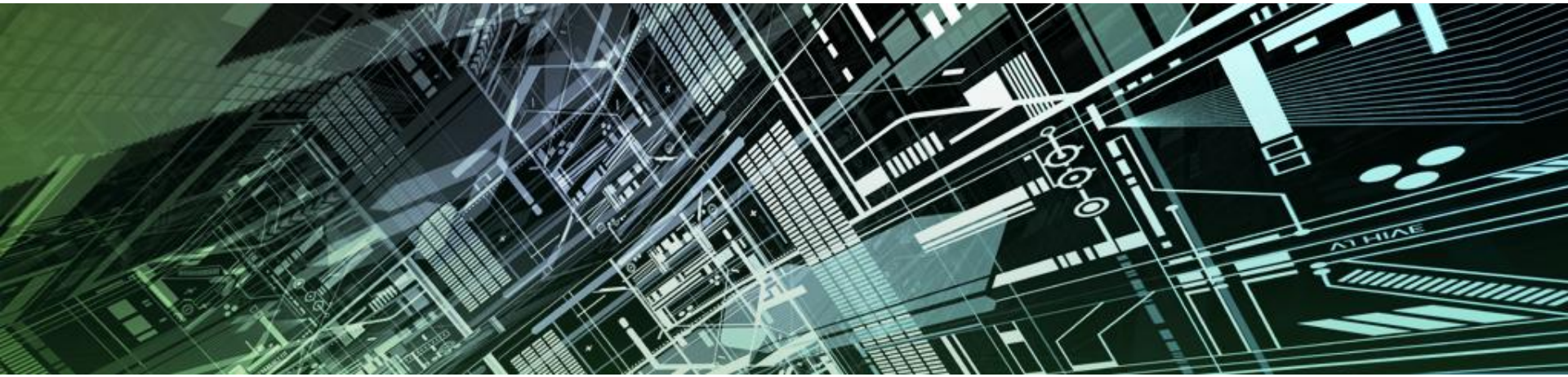
DANISH BUILDING AND PROPERTY AGENCY
Danish Ministry of Climate, Energy and Building

The Danish Digital Construction Initiative

by Civil Engineer, M.Sc., Morten Steffensen



Content of presentation

1. About the Danish Building and Property Agency
2. Why digitisation?
3. Our vision for digitisation
4. Prerequisites for digitisation
5. The Danish Digital Construction Initiative
   - History
   - The ICT-declaration
   - The Digital Foundation
   - The Danish Building Classification System (DBK)
   - What are our future plans?
6. Implementing the digital construction initiative in our own organisation
7. International statement on use of open standards in digital construction
8. Development projects in relation to DCI
9. Background for the cuneco initiative (Søren Spiele)
10. Lessons learned

The Danish Building and Property Agency

- Agency under the Danish Ministry of Climate, Energy and Building.
- Buildings central part of strategy for reducing energy consumption and CO2-emissions.

- Yearly turn-around: Approx. 530 million Euros.
- Administration of approx. 3 million m2 state properties
  - 1,3 million m2 office space (value approx. 1,6 billion Euros)
  - 2 million m2 university space (value approx. 3,3 billion Euros)
- More than 100 ongoing construction projects with a construction value of more than 1,3 billion Euros.
- Approx. 220 employees.
- Situated in Valby, Copenhagen.

- www.bygst.dk

The Danish Building and Property Agency
- new building projects

- **The Panum complex**:
  Approx. 35.000 m2 of biomedical laboratory- and educational facilities, shared facilities, cantine, auditoriums,etc.
  Value: Approx. 160 million Euros
  Year of completion: 2014

- **Niels Bohr Science Park**:
  Approx. 45.000 m2 of new laboratory- and educational facilities.
  Value: Approx. 135 million Euros
  Year of completion: 2015

The Danish Building and Property Agency
- office space administration (1,3 million m2)

- New build, rental, renovating, refurbishment and Facilities Management for:
  - Ministries
  - Agencies
  - Directorates
  - Courthouses
  - Police buildings
  - Etc.

Copenhagen courthouse

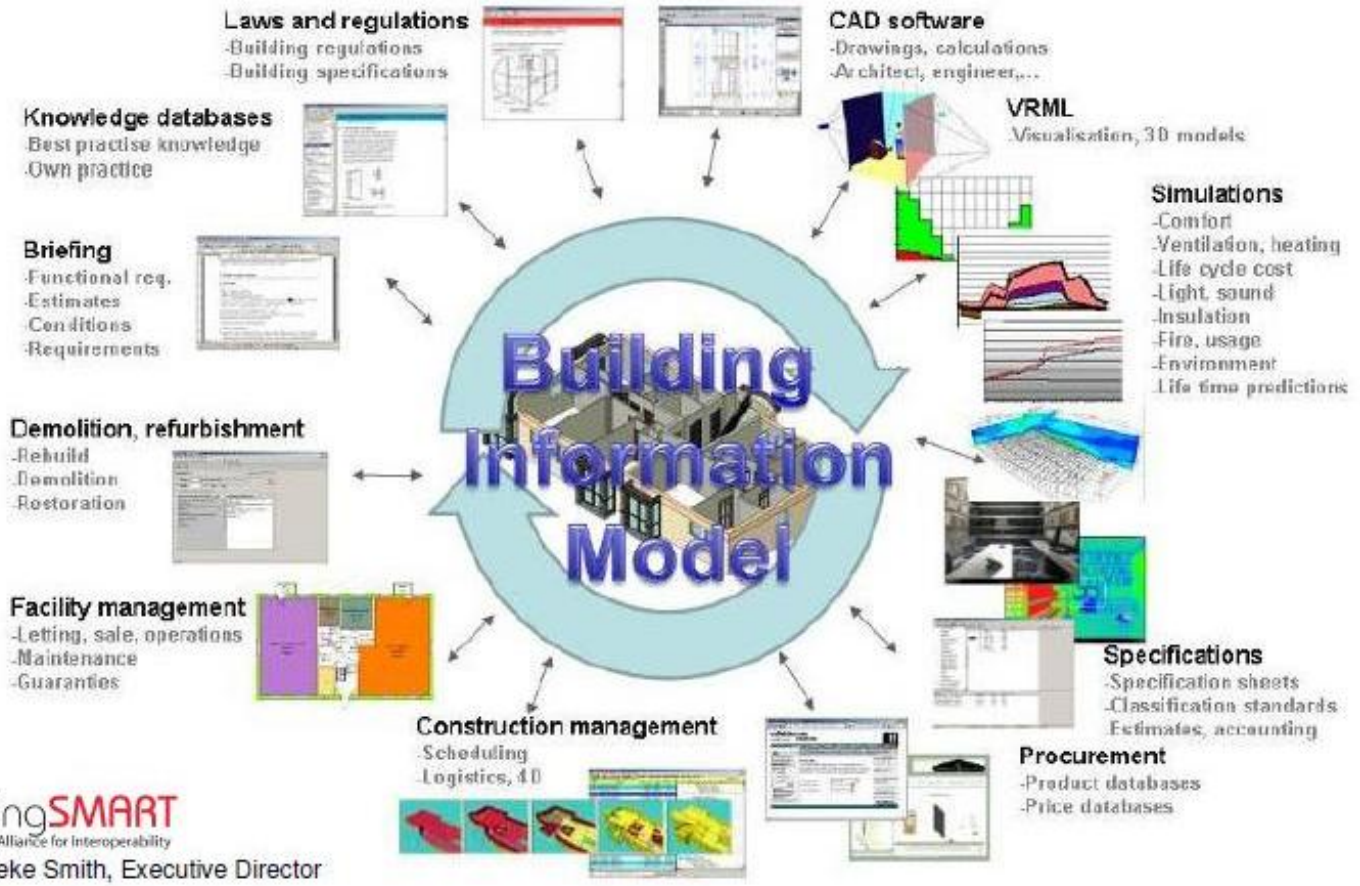

Road Directorate, Skanderborg, Denmark

Why digitise the building industry?

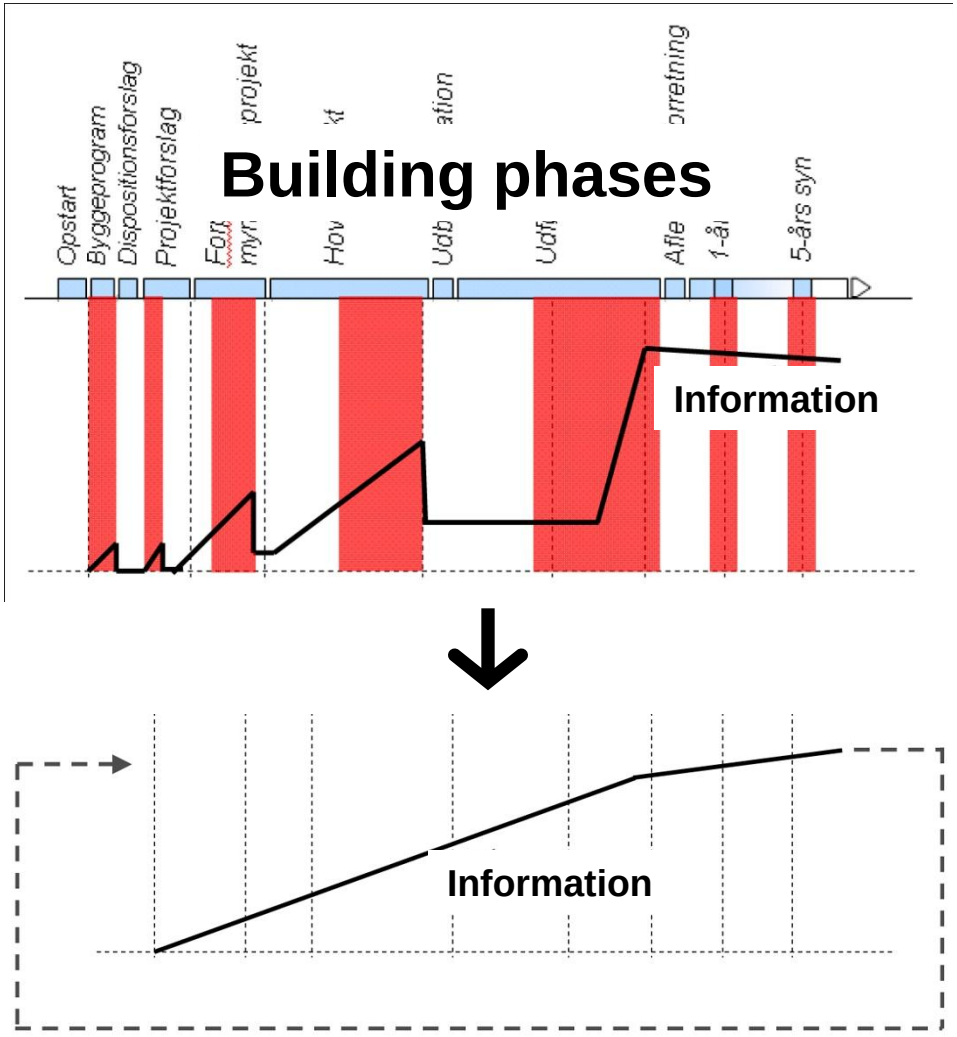
- Increase productivity and quality in our own building activities within State, Regions and Municipalities.
- Increase productivity and growth in the sector and society in general.
- Ensure that Danish companies keeps having an competitive advantage internationally and domestically.
- Improve innovation and optimisation of all design- and building phases through simulations, reuse of data, validation of data, etc.
- Ensure more effective and quality ensured building processes.
- Ensure more effective and quality ensured bidding and tendering processes.
- Ensure a better foundation for optimised, digital Facilities Management, energy efficiency and renovation of buildings.

Our vision

– the object oriented BIM as the fulcrum for digital construction and Facilities Management through the total life cycle of buildings.

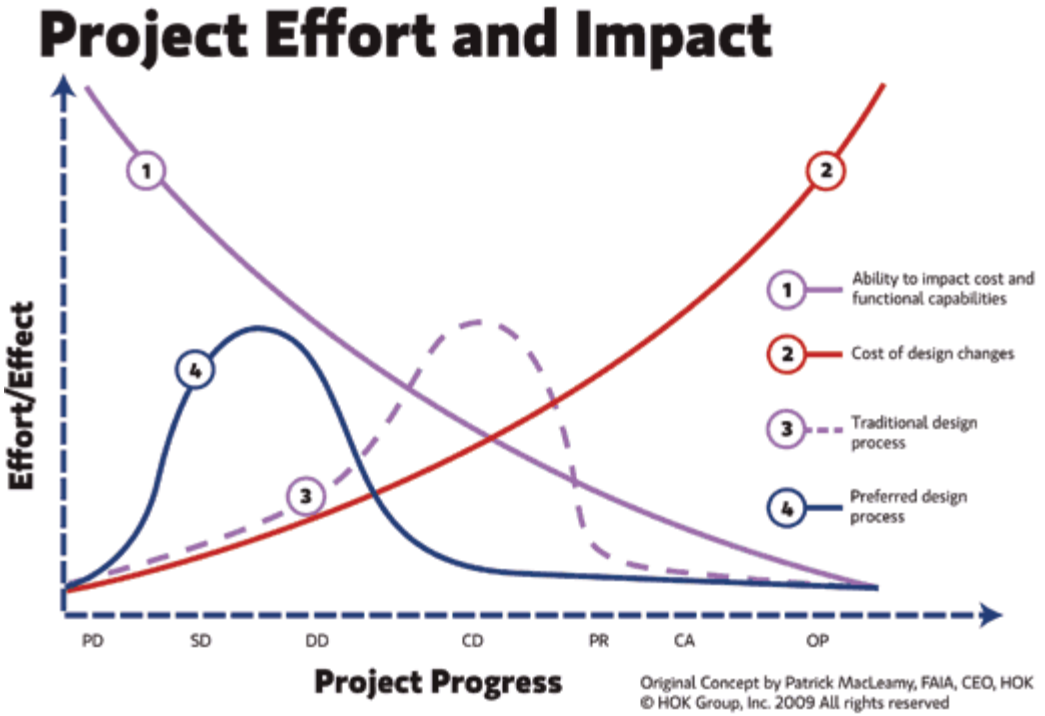


Ideal ‘data-enrichment-chain’ for building projects



BIM changes our ways of working!

- Use of BIM changes the traditional workflow.
- Creates new challenges, possibilities and business areas.
- Experiences show that 70% of all decisions have to be taken earlier.
- Proper agreements on work divisions become very important!

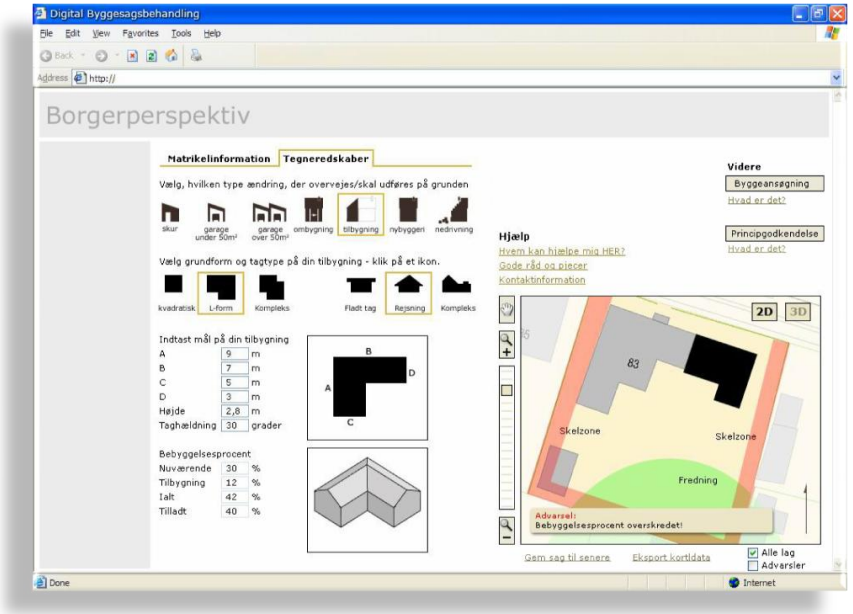


Prerequisite – digital infrastructure and incentives

- Infrastructure that ensures full and standardised, digital flow:
  - Neutral data exchange formats (IFC, IFD, IDM). Can be used through the total life cycle.
  - Classification systems (compatible)
  - Rules for taking out quantities and measurements (from BIM).
  - Properties sets for building objects (classification)
  - Information levels (level of detail of 3D-models)
- All the actors should be able to see and reap economic benefits of these actions!

Digitisation of public building permit application handling

- Big potential in avoiding slow and ‘heavy’ paper handling processes.
- Ensures more efficient, public working processes and greater transparency in public decision making.
- Provided that public authorities has the right hardware, software and competences!
- Motivates actors to work more digitally. Can for example apply by already produced BIM instead of print-outs and similar.
- BIM can help asses accessibility, fire, evacuation, shadows, distances between houses, volume, hight, noise, indoor climate etc. in relation to the Building Regulations.
- Norway + Singapore has experiences.



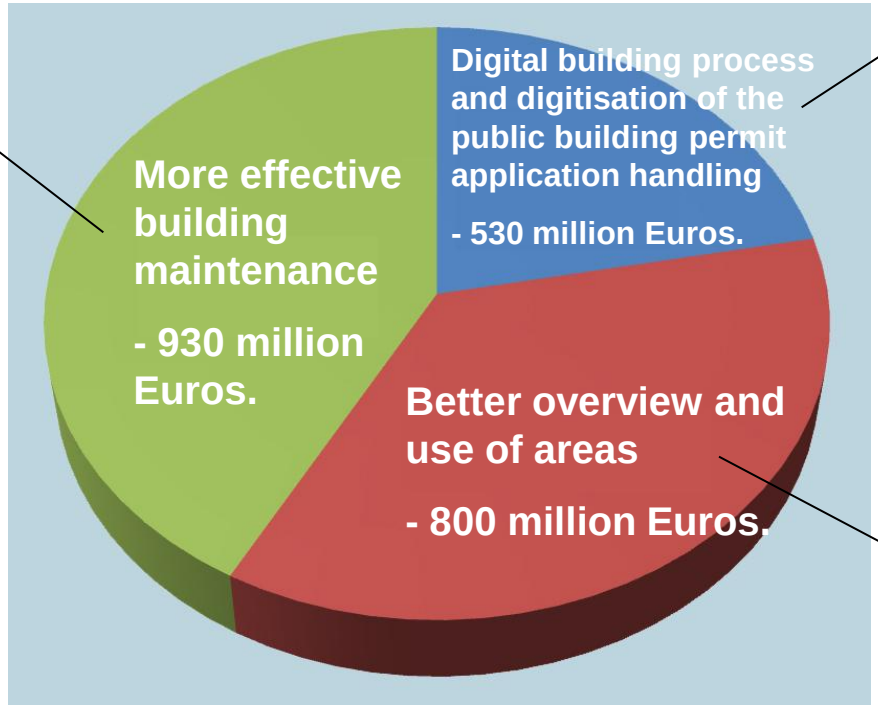
- Former Enterprise- and Construction Authority has made a 3-year demonstration project together with 6 different municipalities to show the potentials of digital, public building permit application handling. Is now being rolled out in different municipalities. Results can be seen on (only in Danish): www.byggetilladelse.boligejer.dk/

The Cowi-rapport, 2009

- Unleashed potential in the Danish society of up to 2,3 billion Euros per year, if buildings are handled 100% digitally from ’cradle to grave’. (Production value of buildings sector= approx. 19 billion Euros).

- **Who reaps the benefits?**

FM-client

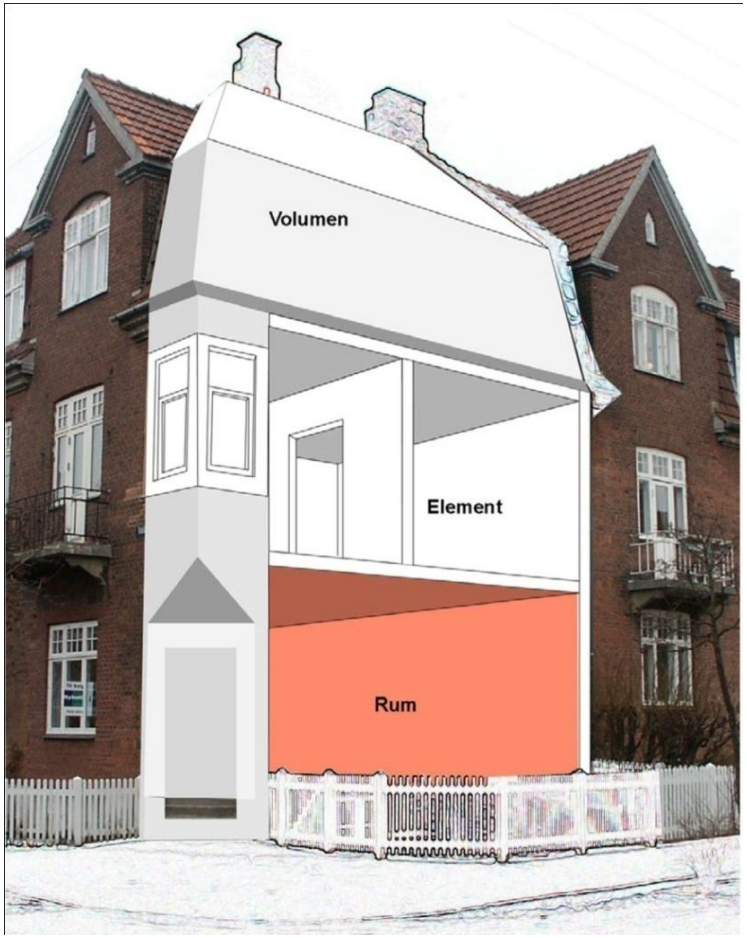


- Building Client
- FM-client
- Authorities
- Advisors
- Entrepreneurs
- Building material providers
- Insurance companies

FM-client

Digitisation of the existing building mass

- Prerequisite for reaping the economic benefits found in the Cowi-rapport.
- To what level?
- In principle an endless task!
- There is a lack of standards in this area.
- Energy renovation of existing building mass as driver for increased digitisation.
- BIM can help with energy simulations etc. on different levels to asses consequences of different initiatives.

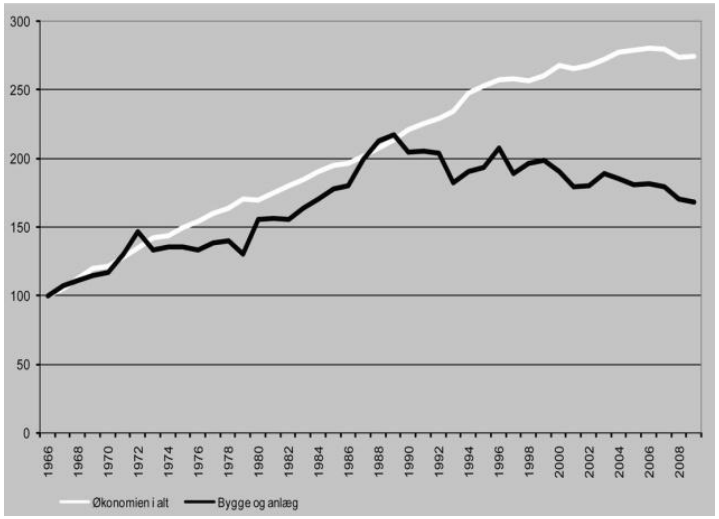


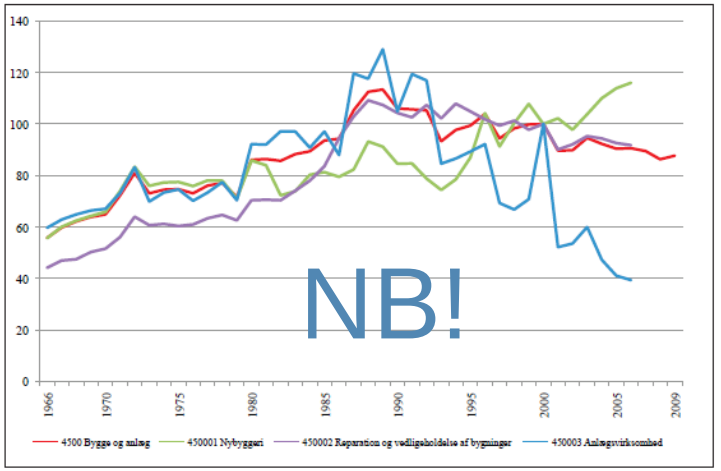
Background for The Digital Construction Initiative (DCI) 2002-2007

- Lack of increase in productivity in the building sector compared with total economy.

- Several different rapports stating:
  - Annual cost of errors, deficiencies and mistakes in the building industry amount to approx. 1,6 billion Euros per year in 2004 (10%)!

    (Production value = 19 billion Euros yearly)
  - 60% of all mistakes, errors and deficiencies in the building industry are caused by lack of poor cooperation and communication across the many different actors and building phases, which characterises the building industry (2004).
  - Potentials for increasing productivity should be found in the 'phase-shift-situation'.
  - ICT-readiness in DK is generally high, but there is a lack of coordination between the actors of the industry, which requires a massive, coordinated effort concerning establishing and standardising the ICT-infrastructure.





Kilde: Danmarks Statistik, tabel NAT23.

The economic foundation

Approx. 5.3 million Euros in total:

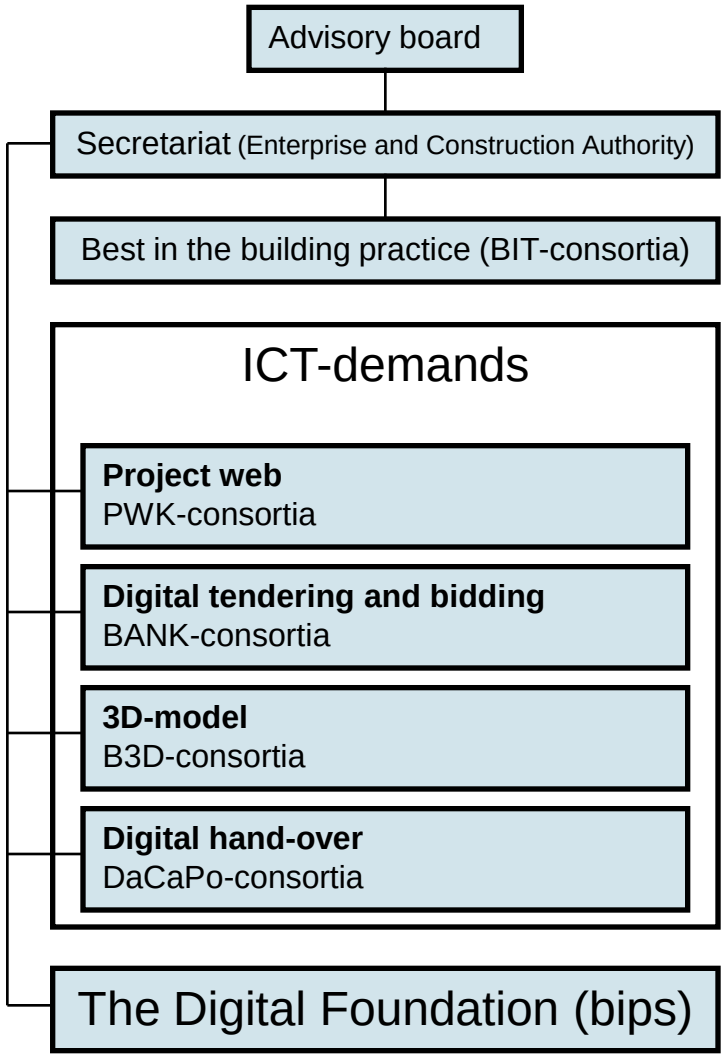
- State funds - 2.7 million Euros.
- Private fund, Realdania – 1.3 million Euros.
- Private financing by participating actors – 1.3 million Euros.

The Digital Construction initiative 2002-2007

Strategy by Danish Enterprise- and Construction Authority :

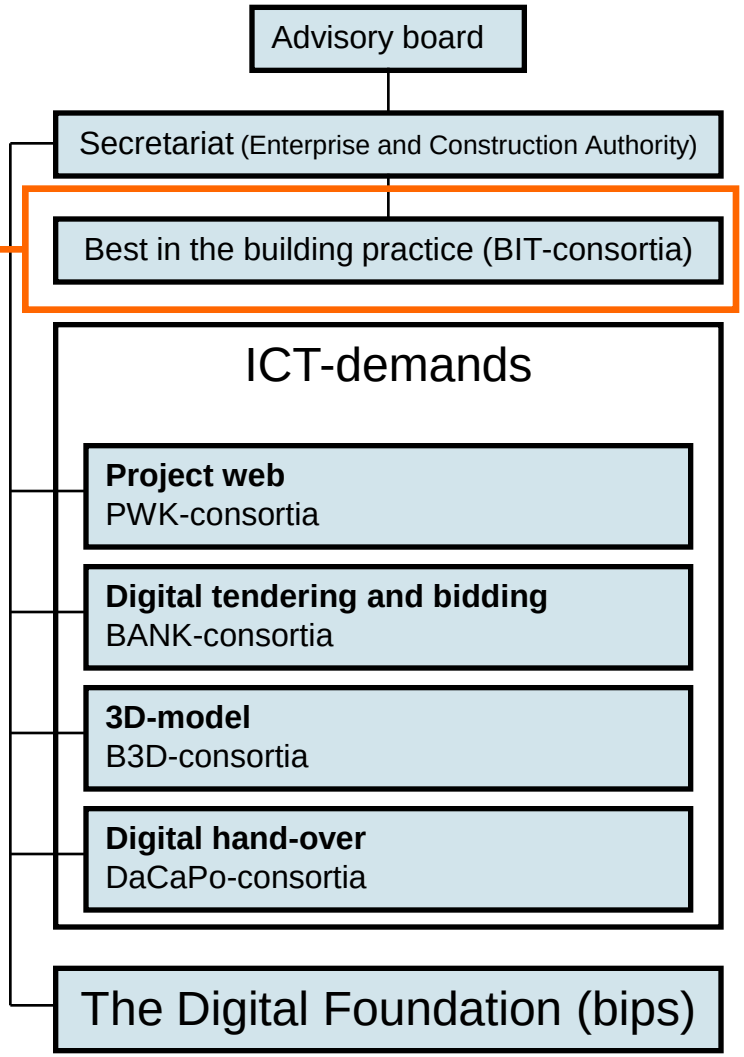
- To develop a foundation of common/shared ICT-standards and guidelines in connection with digital construction projects.
- Implement them on state building projects and through demands to state suppliers.
- The State as 'locomotive' for the promotion of digital standard, methods and tools.
- Development of best-practice examples.

- 4 consortias developed the ICT-demands from 2004-2006
- bips developed "The Digital Foundation".

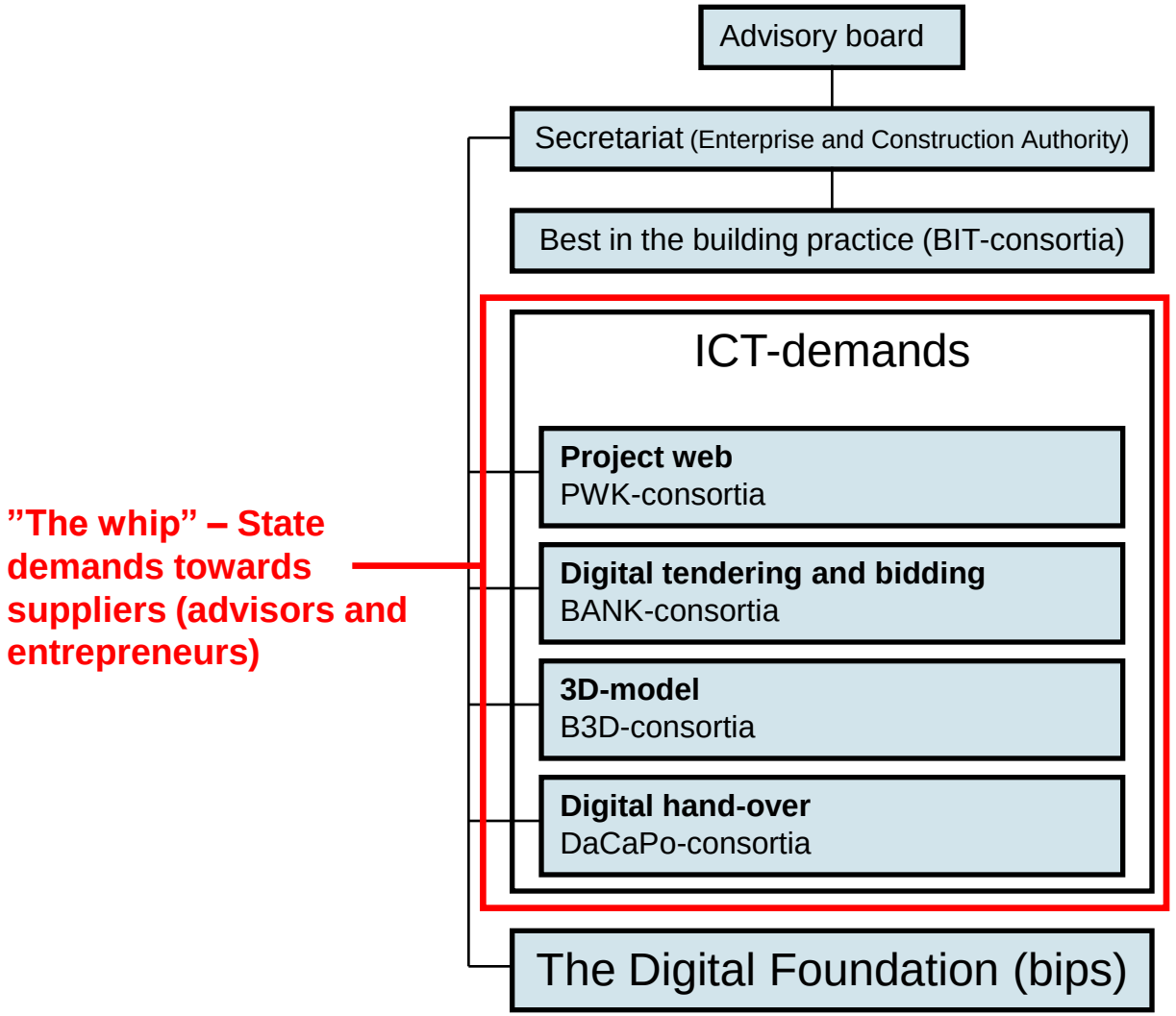


The Digital Construction initiative 2002-2007

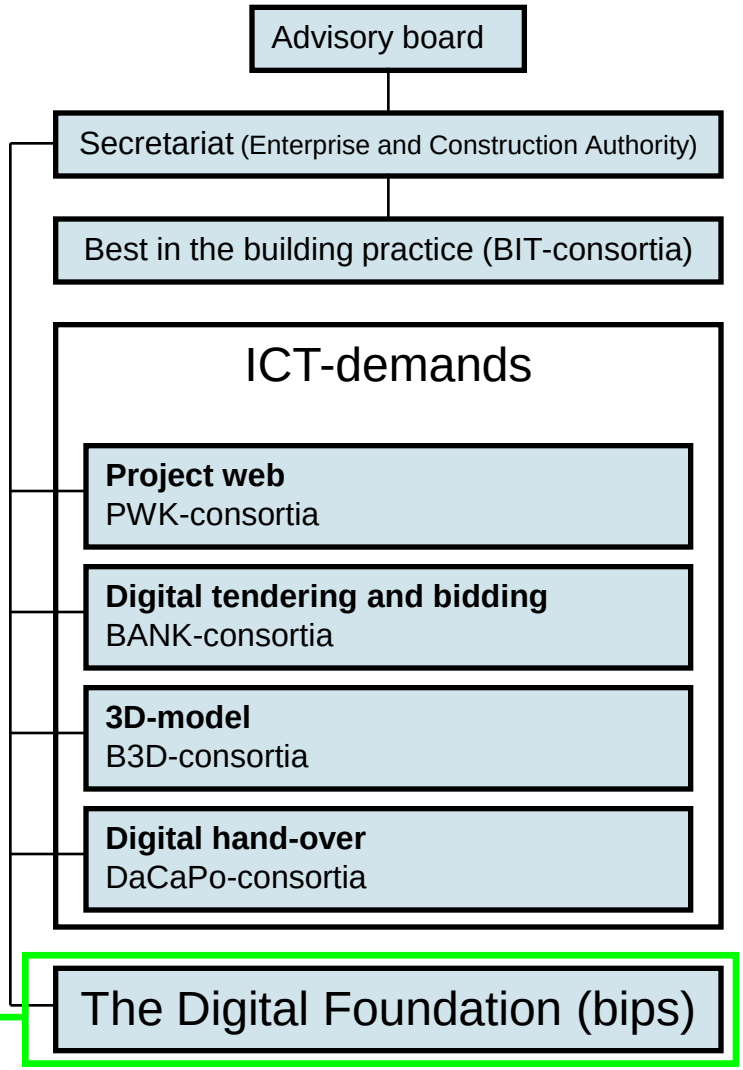
”The carrot” – 17 best-practice cases, 5 concerning 3D-models



The Digital Construction initiative 2002-2007



The Digital Construction initiative 2002-2007



"The Foundation" – common standards, methods and guidelines

(Danish Building Classification System, 3D working method, etc.)

The ICT-declaration – 1st of January 2007

Sets up demands within 5 main areas:

1. The Danish Building Classification System (or classification based on ISO 12006-2)
2. Use of project web-system for exchange of digital information on building projects
3. Use of 3D-models (BIM) in competitions, design and construction.
4. Digital bidding and tendering (based on 3D-model)
5. Hand-over of relevant, digital information at the end of the building process

- Data exchange should be done as a minimum by use of the IFC-format.

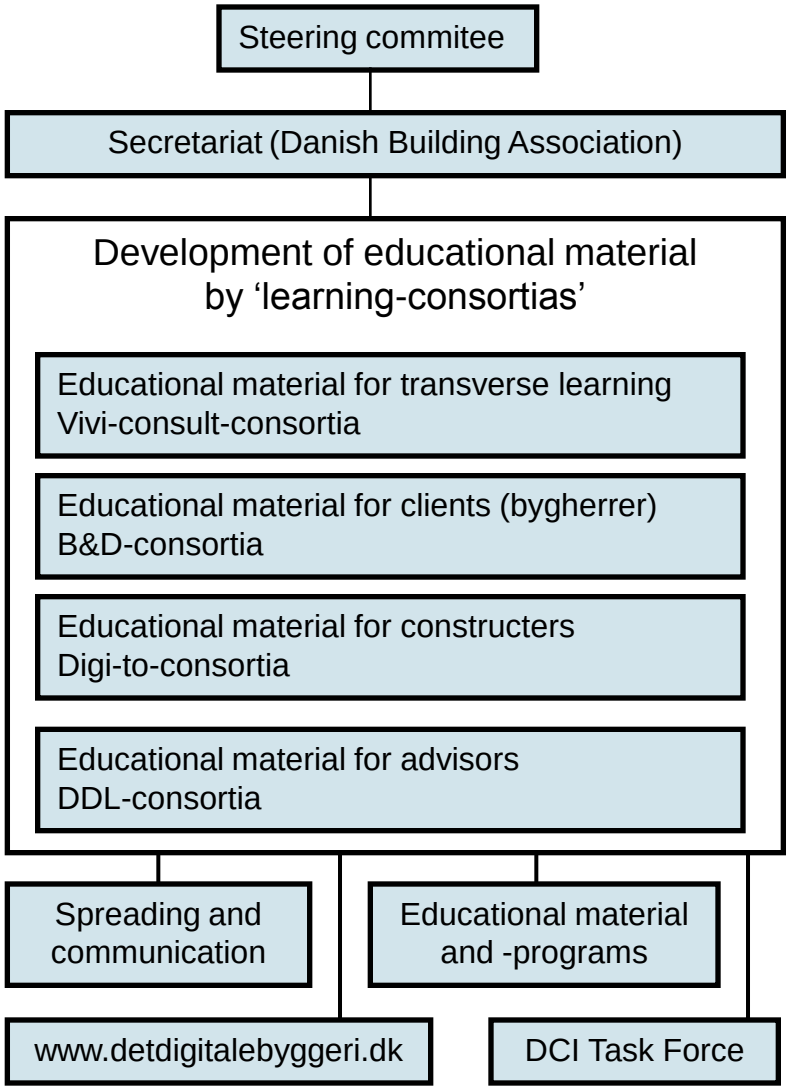
Who is affected?

- All State building projects above 666.667 Euros.
- All types of building projects – new build, additions, renovating, maintenance and related infrastructure.
- New, Regional hospital-projects for the value of approx. 5,6 billion Euros (receives subsidies from the State of more than 50 pct. of the building sum)

- **About to be implemented towards regions and municipalities.**

The Implementation Network for DCI 2007-2010

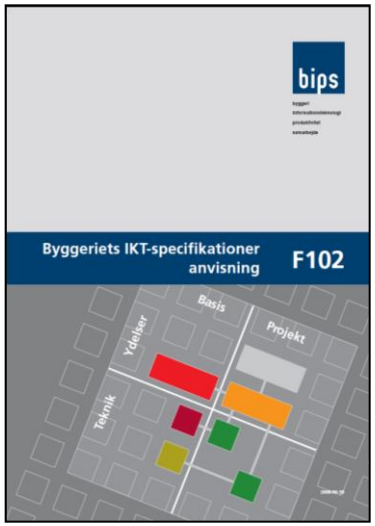
- Established in connection with launching the ICT-declaration
- The sector itself takes on the responsibility of spreading the results of DCI to the companies of the building sector.
- Tasks:
  - Testing of standards on ‘real-life’ projects,
  - Implementation of 3D-software
  - Development of manuals
  - Education of staff, etc.
- www.detdigitalebyggeri.dk
- Activities was given over to Cuneco 1st of March 2011.

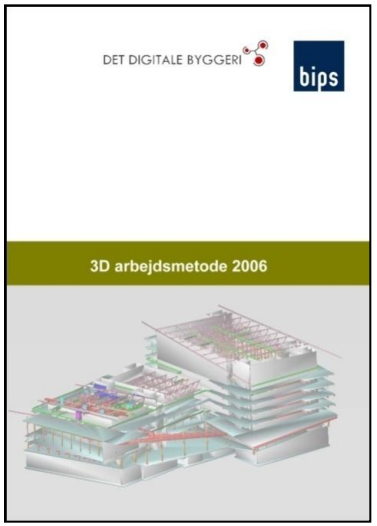


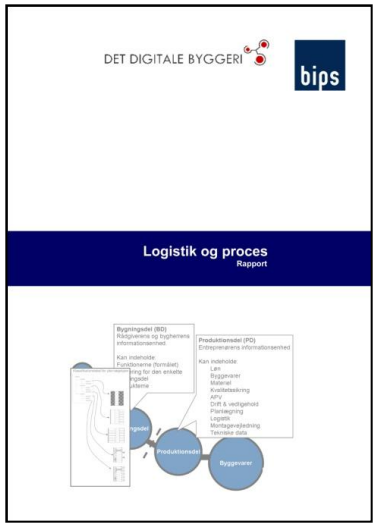
The Digital Foundation by bips

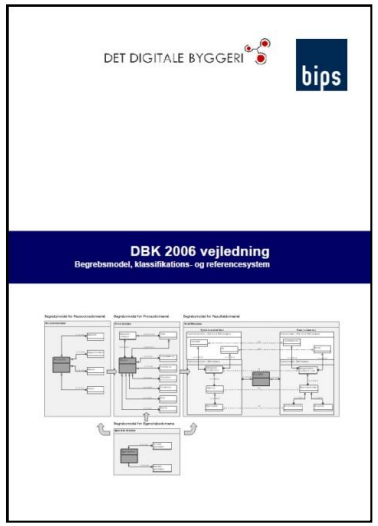
- Bips – non-profit membership organisation with approx. 550 members. Supports its members (and the public) with different standards and tools in relation to digital construction.

- The Danish Building Classification System (DBK) – 8 guides and 29 classification tables.
- 3D working method – how do you work with 3D-models?
- Logistics & Process – What digital information does the entrepreneurs need, etc.?
- ICT-specifications – guides that help define agreements between the actors concerning digital deliveries.



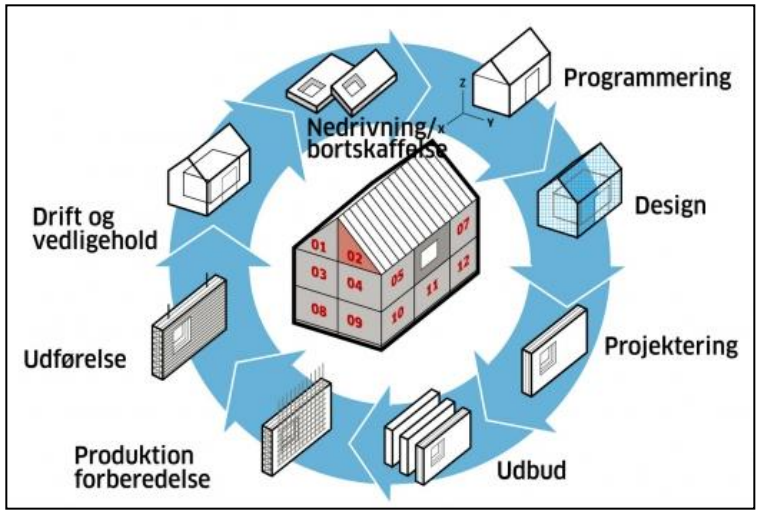


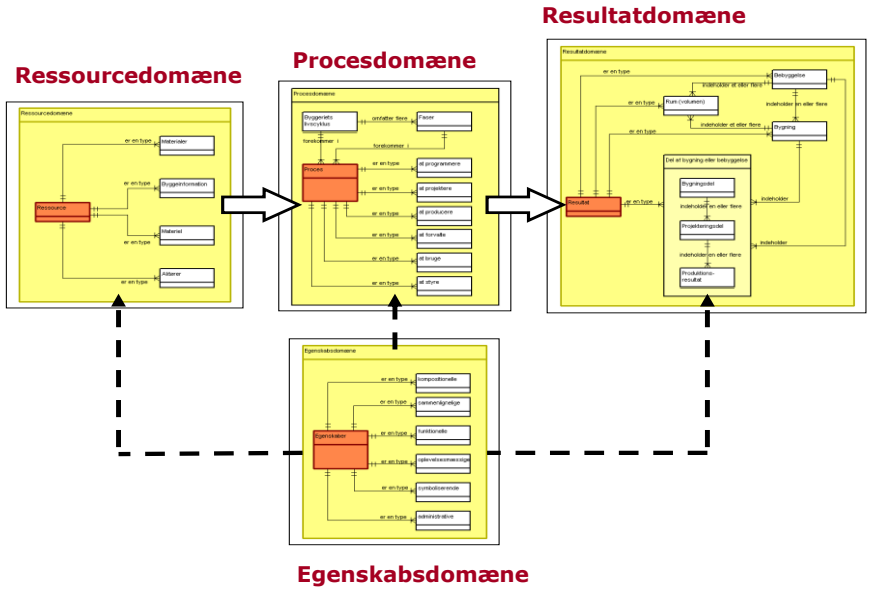




The Danish Building Classification System (DBK)

- Necessary for seamless exchange off data trough total life cycle.
- Classifies building objects, actors, processes, property sets (FM).
- Should work both ‘inside’ and ‘outside’ of BIM-software and 3D-models!
- Based upon the international ISO-standard ISO 12006-2 and the electro-technical ISO-standard ISO/IEC 81346.
- ISO 12006-2 base for many different, national classification systems (OmniClass, BSAB, etc.)





The Danish Building Classification System (DBK)

Combines

'Classical' classification (type-of) with reference system (part-of).

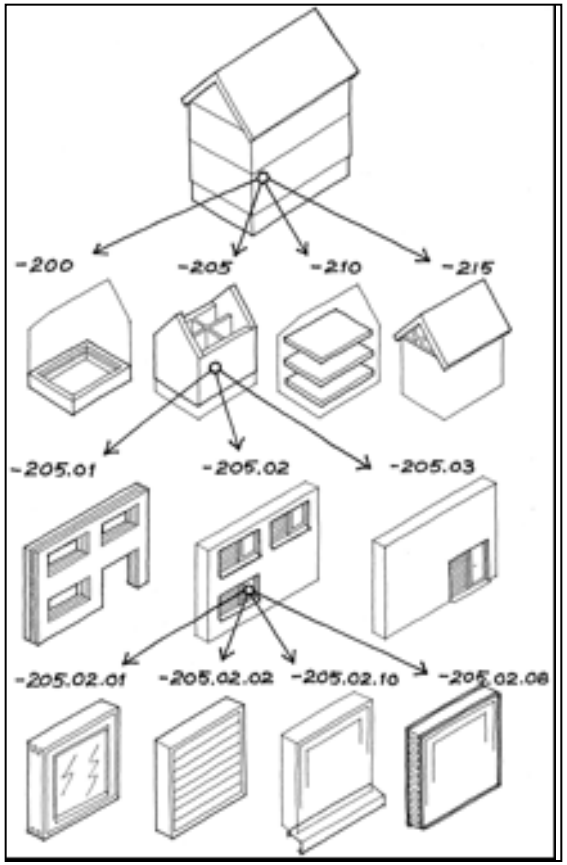
DBK-tabel 25: Bygningsdele, forekomster i produktaspektet | Rev., Dato | : A, 2006-12-01

Alle niveauer

-100	Terræn		
	01	Jordprofil	
		01	Udgravning
		02	Fyld
		03	Sænkning
		04	Hævning
		05	Dræn
	02	Befæstet areal	
		01	Beklædning
		02	Bærelag
	03	Beplantning	
-200	Fundamentsystem		
	01	Fundamentkonstruktion	
		01	Søjle
		02	Bjælke
		03	Plade
		04	Gitter
		05	Samling
		06	Membran
		07	Isolering
		08	Beklædning
		09	Overflade
	02	Bærelag	
	03	Åbning	
	04	Lukning	
	05	Inddækning	
	06	Afslutning	
	07	Afskærmning	
	08	Fuge	
		01	Stopning
		02	Fugemasse
	09	Samling	
	10	Overflade	
-205	Vægsystem		
	01	Vægkonstruktion	
		01	Søjle
		02	Bjælke

Topniveauer i DBK tabel 25 med "produkaspektet

-100	Terræn	
-200	Fundamentsystem	
-205	Vægsystem	
-210	Dæksystem	
-215	Tagsystem	
-300	Vandsystem	
-305	Afløbssystem	
-310	Gas- og luftsystem	
-315	Kølesystem	
-320	Varmesystem	
-325	Ventilationssystem	
-330	Belysningssystem	
-335	Adgangssystem	
-340	Elforsyningssystem	
-345	Automationssystem	
-350	Beskyttelsessystem	
	01	Udligningsforbindelse
	02	Katodisk beskyttelse
	03	Jordingsanlæg
	04	Lynbeskyttelsesanlæg
		01 Indfanger
		02 Nedføring
		03 Jordingsanlæg
	05	Transientbeskyttelse
-355	Transportsystem	
-360	Kommunikationssystem	
-365	Brand- og alarmsystem	
-400	Inventar	
-500	Sammensat bygningsdel	
-600	Reserveret til fremtidige udvidelser	
-700	Reserveret til fremtidige udvidelser	
-800	Reserveret til fremtidige udvidelser	
-900	Projektspecifik bygningsdel	



The Danish Building Classification System (DBK)

Working description/ description of building components

DTU Campus Service, Plan og Projekt — Ny bygning 328 for DTU Space

Dato : 09.11.2010
Rev.dato :
Side : 40/105

Arbejdsbeskrivelse - arkitektprojekt
4. Bygningsdele

Udarbejdet: OBP Kontrolleret: HHO Godkendt: PR

Tømrerarbejdet

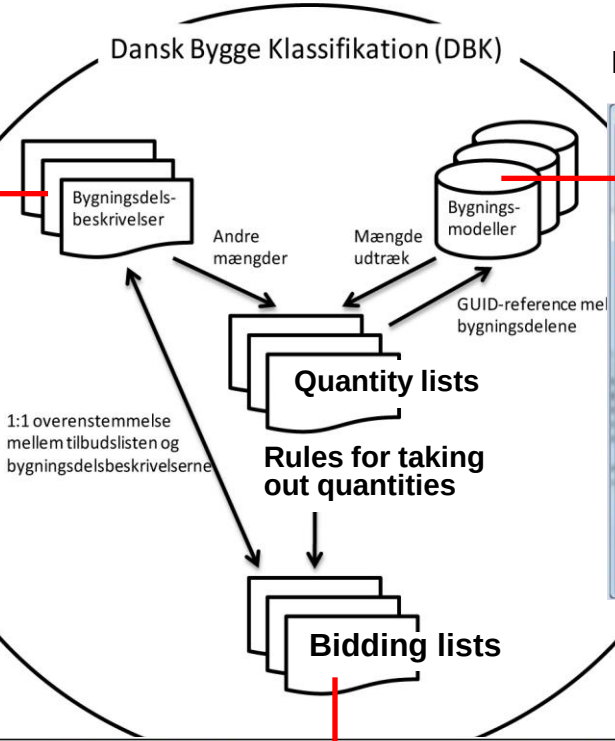
TØM -205.01001 Let indervæg, gips

4.1 Orientering

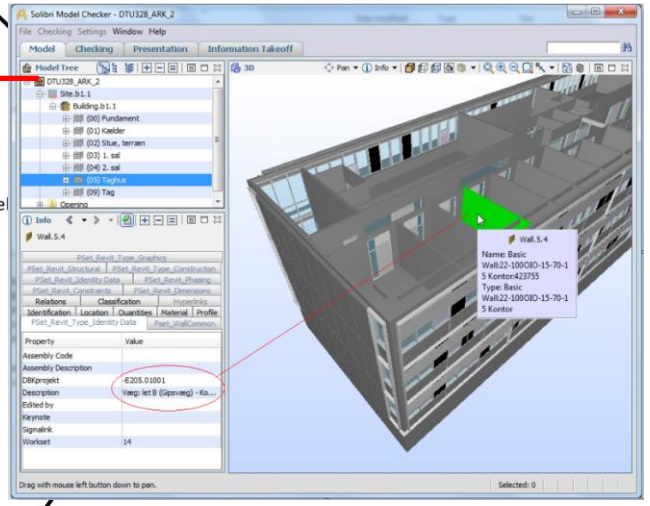
Gældende for denne bygningsdel er:
bips B218, Basisbeskrivelse – skeletkonstruktioner.
bips B2.270, Basisbeskrivelse - træ generelt.
Gipsmontage og overfladebehandling 4. udgave, Dansk Byggeri.

4.2 Omfang

- -Let støvvæg, bygning 327.
- -E205.01001 Let indervæg, rum og skakte (generelt).
- -E205.01002 Let indervæg, renrum.
- -E205.01003 Let indervæg, skørt (på kant af loft ved ovenlys).
- -E205.01004 Let indervæg, skørt (på kant af loft ved glasfacade).
- -E205.01005 Lette indervægge, fodlister.
- -E205.01006 Let indervæg, brystning.
- -E205.01007 Let indervæg, forsatsvæg (kælder, taghus, gavl 327).
- -E205.01008 Let indervæg, sokkel for ovenlys.
- -E205.01009 Let indervæg, væg over mobilvæg og skydedøre.
- -E205.01010 Let indervæg, indklædning stål.



Building component in BIM



Navn: Ny bygning 328, DTU Space — Dato: 09.11.2010
Sagsnr: 8454A327A — Rev:
Tilbudsliste: E4 Inventar — Side: 15 af 82

Post nr.	Arbejde/Ydelse	Enhed	Antal	Enh. pris	Sum
	Overført fra forrige side				kr. .....
	E205.01001 Let indervæg, rum og skakte (generelt).	m²	1.837	.....	kr. .....
	E205.01002 Let indervæg, renrum.	m²	313	.....	kr. .....
	E205.01003 Let indervæg, skørt (på kant af loft ved ovenlys), højde 600mm	lbm	22	.....	kr. .....
	E205.01004 Let indervæg, skørt (på kant af loft ved glasfacade).	lbm	29	.....	kr. .....
	E205.01005 Lette indervægge, fodlister.	lbm	1.058	.....	kr. .....

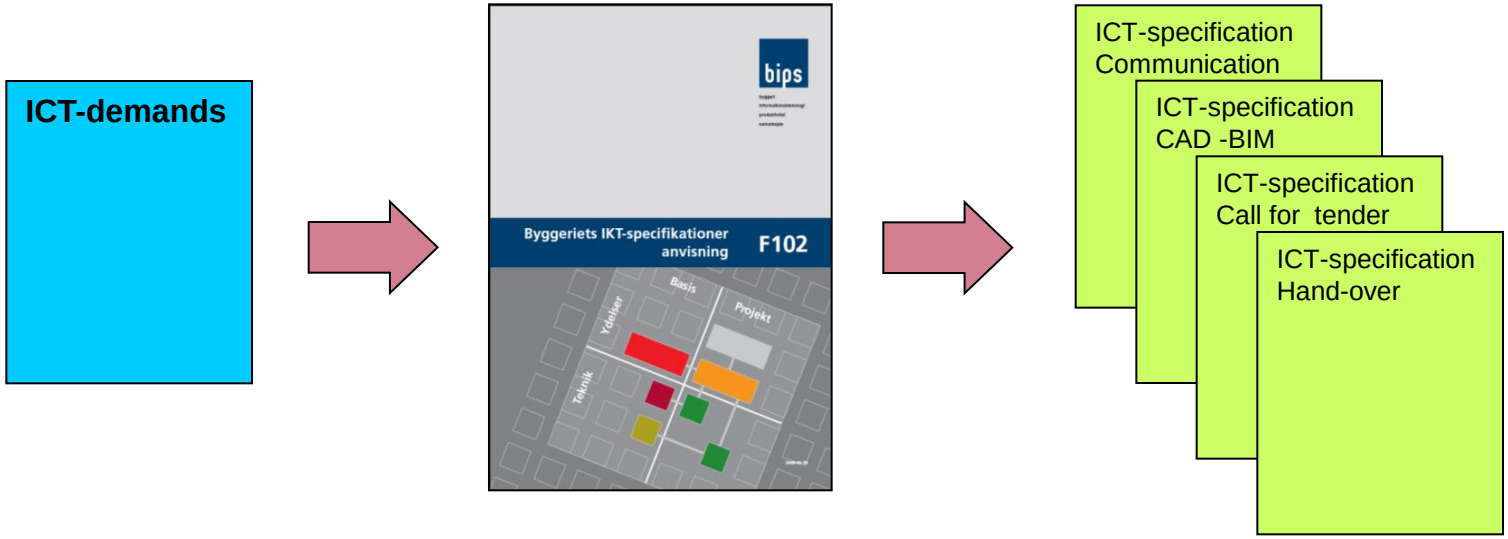
The Danish Building Classification System (DBK)

- Is currently under revision by Cuneco
  → will be Cuneco Classification System (CCS).

- ISO 12006-2 is currently also being revised.
  Goal: To complement with 'part-of'-classification, inspired by Danish revision process (2010-2011).

How do we implement the ICT-demands in our own organisation?

- Project specific ICT-specifications as additions to main project contract. Filled out by advisors and contractors.
- Stipulates the digital services expected from the design team and contractors.



Declaration on use of open standards in digital construction projects

- Agreed, intentional statement to support the continuing development and implementation of open BIM.
- In extension of BIM Umbrella Statement from 2008.
- As driver for innovation, increased productivity, quality and sustainability in building process and Facilities Management.
- Not legally binding.
- Supports international BuildingSmart-standards (IFC, IFD, IDM, MVD)
- Signed by Finland (Sentate Properties), USA (GSA), Norway (Statsbygg), The Netherlands (Rijksgebouwdienst), Iceland (GCCA), Mexico (INDAABIN), Estonia (SRE) and Denmark (BYGST)
- Diminishes dependency on software vendors (non-private data formats).
- Ensures archiving and reuse of data through total life cycle
- Especially of interest for public authorities.

Ongoing development projects in relation to the Digital Construction Initiative

- **“Measuring the economic benefits of the Digital Construction Initiative”**
  - by the Technical University of Denmark and Copenhagen Business School
  - Deadline: Just finished
  - Budget: Approx. 160.000 Euros

- **“From paper to BIM” and “BIM for Facilities Management”**
  - by the Danish Association of Construction Clients
  - Deadline: End 2012 (both).
  - Budget: Approx. 135.000 Euros each.

- **Making digital tendering and bidding more effective for the entrepreneurs.**
  - by the Danish Construction Association
  - Deadline: Momentarily
  - Budget: Approx. 55.000 Euros

Cuneco – centre of knowledge for increased productivity and digitisation

- 2008: Lots of critic in public press, especially from ‘DiKon’, stating:
  - Implementation of tools, standards and methods did not happen at the anticipated speed.
  - DBK was not yet developed to an extent where it was suitable for IT-implementation (reference system in conflict with software)
  - Classification system does not make sense, unless it is fully IT-implemented!
  - State builders were having difficulties implementing the rules.
- In the fall of 2009 the former Enterprise- and Construction Authority made an open bid for the establishment of a knowledge centre - mainly funded by the EU Regional Fond, which were to take care of the following:

Cuneco – centre of knowledge for increased productivity and digitisation

Formal demands:

- **Establish a digital infrastructure for the whole life cycle of building**
  - Covering all phases of the building process
  - Focus on the areas that increases productivity the most
  - Gives most value for the users across the whole value chain of the building

- **Ensure IT-implementation in relevant software and spreading of Danish standards internationally**
  - Ensure that central standards are suited for it-implementation in relevant software
  - Ensure that the digital infrastructure works in practice
  - Strengthen Danish companies competitiveness abroad
  - Ensure that central standards functions together with international standards, as well as together with other countries national standards

- **Spreading of knowledge and educational material**
  - Practise-oriented educational material with the aim of upgrading relevant actors knowledge about digital working methods and tools
  - Develop specific and easy-to-use, best-practice manuals
  - Make all develop results accessible to all of the actors in the building sector

- **Implementation in the building sector**
  - Give expert- and economical support to testing of central standards
  - Make exchange of findings possible across all actors and phases of the building sector

- **The development project should be:**
  - Independent of interests of specific actors
  - In a strong partnership between knowledge institutions and the businesses

Cuneco – centre of knowledge for increased productivity and digitisation

Specific demands (before 2014):

- Developed DBK into 'the winning standard' for the Danish building sector
- Should be able to be implemented into the relevant software
- Finish development of the rules for taking out quantities of 3D-models (connected with DBK)

In their application the network themselves added:

- Development of Property sets
- Development of Information levels

Partnership network:

- Bips (lead), Aarhus Engineering School (Aarhus University), Danish Standards
- Organisational network: Danish Association of Architectural Firms, Danish Association of Consulting Engineers, The Danish Construction Association, Danish Mechanical and Electrical Contractors Association (TEKNIQ), and the BAT-cartel (Association of wood industry actors).

Financing:

- Approx. 9 million Euros in total.

  50% from the EU Regional Fund, 25% from EBST, 12,5% Realdania and 12,5% own financing.

Lessons learned

- Have the proper funding in place before starting initiatives.
- For example: Don’t launch a classification system, unless it is fully developed and able to be implemented in the relevant software.
- Digitisation affects just as much the way building activities are organised and conducted. It is not only about implementing new technology, but also adjusting organisations!
- Therefore: Make sure that the legal foundation (agreed, binding, legal documents, etc.) is suited or adjusted for the implementation of the new technology.
- Take a critical look at the way money is shared on a building project. Some actors have to do a lot of new work (building BIM models, etc.), while others reaps the benefits more easily (FM-phase).
- The public domain can be an central driver, but it is the private actors that should be the main drivers.
- Have focus on the **drivers/motivation** for implementing the new, digital technology. There are no benefits in the technology itself, but only in the things you can do with it!