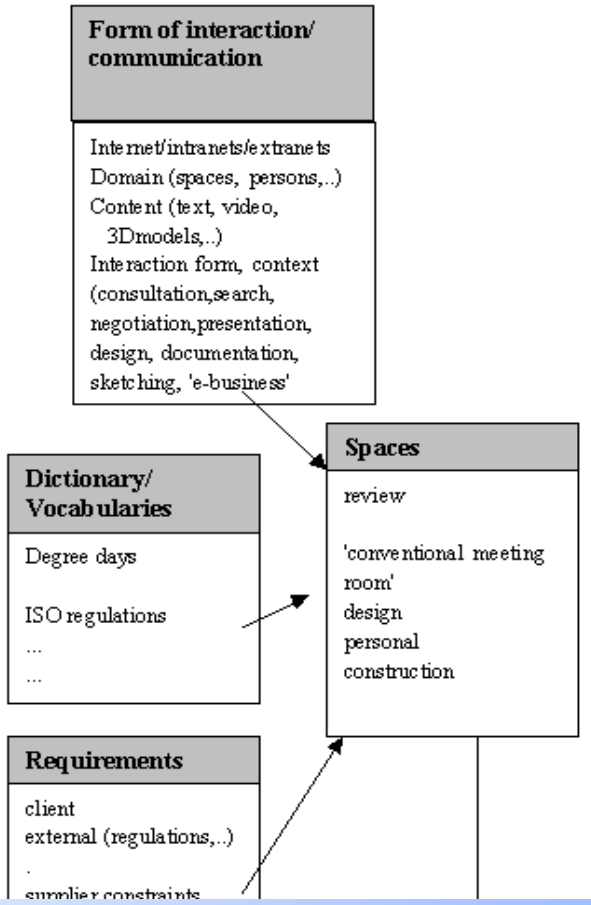
Internal sources
- Experiences
- Best Practices
- Tacit knowledge from partners and colleagues
- Intranet
- Extranet

External sources
- Internet
  - WEB-sites
  - Standards
- Physical documents, such as
  - Books and manuals
  - Law and regulation text

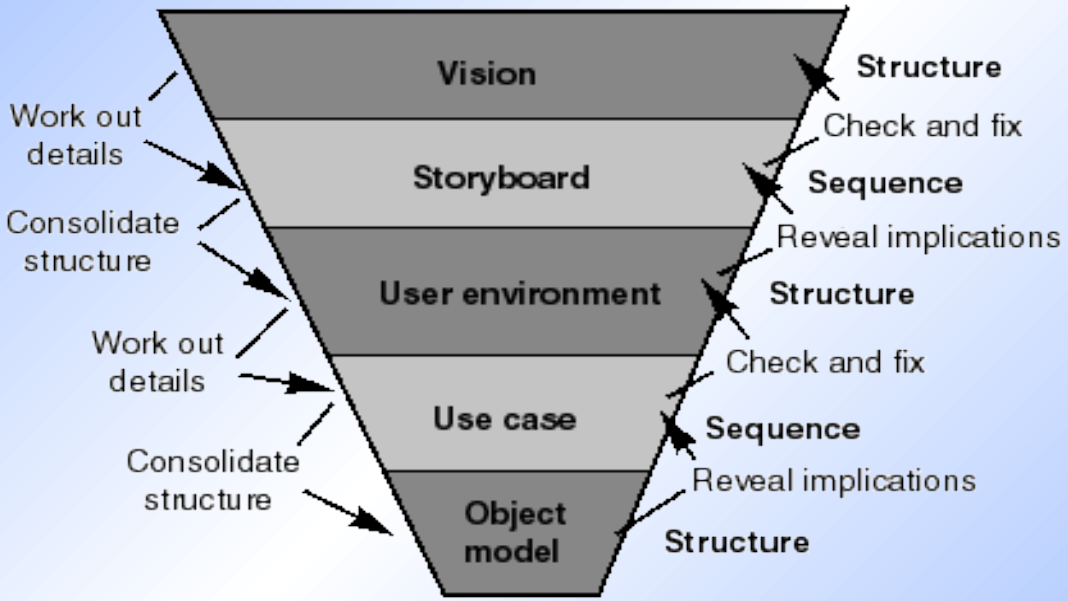
All selected and validated documents are time marked and stored with links and annotations.

The specific information is linked to the process line and locked. When information is changed, notifications are made to validate the alteration.

The Light engineer draws up principles for the light geometry based on physical conditions: use



Contextual Design. Structure and Sequence



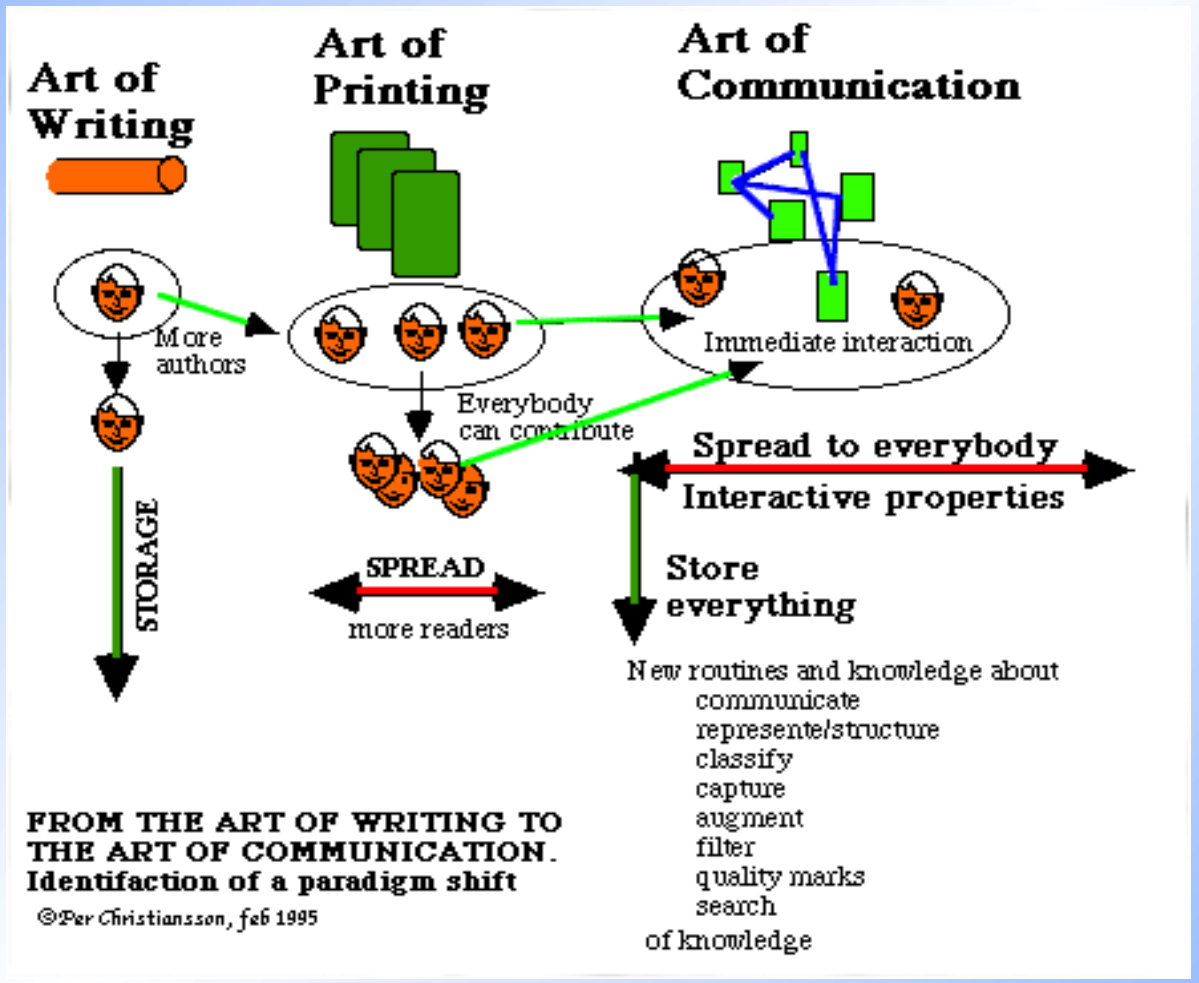
After (Beyer & Holltzblatt, 1998) figure 14.6.

Per Christiansson 9 2000

Contextual design

UML based modelling

Changing Paradigm



- Storage (representation) and Access (User Environment) media are separated
- ……..

Benefits

- Integrated products to use IFC standard
- Visualisation of technical solutions.
- Integration of multiple solutions in one distributed model.
- Presentation of complex solutions in a visual and comprehensible form.
- Improved mobility.
- Basic structure for future developments

Success Criteria

* *User participation* in User Environments and systems development The *building community* must and will actively participate in the *design*, *try out*, and *implementation* of *new IT tools* to support high quality building products in a life cycle perspective.
* Design and try out of *new tools* for collaboration, communication and information handling.
* Increased knowledge transfer and *ICT competence. Knowledge communication* crucial (companies, schools, public services).
* Increase of *awareness* on fundamentals and methods for a beneficial change of building processes and organisation (knowledge exchange and management, demonstrations, implications, participatory design).
* Increased *international* project participation.
* Basic research, applied research and development activities are *all* required.
* Utilisation of changed *communication networks* on all levels.
* Utilisation of increased possibilities to build (low cost) *Virtual Worlds/rooms* and *Virtual Buildings* (with partly redundant knowledge representations, meta data, temporal and intelligent properties).
* *Client*, building product *users, and suppliers* with greater influences in the design process.

We are all involved in a continuos change process and **design of the future** together (with constant re-assessments). Great possibilities and time to do some creative, bold, and holistic inceptions at universities/industries.