

# True or False??



**Increase of productivity by 70%**

**Reduction of inconsistency in documents 95%**

**Reduction of collisions by 100%**

**Reduction of bid price by 30%**

**Reduction of faults on site by 90%**

**Reduction of cost of FM by 20%**

# ØG-DDB: Measuring profit by using Open BIM – tools from “Det Digitale Byggeri”

Research project financed by “Danish Building and Property Agency”  
 “Danish Ministry of Climate, Energy and Building” 2009-2013

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## **Agenda – highlights from - -**

- **The project – background and challenges**
- **The ØG-DDB Manual - method and tools**
- **The outcome of the 4 cases**
- **Other interesting findings**
- **Five minutes for questions**

# The material result of the project

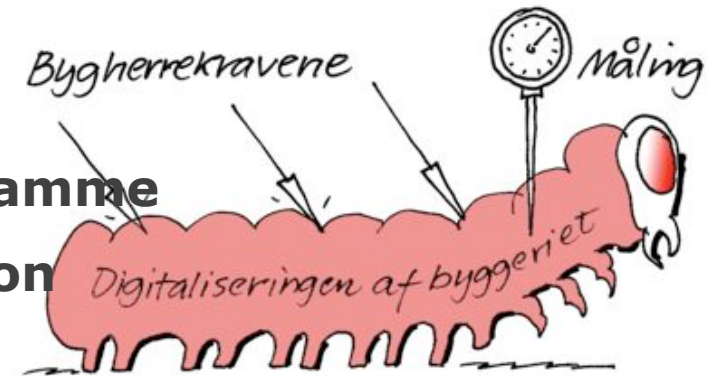


**Homepage?**  
**Blog?**  
**English version?**



## Background and Challenges

- **DDB – the Digital Construction Programme**
  - **The Government PBO-ICT-specification**
  - **Best Practice in Construction**
  - **Implementation Network ICT**
- 
- There are economical benefits using ICT/BIM
  - The benefits are widely distributed among processes and agents
  - The benefits are difficult to localize and to quantify
  - There is a need to identify and calculate cost and benefit/profit



# Measuring cost and profit in construction 1

- **We have no tradition for historic cost- and profit statistics in the industry on investments**
- **We have no tradition for historic cost- and profit statistics within the companies in the industry**
- **You must study cost and profit within the value chain**
- **The market effect evens all difference**

## Measuring cost and profit in construction 2

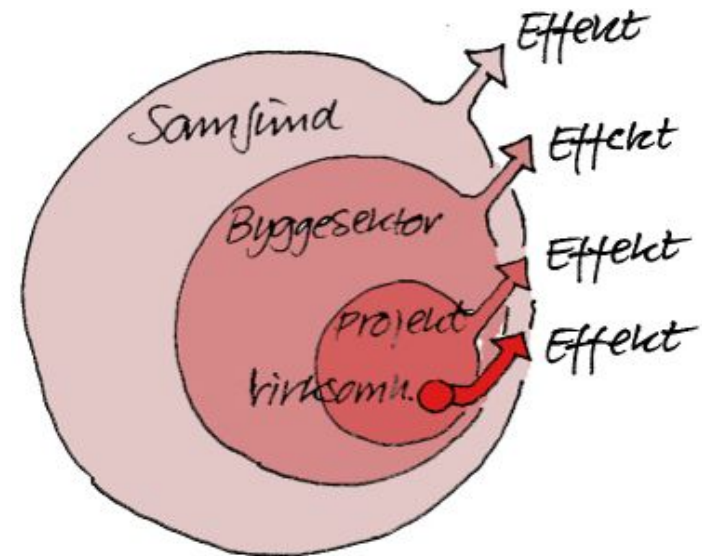
- Measuring cost and profit within cases and projects in real life
- **Objectivity**
- **Exact measurement – when possible**
- **Estimates supported by experience, cross-check and structured documentation**
  
- **We specify “the context” and the “conditions”**
- **We want it to be possible to reproduce our results**
- **We want others – including companies – to be able to compare and to benchmark**



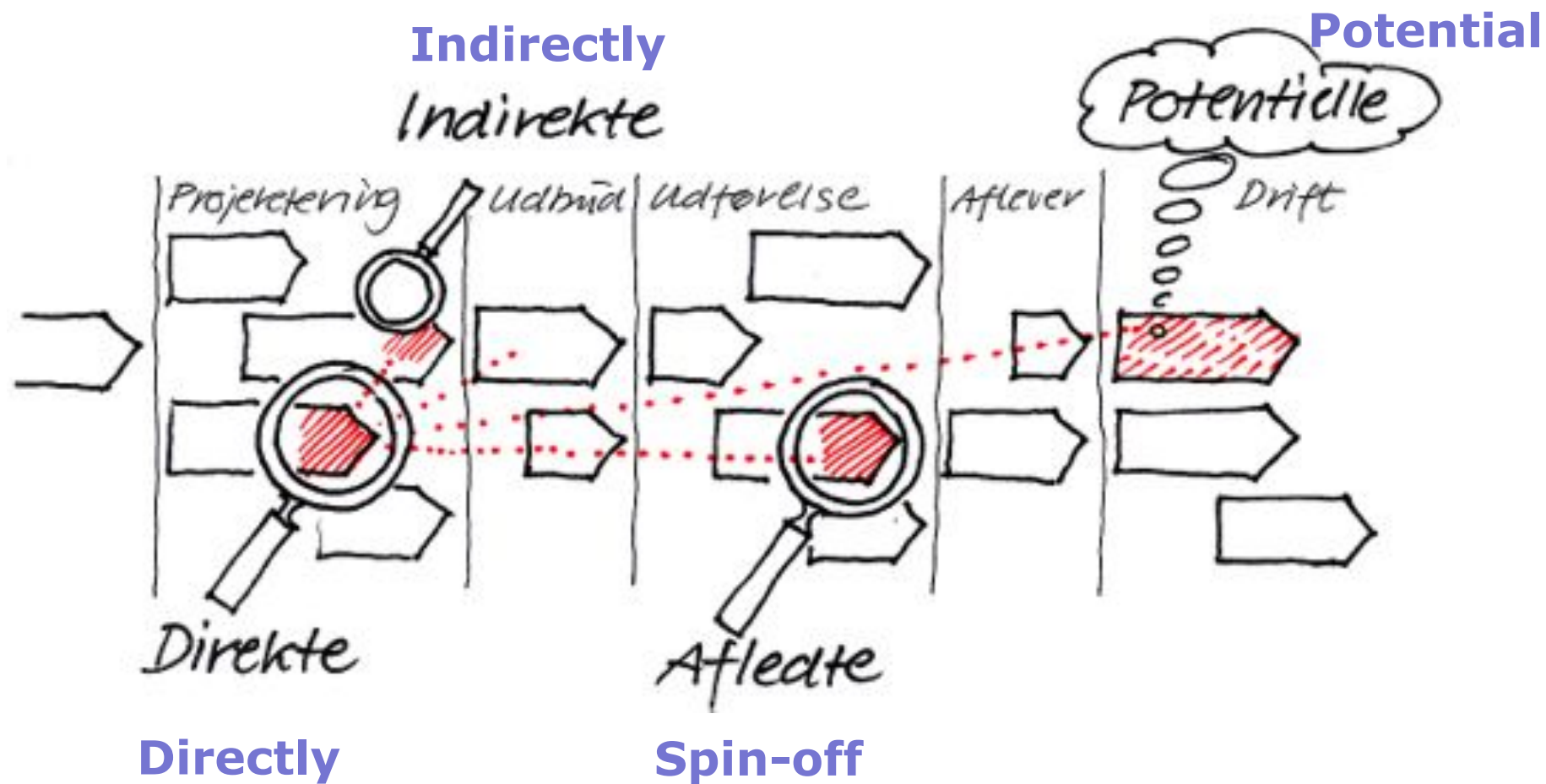
# Target levels

We look at all elements of the value chain – inside out

- The company system in the industry
- The Company level
  - decides on BIM-strategy,
  - decides on development of methods, tools, qualifications and collaboration within projects
- Project level
  - government PBO-ICT-Specification related to projects
  - collaboration with others take place within projects
  - ICT/BIM-setup is decided within the project



# Identifying profit - type of benefit 1



# ØG-DDB Manual

## Detailed specification – “How to do Manual”



A detailed specification of the method used meant for others to use.

Available for all within the sector – organisations, **companies**, research etc.

More cases and more benchmarking.

# ØG-DDB Manual

## List of Contents



- Story board for a case study
- Value analysis
- How to choose the case
- Potentials
- Expected findings
- Measuring the effects
- Checklists and schemas
- Excel spreadsheets
- Evaluating the results
- QA
- Describing the case

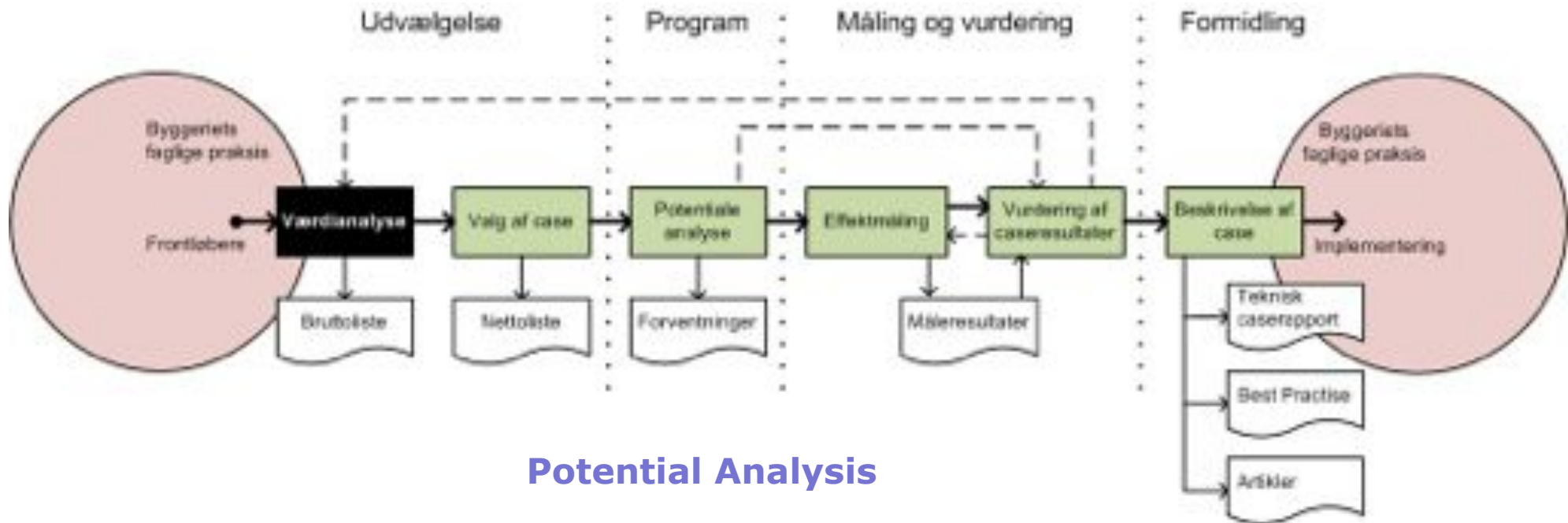
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 Dokumenttype: Værktøj  
 Dokumentførertid: Casestudier  
 Drevet ud af af: Navn: Navn, Virksomhed  
 ØG DDB EBST  
 Dato: ??/??/??

Udviklings- og implementeringsomkostninger		Type af omkostning (direkte, indirekte, afledt og potentielt)	Omkostninger (DKK)	
			Engangsbetalt	Pr. år
<b>A</b>	Udviklingsindsats			
	1. Udviklingsfase af IKT-konceptet			
	2. Ekstra udviklingspersonale			
	3. Test af E-mail-standard			
<b>B</b>	Ny hardware			
	1. Computere, printere, kommunikationsudstyr			
	2. Andet			
<b>C</b>	Ny software			
	1. Softwareindkøb			
	2. Andet			
<b>D</b>	Udpertræning			
	1. (Udvalgte) Udvalgte			
<b>E</b>	Implementering			
	1. Organisatoriske ændringer			
	2. Arbejdsstrategiske ændringer			
	3. Udsættelse af manualer etc.			
	4. Installation			
<b>F</b>	Andet:			
<b>Driftsomkostninger</b>				
<b>A</b>	Soft- og hardware vedligeholdelse			
<b>B</b>	Datavedligeholdelse			
<b>C</b>	Opgraderinger			
<b>D</b>	Leje af software og hardware			
<b>E</b>	Helpdesk			
<b>F</b>	Andet:			
Totalomkostninger (Udvikling+Implementering+drift)				

# Story board – and Toolbox

## Select Case

## Measure, Evaluate and QA



## Potential Analysis

## Present and Communicate



# ØG-DDB Manual – Spreadsheets examples



Dokumentnavn: Effektivisering, Potensialanalyse  
 Dokumenttype: Vurdering  
 Dokumentansvarlig: Casper Søgaard

ØG DDB  
 EBST  
 Draft udfyldt af: Navn: Årnet, Vinkenskov  
 Dato: 7/7/77-77

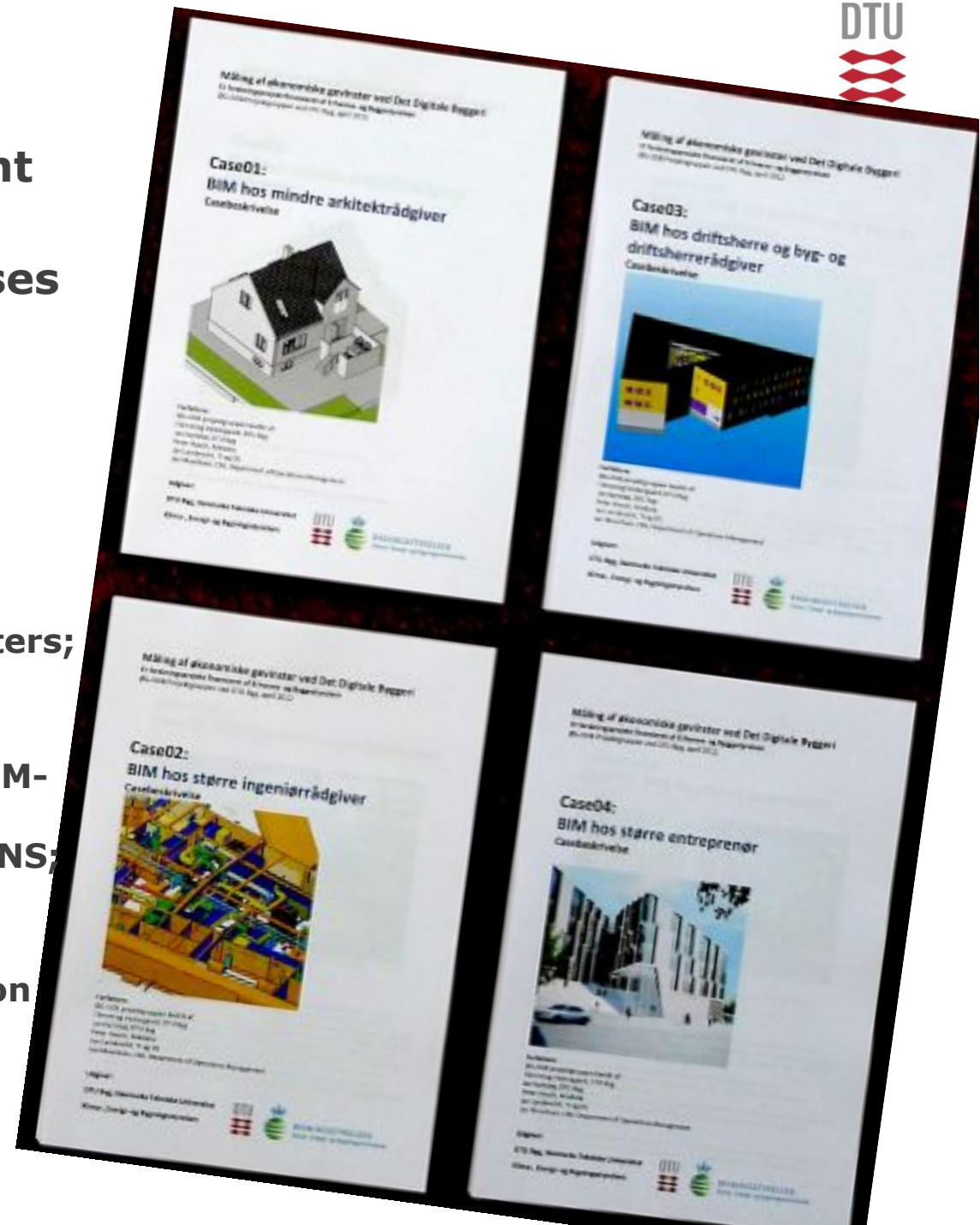
**Potentialeliste**  
 Gevinstbeskrivelse

Generelt:	Type	Målepåvirkning (posit./negativ)	Målingruppe
<b>Samarbejde</b> Støtte arbejdspladse gennem et integreret samarbejde mellem projektdeltagere og deres medarbejdere. Bedre projektkommunikation og forbedrede arbejdsprocesser ved 3D arbejdsmetode.	Ikke finansiel	eller estimat på en produktværdiændring	alle parter
<b>Projektkommunikation</b> Bedre pålidelighed af projektkommunikation gennem 3D modellering, samarbejde. Bedre kvalitet af projektkommunikation – og af informationer. Bedre samarbejdsrelationer via adgang til fælles informationer.	Finansiel	eller estimat på en produktværdiændring	alle parter
<b>It-udrustning</b> Forbedret It-udrustning, reduktion i udstyrsomkostninger.	Ikke finansiel	eller estimat på reduktion i de enkelte processer (vi kunne reducere ved konkrete processer - se andet afsnit)	alle parter
<b>Kommunikation</b> Bedre kommunikation mellem aktører i værdikæden. Bedre overblik og transparens i projekt og proces.	Ikke finansiel	eller estimat på reduktion i de enkelte processer (vi kunne reducere ved konkrete processer - se andet afsnit)	alle parter
<b>Økonomi</b> Bedre mulighed for at udvide røkt, medarbejderne fremtidsorienteret. Afløsning af processer/aktiviteter af tiden. Forbedret mulighed for innovation, grænser IKT-værktøjer og 3D arbejdsmetoder.	Finansiel	eller estimat på reduktion i de enkelte processer (vi kunne reducere ved konkrete processer - se andet afsnit)	alle parter
<b>Branding</b> Branding som teknologisk ledende i 3D og ØG DDB. Forbedret mulighed for større kompleksitet i bygningsskemaer.	Ikke finansiel	regulering af oplysninger af afleveringsmateriale eller estimat på reduktion i processer	alle parter
<b>Human resources</b> Bedre mulighed for at fastholde og rekruttere innovative medarbejdere.	Ikke finansiel	underbygget ved fastholdelse af kunder samt tiltrækning af nye	alle parter
<b>Programfasen:</b>	Ikke finansiel	variering på skala	alle parter

# The four cases

- 4 groups with engagement and BIM-competence
- Front-end/higher end cases

1. Tværsnit: Small architects firm specializing in; renewal of one family house; 1.8 Mill. Dkr.
2. Ramboll: Major Engineering Consultant; Ramboll Headquarters; 100 Mill. Dkr.
3. Archiwise and UCC: BOC and BIM-coordinator, Building Owner/ Facility Manager; UCC Campus NS; 65 Mill. Dkr.
4. MT Hojgaard: Major Construction Company; KPMG Headquarters CPH; 1 Bill. Dkr.



# The four cases – Value chain



Detailed design  
 Tender process  
 Production planning  
 Delivery  
 FM  
 Disposal

	Program	Design	Projektering	Udbud	Produktionsforberedelse	Produktion	Aflevering	Drift og vedligehold	Bortskaffelse
Case01	Light	Dark	Dark	Dark	Light	Light	Light	White	White
Case02	White	Light	Dark	Dark	Dark	Light	Light	Light	White
Case03	White	White	Light	Dark	Dark	Dark	Dark	Dark	White
Case04	White	Light	Dark	Light	Dark	Dark	Dark	White	White



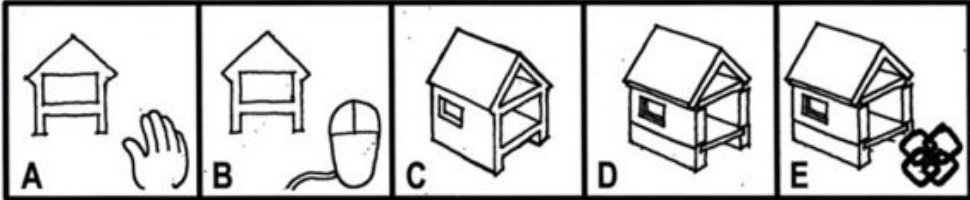
# The four cases – Process and Activity



Coordination  
 Consistency control  
 Data exchange  
 Simulation  
 Data analysis  
 Drawing prod.  
 Visualisation

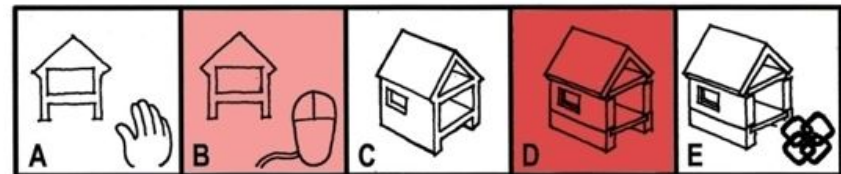
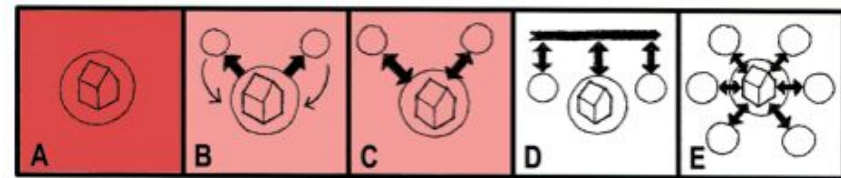
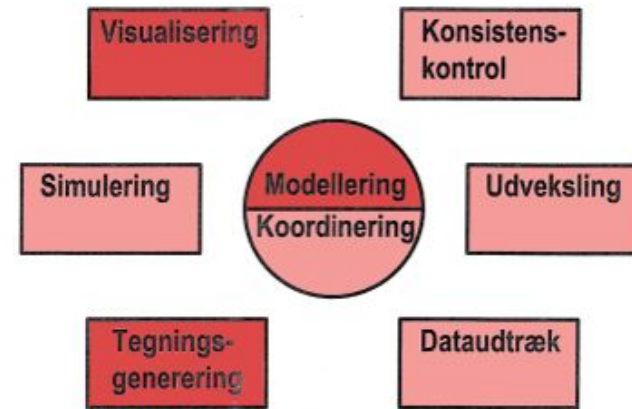
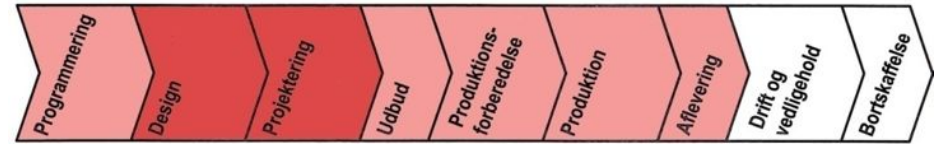
	Modellering	Koordinering	Konsistens kontrol	Udveksling	Simulering	Dataudtraek	Tegnings generering	Visualisering
Case01	Dark Red	Light Red	Light Red	Light Red	Light Red	Light Red	Dark Red	Dark Red
Case02	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red
Case03	Dark Red	Dark Red	Dark Red	Light Red	Dark Red	Dark Red	White	White
Case04	Dark Red	White	Light Red	Light Red	White	Light Red	Dark Red	Dark Red

# The four cases – Model level



	A	B	C	D	E
Case01					
Case02					
Case03					
Case04					

# Case01: BIM at the smaller architects



# Case01: Financial findings – summary



## Benefits and cost at the project level by all participants

Projektniveau: Samlede gevinster og omkostninger for aktørerne	Gevinst, Omkostning og resultat finansielt	Gevinst værdisat ikke finansielt
<b>Samlet projekt (byggesum: 1.800.000)</b>		
<b>Gevinster</b>		
Arkitekt	15.500	A
Ingeniør	13.000	A
Entreprenør	0	B
Bygherre indløst	183.500	A
<b><i>Gevinster total</i></b>	<b>212.000</b>	<b>Meget højt</b>
<b>Omkostninger</b>		
Arkitekt	16.311	
Ingeniør	12.350	
Entreprenør	0	
Bygherre	9.000	
<b><i>Omkostninger total</i></b>	<b>37.661</b>	
<b><i>Netto resultat</i></b>	<b>174.339</b>	<b>Meget højt</b>

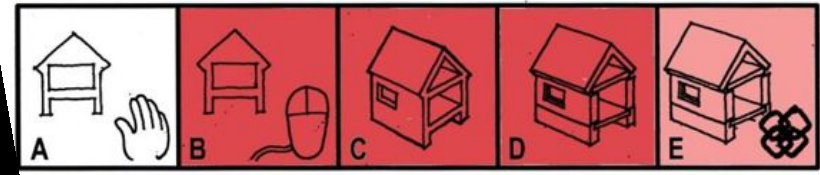
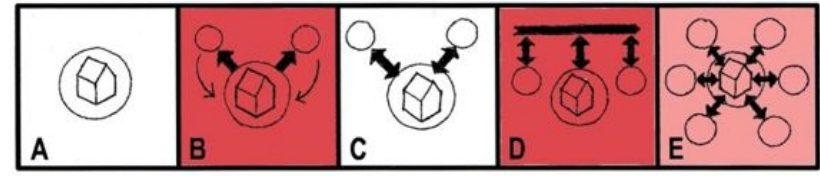
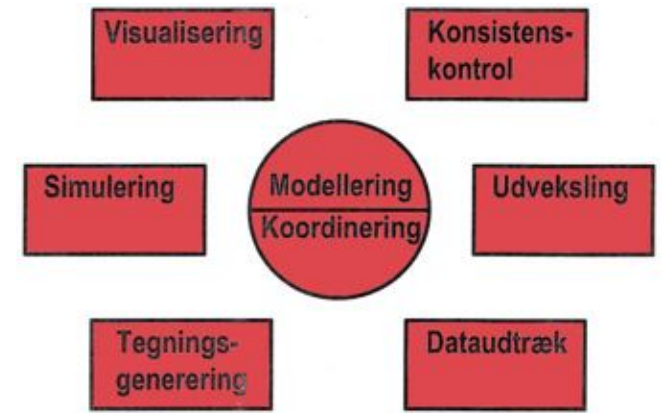
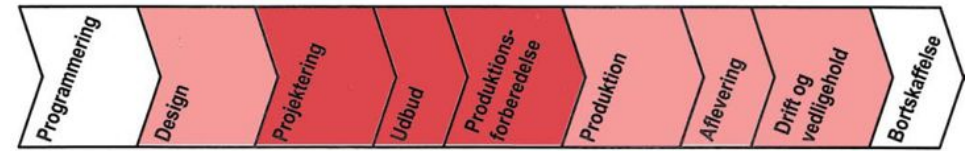
# Case01: Other findings – summary



- For the two smaller consultants there are benefits by using BIM. Even though the fee is the same as normal there are benefits that comfortably outbalances the cost.
- The BIM-method resulted in a more consistent project, better communication, better flow, less faults and no claims – all in all less time and trouble for the consultants.
- The high project quality resulted in a better economic result for the contractor and a 10% reduction of the contractors bid price. We can conclude, that both the building owner and the contractor benefitted from the spin-off of the 3D model.
- The model was used as the basis for simulation of energy consumption. The result of this is a low-energy house. The building owner will benefit from this during a long period of time – and so will society.



# Case02: BIM at the major engineering comp.



# Case02: Financial findings – summary



## Benefits and cost by using design models

Hovedproces 1: Projektledelse og projektering med brug af fag- og fællesmodeller									
Delprocesser	Gevinst- type	Hovedrådgiver	Fagrådgivere	Fagentreprenør	Bygherre	Driftsherre	Brugere	Gevinst målt i kr, eller procenter	Gevinst- niveau for ikke finansiel le effektor
<b>Hovedrådgiver:</b>									
Bedre kommunikation med samarbejdsparter	Direkte								A
Mindre behov for fysisk kommunikation	Direkte								C
Mere konsistent projektmateriale, reduktion af fejl, eksempel: dørentreprise	Direkte							350.000	
Hurtig ændring og opdatering af projektmat.	Direkte								B
Automation ved generering af ståltegninger	Direkte							40.000	
Hurtig afvikling af projekteringsteamet	Direkte							3.767.500	
Medarbejderinvolvering	Indirekte								A
Bedre motivation	Indirekte								C
Bedre procesforståelse gennem BIM	Indirekte								A
Aflevering til tiden, delvis BIM	Indirekte								A
Bedre indeklima grundet simulering af bygningsfysiske egenskaber	Afledte								A
Mulighed for større kompleksitet i bygningsdesign	Afledte								B
<b>Målte gevinster total</b>								4.157.500	Højt
<b>Omkostninger</b>									
Årlige afskrivninger								50.000	
Driftsomkostninger								189.000	
<b>Målte omkostninger</b>								239.000	
<b>Netto resultat</b>								3.918.500	

# Case02: Financial findings – summary



Benefits and cost in production planning and logistics by Ventilation Contractor

Hovedproces 2: Udbud/tilbud og produktionsforberedelse									
Delprocesser	Gevinst- type	Gevinstkilder						Gevinst målt i kr. eller procenter	Gevinst- niveau for ikke finansielle effekter
		Hovedrådgiver	Fagrådgivere	Fagentrepræner	Bygherre	Driftsherre	Brugere		
<b>Hovedrådgiver:</b>									
Tidsreduktion ved bedre koordinering mellem fagmodeller	Direkte								B
Informationsoverførsel til stålleverandør	Direkte						15%		
<b>Fagentrepræner, Ventilation (entreprisenum: 36 mio. kr.)</b>									
Reduktion i tilbud til supplerende arbejde	Afledte								IM
Reduktion i tid ved koordinering af fag	Afledte						3.240.000 15 %		
<b>Fagentrepræner, VVS</b>									
Reduktion i tid og spild ved digital materialebestilling	Afledte						20-25 %		
<b>Fagentrepræner, El</b>									
Hurtigere overblik over projektet									B/C
<i>Målte gevinster total</i>							3.240.000 15-25 %		Højt
<b>Omkostninger</b>									
Hovedrådgiver									-
Fagentrepræner, Ventilation							133.333		
Fagentrepræner, VVS							0		
Fagentrepræner, El							0		
<i>Målte omkostninger ialt</i>							133.333		
<i>Netto resultat</i>	Afledte						3.376.667		

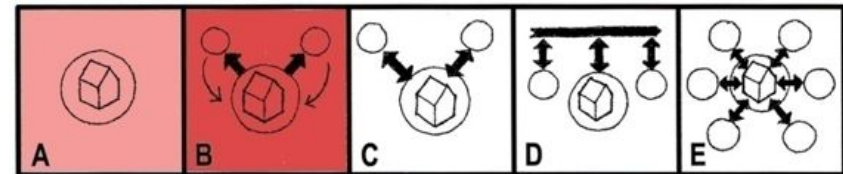
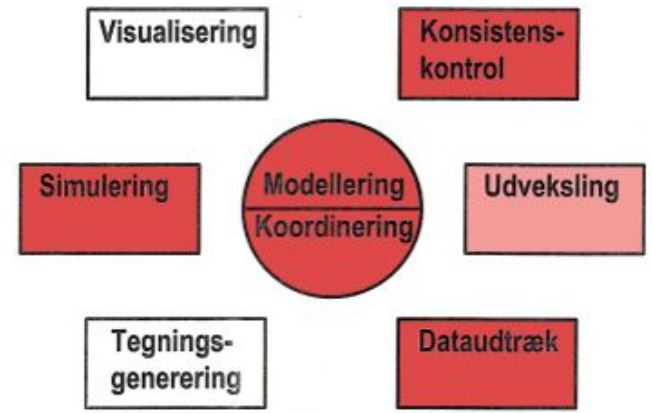
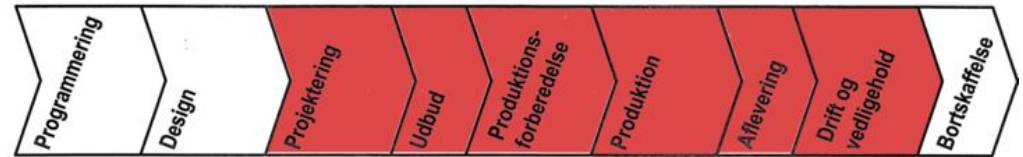


# Case02: Other findings – summary



- **It was possible to carry out the BIM-modelling within the same economy as normally. There is a benefit even if you only communicate through traditional documents – because they are of a higher standard.**
- **Ramboll played several roles within the project and could benefit within several areas. A major win was the faster closing down of the project team worth 3.8 Mill. Dkr.**
- **There are benefits to pick up for all contractors in the case. But there is a greater benefit the more you invest and collaborate with others based on the model.**
- **The Ventilation contractor reduced coordination cost by 3.5 Mill. Dkr., reduced the time spent on site by 15-20% and reduced flow stop by 85–90%.**
- **Finally the model was used when tendering the cleaning- and service-contract, resulting in a 30% price reduction.**

# Case 03: BIM at BOC and BIM consultants



# Case03: Financial findings – summary

## Benefits and cost at the project level by Building Owner

Samlet resultat for byg- og driftsherre for finansielle gevinster										
Delprocesser	Gevinst-type	Projektleder	Rådgivere	Entreprenør	Bygherre	Driftsherre	D&V-	Brugere	Gevinst målt i kr.	Gevinst-niveau for ikke finansielle effekter
<b>Byg- og driftsherre (anlægssum 65 mio. kr.)</b>										
<b>Hovedproces 1</b> Bygherrerådgivning under projektering med brug af styringsmodel	Direkte								1.450.000	Højt
<b>Hovedproces 2</b> Udbud/tilbud og produktionsforberedelse	Direkte								7.560.000	-
<b>Hovedproces 3</b> Udførelse på byggeplads	Direkte								307.000	Højt
<b>Hovedproces 4</b> Aflevering og drift og vedligehold	Direkte								*9.000.000	Højt
<b>Målte gevinster for driftsherren total</b>	Direkte								18.317.000	Højt
<b>Omkostninger</b>										
<i>Samlede omkostninger for IKT-konceptet</i>									938.000	
<b>Samlet nettoresultat for driftsherren</b>									*17.379.000	

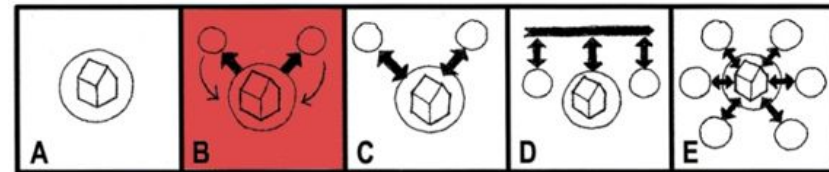
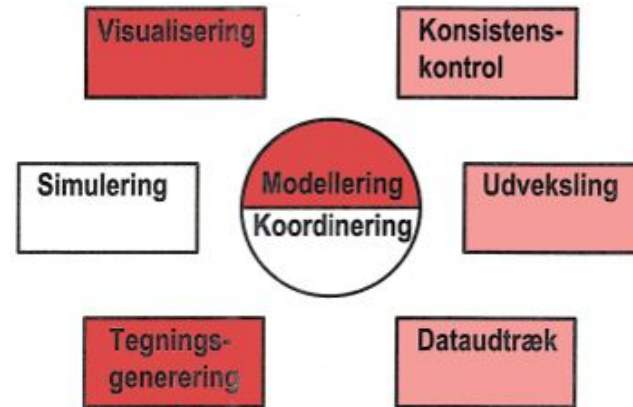
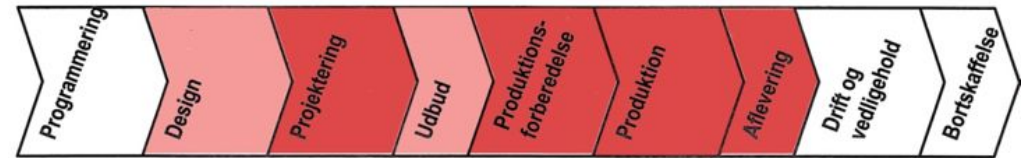
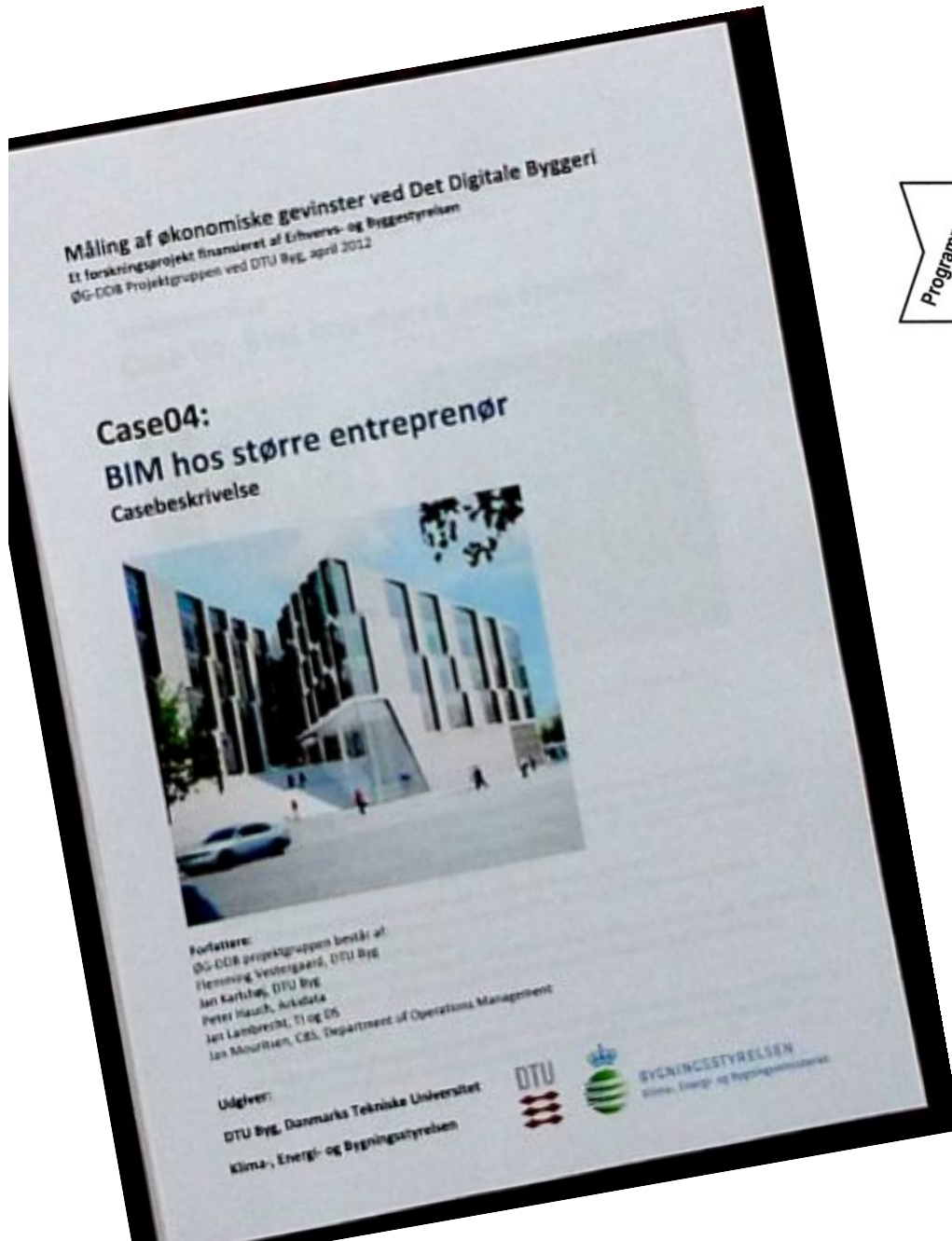
# Case03: Other findings – summary



- There are benefits within all processes. The major benefit in the design phase is the better and more consistent project with much less faults and deficiencies – representing a benefit worth 1.2 Mill. Dkr. , a 250.000 Dkr. reduction on establishing the basis for FM.
- The major benefit was a 15% reduction of the tender price equivalent to 7.56 Mill. Dkr.
- Closer follow up the economy reduced mortgage by 307.000 Dkr.
- The FM-body calculates a reduction of FM-costs by 15% equivalent to 7.56 Mill. Dkr. In a 15 year perspective this gives a calculated value of today at 9 Mill. Dkr.
- The case seems to confirm that the BO-FM can profit very much by insisting on the use of BIM – from programming to FM.



# Case 04: BIM at the major contractors



# Case04: Other findings – summary



- The total cost of this “low-end” BIM implementation sums up to 1 Mill. Dkr. including training, development of object library, new processes etc. This must be considered as an investment to be distributed between several projects.
- If we distribute the cost between three projects it is 333.333 Dkr. for each project. Already the second time the concept is in use there is a benefit of 300.000 Dkr. on a similar project.
- **The contractor has within his design engineering shop implemented a BIM-based practise to improve and reduce the cost of one of his major functions – shop drawing production. This pays back even after being used only twice, and even without realising an enormous potential within calculation, bidding, production planning, production flow etc. etc.**
- A step-by-step implementation of this kind can pay off – but you will not be able to realize the full potential of BIM.

# Cross case summary 1

## - on implementation

- **You can do a step-by-step transformation from document based collaboration to BIM.**
- **Start with simple, model based processes like generation of drawings and collision- and consistency control.**
- **You can benefit from these low-end implementations at each step.**
- **Those cases representing the most intensive use of the BIM-model in most processes also show the best results.**

# Cross case summary 2

## - on user response



- **All those who have implemented BIM-like technology and -methods will never go back.**
- **BIM-methods give a better coordination between disciplines and more valid data.**
- **BIM? - is no longer a question of IF – but WHEN.**
- **The Government PBO-ICT-Specifications bring us in the right direction.**
- **BIM and the following change in processes has a positive impact on collaboration and on the climate within the project.**



# Cross case summary 3

## - is the cost frightening?



- **A stepwise upgrade from CAD to BIM can balance over a very short period of time and within few cycles.**
- **Start sub optimizing your well-known key workflows.**
- **BIM- and document based workflows can coexist within the company and the project, but it minimizes potential.**
- **The cost is on lifting qualifications and developing and implementing new workflows and collaboration – not on ICT-tools.**
- **Size is no big deal. The smaller company can easily do a total implementation – but so can a small department.**

# Cross case summary 4

## - focus on data-exchange and reuse of data



- **The more times you use and reuse BIM-data (where it gives a meaning and adds value for the user) the more you - and others - benefit.**
- **Those participants who are aware of their possibility to reuse data from the model to support their own processes are those that benefit the most.**
- **It is a challenge to your creativity and knowledge to figure out how to reuse BIM-data in your workflow, how to change your workflow and maybe even move into new business areas. This counts for both the manager and for the man I the shop and on site.**

# Cross case summary 5

## - everybody is a winner – it is a win-win

- The benefits are bigger within the project than within the company.
- The more you invest in competence, new workflows and in collaboration – the more you benefit.
- Even sub optimizing a single process can be a winner.
- Productivity boosts with each repetition.
- Your partners in the project that do not invest in ICT/ BIM will also benefit – but less than you.
- Keep and recruit valuable employees through BIM

# Cross case summary 6

## - Who will harvest?



- **The direct and indirect benefits reflect the cost within the company, and the benefits are often caused by automation.**
- **The spin-off benefits you find within the project where the cost is unevenly distributed. Some sow others reap.**
- **Someone has to take the initiative – and the initial cost.**
- **Integration and interdisciplinary collaboration is not in the way of getting a hand on the benefits – on the contrary – it can open up for the even bigger win.**

# True! – depending on - - -

**Increase of productivity by 70%**

**Reduction of inconsistency in documents 95%**

**Reduction of collisions by 100%**

**Reduction of bid price by 30%**

**Reduction of faults on site by 90%**

**Reduction of cost of FM by 20%**

## Why doesn't everybody do it?

# Questions?

Well – was it of any help??

Thank you!

Se an extended version of the slideshow at  
BuildingSMART.NO

You will find the reports here:

[http://www.byg.dtu.dk/Publikationer/Byg\\_rapporter.aspx](http://www.byg.dtu.dk/Publikationer/Byg_rapporter.aspx)

