



In Pursuit of Perfect Process with BIM and Lean

Heikki Halttula

25/10/2017 LCI – UK

Viasys **VDC**
Topcon Positioning Group

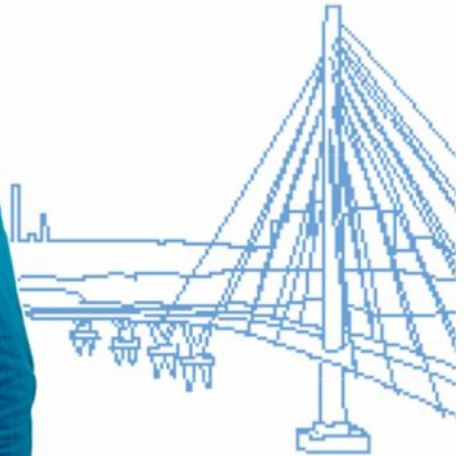
In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI

WHO WE ARE

VIASYS VDC INTRODUCTION



Viasys VDC
Topcon Positioning Group



- Founded in 1989 and headquartered in Espoo, Finland with operations in Asia
- A team of ~30 experts in civil engineering and software development.
- Customers include public organizations as well as major infra design consulting and construction companies
- Part of the global network of Topcon Positioning Group since 2016

WHAT WE DO?

We provide digital information management solutions that boost productivity in civil engineering and improve maintenance of infrastructure assets.



Construction automation using digital models



Mr. Heikki Halttula Biograph 2017

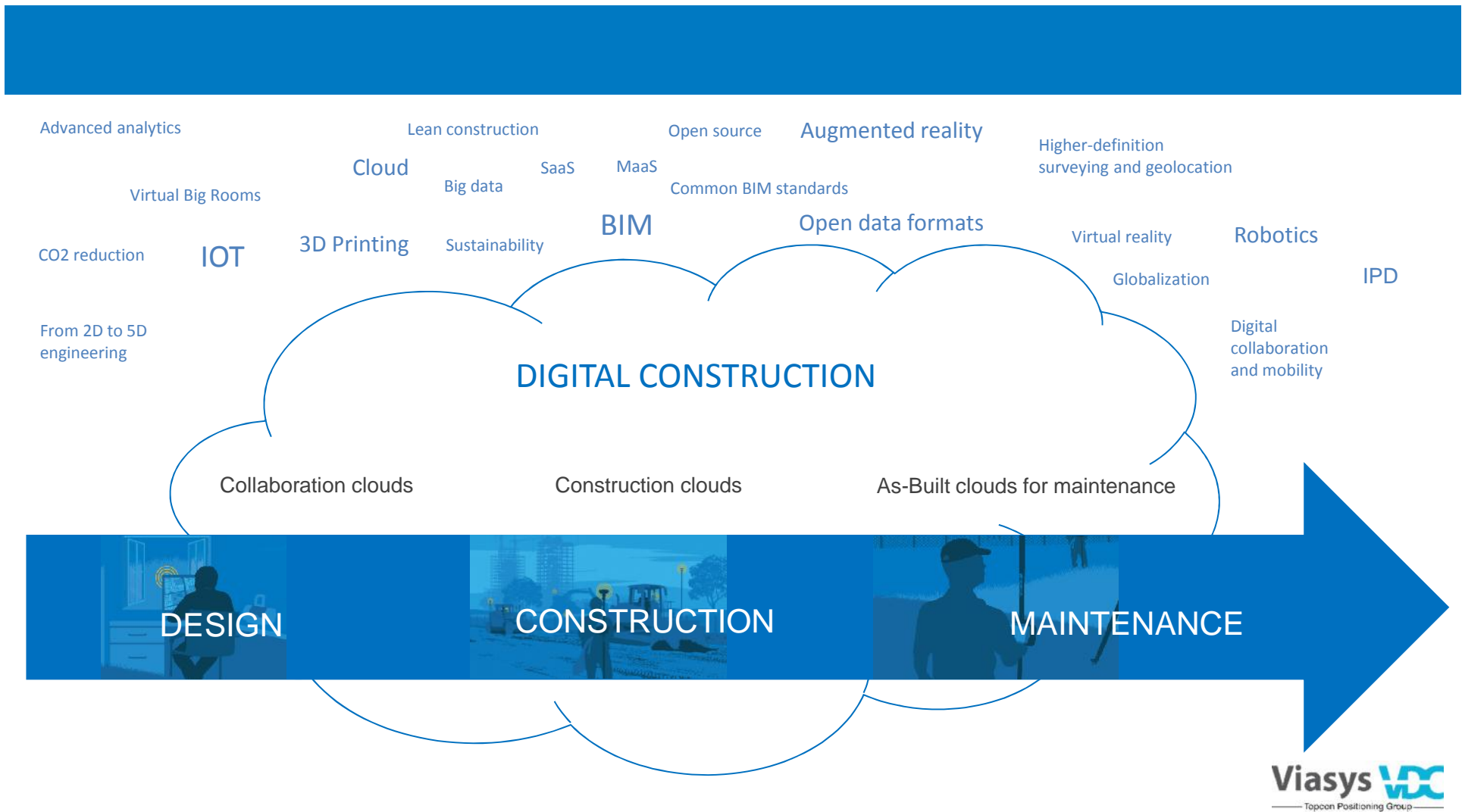
Mr. Heikki Halttula (M.Sc.) has over 30 years' experience in civil engineering projects, BIM, GIS, and CAD software development projects, BIM implementation projects, lean implementation, and lean consultancy projects. He is President and CEO of BIM Software Development Company Viasys VDC Ltd. since 1999. Viasys VDC is today part of Topcon Position Group. He is an active member of RIL (Finnish Association of Civil Engineers) and acted as the chairperson of the RIL BIM Committee for ten years and has been a member of Building Smart Finland Infra committee advisory group. The past few years he has been very active in Lean Construction Institute Finland community. He is a member of Finnish Transport and Communication Minister's advisory group. He is also Ph.D. Student at the University of Oulu. His research is focusing on the simultaneous use of BIM and Lean in construction projects.



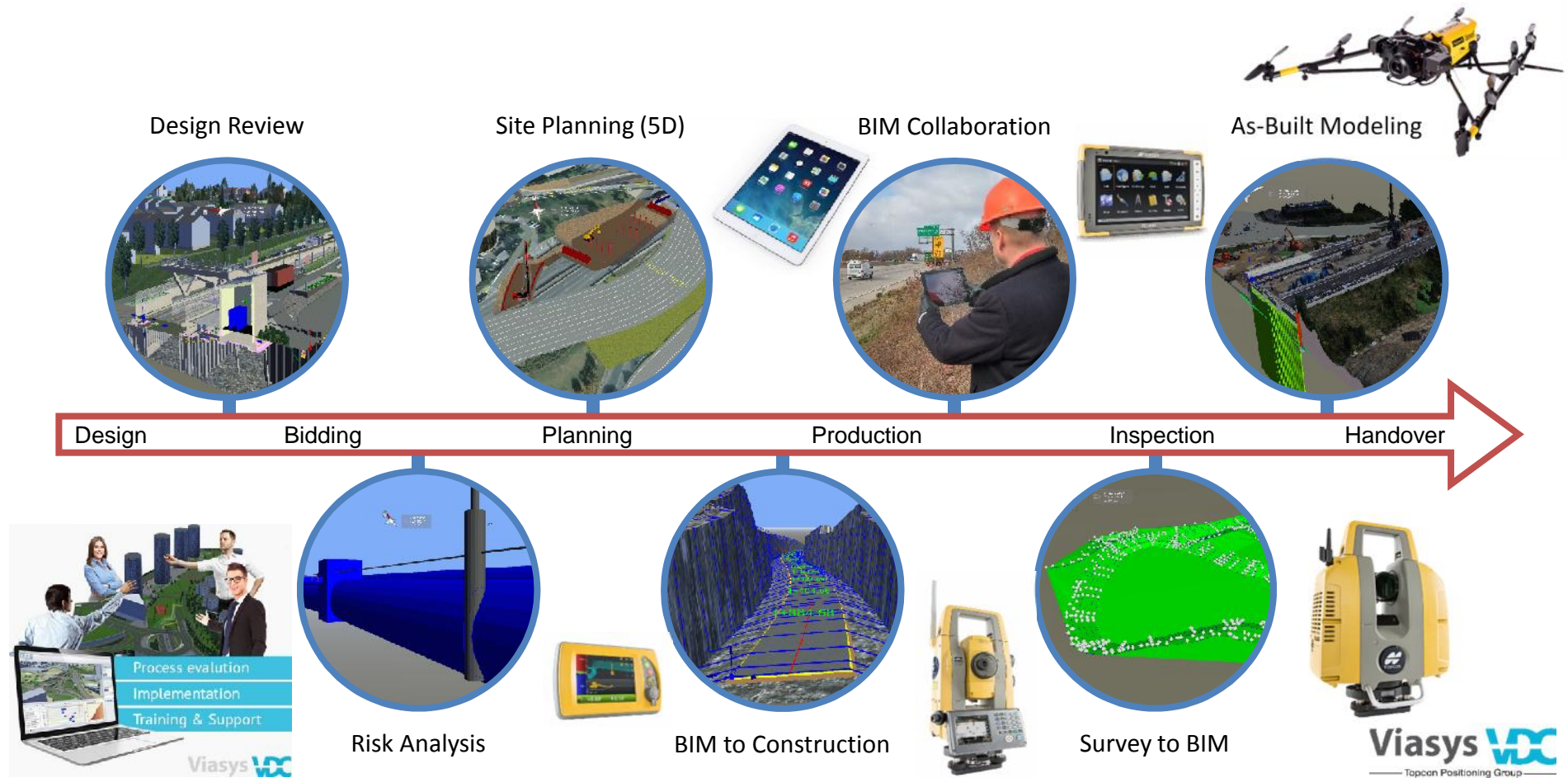
In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - *Infra lifecycle phases*
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI



Virtual Design and Construction



Data Transfer Based on Open Standards



In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - *Workshop: Stakeholders in infra project design-construction-maintenance*
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI

Workshop: Stakeholders in infra project design-construction-maintenance

- What are the major stakeholders in **highway design project**
- The whole life cycle
- 15 min
- Example of a building project



In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - *Workshop: Information needs in infra project*
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI

Workshop: Information needs in infra project design-construction-maintenance

- What are the major stakeholders' information needs in highway design project in different project phases
- The Whole life cycle: design-construction-maintenance
- 20 min

In Pursuit of Perfect Process with BIM and Lean

Agenda

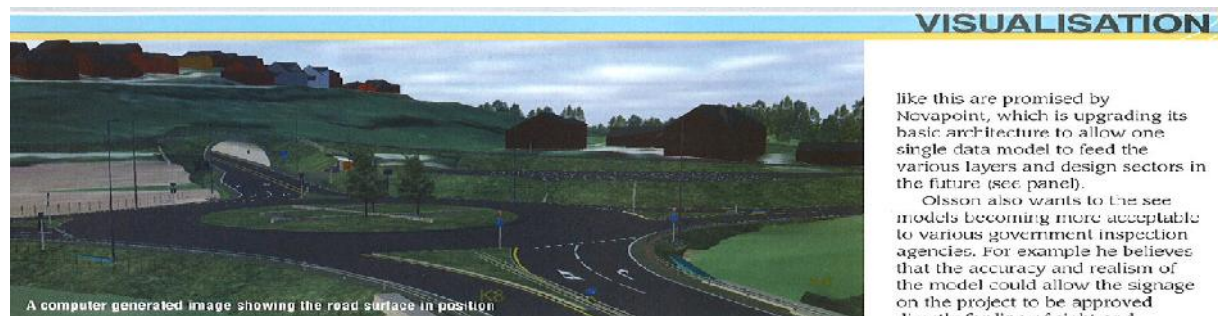
- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - *Coffee break*
- 10:45
 - *BIM characteristics and benefits*
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI

First VDC models 2006 / 2007

- Closer to non paper construction

A highly precise virtual reality model is being created in parallel with the design of a Norwegian road, to help avoid conflicts in both design and construction.

(World Highways 7 January 2008)



drawing. And then that would have been too cluttered and you would ask them to separate it all again," he adds.

The model has helped particularly on this project which is being carried out very fast in just a year from start to finish, including the tunnel.

He would like to see more included in the visualisation to get a more direct link between the model and the work on site. At present the process of building the model is one way, information is passed into the model and it can be used for seeing all the problems – "and to keep the local community

“We think it is the first time a scheme has been done like this, certainly in Norway and probably in Europe”

Asbjørn Hagen

being used on site were from Denmark company Mikrofyn.

"We are closer to completely non-paper construction," says Olsson, though not quite there yet. He says that increasingly the contractor will ask for much more detail about coordinates from the consultant rather than just being given perhaps two end points for a curve or a top position for a manhole, as was traditionally done. We had to calculate ourselves the intermediate points but now we ask for those too."

But though the 3D design model can generate such information, he

like this are promised by Navapoint, which is upgrading its basic architecture to allow one single data model to feed the various layers and design sectors in the future (see panel).

Olsson also wants to see models becoming more acceptable to various government inspection agencies. For example he believes that the accuracy and realism of the model could allow the signage on the project to be approved directly for line of sight and legibility, because the signs are shown in exactly the position and to the design that they finally have. For this pilot at least however, the physical inspection is still being demanded for items like that.

Hagen would also like to see the model being advanced to allow the contractors to use it for planning their construction sequences and looking for potential difficulties.

"We are not there completely with this trial," says Hagen, but with this project we have taken a large step" ■

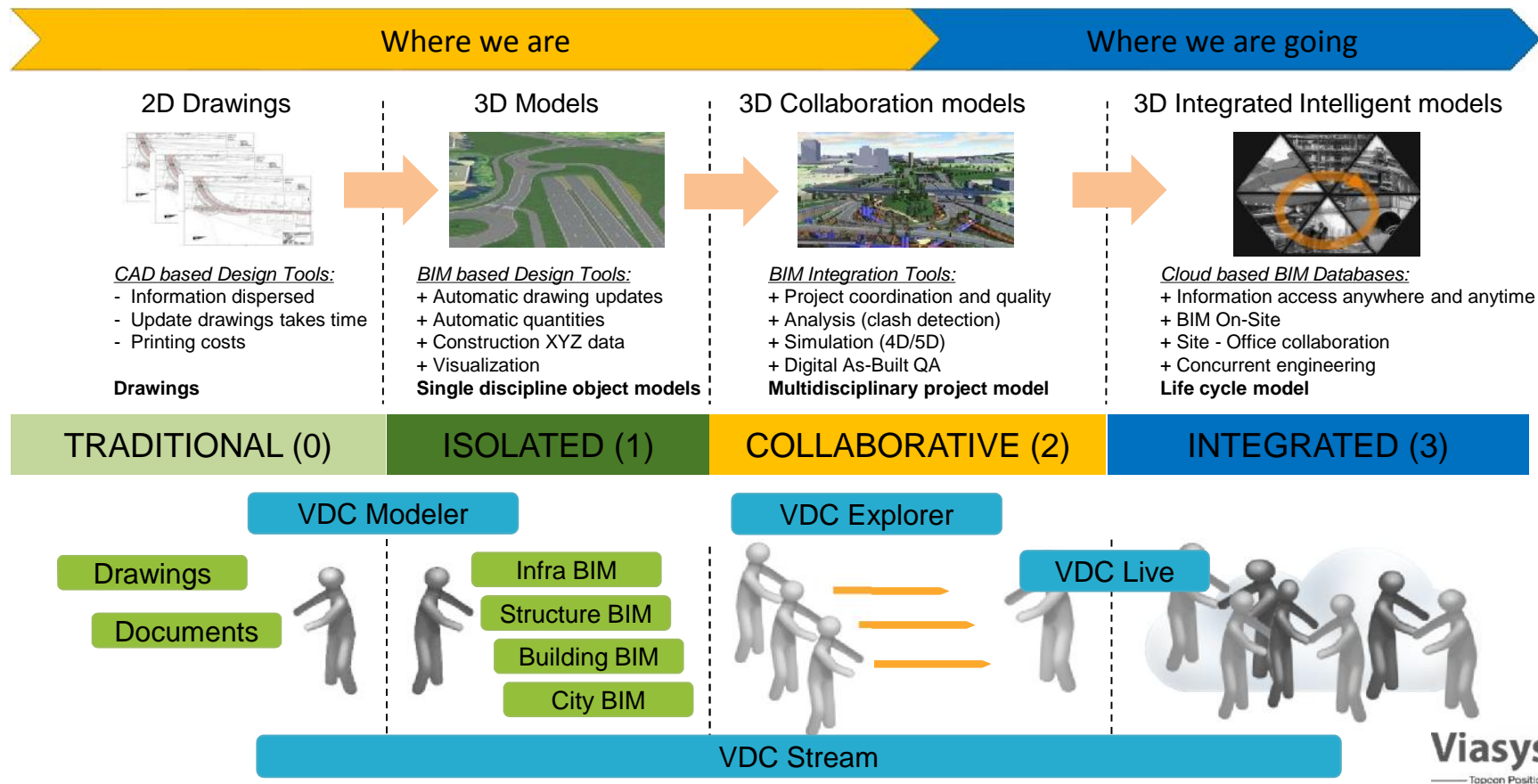
Navapoint
www.navapoint.com

Viasys VDC
Topcon Positioning Group

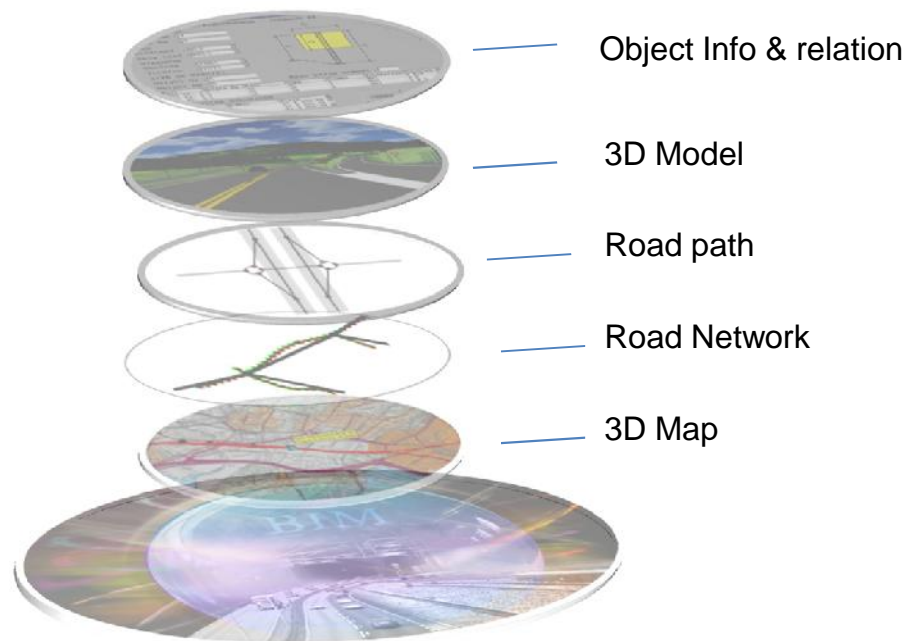
BIM Definition

- Building Information Model is a description of the facility in computers memory as a result of modeling work.
- Model includes design, construction and maintenance data of the facility as well as information how these data objects behave in different situations. AGC BIM Guide (2006).

Industry is changing from documents to BIM



CIM – Civil Information Model



BIM Standardization

Data Transfer Formats

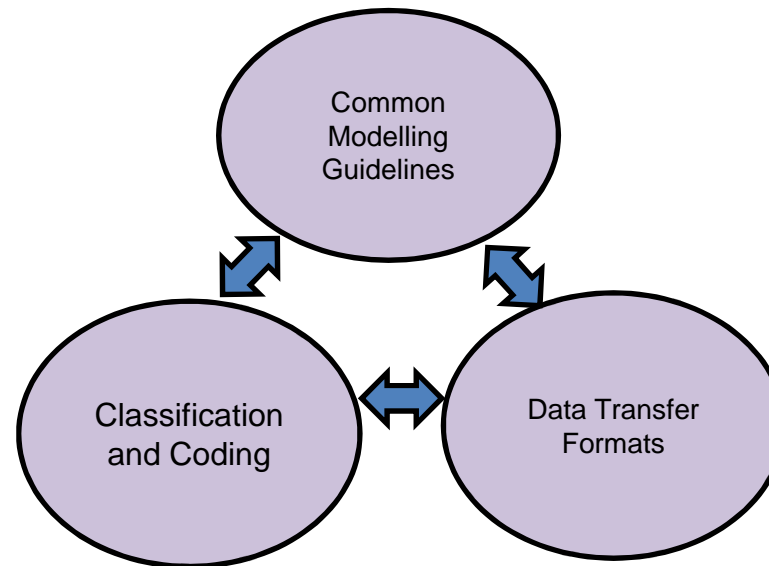
- LandXML for roads and pipe networks
- IFC for structures

Classification and Coding

- Coding and naming of objects (Uniclass)

Common Modelling Guidelines

- Describe the requirements and process in different project phases



Benefits of using BIM



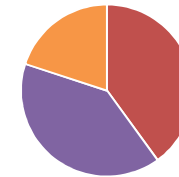
The major benefits of BIM include

- Cost savings,
- Less CO2 emission, more sustainable construction,
- Better data and information flow,
- Shorter project timelines,
- Better quality,
- Facilitate collaboration and the use of Alliance/IPD
- Facilitates Early involvement and Integration

5% - 15% Lower Project Cost

- Design conflicts found during construction cause extra costs
- With BIM conflicts can be eliminated
- Faster construction with lower cost
- The analysis shows 75 % decrease in construction change orders when BIM is used

Additional costs in construction

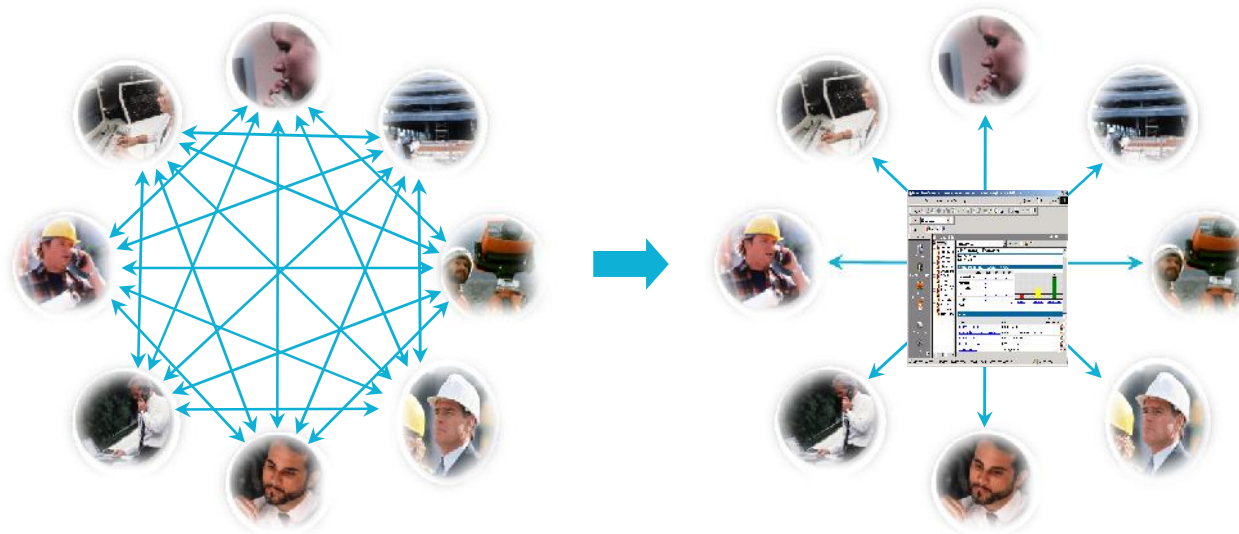


■ Unforeseen ■ Design issues ■ Other

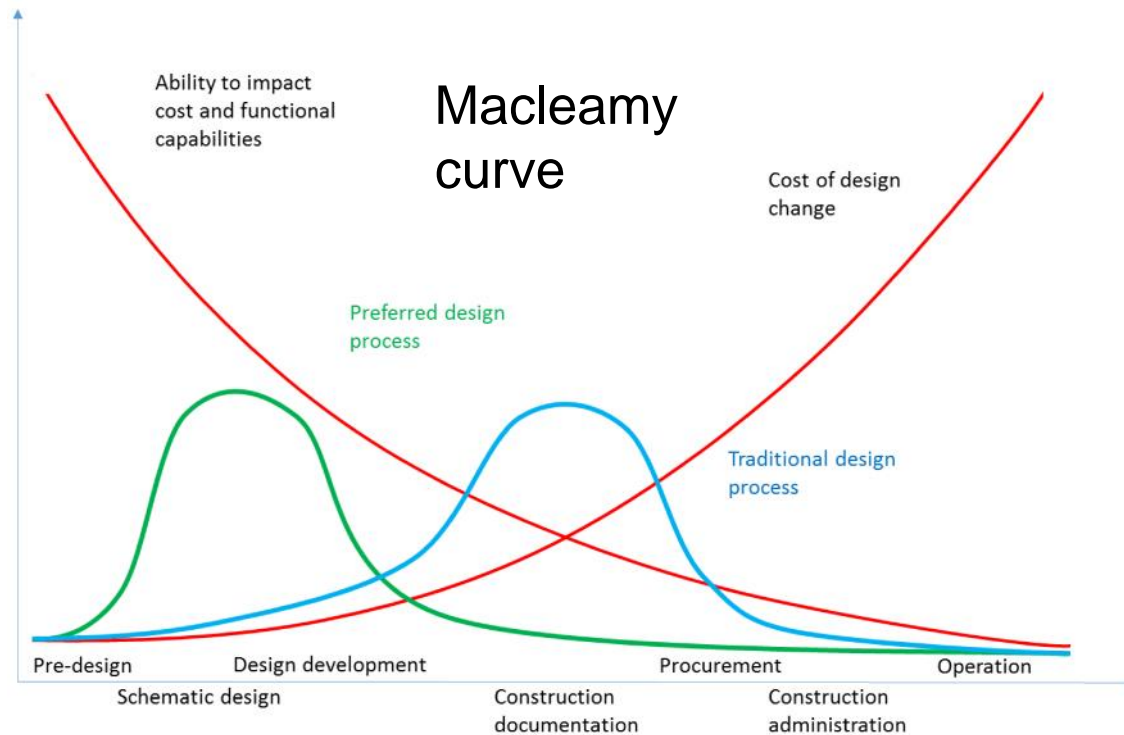
Project	Project method	Contract sum	CCO %	Contractor
RV 150 - E03; Ring 3 Ulven-Sinsen	Traditional	301 mill	18,9%	NCC Construction
RV 150 - E22; Ring 3 Ulven-Sinsen	BIM	532 mill	9,8%	Veidekke
E6 – Nordre, Trondheim	BIM	263 mill	7,6%	Skanska
Fv. 456 Vågsbygdveien	BIM	43,7 mill	4,2%	Veidekke Entreprenør
E6 Skaberud - Kolomoen	Traditional	470 mill	18,1%	Hæhre Entreprenør
Joint Project E6-Dovrebanen	BIM	1,8 mrd	8,3%	Hæhre Entreprenør

Norwegian Public Road Administration

Communication and information management

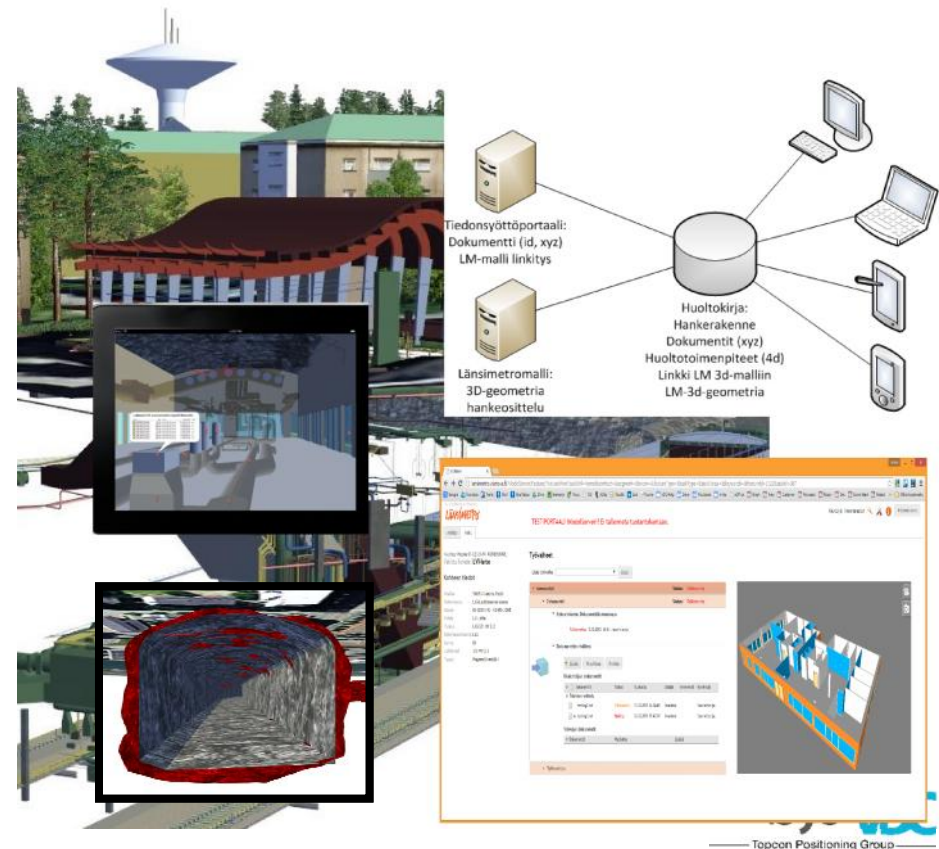


The early involvement of all project parties (IPD)



Case Study: West Metro, Finland

- **Combined BIM model**
 - GIS (GML: surroundings)
 - Civil (LandXML: subway)
 - Building (IFC: structures, MEP)
- **Maintenance Management**
 - Digital service manual
 - BIM Model
 - Web and Mobile
- **Savings**
 - No physical document archive
 - Information available anywhere anytime
 - Maintenance and operations optimization
 - Potential cost savings \$ 10 mill





CASE EXAMPLE

VIRTUAL DESIGN HELPED REMOVE DESIGN CONFLICTS - GJØNNES STATION

Renewal of the Oslo metro rail line
Norwegian Public Road Administration

Read more at:
www.viasys.com/success-stories/virtual-design-helped-remove-design-conflicts-gjonnes-station/

Modeling helped the customer identify over 350 expensive pitfalls – half of which were not detected using the traditional design workflows – saving the taxpayer around 1 700 000 euros.

VDC Benefits in Construction- Contractor Comments

“The 3D discipline **models make our work day simpler and more effective**. There are almost no errors or conflicts between the disciplines in the models, from which we build the E22.”



*Petter Bakke
Project Manager*

“The collaboration model provides a true understanding of the objects. **This improves communication and provides a neat and accurate picture that everyone understands**. We eliminate misunderstandings. This includes communication with the public, as well as with the participants of the project.”



Statens vegvesen

*Erling Guttormsen
Statens vegvesen Region Sør*

“The use of a coordination model in the project made sure we had **practically no stops due to design errors**, such as collisions between disciplines. We could produce continuously. Uninterrupted construction by crew and equipment, are the two most important factors for a cost-efficient production.”

*Bård Olav Aune
BIM Manager
Skanska Survey*



“The quality of the set out data using a coordination model is the greatest benefit of model use. **The data flow to machine control prevents manual errors.**”



Statens vegvesen

*Jarle Kristian Tangen
Division Manager
Statens vegvesen Region Sør*

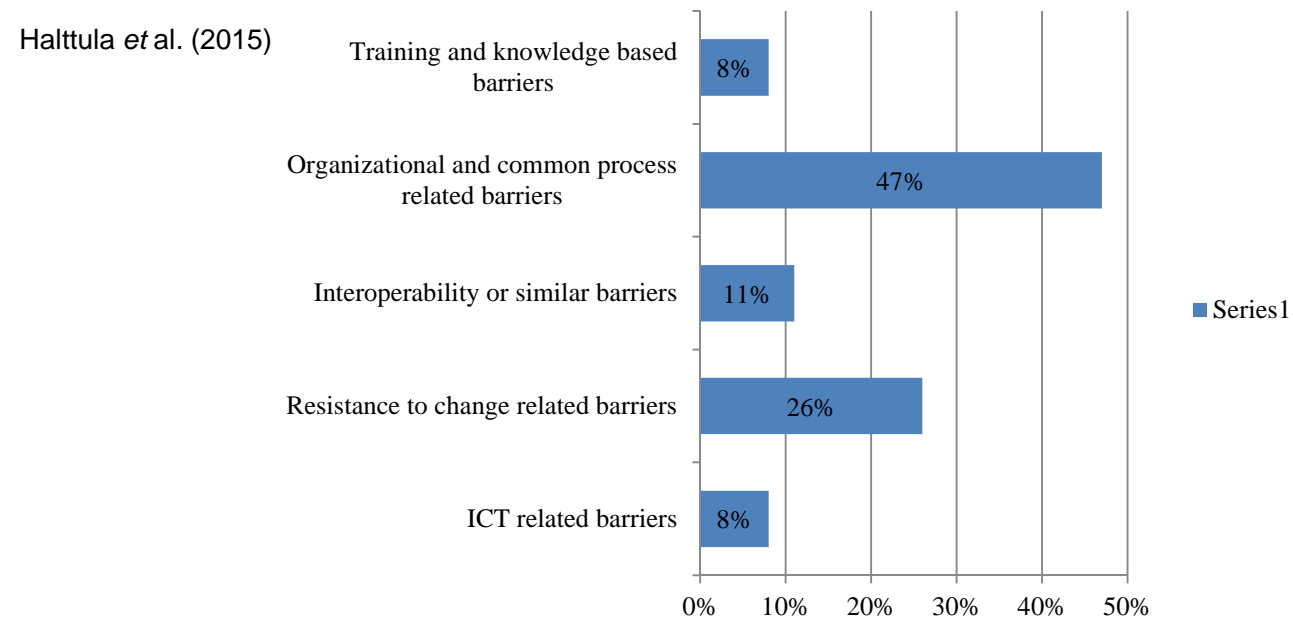
“BIM models no doubt contribute to **reducing the contractor's risk**. One feels safer both about price and project implementation when handing over the tender.”



*Arve Krogseth
Project Manager*



Barriers to Achieving the Benefits of BIM



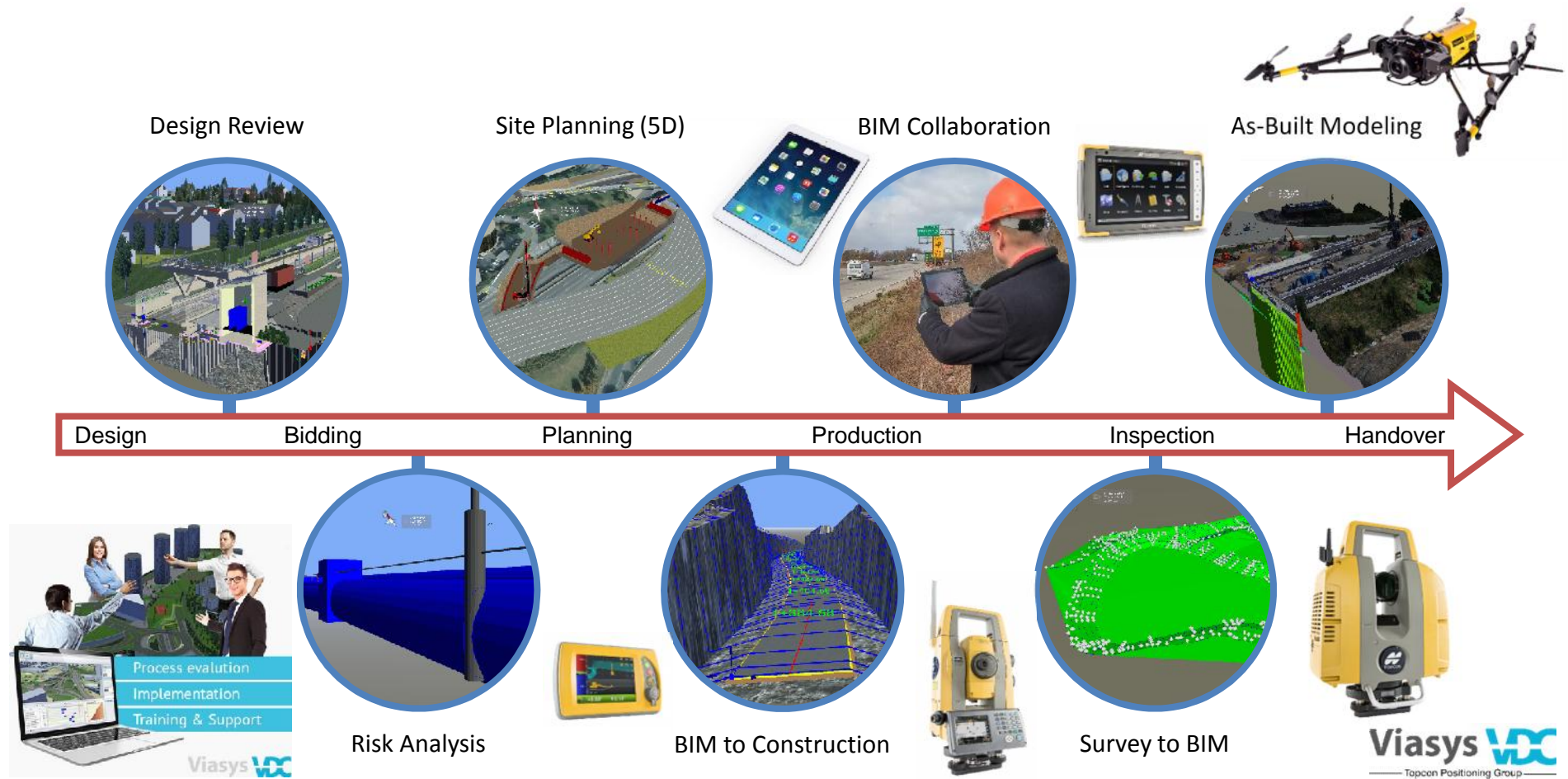
The share of barriers in each type of category

Benefits	The share of barriers in each type of category				
	ICT related	Resistance to change	Interoperability or similar	Organizational and common process	Training and knowledge
Benefits of BIM to Clients/Owners	9 %	31 %	10 %	45 %	6 %
Benefits of BIM to designers and constructors	8 %	22 %	13 %	49 %	9 %
Average total share %	8 %	26 %	11 %	47 %	8 %

Conclusion

- Productivity increase and cost savings are not enough to activate the change. (Bernstein and Pittman 2004)
- Instead, there must be an external driver such as owner demand and changes to risk/reward systems to break the old business models.
- Properly acknowledging customer requirements truly works as shown by the experiences of UK Government's construction strategy.
- The wider use of relational project delivery agreements (Alliance, IPD) may change the risk/reward ratios.

Virtual Design and Construction



Workshop: How the use of BIM changes the RFI (Requests For Information)

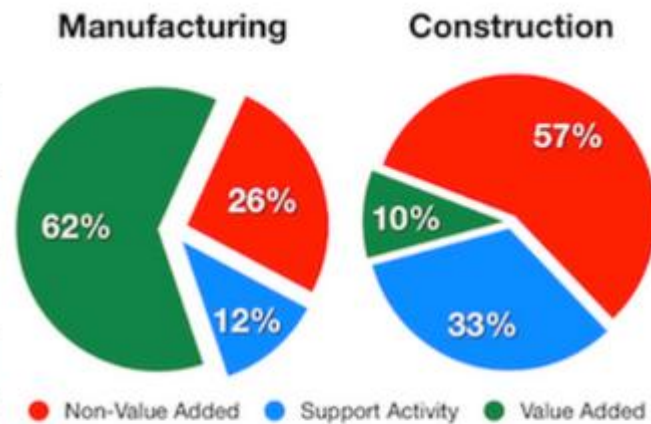
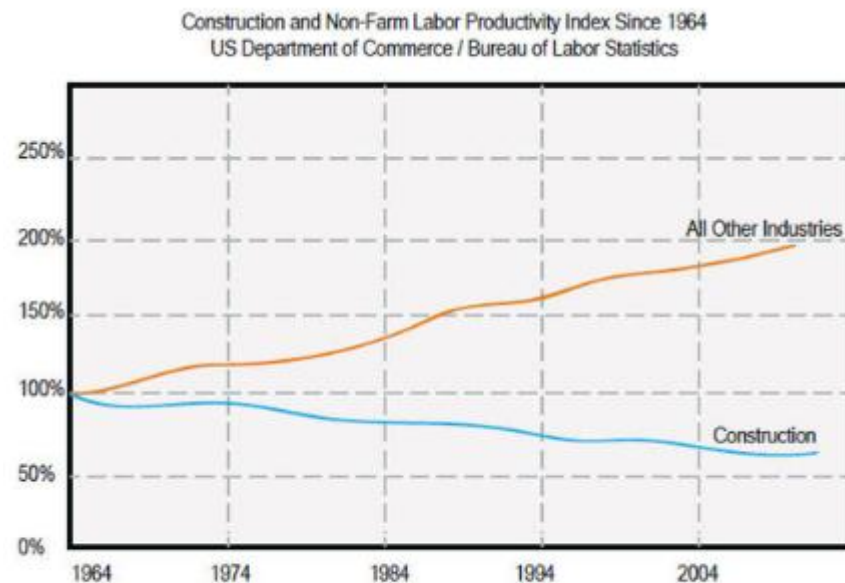
- What is the current document based process
- What is the new BIM-based process
- What is the change in RFI
- 20 min
- The RFI means a practice where it is needed to confirm a clarification of a detail, specification, or note on the construction drawings, or to secure a documented instruction or explanation from the architect or client that is needed to continue work.

In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - *Lean and Lean construction*
 - BIM&Lean interaction and benefits when used simultaneously
 - Workshop: How the use of BIM&Lean together changes the RFI

Productivity and Value added production



BIM Handbook

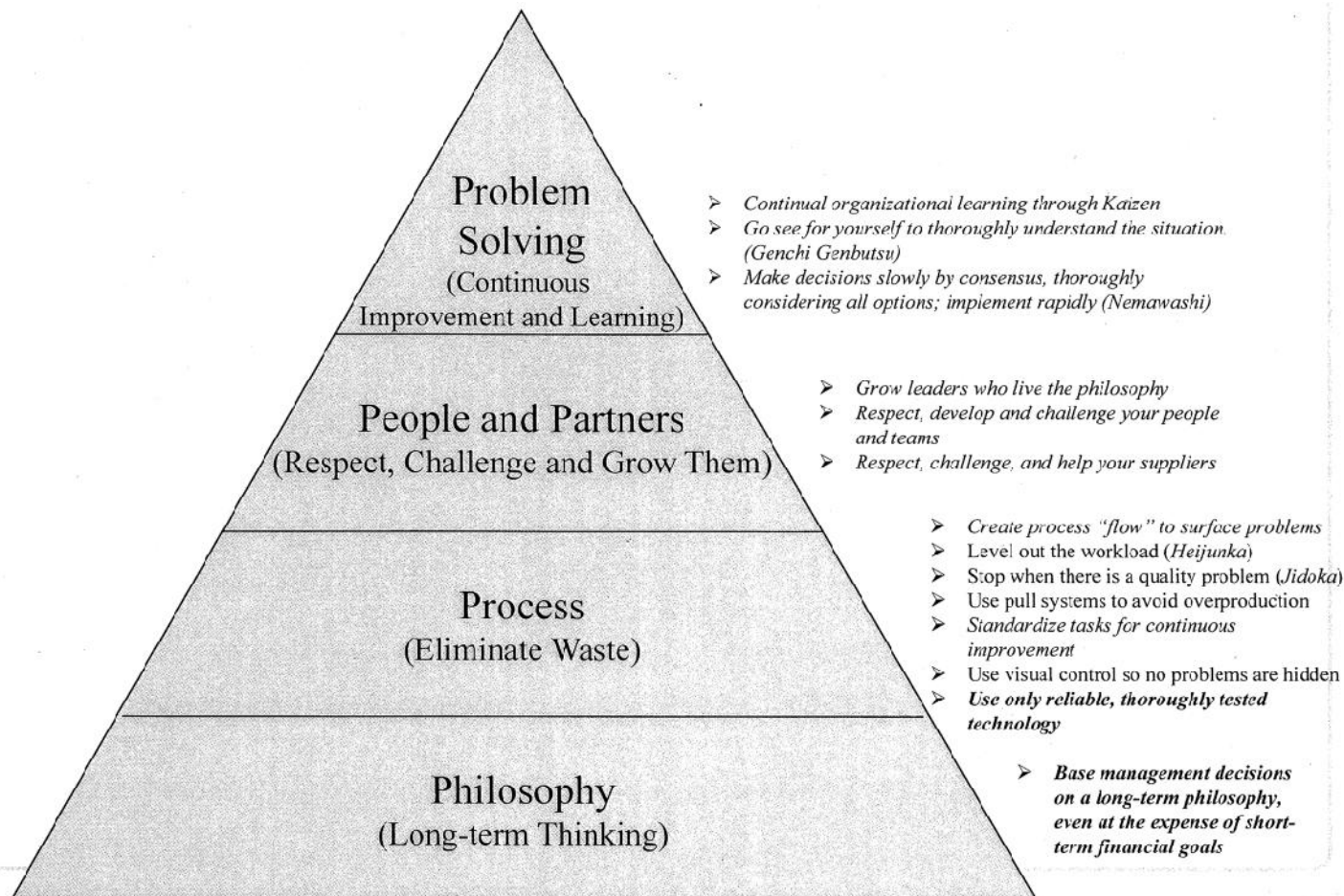
The Lean Ideal

Give customer products exactly fit
for purpose, instantly, with no waste

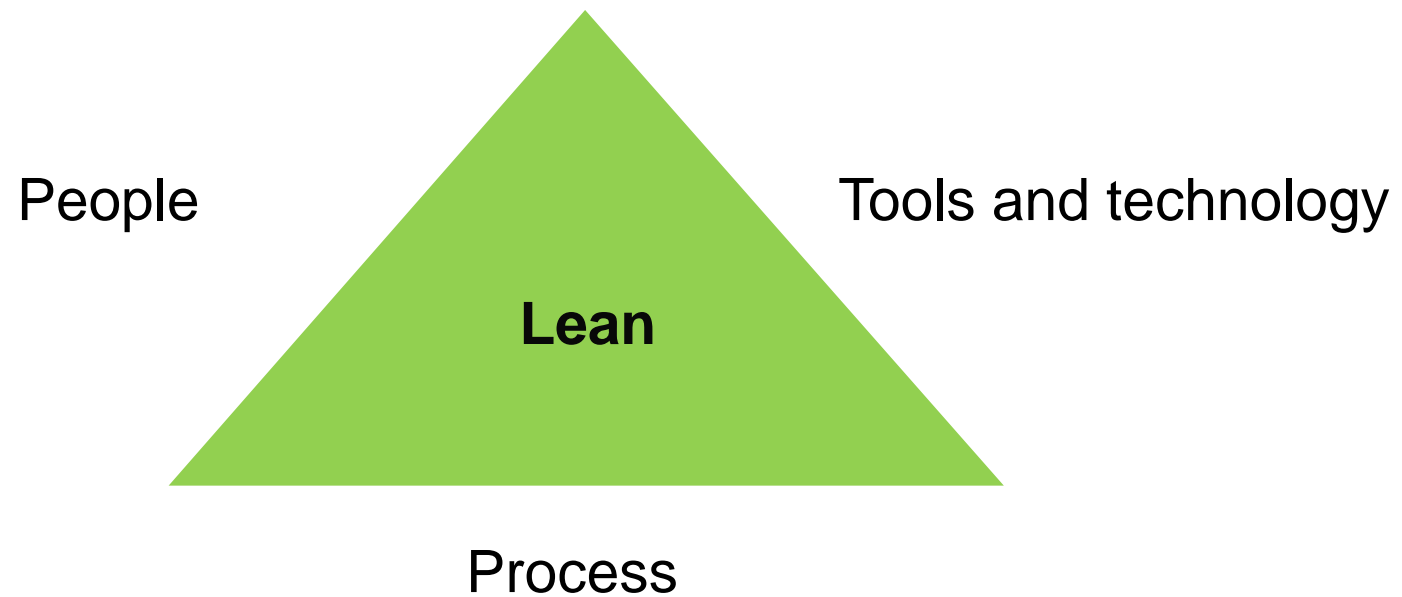
Maximize value for customer and minimize waste

© Lean Construction Institute 2008

4P Model (The Toyota Way, Liker)



Lean production system



Lean Construction

Lean Construction extends from the objectives of a Lean production system—maximize value and minimize waste—to specific techniques, and applies them in a new project delivery process.



Lean Construction vs. typical contemporary practices

- Managing construction using Lean Construction methods differs from typical contemporary practices in the following ways:
 - It employs a clear set of objectives for the delivery process;
 - It is aimed at maximising performance for the customer at the project level;
 - It designs products and processes concurrently and
 - It applies production controls throughout the life of the project.

Tommelein and Ballard (1999),

Lean design vs. western tradition - Four differences

Better results faster, with less work

Leadership

- Project managers have more power

Teamwork Incentives

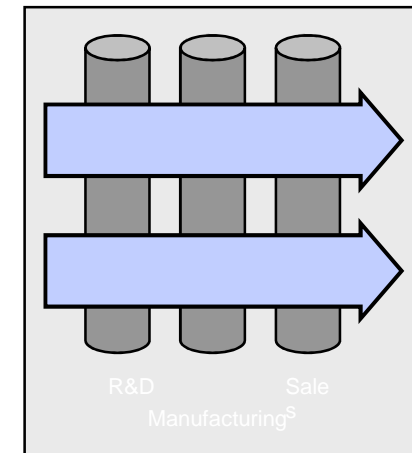
- Projects are well done vs. line organization's profit

Communication

- Confront conflicts directly

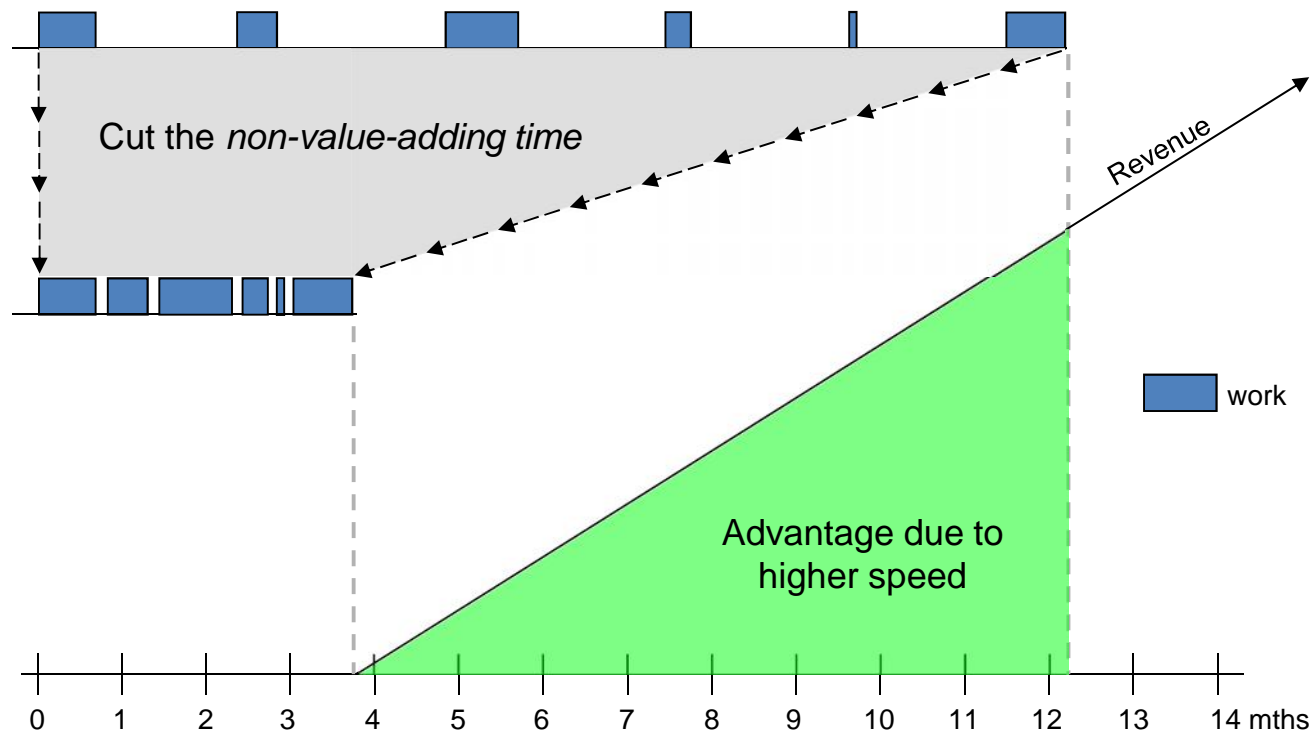
Simultaneous development

- Work starts immediately, when there is enough information vs sequential from department to another



- (Machine that changed the world, Womack & Jones)

Speed is important factor in production



In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - *BIM&Lean interaction and benefits when used simultaneously*
 - Workshop: How the use of BIM&Lean together changes the RFI

Lean - BIM Interaction Matrix

Lean Principles BIM Functionality	Lean Principles																			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Visualization of form	1	1,2												3				4		11
Rapid generation and evaluation of multiple design alternatives	2	1	22									/	/		8				16	5
	3	9	9	22		51												1	16	5
	4		10	12											8				16	5
	5	1,2	1	12														1	1	5
Maintenance of information and design model integrity	6	11	11																	11
	7	12	12	22																12
Automated generation of drawings and documents	8	11		22	(52)	53									54	54				
Collaboration in design and construction	9		23						36						36					
	10	2,13	24				33										43		46	49
Rapid generation and evaluation of multiple construction plan alternatives	11	14	25	(29)	31									(41)				44		
	12		15	25	(29)				37					(41)				44	47	
	13	2	40	25	(29)				17	40	40		40					44	47	49
Online/electronic subject-based communication	14	29	26	30	30		34					34			(42)				47	48
	15	16		26	30	30		34	38	38	34				(42)			45		49
	16	15		27		32														
	17		20	28			35								(42)					50
	18		21	30	30		34			39					(42)				47	48





Available online at www.sciencedirect.com

ScienceDirect

Procedia Economics and Finance 21 (2015) 532 – 539

Procedia

Economics and Finance

www.elsevier.com/locate/procedia

8th Nordic Conference on Construction Economics and Organization

The contemporaneous use of building information modeling and relational project delivery arrangements

Heikki Halttula^{a*}, Aki Aapaoja^b, Harri Haapasalo^c

^a*Vianova Systems Finland, Espoo, 02130, Finland*

^b*VTT Technical Research Centre of Finland Ltd., Oulu, 90810, Finland*

^c*University of Oulu, University of Oulu, 90014, Finland*

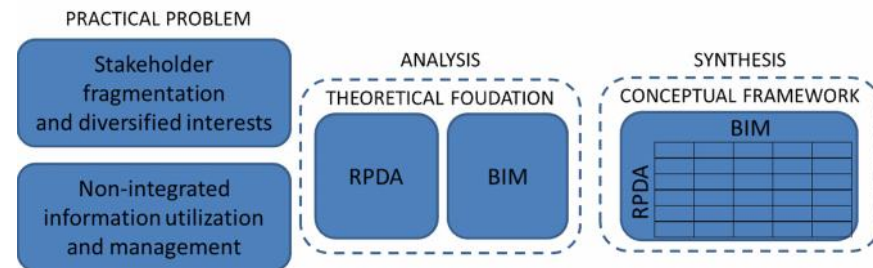
Introduction

- Construction business has been accused of low productivity development.
- BIM and RPDA both aim to enhance customer value.
- Fragmentation of project deployment.
- Stakeholders' multiple interests. Each stakeholder has specific requirements with respect to a project that can create fundamental conflicts with others
- Despite the complexity of projects, requirements and schedules have been continuously tightening,
- The use of BIM is on low maturity stage or not implemented properly

Purpose of the study

- BIM and RPDA have a lot in common.
- This paper studies the characteristics of BIM and RPDA and
- Main benefits when utilized simultaneously

The Logic of the paper.



The characteristics of BIM

Information centre

- All information is stored into the model or the model has direct links to the information.

Collaboration model

- A collaboration model can be used to find clashes between design domains and to find other design mistakes.
- A common real-time collaboration model helps improve communication between stakeholders.
- BIM helps to arrange collaborative meetings based on a shared model and a virtual reality application.

Simulations

- Model can be used to simulate the construction operation and maintenance process.

The characteristics of RPDA

Mutual and single object

- Mutual and single project objective.
- Open accounting documents among team members
- Shared project benefits and risks (value-based approach)
- Unrestrained communication and wide use of technology

Integration

- No organizational boundaries
- Co-location of a project team
- Focus on solving problems, not on finding out who is guilty ('no blame' culture)
- Fair and respectful culture among team members.
- Value co-creation

Early stakeholder involvement

- Early involvement of key stakeholder
- Each team member has an equal opportunity to contribute to the project objective and delivery process.
- Increased predictability of overall costs and schedule
- Unrestrained communication and wide use of technology

The simultaneous use of BIM and RPDA

Activities are integrated

- All information is available to all stakeholders in the same model.
- Virtual reality models and simulations help all stakeholders to understand and influence each other's work.
- Collaboration models make the co-operation easier in Big Room.
- A model helps to find the root cause of the problem.
- BIM is a good tool for value co-creation. It is possible to make costs, energy consumption, resources or CO2 emission simulations with the model

The simultaneous use of BIM and RPDA

Single and a mutual project objective

- BIM has all the needed information for the project and project parties.
- Collaboration models show how current designs affect other part of the project.
- All the information equally for all the stakeholders
- Simulations of the whole project model can be used to guarantee that the decisions made are appropriate for the mutual and single project objective.

The simultaneous use of BIM and RPDA

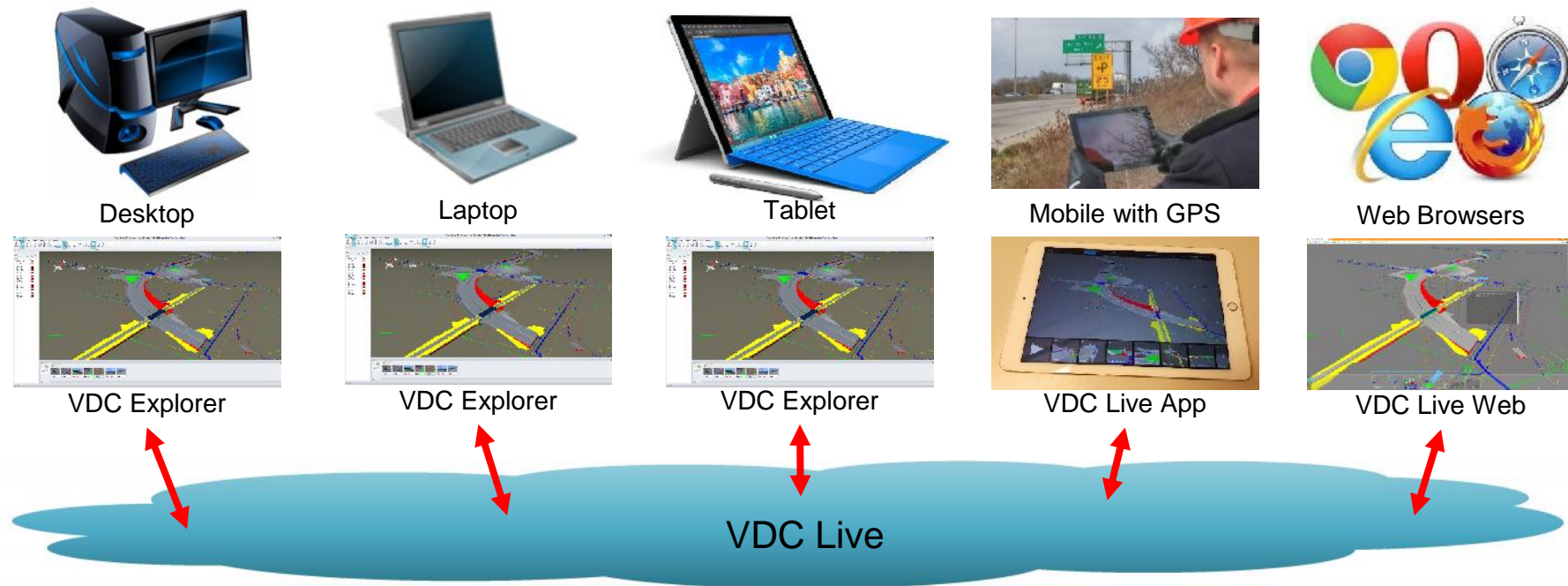
Early involvement of key stakeholders is essential

- It is possible to make draft model of a project that is already in the feasibility stage.
- 3D simulations that include cost information help to push the design towards the target value of a project.
- Constructability can be estimated with the help of 4D simulation.
- An entire project's life phases, from feasibility study, planning, detailed design, construction, operation and maintenance, can be simulated in the early stage of the project.

Conclusions

- The contemporaneous use of BIM and RPDA give benefits to the project
- Integration is easier with a common model that includes the necessary information for all stakeholders during all project phases
- BIM is a technology that eases early involvement. The use of BIM and RPDA both change the timing of design earlier in the project timeline.
- More added value to the client. Design quality gets better, construction is more efficient and sustainable, and operations are smoother and defect free.
- A practical implementation suggestion is to use collaboration models in Big Rooms to help improve the communication between all stakeholders.
- Clients should require the contemporaneous use of RPDA and BIM more often.

Collaborate using BIM on Cloud at Site and Office



In Pursuit of Perfect Process with BIM and Lean

Agenda

- 9:00
 - Introduction
 - Infra lifecycle phases
 - Workshop: Stakeholders in infra project design-construction-maintenance
 - Workshop: Information needs in infra project
- 10:15
 - Coffee break
- 10:45
 - BIM characteristics and benefits
 - Workshop: How the use of BIM changes the RFI (Requests For Information)
 - Lean and Lean construction
 - BIM&Lean interaction and benefits when used simultaneously
 - *Workshop: How the use of BIM&Lean together changes the RFI*

Workshop: How the use of BIM&Lean together changes the RFI (Requests For Information)

- What is the change in RFIs
- 20 min
- The RFI means a practice where it is needed to confirm a clarification of a detail, specification, or note on the construction drawings, or to secure a documented instruction or explanation from the architect or client that is needed to continue work.