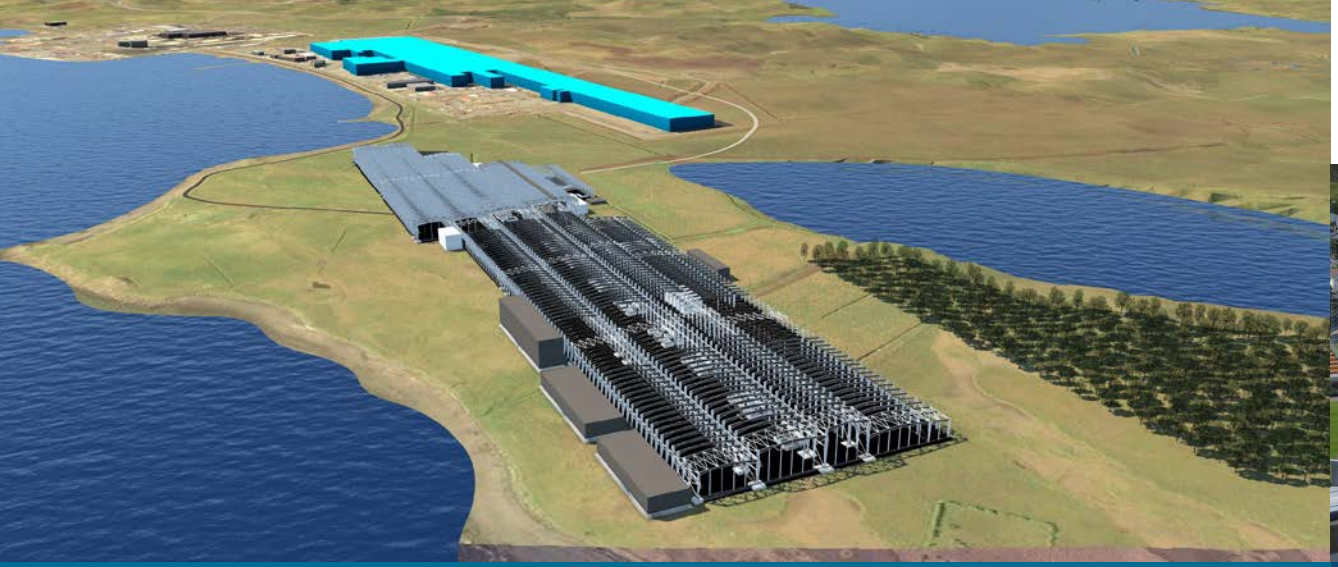
Kvaliteten og produktiviteten øges i byggeriet med det rigtige digitale samarbejde

Peter Bo Olsen
14. november 2016

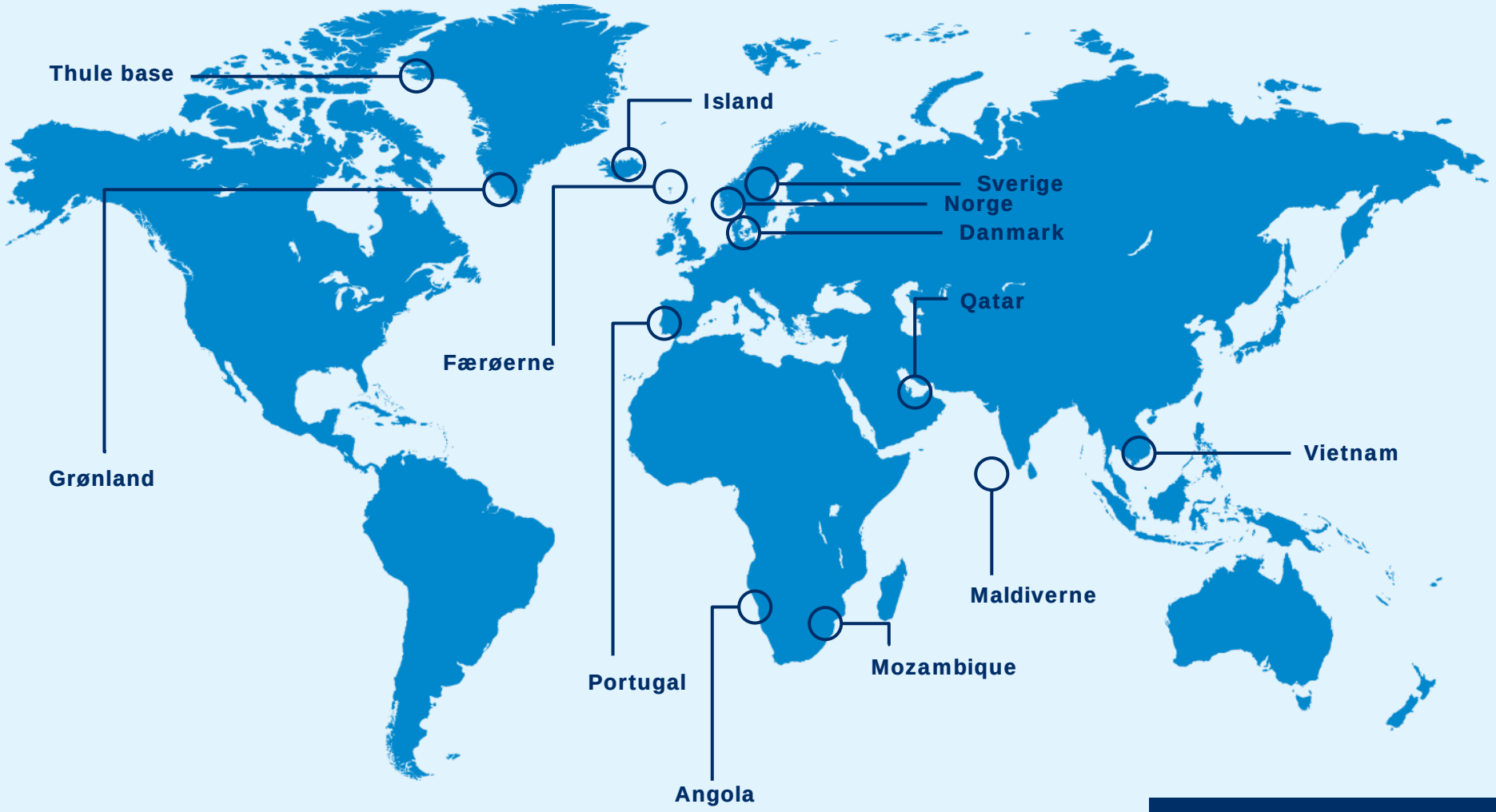
MTHøjgaard



I næsten 100 år har MT Højgaard skabt bygninger og faciliteter, hvor vi bor, arbejder og rejser ...

- Kontorer, boliger og indkøbscentre
- Hospitaler, skoler og idrætsanlæg
- Beton og stålbroer
- Lufthavne, havne, veje og vandforsyning
- Produktionsanlæg.

MT Højgaard | Geografisk platform



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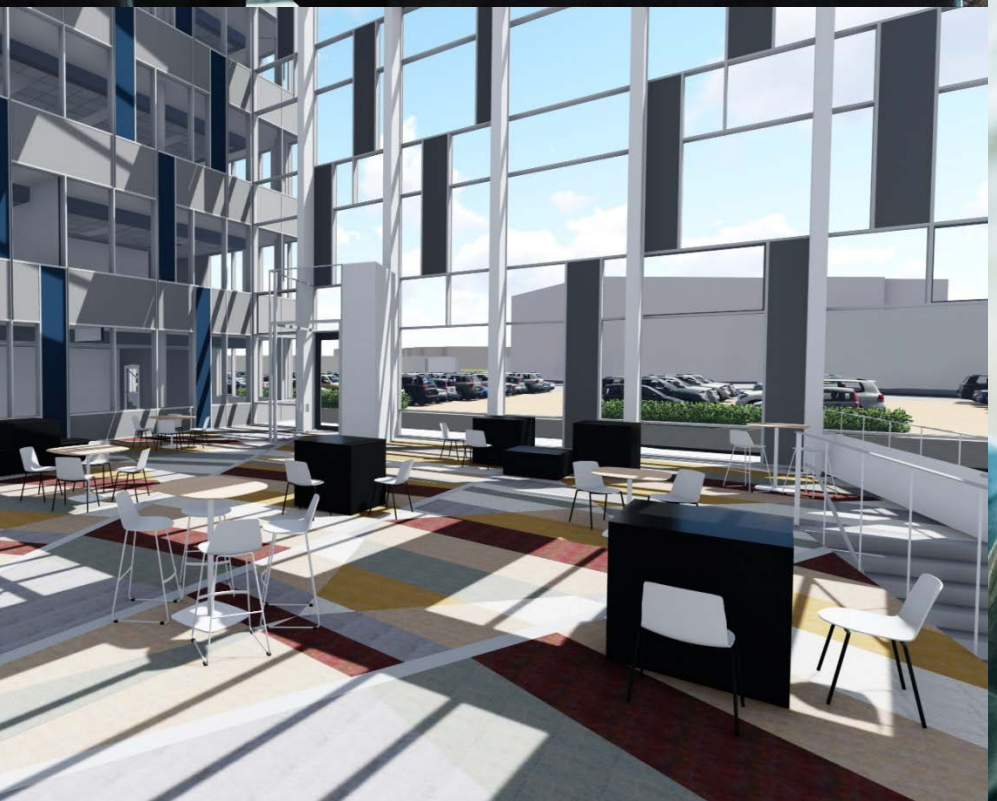

Vi bygger virtuelt før, vi bygger i virkeligheden

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Strategirammen

Vision
Den mest produktivitetsfremmende koncern i bygge- og anlægsbranchen

Krav
5% EBIT som minimum i alle forretningsområder og dattervirksomheder
Positivt cash flow

Mål
Kundetilfredshed indeks 76
60% omsætning fra nøglekunder
Medarbejdertilfredshed indeks 76
Ingen fejl og mangler
Max. 15 ulykker pr. 1. mio. arbejdstimer
Løbende produktivitetsforbedring

Projekter fra samfund til drift

Best in class VDC

Udnytte koncernsynergier

Styr på driften

Medarbejdere, ledelse, kultur og værdier

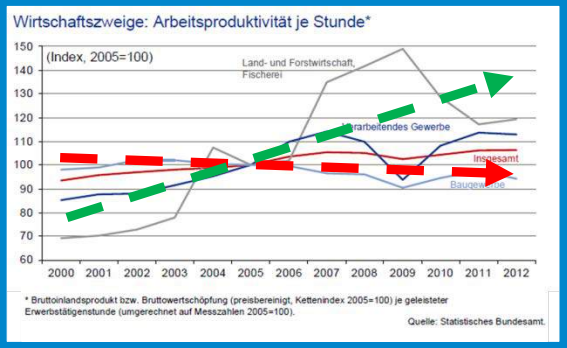
Projekt- og prisoptimering

Marked og kunder

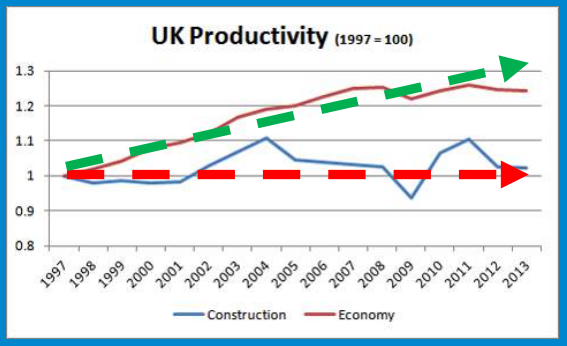
Koncernstrategi

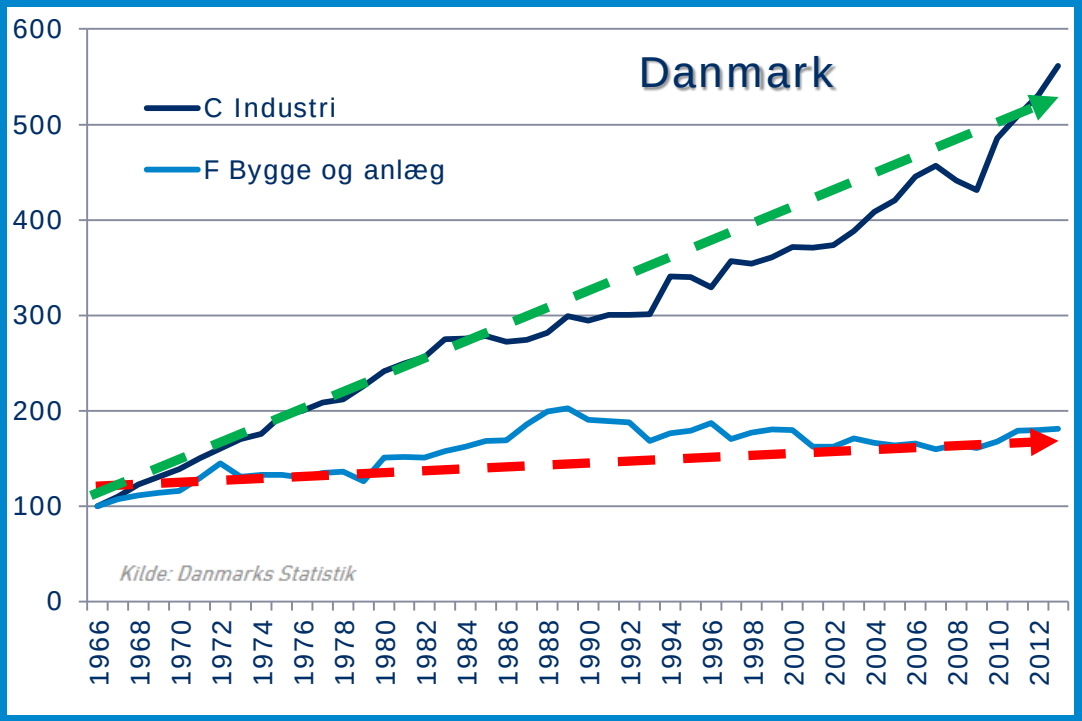
Produktivitet | Byggebranche GER, UK, USA & DK

Tyskland

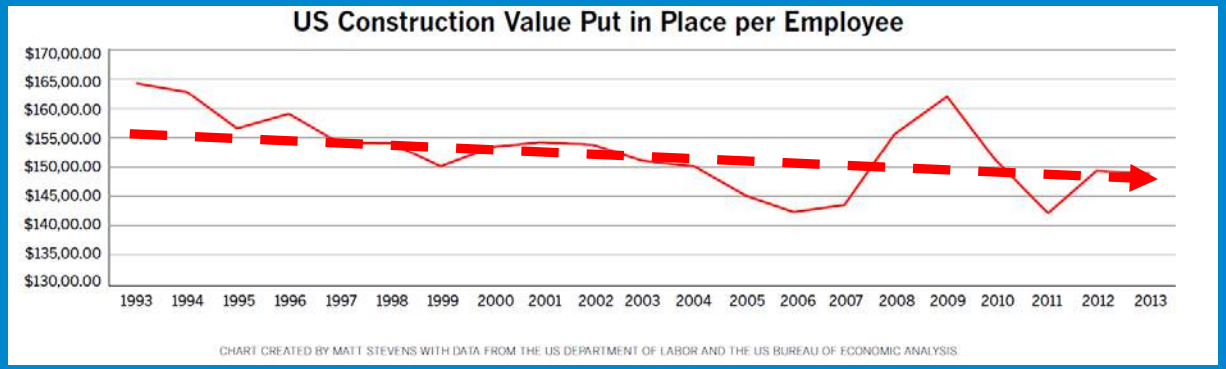


UK





USA



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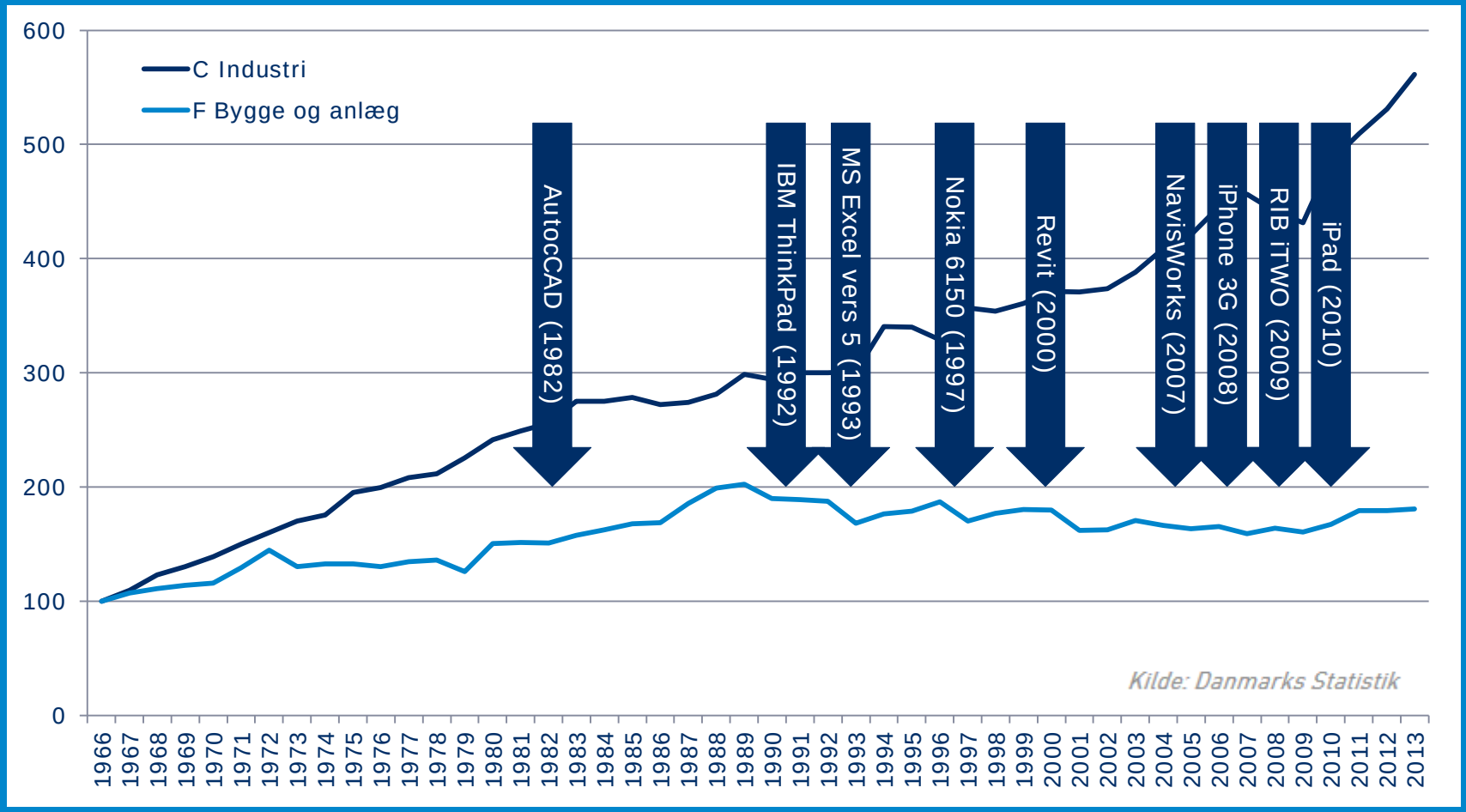
Produktivitet | Indflydelse af teknologi



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Produktivitet | Kulturen

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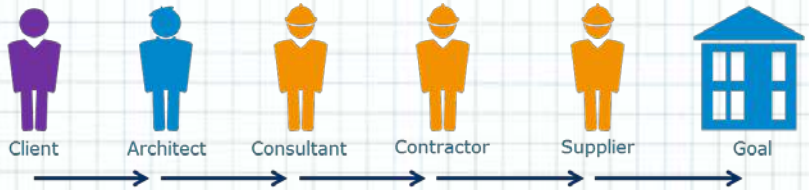
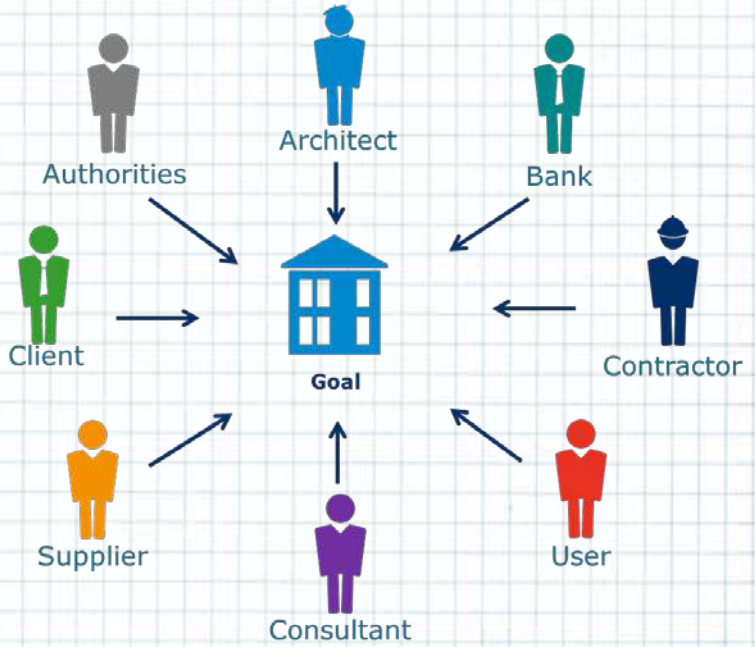
Kontrakter, der understøtter samarbejde





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Der er meget, vi kan gøre for at forbedre ...

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Den tidlige involvering stiller nye krav til os

Vi skal

- gøre det **nemmere for bygherre** at tage beslutninger
- **give bedre og hurtigere svar** om pris og tid til arkitekten og ingeniøren, så de ikke går i stå med deres arbejde

Visualiseringer

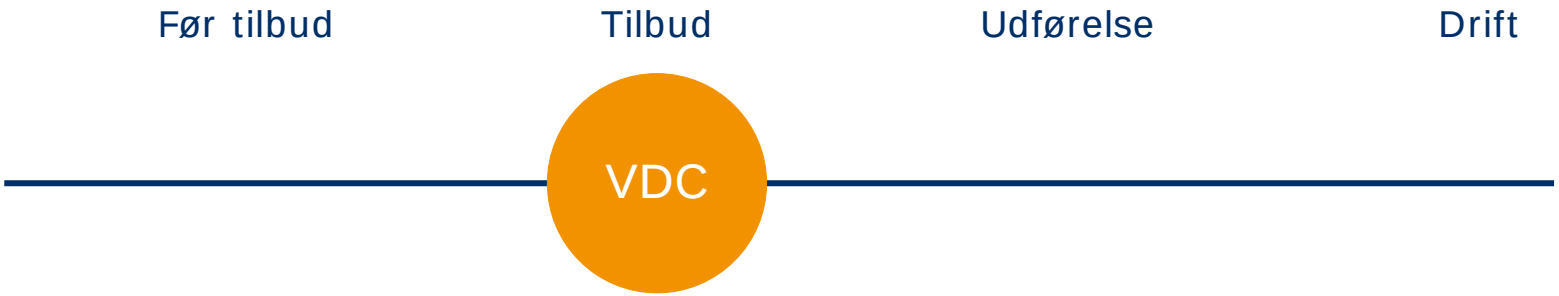
Virtual reality

Tidlige modeller

Integreret overslagsberegning

Integreret tilbudsberegning

VDC | Udgangspunkt i tilbudsfasen



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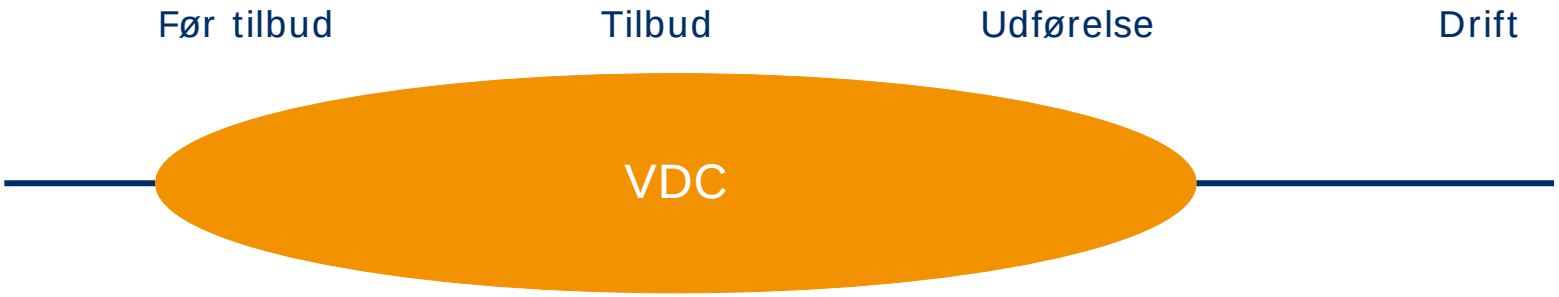
VDC | Tidlig involvering sikre godt grundlag for produktionen



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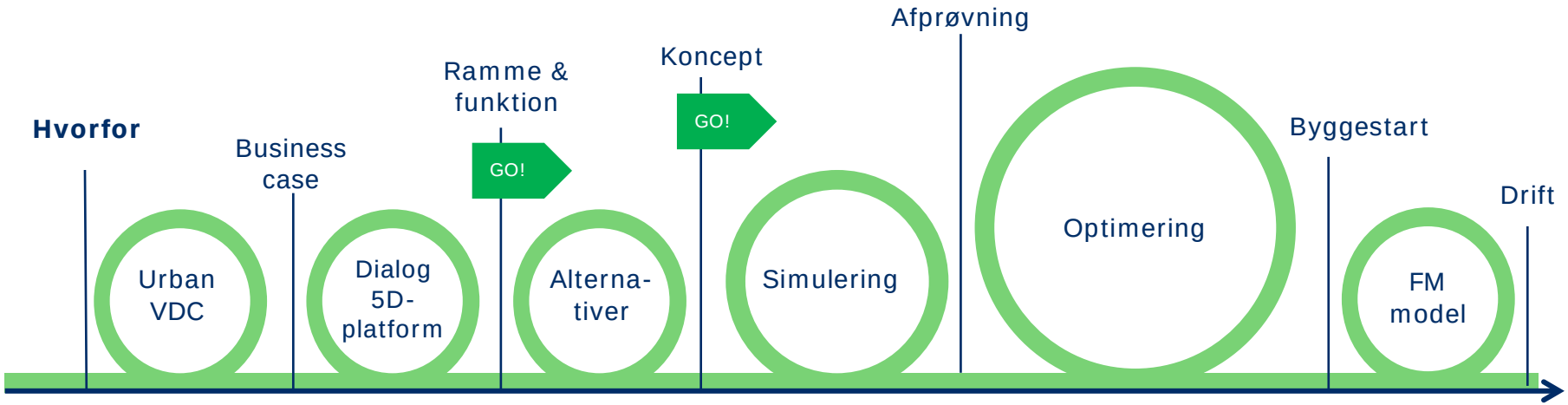
Vi tilpasser vores indsats ud fra projektets kommercielle mål og strategiske fokusområder


Vi inddrager relevante kompetencer tidligt, og optimerer projektet i fællesskab

Vi arbejder integreret og modelbaseret med design, planlægning, kalkulation og udførelse.


Vi arbejder med alternativer og korte iterationer

VDC-samarbejdet i praksis



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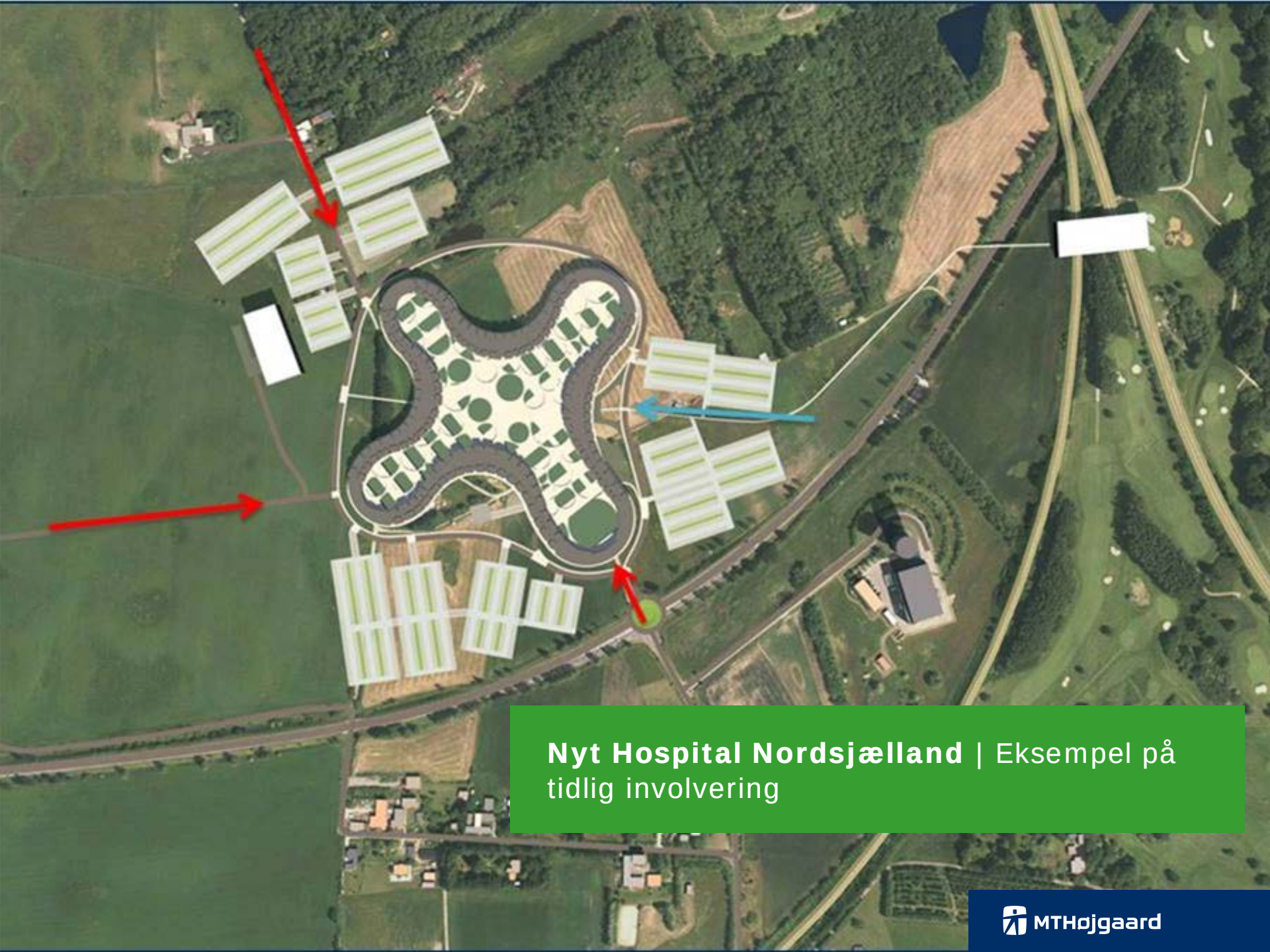
Effektivitet | Tidlige involvering



Nyt Hospital Nordsjælland | Eksempel på tidlig involvering

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Nyt Hospital Nordsjælland | Optimering af logistik og tilgængelighed

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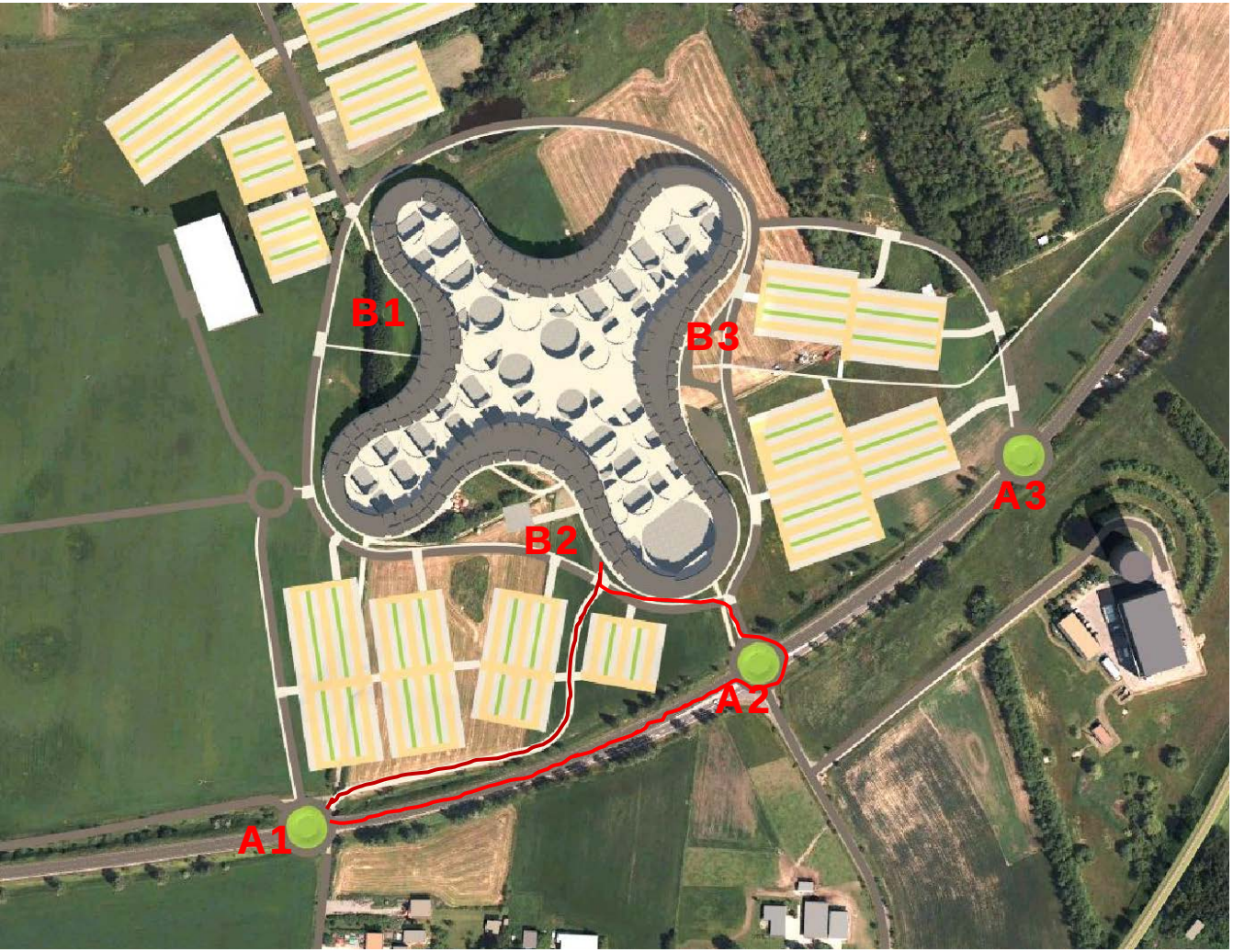
Nyt Hospital Nordsjælland | Tilgængelighed



Designforslag
A1-A2-B2
= 45sek

MTH-forslag
A1-B2
= 30sek

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Nyt Hospital Nordsjælland |
Logistik, tilgængelighed og …..

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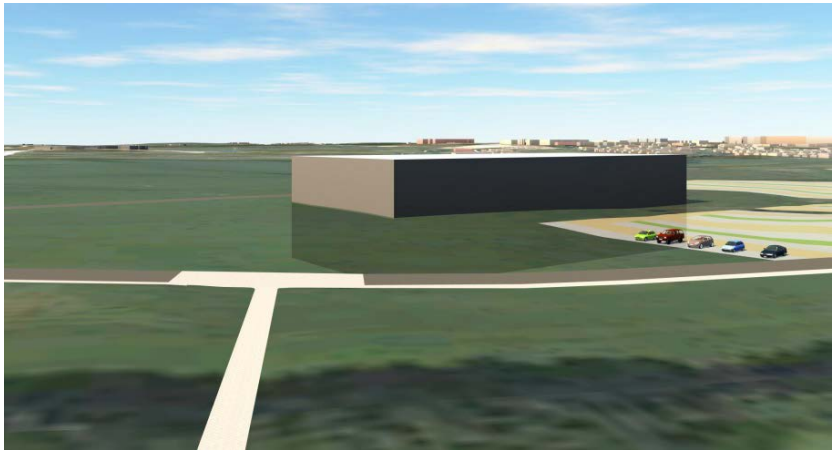
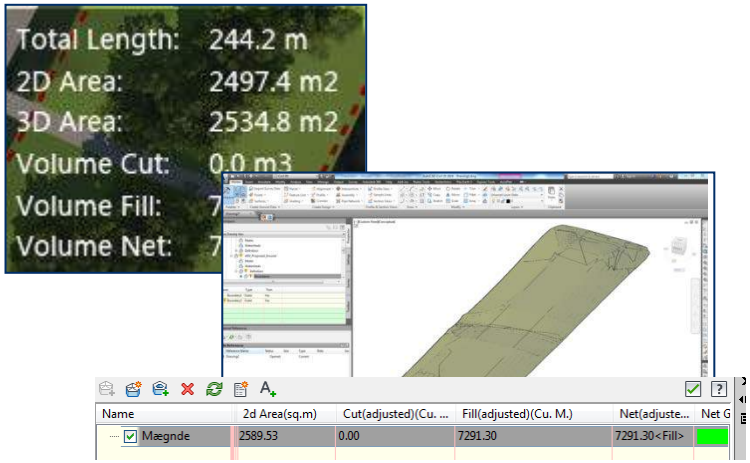
Nyt Hospital Nordsjælland | Udsigtsanalyse og konkretisering af alternativer





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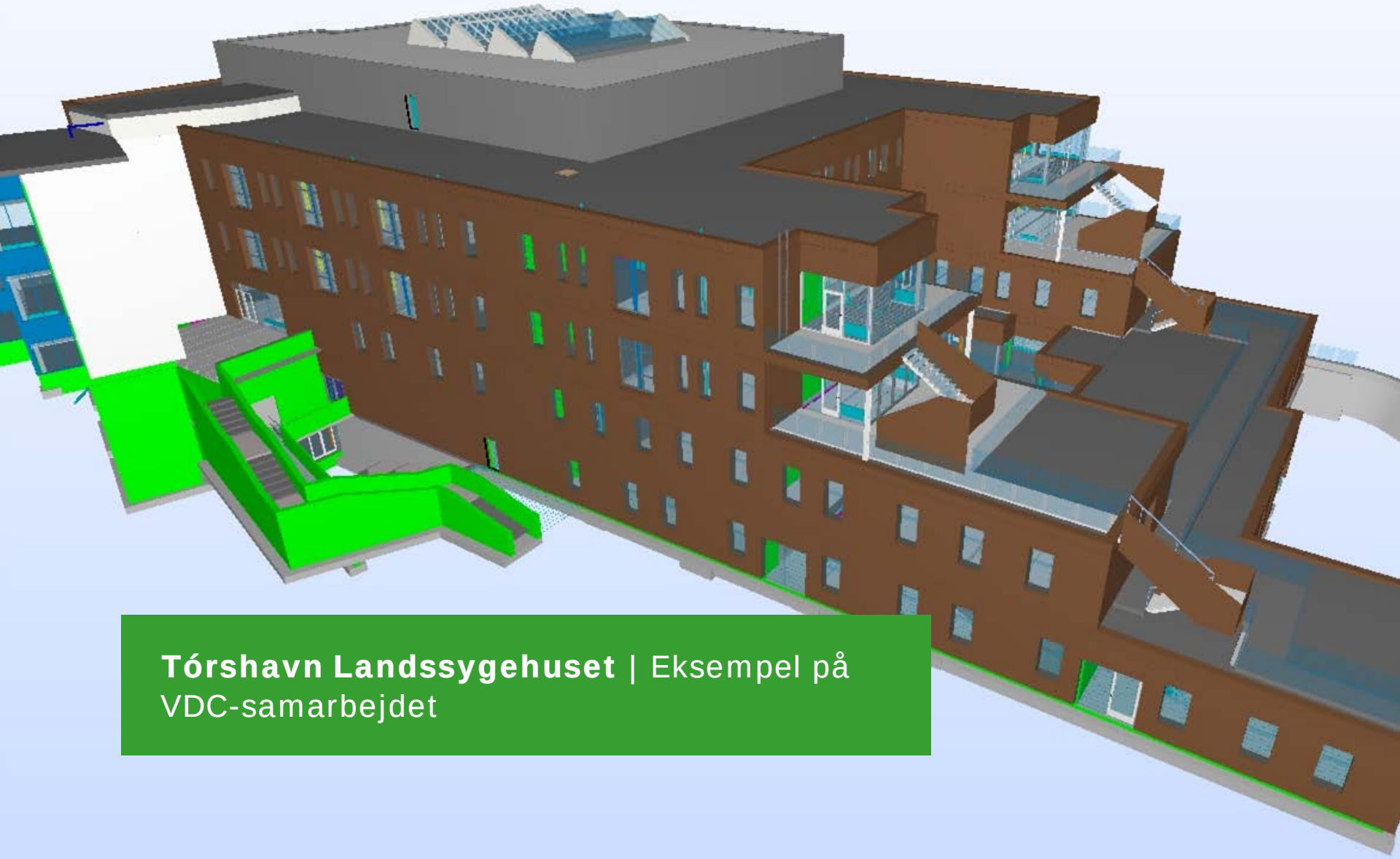

Tórshavn Landssygehuset | Eksempel på VDC-samarbejdet

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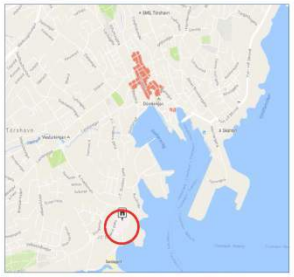
Tórshavn Landssygehuset | Urban VDC

Tórshavn Landssygehuset | Landssygehuset

- Landssygehuset i Tórshavn (Landssjúkrahúsið)
  - Udgør et grundareal på 150.000 [m^2] fordelt på begge sider af J. C. Svabosgøta
  - Gulvarealet udgør i alt 50.000 [m^2] fordelt på flere bygninger , hvor skadestue og fødeafdeling samt intensive, medicinske og kirurgiske afdelinger er lokaliseret øst for J. C. Svabosgøta



Kilde: http://www.lsh.fo/sjukingar/finn-veg/finn-veg-til-sjukrahusid/

Aktivitet
Ca. 850 medarbejdere fordelt i ca. 30 faggrupper
29 specialer (heraf 9 konsulentordninger)
170 sengepladser
8.000 indlæggelser om året
60.000 ambulante besøg om året
524.000 analyser i klinisk kemi om året
34.000 røntgenundersøgelser om året

Kilde: http://www.ls.fo/media/3106/ls-fakta_dk.pdf

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Tórshavn Landssygehuset | Introduktion

Kilde: https://da.wikipedia.org/wiki/F%C3%A6r%C3%B8erne

Kilde: www.torshavn.fo

	Areal
- Total	1.399 km² (nr. 180)
- Vand (%)	0,5
	Indbyggertal
- Ansiået juli 2015	50.196 (nr. 206)
- Folketælling 2007	48.760
- Tæthed	36/km² (nr. 91)
Etnicitet	91,7% færinger 5,8% danskere 0,4% islændinge 0,2% nordmænd 0,2% polakker

- Færøerne er en øgruppe af bestående af i alt 18 øer
  - Delvis selvstyre under Rigsfællesskabet dog uden at være EU medlem
  - Landet består af 6 syssler og 30 kommuner
- Torshavn Kommune ligger på øen Streymoy og den består af hovedstaden Tórshavn og omegn
  - Tórshavn Kommune udgør et areal på 173km^2, hvor 20.521 af landets 50.196 indbyggere bor (~41%)
- I alt 3 sygehuse på Færøerne:
  - Landssygehuset i Tórshavn, Sygehuset i Klaksvík og nordøerne samt Sygehuset på Suðuroy (den sydligste ø).

→ Der skal opføres en ny tilbygning til Landssygehuset i Tórshavn.

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Tórshavn Landssygehuset | Bygning H

Det færøske sundhedsvæsen er i dag et moderne sundhedsvæsen med et godt og veluddannet personale på alle fronter.

På Landssygehuset i Thorshavn har man netop taget et stort, nyt og topmoderne vaskeri i brug. Et vaskeri, der ud over at tage sig af sygehusets tøj også vil vaske tøj for hele Færøernes store fiskeflåde. Dertil tager sygehusets nye vaskeri sig også af alt tøj fra Færøernes store passagerflåde, Norrøna, der har plads til mere end 1200 passagerer. Norrøna er i passagerfart mellem Danmark, Færøerne og Island.

Man har udført en særdeles vellykket digitalisering af det færøske sundhedssystem, der har skabt stor interesse i udlandet. Det ene regionale sygehus (der er to, et i Klaksvik og et i Tvøroyri, Sudoerø) skal etableres for mange millioner kroner. Og nu skal man til at byggenye sygehuse i Tórshavn. Det er en udvidelse – sygehusbygning i Tórshavn. Dristig, blandt andet fordi man i den nye bygning, både skal have plads til psykiatriske og somatiske patienter – tæt på hinanden.

Meget spændende nybygning

"Der er tale om nytænkning på flere områder, blandt andet sammensætning af patienter og personale i den nye sygehusbygning," siger Ian á Argjadoofta, ingeniør og projektleder.

De fysiske omstændigheder for psykiatrien på Færøerne har længe været ude af trit med nutidens krav og behov. Med den nye sygehusbygning bliver forholdene i psykiatrien ajourført. Den nye bygning skal nemlig bl.a. huse Psykiatrisk Center. Der bliver en fælles indgang, og bygningen kommer til at indeholde. Psykiatrisk Center, somatisk sengeafdeling, fødeafdeling, rehabilitering, køkken og kantine samt sengecentral.

"Når det kommer til sengecentralen, har vi planer om at lave et elevatortårn, der skal fungere som sengecentral. Det bliver således langt enklere at flytte senge, vedligeholdelsen bliver mere effektiv, og rengøringen bliver også enklere. Man har ikke prøvet noget lignende andre steder, så det er vi meget spændte på," siger Ian á Argjadoofta, der pointerer, at den stærkte fordel med et elevatortårn er besparelsen af gulvplads.

Digital 3D projektering

Grønt og sammenhængende arbejdsplads

Store omkostninger

- Grønt/innovativt projekt:
  - 100% varme fra overskuds- og havenergi + logistiske løsninger for optimeret drift

➢ Fokus på IT-løsninger igennem projektet → Stort potentiale for BIM og VDC

Kilde: http://www.hospitaldrift.dk/sites/default/files/hospital20drift20arkitektur_5_2014_0.pdf

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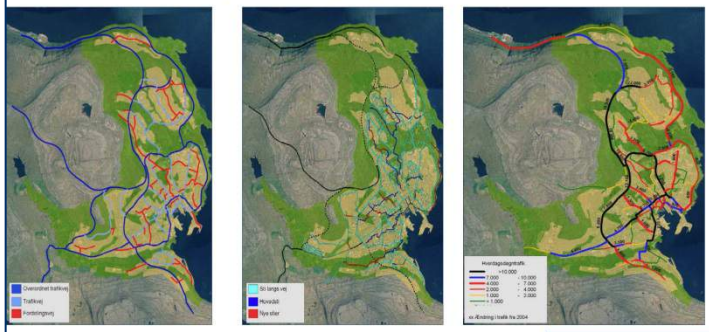
Tórshavn Landssygehuset | Urban VDC

Tórshavn Landssygehuset | Trafik

- 2 former for veje (Trafikveje og fordelingsveje)
- Landssygehuset ligger på J. C. Svabosgøta, en af Tórshavns overordnede trafikveje m. en hverdagsdøgntrafik på >10.000



Kilde: http://www.torshavn.fo/get.file?ID=2024

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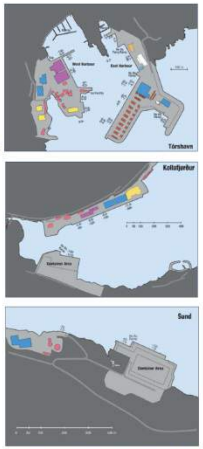
Tórshavn Landssygehuset | Fragt

3 havneanlæg tilknyttet Tórshavn:

- Tórshavn havn er den klar største og ligger i hjertet af byen. Multifunktionel havn: lystbåde, fiskeri, fragt af gods og mennesker
  - Afstand til landssygehuset: 2 km
- Kollafjørðu havn bruges til fiskeri og gods
  - Afstand til landssygehus: 23,3 km
- Sund havn er en mindre havn med begrænset aktivitet
  - Afstand til Landssygehuset: 10,5 km



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Tórshavn Landssygehuset | Klima

Moderate temperaturerne, mellem 1-6 grader i koldeste måneder og sne få dage om året.

- Hyppigt fremkommende storme i vintermåneder

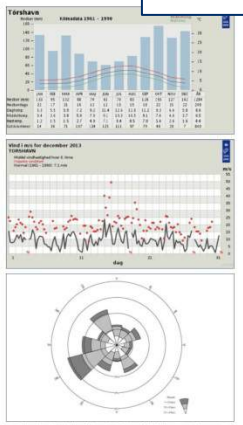
I sommermånederne ligger temperaturen mellem 8-13 grader og kommer sjældent over 20 grader

Dominerende vesten/sydvestenvind i Tórshavn

- Dog lavere vindstyrke end resten af Færøerne pga. placering i læ
- Ved orkaner: (10-minutters middel) på op til 40 m/s og vindstød på op til 70 m/s.

➢ De kraftige vindstød kan give uheldige situationer

- Eks. ofte medfører stormene så store bølger, at det kan være vanskeligt at besejle flere af havnene



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Tórshavn Landssygehuset | Mange års erfaring

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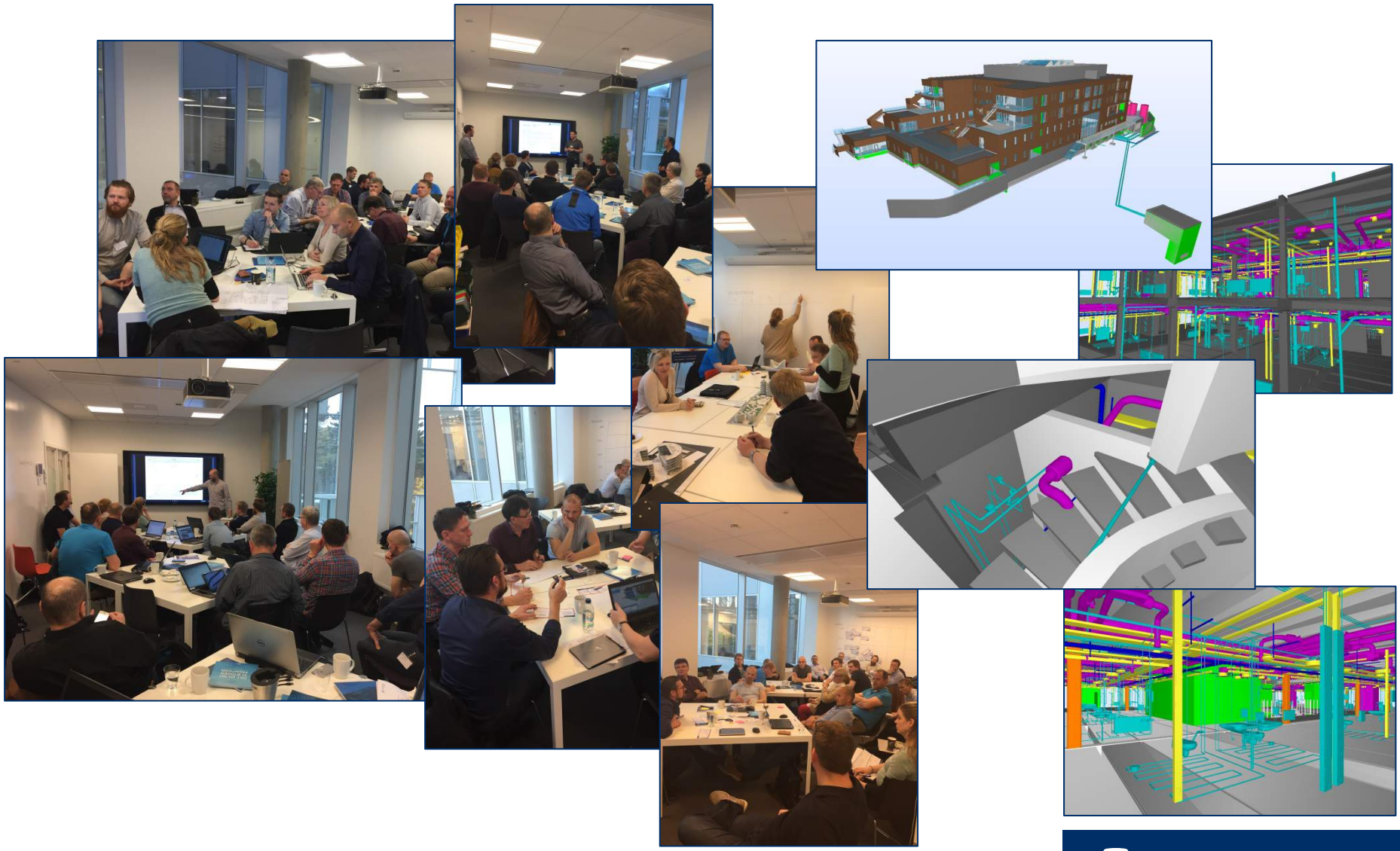
Tórshavn Landssygehuset | VDC-samarbejdet



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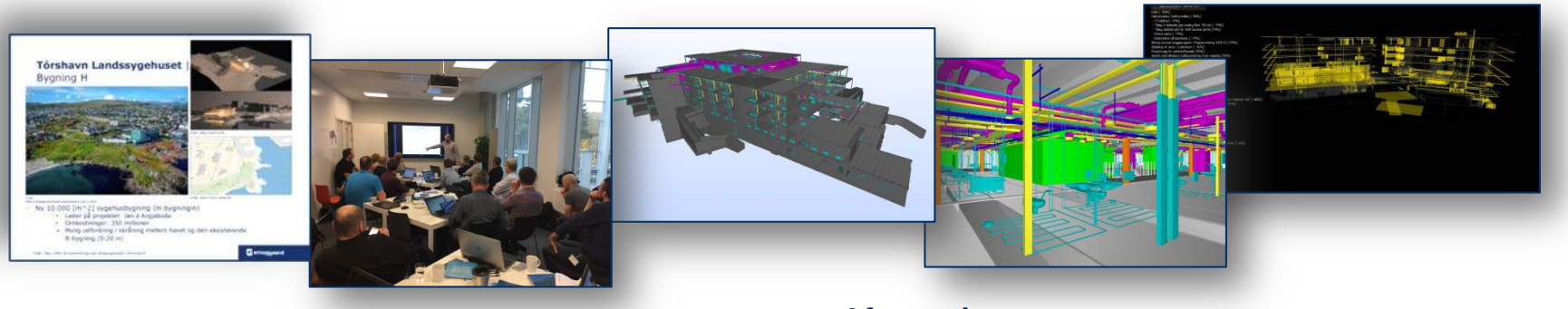
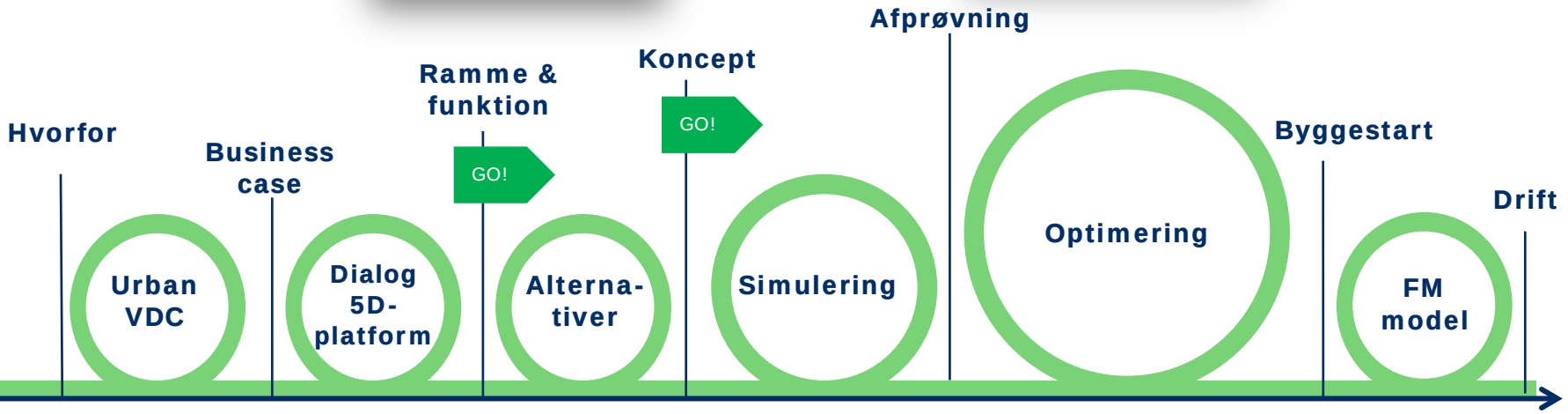
Effektivitet | VDC-samarbejde





- Analyser
- Simuleringer
- Muligheder
- Indsigter

- Hvad er vigtigt?
- Centrale risici
- Procesforslag
- Funktioner
- Prisramme
- Tidsramme
- Businesscase
- Udbudsdefinition

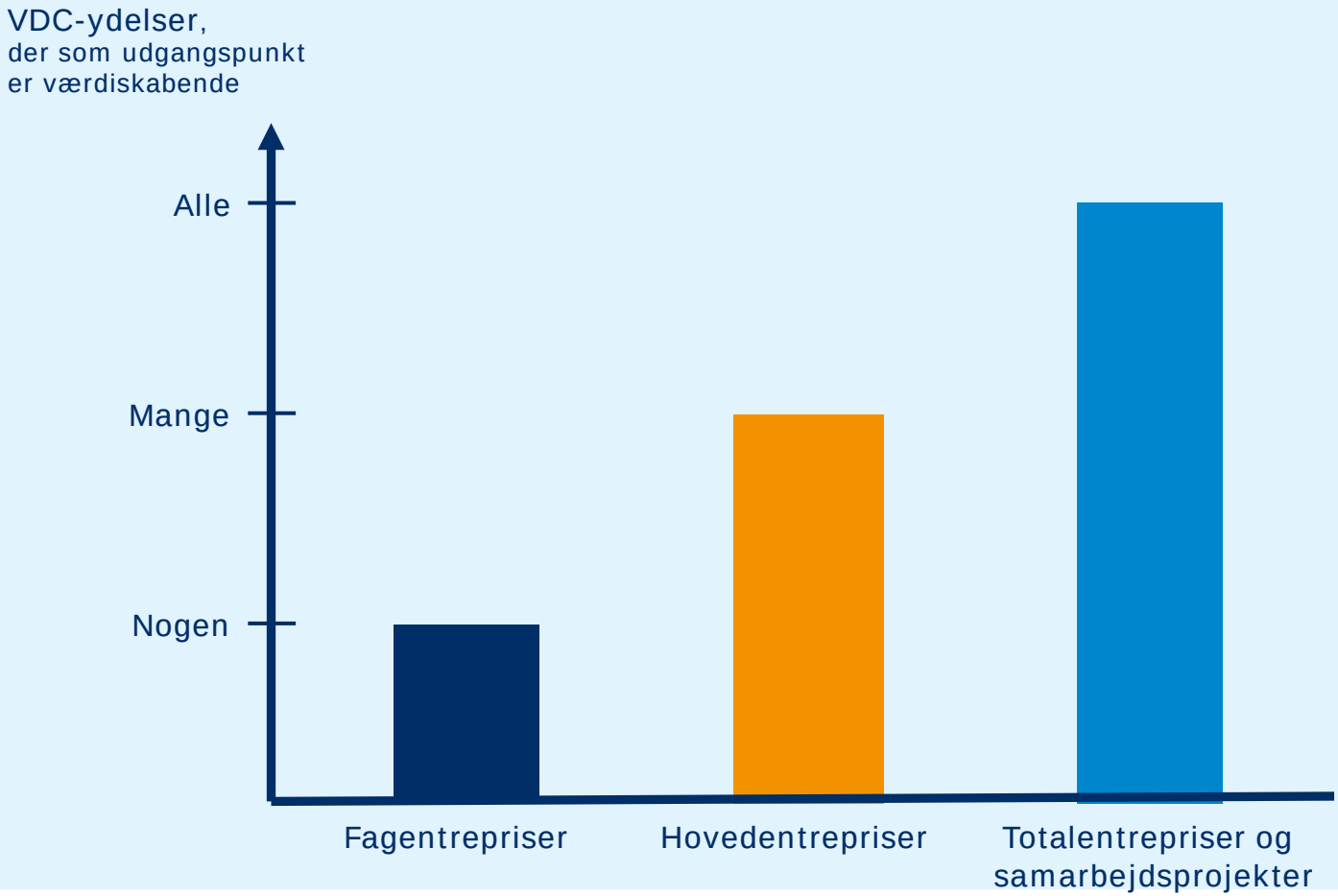
- Koncept
- Fokusområder
- Hvem kan?
- Involvering af leverandører
- Pris- og tidsdrivers
- Kapacitet
- Risici og muligheder
- Grænseflader

- Beslutningsplan
- TCO
- Projekteringsplan
- Valg af løsninger
- Valg af partnere
- Endelig procesdesign

- Produktionsplan
- Detaljeret design
- KPI follow-up
- Forbedringsprojeker
- Design intent validation
- Ændringshåndtering
- Risikostyring

- Monitorering
- As-build model
- Aflevering
- Commissioning
- KPI-målinger

Værdiskabelse af VDC-ydelser ift. entreprisetyper



VDC | Visualiseringer af alternativer

VDC i praksis | Systematisk opfølgning på den digitale praksis på projekterne

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Whitepaper:
Value drivers in the Danish national ICT regulations

Vers. 1 - December 2014

MTHøjgaard

October 2015
MT Højgaard A/S

Page 6/6

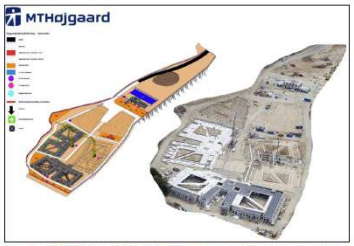

Figure 4: The left side shows the BIM for SLWE on one of the top performing projects and their actual construction site on the right. The illustration originates from a Danish project hence the Danish text.

The BIM coordinators on the project stressed how important the BIM model and 3D site plan was in regards to logistics, toolbox meetings and coordinating safety on site. Some skepticism was identified in the beginning while the BIM coordinators developed the 3D site plan but the project team rapidly acknowledged that the BIM contributed to solve unexpected problems very effectively. As an example stakeholder management in terms of inclusion of and communication with neighbors was successfully facilitated with BIM as an essential tool. The BIM model and 3D site plan is considered as a dynamic tool on the project and became an integrated part of planning and communication. The fact that BIM was the primary tool for managing SLWE proved to be crucial for sharing knowledge and experience with the rest of the organisation, since the approach was easy to copy. The project team used many objects from an object library in MT Højgaard and developed specific objects when needed. This meant that other projects easily could populate their equivalent BIM with useful objects with minimal effort.

After an extensive effort to spread these competences among other projects the score of SLWE started to increase across all projects with a small dive and have reached its top in the latest evaluation in August 2015.

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October 2015
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Page 4/4

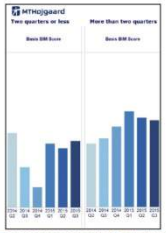


Figure 2: The Basis BIM scores for projects active for two quarters or less are compared with projects active for more than two quarters.

It can be concluded that the Basis BIM Score is 33% higher, in 2015 Q3, for projects that have been active for more than two quarters compared with projects active less than two quarters. Furthermore in 7 out of 8 BIM processes the projects active for more than two quarters score higher than projects active less than two quarters. The overview provided in figure 2 is among other used to better understand when specific BIM processes add value and thereby make sure to activate the right competences at the right time in the project. Monitoring the impact of different BIM processes over time enables a focused allocation of resources to continuously improve BIM. This can both be achieved by increasing resources on a project struggling with a BIM process or by extracting valuable best practice from top performing projects with the intent to develop a similar practice on other projects and increase productivity in MT Højgaard. At the same time if a BIM process proves not to provide any value then a decision to either terminate or refine the process must be taken as low scores can represent wasted potential or wasted resources. BIM in MT Højgaard is a tool that supports our strategy to increase productivity in the AEC industry, and therefore our productivity agenda is deeply anchored every time a BIM process is assessed.

Figure 2 shows a decrease in the Basis BIM Score from 2015 Q1, but this can be caused by high performing projects coming to an end or new projects in the start-up phase thus not necessarily that performance has decreased. Equally sometimes MT Højgaard experience that the design material provided is of a quality that simply doesn't support the intended BIM process.

In MT Højgaard we strive to inform decision-making by actively using data about our projects. The following is an example of how MT Højgaard has used this approach to improve BIM and drive productivity both for individual projects but also for the entire organisation.

MTHøjgaard

October 2015
MT Højgaard A/S

Page 5/5

Closing the feedback loop
Utilising data from projects is a methodology that is applied both internally in MT Højgaard and externally, since many projects are relying on an effective data flow between companies and different trade disciplines. The following example focuses on an internal application.

Considering figure 3 and the BIM process Site logistics and work environment (SLWE), it becomes obvious that this BIM process could have a better overall performance.

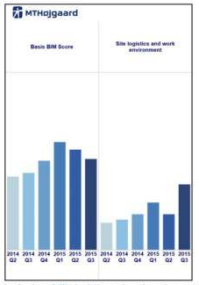


Figure 3: The perceived value of Site logistics and work environment compared with the average of all BIM processes.

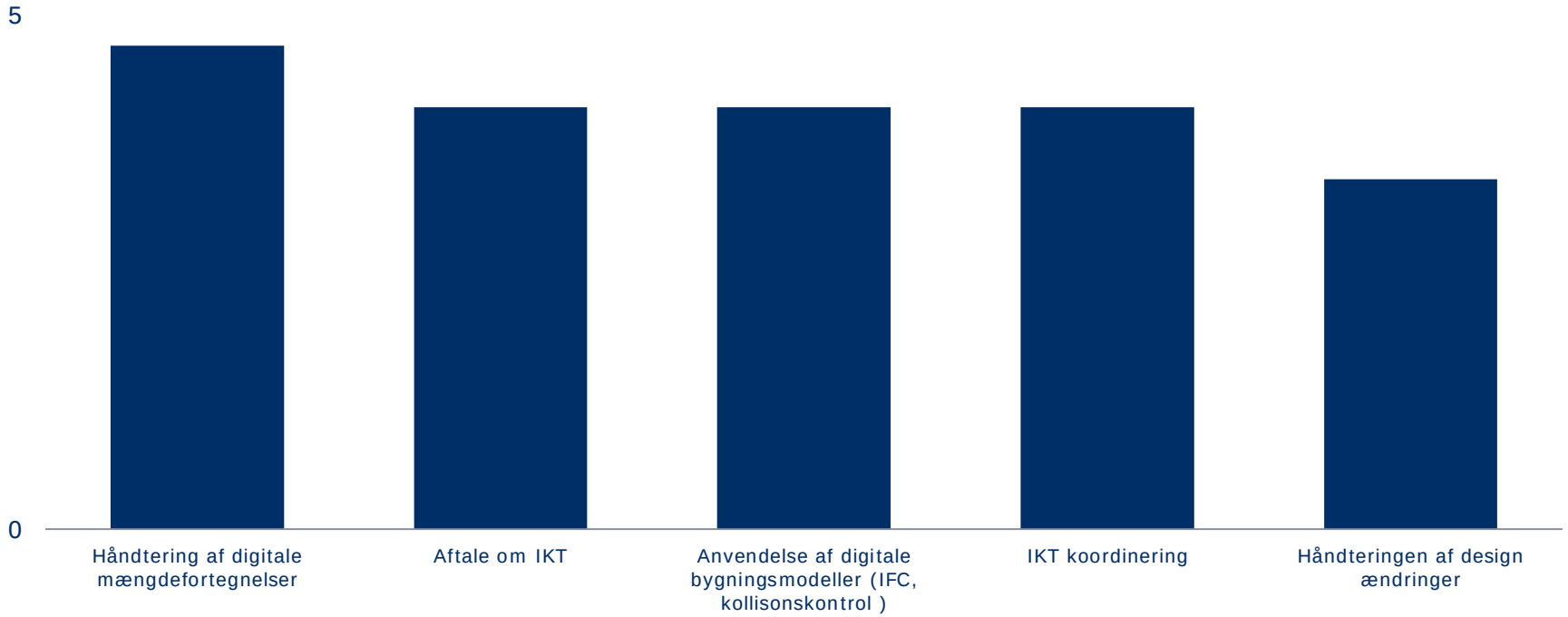
Around 2014 Q3 MT Højgaard decided to investigate why some of the projects didn't perceive value from SLWE. Considering SLWE for all projects some projects showed excellent performance month after month achieving the highest possible score. In order to benefit on an organisational level from the achievements of these their experience were gathered with the intention to share it with other projects. The BIM coordinators from these projects were invited to several workshops to present their achievements with SLWE and a process manual and new best practice was developed on this basis. The following illustrations show how the project's BIM was used to manage planning and site logistics.

Læring gennem opfølgning på vores praksis

MTHøjgaard

VDC i praksis | Udveksling af god digital praksis fra vores projekter

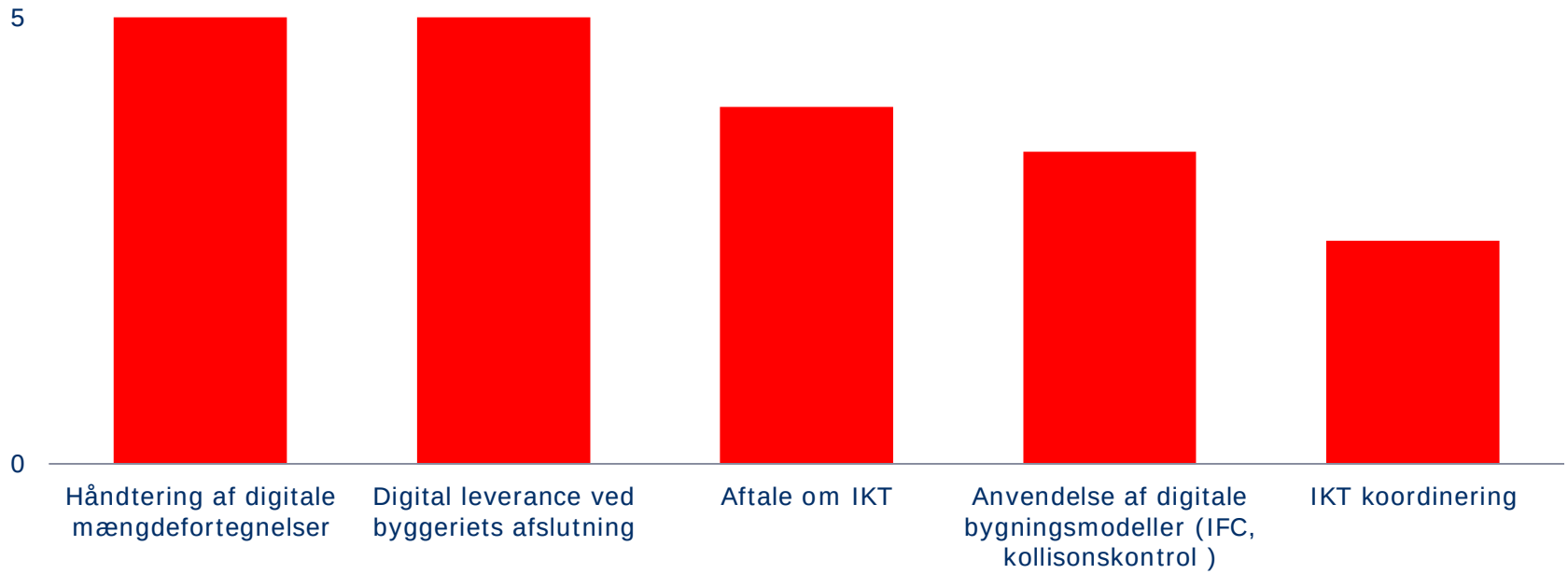
De 5 BIM-indsatser der giver entreprenøren den største værdi



Kilde: white paper: The strength of the local BIM efforts in a larger perspectiv – maj 2016

VDC i praksis | Udveksling af god digital praksis i vores industri

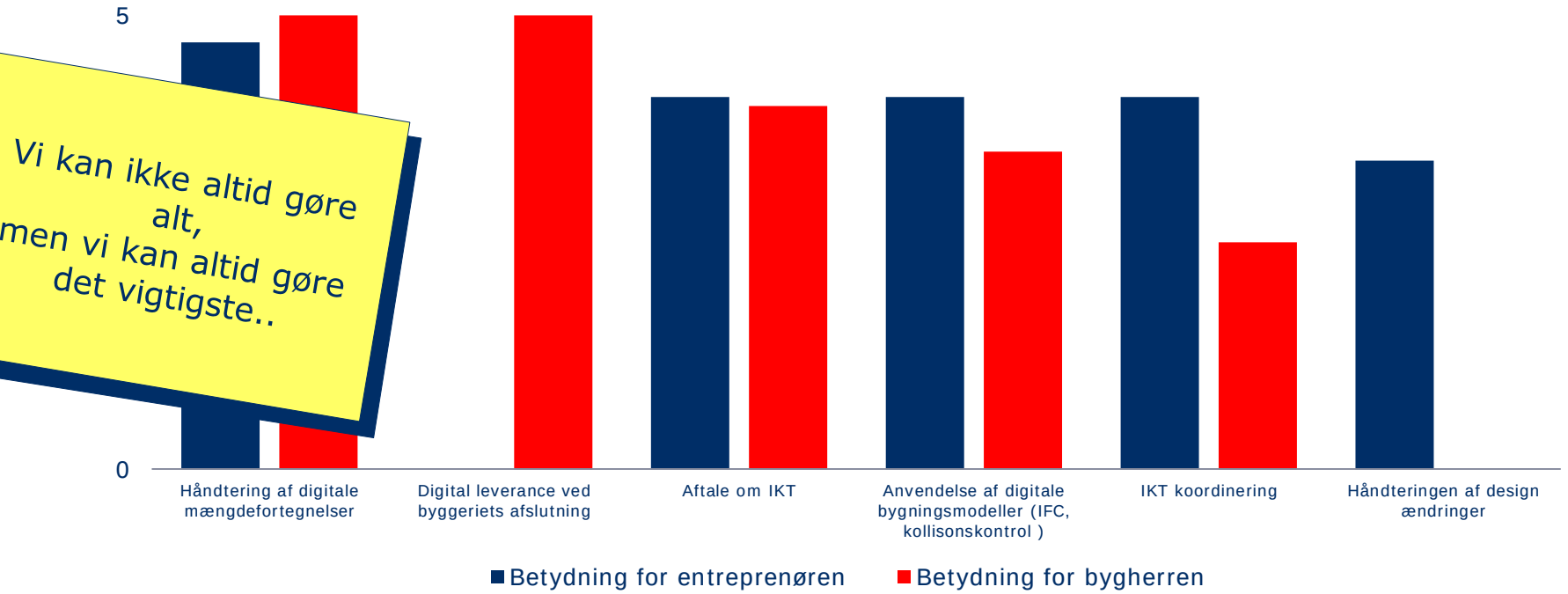
De 5 BIM-indsatser der giver bygherren den største værdi



Kilde: white paper: The strength of the local BIM efforts in a larger perspective – maj 2016

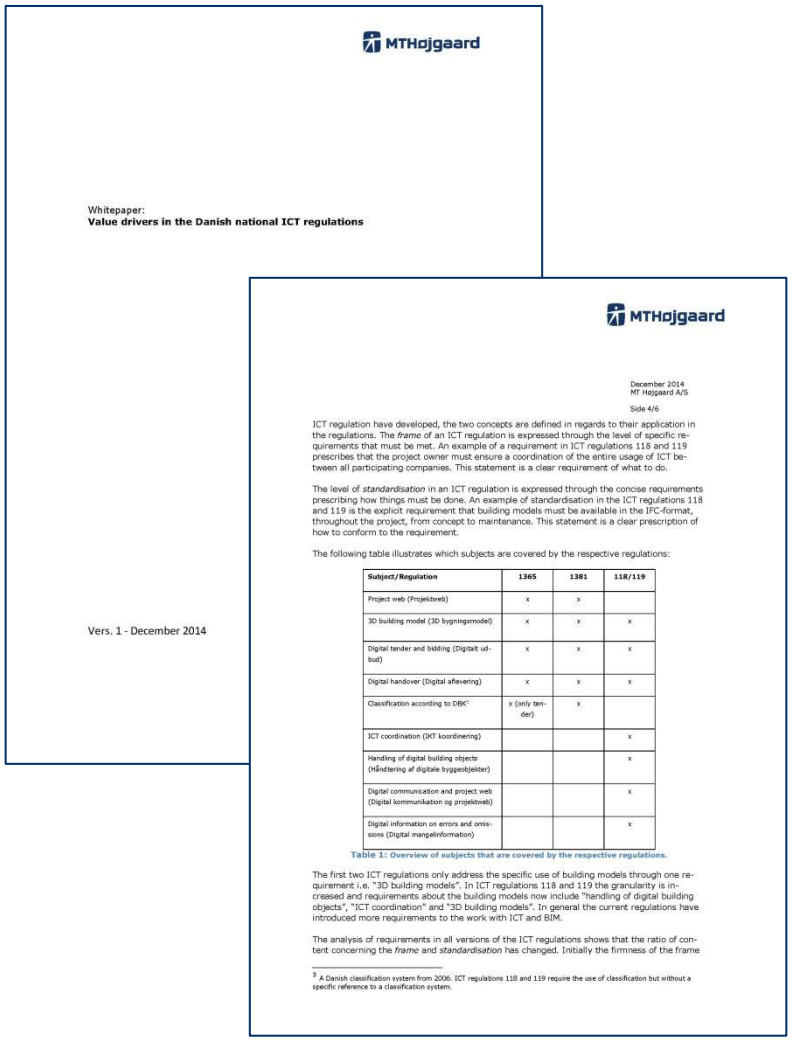
VDC i praksis | Udveksling af god digital praksis i vores industri

BIM indsatserne der giver den største værdi for det digitale samarbejde på et byggeprojekt



Kilde: white paper: The strength of the local BIM efforts in a larger perspective – maj 2016

Kvalitet | IKT Bekendtgørelserne 118 og 119



MTHøjgaard

Whitepaper:
Value drivers in the Danish national ICT regulations

Vers. 1 - December 2014

MTHøjgaard

December 2014
MT Højgaard A/S

Side 4/6

ICT regulation have developed, the two concepts are defined in regards to their application in the regulations. The *frame* of an ICT regulation is expressed through the level of specific requirements that must be met. An example of a requirement in ICT regulations 118 and 119 prescribes that the project owner must ensure a coordination of the entire usage of ICT between all participating companies. This statement is a clear requirement of what to do.

The level of *standardisation* in an ICT regulation is expressed through the concise requirements prescribing how things must be done. An example of standardisation in the ICT regulations 118 and 119 is the explicit requirement that building models must be available in the IFC-format, throughout the project, from concept to maintenance. This statement is a clear prescription of how to conform to the requirement.

The following table illustrates which subjects are covered by the respective regulations:

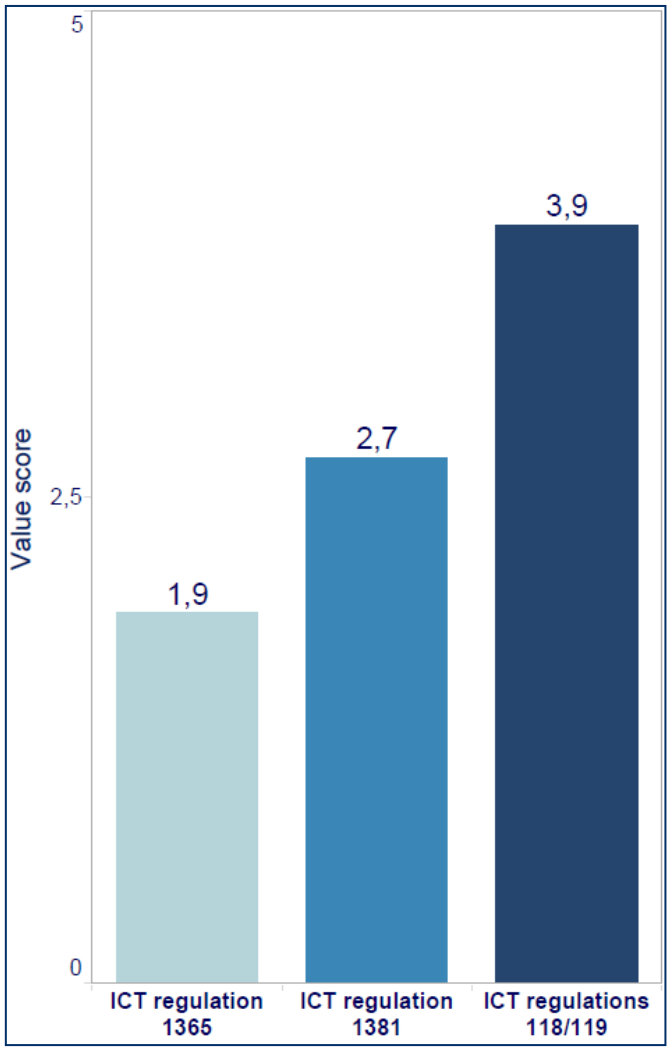
Subject/Regulation	1365	1381	118/119
Project web (Projektweb)	x	x	
3D building model (3D bygningsmodel)	x	x	x
Digital tender and bidding (Digitalt udbud)	x	x	x
Digital handover (Digital aflevering)	x	x	x
Classification according to DBC[3]	x (only tender)	x	
ICT coordination (IKT koordinering)			x
Handling of digital building objects (Håndtering af digitale byggeobjekter)			x
Digital communication and project web (Digital kommunikation og projektweb)			x
Digital information on errors and omissions (Digital mangelinformation)			x

Table 1: Overview of subjects that are covered by the respective regulations.

The first two ICT regulations only address the specific use of building models through one requirement i.e. "3D building models". In ICT regulations 118 and 119 the granularity is increased and requirements about the building models now include "handling of digital building objects", "ICT coordination" and "3D building models". In general the current regulations have introduced more requirements to the work with ICT and BIM.

The analysis of requirements in all versions of the ICT regulations shows that the ratio of content concerning the *frame* and *standardisation* has changed. Initially the firmness of the frame

[3] A Danish classification system from 2006. ICT regulations 118 and 119 require the use of classification but without a specific reference to a classification system.



Kilde: white paper: Value drivers in the Danish national ICT regulations – december 2014

Kvalitet | Værdien af IKT Bekendtgørelserne 118 og 119 samt klassifikation

80 projekter med 3D designmateriale fordelt på 196 fagmodeller fra arkitekter, ingeniører samt MEP'er med 3.168.926 BIM objekter:


MTHøjgaard

Whitepaper:
Addressing classification in the Danish AEC industry

Vers. 1 - June 2015

MT Højgaard A/S
Knud Højgaards Vej 9
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+45 7012 2400
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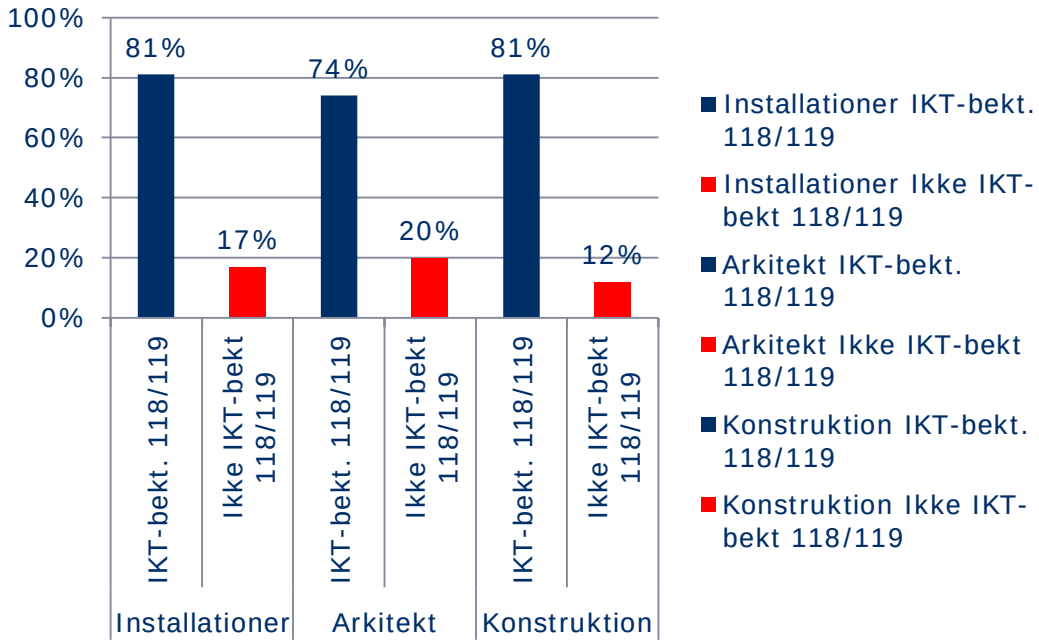
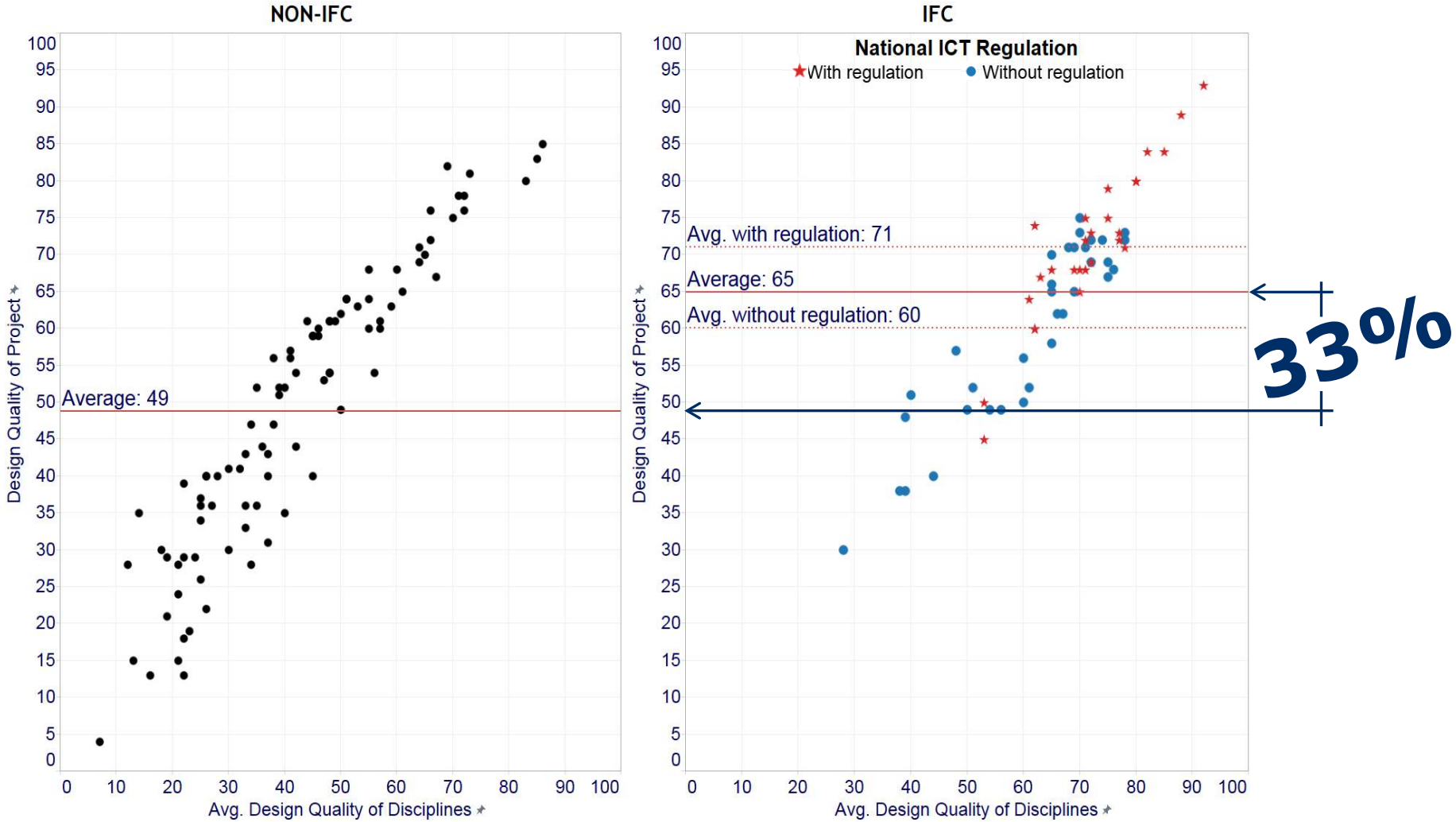
CVR 12562233



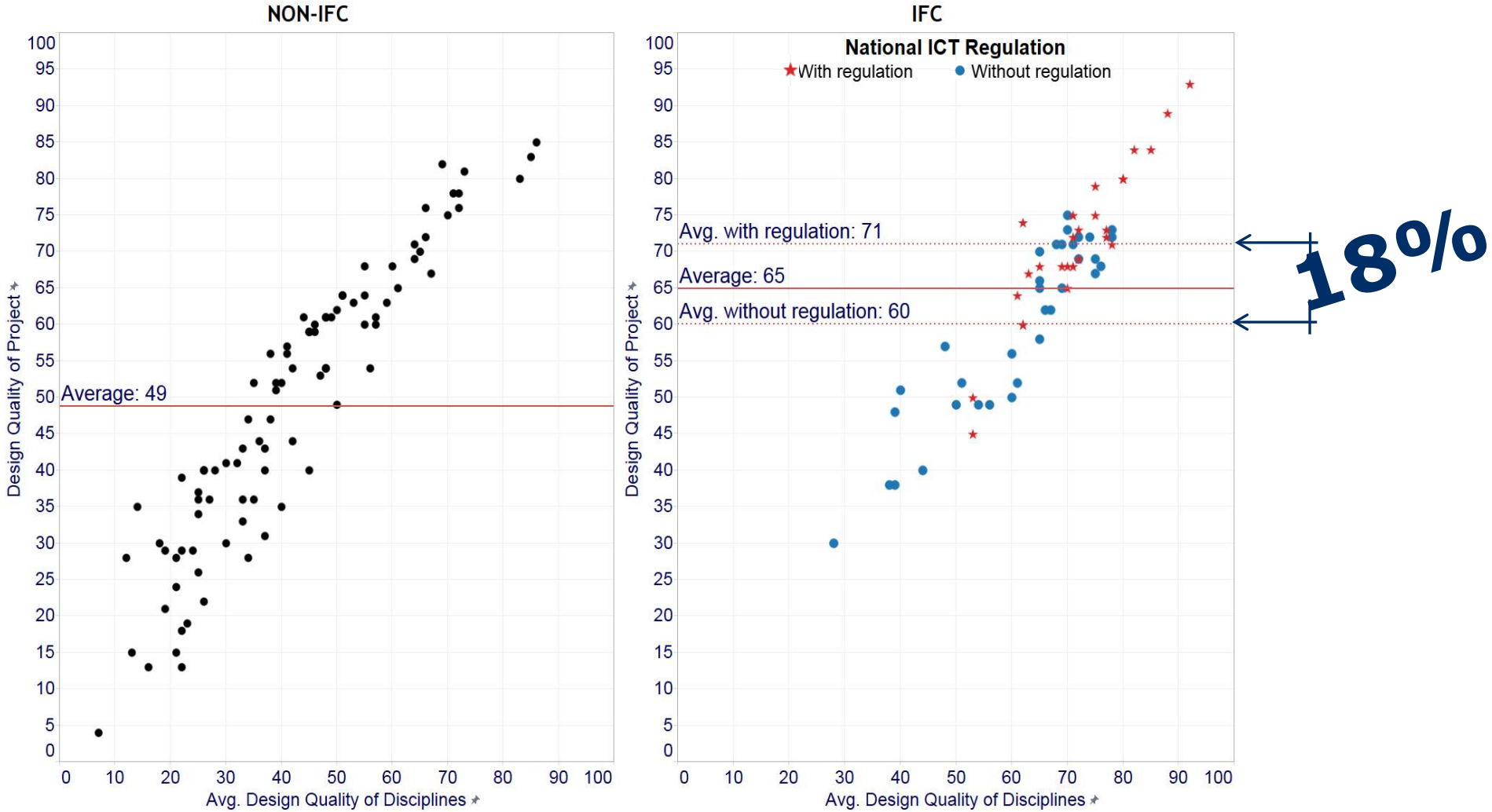
Kilde: white paper: Addressing classification in the Danish AEC industry – juni 2015

Kvalitet | Det gode grundlag for samarbejdet



Kilde: white paper: IFC – A driver for design quality in the AEC industry – august 2014

Kvalitet | Kravet om IFC skaber klar værdi

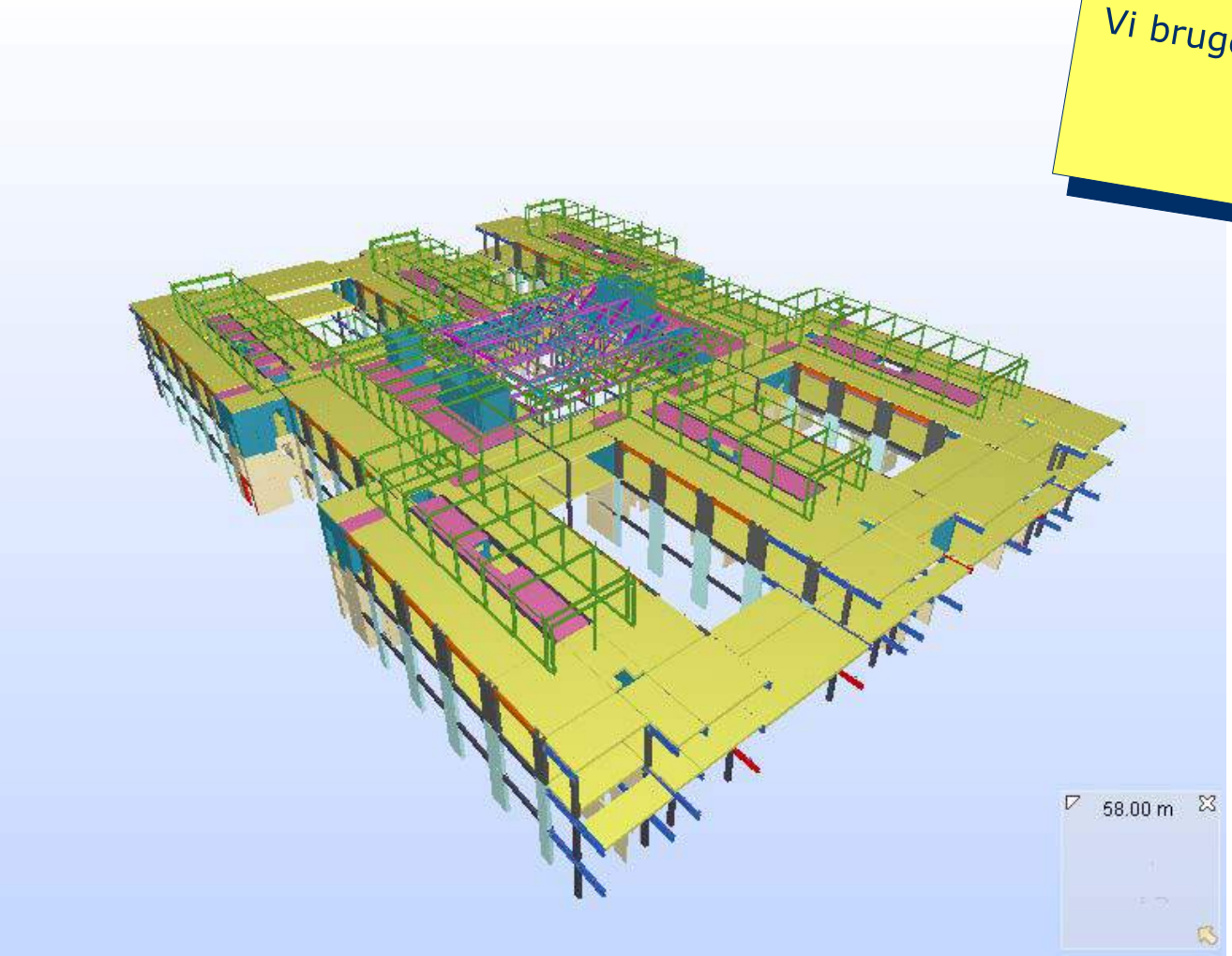


Kilde: white paper: IFC – A driver for design quality in the AEC industry – august 2014

MTHøjgaard

VDC | Kvalitet og produktionsgrundlag

Vi bruger IFC hver dag



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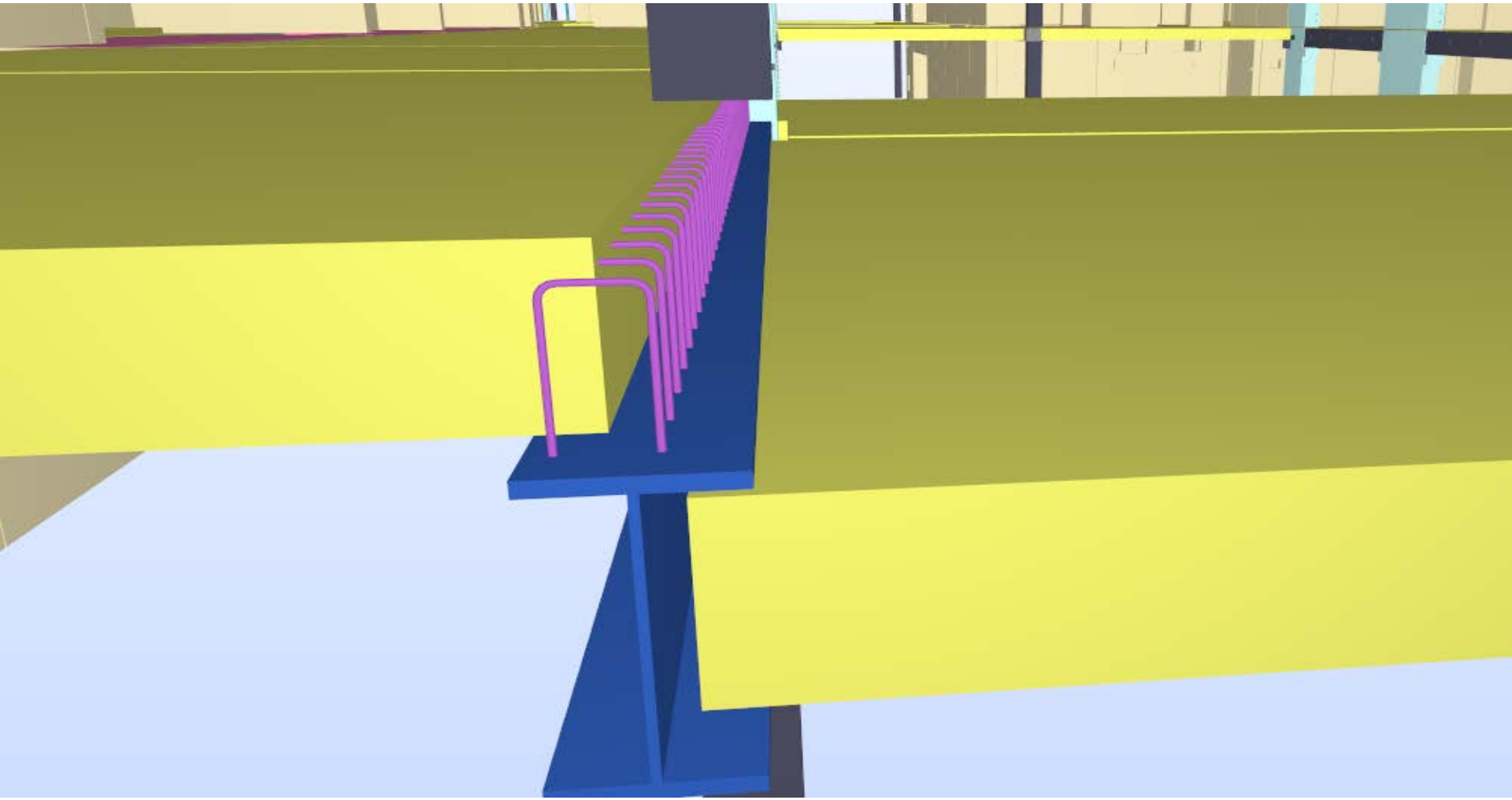
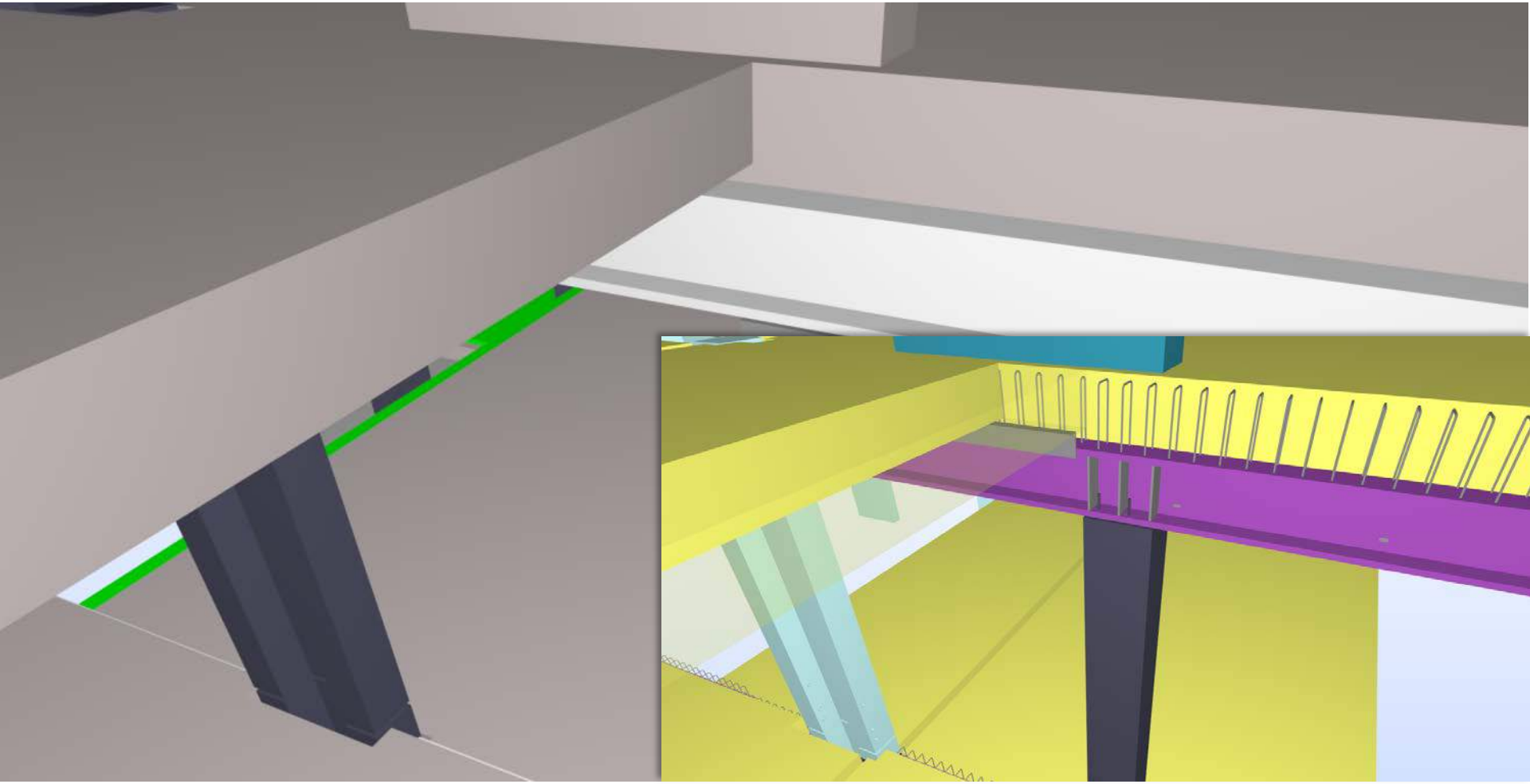
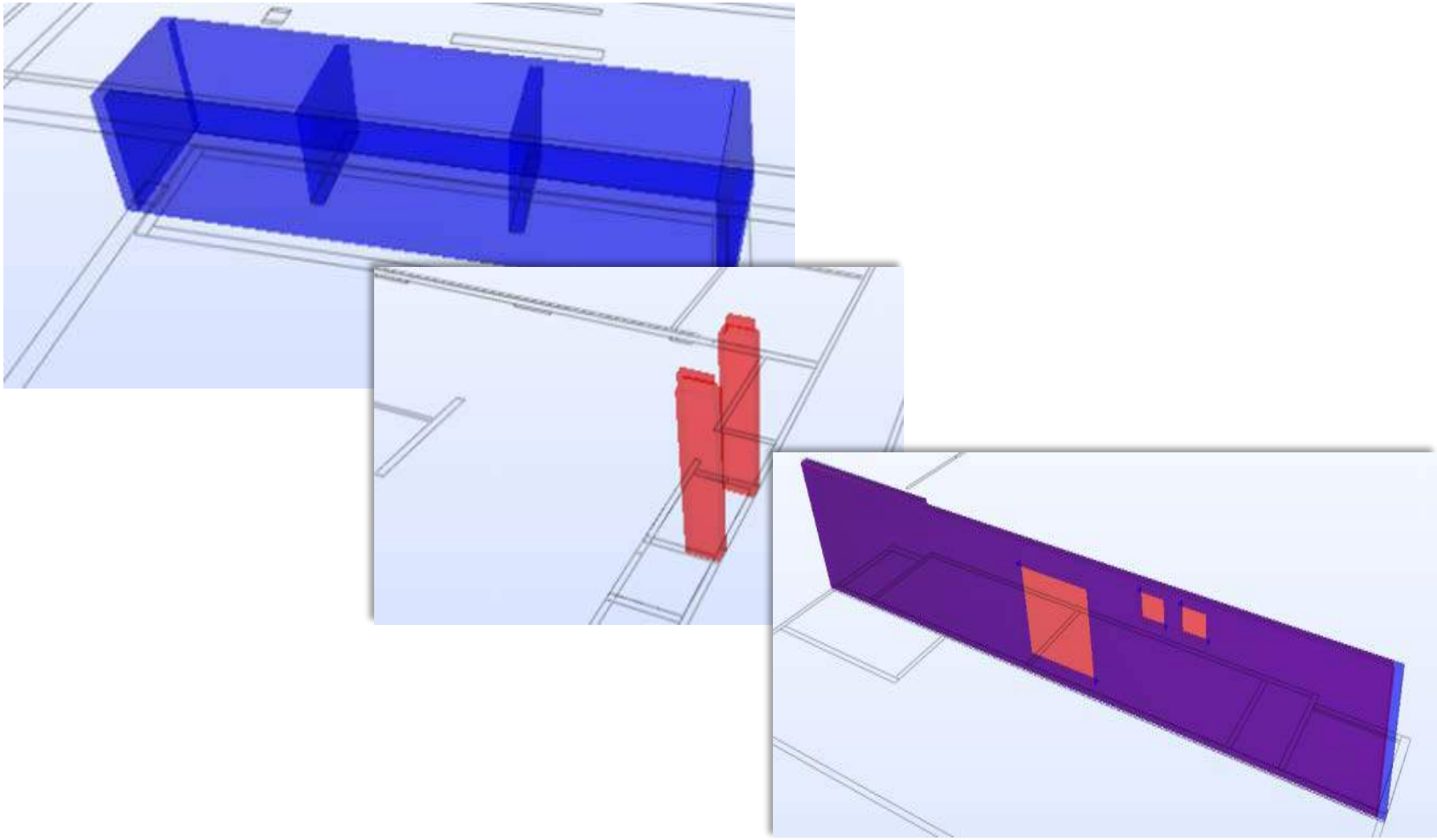
VDC | Målet er ikke 0 kollisioner



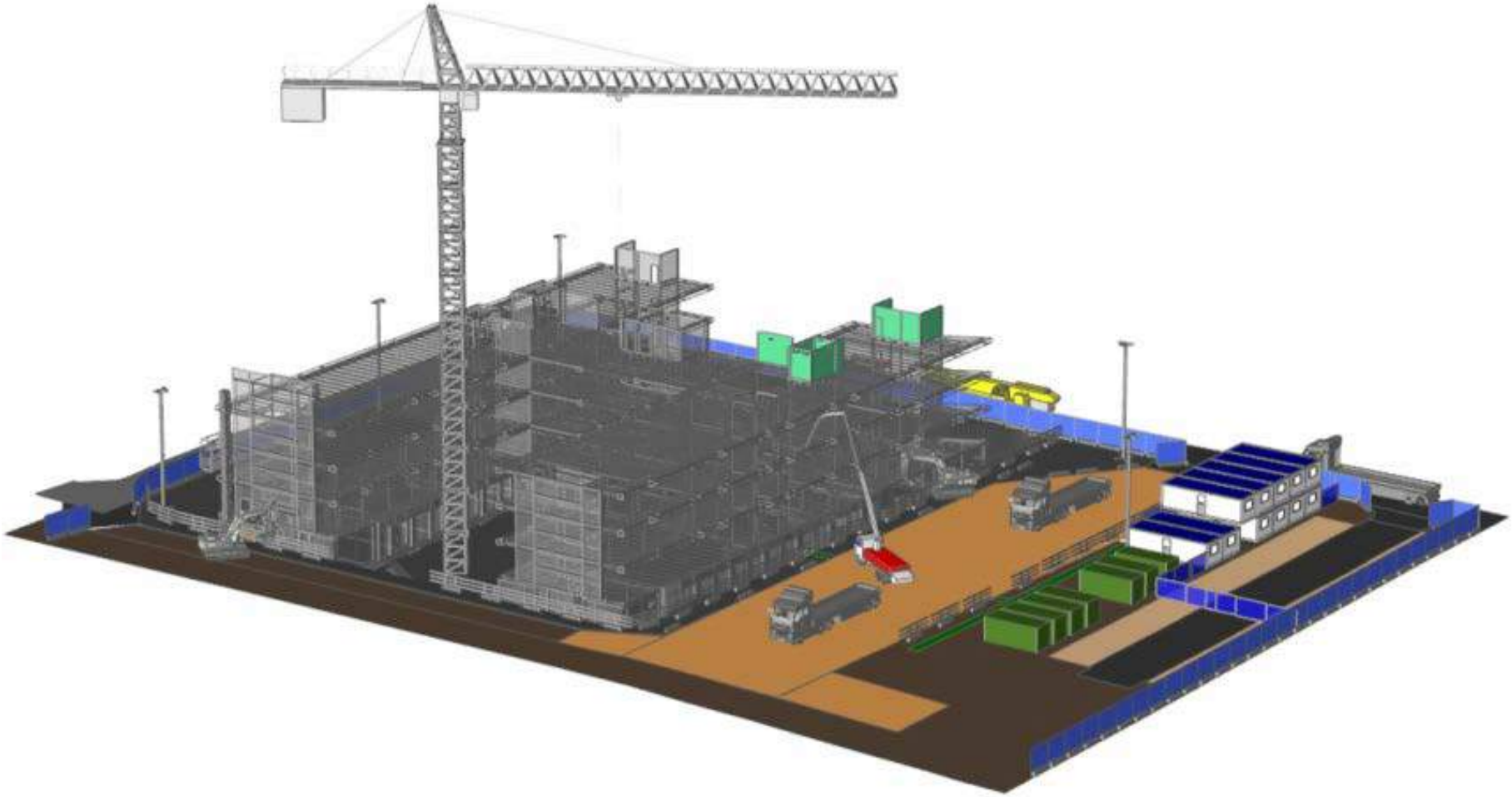
VDC | Koordinering og brug af UE modeller



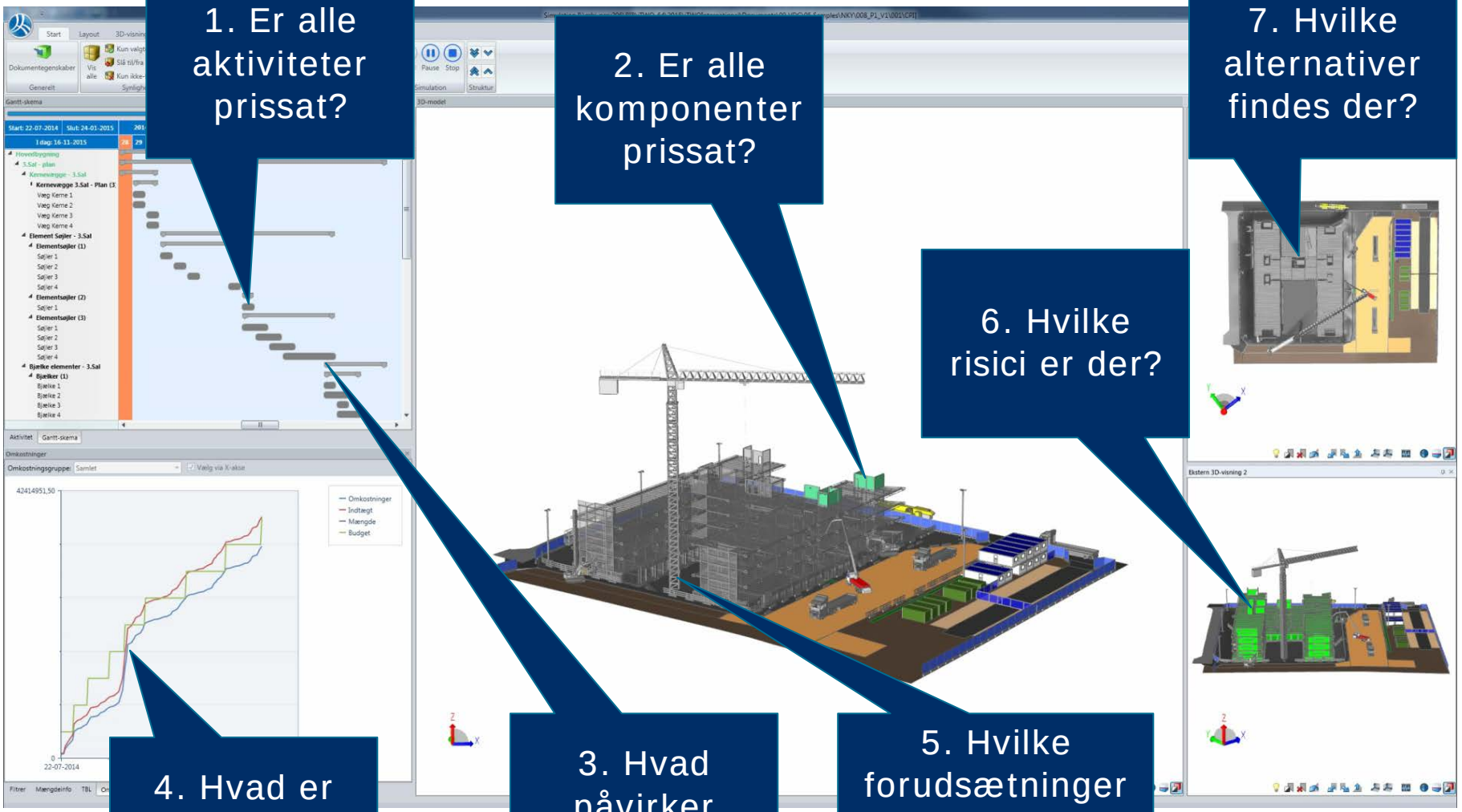
VDC | Sammenligning af både model- og tegningsrevisioner



VDC | Byggepladsindretning og -simulering



VDC | 5D-modeller

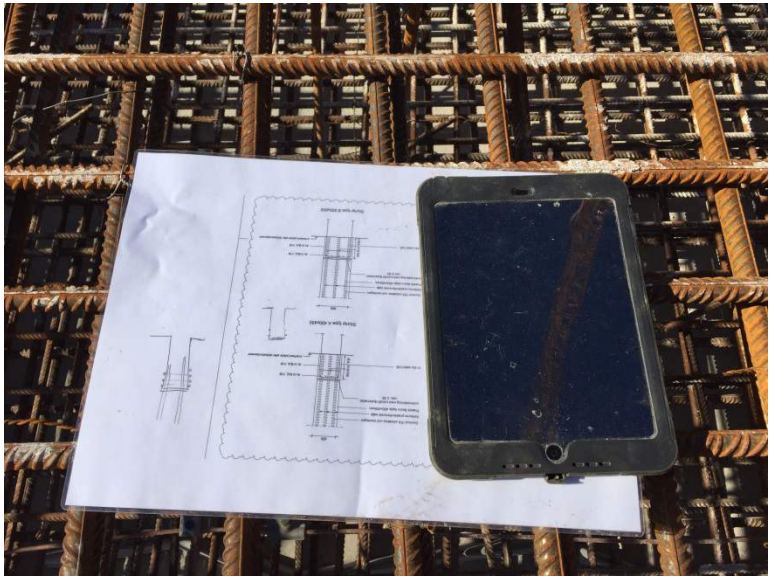


VDC | iPads på byggepladsen

Projektweb

Autodesk 360 Glue

BlueBeam til tegninger



VDC | Digitalt grundlag når byggeriet anvendes

MTHøjgaard

Efficient digital delivery of construction projects with COBie

22 August 2016
Side **1** af **6**

MT Højgaard has over the years
tice both BIM and VDC to increa
ties with the common goal of de
methods and opportunities in di
for a better support for digital d
cled throughout the building's li
the subsequent operation and m
operation and maintenance of t
information should be handed o
clarification MT Højgaard has de

The digital handover has becom
Some clients has for a while be
mation of the building and how
paper, *The strength of the local*
authority The Danish Building &
tion using BIM in public constru
Regulation 118. The ICT Regula
flects the importance of support
throughout the project. Subseq
method to assess the value of t
sessment that the value of digit
great importance for the client.

Basis for digital operation pr
The final handover of a building
(construction geometry) and a
O&M.

An increasing number of clients
the potential to ensure efficient
budget items in the operating o
can be found and used digitally
manage and optimize operation

Delivery for the operation is oft
tion of information after the co
is incorporated earlier in the co
decide what is to be delivered f
applied to the building compone
mation must be delivered at an
the architect, consultant or cont
and effective process for collect
is not pushed to the end, where

MTHøjgaard

22 August 2016
Side **3** af **6**

requirements for use of IFC, made today in the Danish Executive Orders 118 and 119, for example, requirements for classification and cooperation on IFC[5].

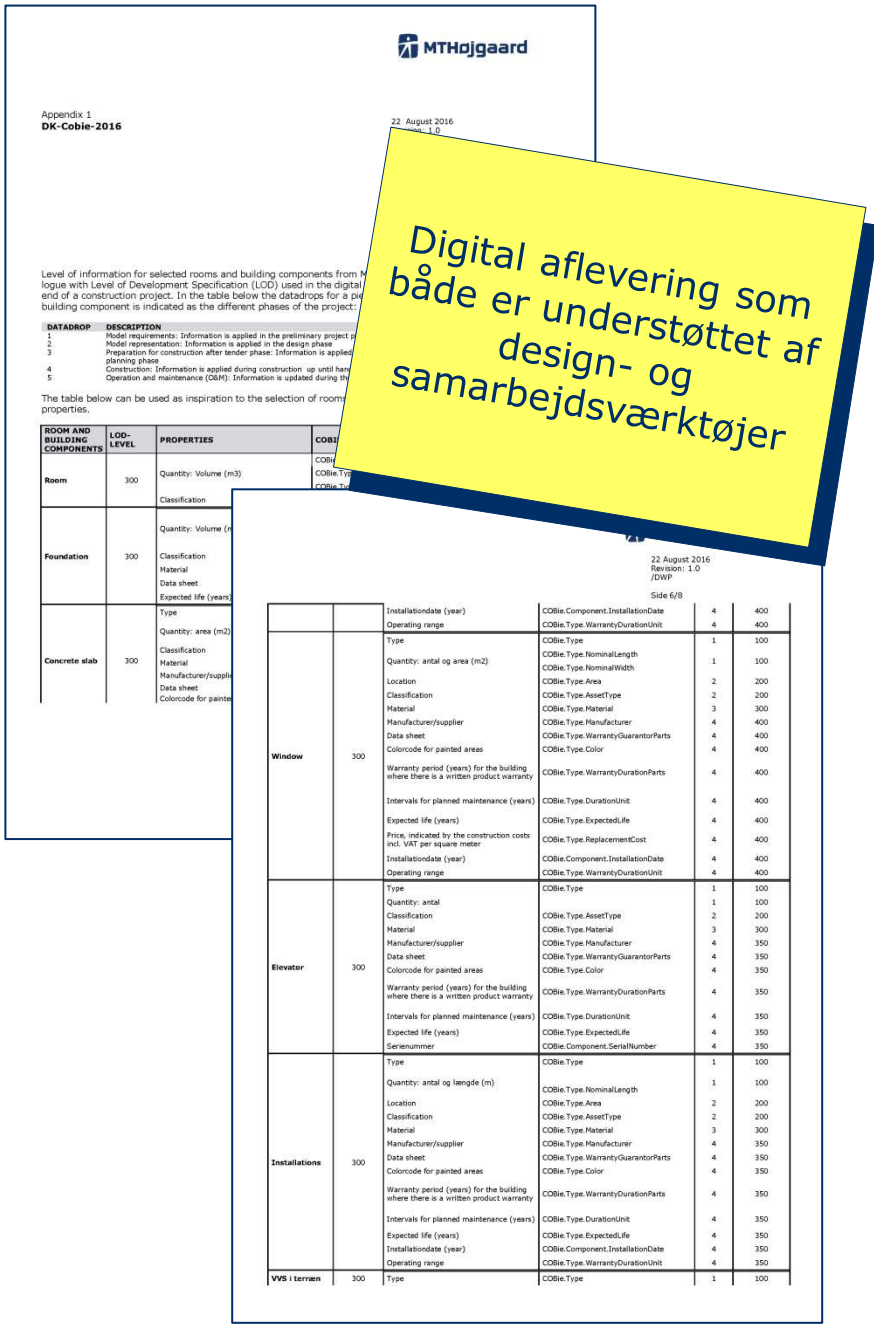
The British government is working on a comprehensive standardization work to create a link between the construction industry, for example through the British standard: PAS1192-1: 2007, which is developed for the British government, whom as a great client in the construction and operation of building has a great interest in optimizing the operation of the building stock to reduce costs among other things. Today the British government therefore requires the use of BIM on public projects because it offers the possibility of developing and structuring relevant information about the building. For the British government, it's very much concerns Asset Information Management - that is, how to use information about the construction of the various British standards 1192-1, 1192-2, 1192-3, 1192-4 therefore describes how the information exchange can take place at each project.

Digital delivery on the basis of specific tools
Today MT Højgaard uses eg 3 tools to ensure exchange of information on each project: 1. *Building Component Catalogue with Level Of Development (LOD)*, 2. *DK-COBie-2016* and 3. *Model Progression Specification (MPS)*.

MT Højgaard uses our *Building Component Catalogue with Level of Development (LOD)*[6] (LOD catalog) to ensure a mutual understanding and agreement on the geometry and the information that must be for a BIM delivery at any given time. the LOD catalogue serves as an annex to the project's ICT agreement, and there is a clear connection to one of the other annexes: *DK-Cobie-2016* contains a list of selected building objects eg from LOD catalogue and used to identify, which building components as well as the specific information to be delivered to the client, see Appendix 1. It shall ensure that relevant information about the building of the individual building components can be found and used in the operation phase. Finally, the annex contains information about when information is to be applied to each object through the construction process indicated as datadrops, and allows you to specify which project partners to deliver the information. *DK-Cobie-2016* uses the COBie standard and provides a reference for COBie extensions in Revit. In this way *DK-Cobie-2016* a platform for the third tool: *Model Progression Specification (MPS)*, which describes a plan for where in the construction process the different information should be delivered according to project milestones - A *Model Progression Specification - MPS*.

The clear correlation between the three tools provide individ-

[5] Read MT Højgaards White paper *Value drivers in the Danish national ICT regulations*, December 2014, mth.com.
[6] MT Højgaards *Building Component Catalogue with level of informations (LOD)* is published in Danish, English, Norwegian and German on mth.com.



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Appendix 1
DK-Cobie-2016

22 August 2016
Revision: 1.0

Level of information for selected rooms and building components from M
logue with Level of Development Specification (LOD) used in the digital
end of a construction project. In the table below the datadrops for a pi
building component is indicated as the different phases of the project:

DATADROP	DESCRIPTION
1	Model requirements: Information is applied in the preliminary project p
2	Model representation: Information is applied in the design phase
3	Preparation for construction after tender phase: Information is applied planning phase
4	Construction: Information is applied during construction up until han
5	Operation and maintenance (O&M): Information is updated during th

The table below can be used as inspiration to the selection of room
properties.

ROOM AND BUILDING COMPONENTS	LOD-LEVEL	PROPERTIES	COBI
Room	300	Quantity: Volume (m3) Classification	COBi COBie.Typ COBie.To
Foundation	300	Quantity: Volume (m Classification Material Data sheet Expected life (years)	
Concrete slab	300	Type Quantity: area (m2) Classification Material Manufacturer/supplie Data sheet Colorcode for painte	

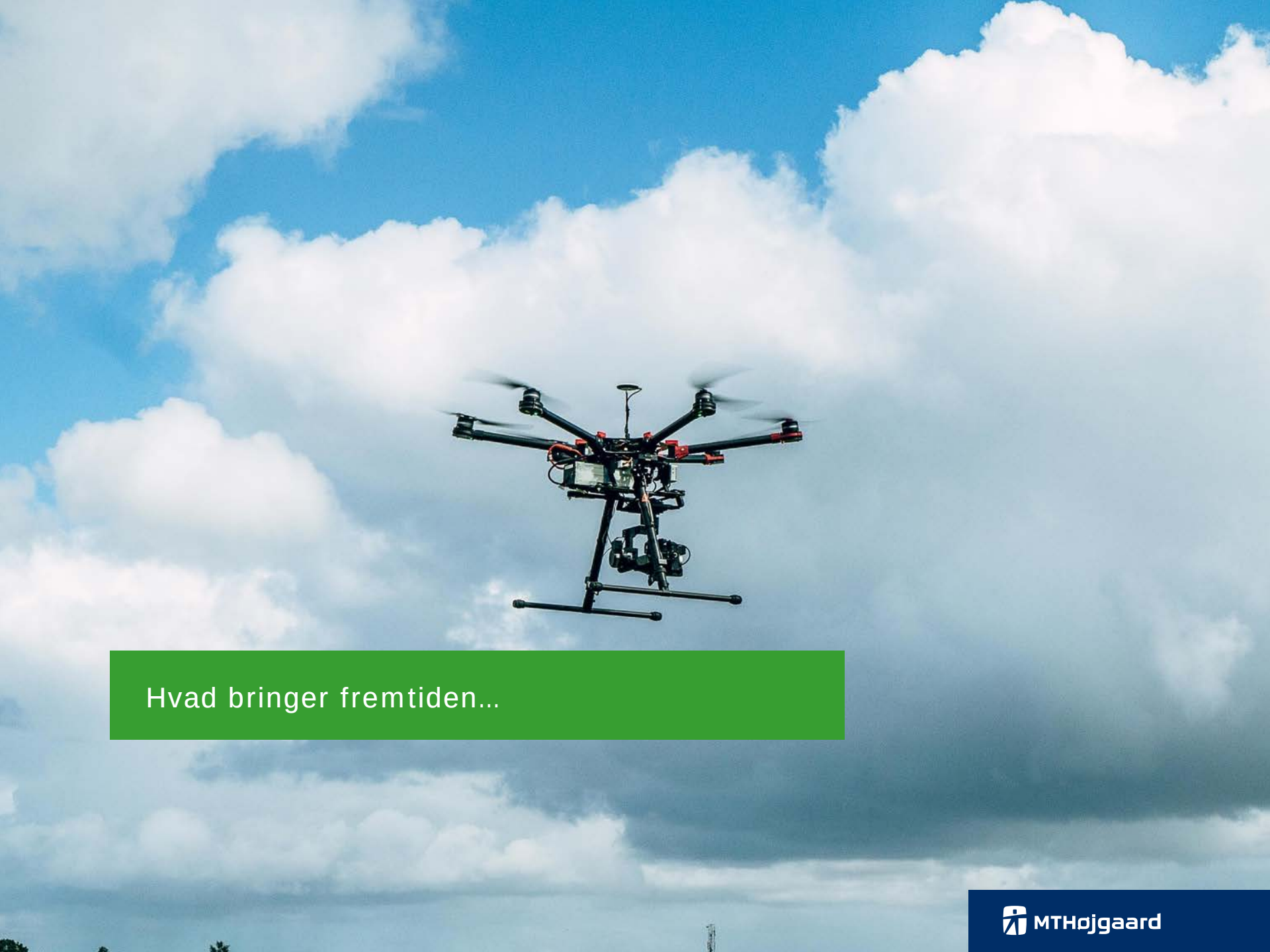
Digital aflevering som både er understøttet af design- og samarbejdsværktøjer

22 August 2016
Revision: 1.0
/DWP

Side 6/8

		Installationdate (year)	COBie.Component.InstallationDate	4	400
		Operating range	COBie.Type.WarrantyDurationUnit	4	400
Window	300	Type	COBie.Type	1	100
		Quantity: antal og area (m2)	COBie.Type.NominalLength COBie.Type.NominalWidth	1	100
		Location	COBie.Type.Area	2	200
		Classification	COBie.Type.AssetType	2	200
		Material	COBie.Type.Material	3	300
		Manufacturer/supplier	COBie.Type.Manufacturer	4	400
		Data sheet	COBie.Type.WarrantyGuarantorParts	4	400
		Colorcode for painted areas	COBie.Type.Color	4	400
		Warranty period (years) for the building where there is a written product warranty	COBie.Type.WarrantyDurationParts	4	400
		Intervals for planned maintenance (years)	COBie.Type.DurationUnit	4	400
		Expected life (years)	COBie.Type.ExpectedLife	4	400
		Price, indicated by the construction costs incl. VAT per square meter	COBie.Type.ReplacementCost	4	400
		Installationdate (year)	COBie.Component.InstallationDate	4	400
		Operating range	COBie.Type.WarrantyDurationUnit	4	400
Elevator	300	Type	COBie.Type	1	100
		Quantity: antal		1	100
		Classification	COBie.Type.AssetType	2	200
		Material	COBie.Type.Material	3	300
		Manufacturer/supplier	COBie.Type.Manufacturer	4	350
		Data sheet	COBie.Type.WarrantyGuarantorParts	4	350
		Colorcode for painted areas	COBie.Type.Color	4	350
		Warranty period (years) for the building where there is a written product warranty	COBie.Type.WarrantyDurationParts	4	350
		Intervals for planned maintenance (years)	COBie.Type.DurationUnit	4	350
		Expected life (years)	COBie.Type.ExpectedLife	4	350
		Serienummer	COBie.Component.SerialNumber	4	350
Installations	300	Type	COBie.Type	1	100
		Quantity: antal og længde (m)	COBie.Type.NominalLength	1	100
		Location	COBie.Type.Area	2	200
		Classification	COBie.Type.AssetType	2	200
		Material	COBie.Type.Material	3	300
		Manufacturer/supplier	COBie.Type.Manufacturer	4	350
		Data sheet	COBie.Type.WarrantyGuarantorParts	4	350
		Colorcode for painted areas	COBie.Type.Color	4	350
		Warranty period (years) for the building where there is a written product warranty	COBie.Type.WarrantyDurationParts	4	350
		Intervals for planned maintenance (years)	COBie.Type.DurationUnit	4	350
		Expected life (years)	COBie.Type.ExpectedLife	4	350
		Installationdate (year)	COBie.Component.InstallationDate	4	350
		Operating range	COBie.Type.WarrantyDurationUnit	4	350
VVS i terræn	300	Type	COBie.Type	1	100

Kilde: white paper: Efficient digital delivery of construction projects with COBie – august 2016



Hvad bringer fremtiden…

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VDC | Virtual Reality og 3D-print











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VDC | Brug af droner og laserscan er stigende

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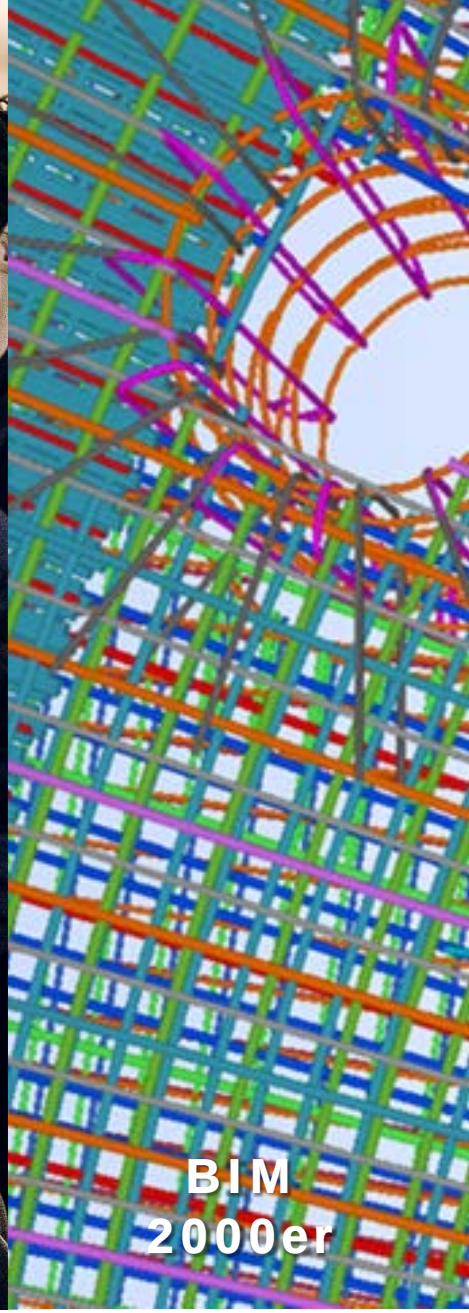
Prefabrikation
1960er

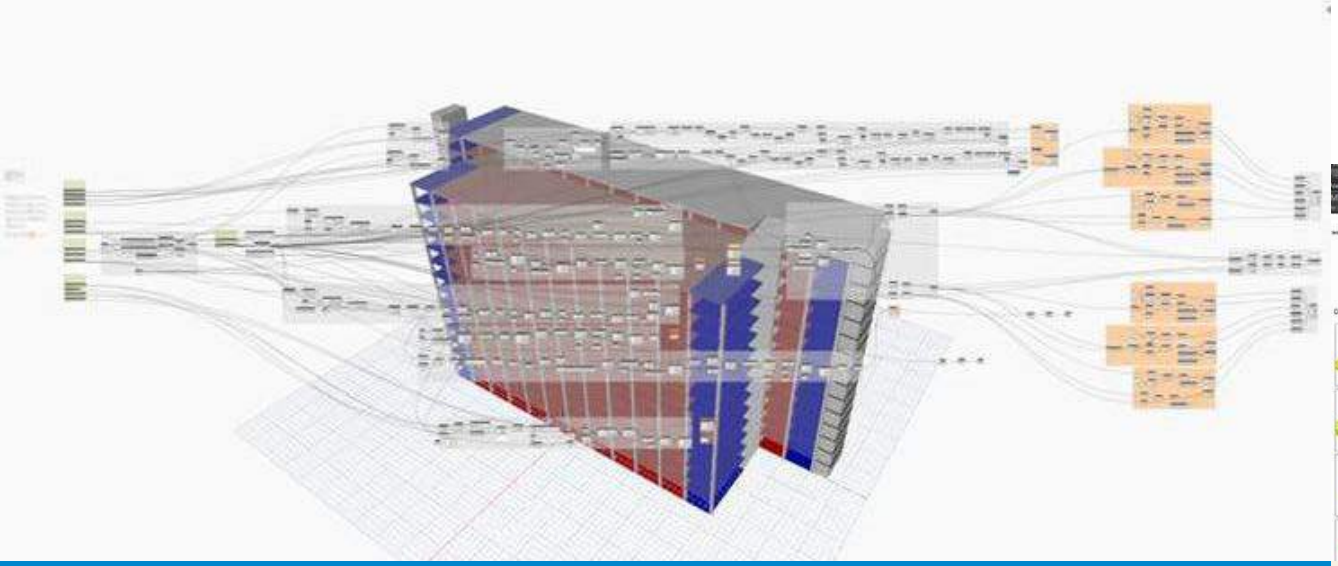
Robotteknologi
1980er

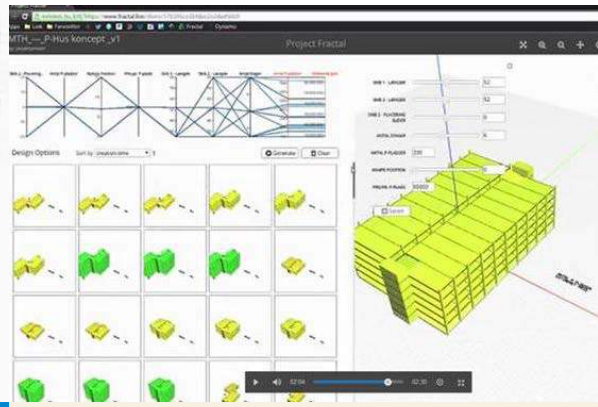
Virtual Reality
1990er



BIM
2000er

MTHøjgaard





VDC | Automatisering af designet

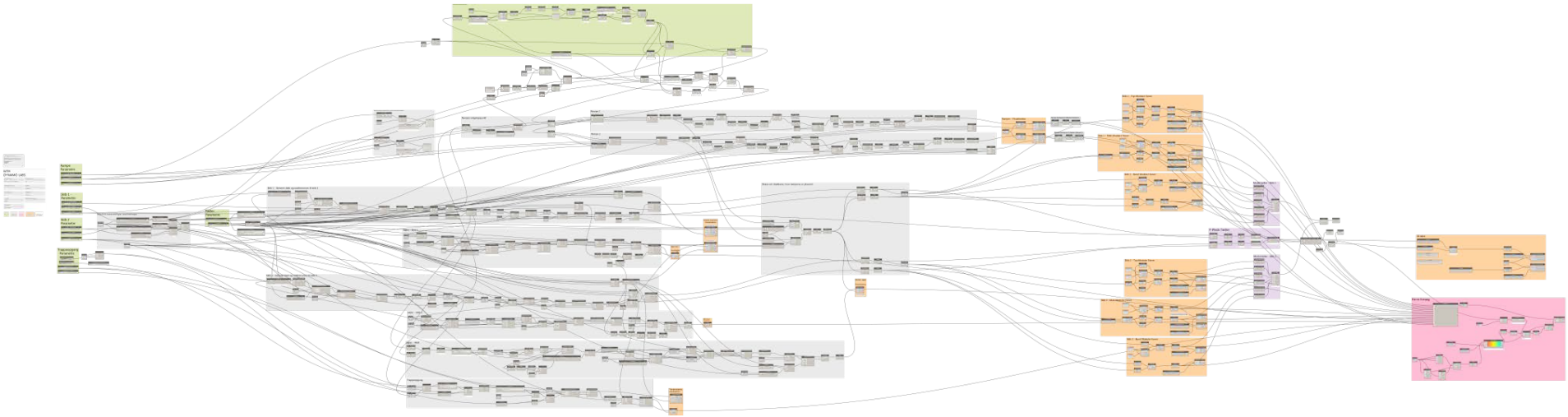
Flere alternativer

Øget produktivitet og kvalitet

Og…….

MTHøjgaard

VDC med Design Automation | Alternativerne



Antal P-pladser: 304
Totalpris: 25,19 mio DKK
Per plads: 82.848 DKK

Antal P-pladser: 308
Totalpris: 25,27 mio DKK
Per plads: 82.040 DKK

Antal P-pladser: 304
Totalpris: 25,25 mio DKK
Per plads: 83.963 DKK

VDC med Automated Design | Hvad er det næste?

VVS rørføringer allerede i tilbudet

BuildingSP

Et design man ikke selv havde tænkt på

Project Fractals

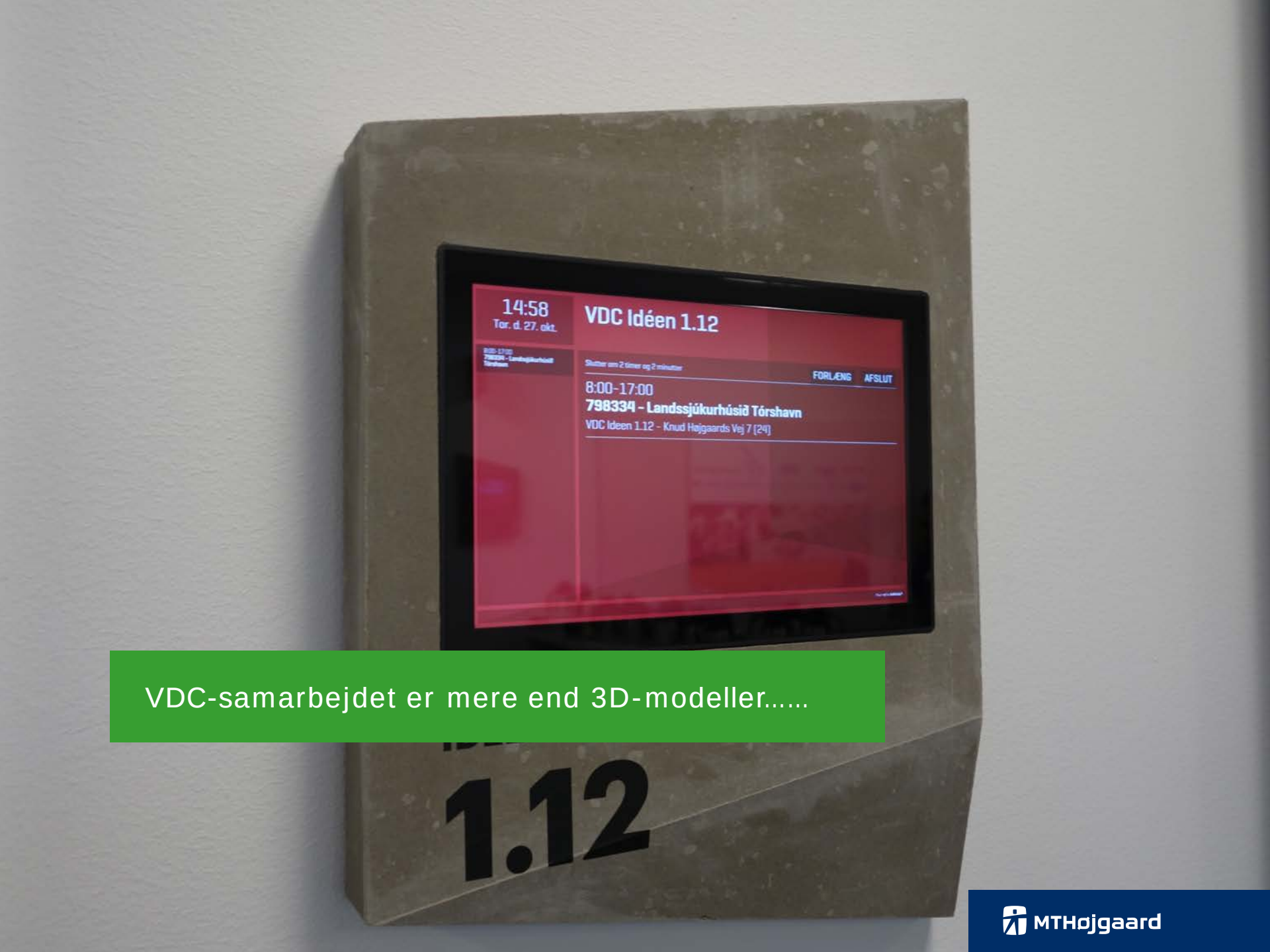
Den bedste tidsplan ud af 10.000+ mulige

Alice Technologies

Det bedste design i 6 dimensioner

Beck technologies - Optioneer

MTHøjgaard



VDC-samarbejdet er mere end 3D-modeller.....

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