ETH zürich

New Business Models for Disruptive Innovation in Construction

Prof. Dr. Daniel M. Hall
DBAUG, Institute for Construction and Infrastructure Management
Chair of Innovative and Industrial Construction

Swiss Lean Construction Institute
Roundtable | Zoom
10 November 2020

Prof. Dr. Daniel M. Hall

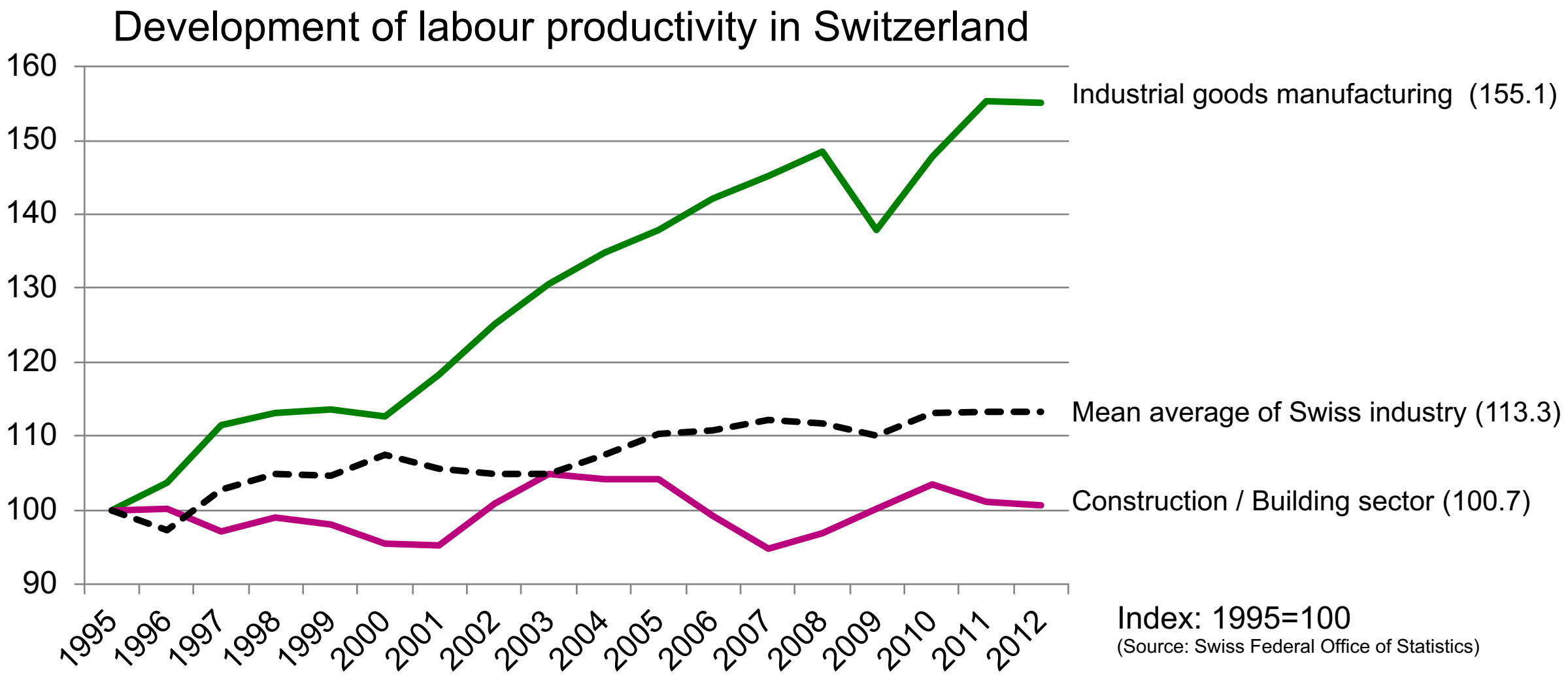
- Chair of Innovative and Industrial Construction
- PhD Civil Engineering Stanford University 2017
- MS Civil Engineering Stanford University 2014
  - Emphasis Sustainable Design & Construction
- 3 years industry experience (general contractor, concrete contractor)
- Founder of Industrialized Construction Forum at Stanford

Did Time Stand Still?

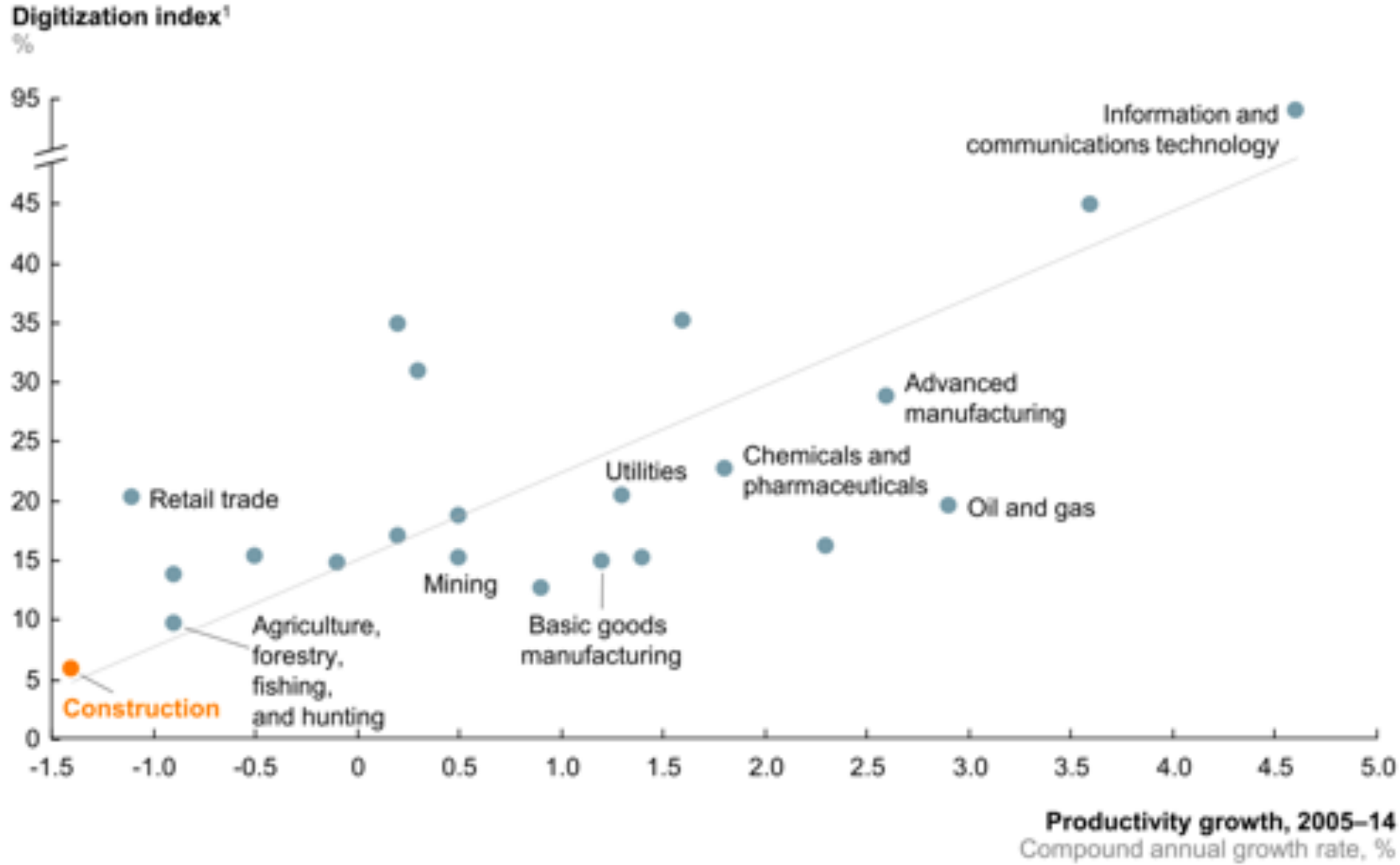
Construction Site ETH Zurich 1919

Construction Site Prime Tower 2009

Lack of Industrialization in Construction



The Challenge: Low Digitalization, Low Productivity Growth in Construction

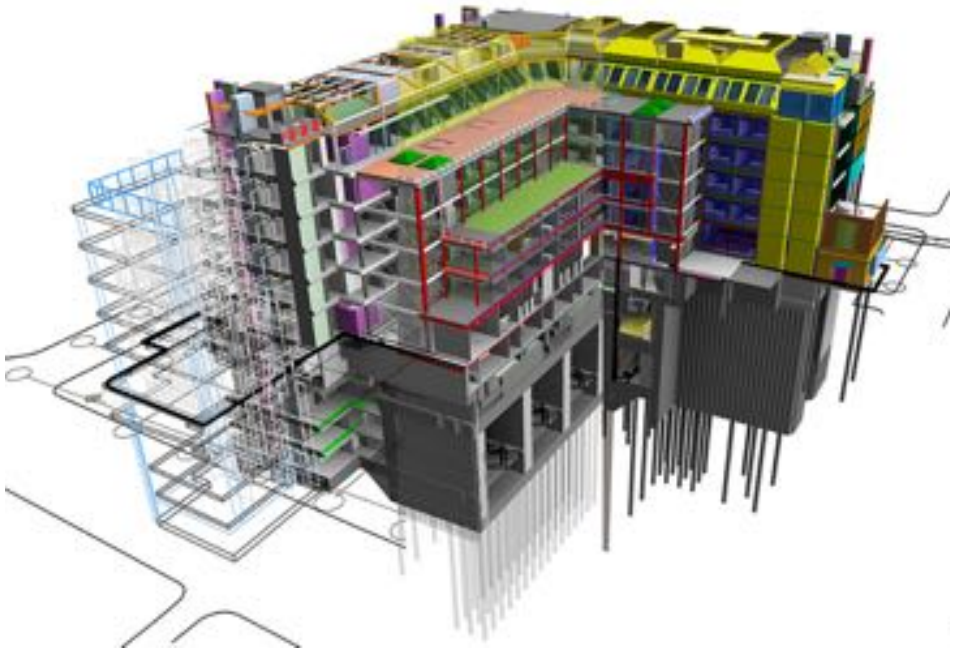


(Source: McKinsey 2017)

What is disruptive innovation?

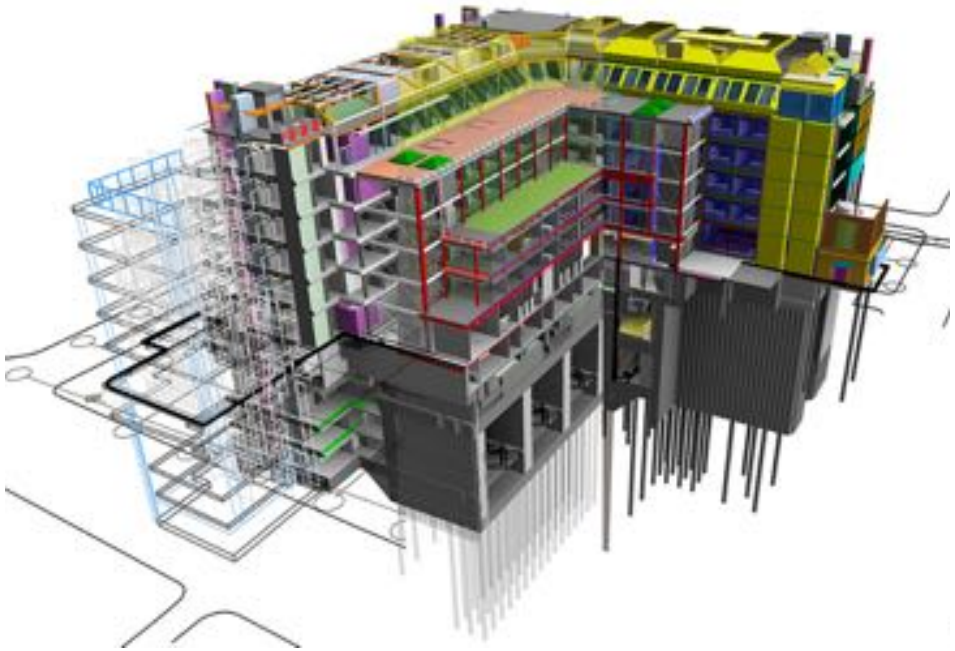
New Technology + New Business Model

What is disruptive innovation in construction?



New Technology

What will be the disruptive business model for BIM + Lean?



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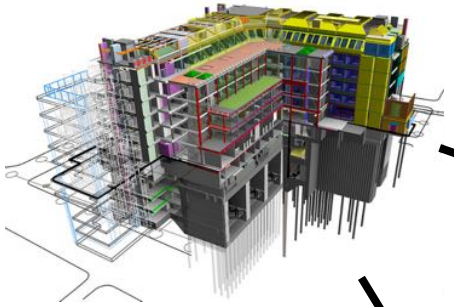
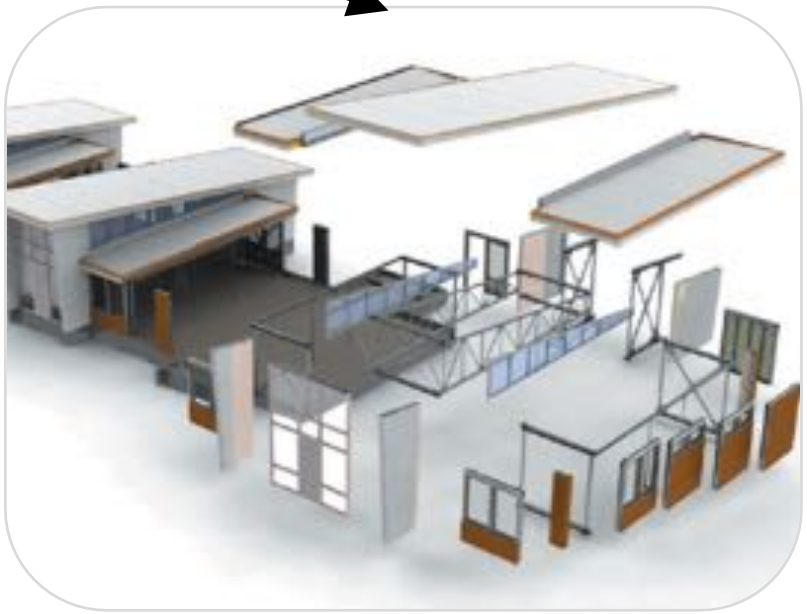
New Technology + New Business Model

New business models in construction?



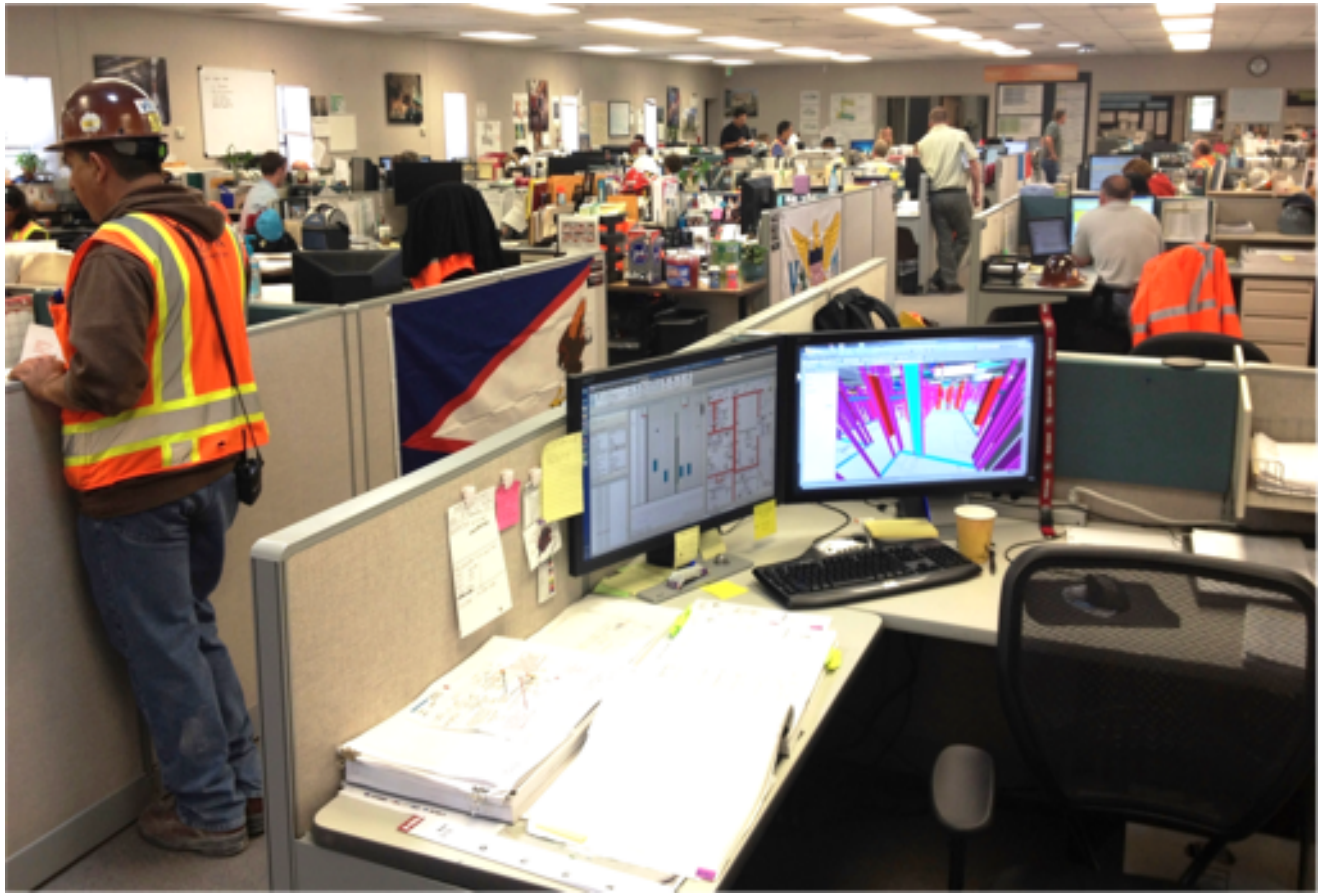


Integrating Project Delivery

Vertical Integration

Digital Systems Integration

(images (L to R) courtesy T. Lehtinen, nArchitects and MIR studio, Project Frog)



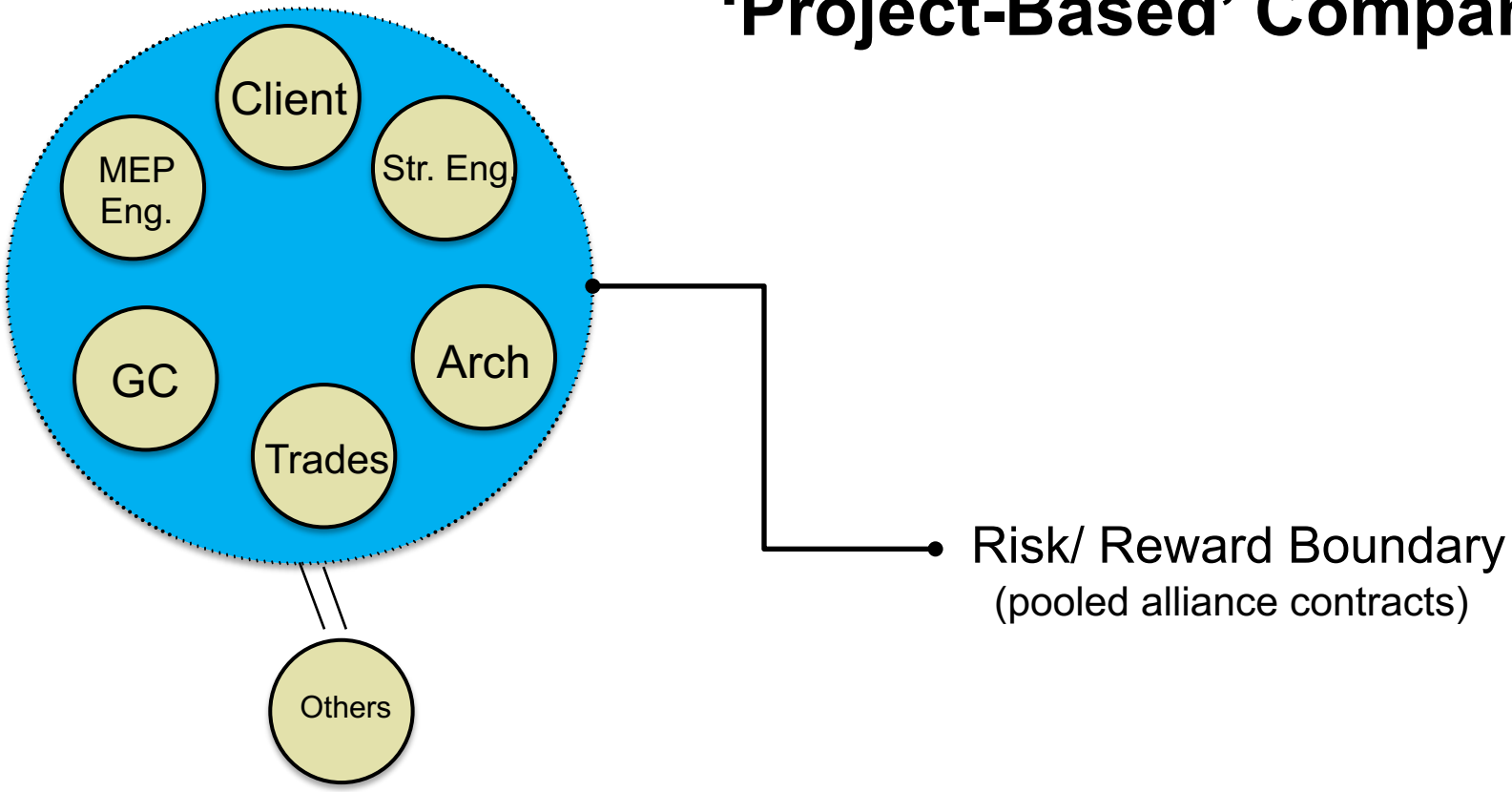
Integrating Project Delivery (IPD)

Business Model #1

What is IPD?

https://leanconstructionblog.com/A-Simple-Framework-for-Putting-Integrated-Project-Delivery-IPD-Into-Action.html

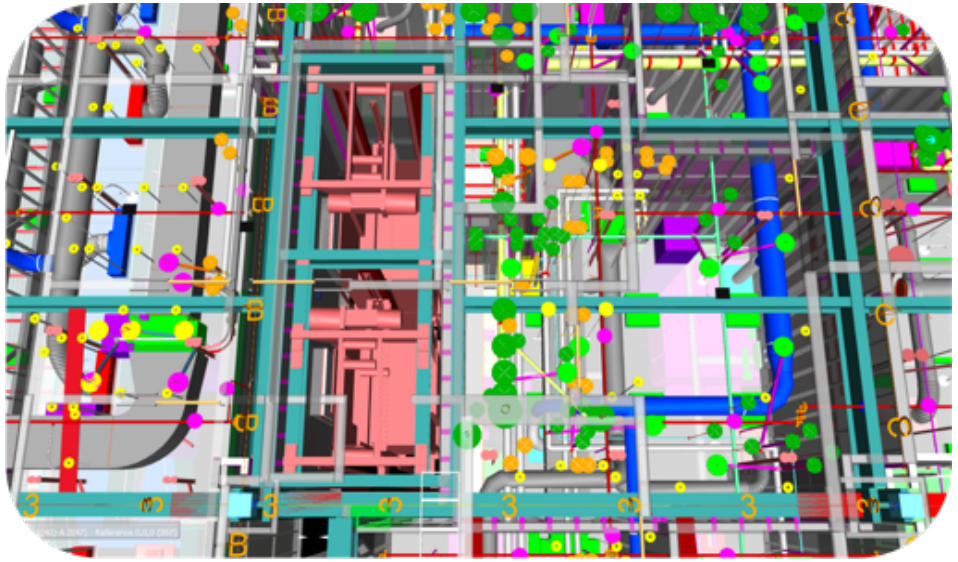
The IPD Agreement: How it works

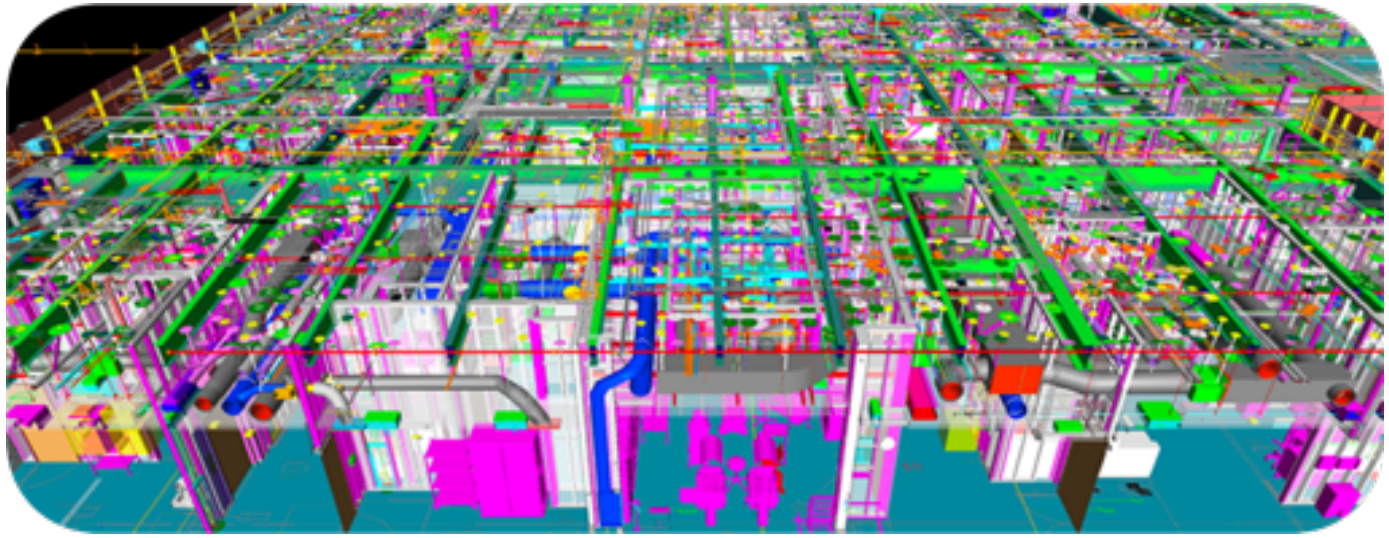


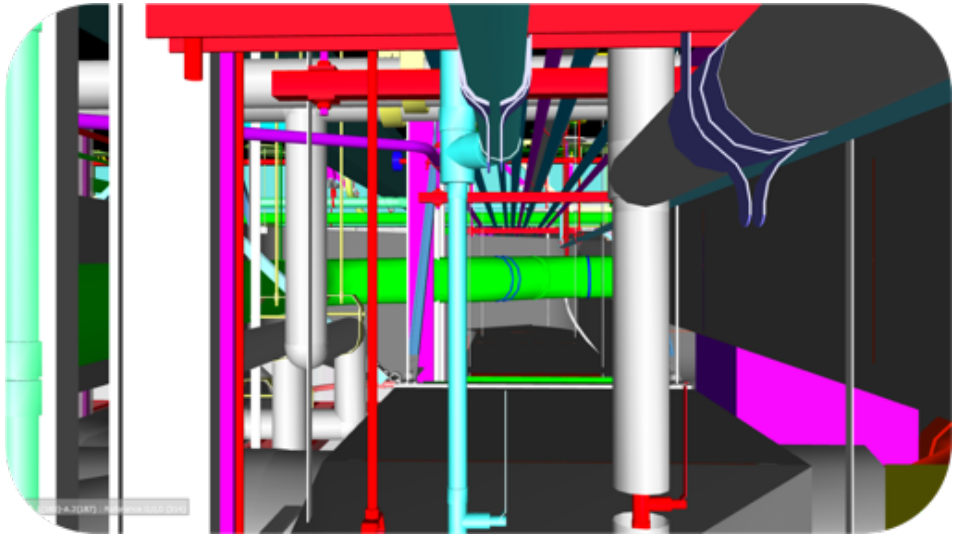
Case A: Sutter Health Hospital (San Francisco) - IPD

(Image courtesy SutterHealth.org)

Case A: Integrated Information (BIM)







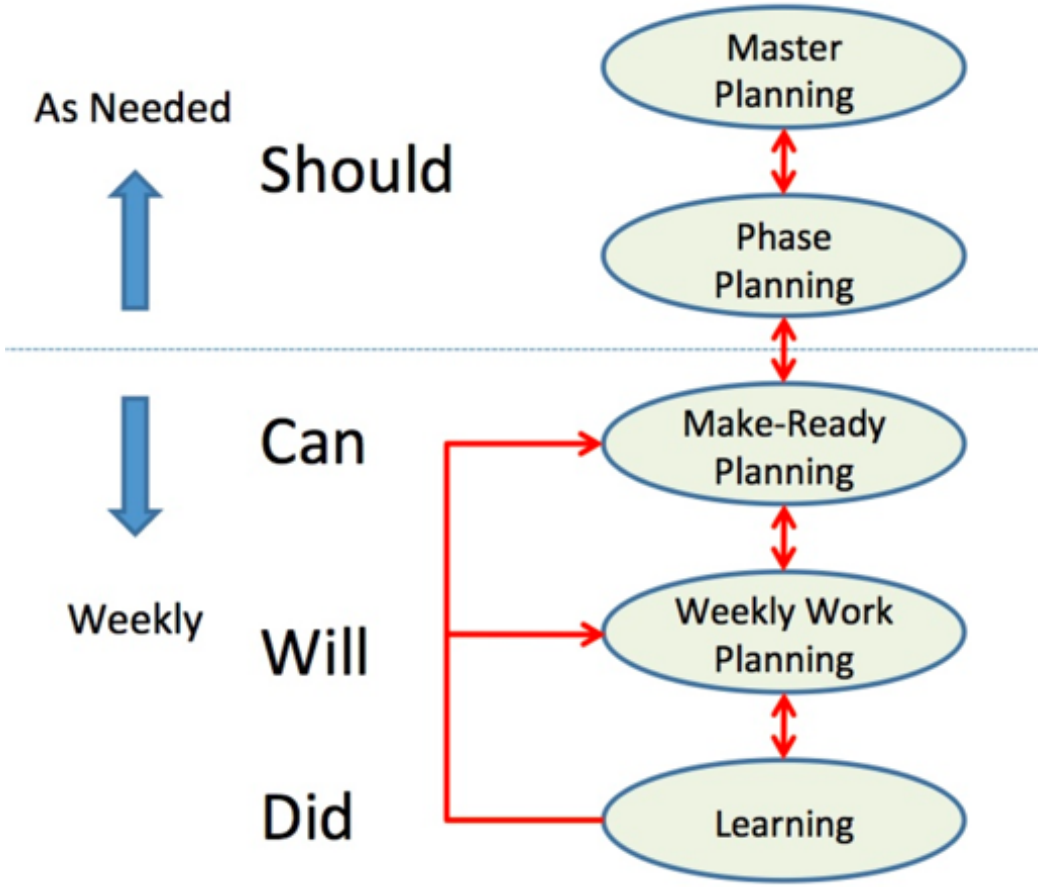
(Images courtesy modulus consulting, https://www.modulusconsulting.com/~modulu5/index.php/sutter-health-vngc-hospital/126?tmpl=component)

Case A: Integrated Organization (Colocation)

(Image courtesy smithgroup.com)

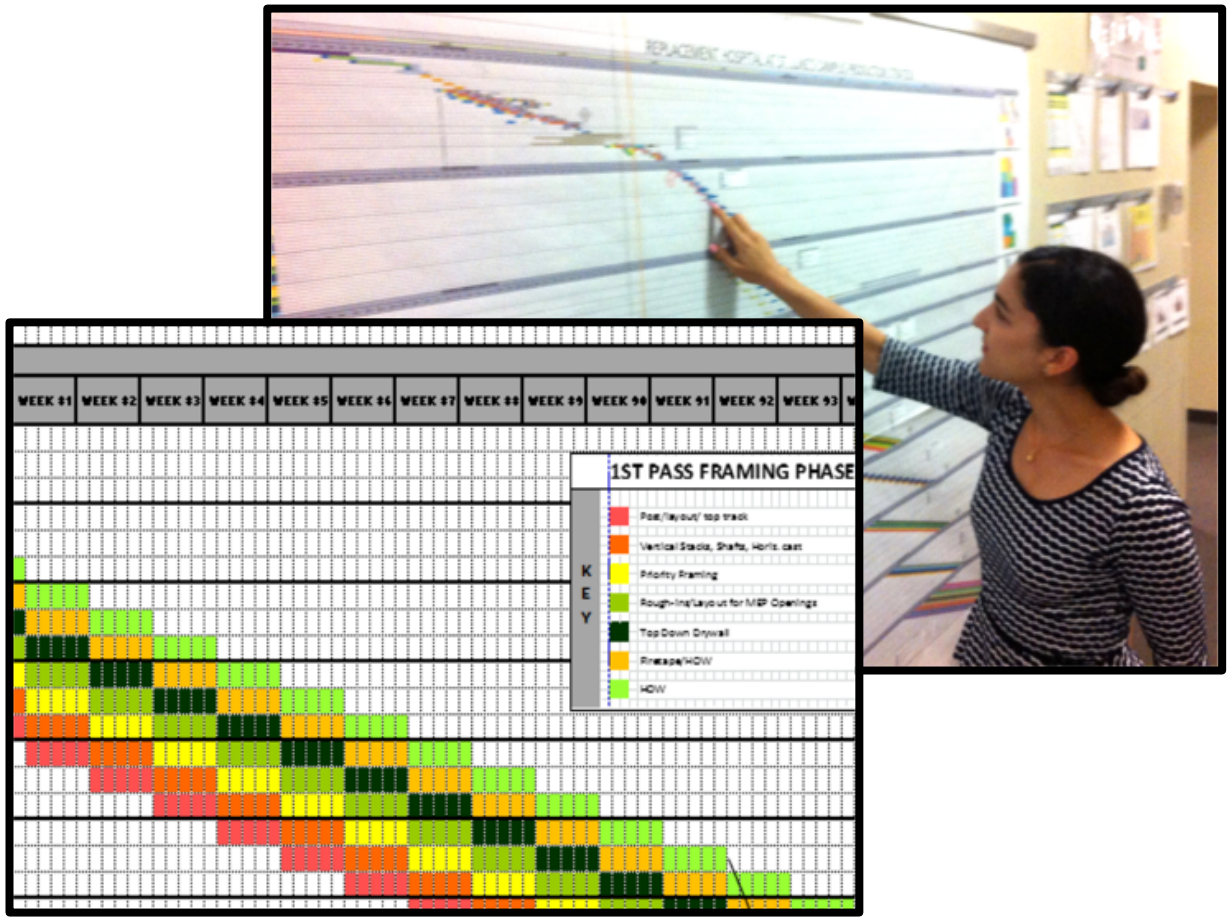
Case A: Integrated Processes (Lean Construction)

Last Planner System



(Image courtesy leanconstructionblog.com)

Takt Time Planning



(Image taken by Daniel Hall)

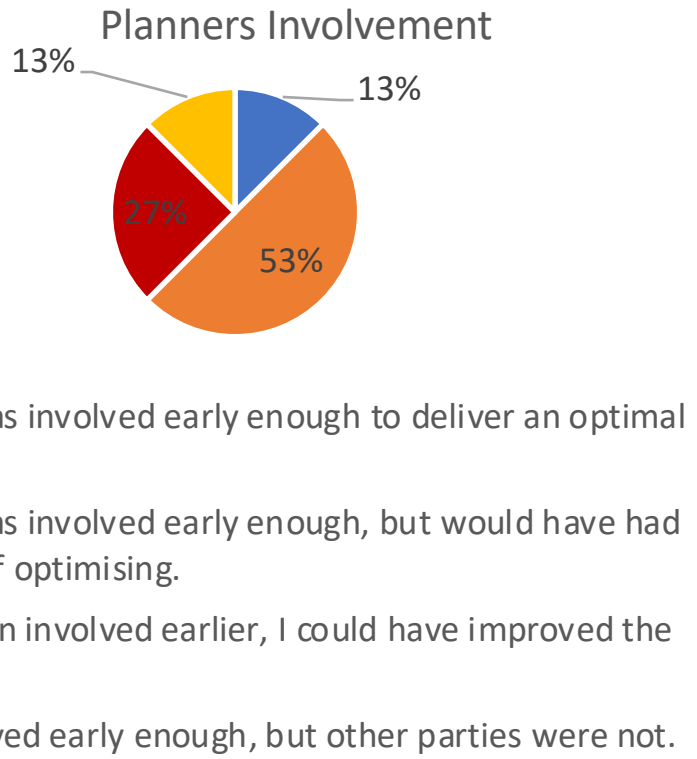
Case A: Positive Outcomes

- $150 million under project budget
- $20 million savings split between the project team
- Met opening date of March 2019

(Image courtesy enr.com)

IPD in Switzerland – an emerging concept?

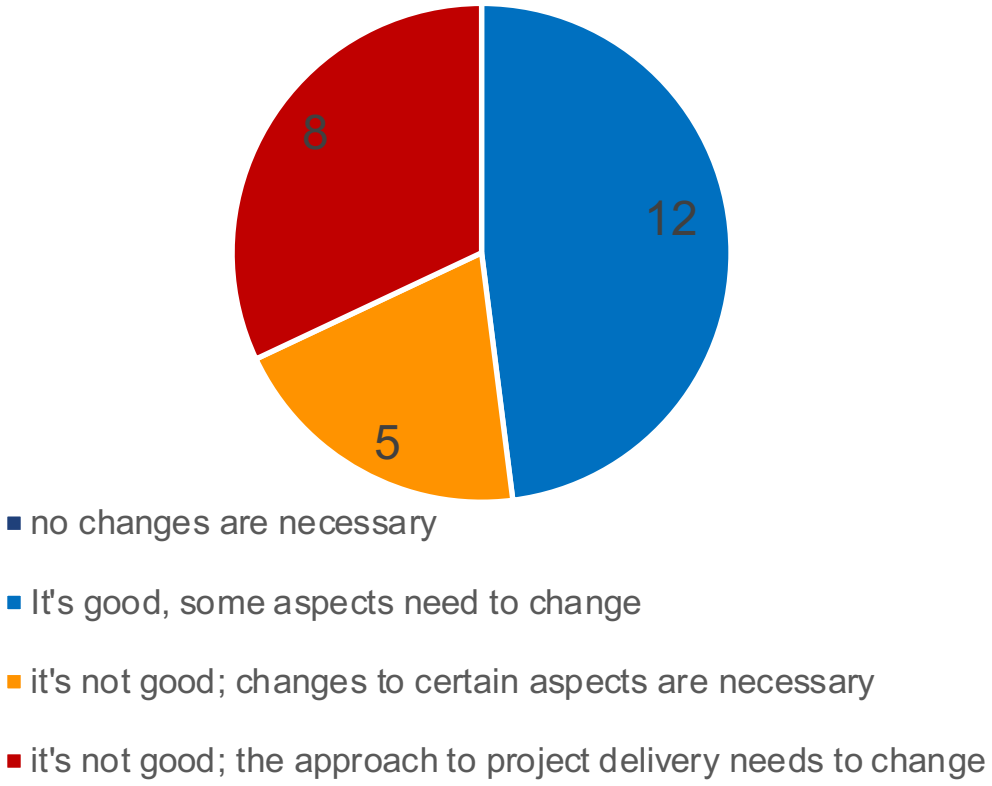
In past projects how do you feel your time of involvement has affected the project delivery?
(due to more than one answer possible, this graph may not add up to 100%)



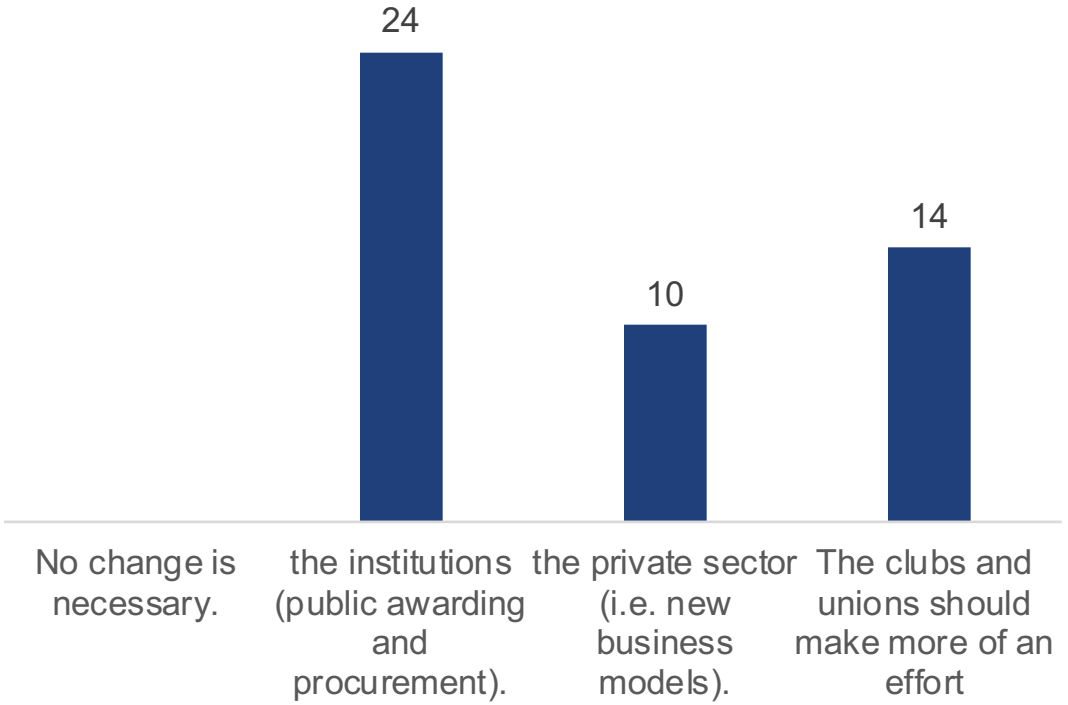
(Wenk 2018)

IPD in Switzerland – an emerging concept?

On principle, is the project delivery good as it is? Is change needed?



Who do you think should initiate changes in project delivery in Switzerland?



(Wenk 2018)

IPD in Switzerland – an emerging concept?

WHITE PAPER

Opportunity and Challenges of Integrated Project Delivery (IPD) in Switzerland

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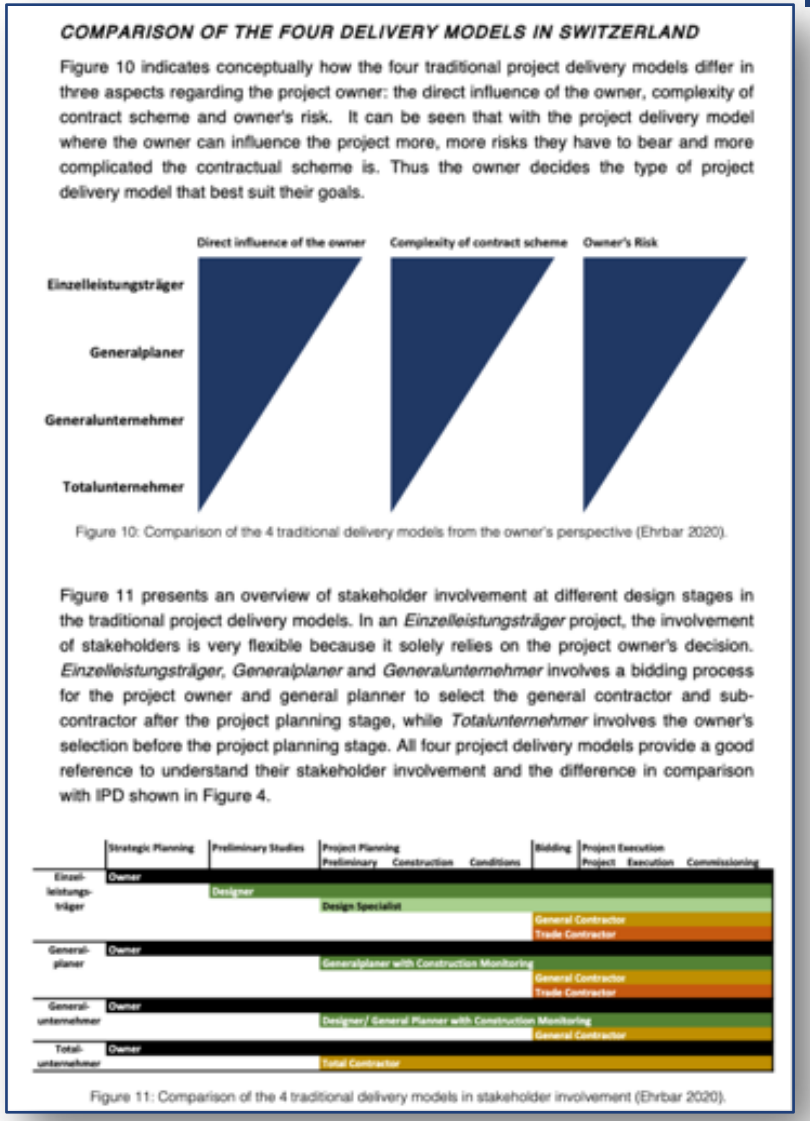
August 2020
Version 1

Comments? https://bit.ly/IPDinCH



COMPARISON OF THE FOUR DELIVERY MODELS IN SWITZERLAND

Figure 10 indicates conceptually how the four traditional project delivery models differ in three aspects regarding the project owner: the direct influence of the owner, complexity of contract scheme and owner's risk. It can be seen that with the project delivery model where the owner can influence the project more, more risks they have to bear and more complicated the contractual scheme is. Thus the owner decides the type of project delivery model that best suit their goals.

Figure 10: Comparison of the 4 traditional delivery models from the owner's perspective (Ehrbar 2020).

Figure 11 presents an overview of stakeholder involvement at different design stages in the traditional project delivery models. In an *Einzelleistungsträger* project, the involvement of stakeholders is very flexible because it solely relies on the project owner's decision. *Einzelleistungsträger*, *Generalplaner* and *Generalunternehmer* involves a bidding process for the project owner and general planner to select the general contractor and sub-contractor after the project planning stage, while *Totalunternehmer* involves the owner's selection before the project planning stage. All four project delivery models provide a good reference to understand their stakeholder involvement and the difference in comparison with IPD shown in Figure 4.

Figure 11: Comparison of the 4 traditional delivery models in stakeholder involvement (Ehrbar 2020).

IPD in Switzerland – an emerging concept?

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Master Project Work

Investigating IPD and Co-location within the Swiss AEC Industry

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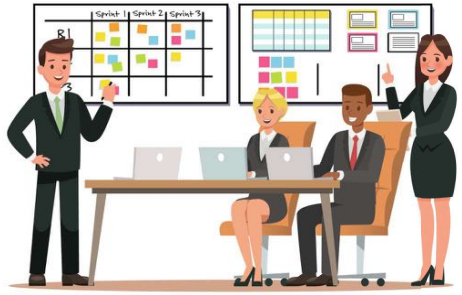
	Dr. Marcella Bonanomi	ETH Zurich
	Maximilian Vomhof	Implenia
Date:	May 29, 2020	



In Cooperation with.

ETH zürich Implenia

Institut für Bau- und Infrastrukturmanagement
Professur für Infrastrukturmanagement

D BAUG

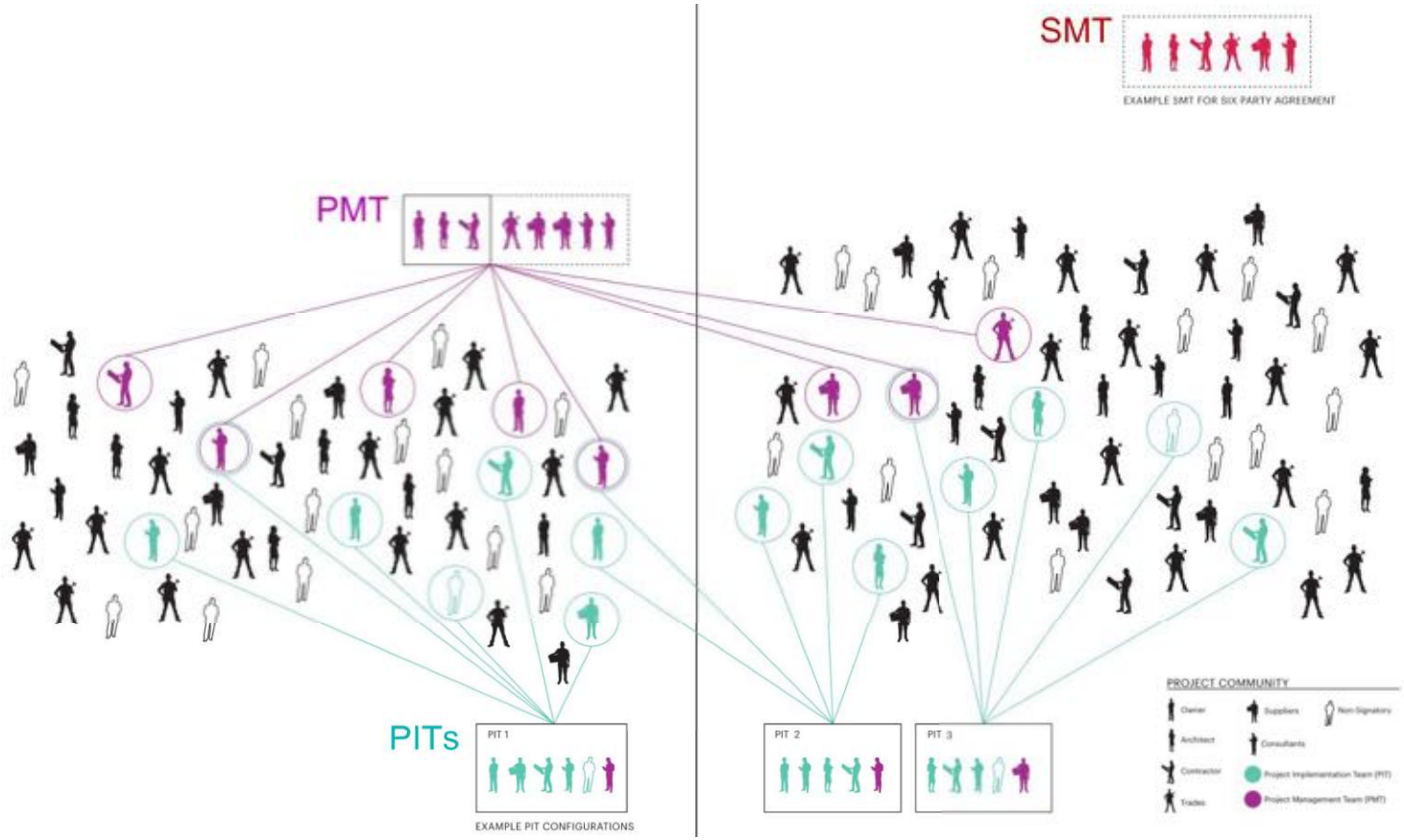


Figure 2.1: IPD Management Structure according to Allison et al. (2017)

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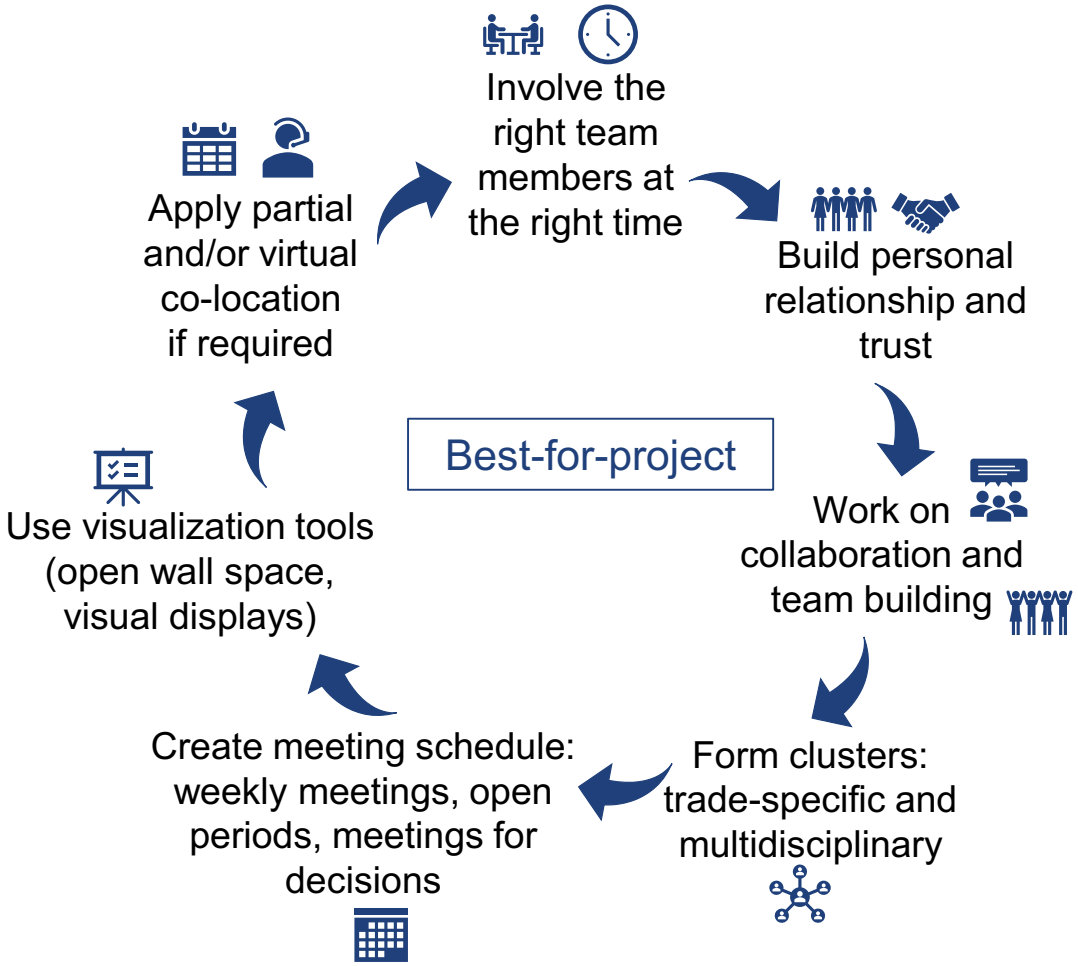
Guideline for the Implementation of IPD with Co-location within the Swiss AEC Industry

Starter kit

- Start early
- Presence of the owner, the planners and general contractor
- Daily huddles
- Support through external coaching
- Location:
  Close to the construction site
  Equally accessible and accepted by entire project team
- Creation of break-out rooms
- Flexible working spaces
  Flexible computer systems
- Software: BIM incl. BIM viewer, file sharing platforms, platforms for social networks

Continuous cycle



Institut für Bau- und Infrastrukturmanagement
Professur für Innovatives und Industrialisiertes Bauen
Prof. Dr. Daniel M. Hall

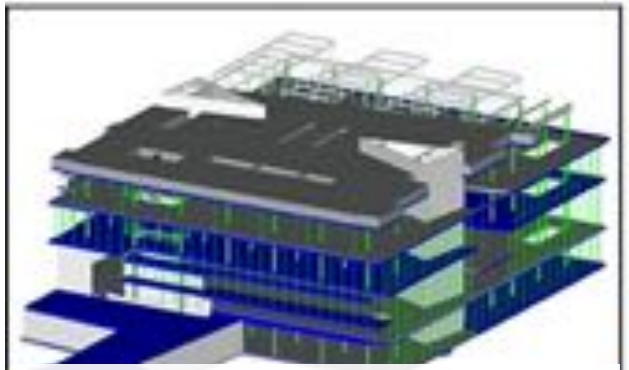
Vertical Integration

Business Model #2

(images courtesy nArchitects and MIR studio)

What is Vertical Integration in Industrialized Construction?

- "Full Stack" integration in one company
  - Real Estate
  - Architecture
  - Planning
  - Engineering
  - Manufacturing
  - Assembly
  - Site Works
  - Operations and Maintenance (?)
- Goes farther than Total Contractor Model
  - Ownership of full supply chain
- Internal Development of Product and Software Systems
  - no more excuses about "every project is a prototype"



Advanced IT tools

Logistics

Automation

Product Platform

Industrialized Construction

Prefabrication

Customer & Market Focus

Control of Process

Re-use of Experience

Case B: Katerra (US + International) - Vertical Integration

TechCrunch

Construction startup Katerra gets $865M in Softbank's latest mega-round

Matthew Lynley @mattlynley / Jan 24, 2018 Comment

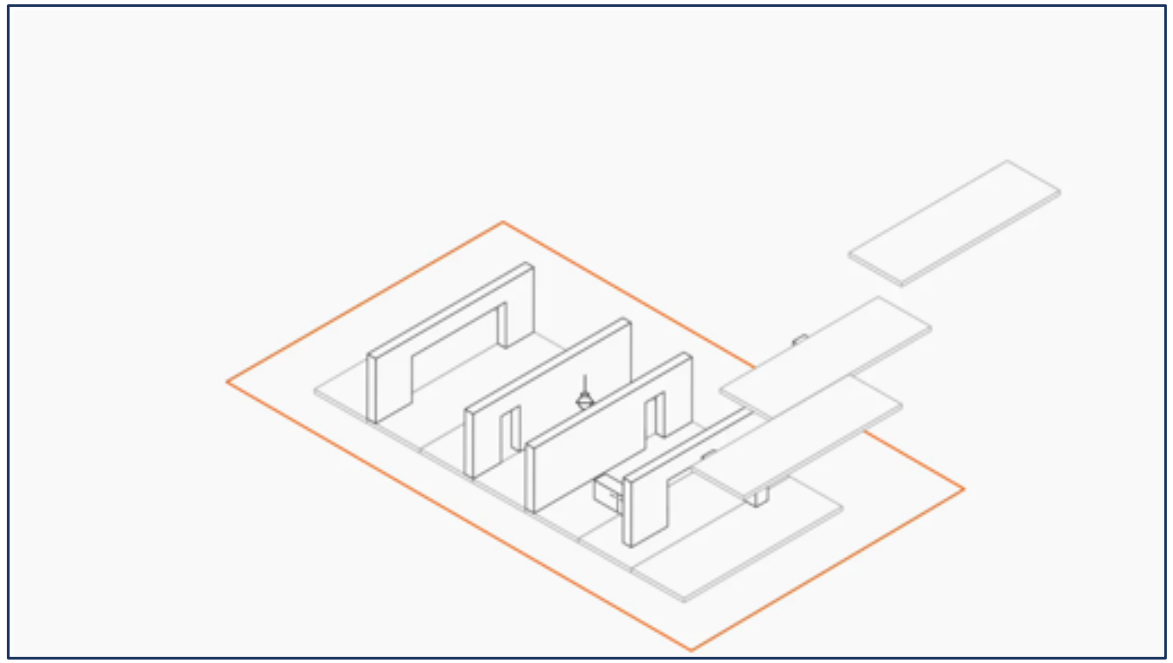
There's another big financing round led by Softbank's mammoth vision fund today, with the firm this time pouring $865 million into a construction startup called Katerra that's a one-stop shop for getting a building up off the ground.

Katerra is creating a full-stack provider for, well, buildings. The company runs the process of getting a building up and people inside it from the architectural design components all the way through labor

KATERRA

Case B: Katerra (US + International) - Vertical Integration

KATERRA



(Image + video courtesy katerra.com)

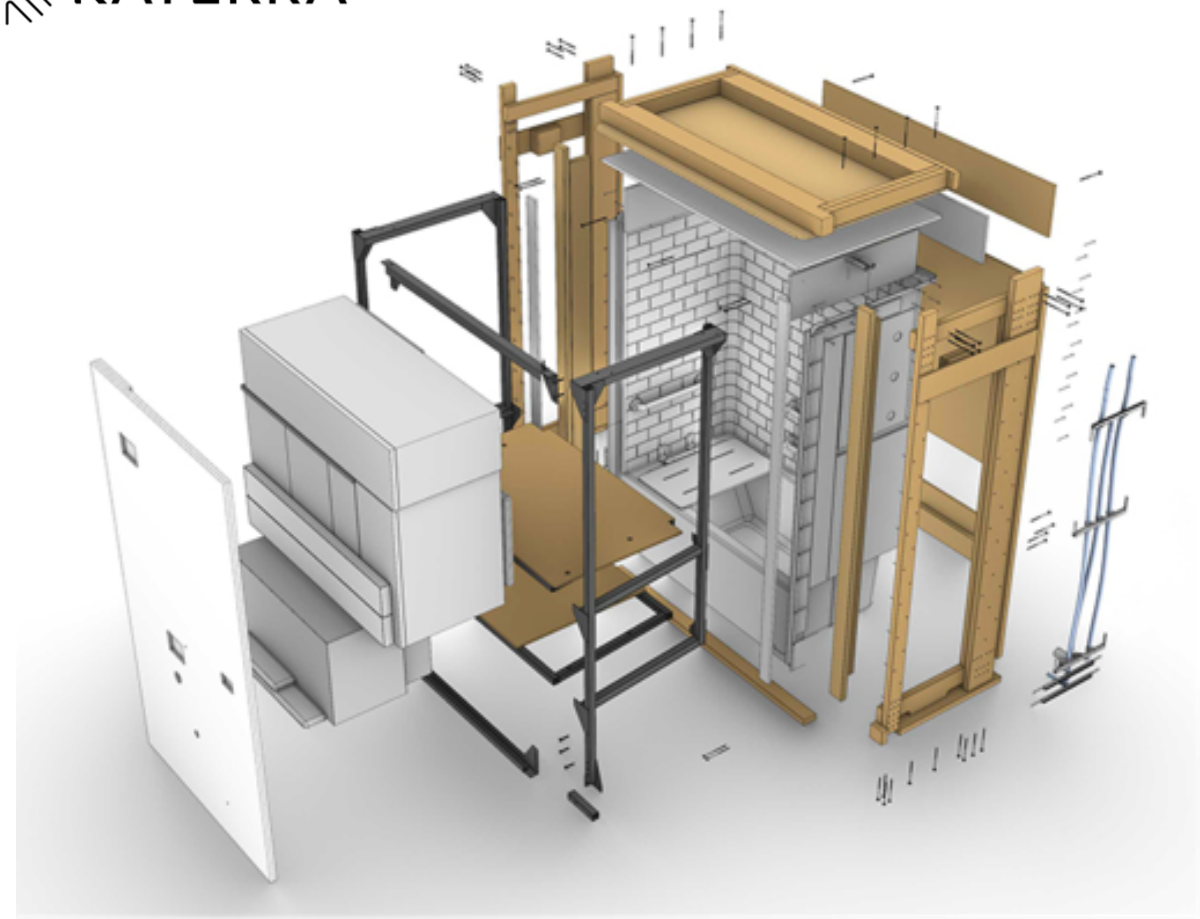
Katerra: the first global industrialized construction company?

KATERRA

Architecture
Interior Design
Engineering
Manufacturing
Building Material
Supply
General Contracting
Skilled Labor
Renovations
Property Management
Software
Intelligent Buildings

New Product Developments

KATERRA



(Images courtesy katerra.com)

New Internal Software Platforms

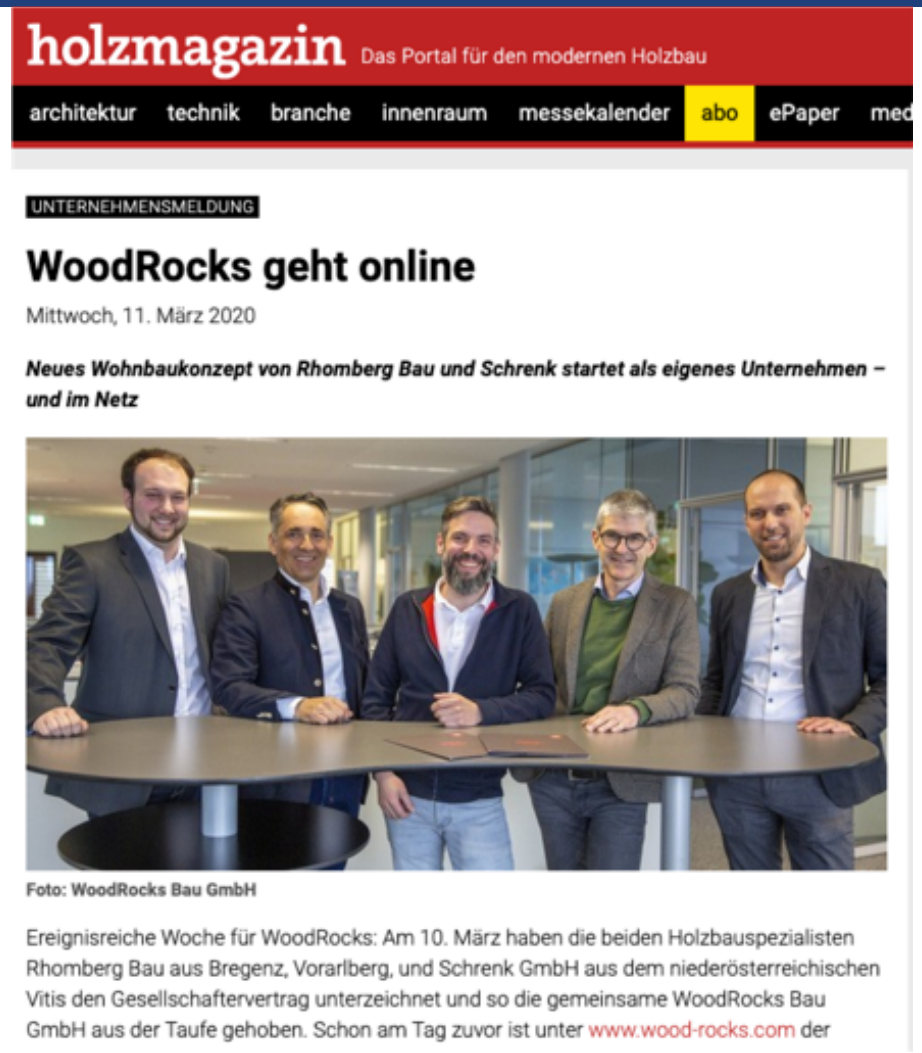
(Video courtesy Katerra YouTube channel)

Another example…

RHOMBERG

schrenk
holztreppen und türen

WOOD ROCKS BY RHOMBERG



holzmagazin Das Portal für den modernen Holzbau

architektur technik branche innenraum messekalender abo ePaper med

UNTERNEHMENSMELDUNG

WoodRocks geht online

Mittwoch, 11. März 2020

Neues Wohnbaukonzept von Rhomberg Bau und Schrenk startet als eigenes Unternehmen – und im Netz

Foto: WoodRocks Bau GmbH

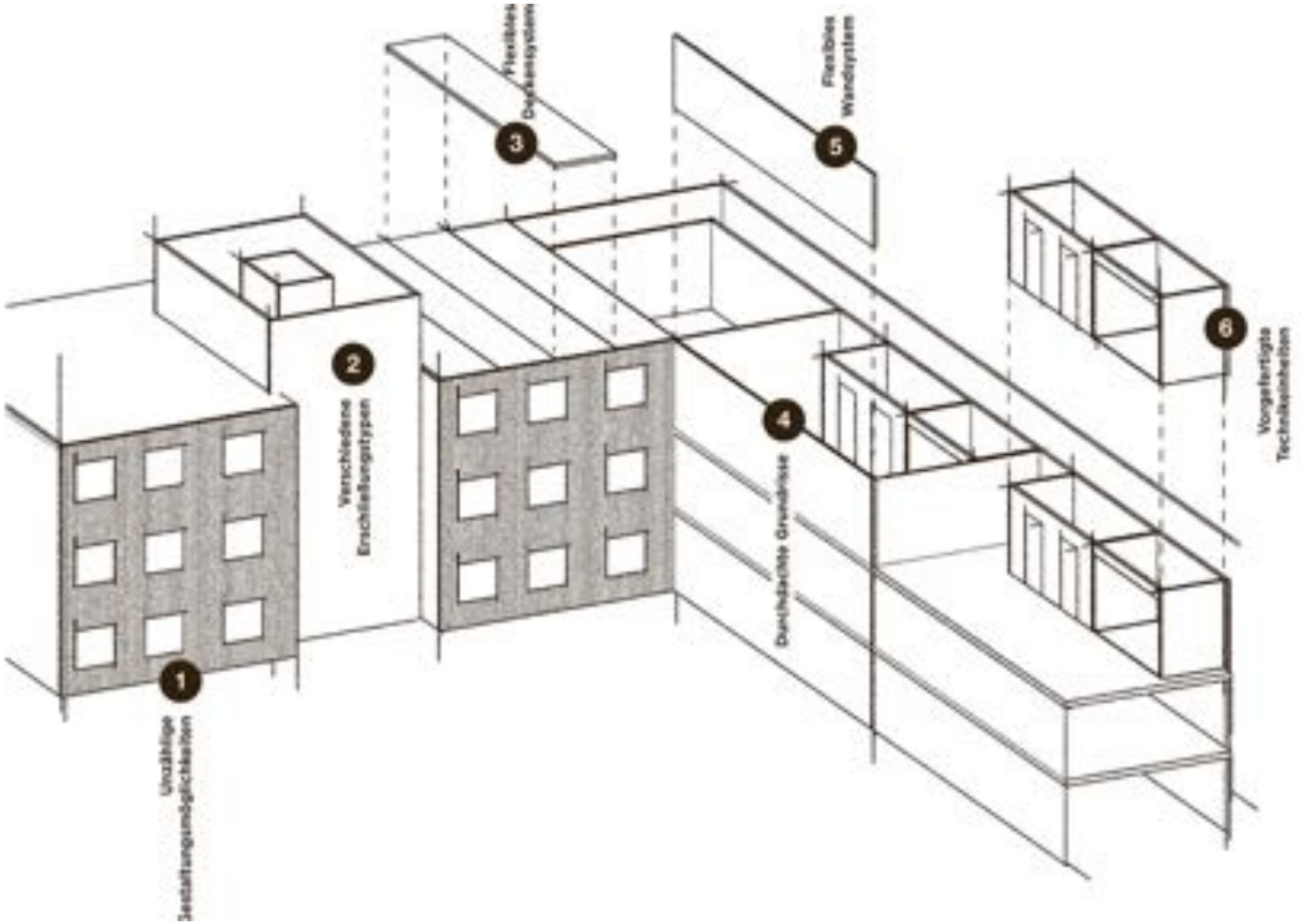
Ereignisreiche Woche für WoodRocks: Am 10. März haben die beiden Holzbauspezialisten Rhomberg Bau aus Bregenz, Vorarlberg, und Schrenk GmbH aus dem niederösterreichischen Vitis den Gesellschaftervertrag unterzeichnet und so die gemeinsame WoodRocks Bau GmbH aus der Taufe gehoben. Schon am Tag zuvor ist unter www.wood-rocks.com der

https://www.holzmagazin.com/branchennews/2263-woodrocks-geht-online

Another example…

RHOMBERG

schrenk
holztreppen und türen



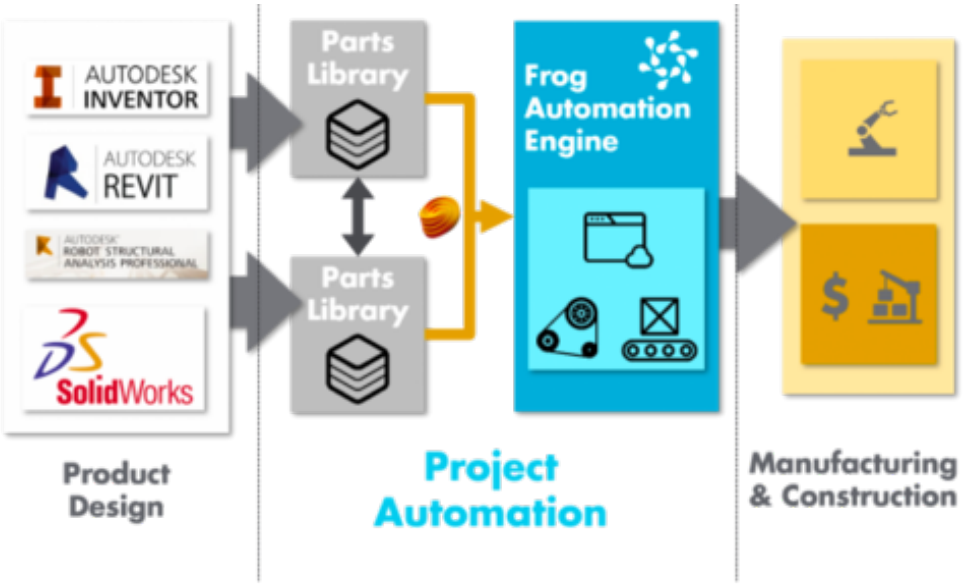
(Images courtesy Wood-rocks.com)

Digital Systems Integration using Platforms

Business Model #3

(images courtesy Project Frog)

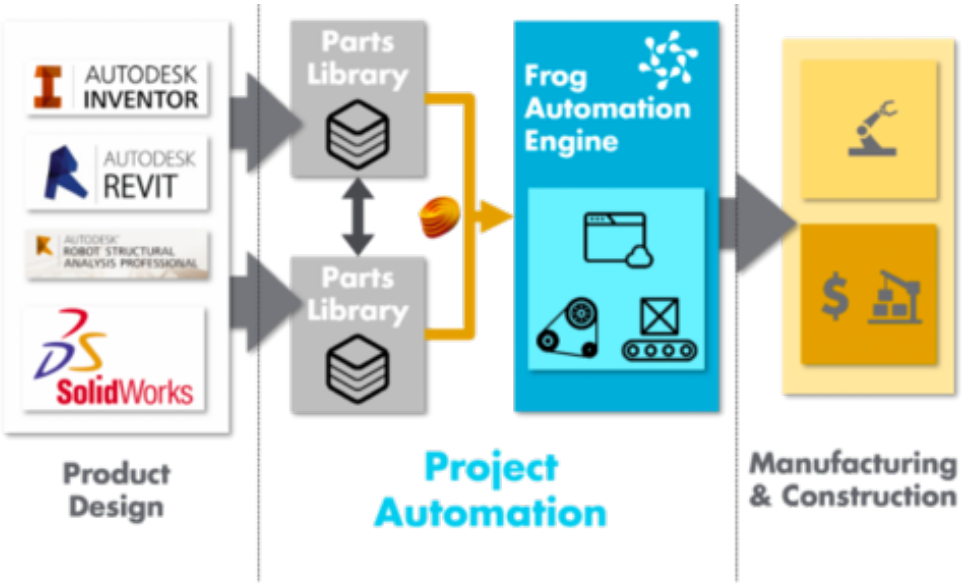
New Business Model: Digital Systems Integration



(images courtesy projectfrog.com)

New Business Model: Digital Systems Integration

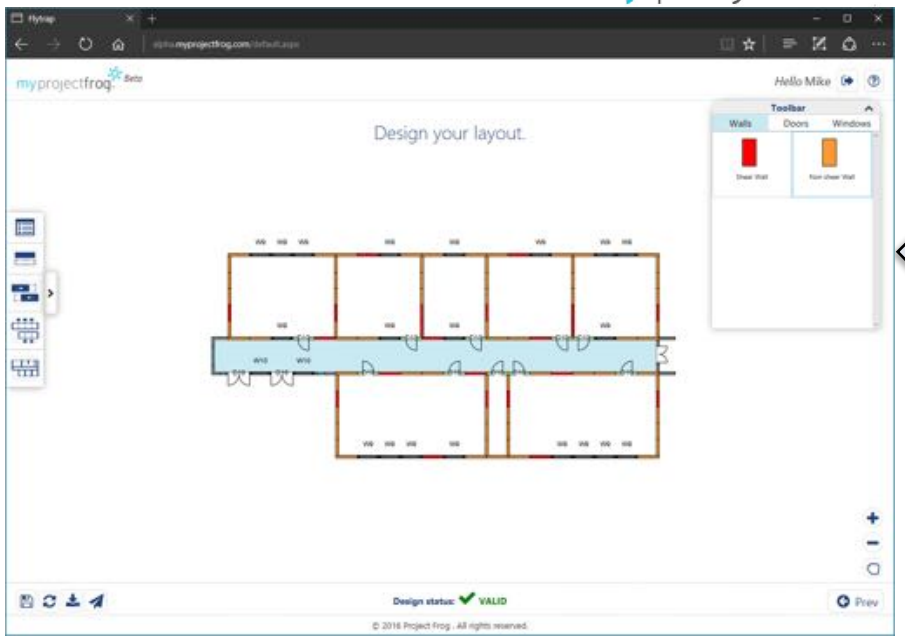
myprojectfrog



(video courtesy http://myprojectfrog.com/videos.html)

New Business Model: Digital Systems Integration

myprojectfrog



Manufacturing

- Bill of Materials
- Component Model (LOD 400)
- Shop Drawings

Permit & Construction

- Structural Calculations
- Architectural Drawings
- Structural Drawings

(video courtesy http://myprojectfrog.com/videos.html)

Comparison of New Business Models

	+	-
IPD	• Less change to business • Structured learning process	• Re-educate supply chain
Vertical	• Full-stack integration • Speed to capture market	• Capital-intensive
Digital Systems	• Capital-light, industry 4.0 • Agile product development	• Less control over product • Longer co-creation process

Comparison of New Business Models

	Understanding Lean in Different Forms	
IPD	• Lean Construction	• Last Planner System • Takt Time Planning • Target Value Design • Colocation + Big Room
Vertical	• Lean Manufacturing	• RFID • Lean Supply Chain Management
Digital Systems	• Agile product development	• Mass Customization • Product Configurators

Trends moving forward

- BIM is the new minimum global standard to be competitive
- New business models emphasize **INTEGRATION** to capture value from BIM
- Huge global investments
- Development of Product Platforms

TechCrunch

Construction startup Katerra gets $865M in Softbank's latest mega-round

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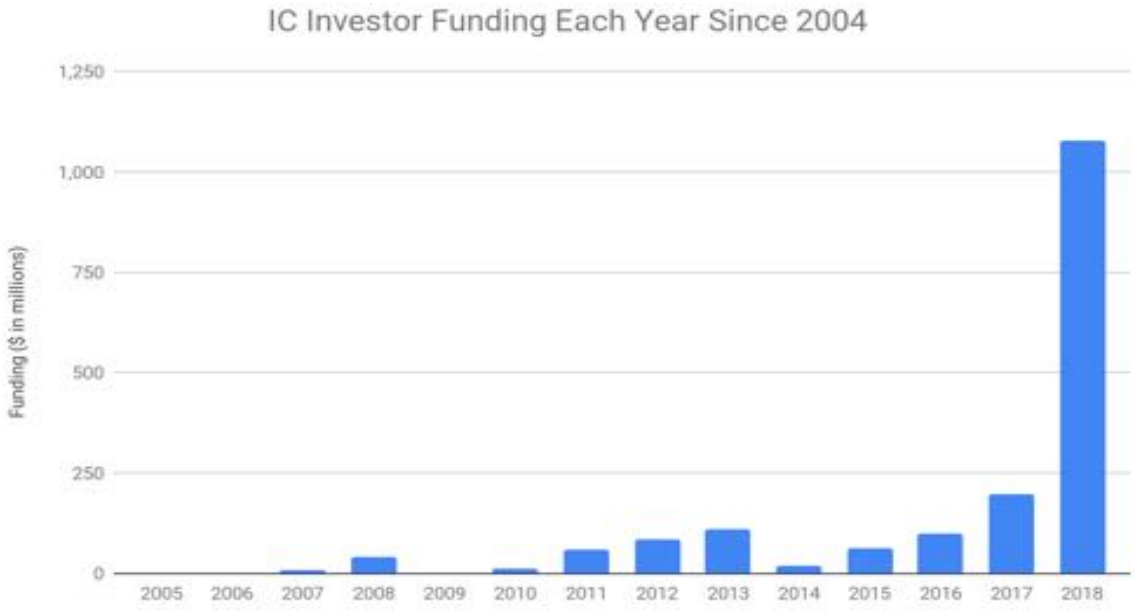
GCR
GLOBAL CONSTRUCTION REVIEW

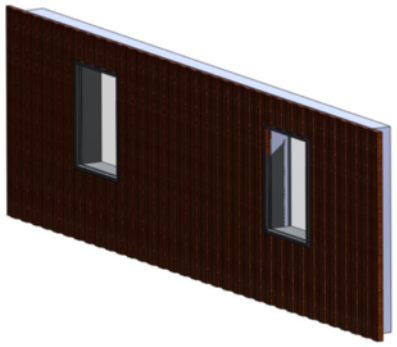
News

Goldman Sachs sinks £75m into UK modular housing firm

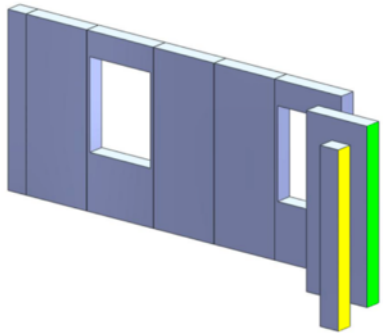


From Projects to Product Platforms

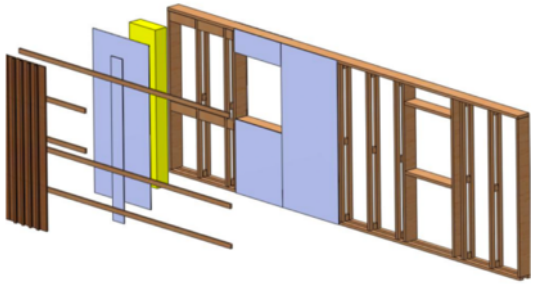
Rules and Restraints Transferred Upstream



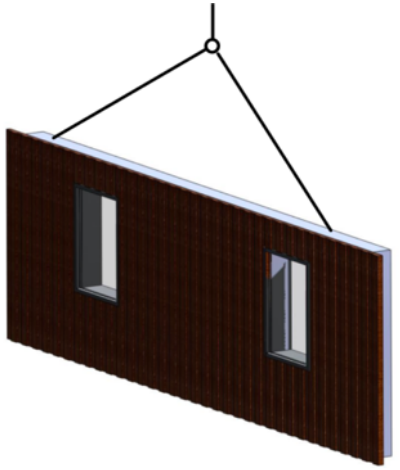
Design & Customer Acquisition



Configuration Engineering



Manufacturing & Production



Assembly & Logistics

Information Transferred Downstream

(Adapted from Malmgren et al. 2011)

Thank you!

Questions, Comments, Feedback?

dhall@ethz.ch OR @daniel_hall_ethz

Group page: http://www.ic.ibi.ethz.ch/