AALBORG UNIVERSITY

Building Informatics

Produkt og Procesmodeller (PPM) i byggeriet.
Product and Process models in Construction.

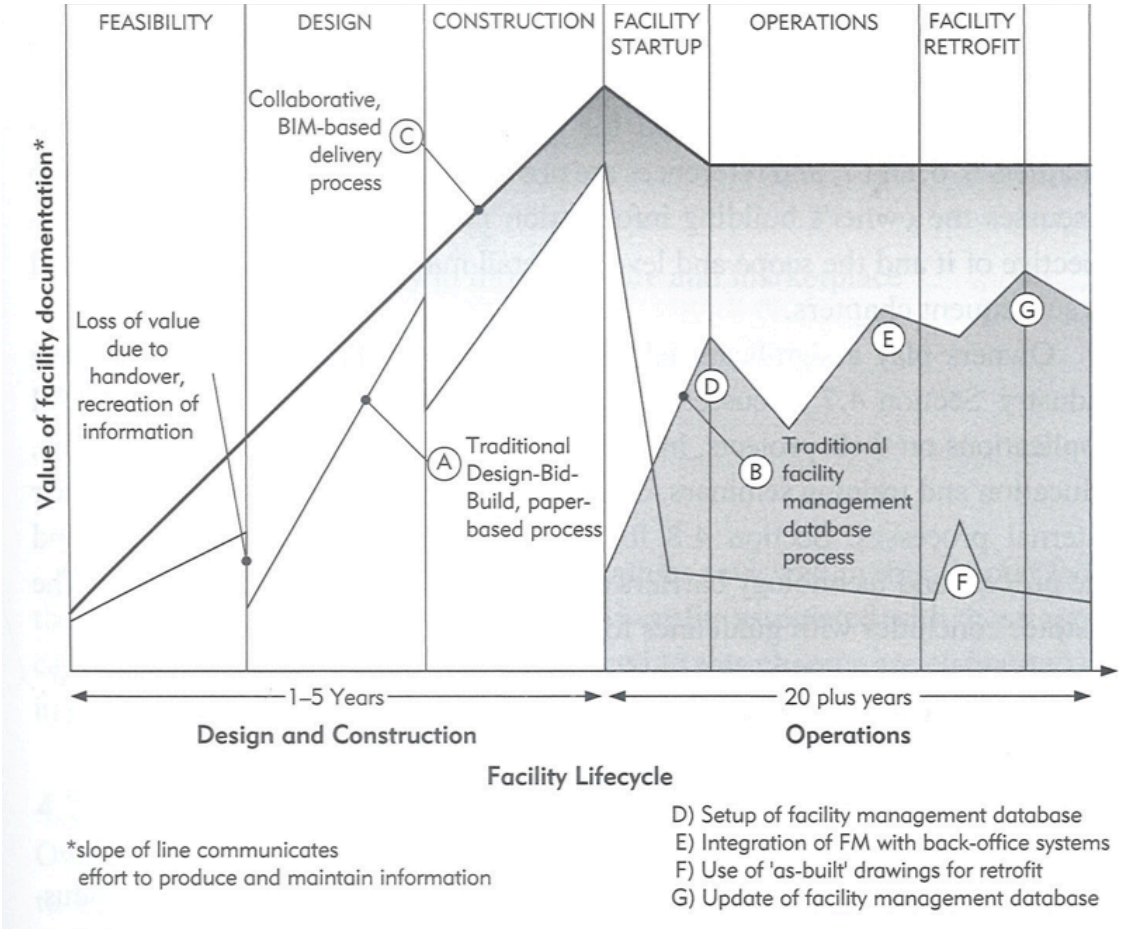
3. BIM for Owners and Facility Managers.

Cand. Scient. Bygningsinformatik.
Semester 1, 2010.

CONTENT

- Potential and barriers
- BIM Application areas for Owners
- How owners build
- BIM Tool Guide
- Building Model (DACaPo)
- Bygherrekrav
- Barriers
- Guidelines for adopting BIM

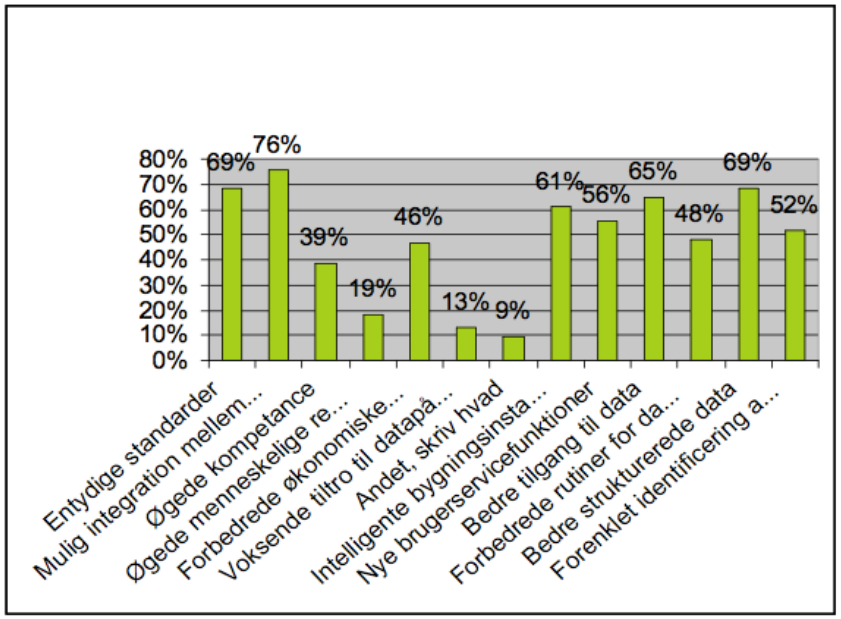
From the BIM handbook. Why owners should care about BIM



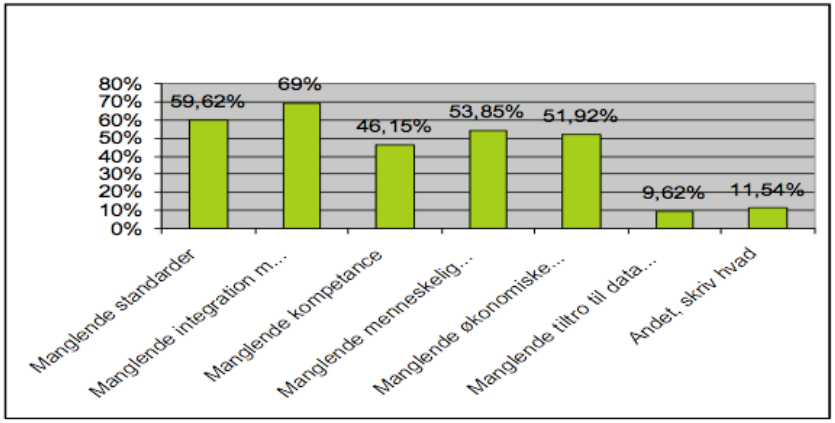
A) Traditional single-stage drawing-based deliverables, B) traditional facility management database system, and C) BIM-based deliverables throughout the project delivery and operation process.

Potentialer Barrierer. DACAPO

Figur 1. Potentialer ved en øget IT anvendelse i fremtiden

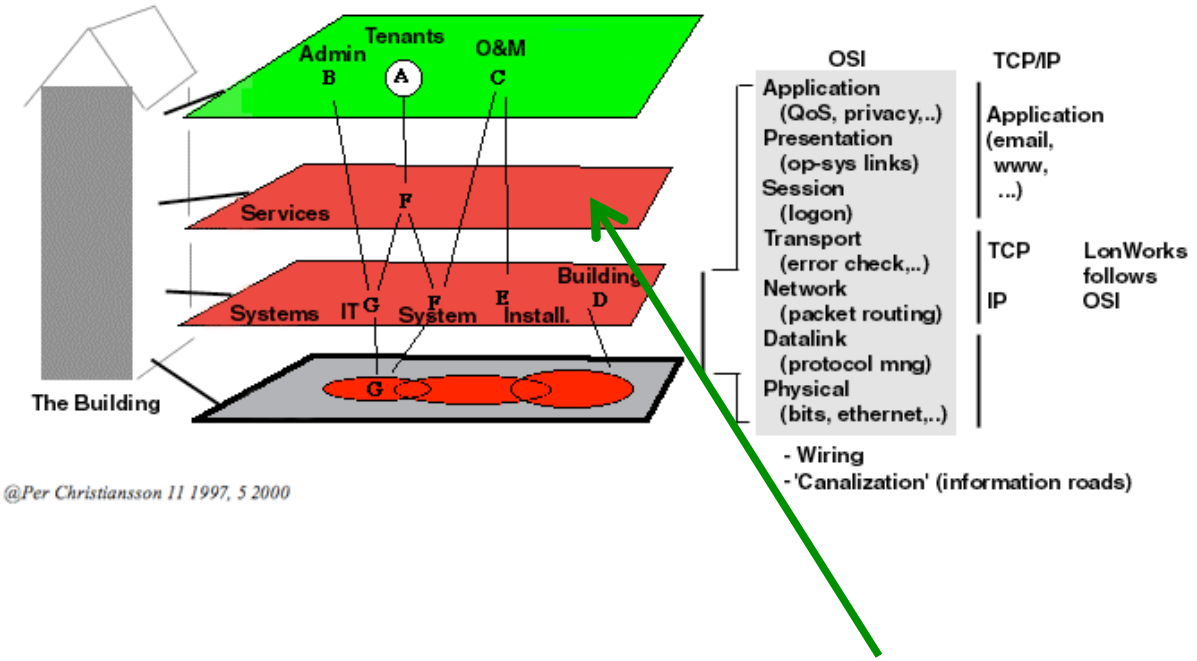


Figur 2. Barrierer for en øget IT anvendelse i fremtiden



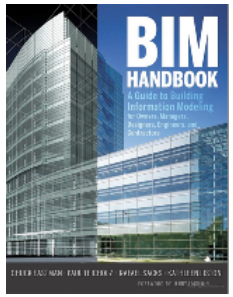
Undersøgelse blandt byningsforvalter (54 svar).
Fra “Potentialer og Barrierer. Byggherrekrav - Digital Aflevering”. DACaPo konsortiet. December 2004. (43 pages).

ICT Enhanced Building Potentials



The Intelligent Building systems gives possibiblities to develop new services in buildings. From (Christiansson, 2000) and (Christiansson, 2007)

From the BIM handbook



4.4 BIM Application areas for Owners (p.96)

"Many owners view construction as relatively small capital expenditure compared to the lifecycle costs or other operational costs that accrue over time"
[One great benefit of the DDB program is raise client attention (and competence) to possible benefits of using BIM. Client and operators may though have different motives]

Drivers
- Cost reliability and management
- Time to market [planning, prefabrication, 4D, re-planning]
- Increasing complexity in infrastructure and marketplace [Coordination 3D-MEP, code-checking, litigation prevention]
- Sustainability [energy efficiency, improve operational productivity]
- Labor shortage
- Language barriers
- Asset management

From the BIM handbook.

4.2.1 Cost Reliability and Management

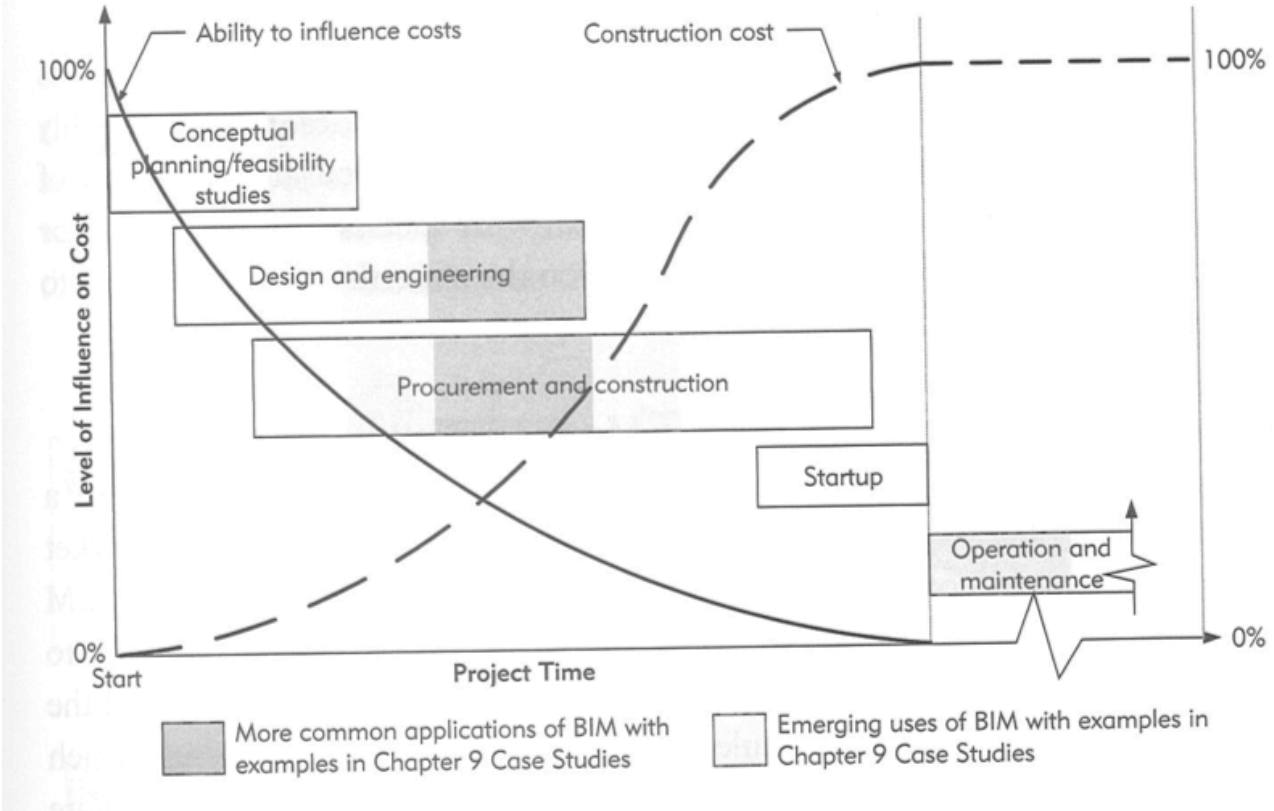
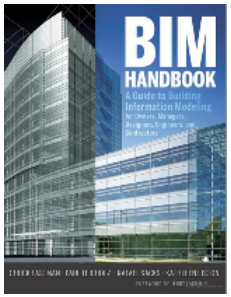


FIGURE 4-3
Influence of overall project cost over the project lifecycle.
Today's use of BIM is typically limited to the late phase of design and engineering or early phases of construction. Use of BIM earlier in design process will have greater influence on cost. Improving overall cost reliability is a key motivator for employing BIM-based cost estimating methods.

From the BIM handbook 1/3



p.100

4.2.2 Time to market: Schedule Management

- Reduce time to market through use of parametric models
- Reduce schedule duration with 3D coordination and prefabrication
- Reduce schedule-related risk with BIM-based planning (4D)
- Simulate facility operations

4.2.3 Complexity of Building Infrastructure and Building Environment

- Coordinating infrastructure through fully-integrated 3D models of MEP, architectural, and structural systems.
- Producing higher quality and maintainable infrastructure through interactive review of coordinated models (simulations,..)
- Conforming to codes and requirements through BIM-based automatic code-checking
- Preventing litigation through collaborative creation and sign-off building information models

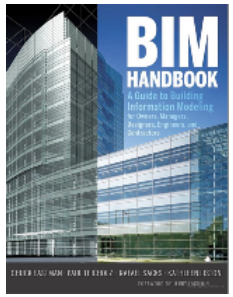
4.2.4 Sustainability (p. 103)

- Reduce energy consumption through energy analyses
- Improve operational productivity with model creation and simulation

4.2.6 Overcoming Labor Shortage, Education, and Language Barriers

- Maximizing labor efficiency through BIM design linked with prefabrication and field planning (.. lean…)
- Overcoming language barriers through BIM simulation and communication

From the BIM handbook



p.106

4.2.6 Design Assessment

- Improve program compliance through BIM spatial analyses
- Receive more valuable input from project stakeholders through visual simulation
- Rapidly reconfigure and explore design scenarios
- Simulate facility operations

4.2.7 Facility and Information Asset Management (p. 108)

- [BIM support in facility management, building maintenance, updating O&M systems]

- Our additions
  User participation in innovative/creative design.

  Needs capture, requirements formulation

The VIC Method

The Arkitema and Rambøll headquarters VIC cases

Design Assessment (from the VIC project) 1/2


Taking notes


2 more workplaces


from opposite direction

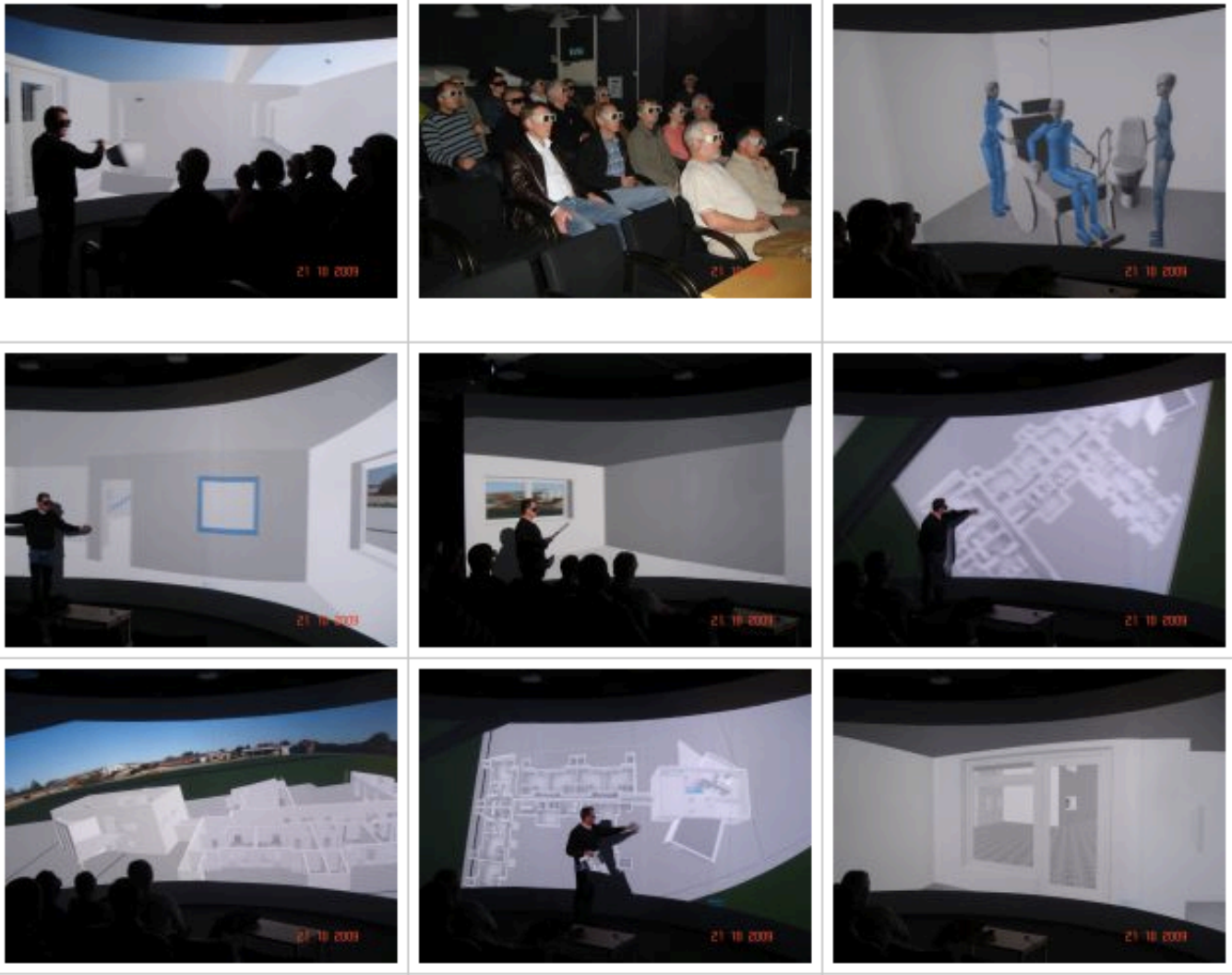

in the CAVE


In the Cave


atrium view

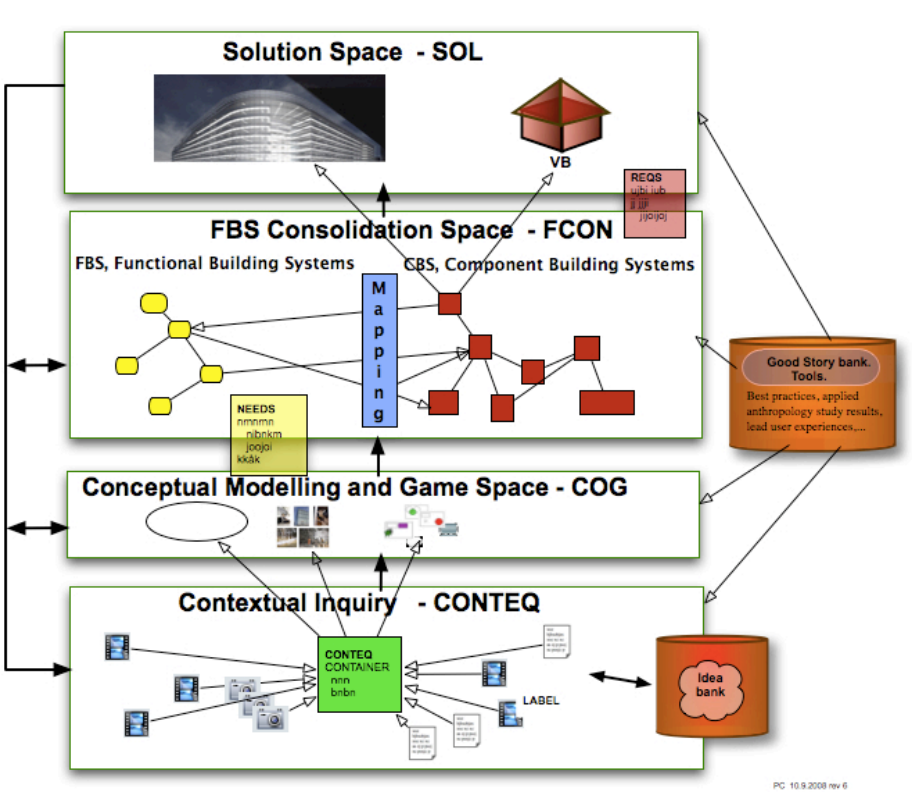
Arkitema assesing design alternatives in office design. The Virtual Innovation in Construction project. See also (Christiansson et.al., 2009)

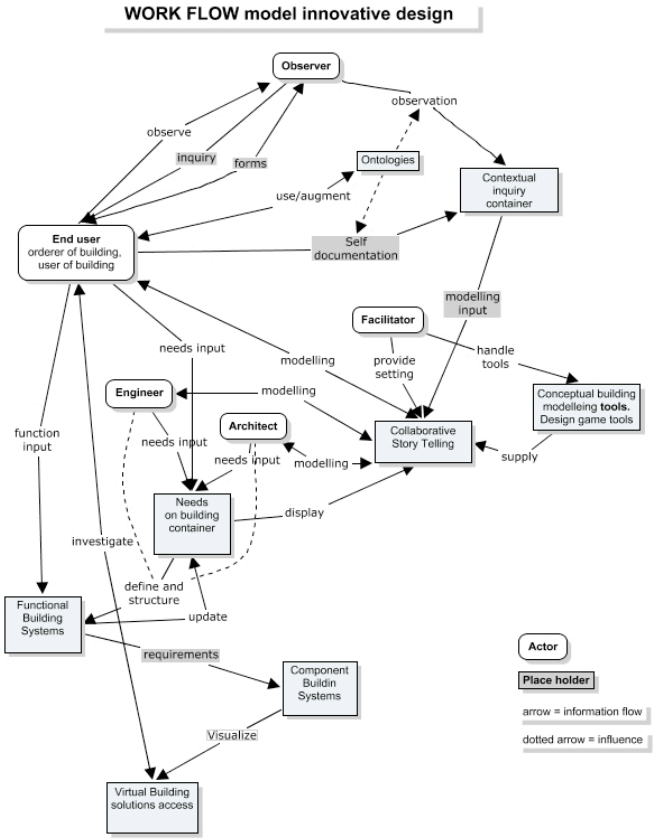
Design Assessment (from the VIC project) 1/2



Clients and end-user groups assesing the overall design of Fredrikshavn Senhjerneskadecenter. From the Virtual Innovation in Construction project, VIC. See also (Christiansson et.al., 2009)

The VIC Method



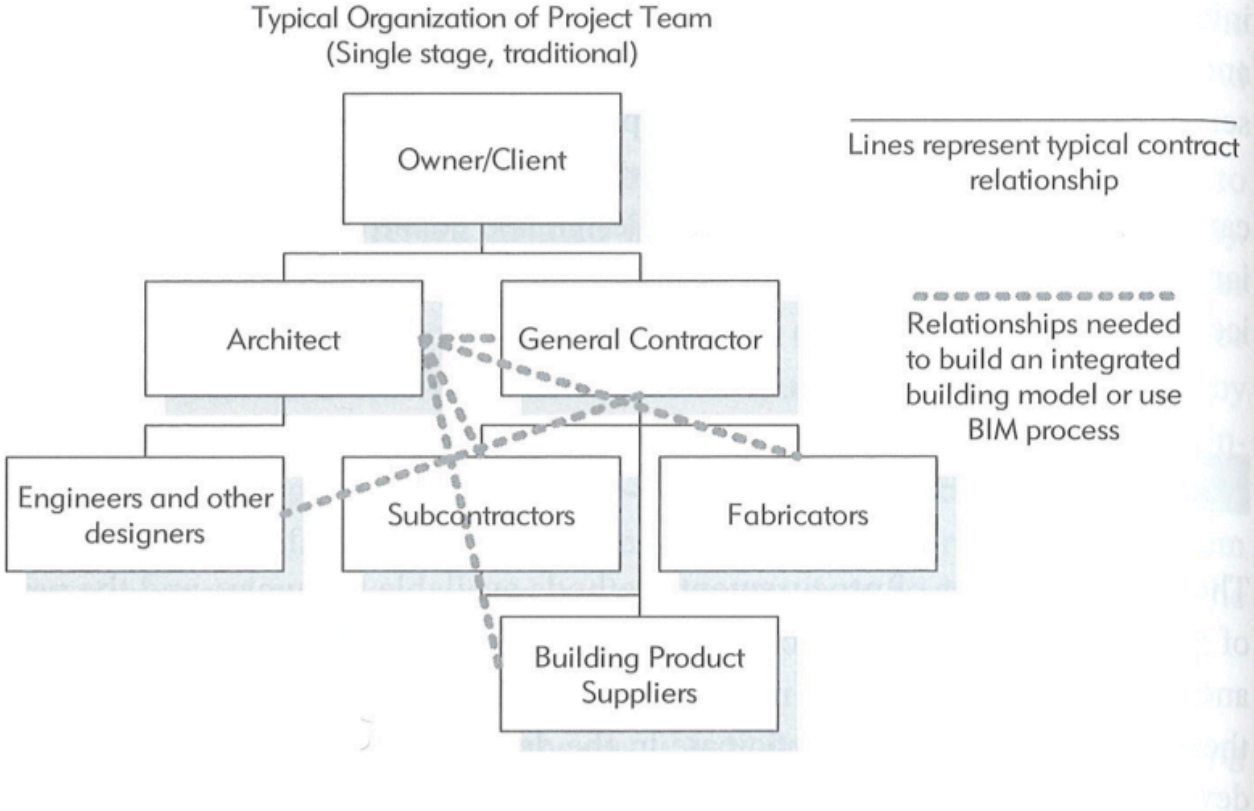


VIC-MET supports innovative and creative design with end user participation. (Christiansson et.al., 2009)

From the BIM handbook.

How Owners Build (p. 115-)

FIGURE 4-12
The traditional organization of a project team involves contracts between the owner and the primary architect and builder, who in turn maintain contracts between these organizations and sub-consultants. This type of contracting often prevents the flow of information, responsibility, and ultimately the ability to effectively use BIM tools and processes.



From the BIM handbook. How Owners Build p. 115-)

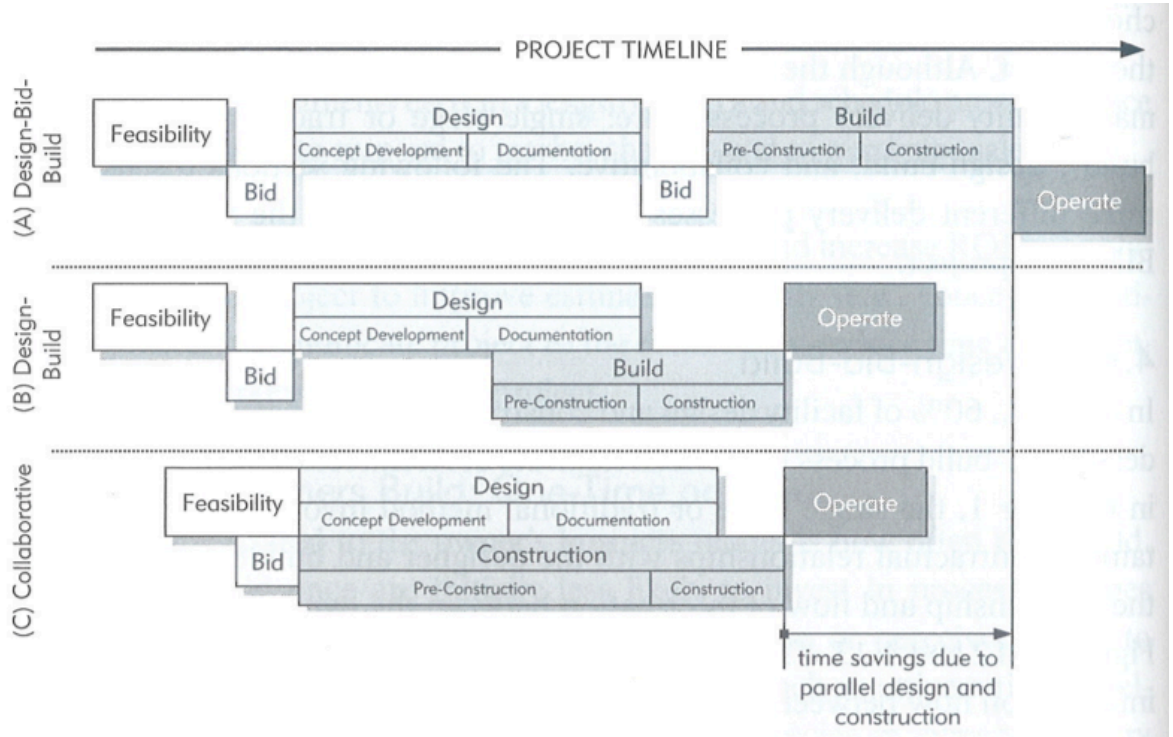
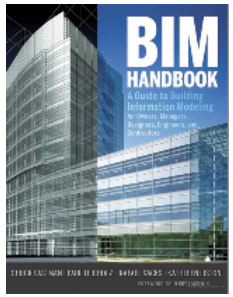


FIGURE 4-13 Diagram comparing three different delivery processes.
A) The traditional single-stage involves the completion of each phase prior to the start of the next phase, often involving a different organization performing each phase in a non-integrative process; B) the design-build process involves an overlap of development phases leading to a shortened overall schedule and requires integration between designers and builders;
c) a collaborative process involves participation by all key participants as early in the process as possible and ongoing collaboration.

Risks with outsourcing is also discussed

From the BIM handbook



p.120 -

4.5 BIM Tool Guide for Owners

- BIM Estimating Tools

(level of estimating detail, organization formats, integration with custom cost/ component databases, manual intervention, model aggregation support, versioning and comparison, reporting features)

- Model Validation, Program, and Code Compliance (p. 121)

- Project Communication and Model Review Tools (p.122)

(different from paper based variants)

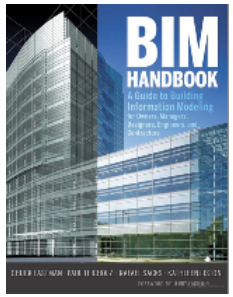
- Model viewing and Review (p.124)

- Model Servers (p. 126)

- Facility and asset Management Tools (p. 127)

- Operation and Simulation Tools (p. 128)

From the BIM handbook



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- Model Validation, Program, and Code Compliance (p. 121)
[Check against requirements, Solibri,…]

- Project Communication and Model Review Tools (p.122)
(different from paper based variants)

- Model viewing and Review (p.124)

- Model Servers (p. 126)

- Facility and asset Management Tools (p. 127)

- Operation and Simulation Tools (p. 128)

From the BIM handbook (p.125)

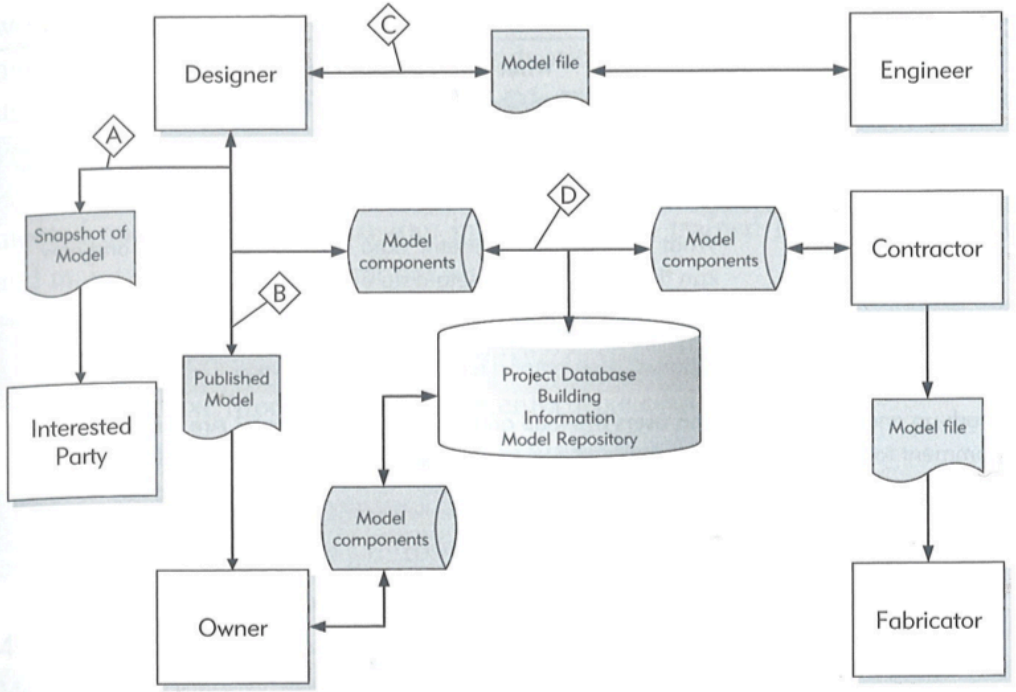
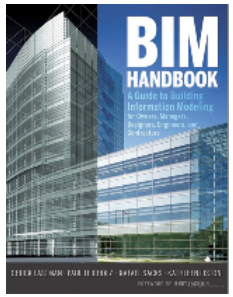


FIGURE 4-16 Conceptual diagram of the different types of communication exchange that might occur on a typical BIM-based project.
This scenario shows a project using a central repository for the project, with the architect, owner, and contractor having access to that model. The architect publishes (A) snapshots and (B) models for interested parties and owners to review. The engineer exchanges model files (C) with the designer such as a .dwg, .rvt. or .dgn file. The contractor exchanges published views of the model, (D) such as PDF or DWF for their subcontractors.

From the BIM handbook



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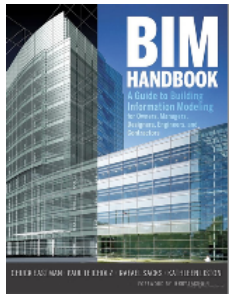
- Model Servers (p. 126)
Bentley ProjectWise (www.bentley.com)
Enterprixe Model Server (www.enterprixe.com)
EPM Technology EDMserver (www.epmtech.jotne.com)
Eurostep modelserver for IFC (www.eurostep.com)
SABLE developed by EurosSTEP
www.bimserver.org,….

- Facility and asset Management Tools (p. 127)
- Operation and Simulation Tools (p. 128)

From the BIM handbook



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- Operation and Simulation Tools (p. 128)

FM and O&M tools 3/3

Facility and asset Management Tools (p. 127)

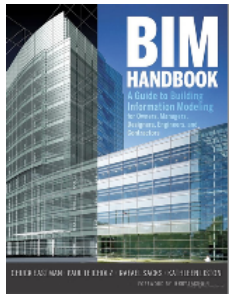
Operation and Simulation Tools (p. 128)

"Today, few tools exists that accept the input of BIM space components or other facility components representing assets. Some of the tools available are:

- ActiveFacility (www.activefacility.com)
- ArchFM (www.graphisoft.co.uk/products/archifm)
- Autodesk FM Desktop (www.autodesk.com)
- ONUMA Planning System (www.onuma.com/products/OnumaPlanningSytstem.php)
- Vizelia suite of FACILITY management products (www.vizelia.com)"

See also
-Rambyg, http://www.rambyg.dk/
and
(Jensen, 2010) ("Effektivisering af bygningsdrift og -vedligehold gennem øget anvendelse af informations- og kommunikationsteknologi").

From the BIM handbook



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4.7 Leading the BIM Implementation on a project

- Build internal leadership and knowledge
- Service provider selection
  - Modifying job skill requirements to include BIM related skills and expertice
  - (example on p. 137)
  - Including BIM-specific pre-qualification criteria
- Build and Educate a qualified Network of BIM Service Providers
- Change Deliverable Requirements: Modify Contracts and Contract Language
  - -Scope and detail of model information
  - -Uses of model information
  - -Organization of model information
  - -(*See also* NBIMS and DDB Bygherrekrav ->)

An Owner and Facility Manager's Building Model (p.131)

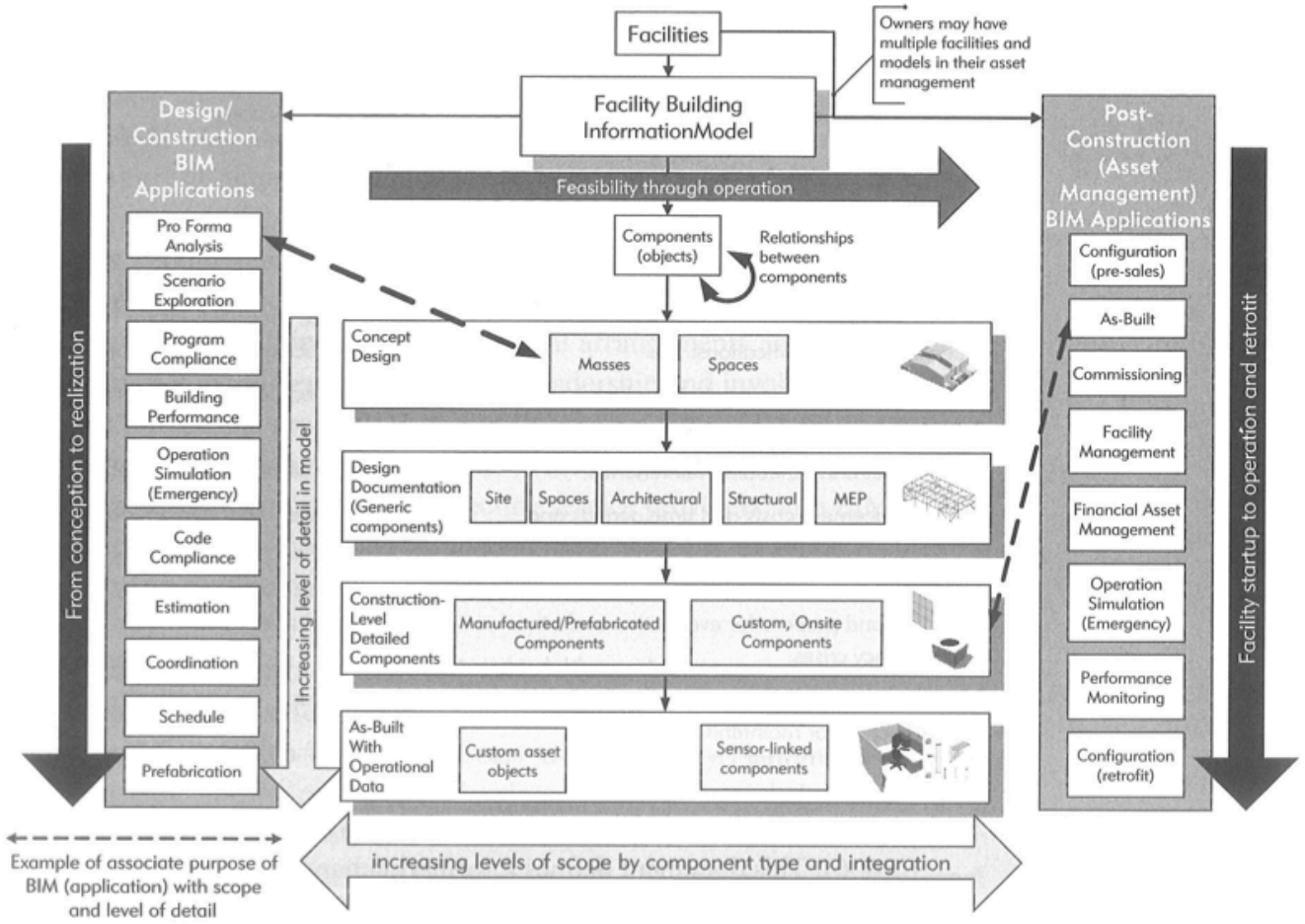
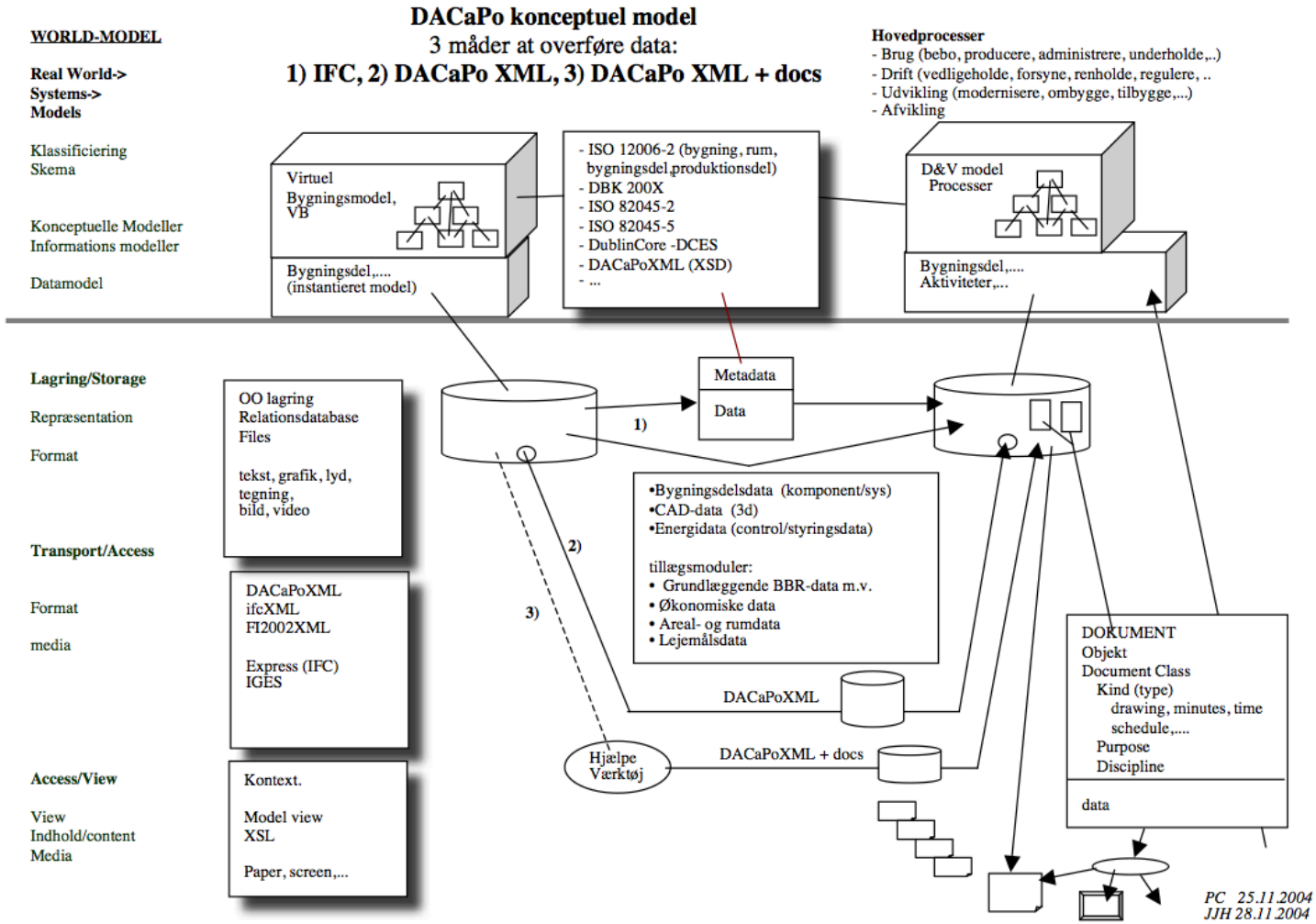
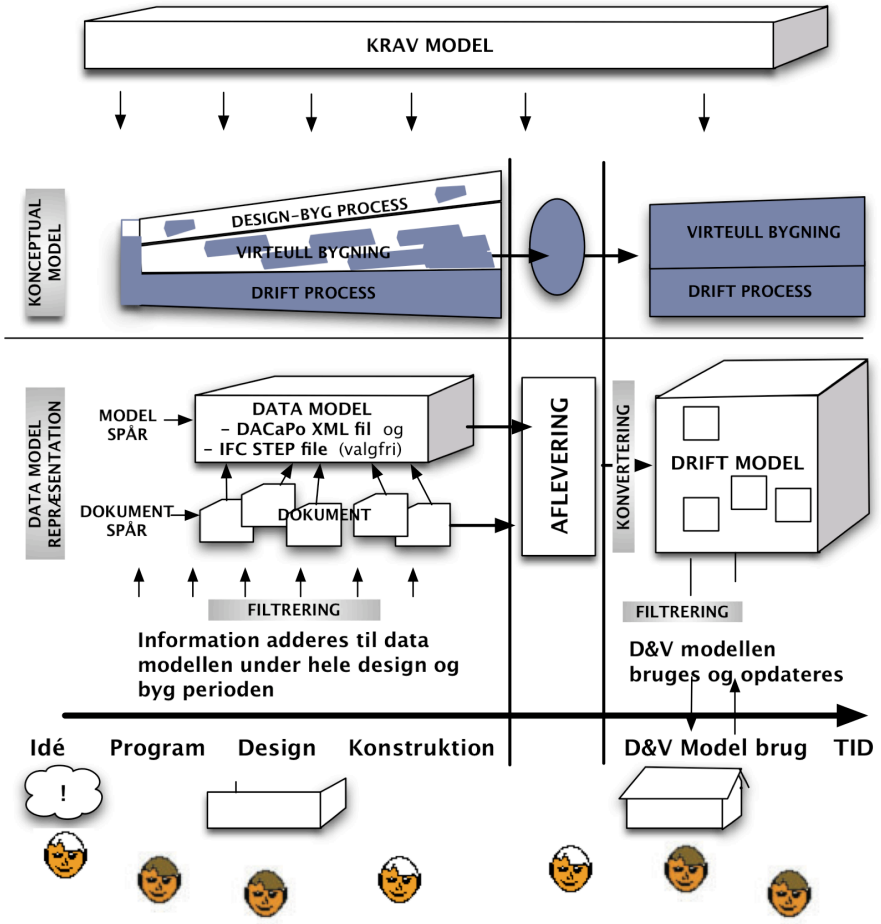


FIGURE 4-18 Conceptual diagram showing the relationship between various BIM applications during the facility delivery process; post-construction and their relationship to the level of scope and detail in the model.

Tidlig DACaPo model

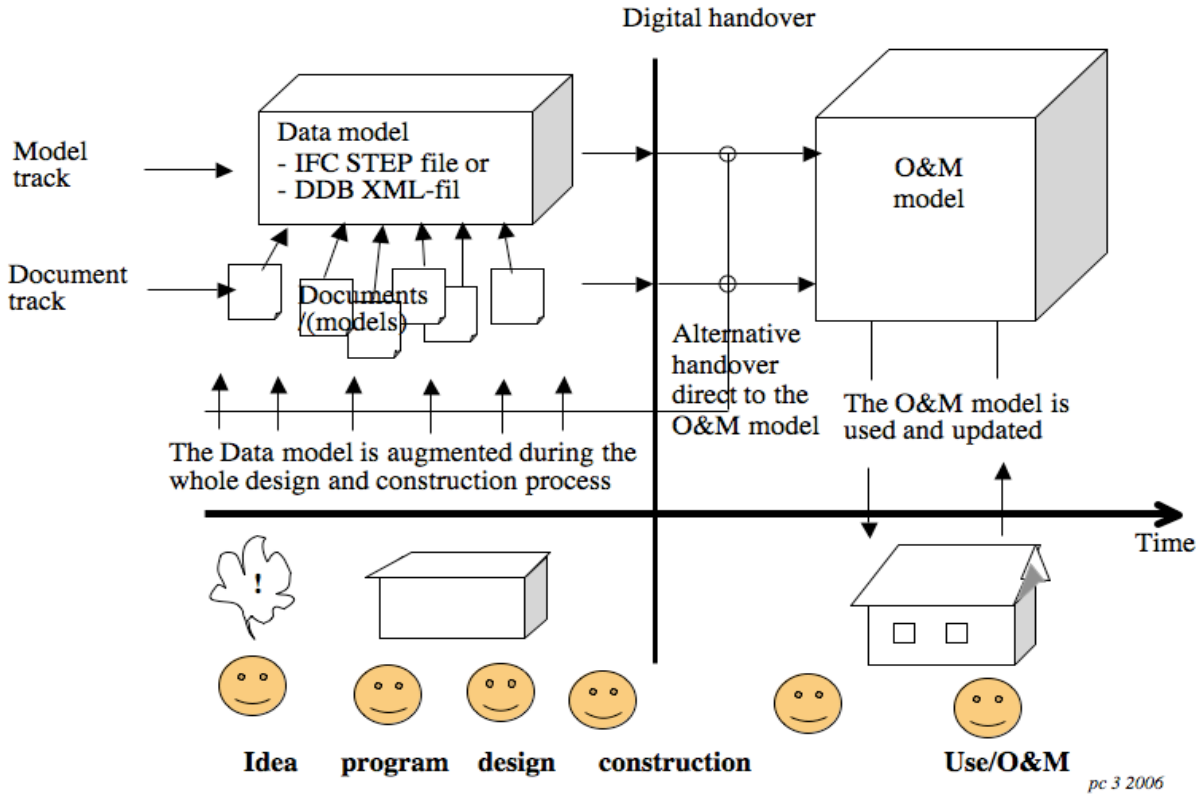


Digital Handover - Digital Aflevering



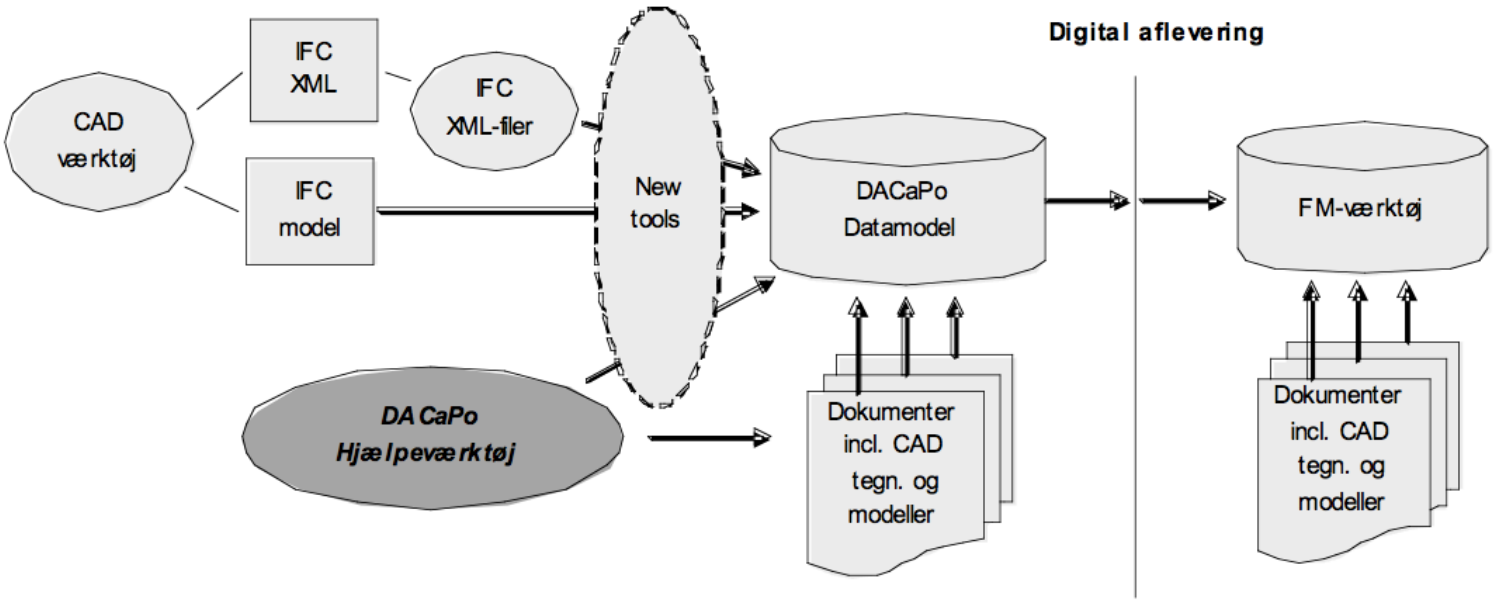
Fra Christiansson P (2005) "Harmonisering af datamodeller". Det Digitale Byggeri Intern WS, BIPS 16.6.2005 København. (8 slides)

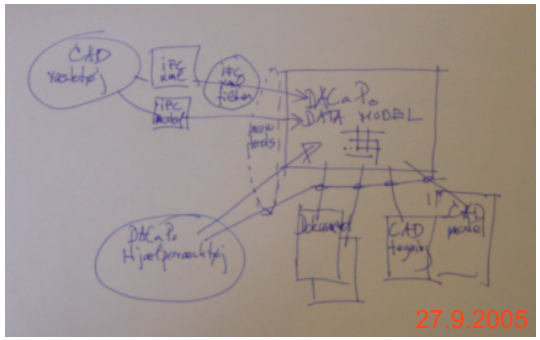
Digital Handover - Digital Aflevering



Danish digital construction requirements, released January 2007, lets public clients put requirements on the content of the digital models of the building handed over to the client after finalised construction. (DDB, 2006)

Digital Handover - Digital Aflevering. DACaPo XML





DACaPo XML hjælpeværktøj (Sarboe et.al., 2006b)

Mer om DDB og Digital Aflevering

Christiansson P. (2009) "Digital aflevering". Kursus ved Teknisk Forvaltning Aalborg Universitet. Aalborg, onsdag den 11 november 2009 (40 pp.)
http://it.civil.aau.dk/it/presentations/2009_11_11_tf_digital_aflevering.pdf

INDHOLD
- Bekendtgørelsen
- Baggrund for afleveringskravet
- Databehov
- Informationsstrukturer
- XML-baserede datamodeller

Oversigt Bygherrekrav

De ti krav gælder som udgangspunkt ved byggesummer over 3 mio. kr. Dog gælder kravet om digital aflevering i første omgang ved byggeprojekter over 15 mio. kr. Anvendelsen af 3D modeller er kun obligatorisk ved byggerier over 20 mio. kr.

Kravene gælder for nybyggeri, hvor rådgivningsydelserne udbydes efter 1. januar 2007. Fra 2008 er også renovering, om- og tilbygninger omfattet af kravene (4, 5 og 6 undtaget). Anlægsarbejder er derimod ikke omfattede.

1. **Obligatorisk brug af projektweb**: Al byggedokumentation udveksles via projektweb. Entreprenøren skal have adgang til projektwebben og kunne udprinte arbejdstegninger i A3 på byggepladsen
2. **Krav til projektweb-løsningen**: Bygherren skal sikre, at der stilles en effektiv og sikker projektwebløsning til rådighed for byggeprojektets parter.
3. **Tegninger i A3**: De projekterende skal udføre alle arbejdstegninger, så de kan udprintes i A3-formatet.
4. **Obligatorisk brug af 3D modeller i konkurrencer**: Bygherren skal ved enhver konkurrence om et byggeprojekt overveje, om der med fordel kan stilles krav til de konkurrende om at opbygge en 3D model af deres projekt som grundlag for bedømmelsen - herunder om der skal stilles krav om bestemte typer simuleringer. Ved byggerier over 20 mio. er brug af 3D modeller obligatorisk.

Oversigt Bygherrekrav 2/3

5. **Obligatorisk brug af 3D modeller i projektering og udbud**: Bygherren skal forud for et hvert nybyggeri vurdere, om der skal stilles krav til de projekterende om at opbygge en digital Bygningsmodel af byggeprojektet. Vurderingen skal ske ud fra en samlet bedømmelse af økonomi og nytteværdi. Ved byggerier over 20 mio. kr er 3D modellen obligatorisk, og entreprenøren skal af modellen kunne udtrække oplysninger om mængder mv. Modellen skal kunne udveksles i IFC-format.

6. **Beskrivende mængdefortegnelse og standardisering af udbudsmateriale (først obligatorisk fra 2009):** Beskrivelser udarbejdes efter principperne i bips B100. Udbudsprojektet skal indeholde en beskrivende mængdefortegnelse, struktureret i henhold til Dansk Bygge Klassifikation, som opgør de mængder, de bydende skal lægge til grund for deres tilbud. Hvis der til byggesagen opbygges en 3D model (obligatorisk ved byggerier over 20 mio. kr) skal entreprenøren kunne udtrække sine mængder af modellen.

7. **Digitalt udbud, tilbudsgivning og licitation**: Udbud af udførelsesentrepriser gennemføres over internettet, hvorudbudsmaterialet skal være tilgængeligt i udbudsperioden. De bydende skal afgive deres tilbud til en portal på internettet, hvor licitationen afholdes ved en samtidig offentliggørelse af tilbudene.

Oversigt Bygherrekrav

8. **Digital aflevering af drifts- og vedligeholdelsesdata**: Bygherren skal identificere hvilke driftsrelevante data fra byggeprocessen, der ønskes afleveret digitalt sammen med byggeriet. Blandt de medvirkende parter udpeges en ansvarlig for afleveringen. Den fysiske aflevering sker under anvendelse af digitale mangellister i overensstemmelse med bips-standarden.

9. **Dokumenter og model**: Den digitale aflevering omfatter såvel dokumenter som datamodel.

10. **Valg af afleveringsformat**: Bygherren skal vælge, om de driftsrelevante data skal afleveres enkeltvis i XML-format, som samlet model i IFC-format - eller indtastes direkte i drifts- og vedligeholdelsessystemer.

Digital Aflevering. Objekt-Dokumenttyp

Fra DACAPO vejledning (Sabroe et.al., 2006b)

"I nedenstående skema er en skematisk oversigt over typiske sammenhænge imellem datamodellens objekter beskrevet i bilag A og dokumenttyper. De angivne sammenhænge er vejledende."

Objekt i datamodel	Dokumenttyper/tegninger
Ejendom	Byggesagsbeskrivelser Arbejds-/bygningsdelsbeskrivelser Ansøgninger/tilladelser As-built CAD-tegninger og modeller Funktionsbeskrivelser Mangellister Vedligeholdsplaner Driftsbudgetter Arealopgørelser
Terræn	As-built CAD-tegninger og modeller Vedligeholdsplaner
Bygning	Garantiblade/ibrugtagningstilladelser As-built CAD-tegninger og modeller Ansøgninger/tilladelser Vedligeholdsplaner Bygningsdelskort
Etage	As-built CAD-tegninger og modeller Arealopgørelser
Rum	As-built tegninger Rumskemaer
Bygningsdel	Garantiblade/ibrugtagningstilladelser As-built CAD-tegninger og modeller Vejledninger Datablade As-built fotos Indregulerings-, tests- og målerapporter Funktionsbeskrivelser
Komponent	Garantiblade/ibrugtagningstilladelser As-built CAD-tegninger og modeller Vejledninger Datablade As-built fotos Indregulerings-, tests- og målerapporter
Arealer/mængder	Arealopgørelser Rumskemaer
Vedligehold	Garantiblade/ibrugtagningstilladelser As-built CAD-tegninger og modeller Vejledninger Datablade As-built fotos

Digital Aflevering. Forvaltningsområder

Fra DACAPO vejledning (Sabroe et.al., 2006b)

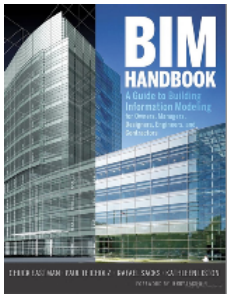
Bilag B Forvaltningsomraåder og dokumenttyper

Ø = Økonomi og administration
E = Ejendomsdrift
A = Arealforvaltning
P = Projekter (ombygning, modernisering m.v.)

I nedenstående skema er angivet, hvilke forvaltningsområder dokumentationen typisk understøtter. Opdelingen af dokumenttyperne i forhold til forvaltnings- områderne er baseret på et skøn og er alene vejledende.

Dokumentklasse	Dokumenttype	Ø	E	A	P
Byggesags-dokumentation	Byggesagsbeskrivelser	X	X		X
	Arbejds- og bygningdels-beskrivelser		X		X
	Ansøgninger/tilladelser	X			X
	Detailtegninger og diagrammer		X		X
	Mangellister	X	X		
	Funktionsbeskrivelser		X		X
	CAD-tegninger og modeller		X	X	X
Drifts-dokumentation	Vejledninger (drift, vedlige-hold, renhold)		X		
	As-built tegninger (hovedteg-ninger)		X	X	X
	Garantiblade	X	X		X
	Datablade		X		X
	Vedligeholdsplaner	X	X		
	Bygningsdelskort		X		
	Indregulerings,- måle,- og testsrapporter		X		
	As-built fotos		X		
Økonomi-dokumentation	Driftsbudgetter	X		X	
Areal-dokumentation	Arealer	X		X	X
	Rumskemaer		X	X	X

From the BIM handbook 2/3



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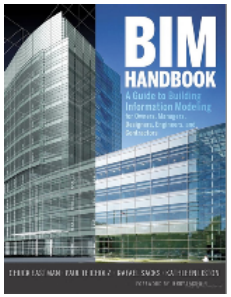
4.8 Barriers to Implementing BIM: Risks and common myths

4.8.1 Process Barriers

- The market is not ready - it's still in the innovation phase
  "The case studies and many additonal refernces in this book also indicate a transition from innovator to early adopter phase for design-related BIM applications"
- The project is already financed and design is complete - it's not worth it to implement BIM.
  [OK the earlier the better, but plenty of time in late design early construction]
- Training costs and the learning curve are too high
- Everyone must be on board to make the BIM effort worthwhile
- Too many legal barriers exist an they are too costly to overcome
  The primary challenge is the assigment of responsibility and risk
- Issues of model ownership and management will be too demanding on owner resources
  Owners need to establish clear roles an resonsibilities and metods to communicate with the project team and ensure that an owner representative is available as-needed

From the BIM handbook



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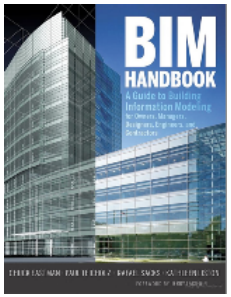
4.8 Barriers to Implementing BIM: Risks and common myths

4.8.2 Technology Risks and Barriers

- Technology is ready for single-discipline design but not integrated design
  The integration of construction-level detail is more difficult, and model review tools are the best solution to achieve this

- Standards are not yet defined or widely adopted - so we would wait
  … a variety of successful BIM implementations have been achieved without relying on these standards; and is not a barrier to implementation.

From the BIM handbook 2/3



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4.9 Guidelines and issues for owners to consider when adopting BIM

- Perform a pilot project with a short time frame, small qualified team, and a clera goal
  [Owner build up knowledge]
- Do a prototpe dry run
- Focus on clear business goals
  … energy analyses, space planning,….
- Establish metric to assess progress
  (CIFE working paper Virtual Design and Construction: Themes, Case Studies and Implementation SuggestionsWP097…)
- Participate in the BIM effort

Senate, Finland (References)

Senate Finland

www.senaatti.fi/ BIM Guidelines

Building Information Model (BIM) Requirements from October 1st, 2007

Volume 1: General part

Volume 2: Modeling of the starting situation

Volume 3: Architectural Design

Volume 4: MEP design

Volume 5: Structural design

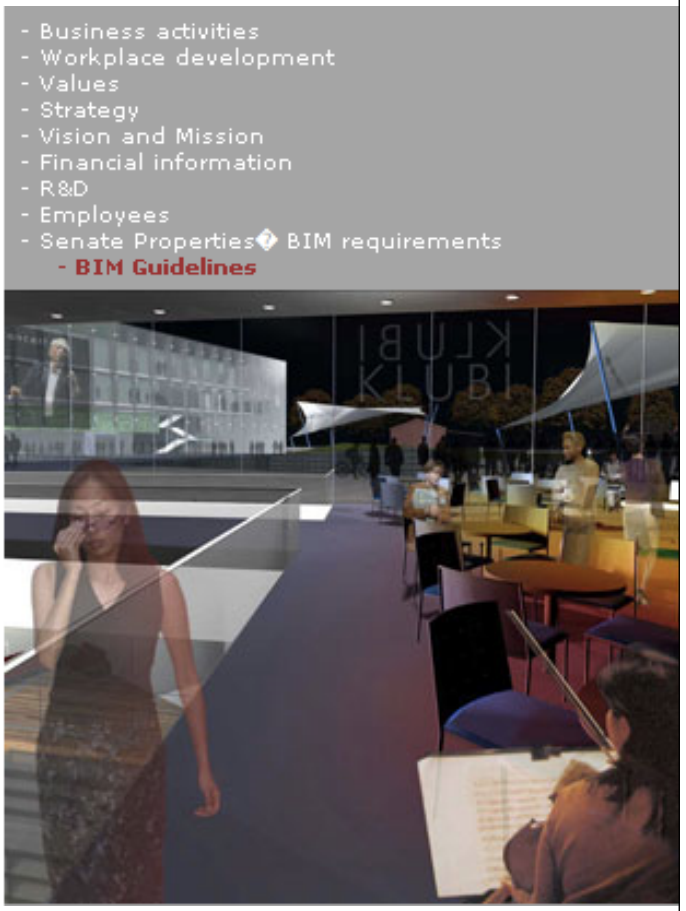
Volume 6: Quality assurance and merging of models

Volume 7: Quantity take-off

Volume 8: Using models for visualization

Volume 9: Use of models in MEP analysis

Senate Properties´ BIM Requirements for Architectural Design, 2007



GSA USA (References)

http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_OVERVIEW&contentId=20917

- Architecture & Engineering
- CAD Standards
- 3D-4D Building Information Modeling
  - 3D-4D-BIM Overview
  - Spatial Program Validation
  - 3D Laser Scanning
  - 4D Phasing
  - Energy Performance and Operations
  - Circulation and Security Validation
  - Building Elements
  - BIM Champions
  - BIM Program In The News
  - BIM Video
  - BIM Mailing List
  - BIM Library
- Commissioning
- Construction Excellence
- Design Excellence and the Arts
- Facility Access for the Disabled

3D-4D-BIM Overview

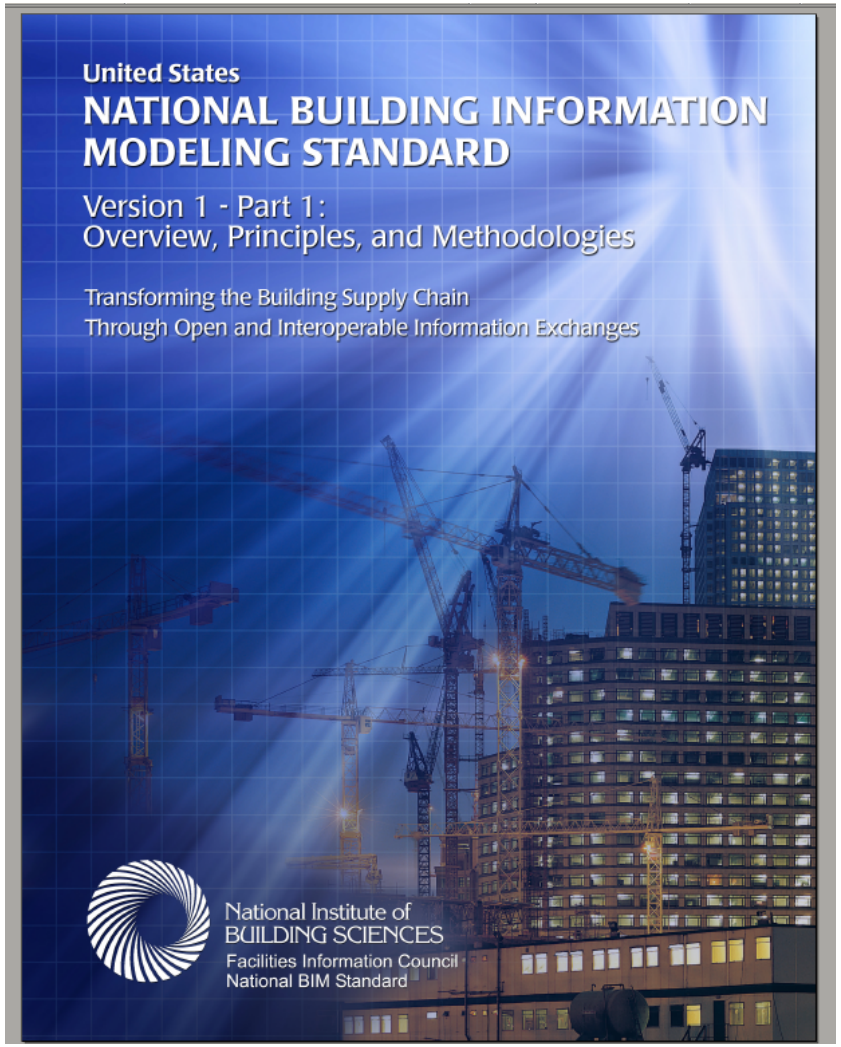
The primary goal of the National 3D-4D-BIM Program is to promote value-added digital visualization, simulation and optimization technologies to increase quality and efficiency throughout GSA project lifecycles and beyond. The long-term objective is to use innovative 3D, 4D, and BIM technologies to complement, leverage, and improve existing technologies to achieve major quality and productivity improvements.

The BIM Guide Series is intended for GSA employees and consultants engaging in BIM practices for the design of new construction and major modernization projects for GSA. GSA BIM Guide Series 01 is an overview of the National 3D-4D-BIM Program, the technologies and services it supports, and an over-arching and executive text to be used as a reference guide for GSA members and associates when determining what BIM applications would be appropriate for their specific project. This Guide will also be of general interest to other members of the project teams, including PBS staff, customer agencies, and contracted parties such as architects and engineers (A/Es), construction managers, construction and design-build contractors, and consultants hoping to understand more about BIM technologies and potential applications. In addition, architect, engineering and construction (AEC) industry software solution providers will find this Guide of interest in providing preliminary clarification and promoting further discussion surrounding the development and adoption of various technologies.

GSA Building Information Modeling Guide Series 01 - Overview DRAFT>>

NIBS NBIM (References)

http://www.nibs.org/nbims.html
http://www.wbdg.org/pdfs/NBIMSv1_p1.pdf



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END

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