AALBORG UNIVERSITY

Building Informatics

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

# 5. BIM for the Construction Industry

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Semester 1, 2010.

# CONTENT

- Chapter 6 of the BIM Handbook (Eastmann et al)
  - Slides 3 - 21
- Det Digitale Byggeri, Logistik og Proces
  - Slides 22 - 27
- IT-på byggepladsen, erfaringer med implementering
  - Separat præsentation

# Applications for contractors

- Clash detection
- Quantity take off and cost estimating
- Construction analysis and planning
- Integration with cost and schedule control and other management functions
- Offsite fabrication
- Verification, guidance and tracking of construction activities

# Types of construction firms

The bulk of the industry consists of contractors who start with a successful bid, self-perform some of the work, and hire subcontractors for specialized services. Some contractors limit their services to managing the process and hire subcontractors for all construction work.

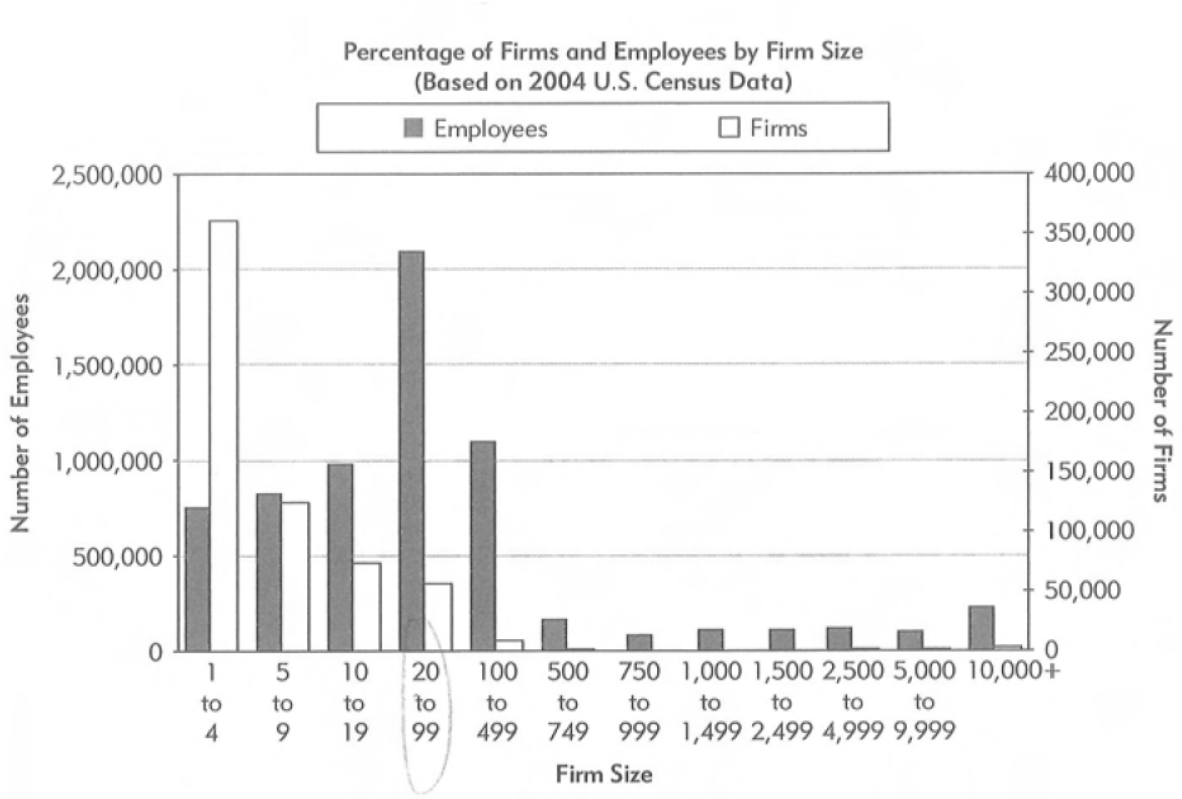



**FIGURE 6-1**
**Distribution of 751,098 construction firms and total employees by size of firm for 2004.**
*Source: US Census Bureau, NAICS 23 – Construction.*

# Specialized contractors

Finally, there are many types of subcontractors that specialize in one area or type of work, such as electrical, plumbing, or mechanical detailing. The general contractor selects these subcontractors based on competitive bids or they are pre-selected based on previous business relationships that have demonstrated effective collaboration. The specialized construction knowledge of these subcontractors can be very valuable during design, and many of them perform design as well as construction services. The percentage of work done by subcontractors varies widely depending on the type of work and contract relationship.

# BIM potentials in Design-Build organisation

- Responsibility for both design and construction
- Single point of responsibility for nearly all problems
- Reduces risk for the client

- Use of BIM in a DB can be very advantegeous
- Early integration of the project team
- Build a shared model based on expertise from different disciplines
- Value of BIM is lost, if the team uses traditional hand-over of drawings or models to the construction group after the design is complete

## Information, contractors want from BIM

- Manually performing quantity take off and producing estimates and schedules is
  - time-consuming
  - tedious
  - error-prone
  - expensive
- Thus, this will often take place late in the design process
- Great benefits if this could be generated from building model

# The optimal building model for the contractor

- ***Detailed building information*** contained in an accurate 3D model that provides graphic views of a building's components comparable to that shown in typical construction drawings and with the ability to extract quantity and component property information.
- ***Temporary components*** to represent equipment, formwork and other temporary components that are critical to the sequencing and planning of the project.
- ***Specification information associated with each building component*** with links to textual specifications for every component that the contractor must purchase or construct.
- ***Analysis data related to performance levels and project requirements*** such as structural loads, connection reactions and maximum expected moments and shear, heating and cooling loads for tonnage of HVAC systems, targeted luminance levels, etc. This data is for fabrication and MEP detailing.
- ***Design and construction status*** of each component to track and validate the progress of components relative to design, procurement, installation, and testing (if relevant). This data is added to the model by the contractor.

# How to develop a contractor BIM-model

- If design teams are not creating usable models, the contractor may take ownership of the modelling process
- Even if designers deliver the models, the contractor must model additional components and add construction specific information
- Leading-edge contractors create their own building models from scratch
- Different model representations usable for different tasks (see next slide)

# Contractors BIM process flow form 2D

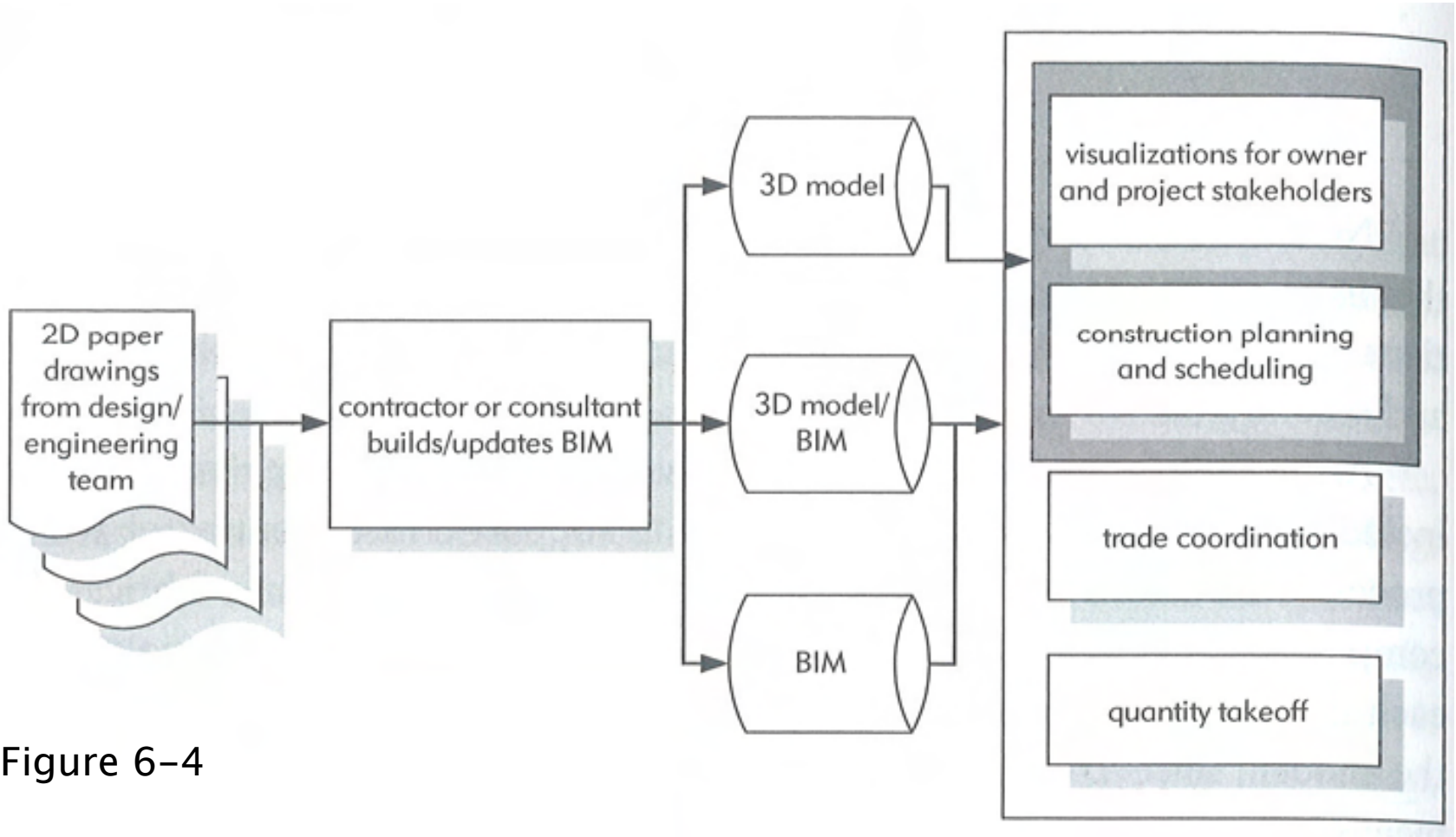
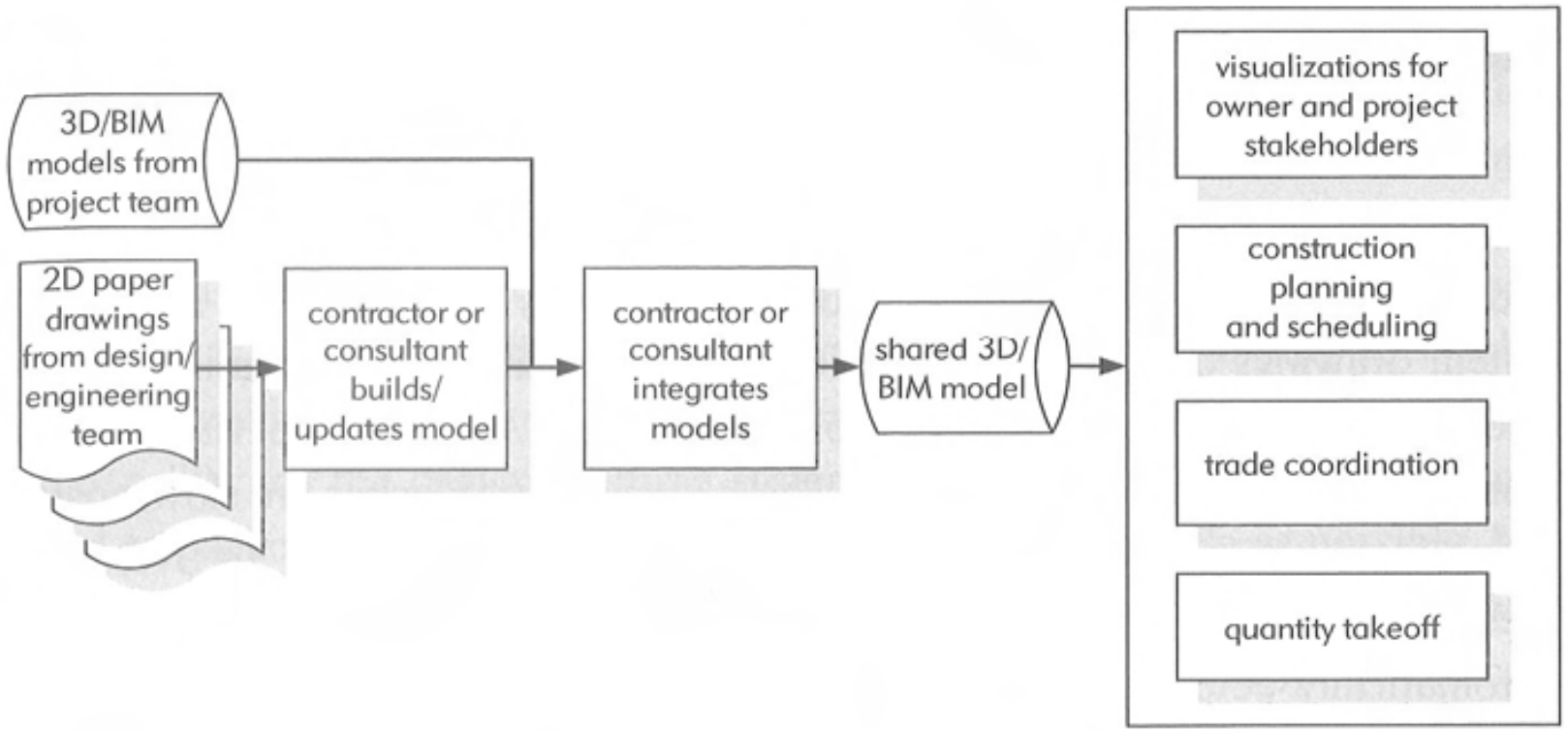



Figure 6-4

# Shared model for the construction team

- 3D model basis for all construction activity
- Contractor can give feedback on constructability and sequencing



# Clash detection

- 2D CAD
  - Manually overlay drawings, e.g. light table
  - visually identify potential conflicts
  - dependant of up-to-date drawings
- 3D CAD
  - based on geometry only
  - only surface clash, not objects inside
  - may return large number of meaningless clashes
- BIM based
  - semantic and rule based analysis
  - selective checking between specific systems
  - soft-clash, e.g. distance from mechanical to floor less than 50 cm

# Clash detection and level of detail

- Model must have an appropriate level of detail
  - piping, dicts, structural steel, etc
- If detailing is not appropriate, too many problems will not be found until construction, where they are costly to resolve
- Subcontractors need to participate as early as possible with model development and clash detection
- Clash detection may be separate tools or more or less integrated in CAD-tools. There are pros and cons of both

# Quantity take off and cost estimating

- Early design phase
  - parametric cost estimate based on major building parameters
  - volumes, type of spaces, quality level of materials, perimeters etc.
  - typically not available in tools for early design
- So, move to BIM-tool early ☺
- Primary options
  - Export building object quantities to estimating software
    - e.g. Excel
  - Link BIM tool directly to estimating software
    - e.g. Vico
  - Use BIM specialized quantity take off tool
    - see next slide

# Specialized quantity take off tools

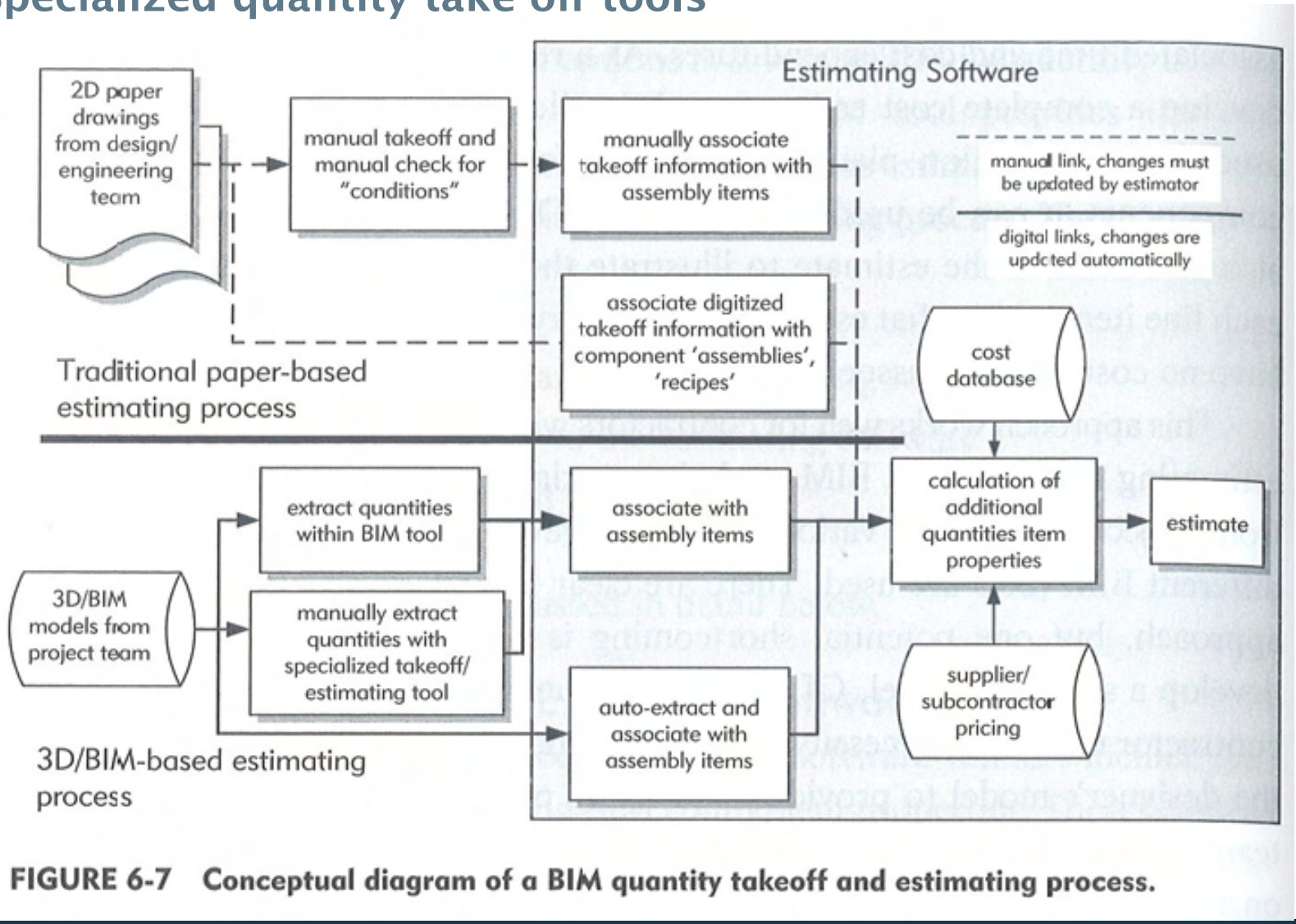


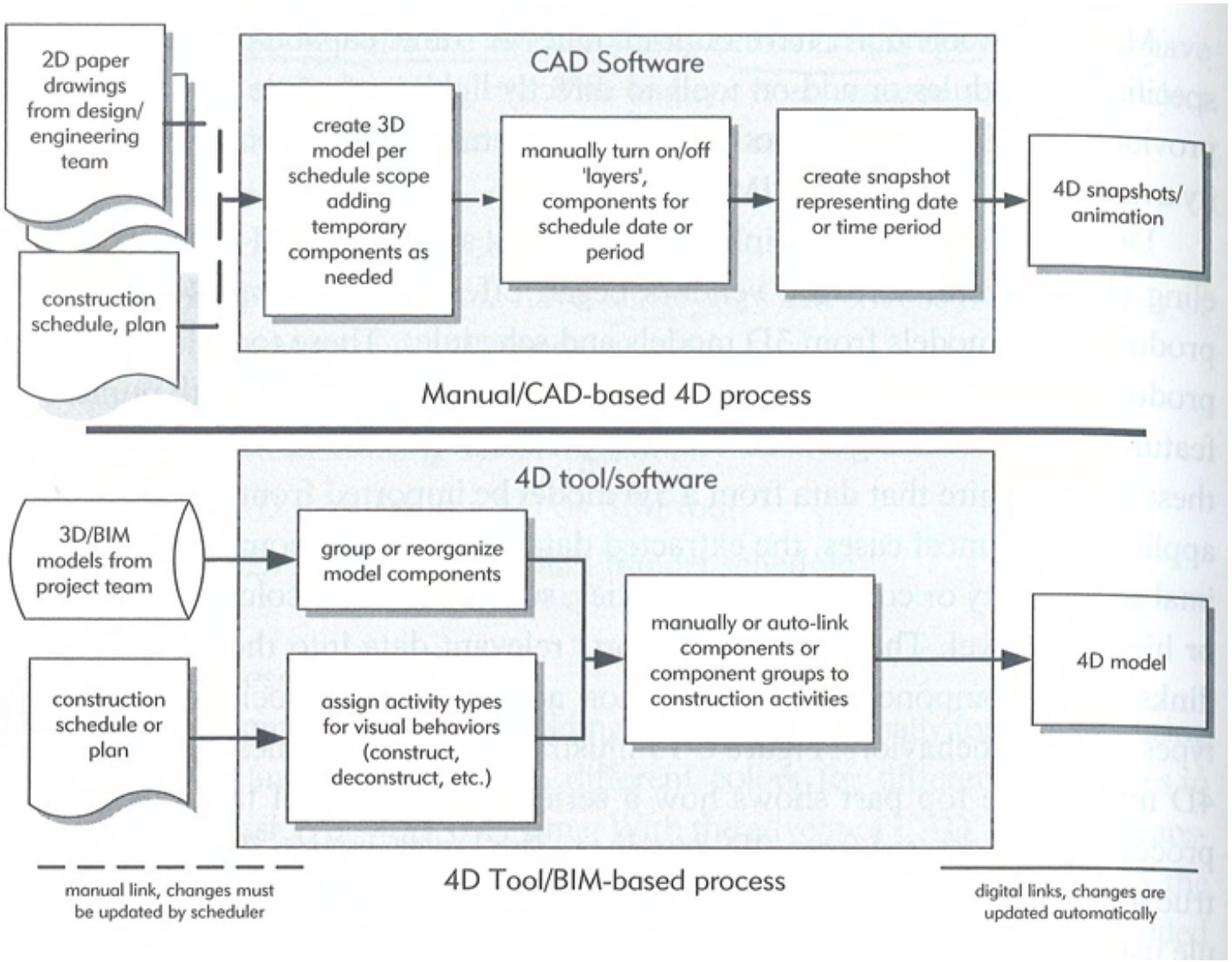

**FIGURE 6-7 Conceptual diagram of a BIM quantity takeoff and estimating process.**

# Quantity take off implementation

- No BIM tool can deliver a full estimate automatically
  - Further data must be entered manually
- Start simple
  - counting doors, windows etc in the BIM software
- Expectations must follow level of detail of the model

# Construction analysis and planning

- 4D models
  - Visual communication
    - more effective than traditional Gantt
  - Multiple stakeholder input
  - Site logistics
    - access to and within site
  - compare schedules and track construction progress
- Requires appropriate 3D models and link to schedule
- Tools
  - Manual
  - BIM tools with 4D
  - external tools


2D paper drawings from design/ engineering team
construction schedule, plan
CAD Software
create 3D model per schedule scope adding temporary components as needed
manually turn on/off 'layers', components for schedule date or period
create snapshot representing date or time period
4D snapshots/ animation
Manual/CAD-based 4D process
4D tool/software
3D/BIM models from project team
construction schedule or plan
group or reorganize model components
assign activity types for visual behaviors (construct, deconstruct, etc.)
manually or auto-link components or component groups to construction activities
4D model
4D Tool/BIM-based process
manual link, changes must be updated by scheduler
digital links, changes are updated automatically

# 4D tools

Table 6-2

# 4D tools properties

- BIM Import capabilities
- Schedule import capabilities
- Merging of BIM and schedule,
- Automatic linking
- Reorganisation
- Temporary components
- Animation
- Analysis
- Output

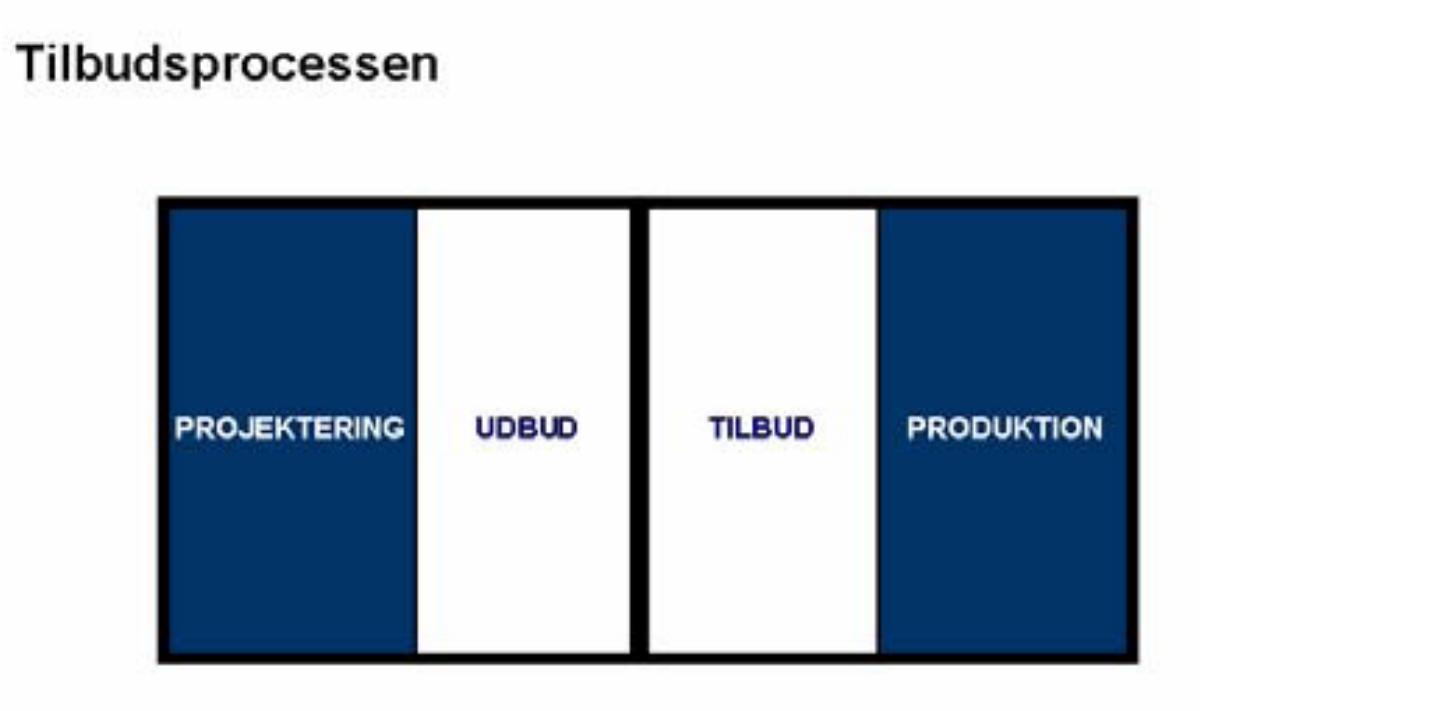
# Use of BIM onsite

## Evolving technologies

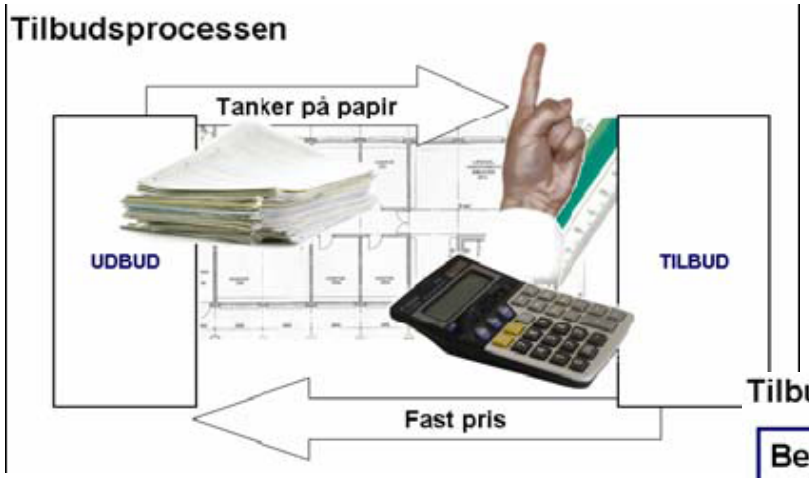
- Laser scanning
- Machine guidance
- Gps
- RFID

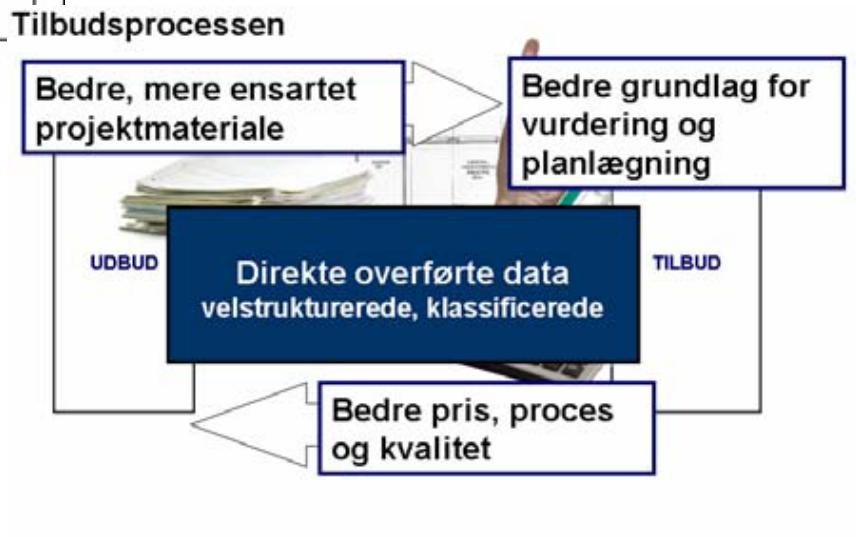
# Det Digitale Byggeri, Logistik og Proces

Rapporten kan hentes her:
http://www2.detdigitalebyggeri.dk/component/option,com_docman/Itemid,181/task,doc_download/gid,89/

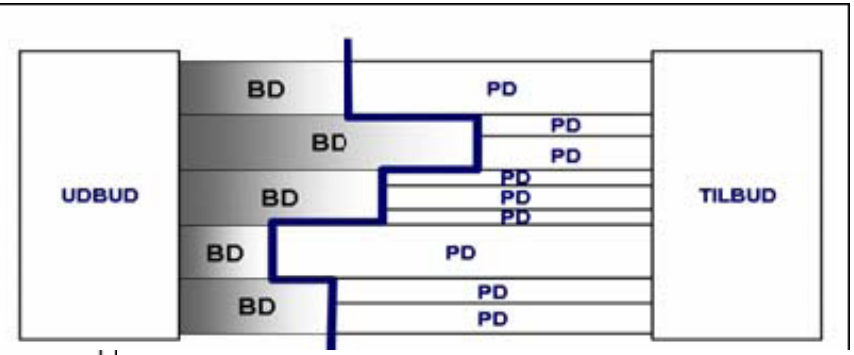


# Kan processen forbedres med BIM?



# Begrebet "produktionsdel"

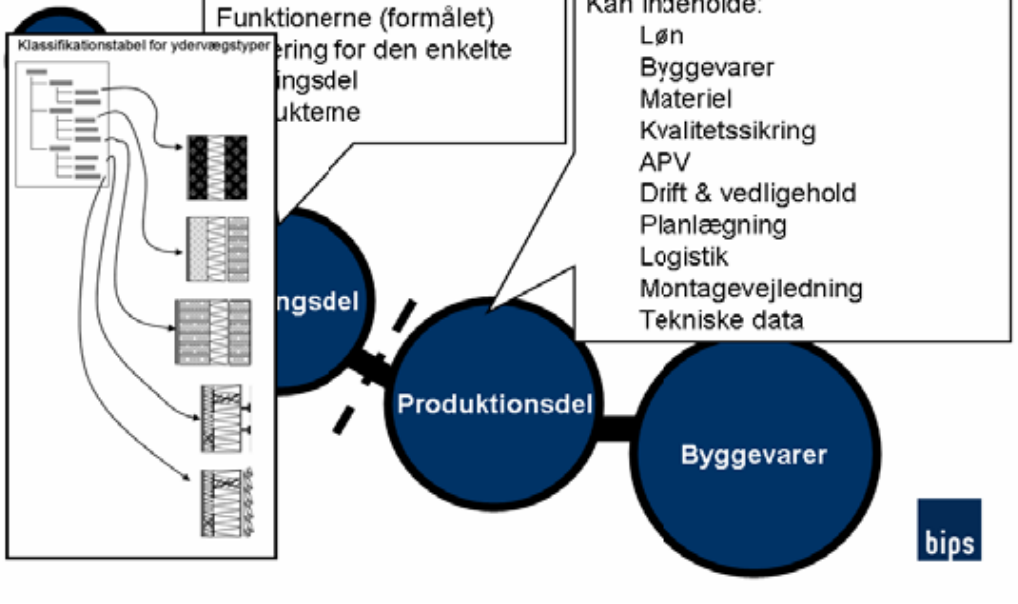



**Bygningsdel (BD)**
Rådgiverens og bygherrens informationsenhed.

Kan indeholde:
Funktionerne (formålet)
ering for den enkelte
ingsdel
ukterne

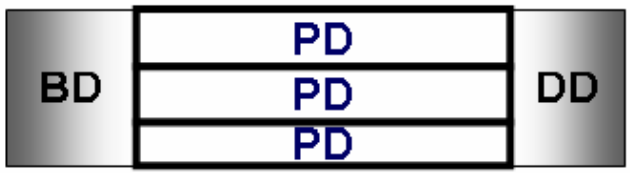
**Produktionsdel (PD)**
Entreprenørens informationsenhed

Kan indeholde:
- Løn
- Byggevarer
- Materiel
- Kvalitetssikring
- APV
- Drift & vedligehold
- Planlægning
- Logistik
- Montagevejledning
- Tekniske data

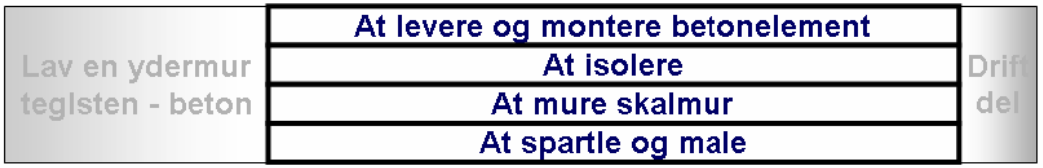


# Produktionsdel

Er det i virkeligheden en proces?




**En produktionsdel er afgrænset til:**
**Noget af EN bygningsdel**
**som laves i EN proces**
**af EN aktør**




# Underentrepriser

## Entrepriseopdeling

| | | |
|---|---|---|
| Entreprise 1 | At levere og montere betonelement | Beton |
| | At isolere | Beton |
| | At mure skalmur | Murer |
| Entreprise 2 | At opsætte skellet og gips på vægside 1 | Tømrer |
| | At isolere | Tømrer |
| | At lukke med gips på vægside 2 | Tømrer |
| Entreprise 3 | At føre installationer | VVS |
| Entreprise 4 | At spartle og male | Maler |
| | At spartle og male | Maler |

# Ideen om et Produktionskort

## Produktionskort: Opsætning af lofter

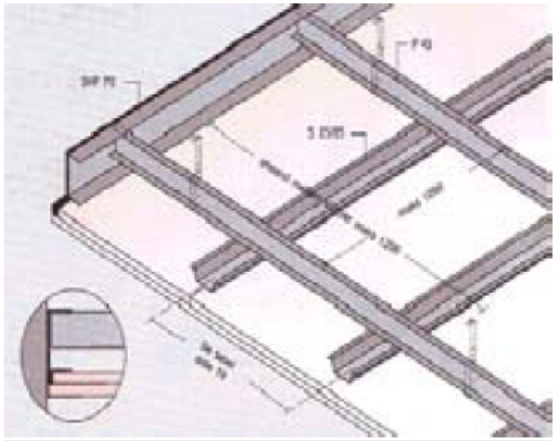
Ringsted Bygningsentreprise

Links → | Tegninger | Beskrivelse | 3 D Model | Montagevejledning | Plan for sikkerhed og sundhed

**Stamdata:**
2711 * AB Trolden
Jens Jensensvej 28 - 2300 KBH. Ø
Rådgivere
Ingeniør: Jens Jensen 22283040
Arkitekt: Hans Jensen 22283040

**Aktivitet:**
Opsætning af lofter i rum 314, 315, 316

**Materiel:**
Eget værktøj anvendes
Gipspladevogn og løfter er til rådighed
Rullestillads anvendes



**Planlægning:**
Opstart: Mandag uge 31
Aflevering senest: Fredag uge 31
Materialer på plads mandag uge 31 kl. 7:00

**Arbejdsmetode:**
Der opsættes SKF 70 vægskinne ved alle be-
Grænsede vægge. Der opsættes 1,5*20 mm
Båndjernsstopper. Der monteres P45 bærepro-
Filer og S 25/85 monteringsprofiler på træ-
Bjælker, stålbjælker eller betondæk. Underste
Lag gips opsættes og der fuges mod begræn-
Sede vægge. Sidste lag gips opsættes og skæres
Tæt mod vægge. Pladeender I det synlige lag
Gips samles med T – samlestykker.
Spartling af plader er ikke indregnet.

**Mandskab:**
Byggeleder: Ole Jensen 22283040
Formand : Hans Jensen 22283040
Tømrer : Per Jensen 22283040

Tidsforbrug: 0,59 timer pr. m² I alt 33 timer
Svendeløn: 4.604,- kr ~ kr. 140,00 / time


**Byggeplads:**
Skurvogn nr. 3 er til disposition
Værktøjs og materialecontainer placeres ved
Siden af skuret

**Miljø og sikkerhed**
Sikkerhedssko, sikkerhedsbriller og høreværn
skal benyttes.
Hjælm anvendes ved ophejsning af materialer
Og i de områder hvor der er hjelmpåbud.

**Affald**
Metalbånd fra gipspladebundter → metal
Loftsskinnerester → metal
Træ, plast, pap og papir → brændbart

**Materialer:**

| | | |
|---|---|---|
| Gips byggeplade A1 13*1200*2400 | m² | 66.85 |
| Gips båndstrop 1.5*20 mm | m | 9,84 |
| Gips lydfuge 0.5 l | antal poser | 9,84 |
| Gips monteringsprofil s 25/85 3800 mm | antal | 217 |
| Gips samlestykker tska | antal | 33 |
| Gips skinne skp 70 med filt | m | 57.86 |
| Gips skruer r/r 13 mm 100/ pk. Til skinne | antal | 619 |
| Gips skruer r/a 25 mm 1000/pk | antal | 1002 |
| Loft bæreprofil p 45*3600 | m | 50.14 |
| Maskinbolt m 8*50 elz | antal | 50 |
| Skrue inkl. Plugs | antal | 165 |

# END

http://it.civil.aau.dk