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Sarah Hodges | @sarahatadsk

Sr. Director, Construction Business Line, Autodesk

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MORE | BETTER | LESS

2017 **7 Billion**

2050 **10 Billion**

3.5 Billion

7 Billion

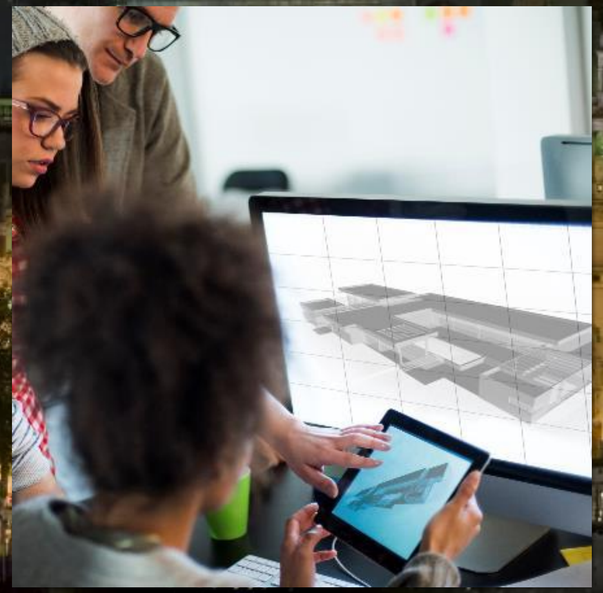
40% global energy

25% water consumption

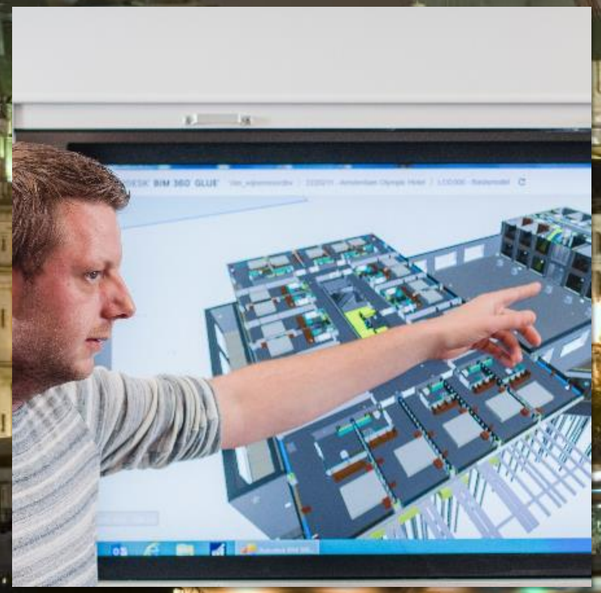
30% greenhouse gases

30% global waste

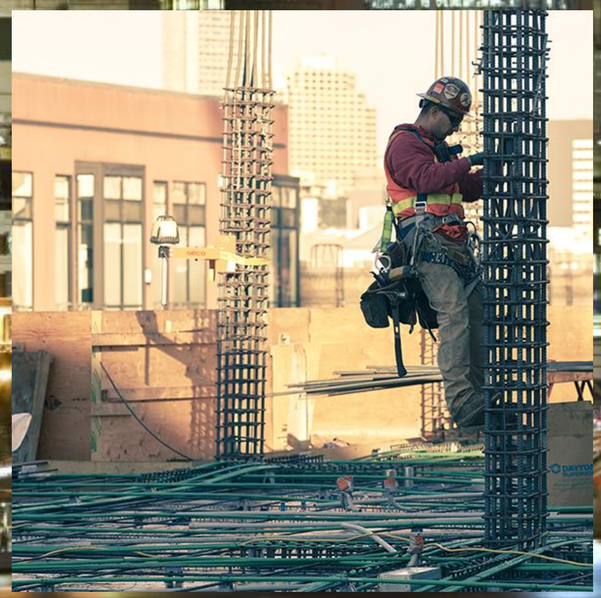
CONNECT & CONSTRUCT



DESIGN



PRECONSTRUCTION



CONSTRUCTION

Photograph by Ben Rahn/A-Frame Inc.

OPERATIONS

$6.4 billion R&D investment

R&D Spend 2008-2018

© Robert Benson Photograph

“...[The] strategy for BIM implementation will change the dynamics and behaviours of the construction supply chain, unlocking new, more efficient, and collaborative ways of working.”

Your technology partner for today
and for the future.

Agenda

PAUL MORRELL, BSC, FRICS, FICE, HONFRIBA, HONFAPM
FORMERLY GOVT. CHIEF CONSTRUCTION ADVISOR

Are we nearly there yet?

DAVID GLENNON, HEAD OF DIGITAL (UK)
ARCADIS

Survive & re-invent. Leading in the digital age

GERT-JAN DITSEL, BIM MANAGER
DURA VERMEER

People are more important than technology

3:00 pm

MELANIE DAWSON, HEAD OF DIGITAL CONSTRUCTION
GRAHAM CONSTRUCTION

More productivity. Better outcomes. Less time.

BRIAN ROEPKE, SR. DIRECTOR, FORGE
AUTODESK

FORGE, a foundation for the future

DR. MARTIN FISCHER
CIFE/STANFORD UNIVERSITY

Digitalizing construction management through industry-academia collaboration

THE FUTURE OF CONSTRUCTION
MODERATOR: PAUL FLEMING, DIRECTOR, AUTODESK

The Future of Construction - Panel Discussion

5:30 pm

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Paul Morrell

Consultant, Educator & Public Speaker

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Are we nearly there yet?

Paul Morrell, **formerly Government Chief Construction Adviser**

www.EgyptSons.com

Generation Z is the smart generation that will redefine work, claims report

The trade association BSRIA has launched a White Paper called Products and Systems for Generation Z in Reduced Carbon Buildings to explore the future needs of buildings designed for what it calls the 'smart generation'. It considers ways in which the value of buildings might be improved in order to raise productivity and wellbeing for occupiers and at the same time generate new revenue streams for suppliers. Authored

Source: Insight, 29 September 2015

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Source: Insight, 29 September 2015

September 2010

They’ve mandated BIM!

IT/Books 09

BIM's journey isn't over

manufacturers of building systems and products have realised putting their technical information in front of architects and engineers, to make it as easy as possible for decision makers to specify them on projects.

Thirty years ago this information was physically distributed: manufacturers' plastic drawing stencils and associated paper catalogues were kept in the office library. By the turn of the century, the stencils were beginning to be replaced by 2D CAD blocks, with the catalogues distributed as digital PDF files on the world wide web. Today, in 2015, this digital revolution is continuing and the industry is now one year from the government mandate that all centrally funded construction projects will use building information modelling (BIM).

Initially, BIM was in many ways 3D CAD. Manufacturers created geometrical 3D objects that could be dropped into a model. Designers could then change the geometric level of detail at a click of a button. But BIM has moved on since then. The geometric issues are now taken for granted and discussions are squarely focussed on the information. This is the I in BIM.

With BIM, each 3D object can have embedded and linked information. This could be the manufacturer product reference of a window, the recycled content value of an insulation board or the expected life of a boiler. This information can then be extracted from the model for scheduling and data analysis. The principles of providing geometry in terms of stencils and information in terms of a catalogue remain – but it is now delivered through a powerful digital object that performs both functions.

Setting the standard

to a different standard. When they schedule information from different manufacturers they want it to align. When they perform an energy calculation based on objects from different manufacturers, they want the information to be consistently presented.

A core objective in the government's 2025 strategy paper was to digitise the product manufacturing industry that serves UK construction. This will both benefit projects here and also create fantastic opportunities for UK manufacturers overseas. The combination of digital BIM objects and distribution through multiple channels on the web will be a once-in-a-generation 'game changer'.

With one year to go until the 2016 BIM mandate, the discussion on whether BIM is a good idea or not is over. However, the key question

30.4-07.05.15 NEW CIVIL ENGINEER 19

Produced in association with MGF

"On Crossrail we are witnessing the modelling of temporary works as being one of the fastest growing BIM adoption areas"

RICHARD VOKE and STEPHEN HOMER Ashfords

The good, the bad, and the law: What BIM means for safety

The 2016 central government mandate requiring Level 2 BIM to be employed for its projects has generated much trade discussion. Some explore the positive outcomes available; others put forward the challenges. These conflicting reactions pervade all aspects of the discussion of BIM.

There has been much discussion of possible problems with contractual arrangements, particularly when it comes to IPR and confidentiality, but initiatives such as the CIC BIM protocol have helped to dampen such concerns.

However, unlike civil law issues, it seems the criminal law possibilities have had little consideration.

The construction industry is necessarily well covered by health, safety and environmental criminal law; only health and safety is considered here. If BIM becomes central to high-profile projects, how will that affect health and s

The first consid how BIM will affec the proposed char

It is foreseeable will be extremely u CDM's proposed rc designer'. The PD have heavier respo CDM co-ordinator

The new role se

a pre-construction assurance role similar to the existing construction phase principal contractor.

Whether by design or accident, BIM and the principal designer role are made for each other.

Another consideration is the transparency BIM will provide to HSE accident investigations. A BIM facility will provide a previously unavailable insight into the design thought process.

Any failures in design, specification or implementation will be easily

44/legal

COMMENT BIM TECHNOLOGY

MIKE KNOWLES
MANAGING DIRECTOR
INTERSERVE ENGINEERING SERVICES

How Interserve has brought BIM into its M&E operations

It has been vital to make BIM an integral part of our processes to meet and exceed government 2016 targets. We have also introduced annual internal BIM awards to recognise and reward those embracing and influencing our shift

Today we operate comfortably in a multi-discipline, co-ordinated Level 2 BIM environment aligned with PAS 1192-2 (the specification for information management for the capital/delivery phase of construction projects using BIM).

Simon Lewis: The government is spearhe new generation of building information m BIM Level 3 have on the way constructior

ARE YOU RE FOR THIS?

ME FAIRLY RADICAL

BUILDING TRUST IN BIM

External management

Designing & building it

Despite its benefits being widely trumpeted, take-up of BIM has been slow – particularly

processes and tools, and as our grows we increasingly find we rec ed applications from BIM-literate who want to work for us because we have fully adopted the system

But in any case, training alwa

Water companies need to lead on BIM

Andrew Cowell
22 April 2015

Topics
BIM
Water

COMMENT TECHNOLOGY

MIKE FOLLETT
UK MANAGING DIRECTOR
RMD KWIKFORM

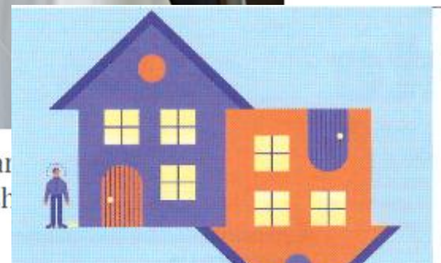
Get ready now for BIM-driven construction cost reductions

For those in the concrete sector using a tried and tested construction methodology, stripping out cost can be difficult.

This is why in 2015, the sector will have to embrace innovation that

more than 25 tonnes of equipment, a good temporary works co-ordinator can save their own cost by managing the site, equipment flow and erection processes properly.

The need for more leadership ar highlighted at the recent British director Andrew Cowell



DIFFERENCE OF OPINION

Will BIM elevate or demote the status of the quantity surveyor? Discuss.

"Open Data" standards to facilitate sharing of data across the market

ishment of a new contractual projects procured using BIM sistency and encourage working on of a cultural environment erative and based upon learning

e public sector client in the use ics mestic and international growth chnology and construction.

Ready, steady, BIM

Wates reveals three-BIM roll-out plan

Contractor's new design boss sets BIM target and says firm wants to work with 'the best' architects

By Iain Withers

Wates is targeting using BIM on

very efficient when we start construction. It's essential if we're going to reach the government's cost savings targets," he said.

ough said Wates was on comply with the ent's requirement of g BIM level two on all procured public from next year, ting: "We will hat, that's not an Wates."

as "made on in the last rs on rracloughis now

using advanced forms of BIM on a number of projects, including 4D time sequencing and 5D cost modelling.

Barraclough called on clients and consultants to come to contractors earlier in the project design process to achieve maximum savings from BIM.

He said: "We need the data but people come to us too late and then it can be almost impossible [to deliver BIM effectively]."

Barraclough said he was brought in by Wates to expand its design management capabilities, in part to help the firm expand in key target markets, including education, the commercial office market and high-density residential.

Wates' approach is to collaborate with "the best" architects, Barraclough said. "I want to make sure we are working with the best architects. I'm sounding them out so they understand our position.

"Contractors have a reputation for being difficult for designers. But it needn't be that way – it can be much more collaborative."

BIMSHOWLIVE The UK's largest BIM conference is 8-9 April in Manchester. Find out more at bimshowlive.co.uk

Viewpoint

Elspeth Finch

Embracing the digital world

Our opportunity to drive value from data.

The digital age has increased exponentially the quantity of

not technical experts can be immensely powerful, particu-

BEST PRACTICE BIM
EVALUATING THE BENEFITS OF THE IMPLEMENTATION OF BIM IN THE UK CONSTRUCTION INDUSTRY
BIM
CONTENT EVELOPMENT
BIM Handbook
K. Pramod Reddy
BIM for BUILDING OWNERS and DEVELOPERS
Green BIM
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IN CURRENT AND FUTURE PRACTICE
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Dana K. Smith
Michael Tardif
THE BIM MANAGEMENT HANDBOOK
Nawari O. Nawari
Michael Kuenstle
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Steve Race
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RAY CROTTY
David A. Ericksen, Esq.
Severson & Werson
San Francisco, California
March 31, 2010
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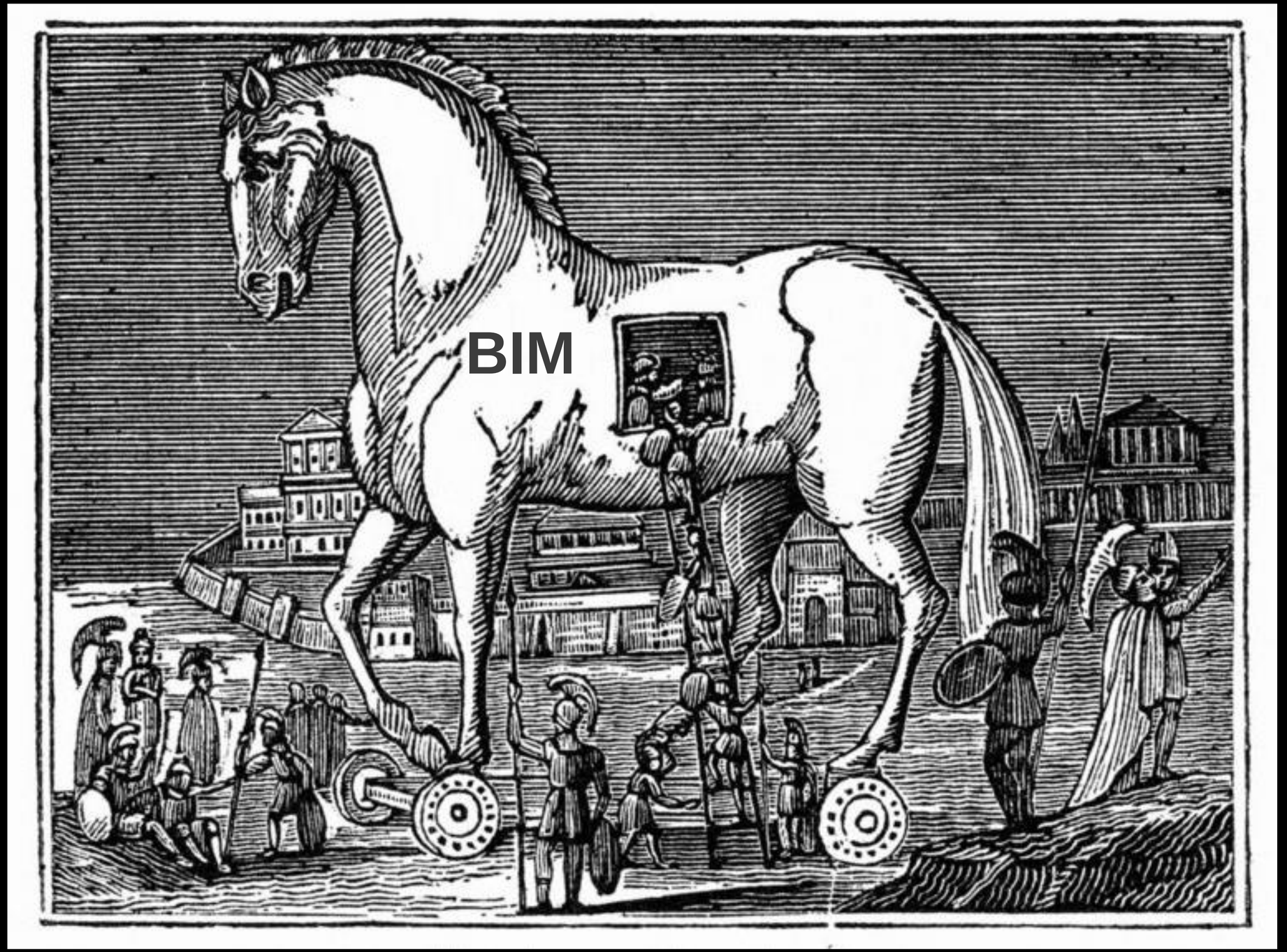
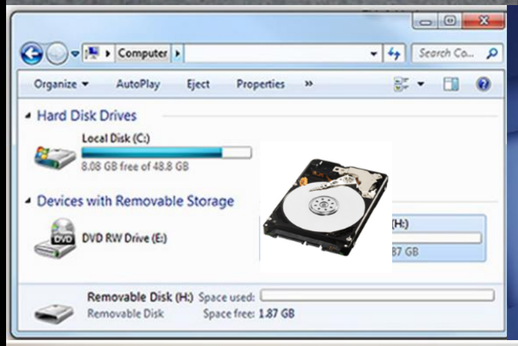

BIM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Eject
Properties
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Local Disk (C:)
8.08 GB free of 48.8 GB
Devices with Removable Storage
DVD RW Drive (E:)
(H:)
87 GB
Removable Disk (H:) Space used:
Removable Disk Space free: 1.87 GB

http://www

mockup
iMore

46°00′N, 8°57′E Piazza Riforma Lugano
Bar/Ristoranti 500m
Caffé Federale
Menu Mostra Navigazion
Bar Vanini
Menu Mostra Navigazion
Bar Argentino
Menu Mostra Navigazion
Mostra:
Bar / Ristoranti
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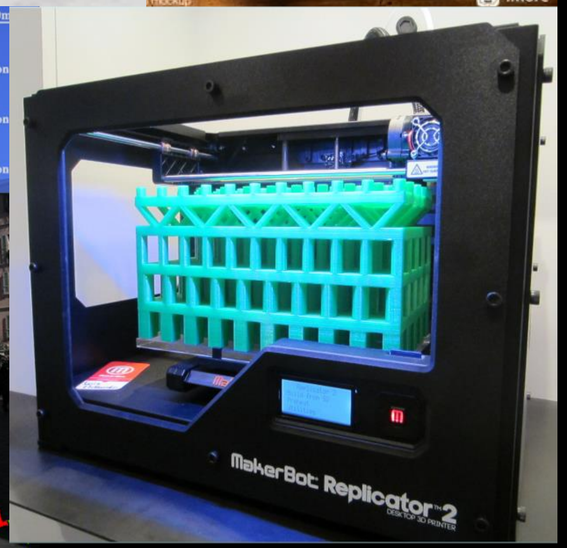
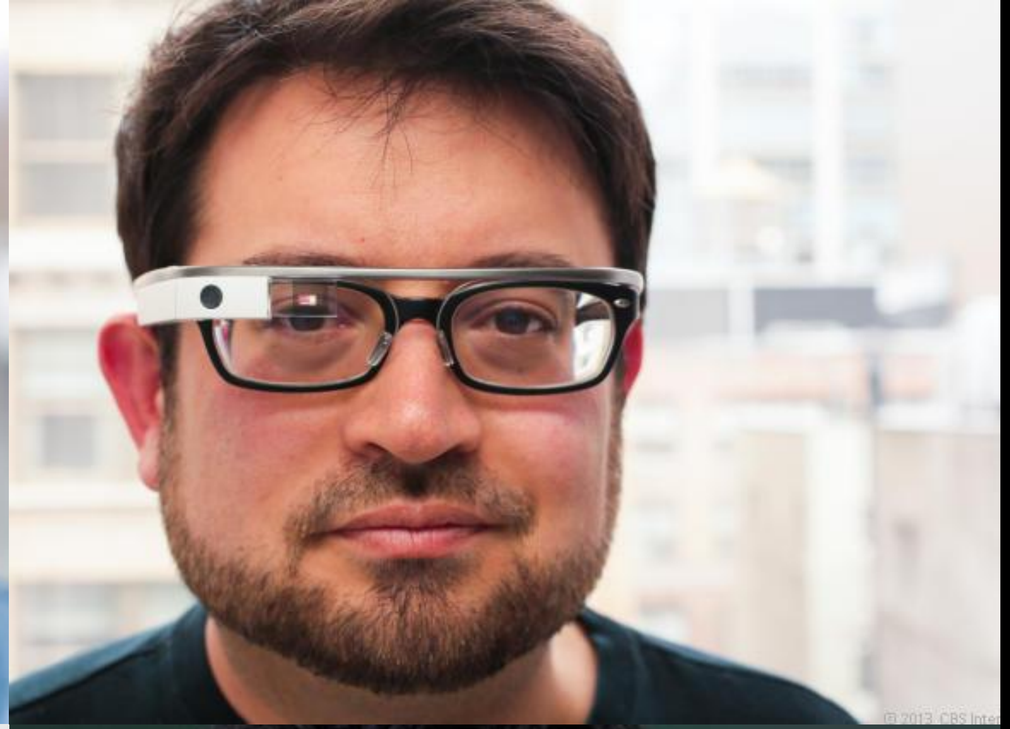
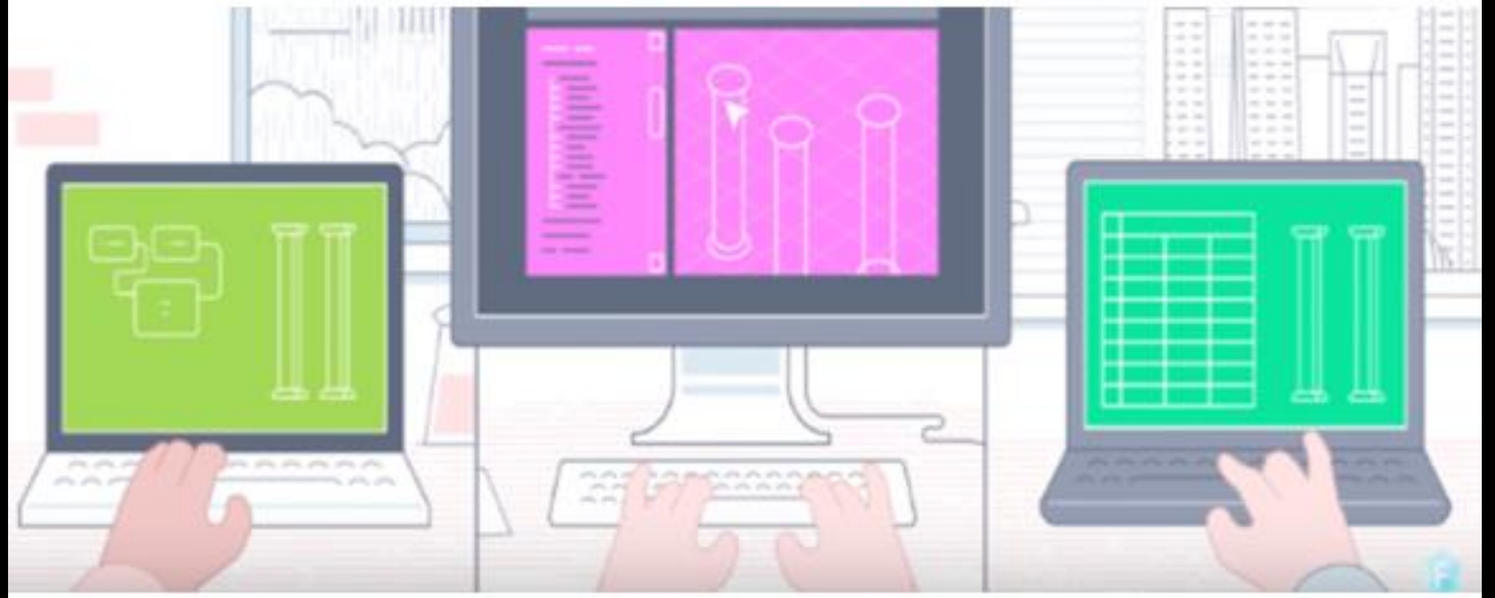

MakerBot Replicator 2



Hard hat evolves to incorporate BIM

Image: www.daqri.com

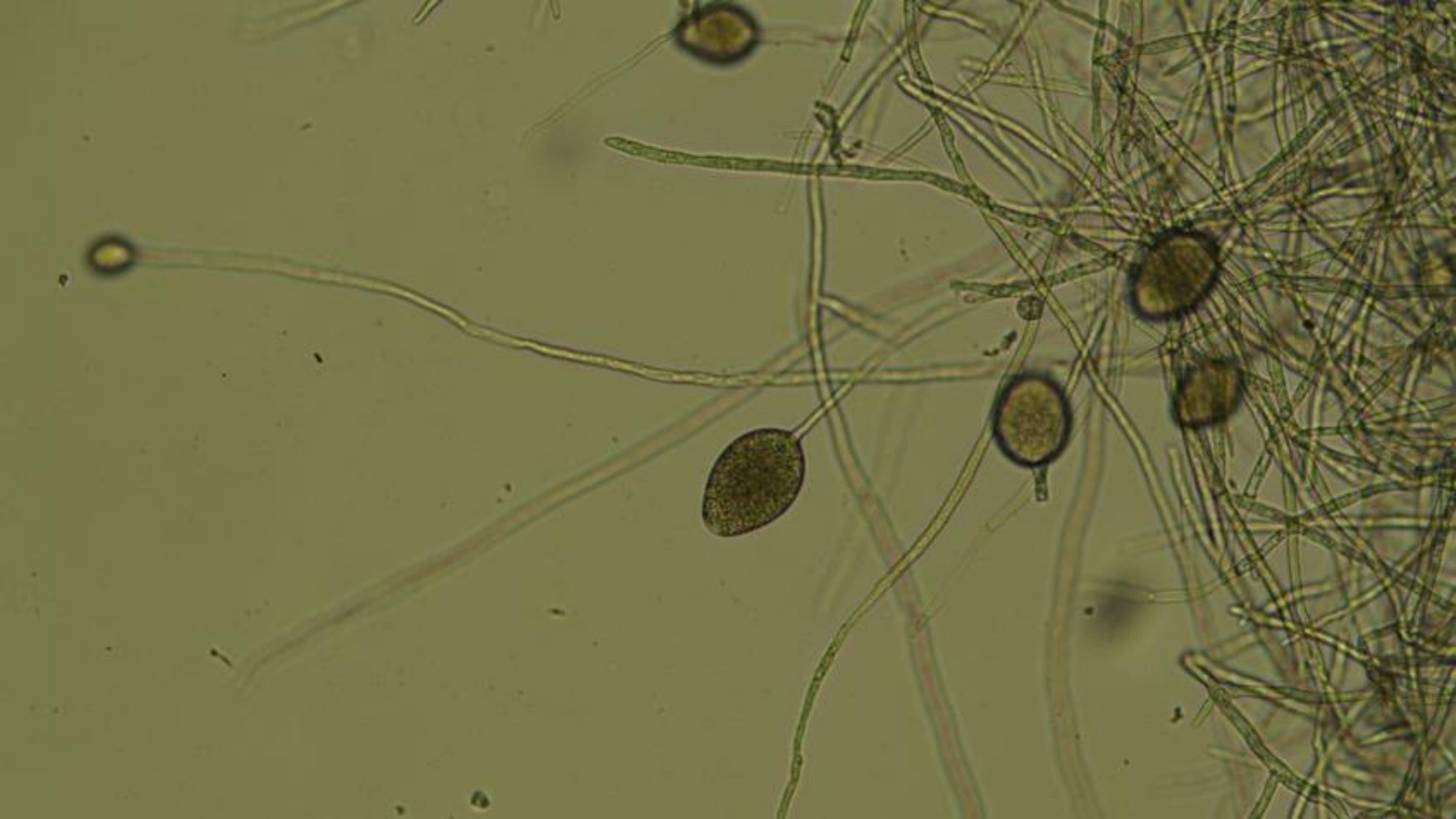
MEET THE TEAM BEHIND THE GOOGLE X STARTUP WHOSE MISSION IS TO HARNESS DATA TO AUTOMATE ARCHITECTURE AND URBAN DESIGN...



Flux is a data exchange and collaboration platform for designing the buildings and cities of tomorrow, born out of Google X Labs in late 2012. Founded by three ex-Google engineers and an architect, Flux is the first - and so far only - startup to spin out of the semi-secret Google X lab.

Transformation in Flux

We're a unique mix of experienced software developers and building professionals approaching the AEC industry's challenges from a fresh perspective. We will never stop challenging the status quo and relentlessly improving our capabilities to serve our users and our vision for a sustainable future.



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Construction Enquirer

News | Jobs

News

Underfloor robot slashes cost of installing insulation

Grant Prior 2 hours ago

Share 0 17 3

Robots are being used by a growing number of housing associations to apply insulation foam to the underside of floorboards in domestic homes.

The Q-Bot works in confined spaces

The Q-Bot machine makes retrofitting of older homes cost effective.

CN Construction News

COMPANIES PROJECTS MARKETS ANALYSIS DATA BEST PRACTICE MORE CAREERS TRY CN FOR £1 SUBSCRIBE

YOUR BUSINESS

Ten robots and Finnish explosives to be used in Didcot demolition

16 JULY, 2016 | BY DANIEL KEMP

Military robots and 250 kilos of plastic explosives will be used to bring down the remainder of the boiler house at Didcot A Power Station tomorrow.

CIOB

BIM+

NEWS

ROBOT BUILT OFFICES "NOT THAT FAR OFF"

0

6 OCTOBER 2016

The replacement of human construction workers by robots is just around the corner, according to the head of one of the UK's largest developers.

Alison Carnwath, the chair of Land Securities, told the Institute of Directors last week that the industry was on the cusp of a technological revolution brought by advances in technologies such as robotics, unmanned vehicles and additive printing, as well as more general industrial control systems.

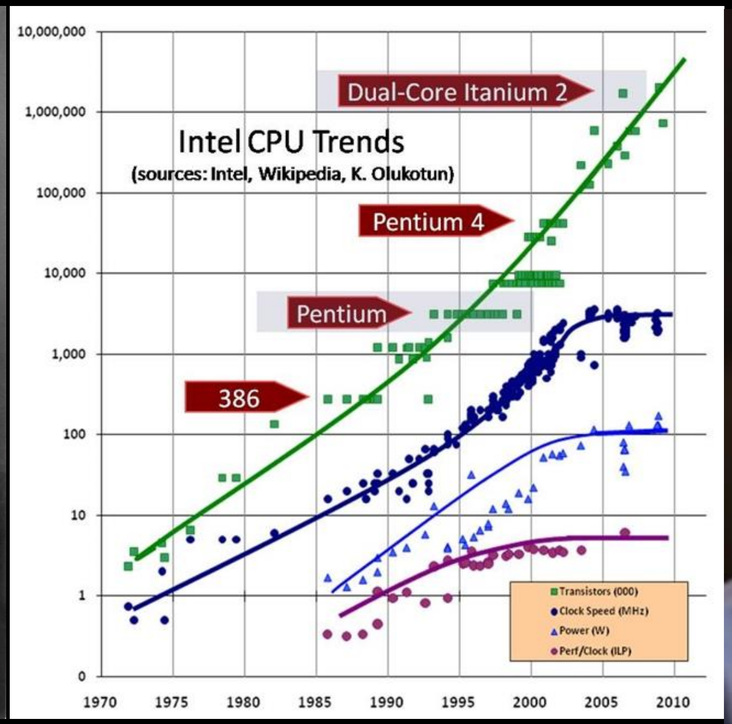
MARC 3D printed robot, designed by Dr John Murray, University of Lincoln

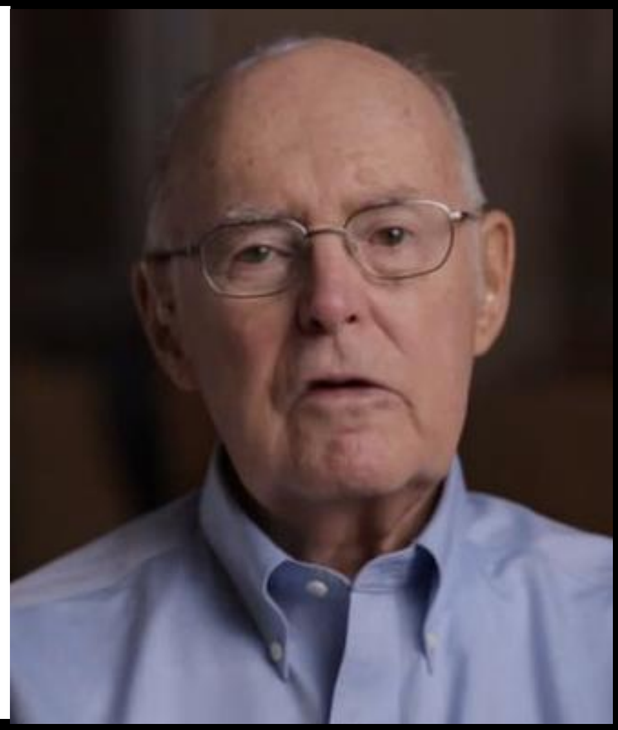
GCR
GLOBAL CONSTRUCTION REVIEW

Scientists to develop flying robots that can print buildings in disaster zones

19 February 2016 | By Rod Sweet

Moore’s Law, 1965 - 2016





By 2020

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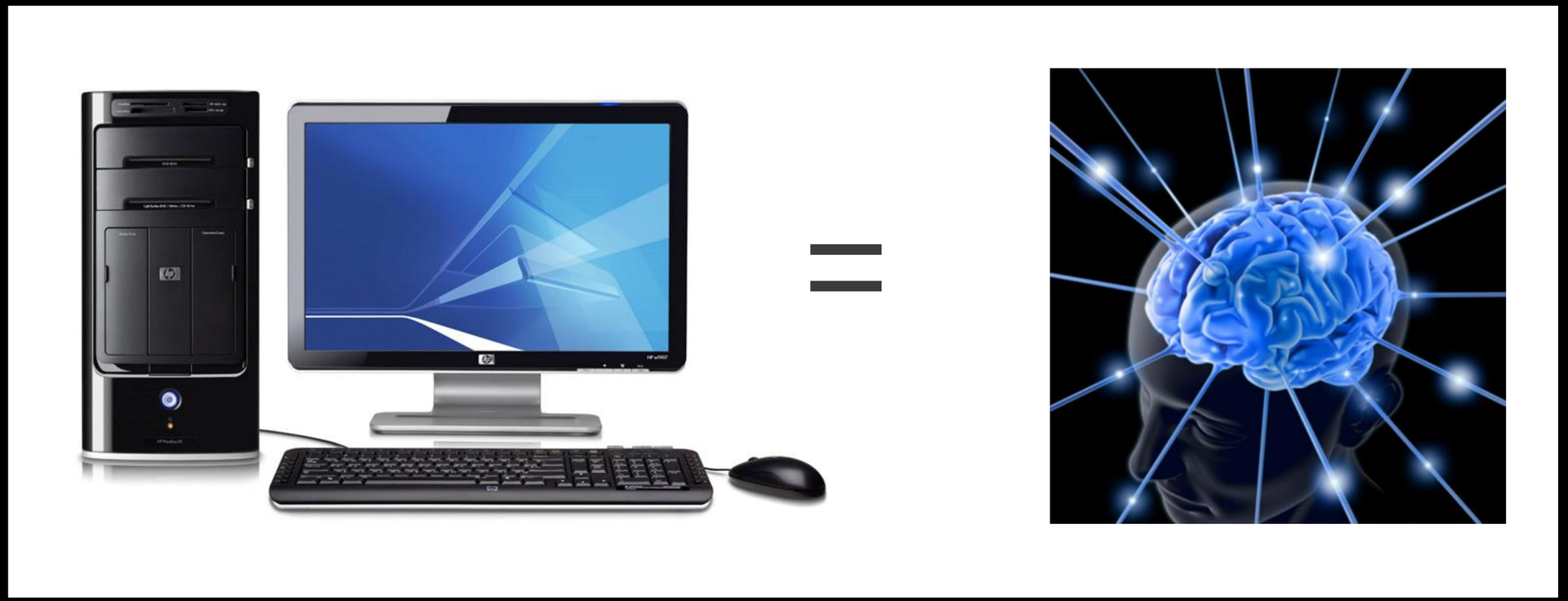
By 2020



= 10^16 calculations per second

By 2050

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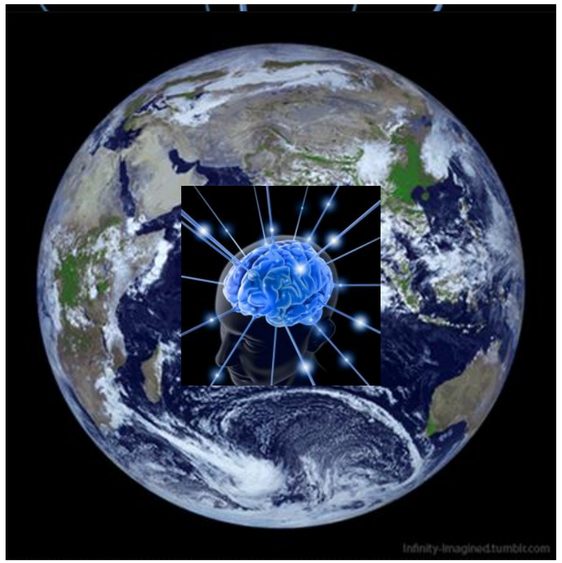
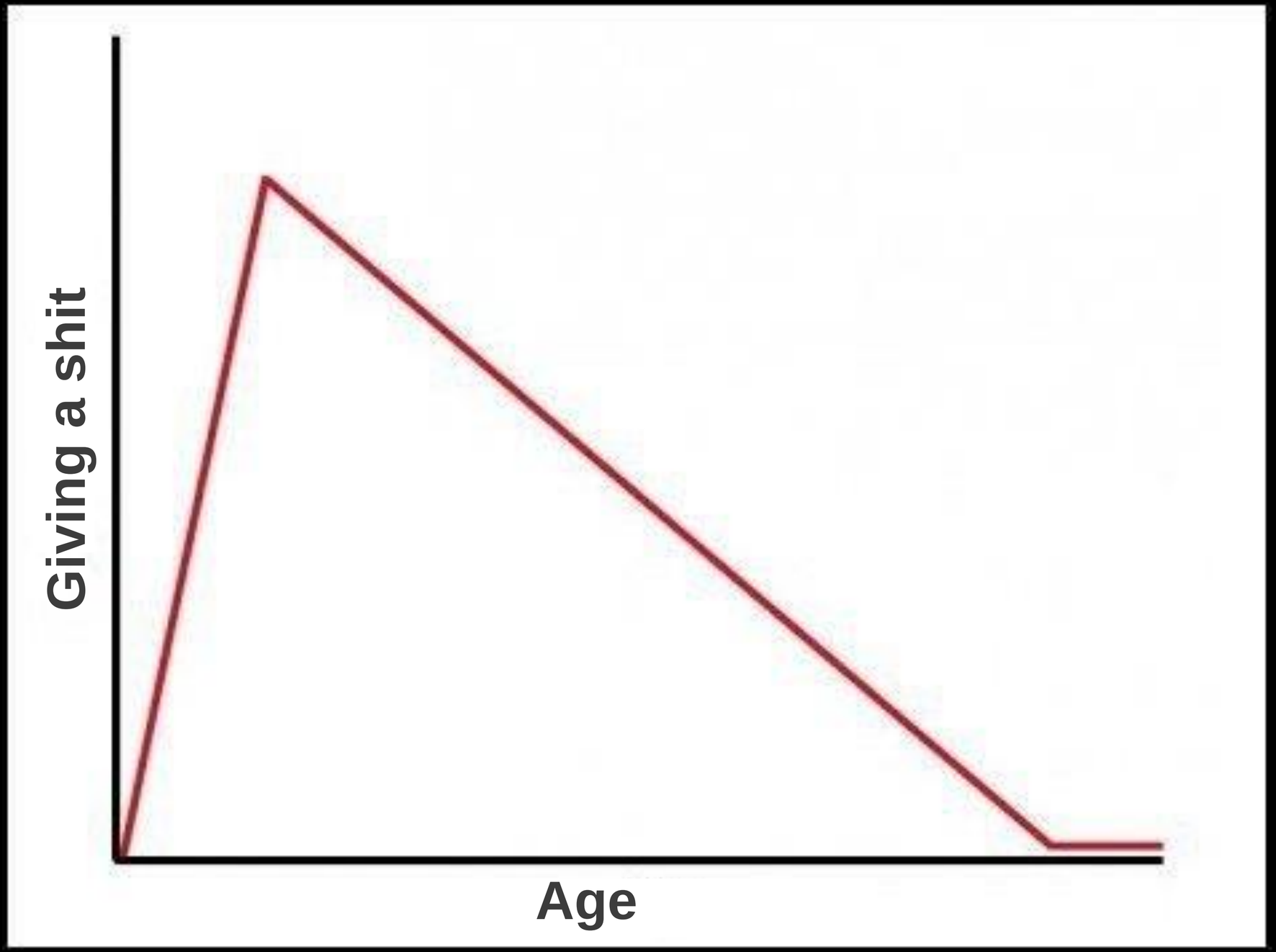


What do you think of it so far?

It’s bloody amazing!

“*Although I am in my 70s, I get quite excited about BIM, and wish I was a graduate again*.”

Doug Oakervee
former Chairman
HS2


Giving a shit
Age

... and yet ...

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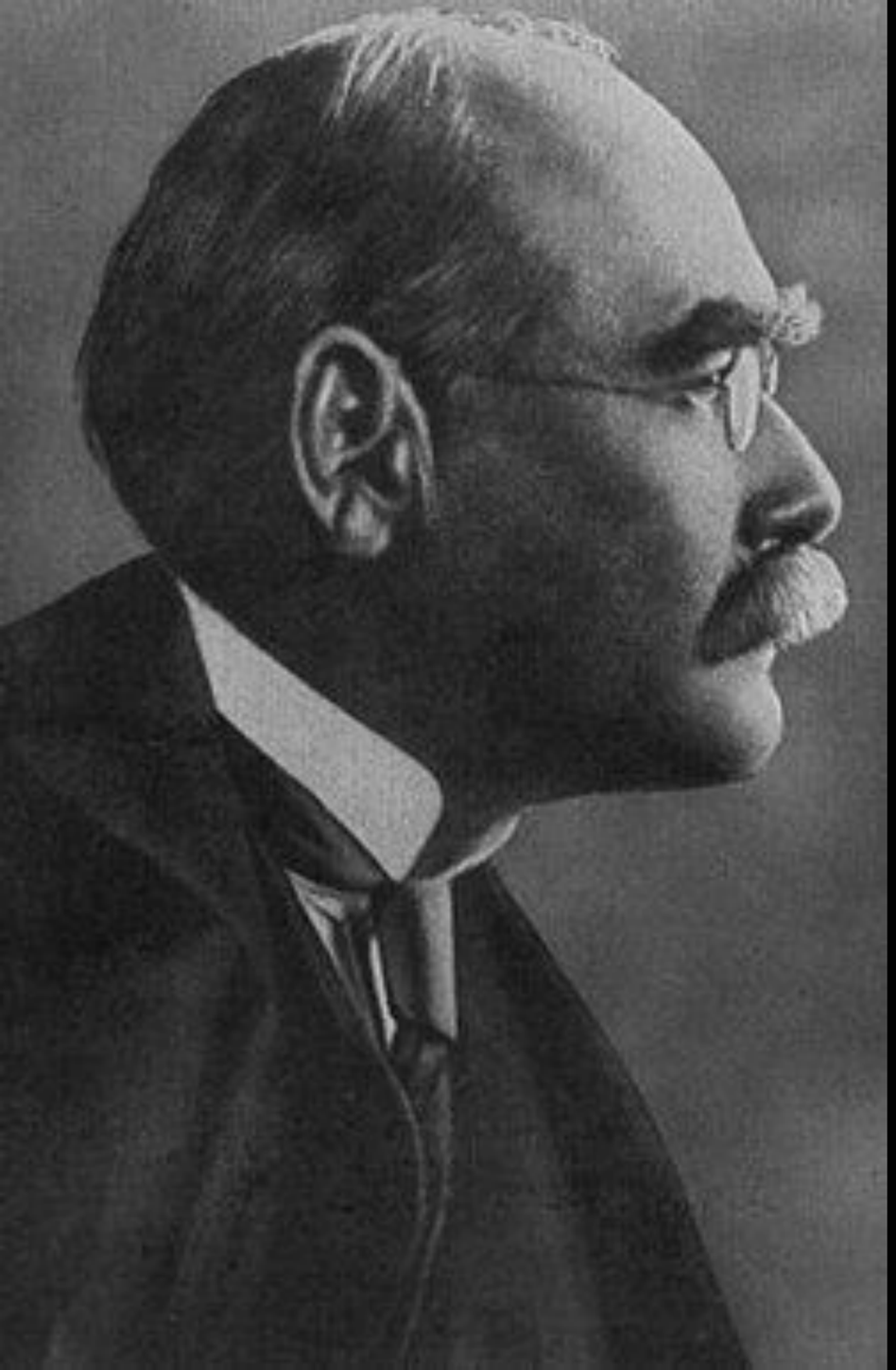
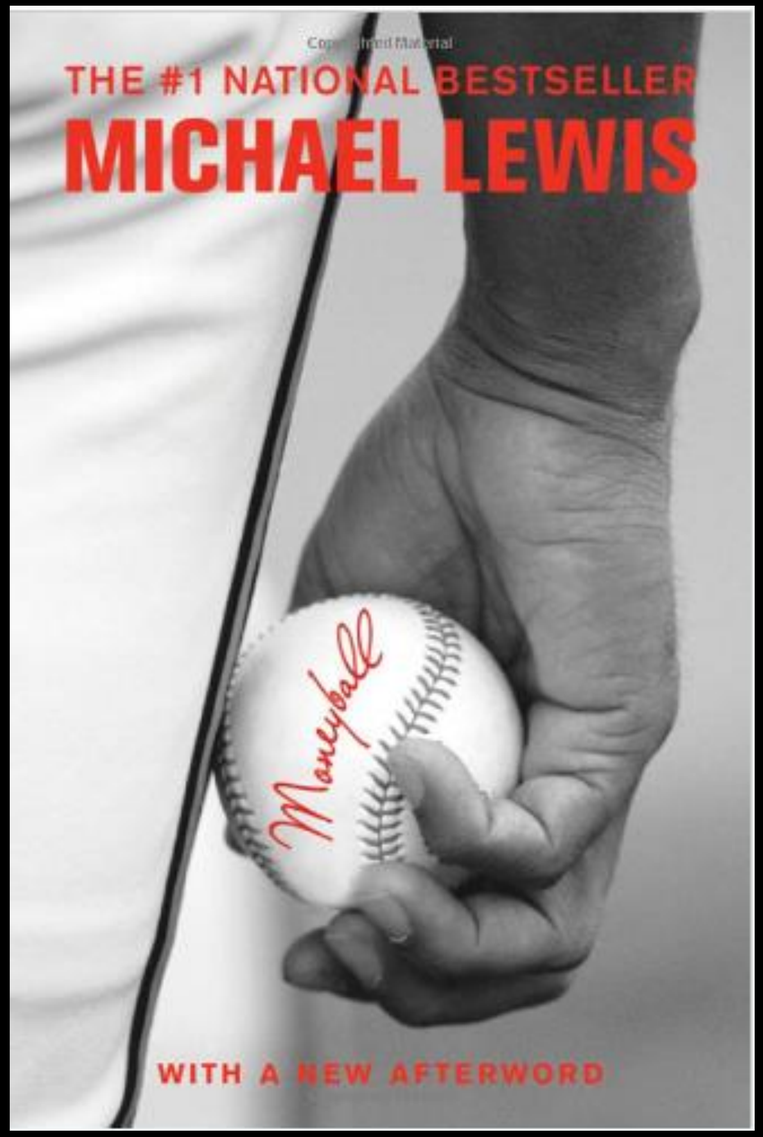


I tell this tale,
which is strictly true,
Just by way of convincing you
How very little,
since things were made,
Things have altered
in the building trade

Rudyard Kipling

It’s not just us, then?



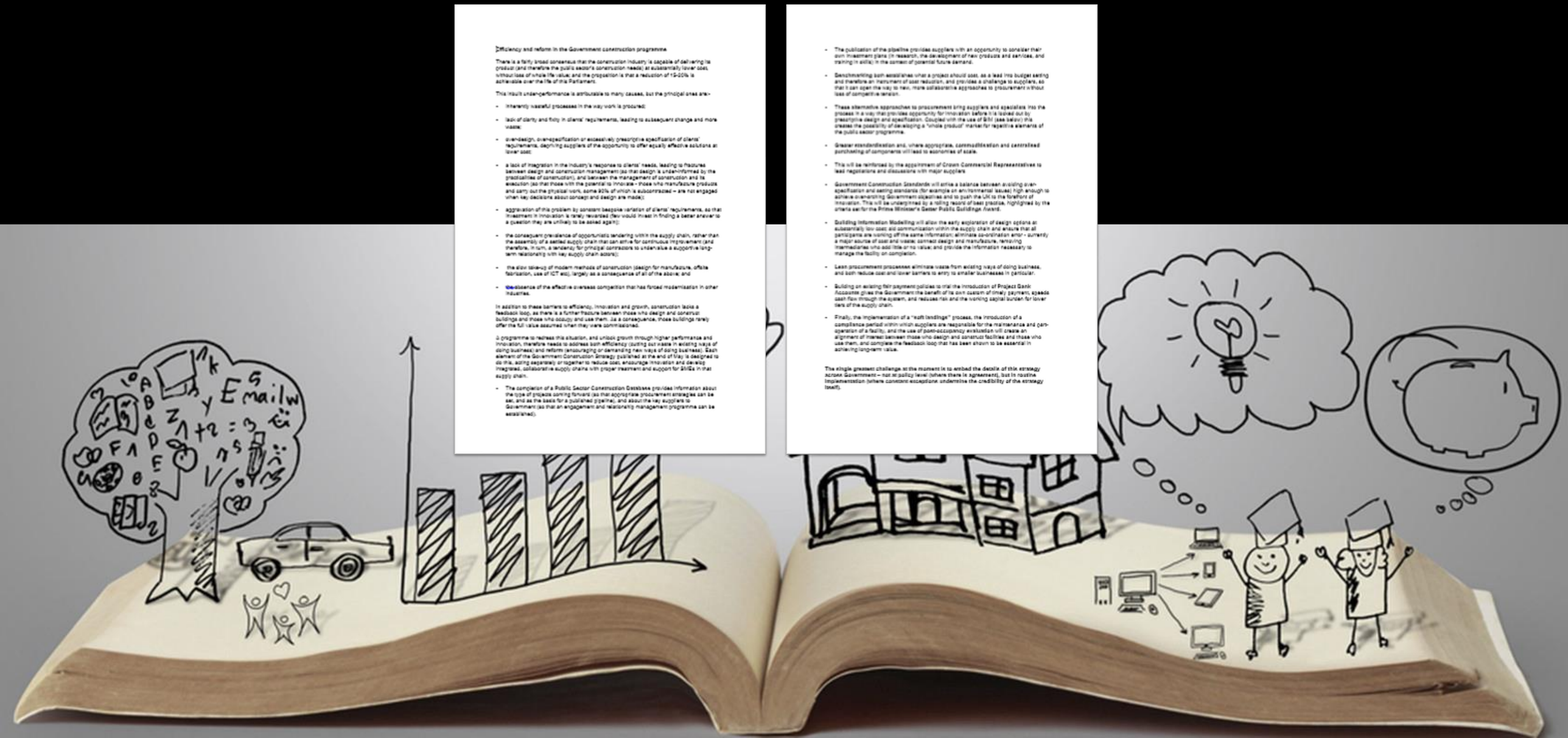
“*If we have been doing things more or less the same way for years, and we are hysterically angry about the results, shouldn’t we be trying something different?*”

Cabinet Office

Government Construction Strategy

May 2011

The construction story



Efficiency and reform in the Government construction programme

There is a fairly broad consensus that the construction industry is capable of delivering its product (and therefore the public sector's construction needs) at substantially lower cost, without loss of whole life value; and the proposition is that a reduction of 15-20% is achievable over the life of this Parliament.

This result underperformance is attributable to many causes, but the principal ones are:-

- inherently wasteful processes in the way work is procured;
- lack of clarity and fixity in clients' requirements, leading to subsequent change and more waste;
- overdesign, overspecification or excessively prescriptive specification of clients' requirements, depriving suppliers of the opportunity to offer equally effective solutions at lower cost;
- a lack of integration in the industry's response to clients' needs, leading to fractures between design and construction management (so that design is uninformed by the practicalities of construction), and between the management of construction and its execution (so that those with the potential to innovate - those who manufacture products and carry out the physical work, some 80% of which is subcontracted – are not engaged when key decisions about concept and design are made);
- aggravation of this problem by constant bespoke variation of clients' requirements, so that investment in innovation is rarely rewarded (few would invest in finding a better answer to a question they are unlikely to be asked again);
- the consequent prevalence of opportunistic tendering within the supply chain, rather than the assembly of a settled supply chain that can strive for continuous improvement (and therefore, in turn, a tendency for principal contractors to undervalue a supportive long-term relationship with key supply chain actors);
- the slow take-up of modern methods of construction (design for manufacture, offsite fabrication, use of ICT etc), largely as a consequence of all of the above; and
- the absence of the effective overseas competition that has forced modernisation in other industries.

In addition to these barriers to efficiency, innovation and growth, construction lacks a feedback loop, as there is a further fracture between those who design and construct buildings and those who occupy and use them. As a consequence, those buildings rarely offer the full value assumed when they were commissioned.

A programme to redress this situation, and unlock growth through higher performance and innovation, therefore needs to address both efficiency (cutting out waste in existing ways of doing business) and reform (encouraging or demanding new ways of doing business). Each element of the Government Construction Strategy published at the end of May is designed to do this, acting separately or together to reduce cost, encourage innovation and develop integrated, collaborative supply chains with proper investment and support for skills in that supply chain.

- The completion of a Public Sector Construction Database provides information about the type of projects coming forward (so that appropriate procurement strategies can be set, and as the basis for a published pipeline), and about the key suppliers to Government (so that an engagement and relationship management programme can be established).

- The publication of the pipeline provides suppliers with an opportunity to consider their own investment plans (in research, the development of new products and services, and training in skills) in the context of potential future demand.

- Benchmarking both establishes what a project should cost, as a lead into budget setting and therefore an instrument of cost reduction, and provides a challenge to suppliers, so that it can open the way to new, more collaborative approaches to procurement without loss of competitive tension.

- These alternative approaches to procurement bring suppliers and specialists into the process in a way that provides opportunity for innovation before it is locked out by prescriptive design and specification. Coupled with the use of BIM (see below) this creates the possibility of developing a "whole product" market for repetitive elements of the public sector programme.

- Greater standardisation and, where appropriate, commoditisation and centralised purchasing of components will lead to economies of scale.

- This will be reinforced by the appointment of Crown Commercial Representatives to lead negotiations and discussions with major suppliers.

- Government Construction Standards will strike a balance between avoiding over-specification and setting standards (for example on environmental issues) high enough to achieve overarching Government objectives and to push the UK to the forefront of innovation. This will be underpinned by a rolling 'exemplar' best practice, highlighted by the criteria set for the Prime Minister's Better Public Buildings Award.

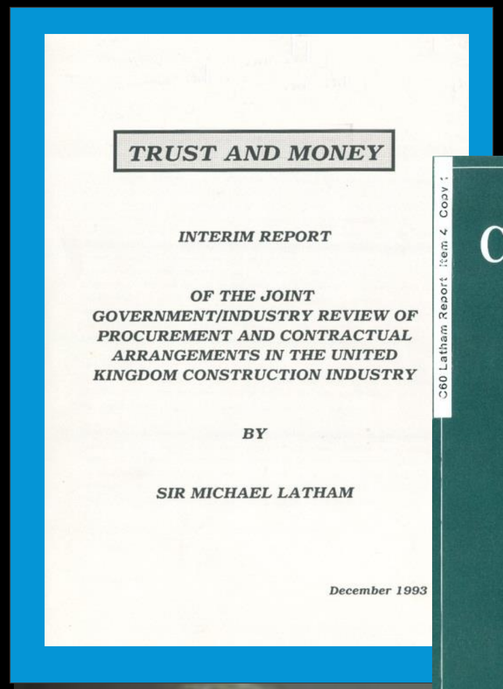
- Building Information Modelling will allow the early exploration of design options at substantially low cost; aid communication within the supply chain and ensure that all participants are working off the same information; eliminate co-ordination error - currently a major source of cost and waste; connect design and manufacture, removing intermediaries who add little or no value; and provide the information necessary to manage the facility on completion.

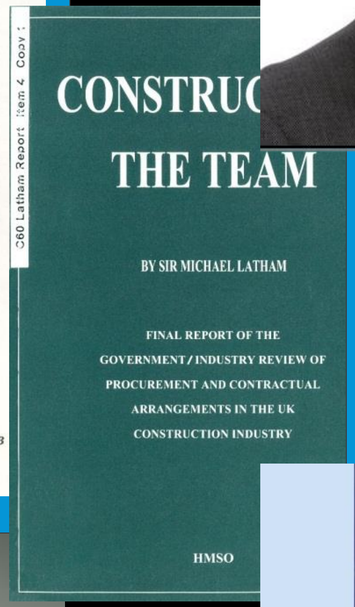
- Lean procurement processes eliminate waste from existing ways of doing business, and both reduce cost and lower barriers to entry to smaller businesses in particular.

- Building on existing fair payment policies is vital the introduction of Project Bank Accounts gives the Government the benefit of its own custom of timely payment, speeds cash flow through the system, and reduces risk and the working capital burden for lower tiers of the supply chain.

- Finally, the implementation of a "soft landings" process, the introduction of a compliance period within which suppliers are responsible for the maintenance and (pre-)operation of a facility, and the use of post-occupancy evaluation will create an alignment of interest between those who design and construct facilities and those who use them, and complete the feedback loop that has been shown to be essential in achieving long-term value.

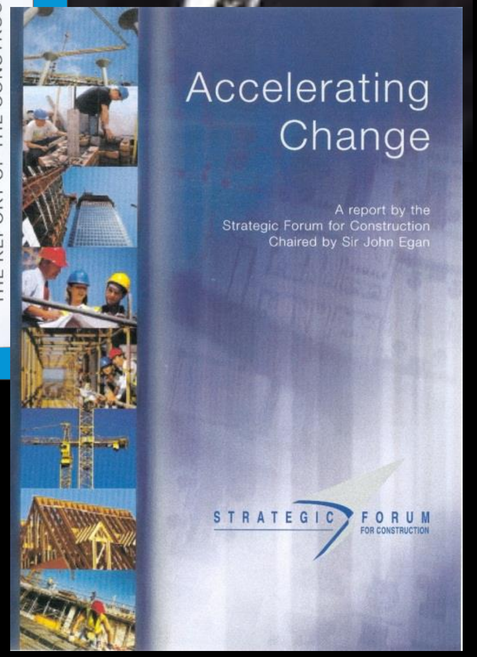
The single greatest challenge at the moment is to embed the details of this strategy across Government – not at policy level (where there is agreement), but in routine implementation (where constant exceptions undermine the credibility of the strategy itself).


TRUST AND MONEY
INTERIM REPORT
OF THE JOINT GOVERNMENT/INDUSTRY REVIEW OF PROCUREMENT AND CONTRACTUAL ARRANGEMENTS IN THE UNITED KINGDOM CONSTRUCTION INDUSTRY
BY
SIR MICHAEL LATHAM
December 1993


CONSTRUC
THE TEAM
BY SIR MICHAEL LATHAM
FINAL REPORT OF THE GOVERNMENT/INDUSTRY REVIEW OF PROCUREMENT AND CONTRACTUAL ARRANGEMENTS IN THE UK CONSTRUCTION INDUSTRY
HMSO

RETHINKING
CONSTRUCTION
THE REPORT OF THE CONSTRUCTION TASK FORCE

Never Waste a Good Crisis
A Review of Progress since Rethinking Construction and Thoughts for Our Future
CONSTRUCTING EXCELLENCE
in the built environment


Accelerating Change
A report by the Strategic Forum for Construction Chaired by Sir John Egan
STRATEGIC FORUM
FOR CONSTRUCTION

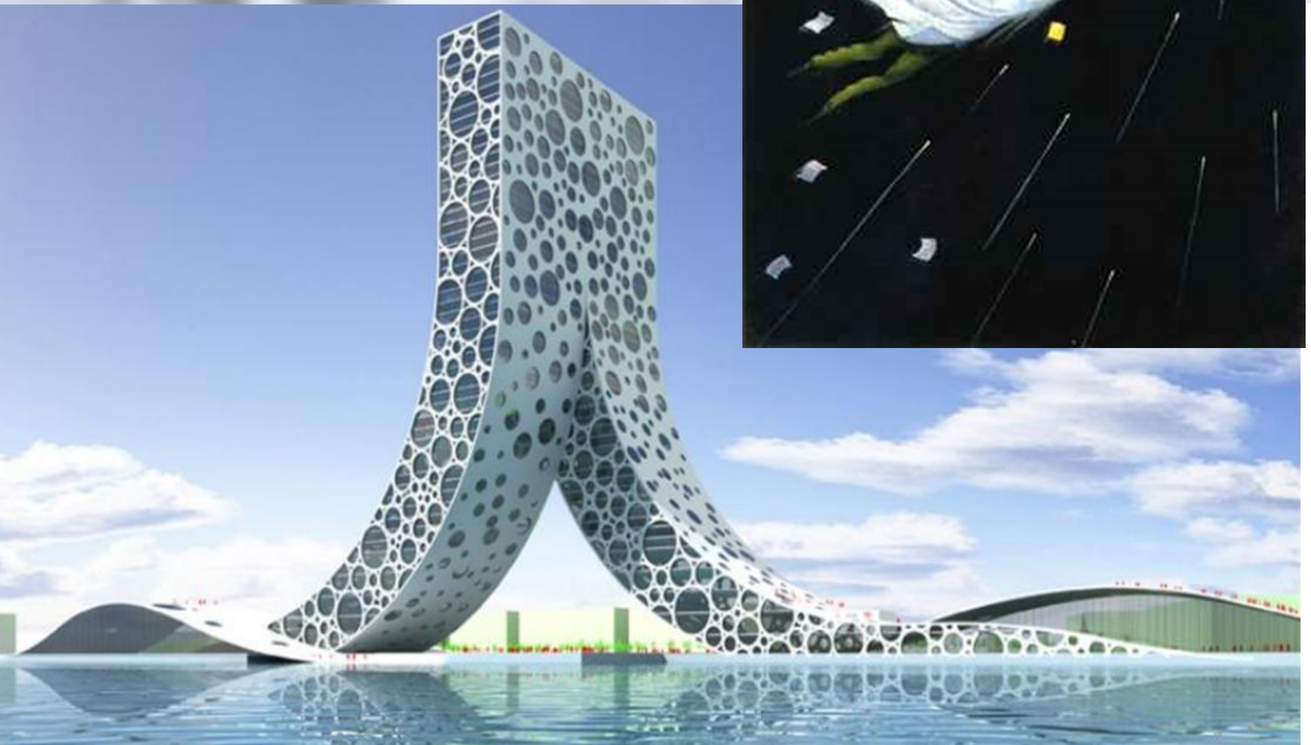
Lack of clarity/fixity in client requirements

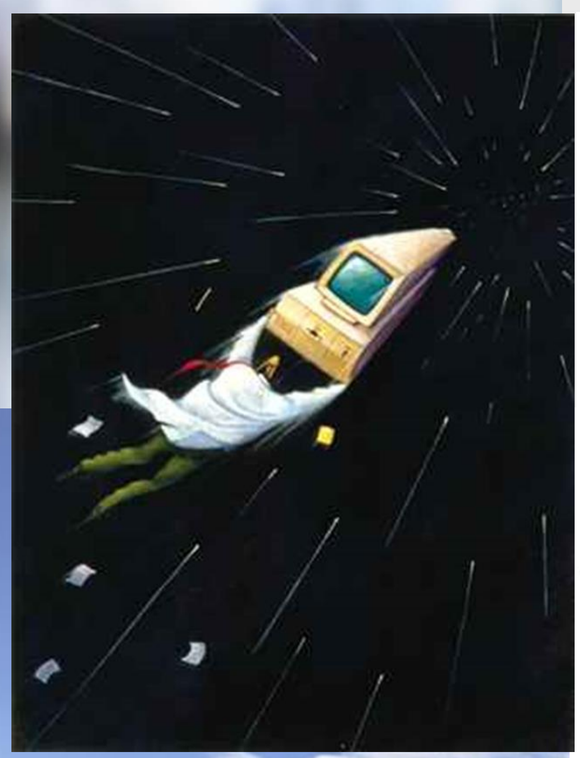
Lack of integration in the industry response

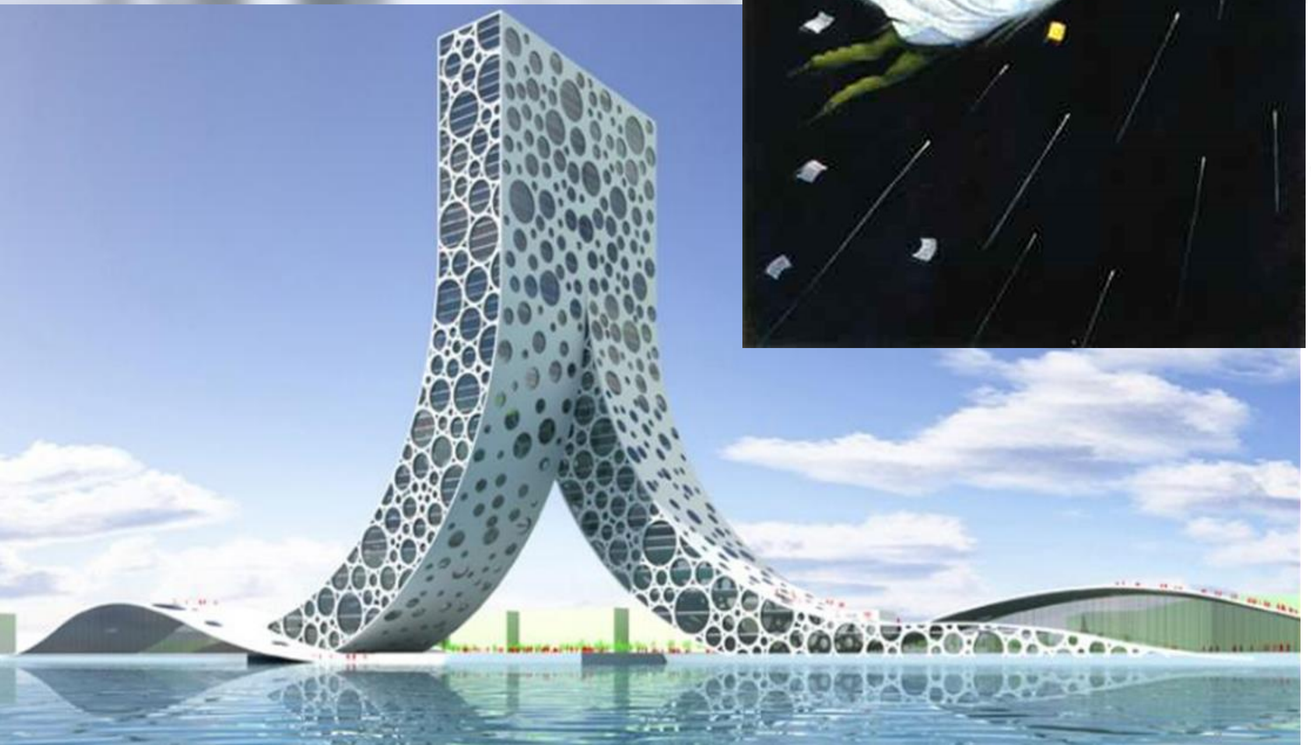
Over-design/excessive prescription locking out supplier innovation

Lack of a feedback loop

Incalculable amounts of waste



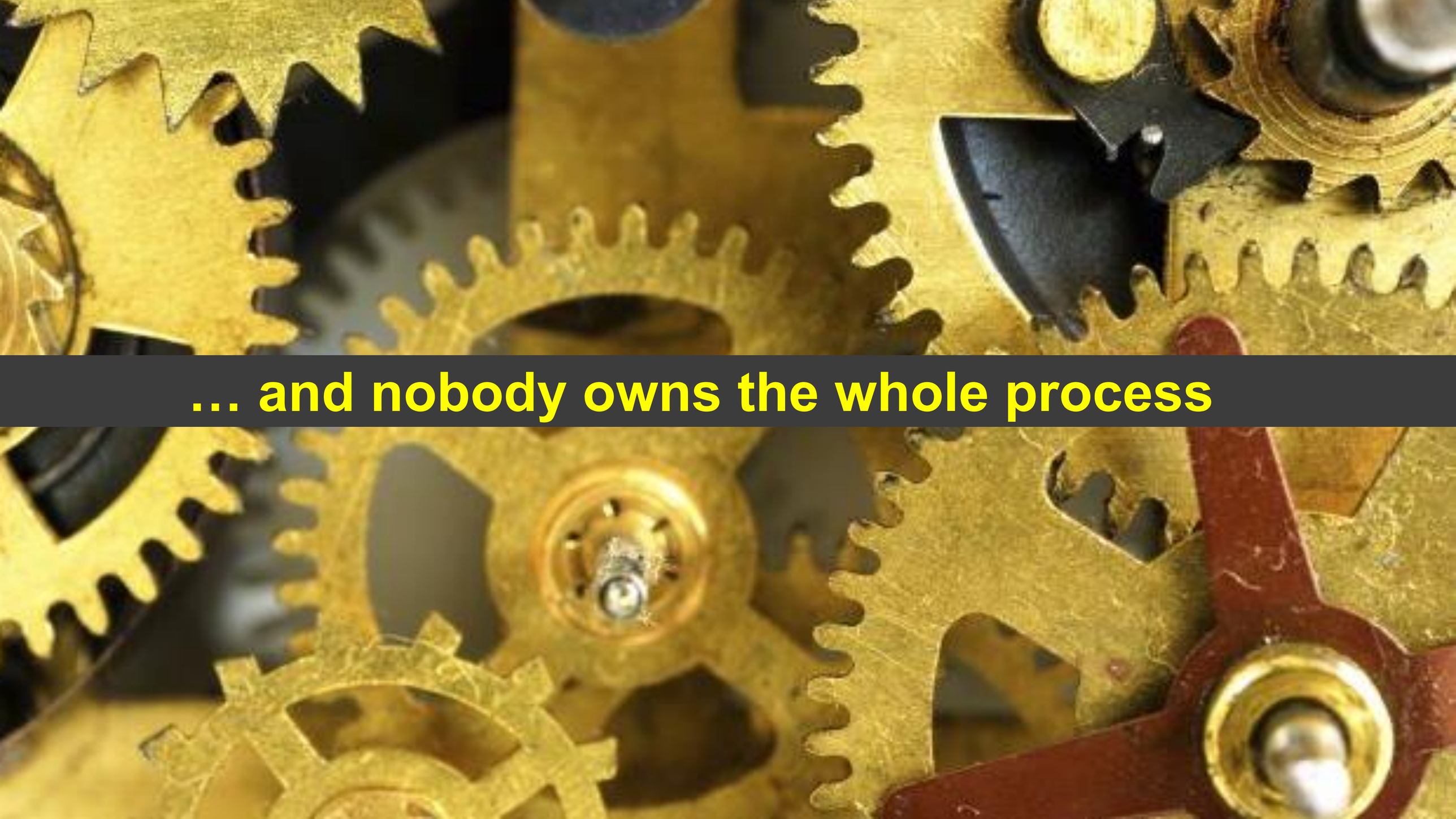




Lack of serious international challenges

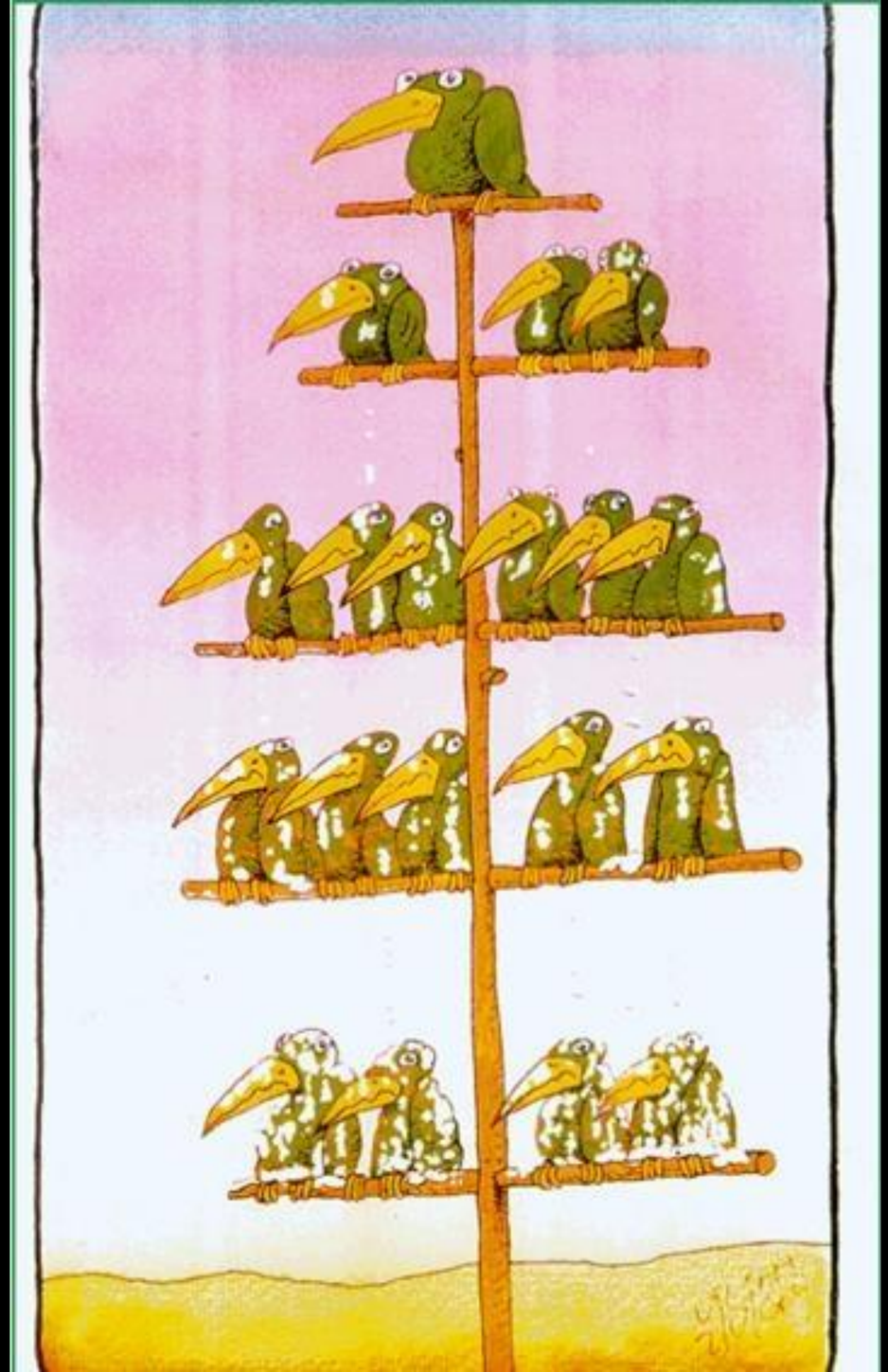
Upside down …

… back to front …

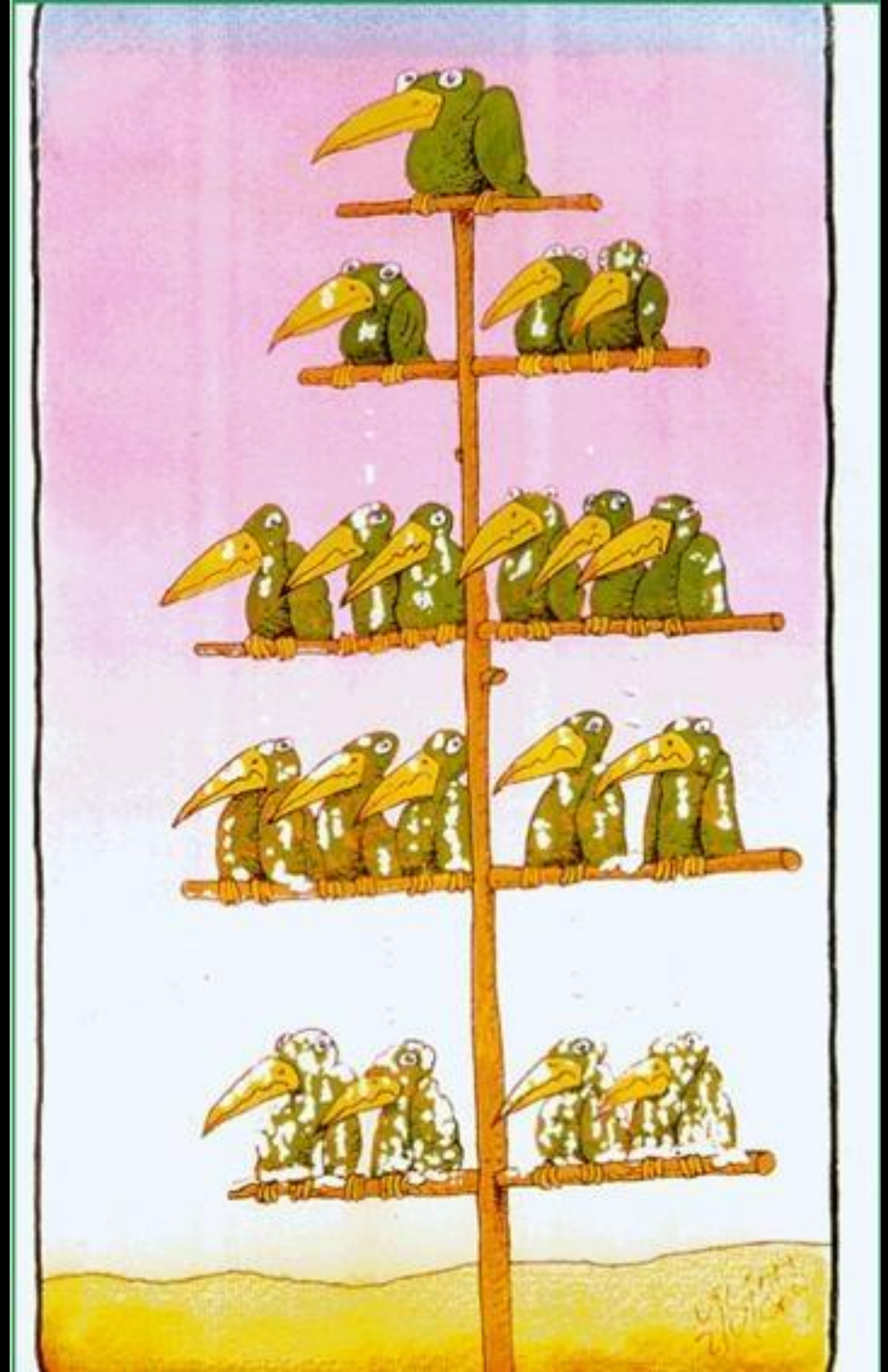

… and nobody owns the whole process

Upside down …

The hierarchy problem



The guano problem

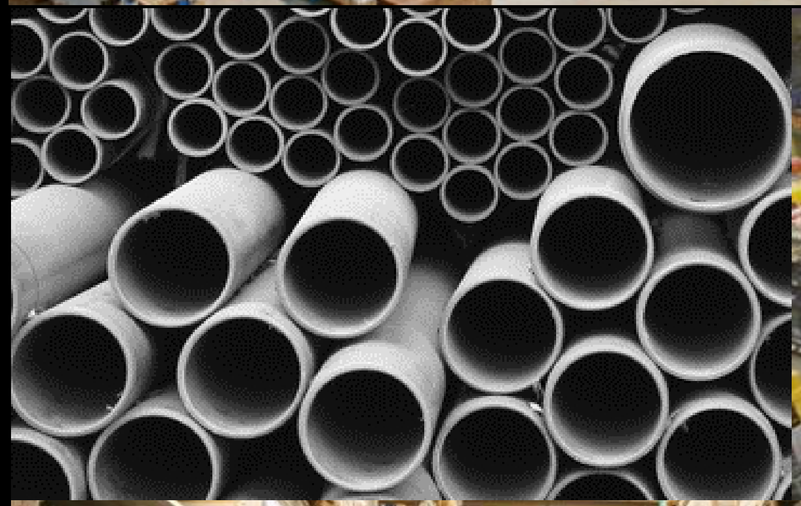


© BBC Picture Archives

Vested interest

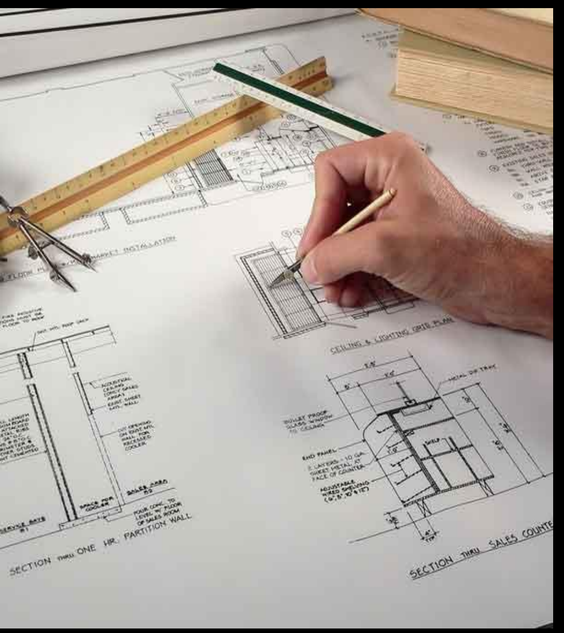
© BBC Picture Archives

TERRAZZA



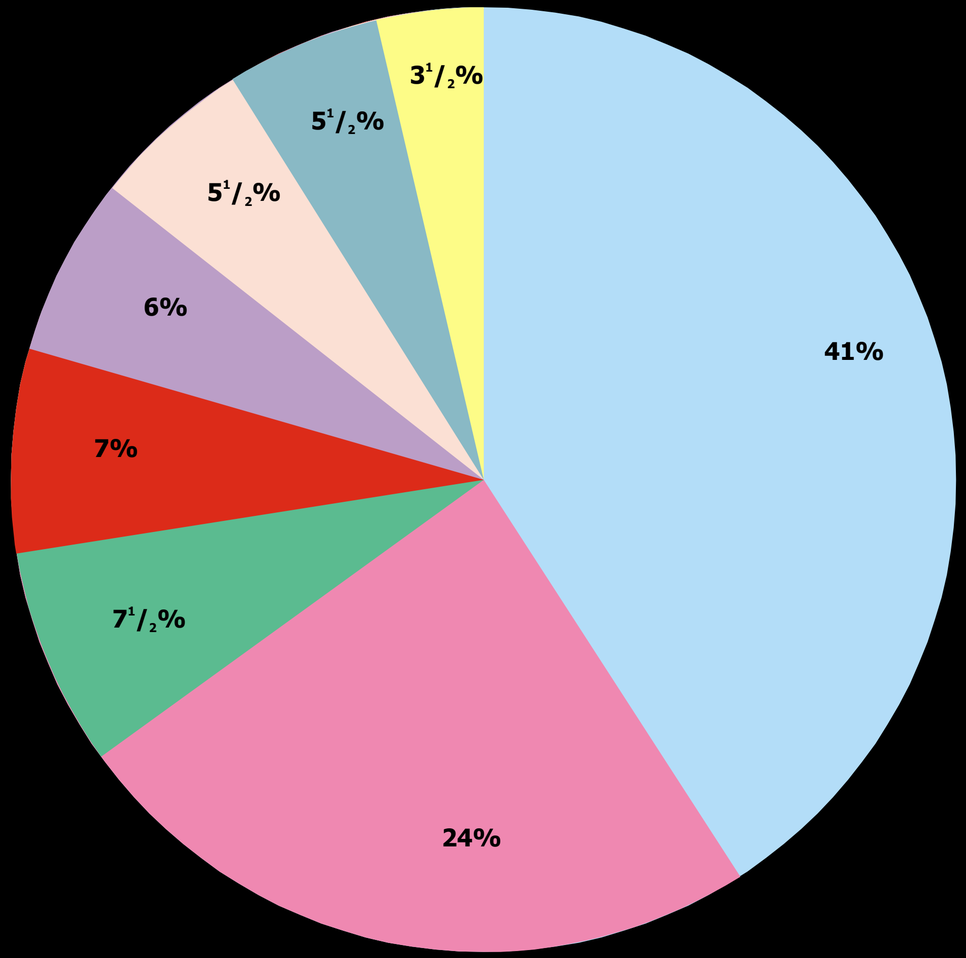
Customer Service Point
Please Pay Here
SERVICE

BACK TO FRONT


SECTION THRU ONE HR. PARTITION WALL
SECTION THRU SALES COUNTE

£££££

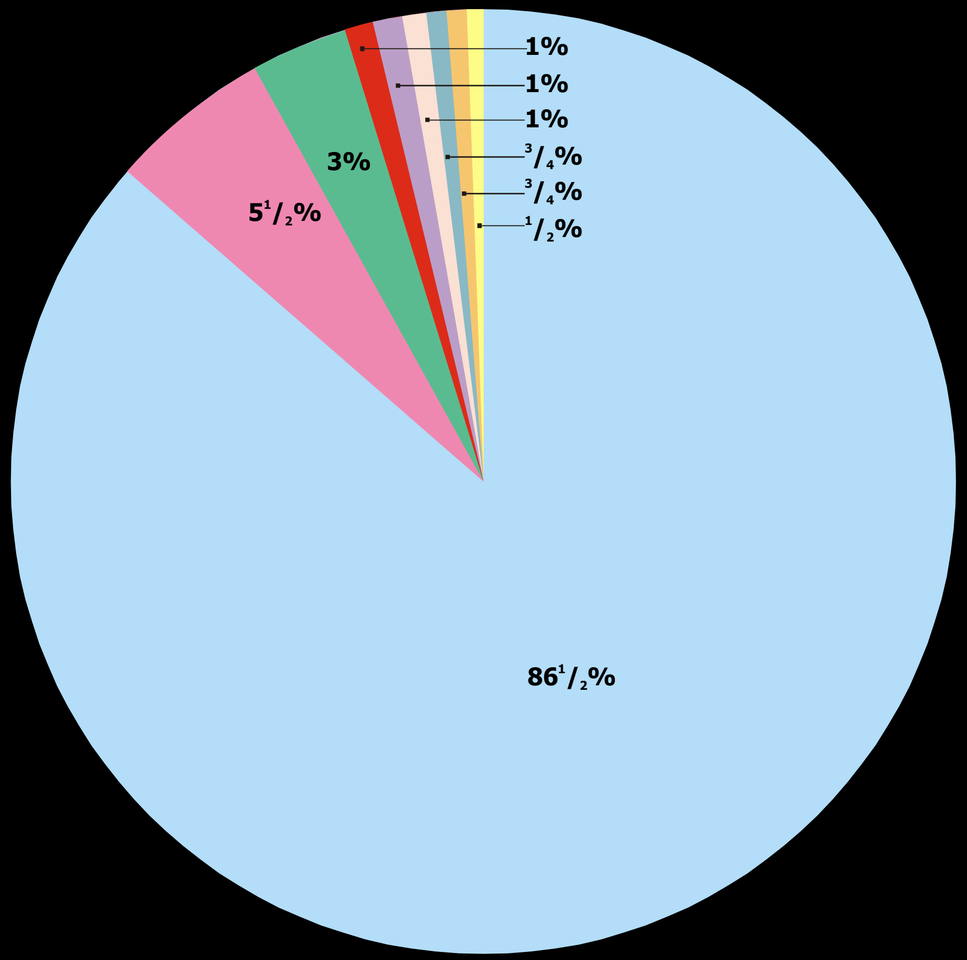
Total Investment in Office Building Discounted to PV



NOTE: EXCLUDES OCCUPANTS' STAFF COSTS

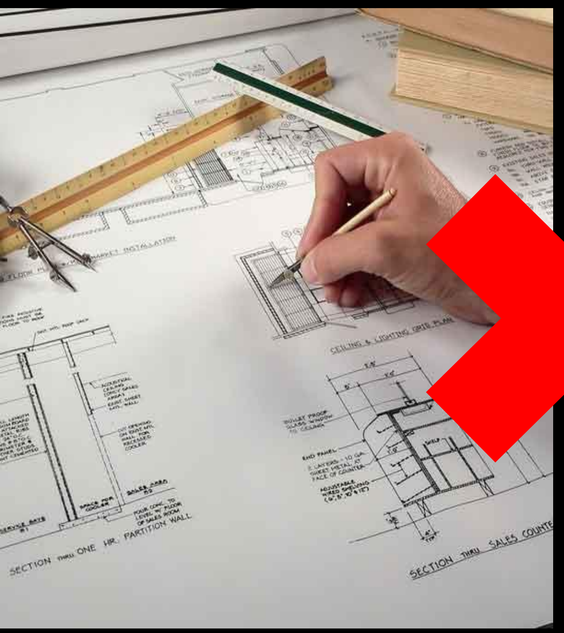
1.	Building - construction cost	41%
2.	M&E services - running & maintenance	24%
3.	Furnishings & furniture - capital cost	7½%
4.	Land	7%
5.	Building - maintenance	6%
6.	Cleaning	5½%
7.	M&E services - depreciation	5½%
8.	Furnishings & furniture - maintenance & depreciation	3½%

Total Investment in Office Building Discounted to PPV

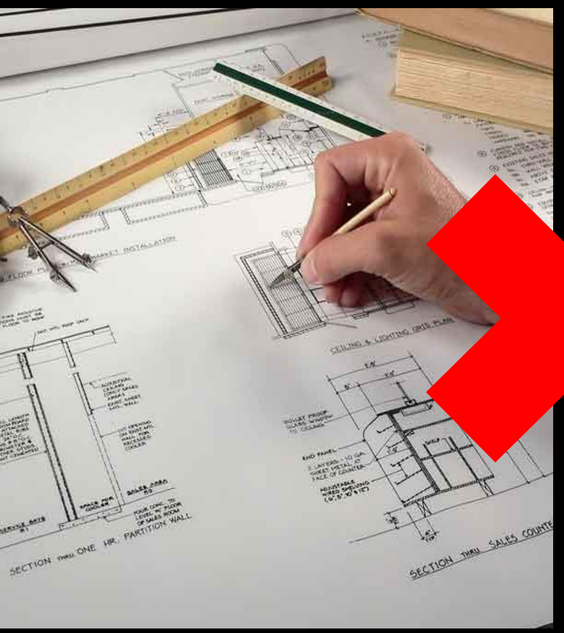


NOTE: INCLUDES OCCUPANTS' STAFF COSTS

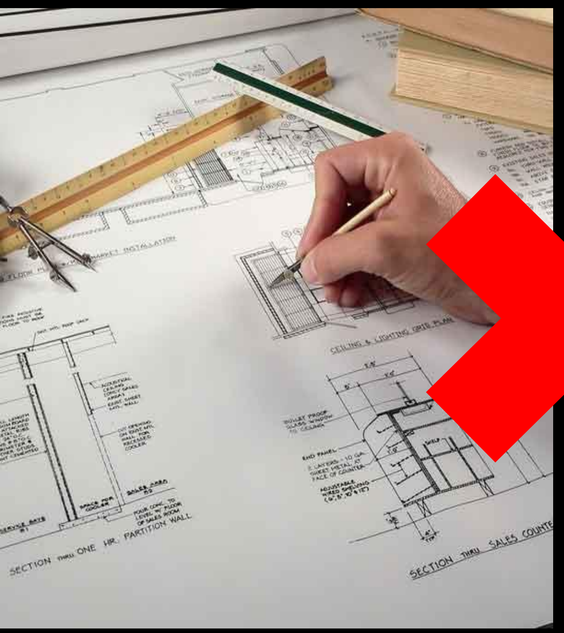
1.	Salaries of occupants	86½%
2.	Building - construction cost	5½%
3.	M&E services - running & maintenance	3%
4.	Furnishings & furniture - capital cost	1%
5.	Land	1%
6.	Building - maintenance	1%
7.	Cleaning	¾%
8.	M&E services - depreciation	¾%
9.	Furnishings & furniture - maintenance & depreciation	½%



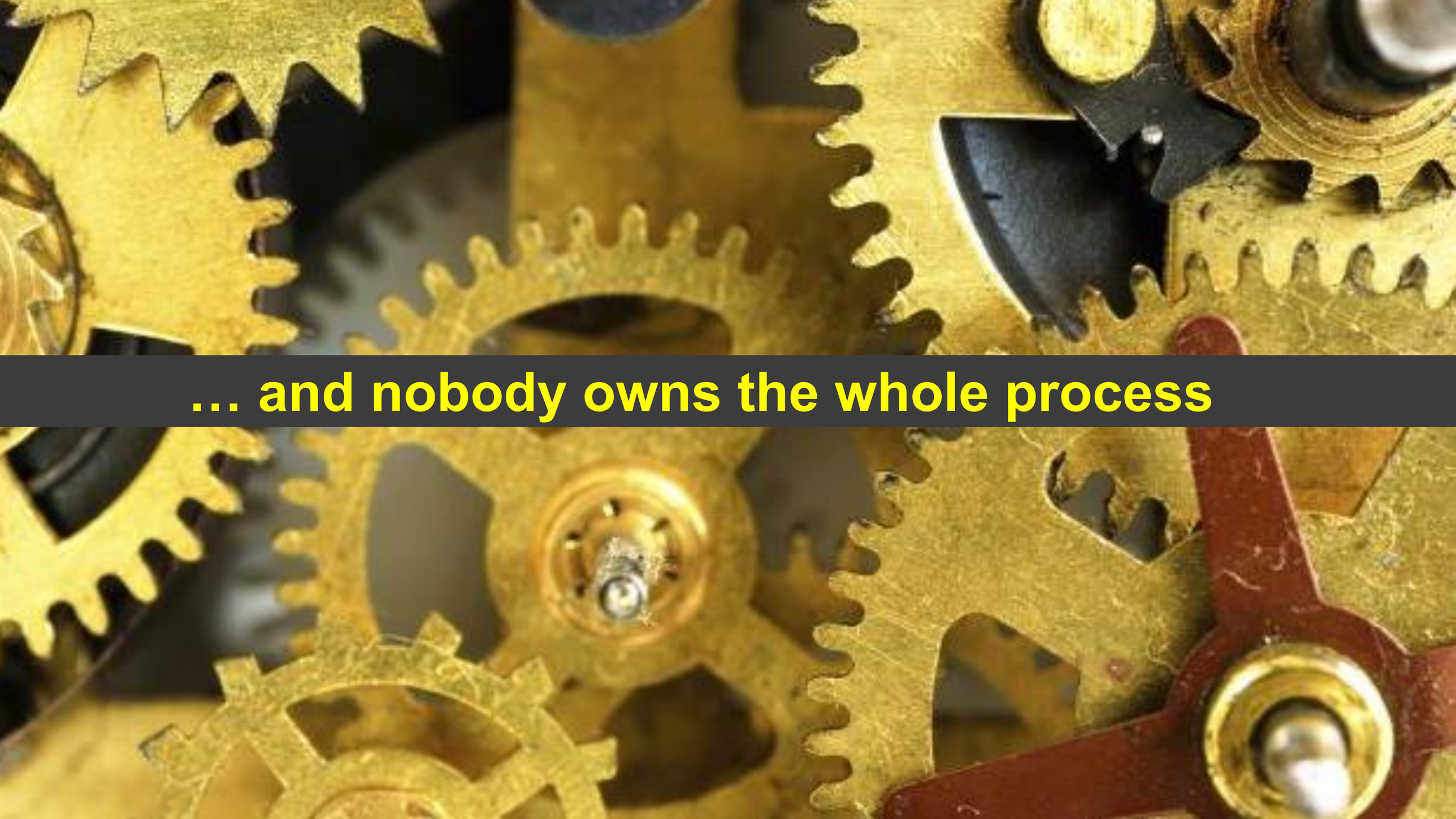
£££££



£££££



£££££

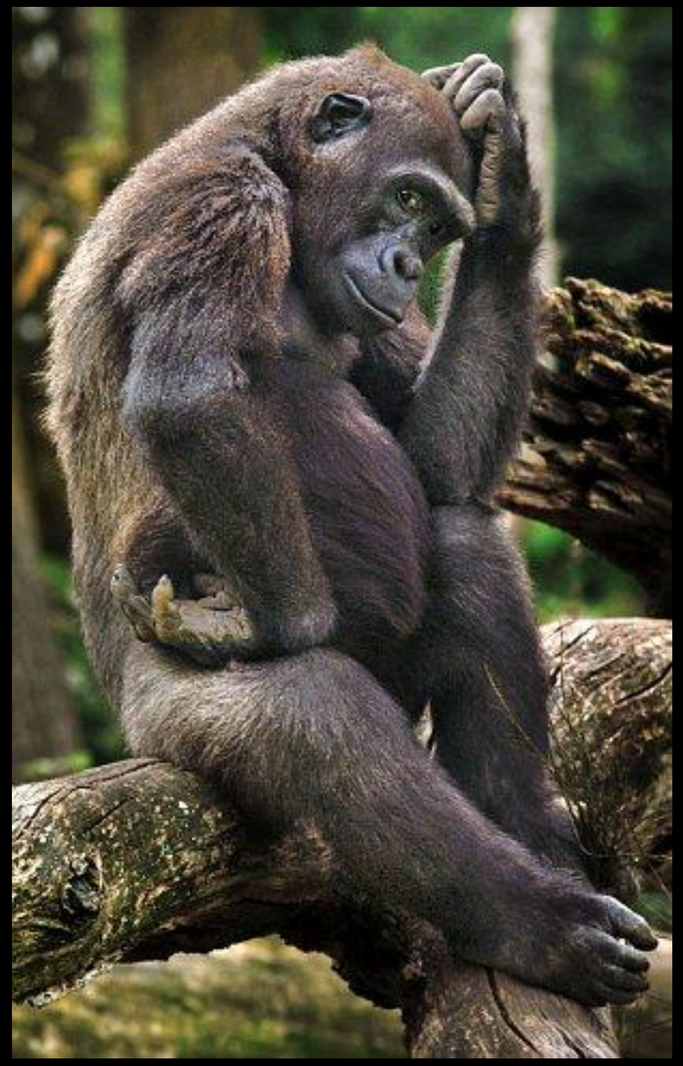

… and nobody owns the whole process

Consultants

Constructors

Producers

So why doesn’t innovation work in construction?



- Because it can’t
- Because even when it could it isn’t worth it
- And because even when it can and is worth it, it still doesn’t have to

Take a glimpse at construction in 2045

Grant Prior | Wed 21st October | 8:14

Tweet 162 Share 568 G+1 17

Equipment hire specialist Hewden has taken a peak into the future of construction to predict how the industry will look in 2045.

The report envisages a world of 30km tall buildings with spaceports, driverless vehicles and mini-cities in the sky while site workers will have super-strength exoskeletons creating half-man, half-machine operatives that can utilise a range of attachments.

Builders will have super-strength exoskeletons creating half-man, half-machine workers.

Builders will have super-strength exoskeletons creating half-man, half-machine workers.

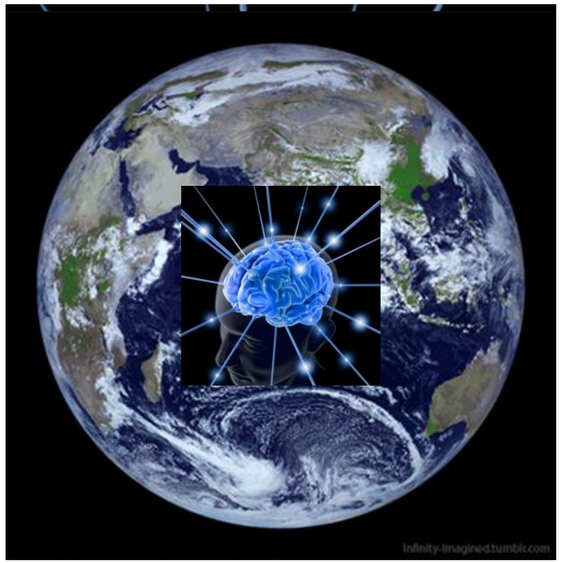
Builders will have super-strength exoskeletons creating half-man, half-machine workers.

Culture eats
strategy
for breakfast

Culture eats
technology
for breakfast

By 2050

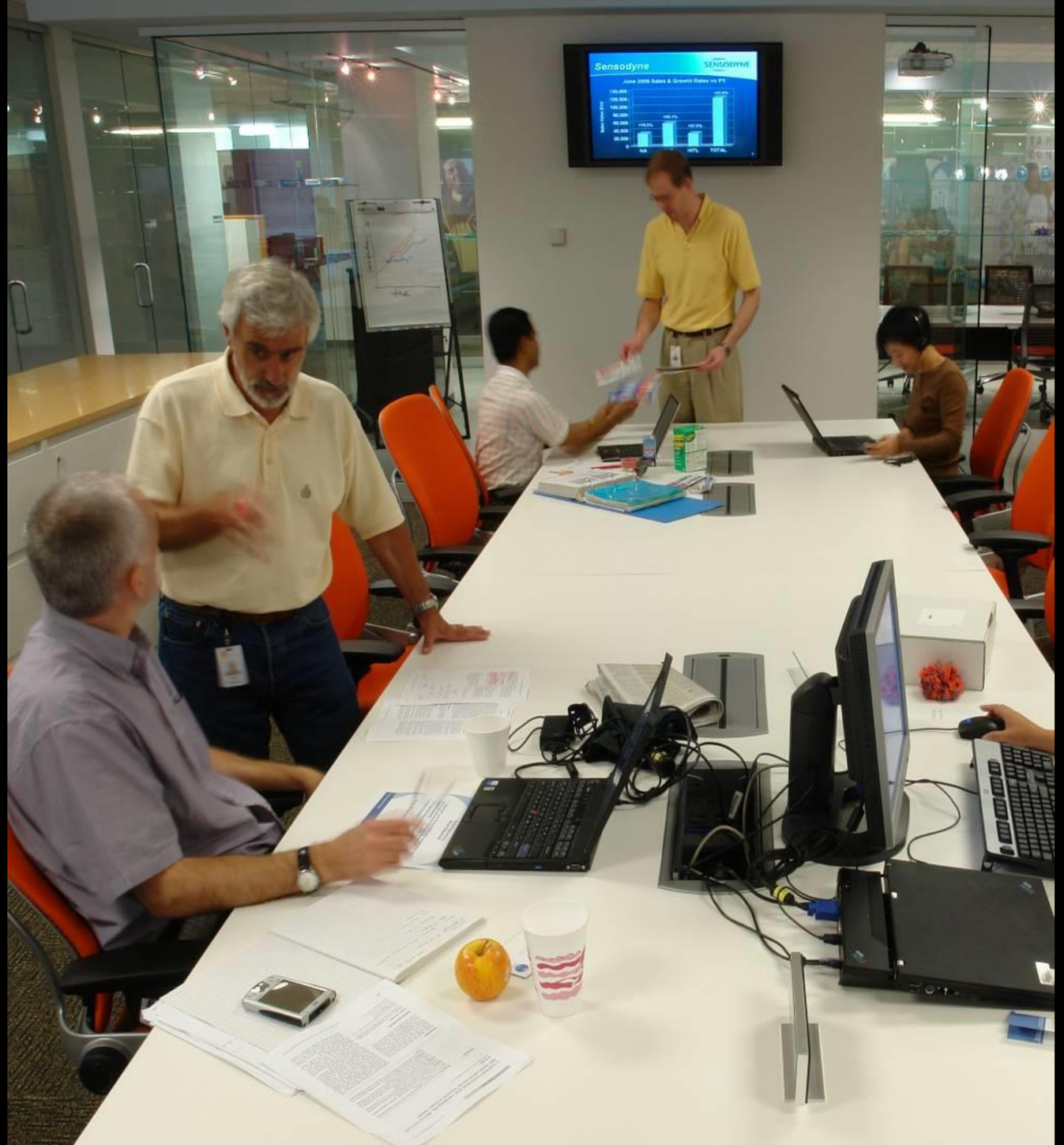
=



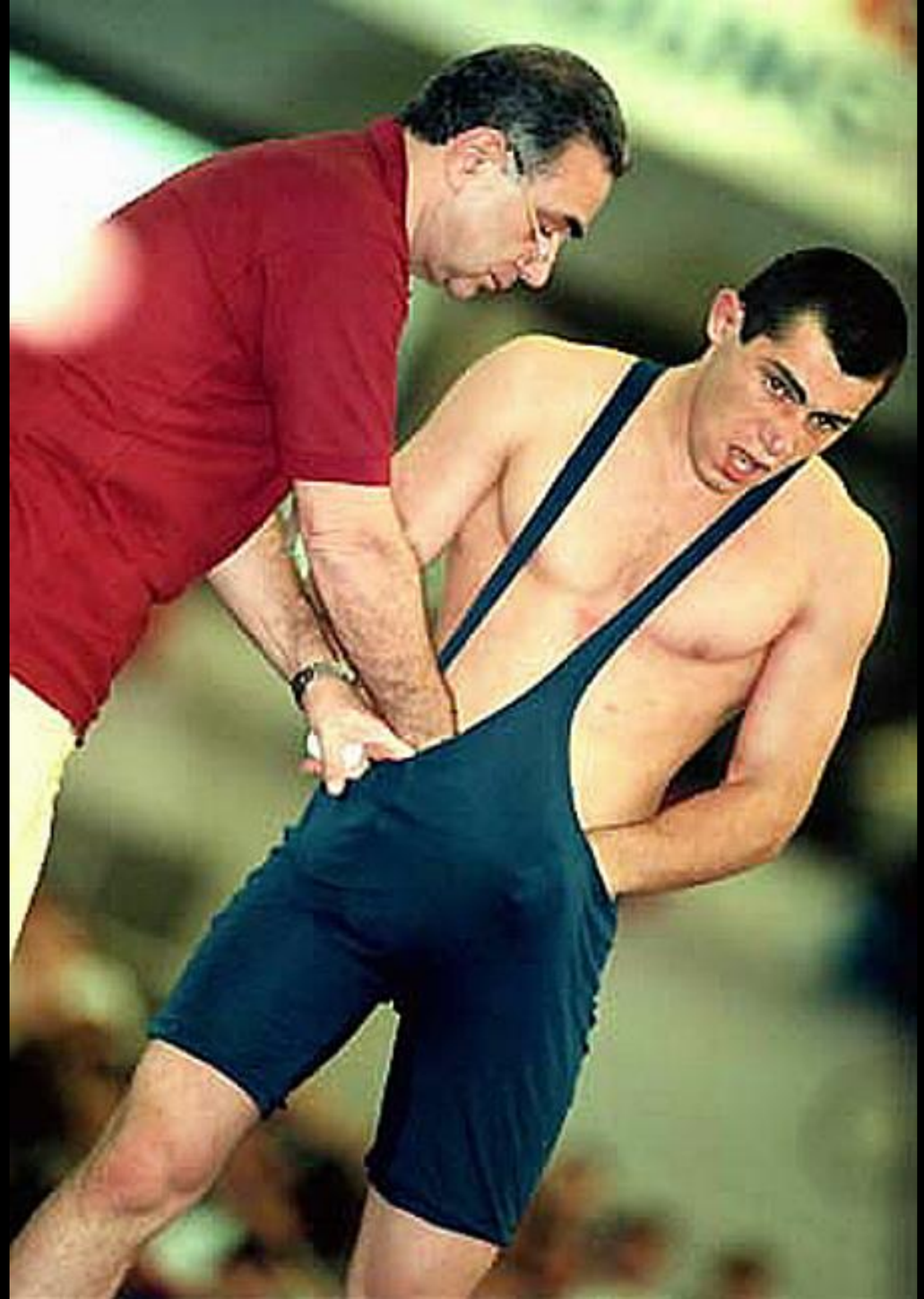
We’ve worked this way for decades. If there were a better way, we’ve have found it, wouldn’t we?

New business models

Integration

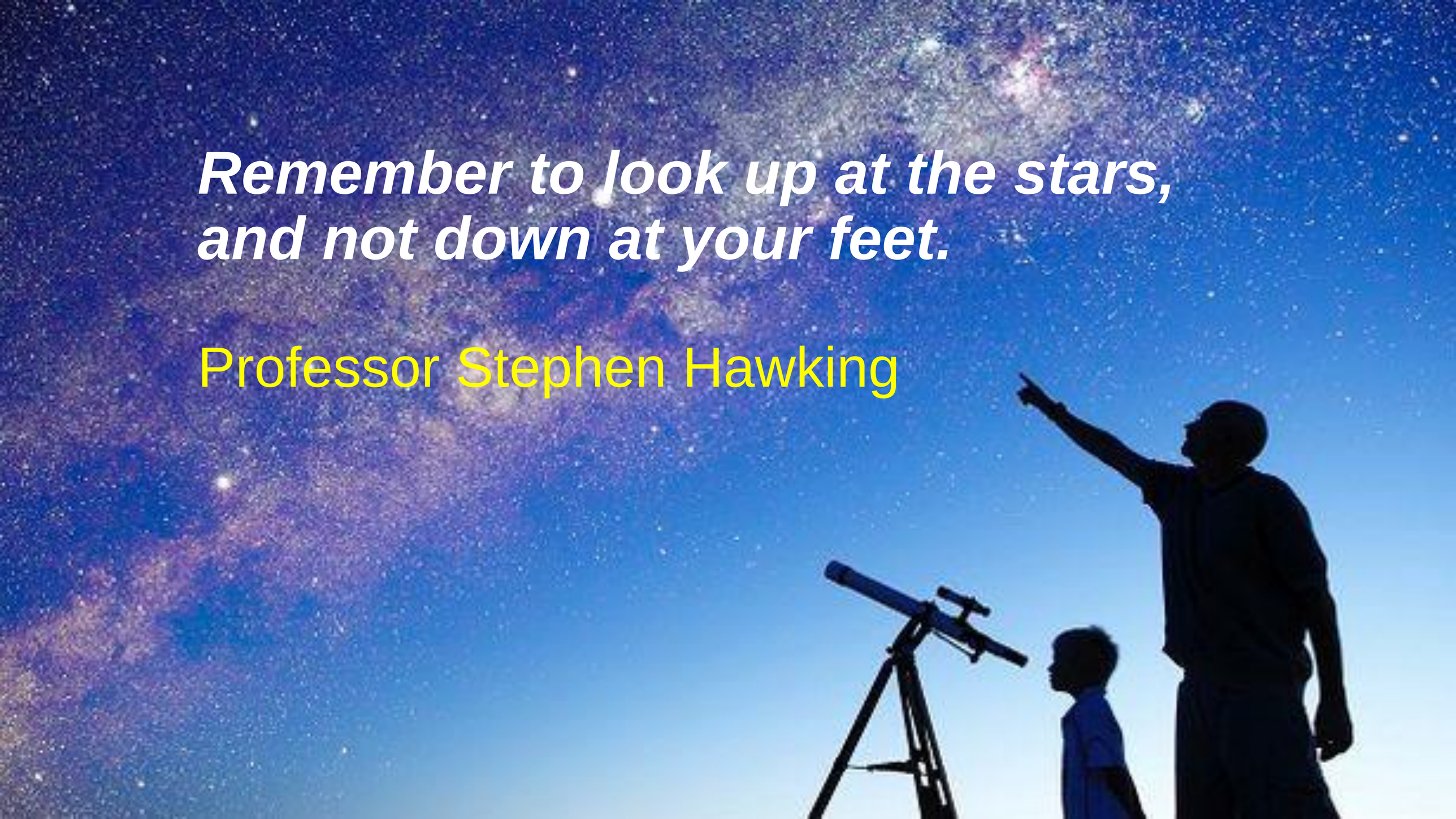

Sensodyne
SENSODYNE
June 2006 Sales & Growth Rates vs PY
INTL
TOTAL

New forms of co-operation

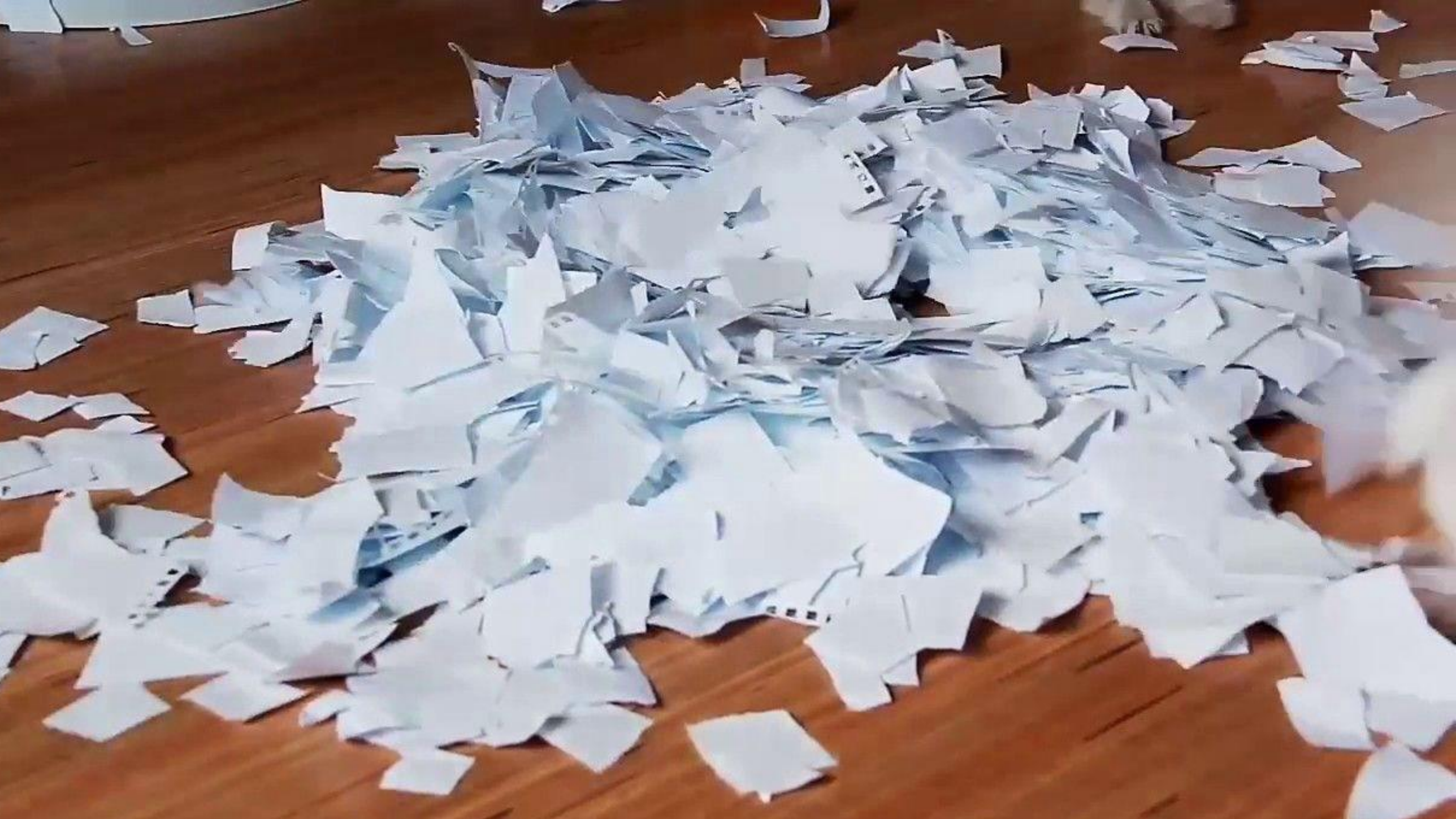


So what now?

An industry to be proud of?


Remember to look up at the stars,
and not down at your feet.
Professor Stephen Hawking

NORTHERNER
NORTHERNER



HELP

We predict too much for the next year,

and yet far too little for the next ten.

Neil Armstrong

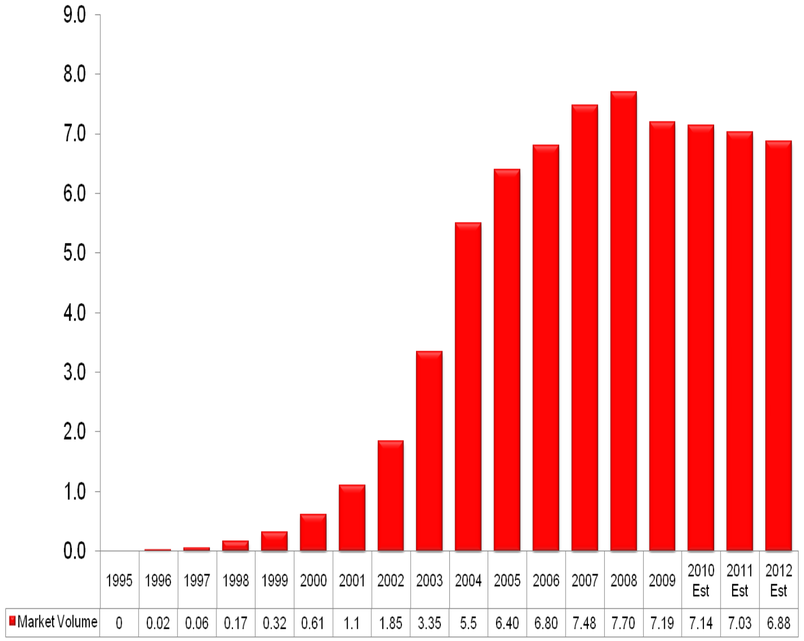
1900

1913

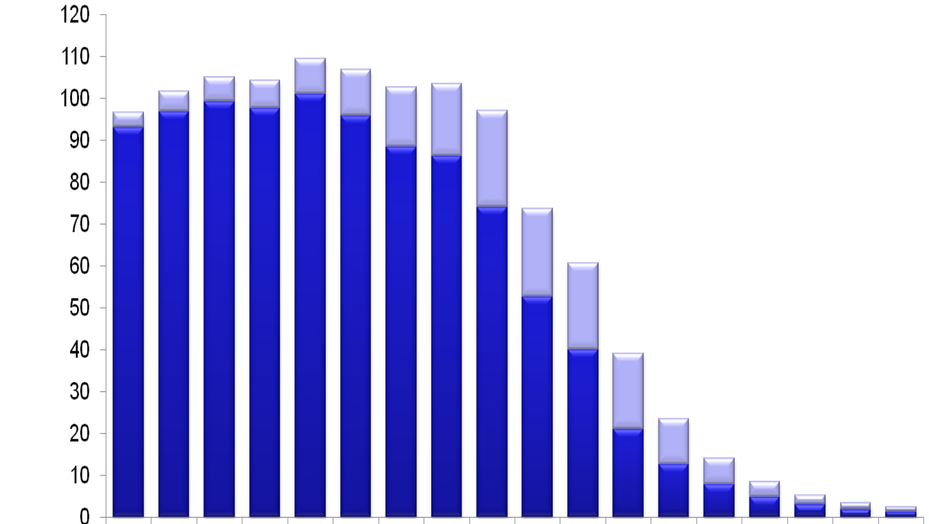
1900

1913

Digital v Film, 1995 - 2012



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 Est	2011 Est	2012 Est
Market Volume	0	0.02	0.06	0.17	0.32	0.61	1.1	1.85	3.35	5.5	6.40	6.80	7.48	7.70	7.19	7.14	7.03	6.88



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 Est	2011 Est	2012 Est
Total SUC	3.5	4.9	5.7	6.6	8.5	10.9	14.1	17.3	23.0	21.0	20.7	18.0	10.8	6.1	3.6	2.2	1.5	1.1
Total CN Film	93.1	96.8	99.3	97.6	101	95.9	88.5	86.2	74.0	52.7	40.0	21.0	12.6	7.9	4.8	3.0	1.9	1.3

HM Government

Digital Built Britain

Level 3 Building Information Modelling - Strategic Plan

August 2014

FUTURE TECHNOLOGY

Ten year journey to BIM level three begins

Next stage of BIM development to lead to better design and planning processes.

By Niall Hunt

The government has launched its building information modelling (BIM) level 3 initiative with the aim of improving data security and accessibility, scrapping paper contracts and driving infrastructure spending efficiencies.

Government BIM task force chief – and BIM working group chair – Mark Bew said "BIM3" would bring every aspect of an infrastructure project into one central plan that each construction team member had access to.

Its predecessor, BIM2, must be used on all government projects from next year. That means client, contractor and designer will be working from data-rich models – but not necessarily the same one.

The government has now begun a 10-year journey towards BIM3, which Bew believes will improve the design process and make it more efficient.

On site: BIM 3 will recognise the fact the engineers are accessing information with a variety of hand held devices

UCL

http://digital-built-britain.com/

Digital Built Britain

CIOB

BIM+

NEWS | PEOPLE | PROJECTS | TECHNOLOGY | MANAGEMENT | EDUCA

NEWS

BIM benefits quantified for the first time

▷PwC report says government could save £400m a year using Level 2

Construction Enquirer

News

Drones to save construction billions

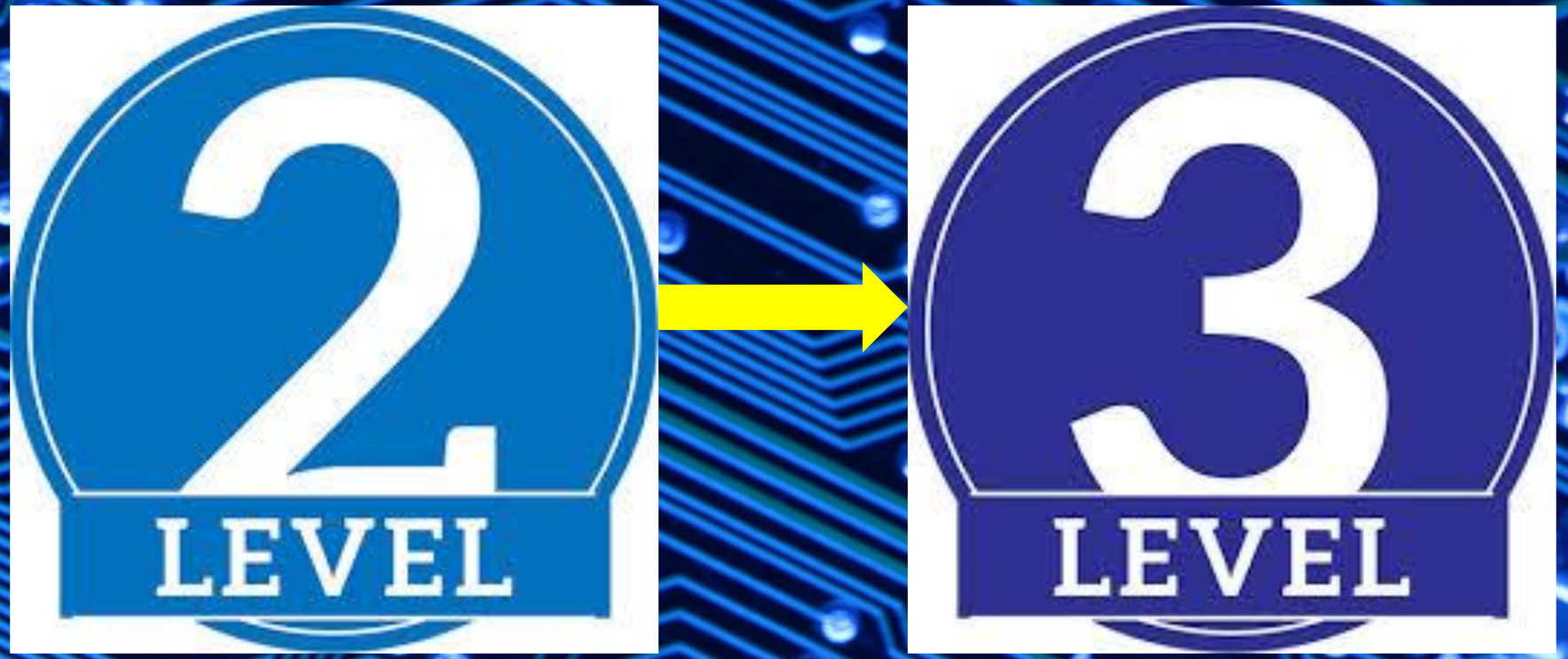
Grant Prior 22 mins ago

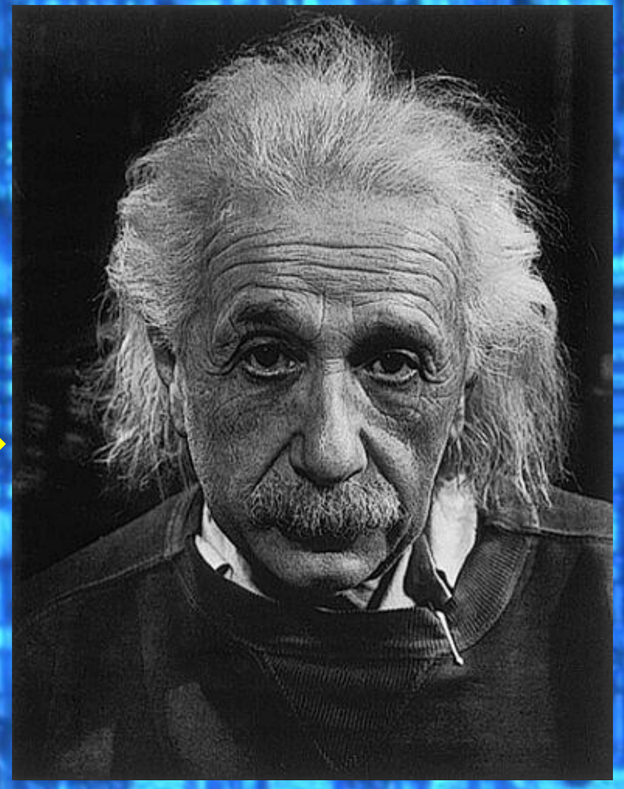
Share

An “explosion” in the use of drones could save construction companies billions by 2030.

A report by accountants PwC has analysed the benefits of increasing drone use across all industries.

And it is forecasting costs savings of £3.5bn across the construction and manufacturing sectors by 2030 resulting in increased productivity of 3.1% as nearly 5,000 drones are in regular use.


2
LEVEL
3
LEVEL



Parametrics

Parametrics
+ data

Looking for Data

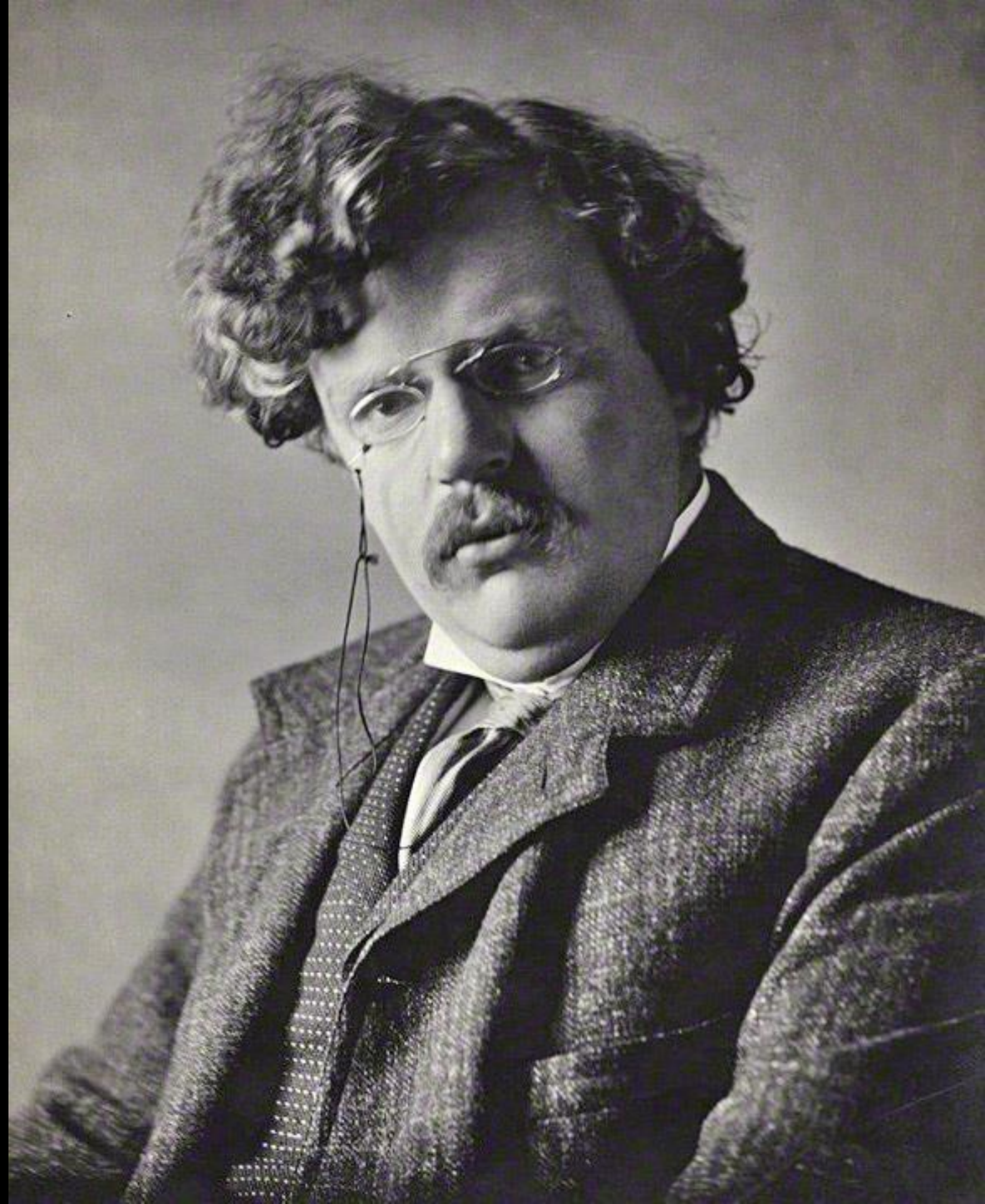
1st
?

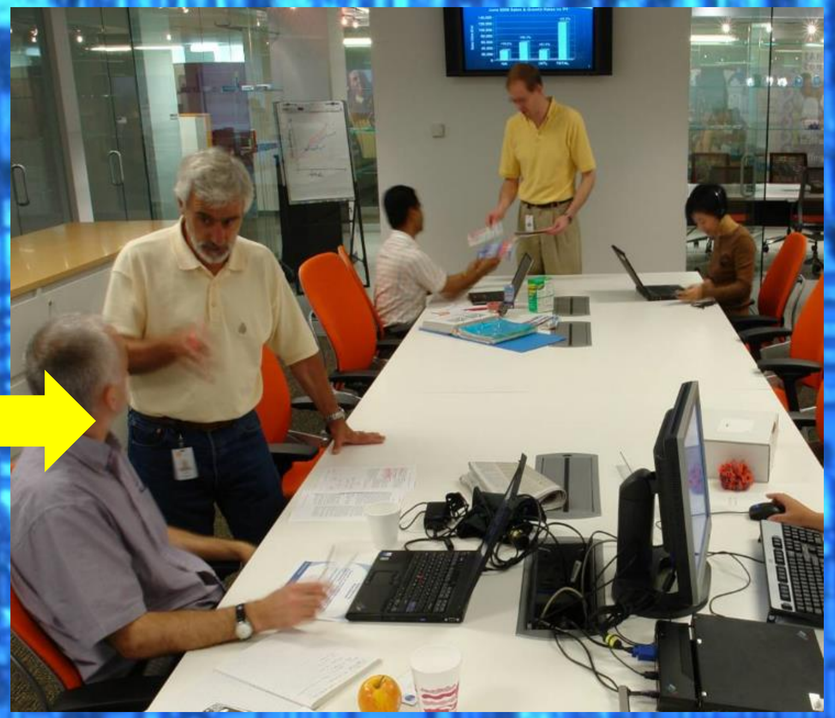
Missing in action

- On one sample day, 6.42m people swiped in to London Underground…
- .. but only 5.76m swiped out.

If a thing is worth doing, it is worth doing badly.

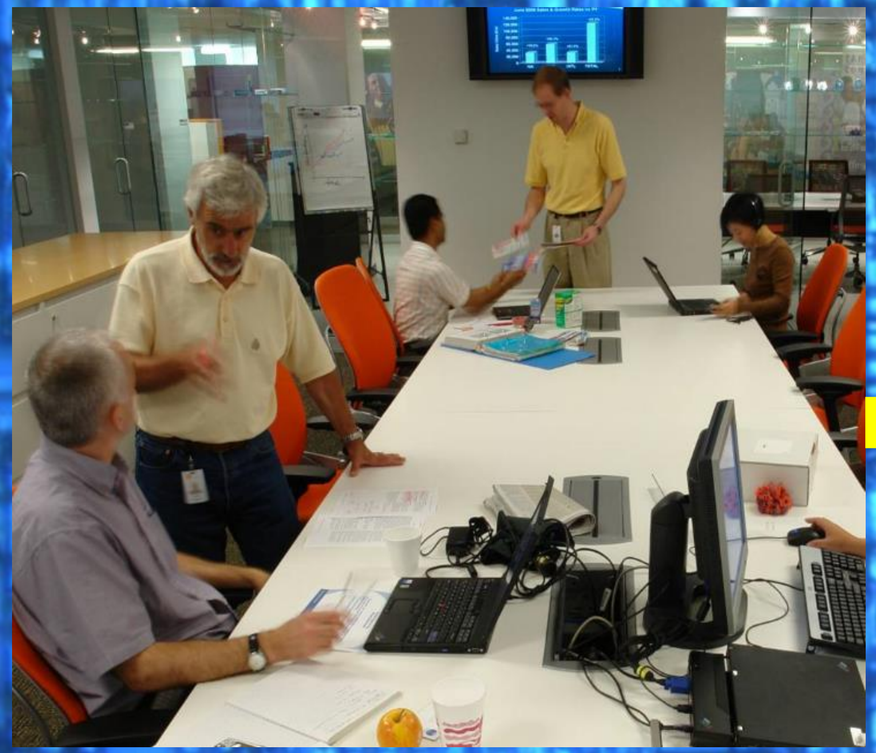
GK Chesterton





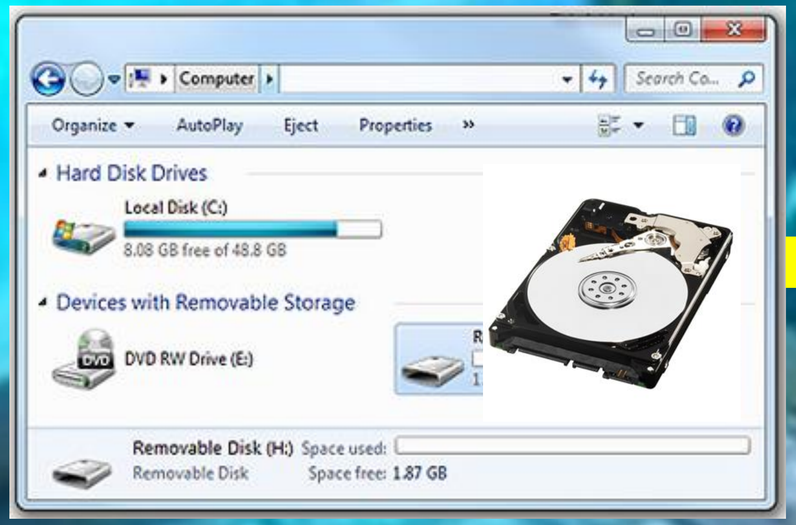
“Lonely BIM”

Integrated team working

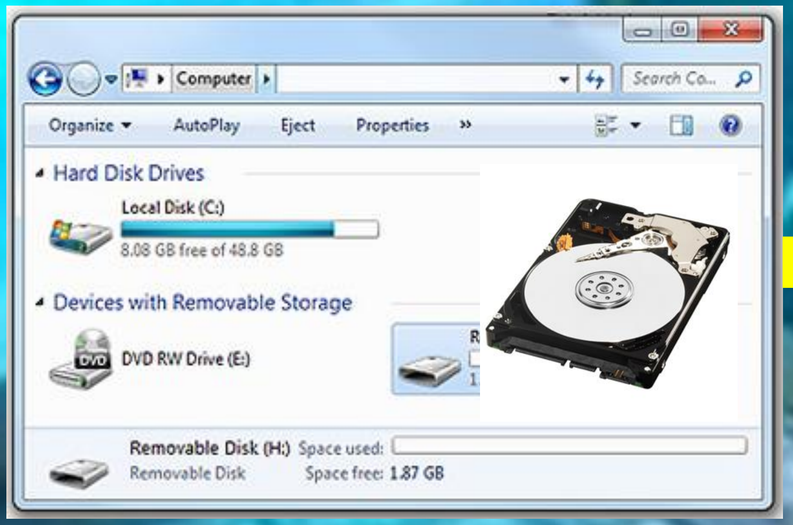


Office

Site


Computer
Search Co...
Organize
AutoPlay
Eject
Properties
Hard Disk Drives
Local Disk (C:)
8.08 GB free of 48.8 GB
Devices with Removable Storage
DVD RW Drive (E:)
Removable Disk (H:)
Removable Disk
Space used:
Space free: 1.87 GB

http://www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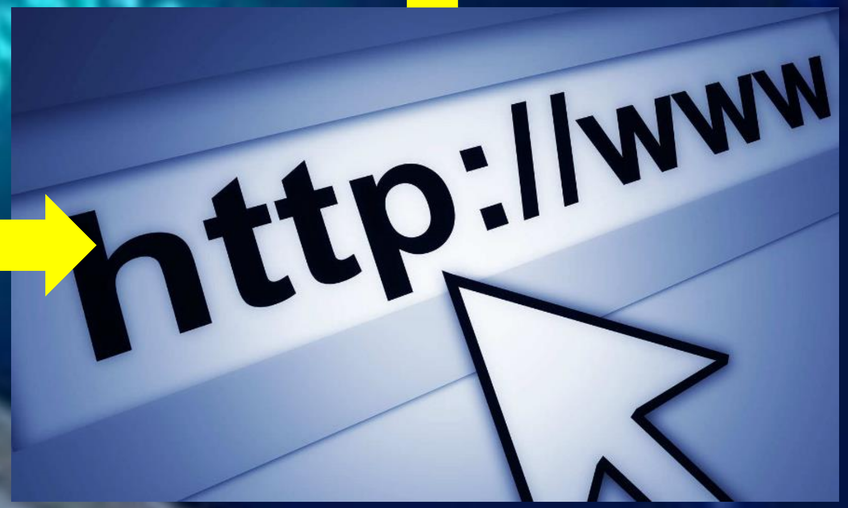
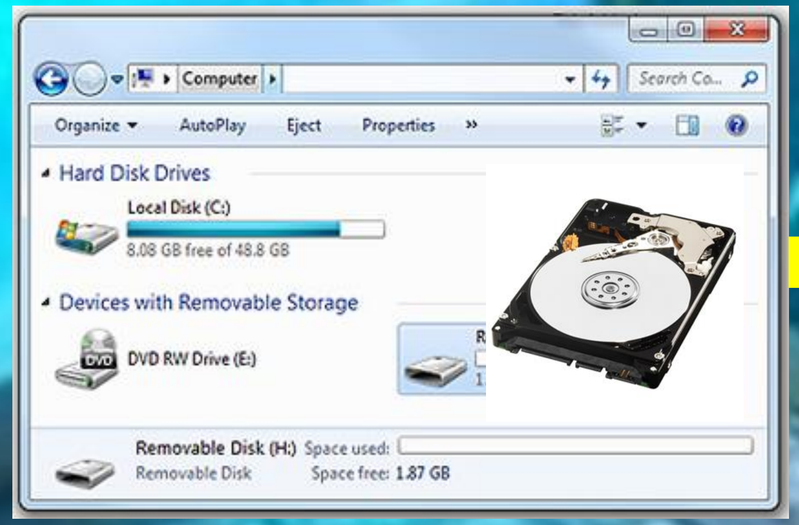

http://www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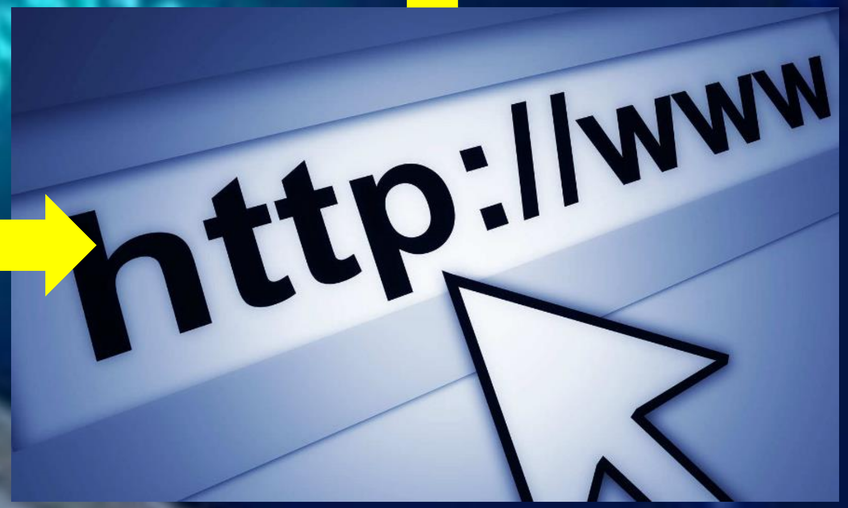
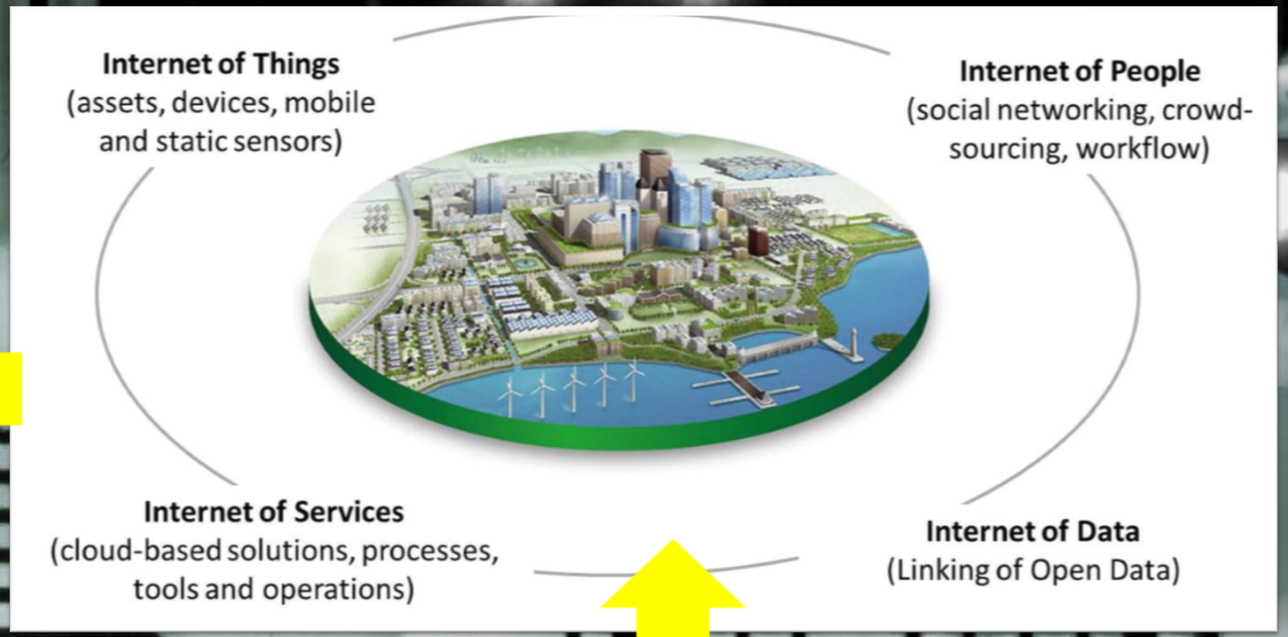
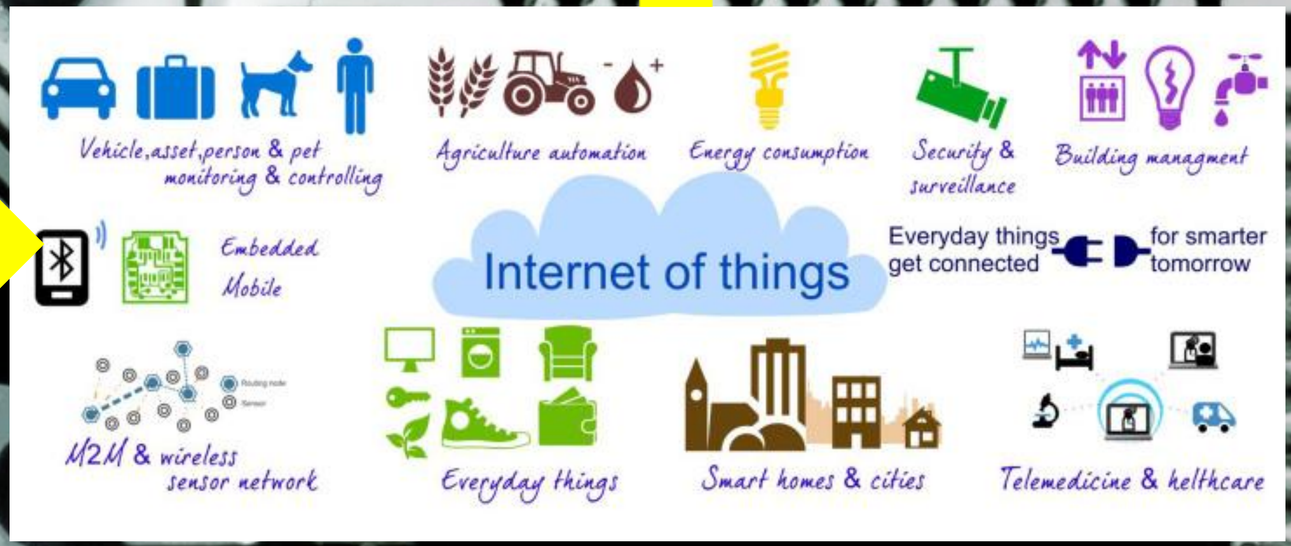

http://www

Building under construction

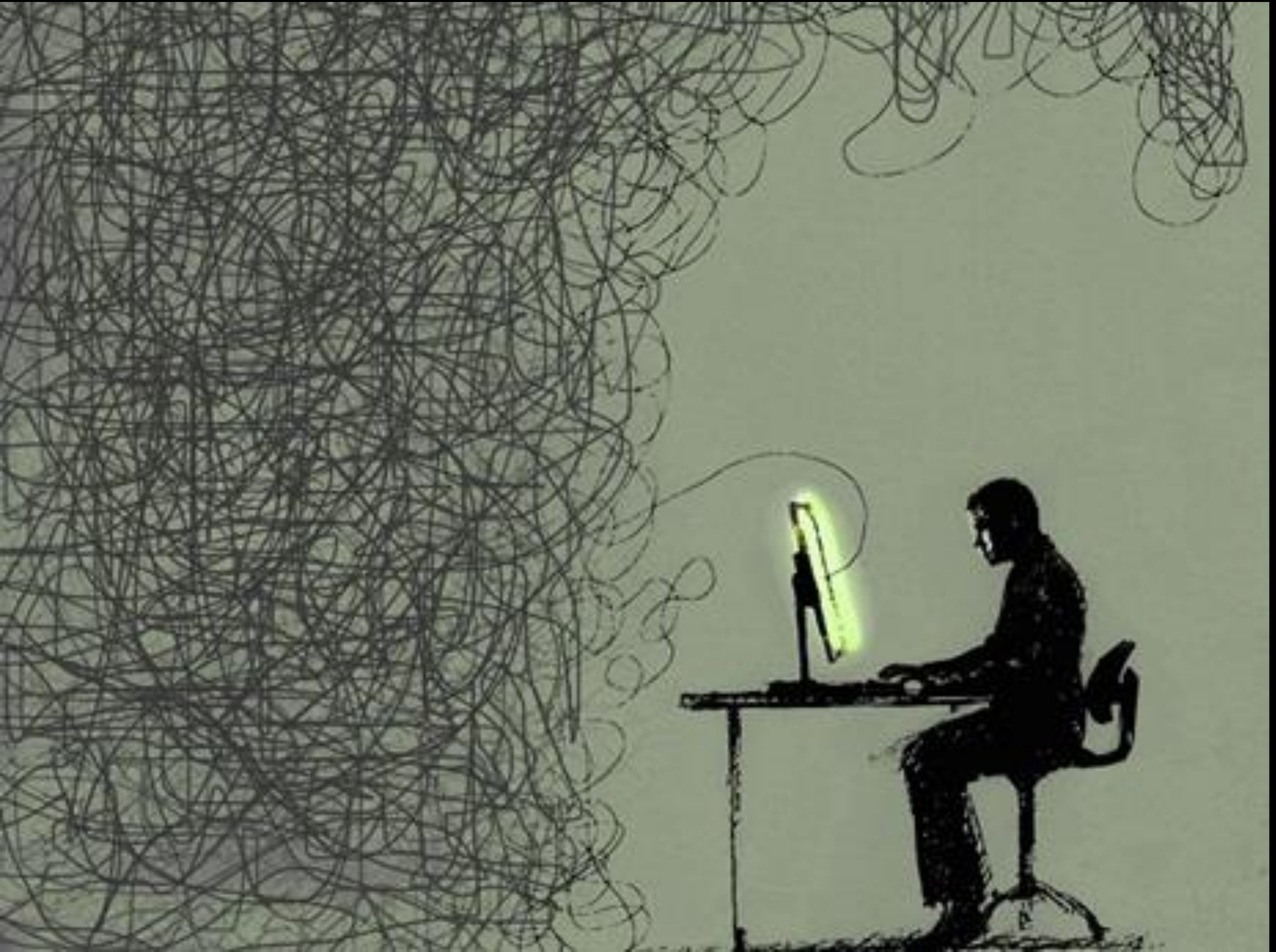
Asset in use

Digital Built Britain


Internet of Things
(assets, devices, mobile and static sensors)
Internet of People
(social networking, crowd-sourcing, workflow)
Internet of Services
(cloud-based solutions, processes, tools and operations)
Internet of Data
(Linking of Open Data)


Vehicle,asset,person & pet monitoring & controlling
Agriculture automation
Energy consumption
Security & surveillance
Building managment
Embedded
Mobile
Internet of things
Everyday things get connected for smarter tomorrow
M2M & wireless sensor network
Everyday things
Smart homes & cities
Telemedicine & helthcare

Digital Built Britain

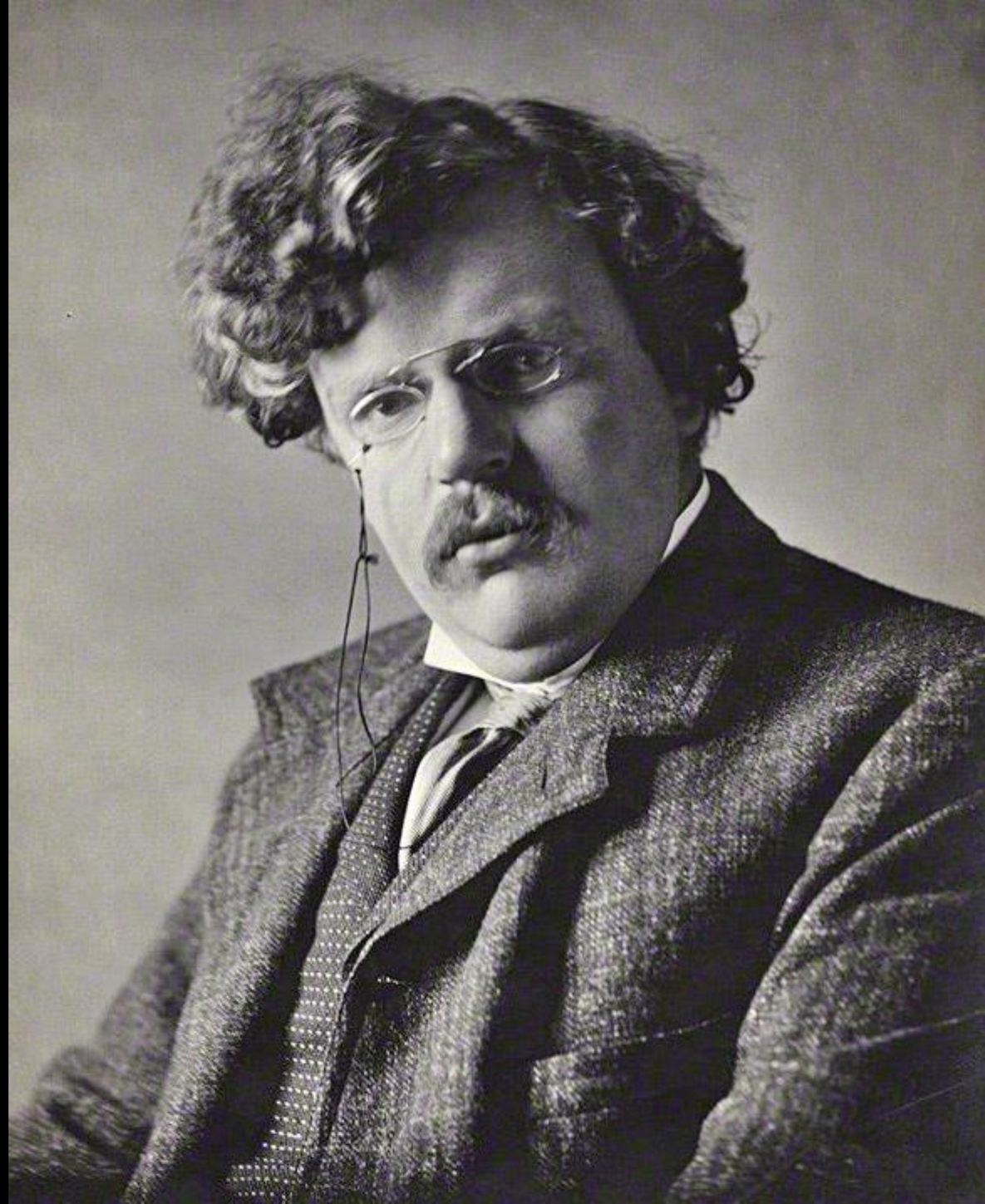


Source: London Loves Business

Get started

If a thing is worth doing, it is worth doing badly.

GK Chesterton



Caminante, no hay camino. Se hace camino al andar.

Traveller, there is no road. We make the road by walking it.

Antonio Machado y Ruiz

Small(ish) steps

The big decisions

A push/pull strategy

“Push”

Packaging BIM Products

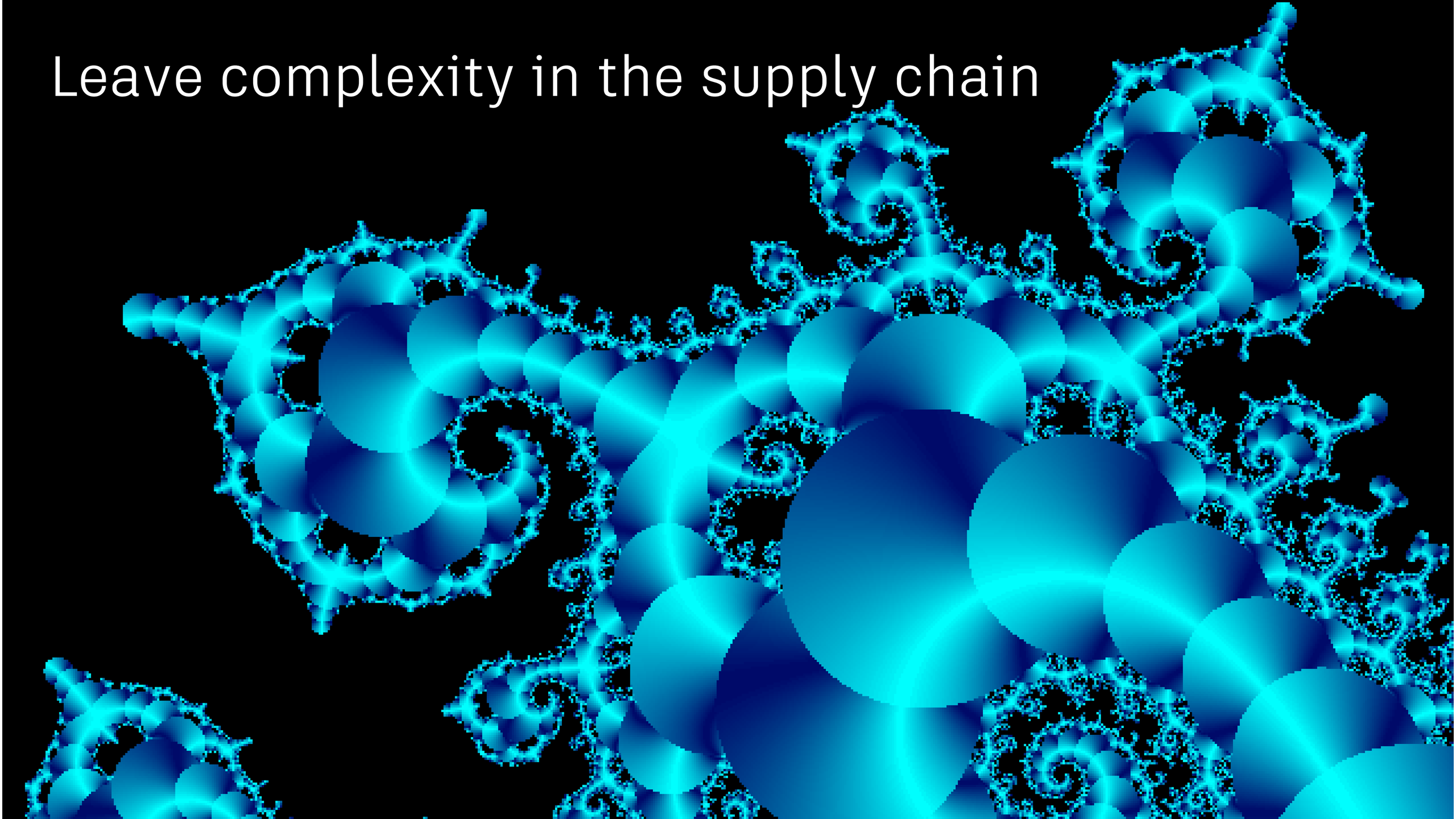
Training
Technology
Standards
Contracts
Understanding

“Pull”

Data Collection & Use

Gateway Reviews
Planning
Handover
O & M
Whole life
Carbon

Leave complexity in the supply chain



BIM

I'll see your 4D, and raise you to 6D

BIM

Only ask for what you will use

No picking winners

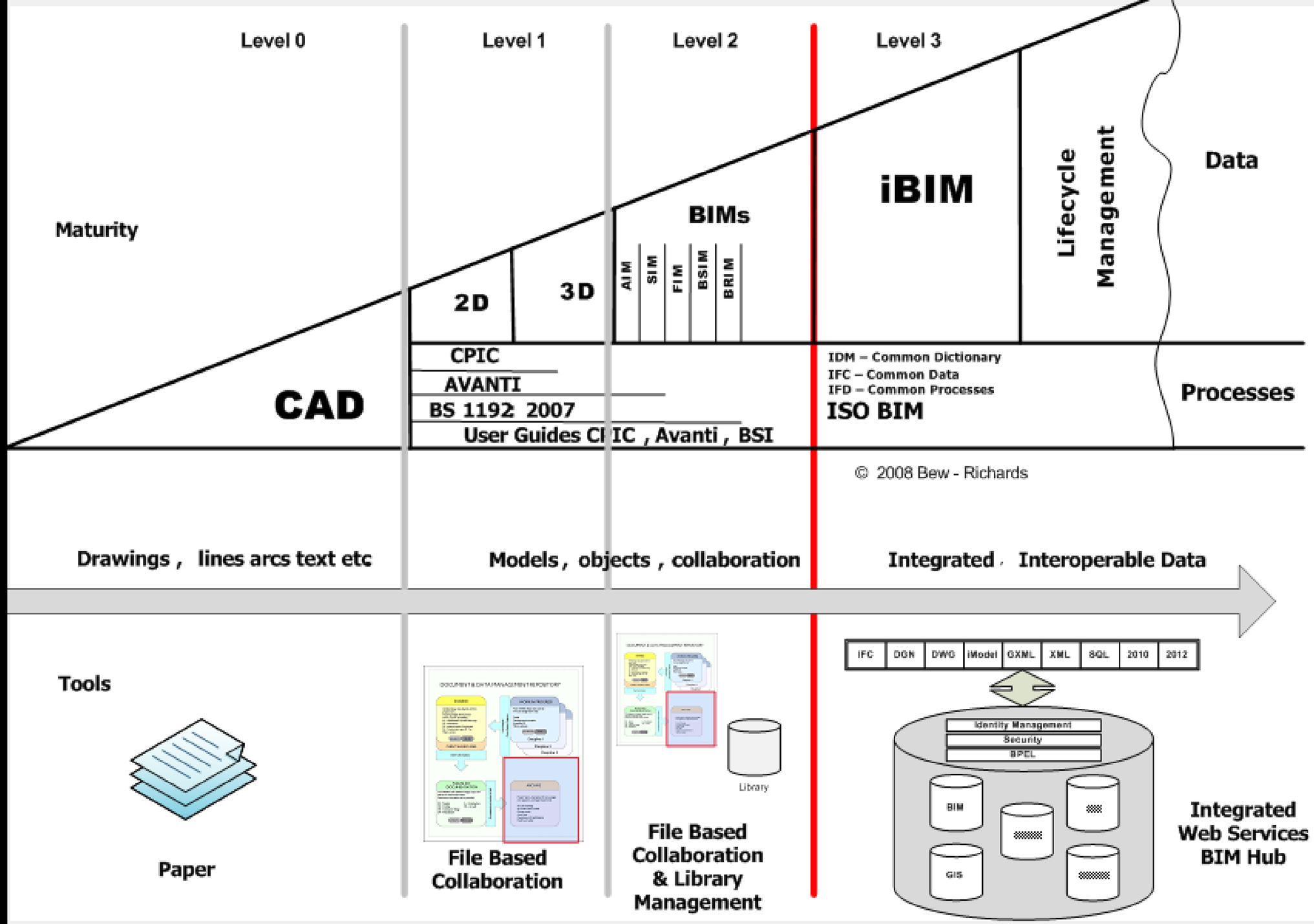
A shared platform

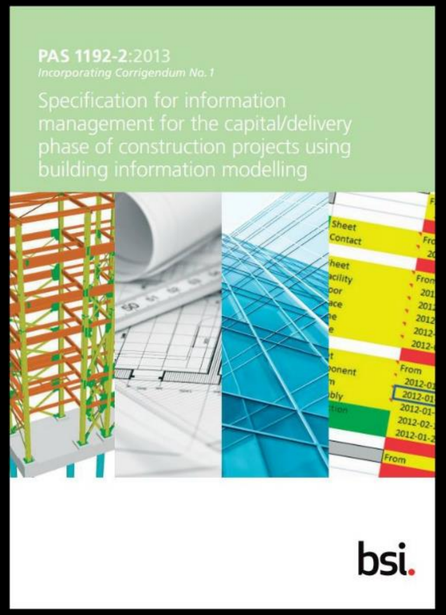
There's an App For That

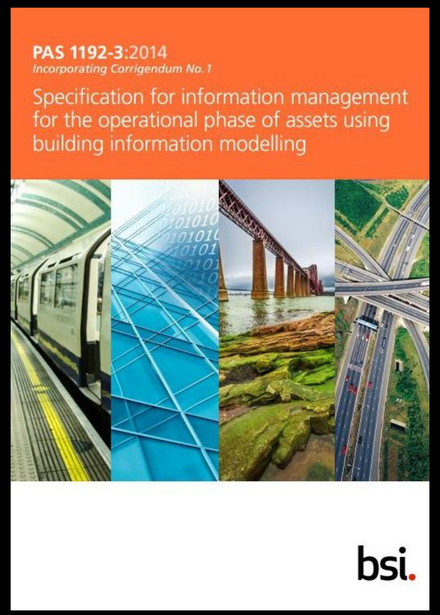
KLYP

Standards and methodologies

A question of balance


Level 0
Level 1
Level 2
Level 3
Maturity
2D
3D
BIMs
AIM
SIM
FIM
BSIM
BRIM
iBIM
Lifecycle Management
Data
CPIC
AVANTI
BS 1192 2007
User Guides CPIC , Avanti , BSI
IDM – Common Dictionary
IFC – Common Data
IFD – Common Processes
ISO BIM
Processes
CAD
© 2008 Bew - Richards
Drawings , lines arcs text etc
Models , objects , collaboration
Integrated . Interoperable Data
Tools
Paper
File Based Collaboration
Library
File Based Collaboration & Library Management
IFC
DGN
DWG
iModel
GXML
XML
SQL
2010
2012
Identity Management
Security
BPEL
BIM
GIS
Integrated Web Services BIM Hub


PAS 1192-2:2013
Incorporating Corrigendum No. 1
Specification for information management for the capital/delivery phase of construction projects using building information modelling
bsi.


PAS 1192-3:2014
Incorporating Corrigendum No. 1
Specification for information management for the operational phase of assets using building information modelling
bsi.

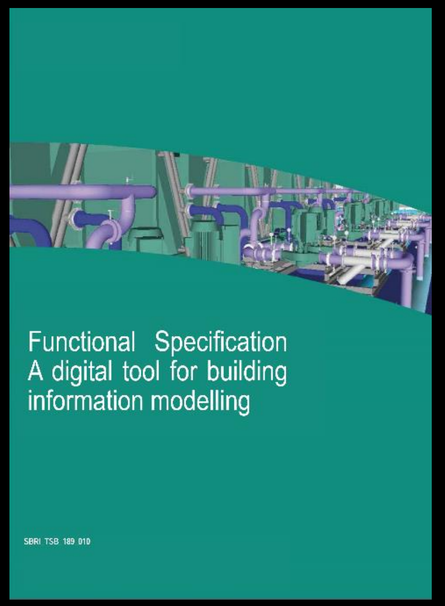
BS 1192-4:2014
BSI Standards Publication
Collaborative production of information
Part 4: Fulfilling employer's information exchange requirements using COBie – Code of practice
bsi.
...making excellence a habit.

PAS 1192-5:2015
Specification for security-minded building information modelling, digital built environments and smart asset management
CPNI
Centre for the Protection of National Infrastructure
bsi.

BUILDING INFORMATION MODEL (BIM) PROTOCOL
CIC/BIM Pro
Standard Protocol for use in projects using Building Information Models

Cabinet Office
Government Soft Landings
Executive Summary
Government Soft Landings
BIM

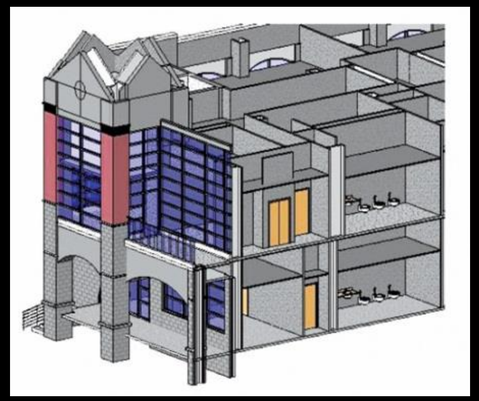
RIBA Plan of Work 2013
RIBA
BIM Overlay
to the RIBA Outline Plan of Work


Functional Specification
A digital tool for building information modelling
SBRI TSB 189 010

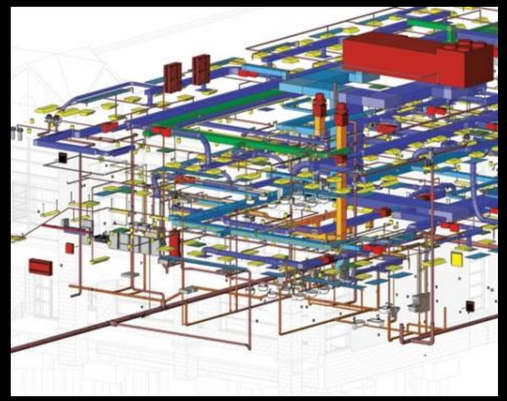
Data drops

Visualization

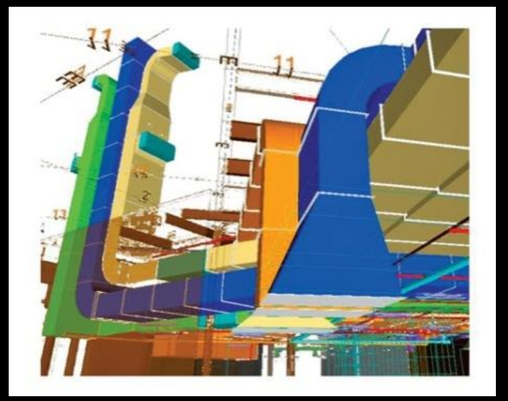
Integration



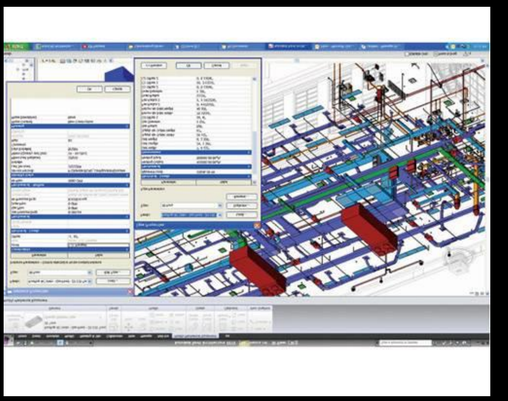
Co-ordination



Construction



Maintenance



Permafile

BIM Steering Group

BIM networks

BIM4Retail

BIM4Commercial

BIM4Rail

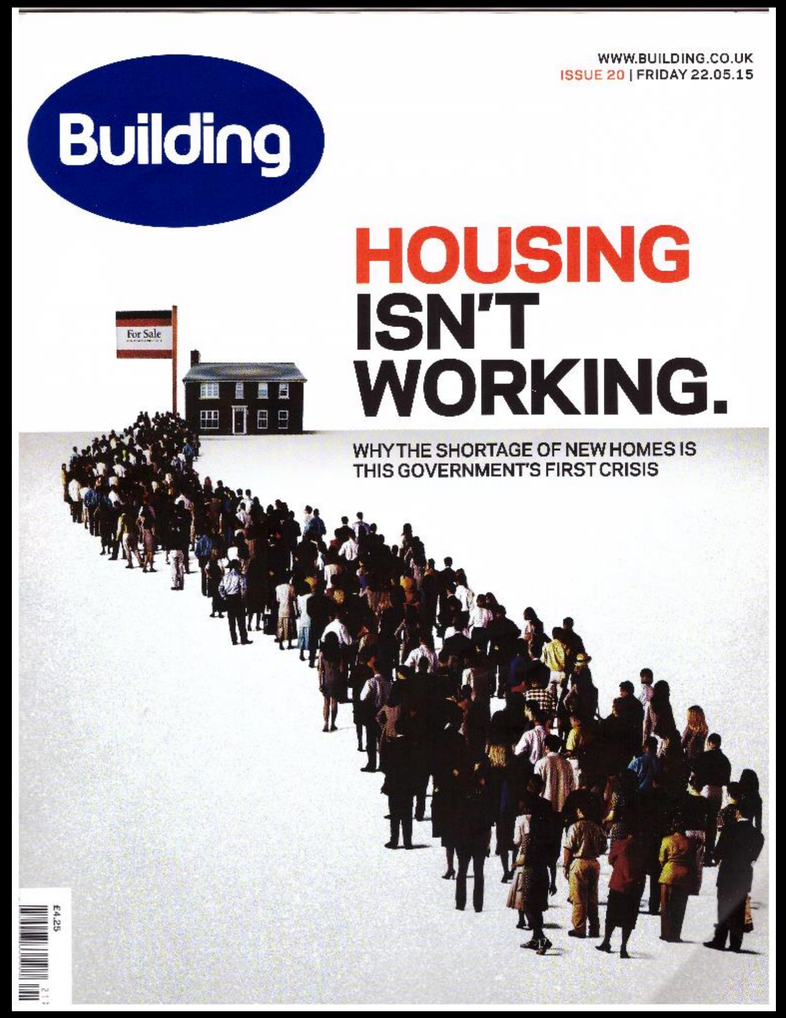
BIM4Lightbulbs

Proposition
Circumstance

Proposition
Circumstance

Opportunity
Proposition
Circumstance

We have a problem

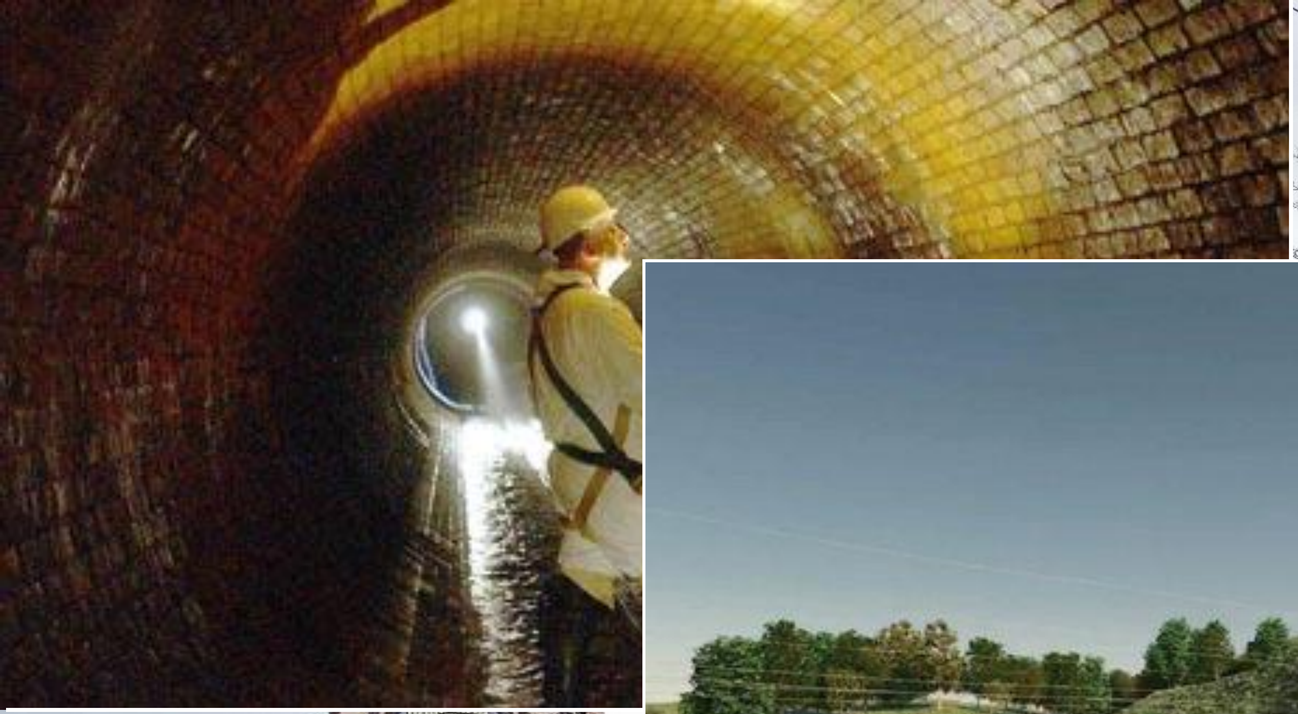

WWW.BUILDING.CO.UK
ISSUE 20 | FRIDAY 22.05.15
Building
HOUSING ISN'T WORKING.
WHY THE SHORTAGE OF NEW HOMES IS THIS GOVERNMENT'S FIRST CRISIS
For Sale
£4.25

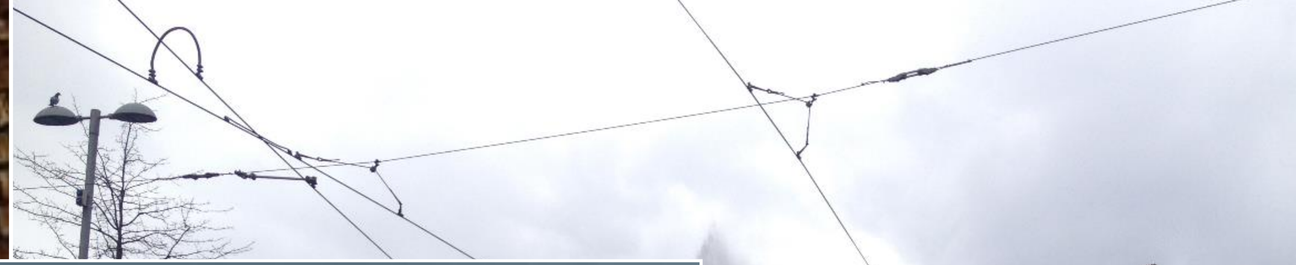
LIMITED

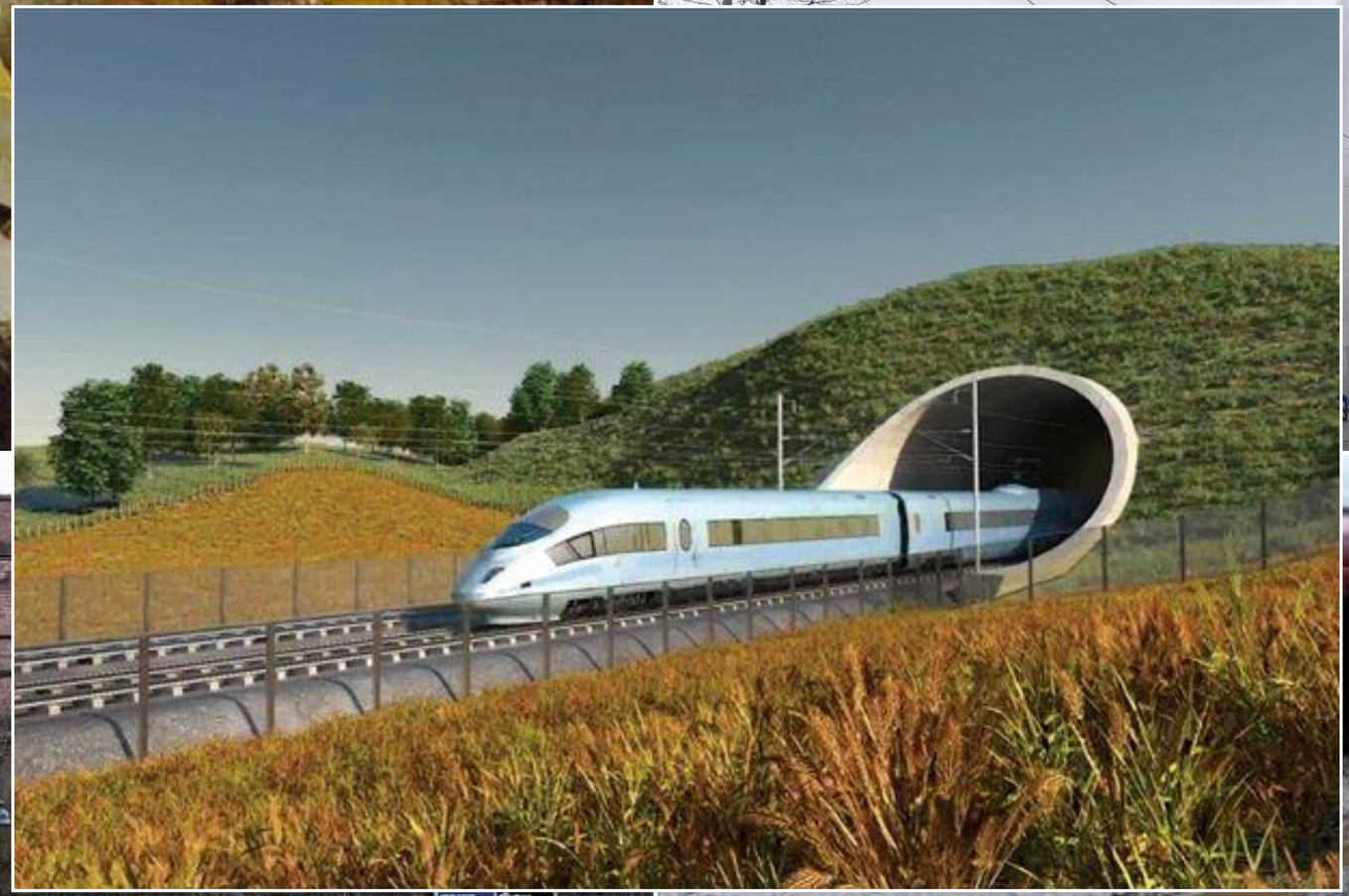
Cartwright Pickard Architects

SUBWAY
SUBWAY

Glenwood







SUBWAY
SUBWAY

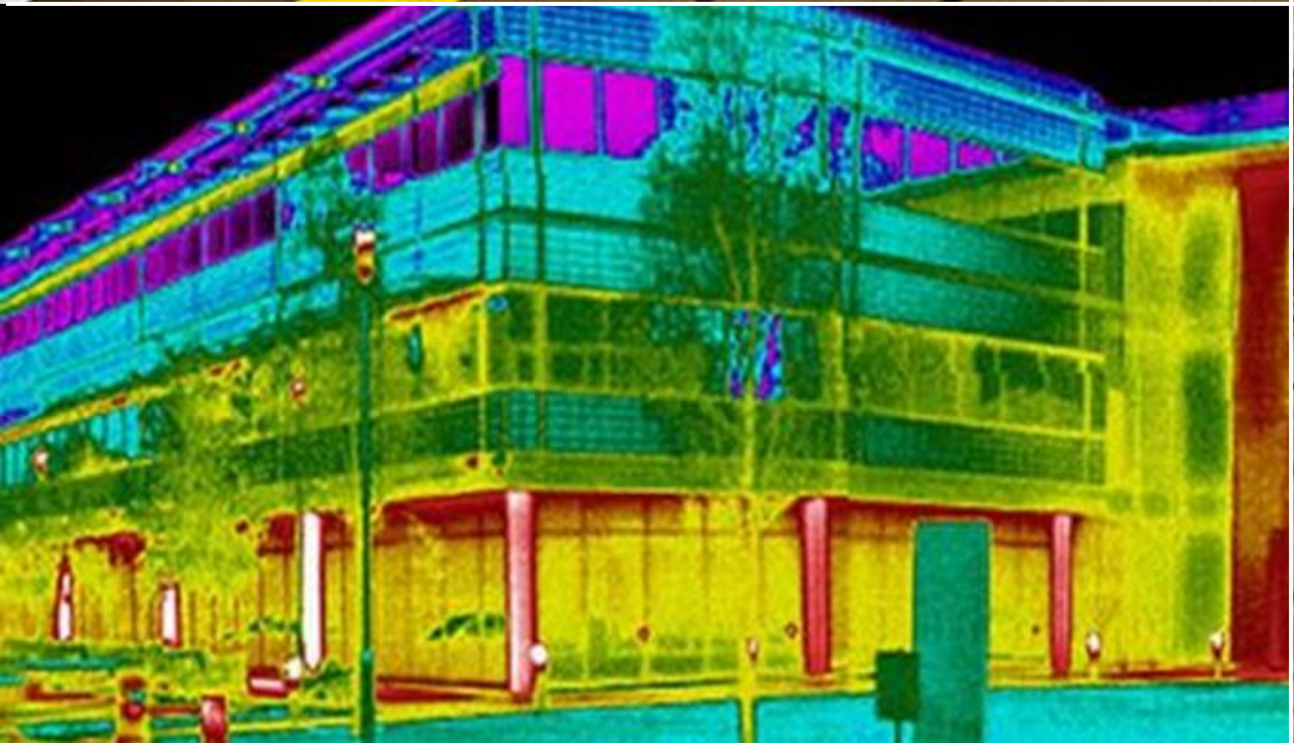
Glenwood

Rex

Schweppes

Chowpatty Beach, Mumbai

x 2-5-14
MIND THE GAP

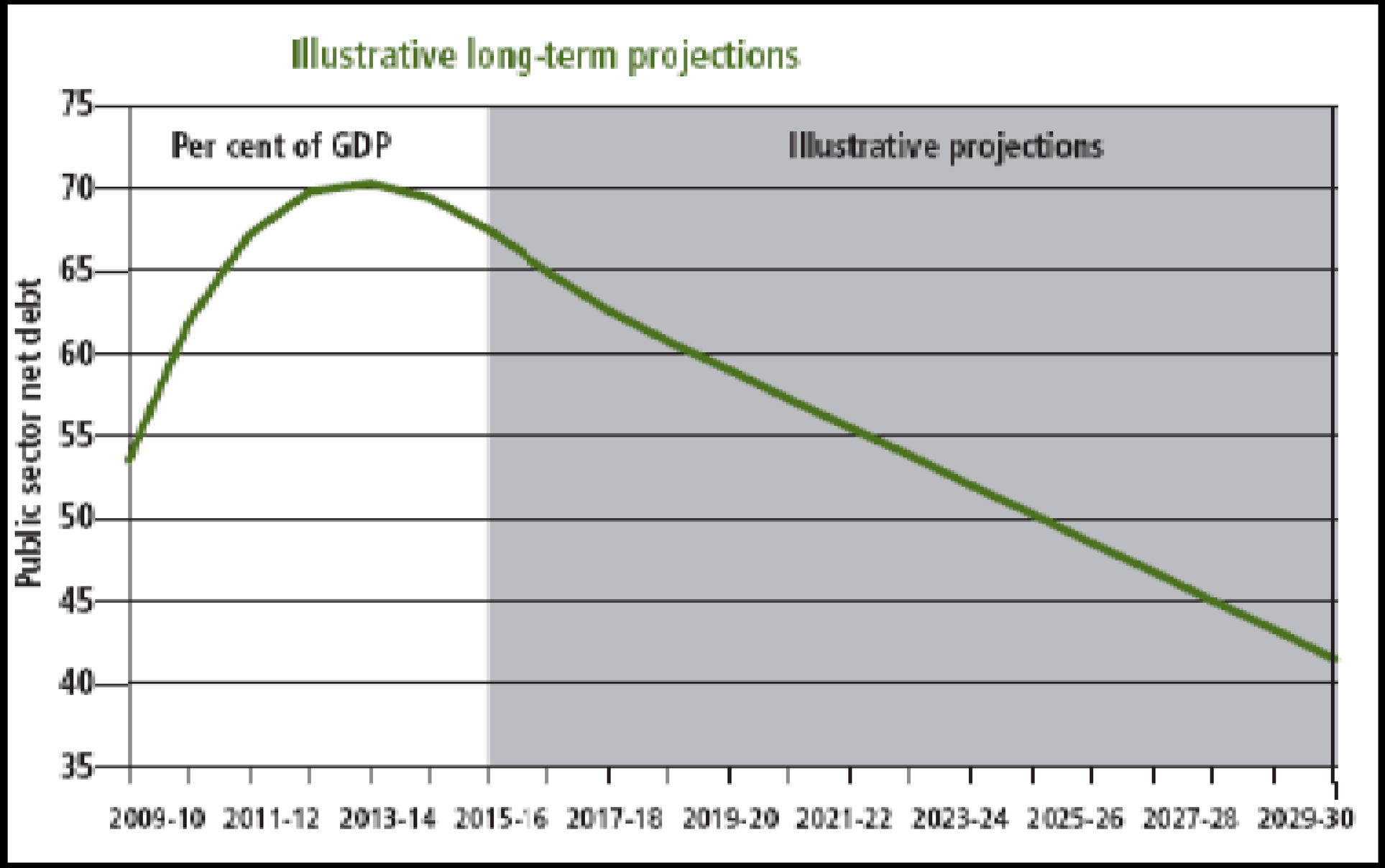


x 2-5-14
MIND THE GAP

Dear Chief Secretary

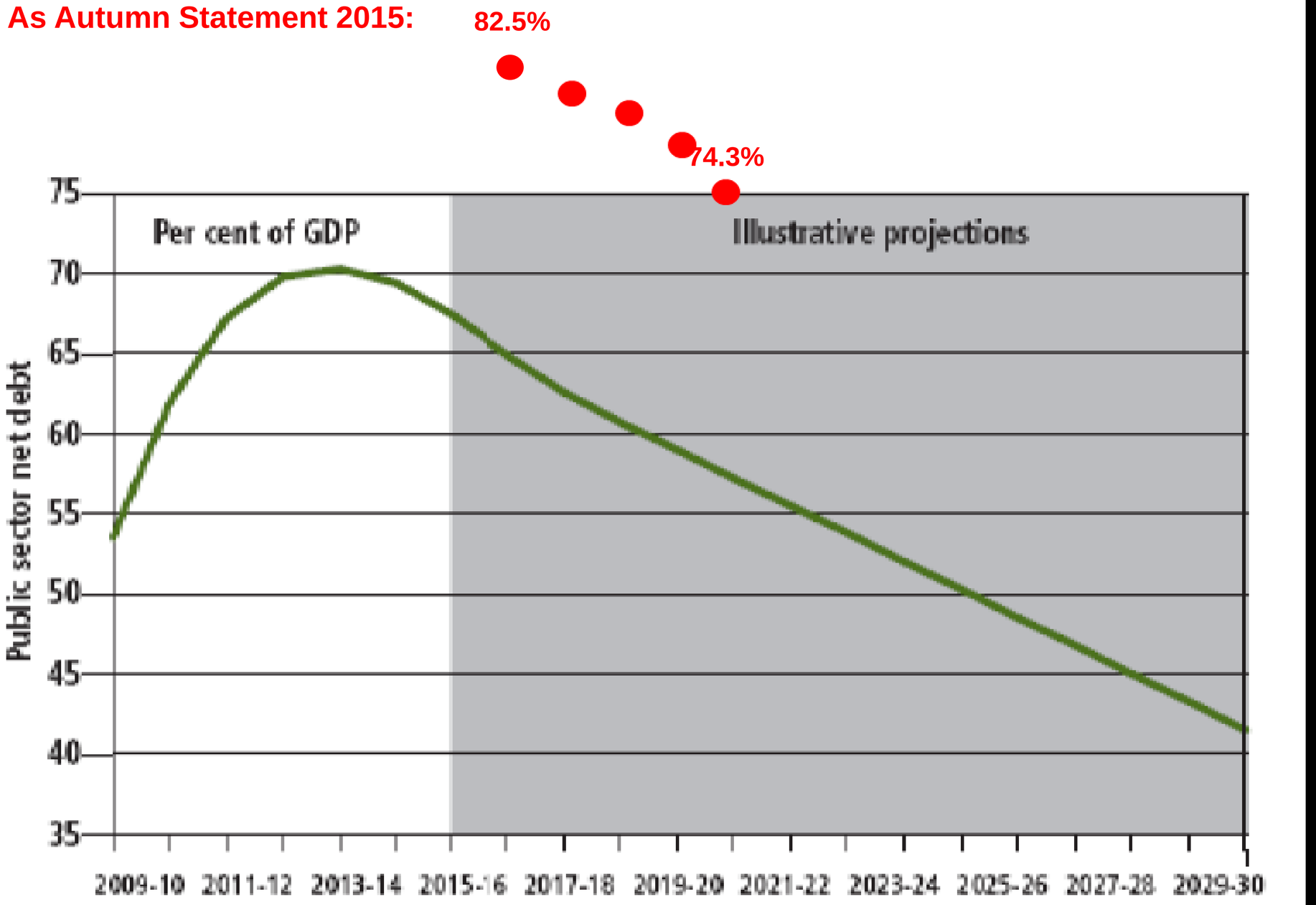
I’m sorry to tell you there’s no money left.

Liam Byrne
Outgoing Chief Secretary to the Treasury, 2010



Source: Office for Budget Responsibility and HM Treasury,
per David Smith, Economics Editor, *The Sunday Times*, 2010

As Autumn Statement 2015:

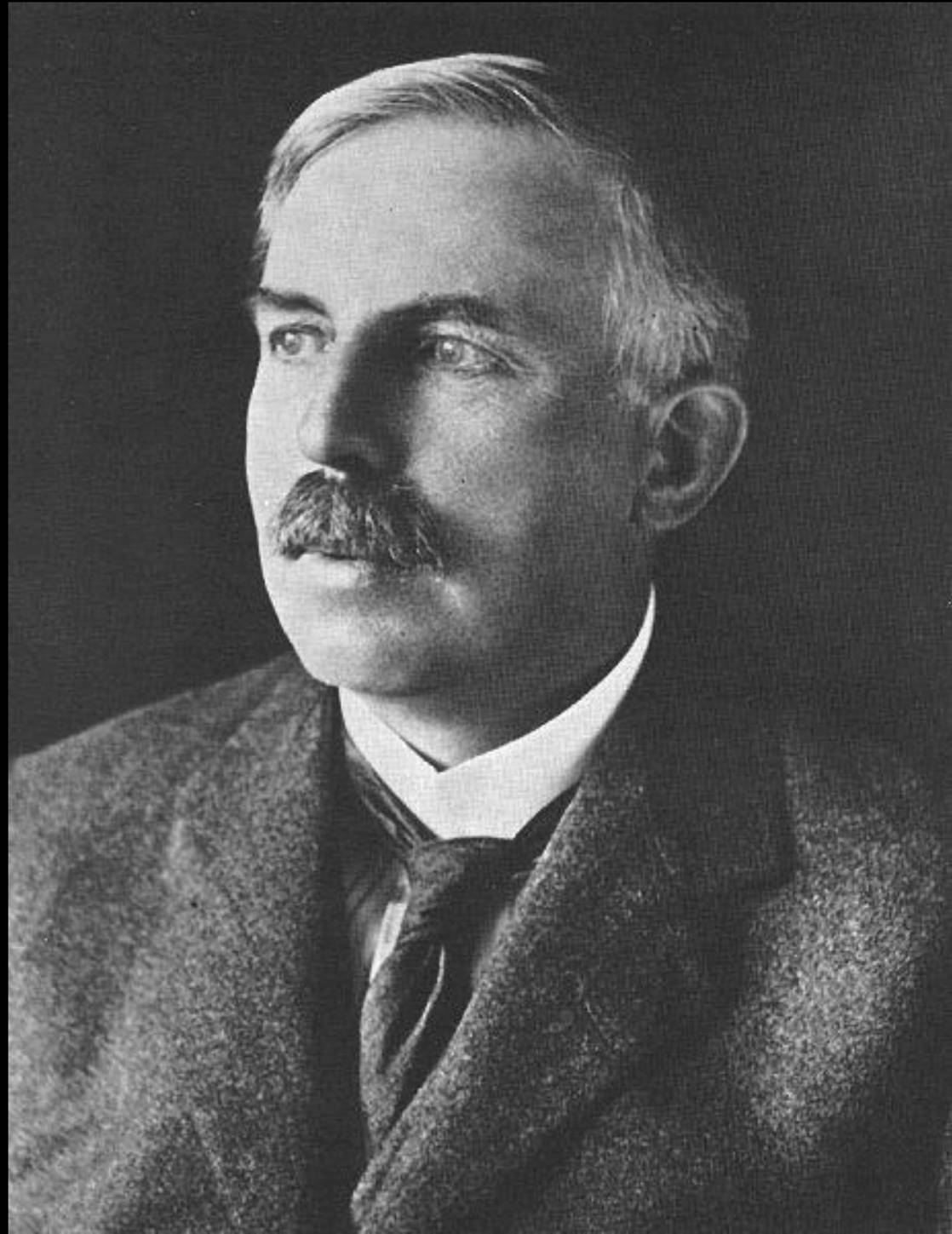


As Budget 2017: 86%

SHIT CREEK
PADDLE STORES

We haven't got the money, so we've got to think.

Ernest Rutherford (Baron Rutherford of Nelson)



We haven't got
the money,
so we've got to
think.

Ernest Rutherford

(Baron Rutherford of Nelson)

Are we nearly there yet?

Are we nearly there yet?

Who?

“Government must act …”

June 2016

August 2016

January 2017

June 2017

June 2016

July 2016

June 2017

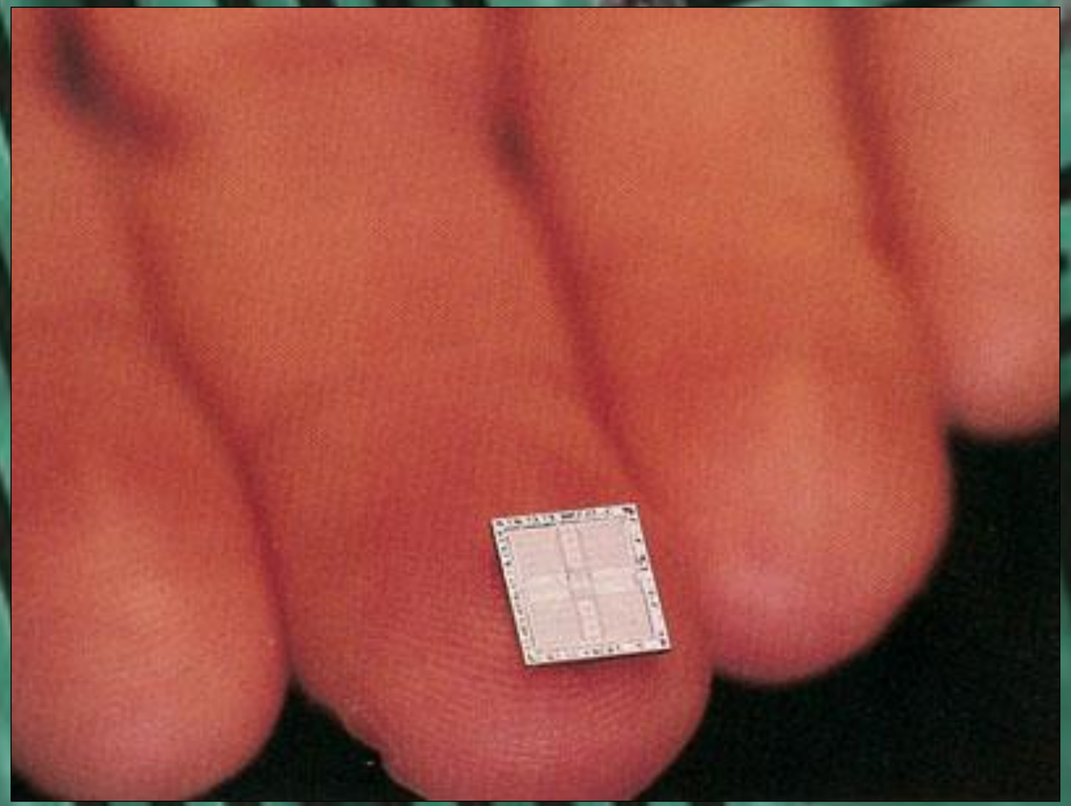
June 2016

July 2016

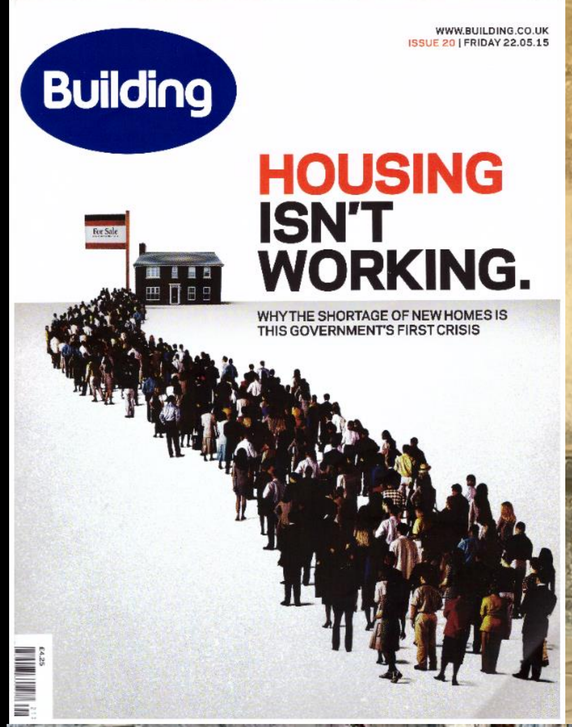
June 2017

TAKE OWNERSHIP.

DISRUPT
OR BE DISRUPTED !



FORWARD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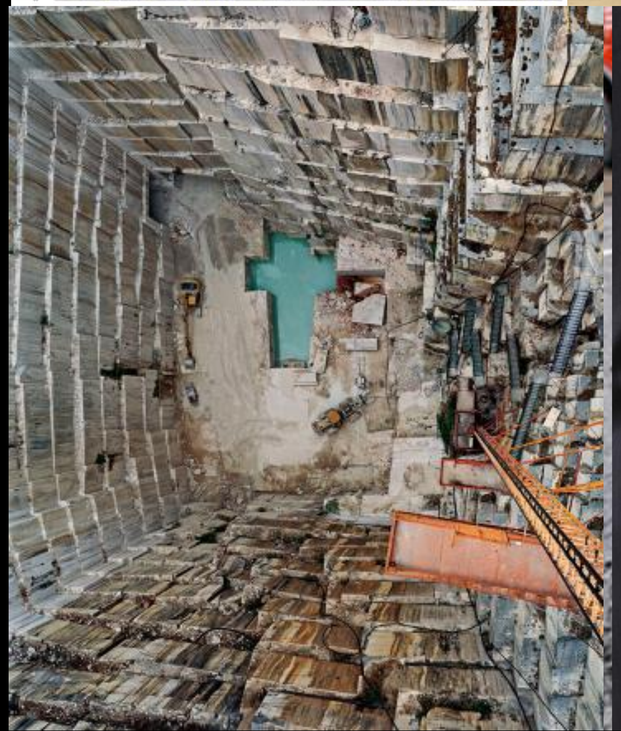
ISN'T
WORKING.
WHY THE SHORTAGE OF NEW HOMES IS
THIS GOVERNMENT'S FIRST CRISIS
For Sale

MJ14 OPH
JCB

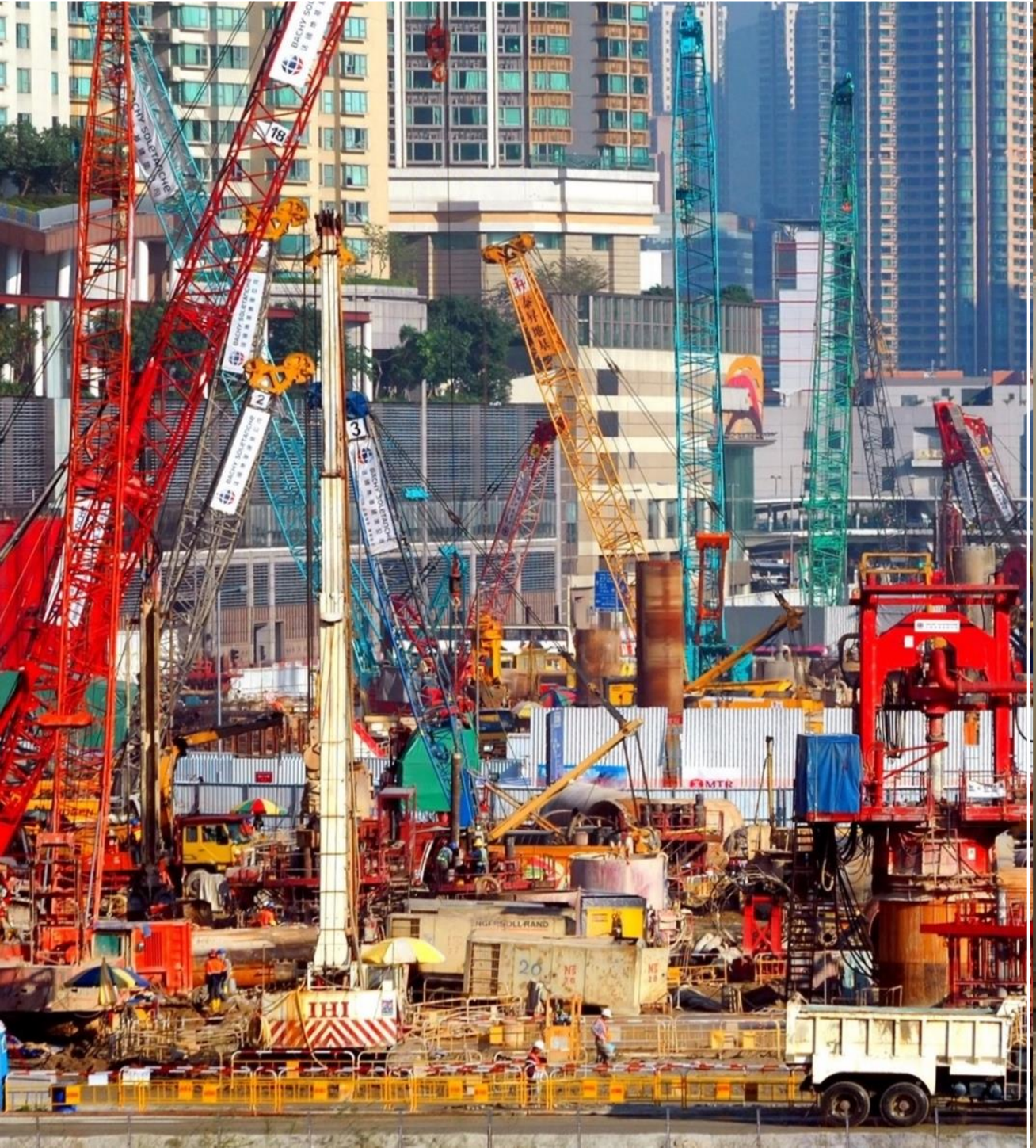


Building
WWW.BUILDING.CO.UK
ISSUE 20 | FRIDAY 22.05.15
HOUSING
ISN'T
W
£
CO2

An industry to be proud of.

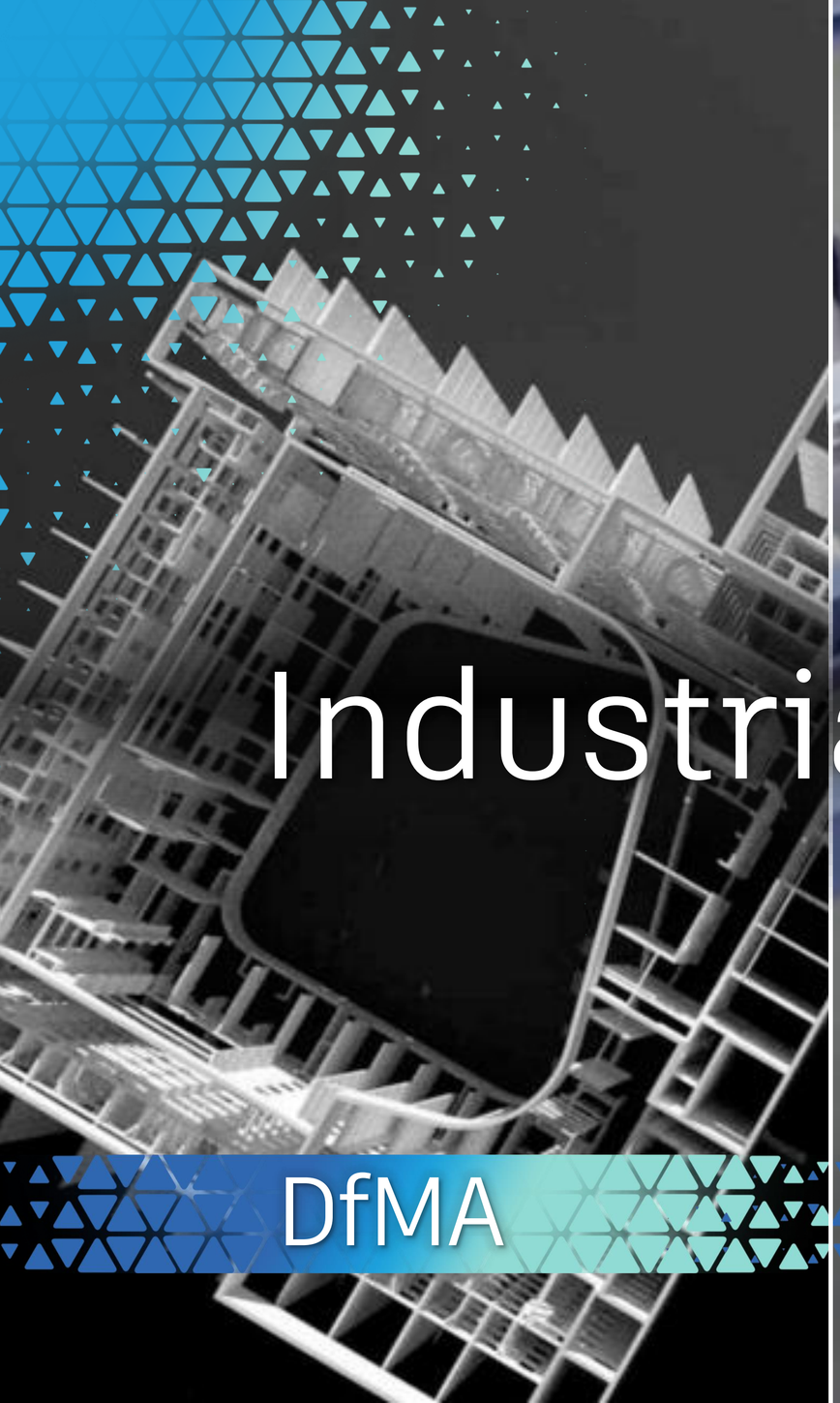
AUTODESK.
UNIVERSITY

CONNECT & CONSTRUCT SUMMIT


IHI
MTR

GRAINGER

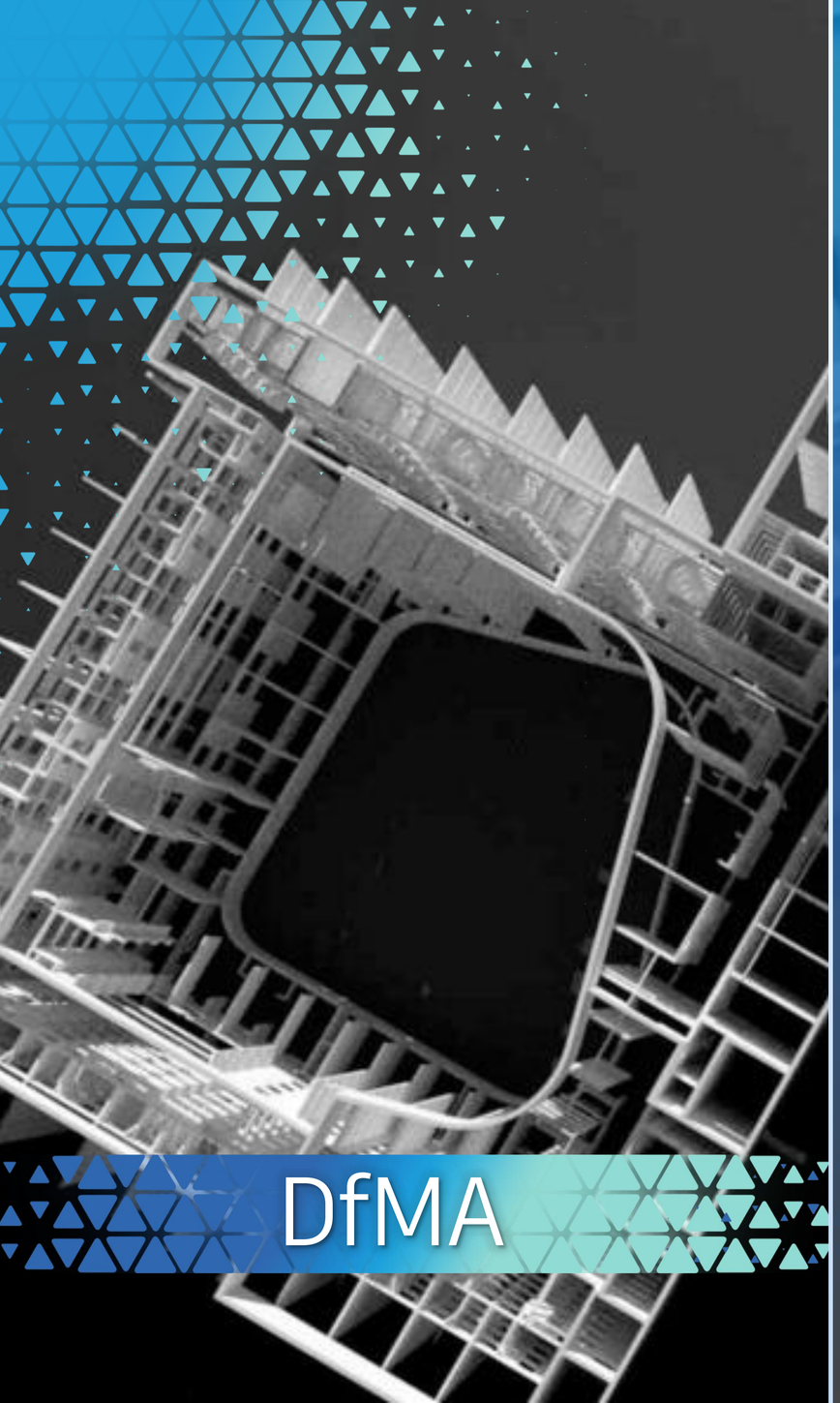
Industrialized Construction



DfMA

FACTORY

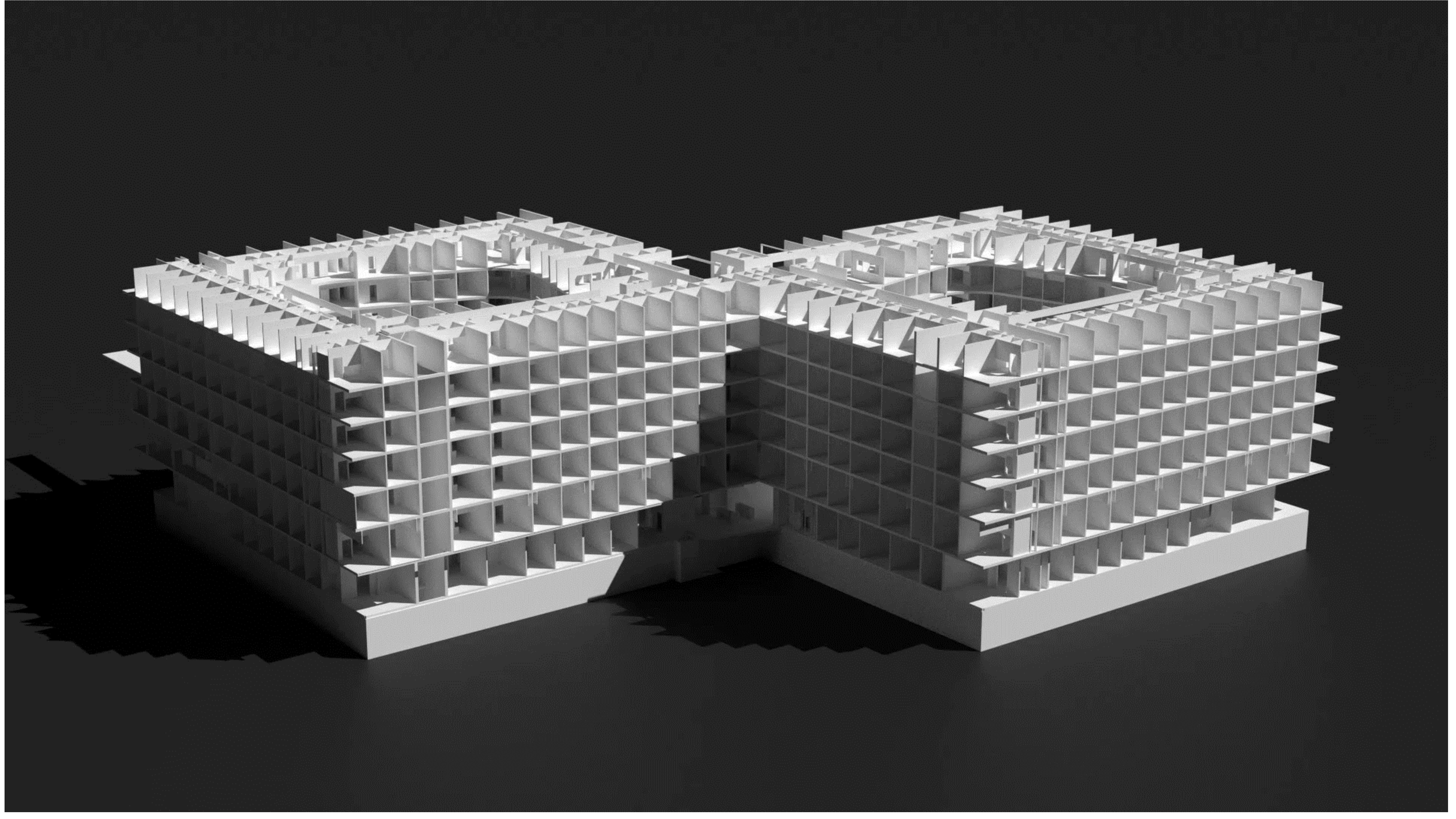
SITE



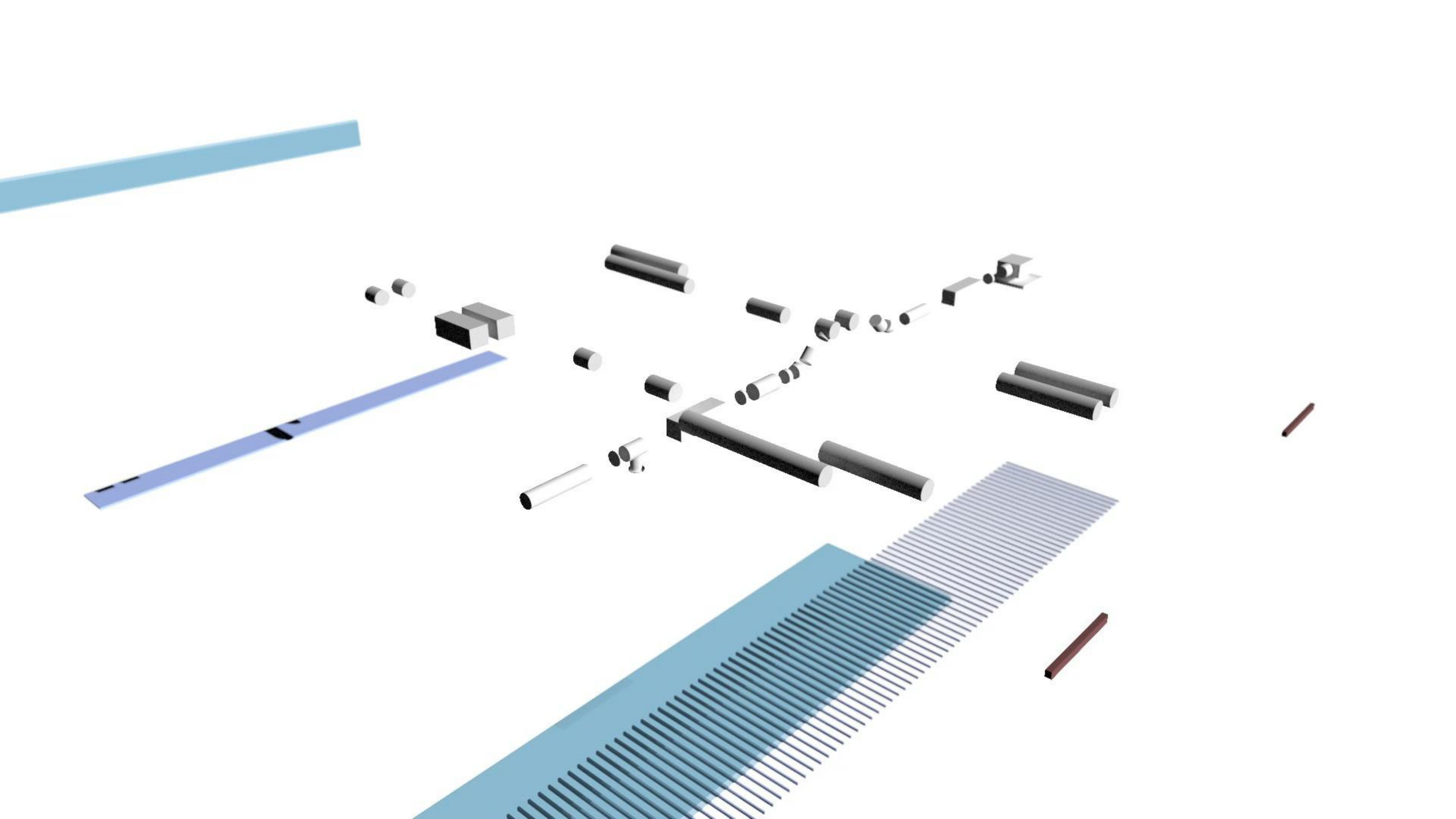
DfMA

FACTORY

SITE



AUTODESK

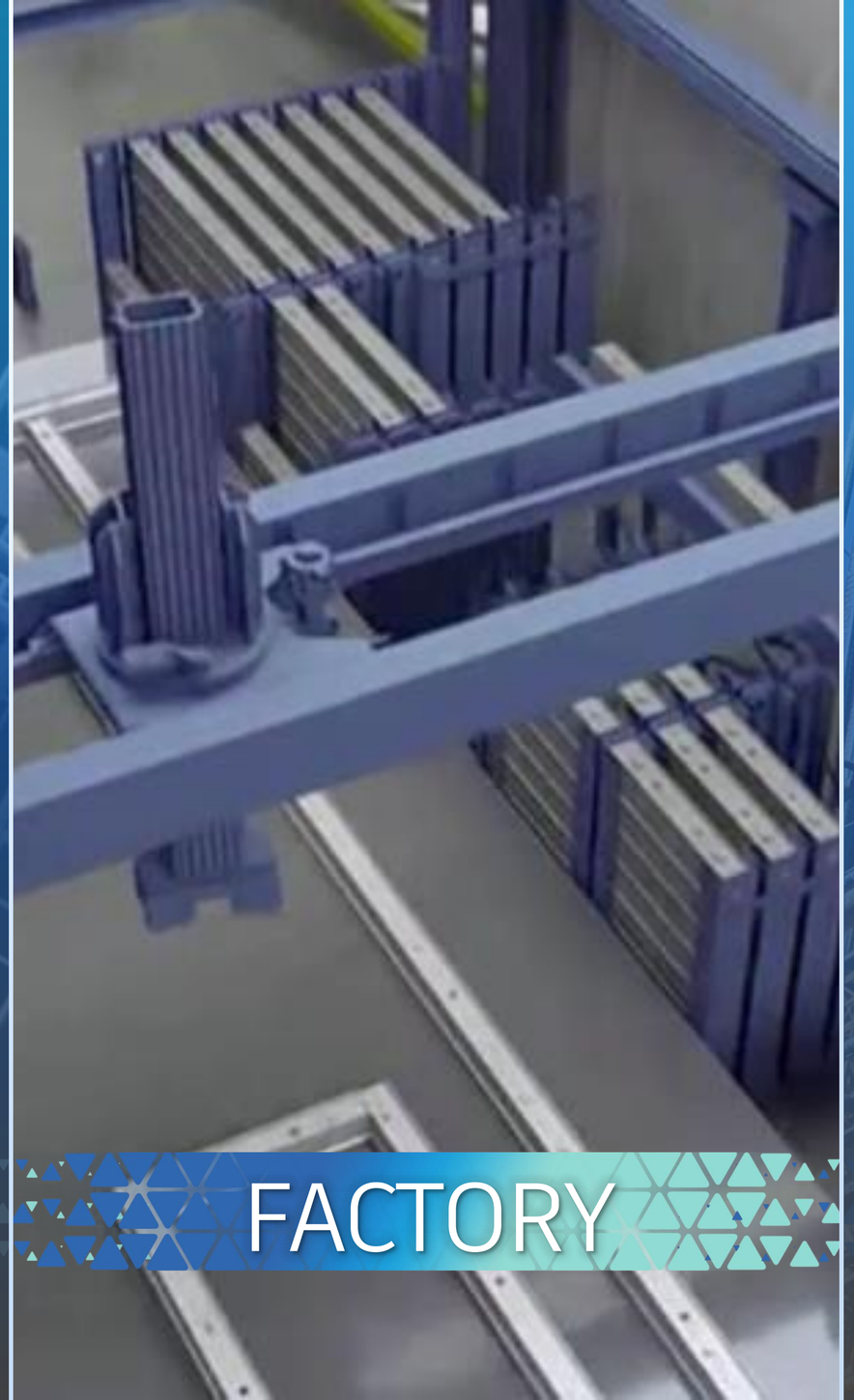


Generative Design

Neighborhood (Urban Planning): Van Wijnen

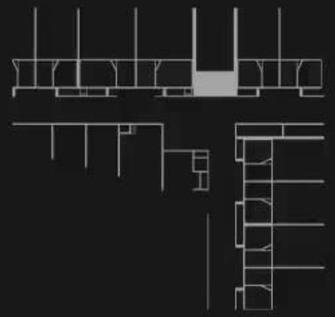
CONFIDENTIAL

DfMA



FACTORY

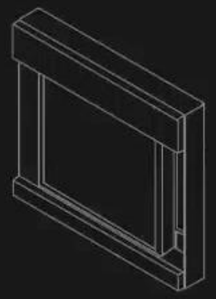
SITE



BLDG 3SW
FLOOR 4, SEC 5B

PANEL GH341

PART	UNITS
PART BH654-033	4
PART BH672-008	2
PART FD745-042	8
PART KE397	27
PART KE401-020	14
PART KR740-007	12



TRACK ID: 3973000453834

FABRICATION

PROCESS CHECK

VALIDATION

ASSEMBLIES

PANEL GH137

PANEL GB355

PANEL GD212

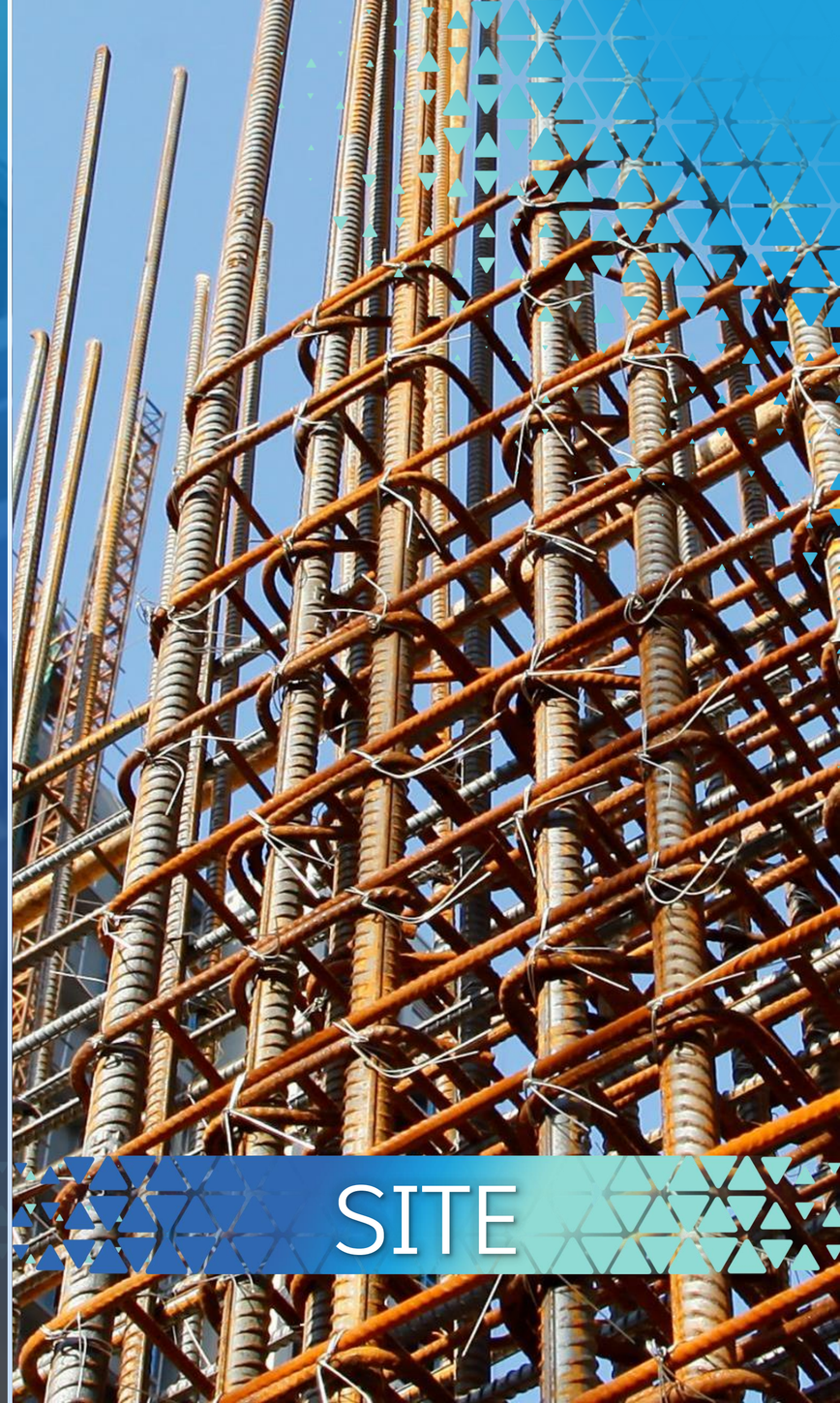
PANEL HA352

PANEL HB551

AUTODESK.

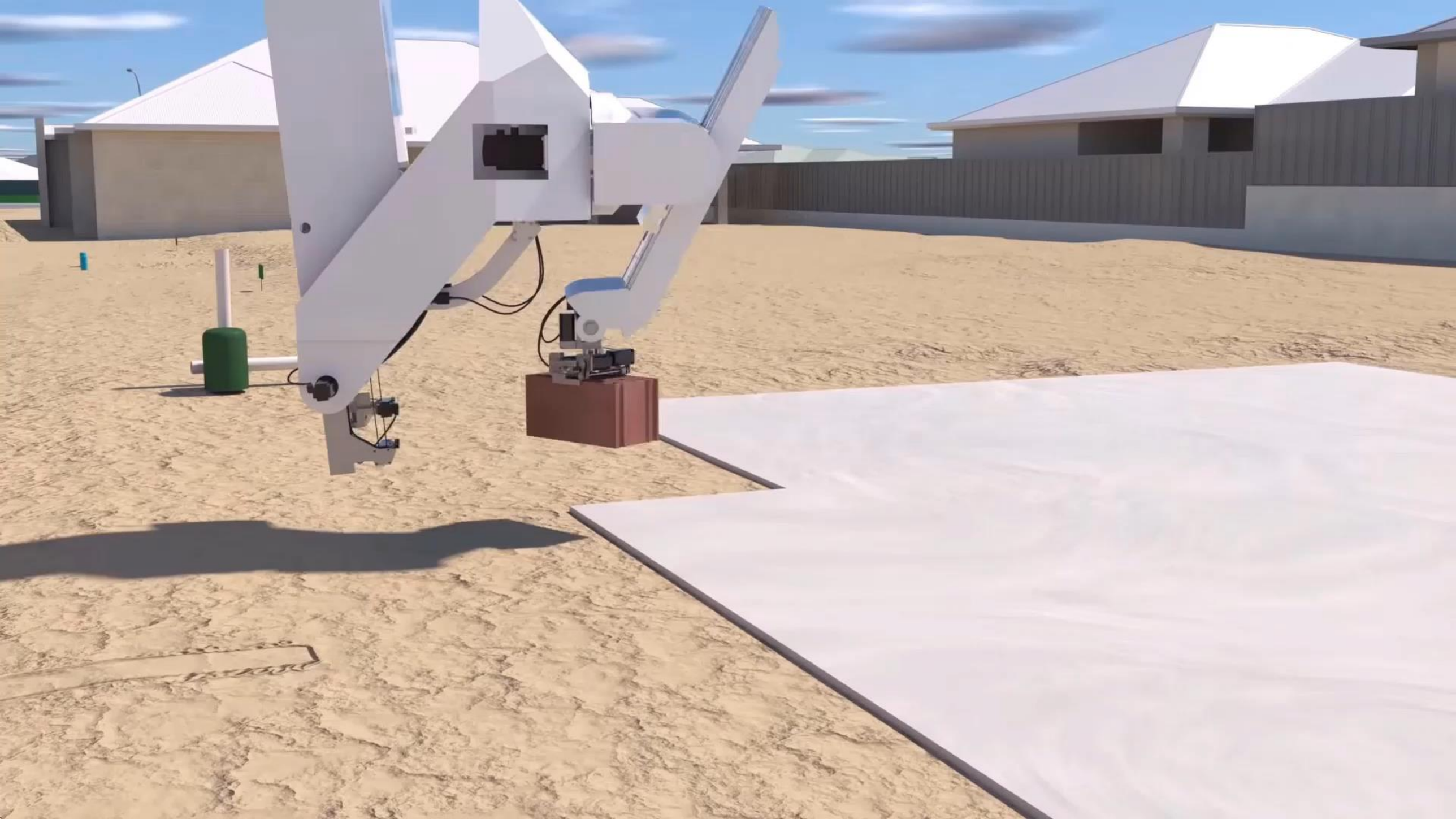
DfMA

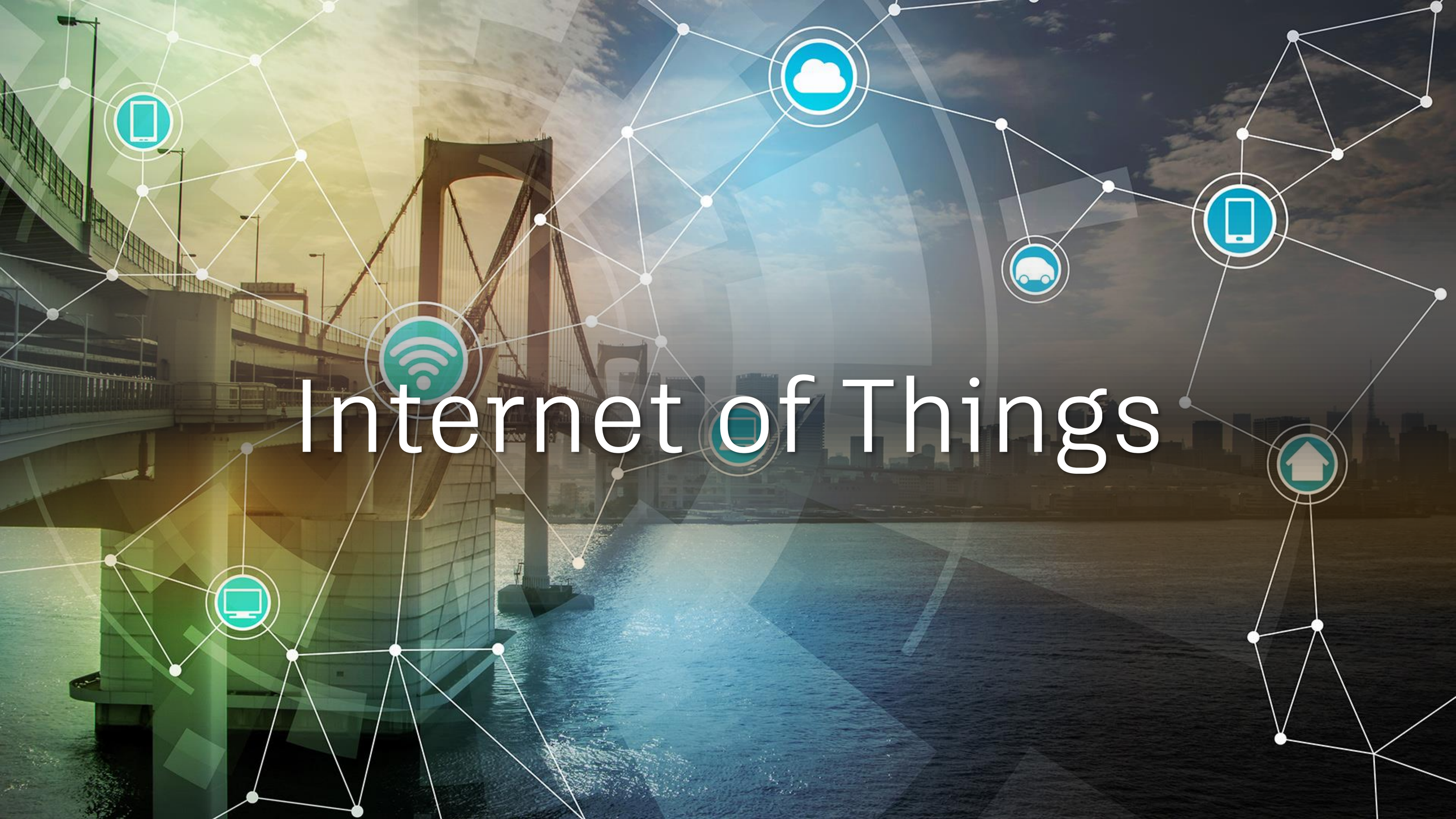
FACTORY

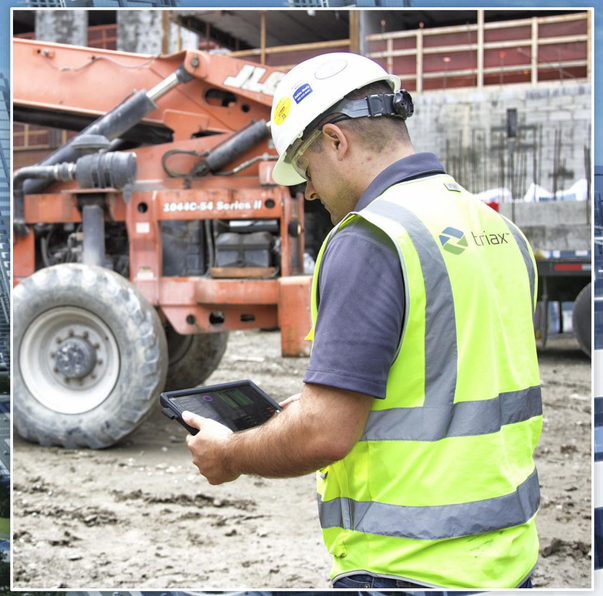


SITE

Robotics

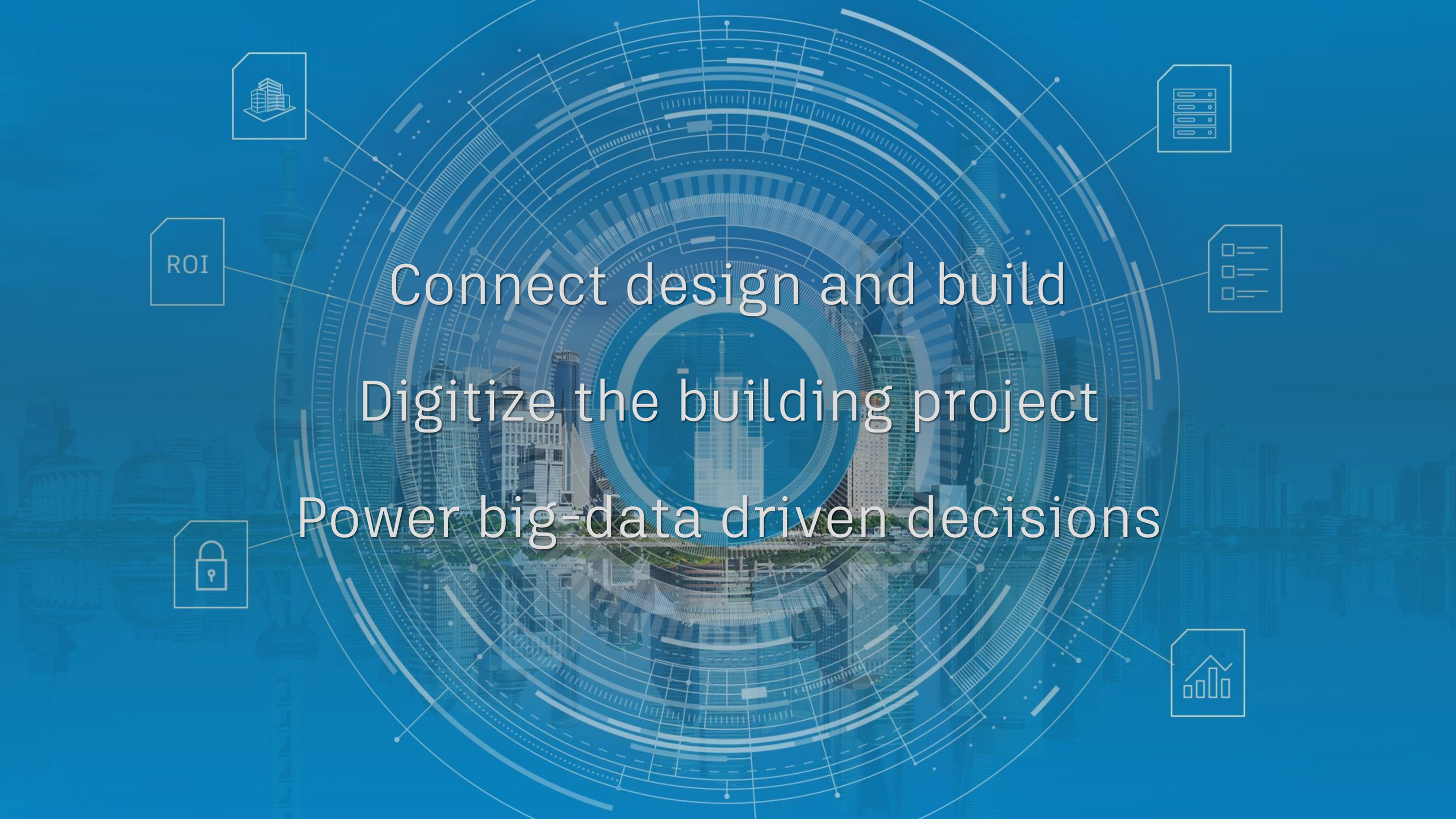



Internet of Things


triax

RFID/BLE ENABLED
KENETIC CHARGING
WORK/ALARM LIGHT
REPETITIVE MOTION SENSING

MORE | BETTER | LESS



Connect design and build

Digitize the building project

Power big-data driven decisions

AUTODESK.
UNIVERSITY

CONNECT & CONSTRUCT SUMMIT

CONNECT & CONSTRUCT

David Glennon

Arcadis

CONNECT & CONSTRUCT SUMMIT

Join the conversation #CONNECT&CONSTRUCT

AUTODESK. UNIVERSITY

Connect & Construct

David Glennon - Arcadis

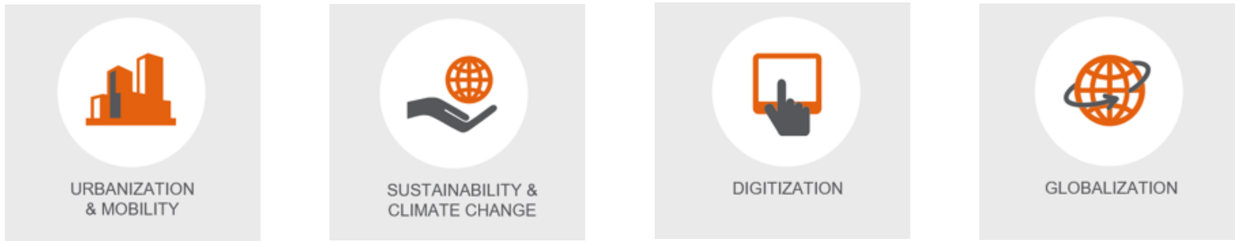
RADICAL

OUTSIDE-IN

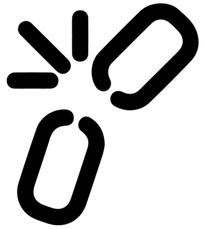
TOGETHER

No Normal is the New Normal

Established Global Mega Trends



UK Mega Trends Arising



“BREAKDOWN”
NO NORMAL
IS THE NEW NORMAL

“LIFT-OFF”
RAPID CHANGE
& GROWTH
OF NEW BUSINESS MODELS

“MEGA vs. MICRO”
SCALE Vs ATOMISATION

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ARCADIS Design & Consultancy for natural and built assets

SURVIVE RE-INVENT

4 Digital Realities
- Customer Experience

TO DARE IS TO DO

THE
LANE
UNDERARMOUR.COM
AIA

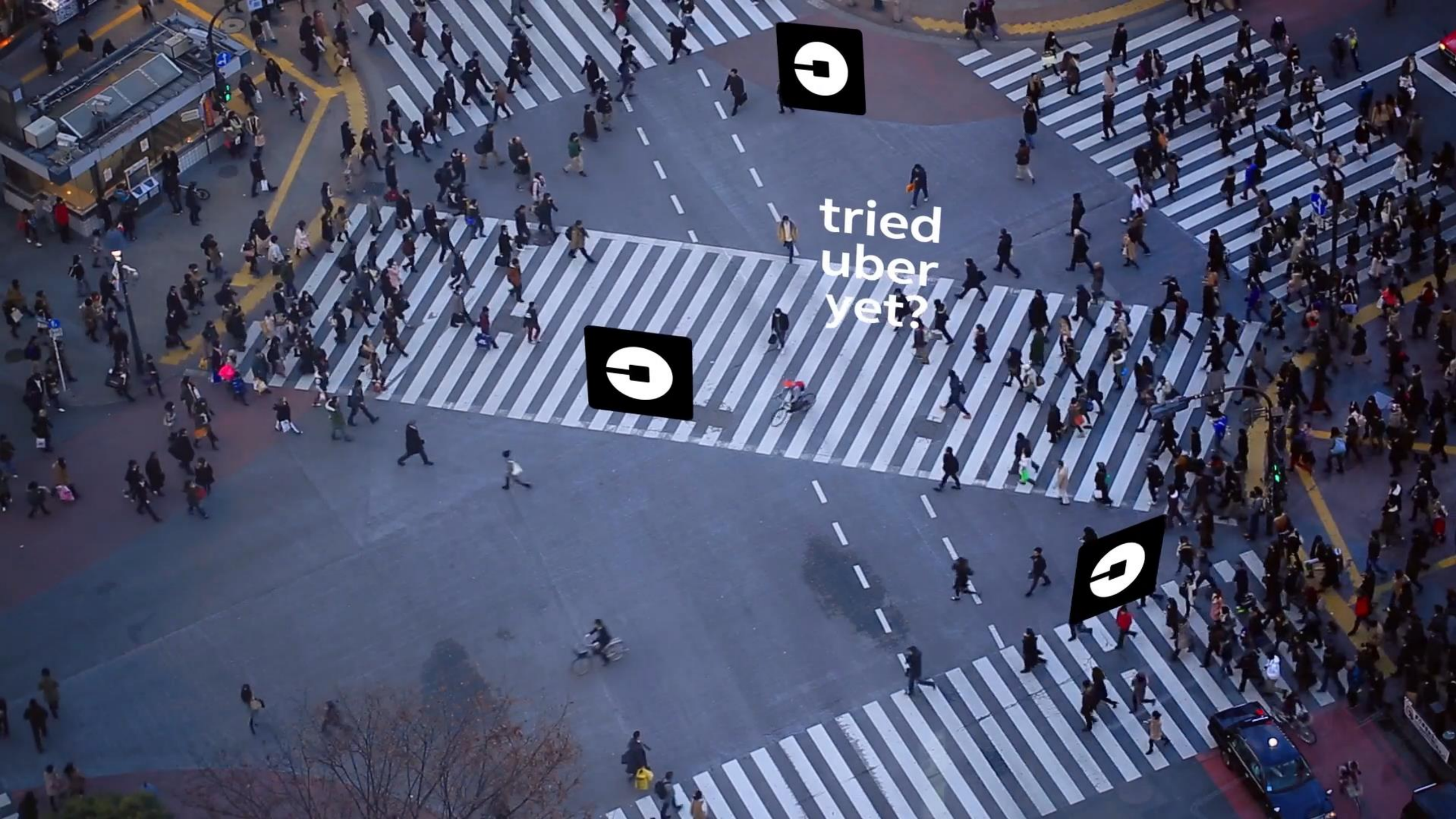
WOMEN
MEN

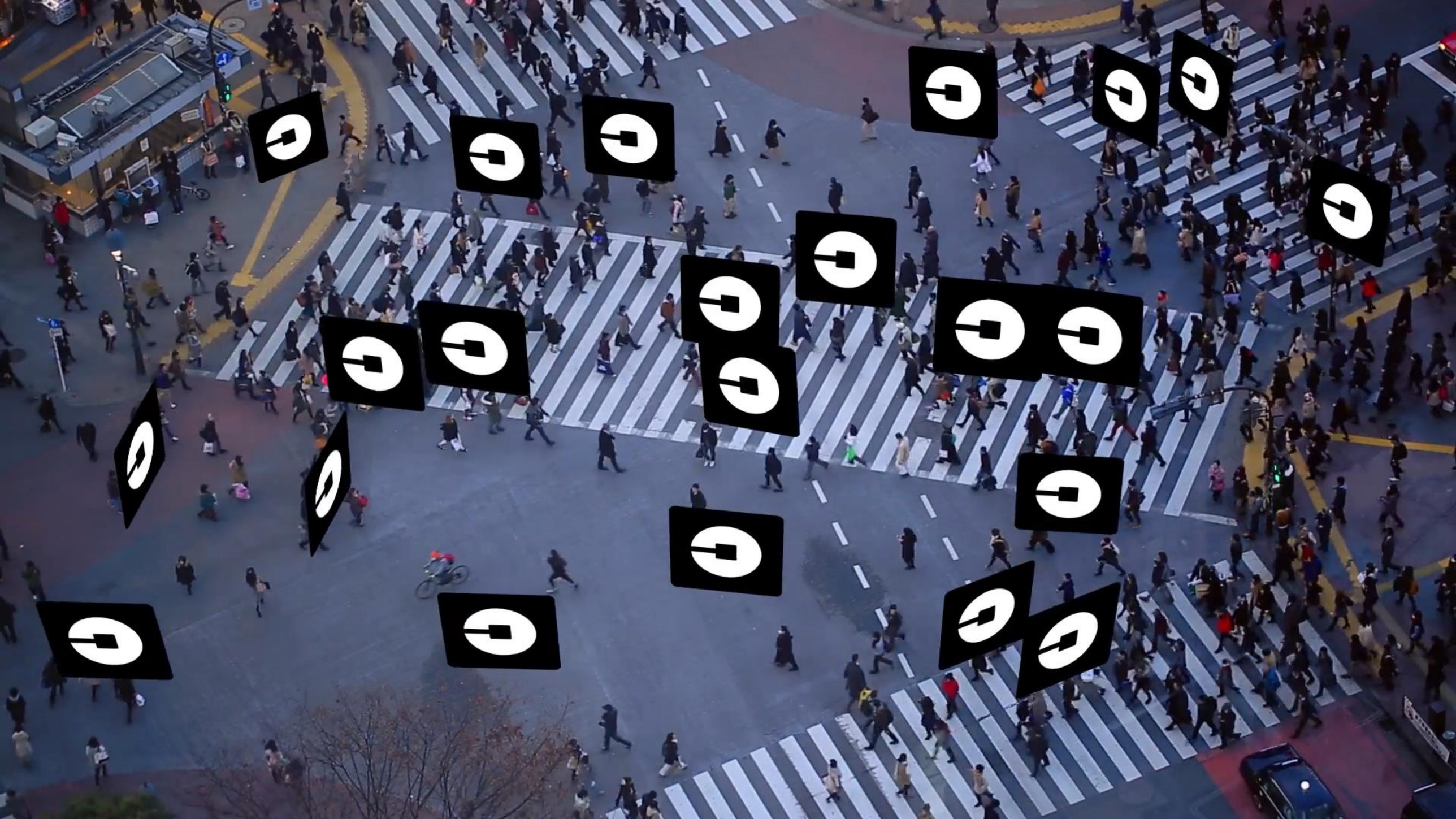
ARCADIS Design & Consultancy for natural and built assets

my experience
my experience
my experience
my experience
esset
8
7
6
5

4 Digital Realities
- Data & Platforms

processor
cost
power
sensors
cost
sensitivity
smartphone
user interface
cost
ease of use


tried
uber
yet?

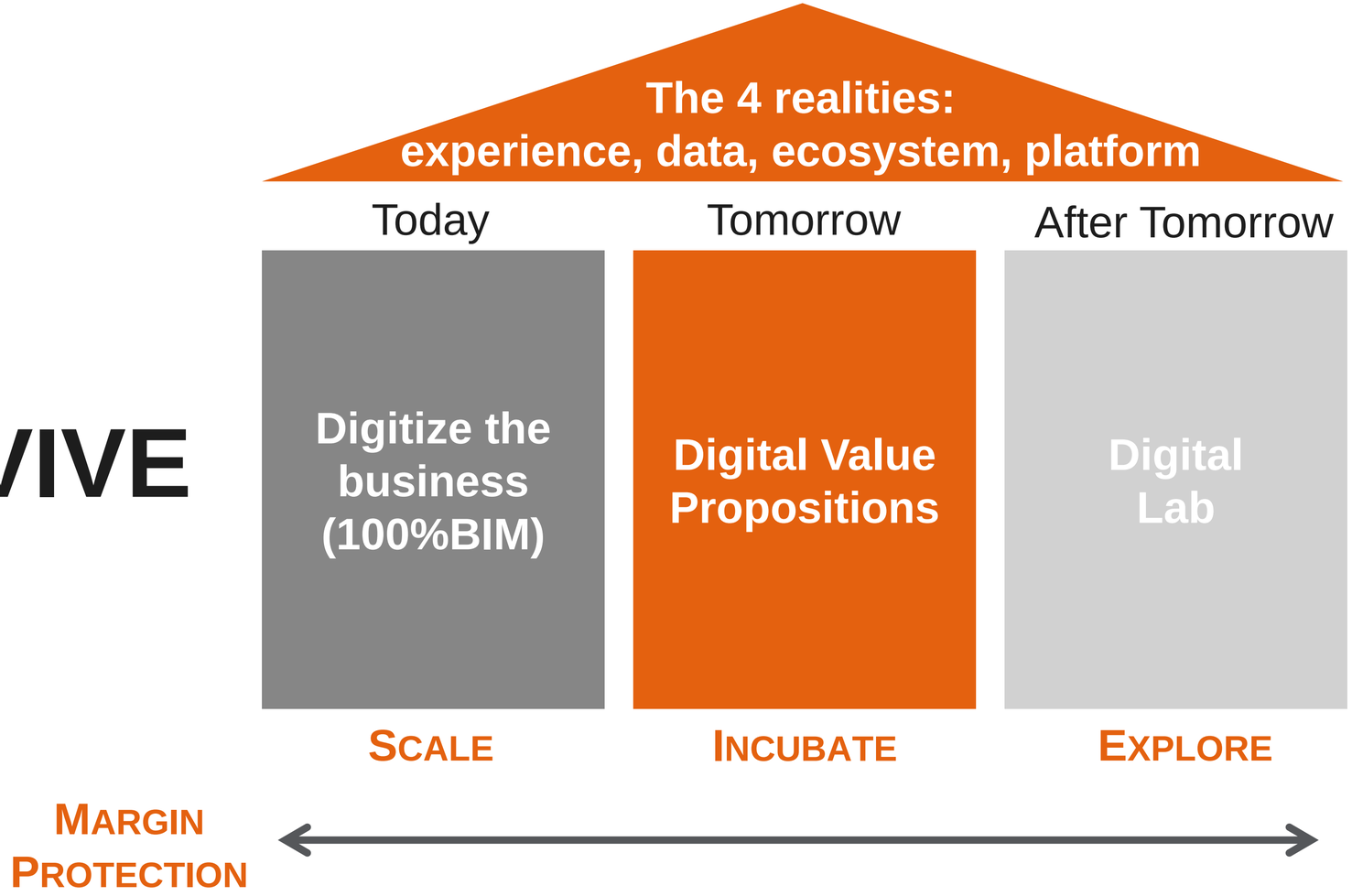


share resources
share power
share workspace
share wifi
share homes
share bikes
share cars
share materials

4 Digital Realities
- Ecosystems

even
competitors
the
end user
the tech
expert
the client
the consultant
the engineer

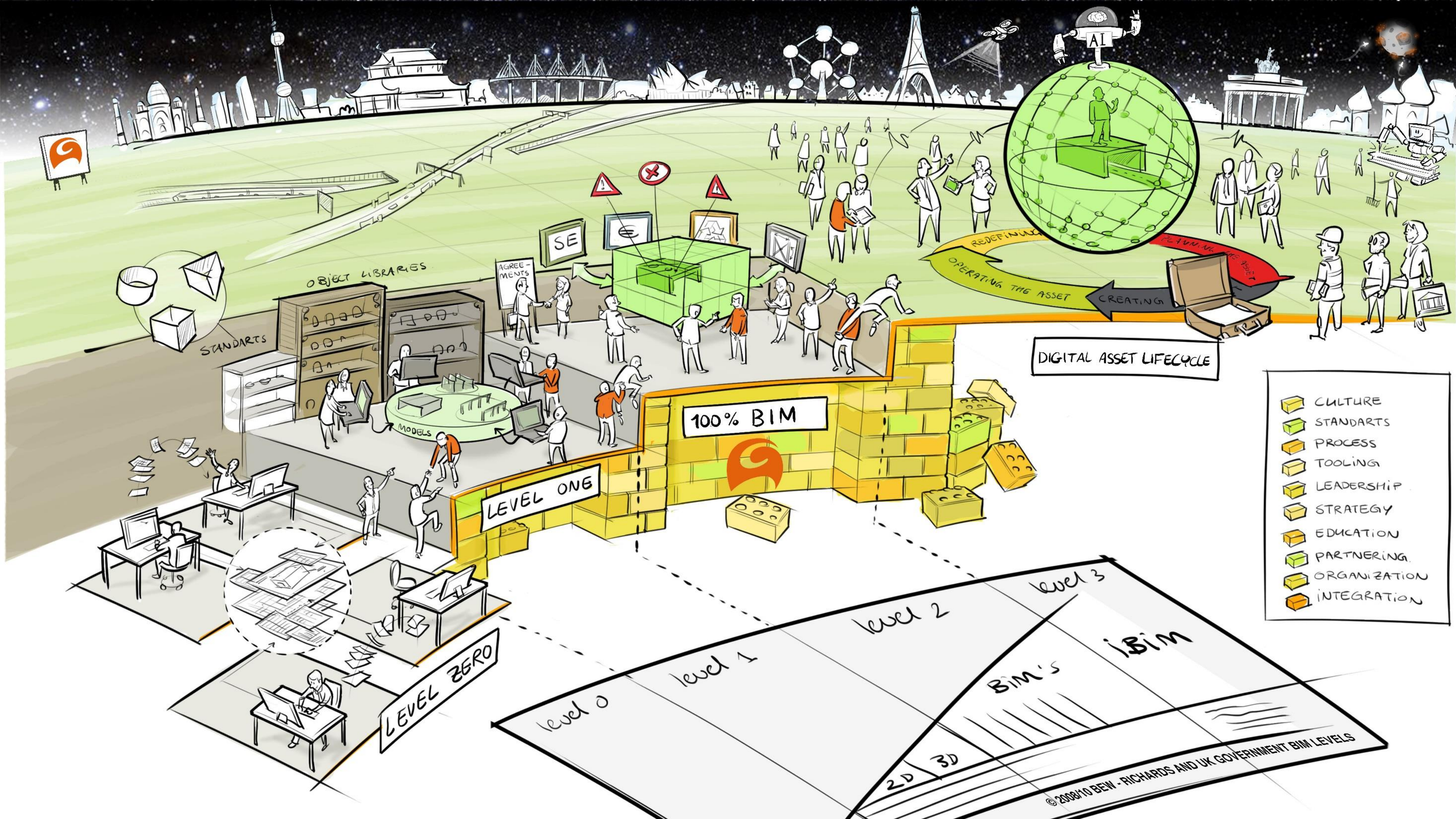
Three time horizons

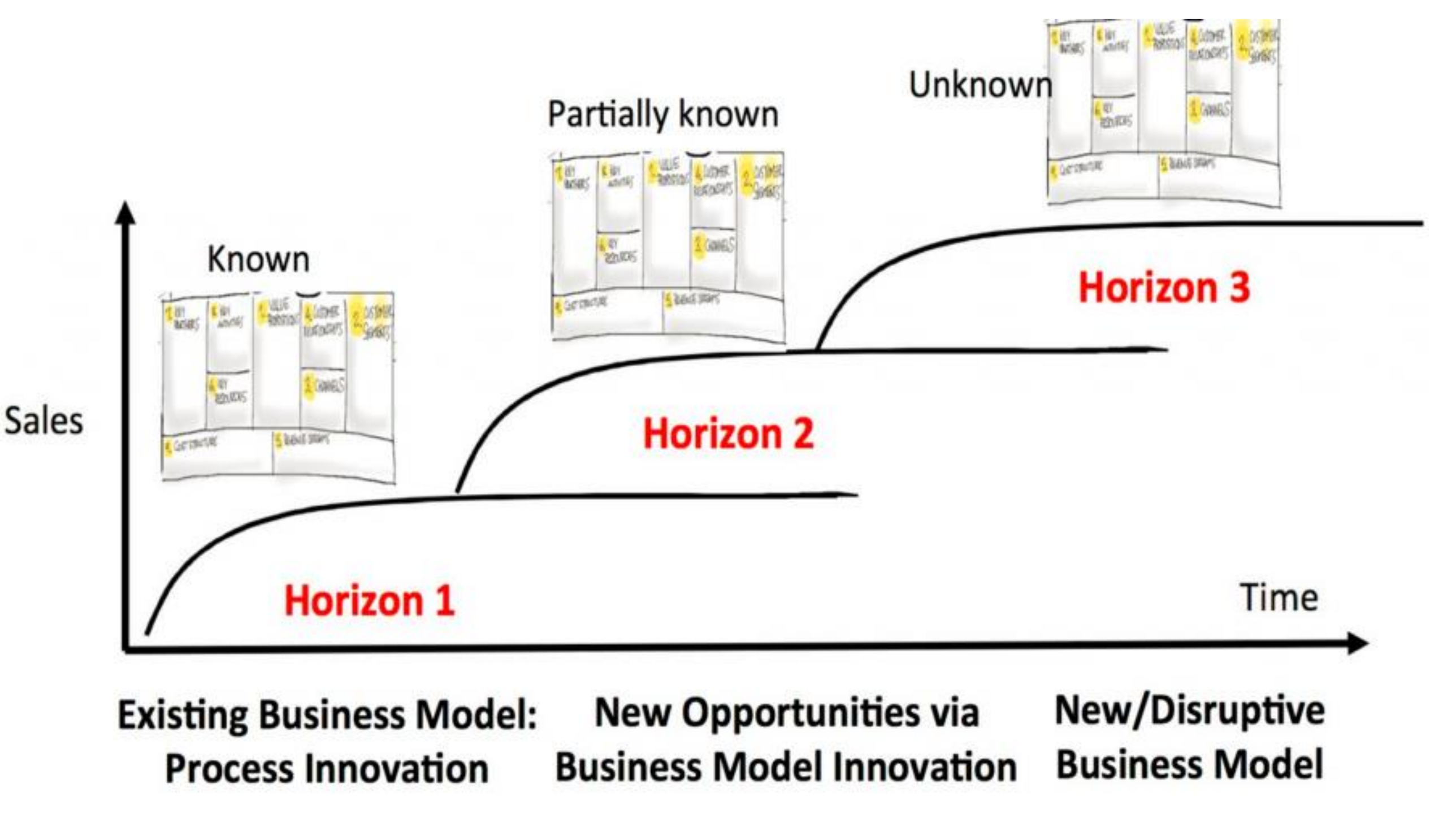


SURVIVE

RE-INVENT

Arcadis
digital basecamp = 100% BIM
Competition


AI
SE
AGREE-
MENTS
OBJECT LIBRARIES
STANDARTS
MODELS
100% BIM
LEVEL ONE
LEVEL ZERO
REDEFINING
OPERATING THE ASSET
CREATING
PLANNING THE ASSET
DIGITAL ASSET LIFECYCLE
CULTURE
STANDARTS
PROCESS
TOOLING
LEADERSHIP
STRATEGY
EDUCATION
PARTNERING
ORGANIZATION
INTEGRATION
level 0
level 1
level 2
level 3
BIM's
iBim
2D
3D
© 2008/10 BEW - RICHARDS AND UK GOVERNMENT BIM LEVELS


Unknown
Partially known
Known
Horizon 3
Horizon 2
Horizon 1
Sales
Time
Existing Business Model:
Process Innovation
New Opportunities via
Business Model Innovation
New/Disruptive
Business Model

WWW
iDeA
45% is SALE!
25%
TEAM
internet
MARKETING
SUCCESS
CLOUD
MAIN
30%
15%
7%
18%

ARCADIS

CITY OF 2030 ACCELERATOR

Powered by techstars

Arcadis City of 2030 Accelerator, Powered by Techstars

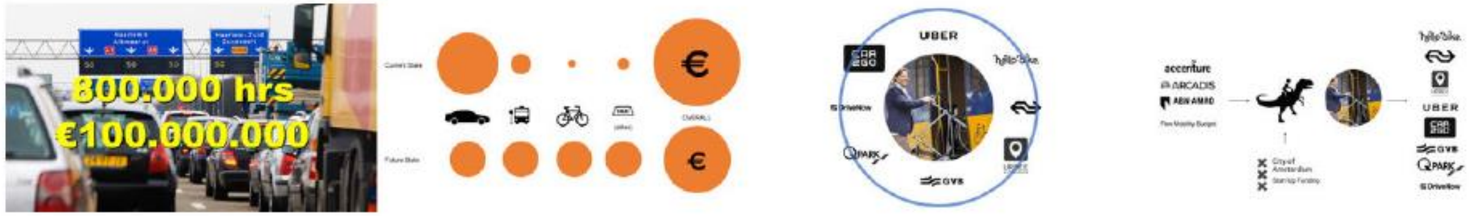
As our first program in Amsterdam, the Arcadis City of 2030 Accelerator, Powered by Techstars is looking for teams pioneering technologies that will revolutionize the construction and engineering industries, including how people move around cities and the associated infrastructure need.

Gartner Hype Cycle for Emerging Technologies, 2015
gartner.com/SmarterWithGartner
Gartner

Design Sprint

A four-day agile co-creation workshop.

Excerpts from the business case and lean canvas.



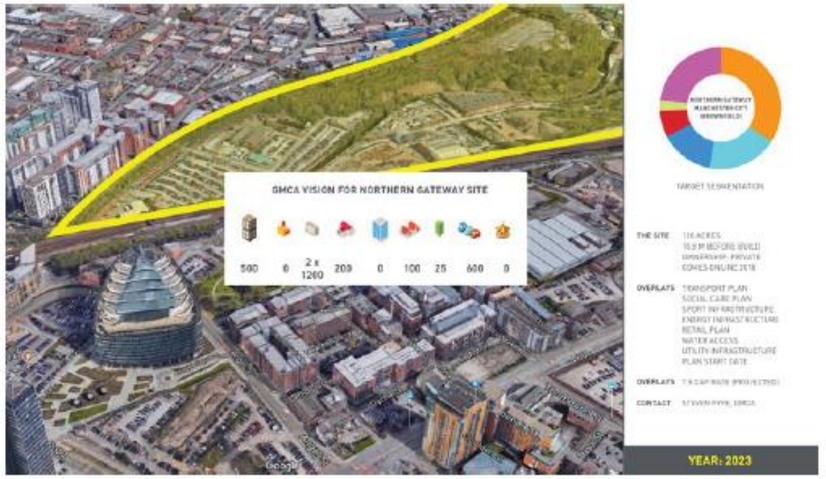
Journey framework, showing use cycle of the app.

Co-creation team testing the clickable app prototype.

MANCHESTER
PLANNING
AUTHORITY

Design Sprint

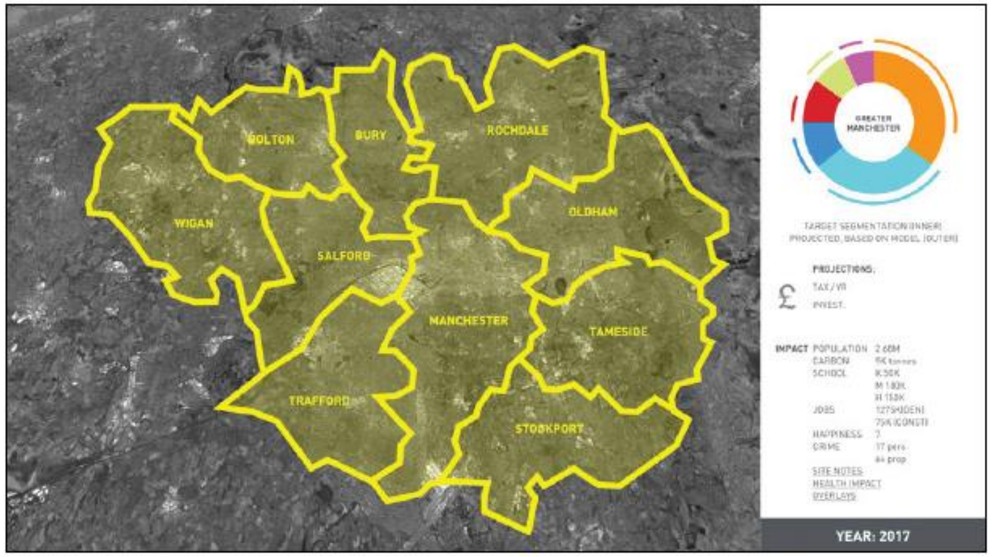
Co-creation of a predictive planning tool for Greater Manchester.

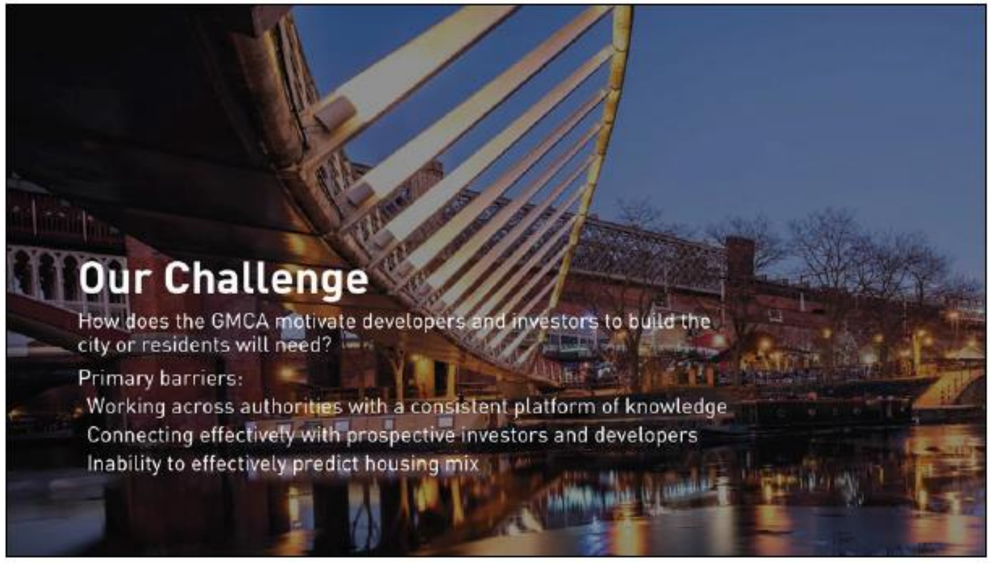


GMCA Owned Planning Data
ONS Data
GIS Data
Pricing Data
Polution Data
Jobs Data
Happiness Index
Resident Segmentation
Housing Targets

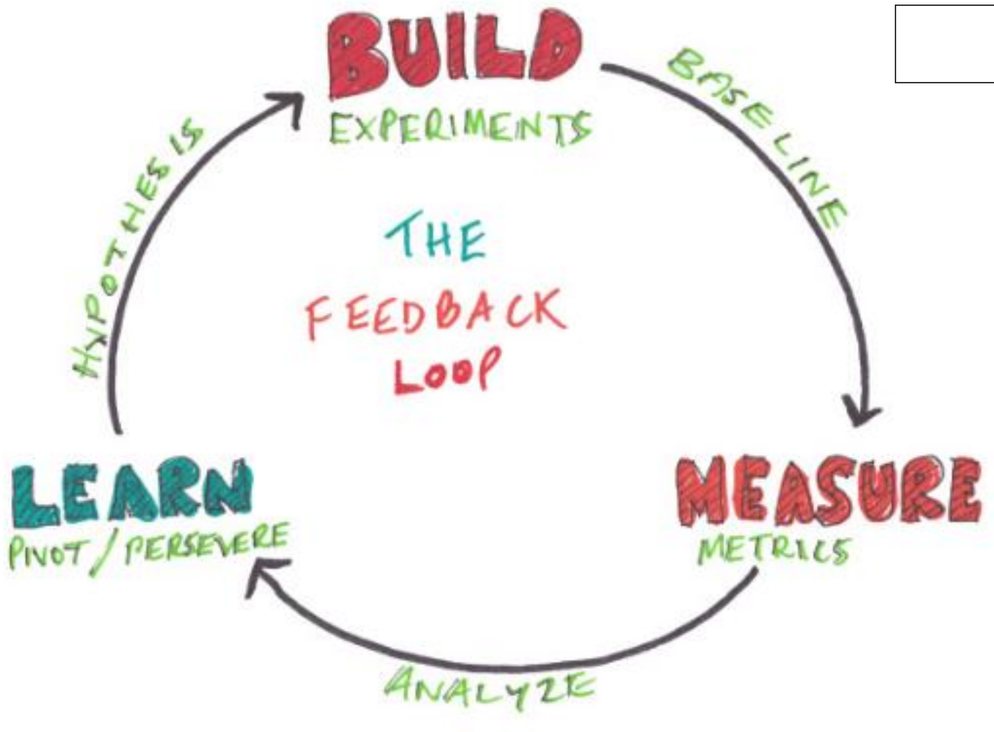
PREDICTIVE PLANNERS TOOLSETS

DEVELOPER PORTAL





The Lean Start-up process is about taking incremental steps and measure what works and learn from it



'Minimal Viable Product' (MVP)

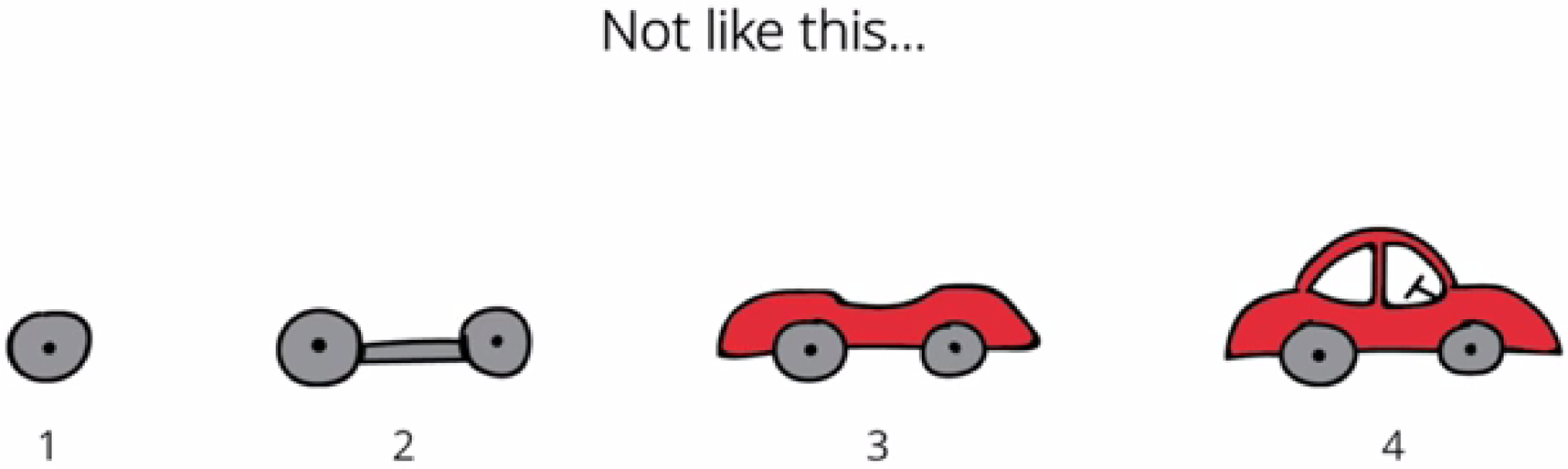
"A Minimum Viable Product is the smallest thing you can build that delivers customer value (and as a bonus captures some of that value back i.e. gets you paid)."

Source: https://blog.leanstack.com/minimum-viable-product-mvp-7e280b0b9418

SCRUM Guide available on Sharepoint: LINK

© Arcadis 2017

Start simple! Develop something that works from day 1



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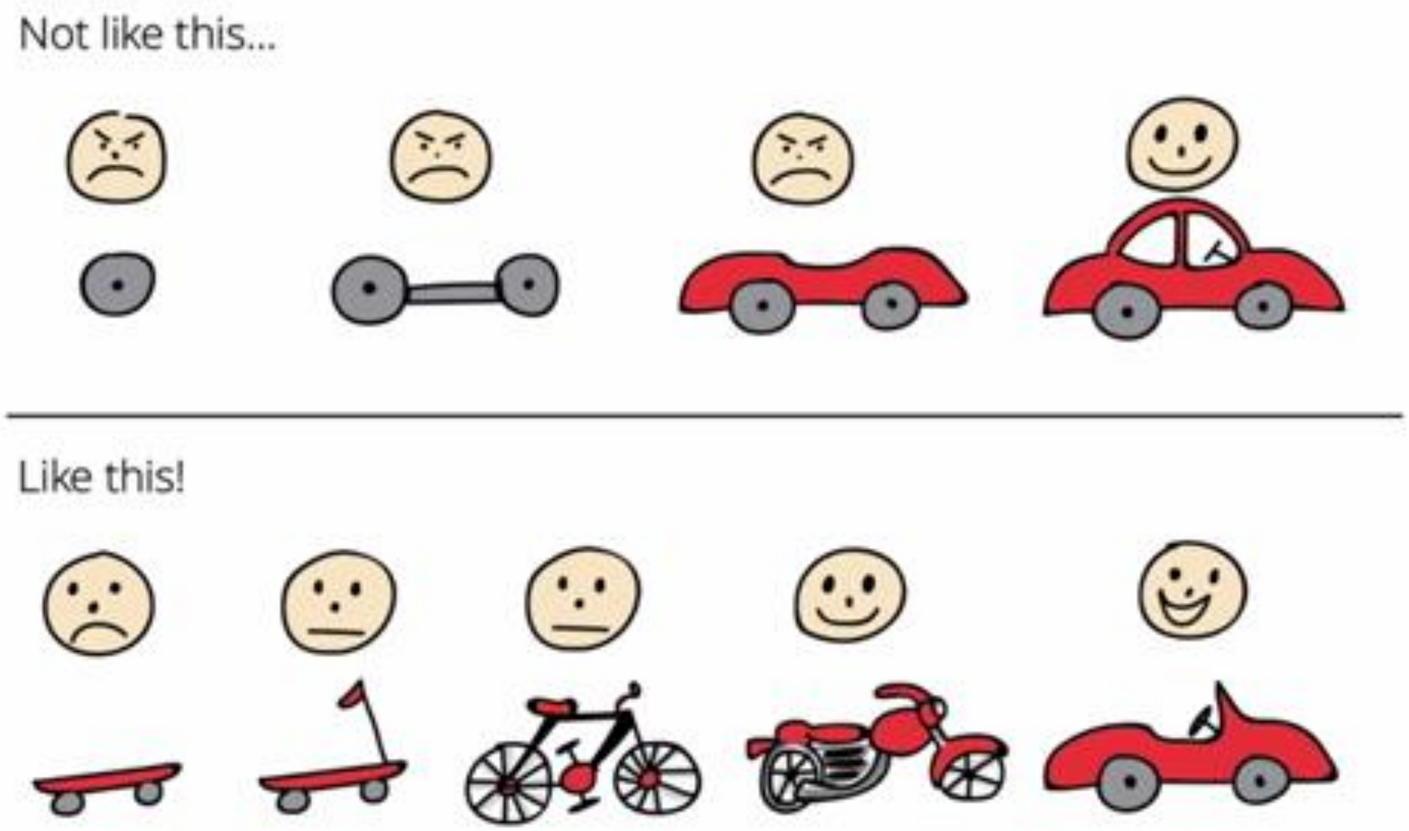
Henrik Kniberg - http://blog.crisp.se/2016/01/25/henrikkniberg/making-sense-of-mvp

Rather you’d create a ’means of transport’, starting with something that does the job

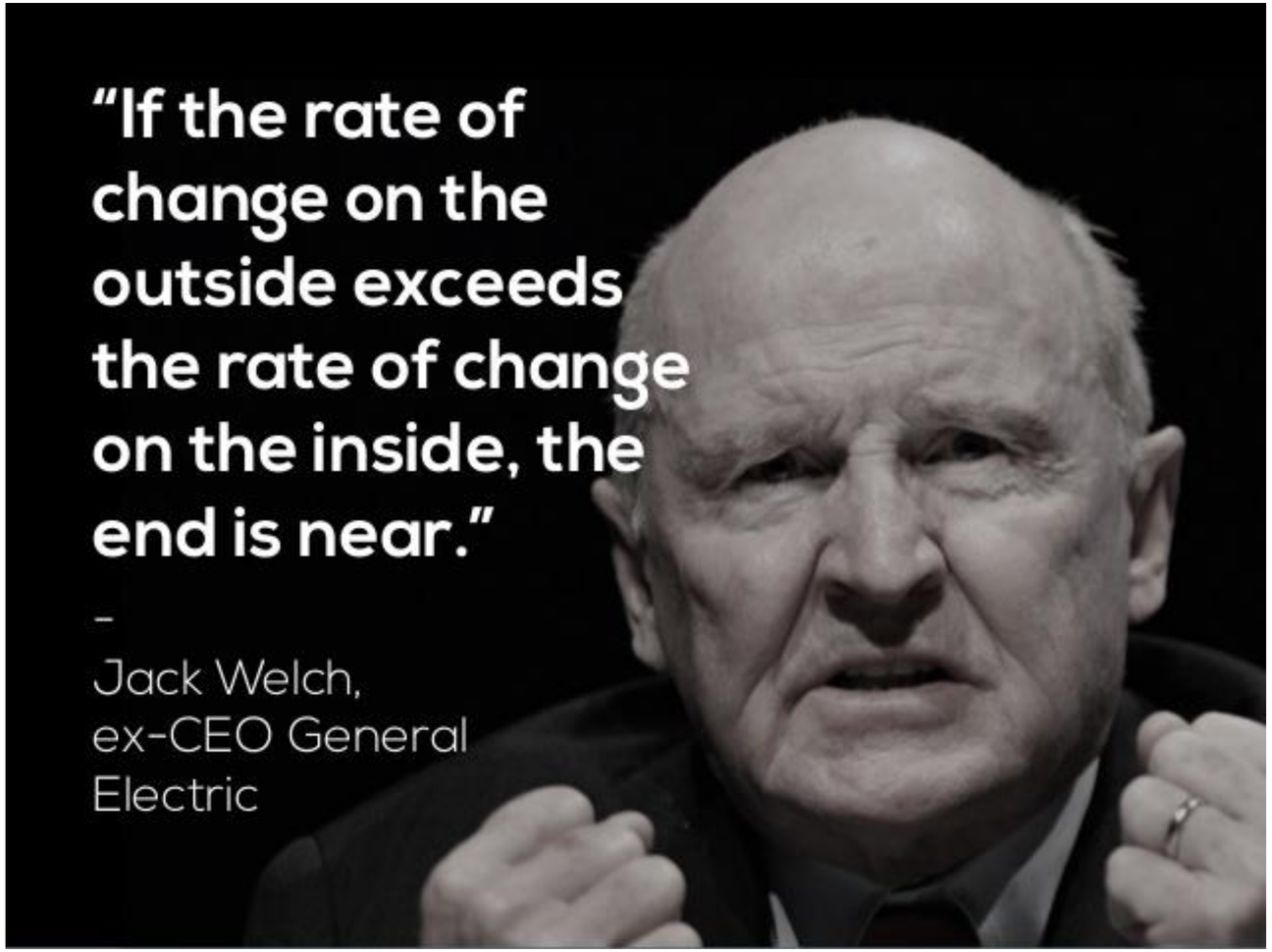
© Arcadis 2017

Henrik Kniberg - http://blog.crisp.se/2016/01/25/henrikkniberg/making-sense-of-mvp

So instead of creating a full-blown product at the end of a process, iterate towards an end-user validated product



Henrik Kniberg - http://blog.crisp.se/2016/01/25/henrikkniberg/making-sense-of-mvp



ARCADIS Design & Consultancy for natural and built assets

https://www.slideshare.net/gerriesmits/why-social-is-key-to-drive-your-digital-innovation-strategy
http://www.europeanbusinessreview.com/what-digital-leadership-does/

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www.linkedin.com/in/dbglennon

@bigman100

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Connect & Construct

David Glennon - Arcadis

RADICAL

OUTSIDE-IN

TOGETHER

AUTODESK.
UNIVERSITY

CONNECT & CONSTRUCT SUMMIT

CONNECT & CONSTRUCT

Gert-Jan Ditsel

Dura Vermeer

CONNECT & CONSTRUCT SUMMIT

Join the conversation #CONNECT&CONSTRUCT

AUTODESK. UNIVERSITY

PEOPLE ARE MORE IMPORTANT THAN TECHNOLOGY

DURA VERMEER

Making ambitions come true

BHV

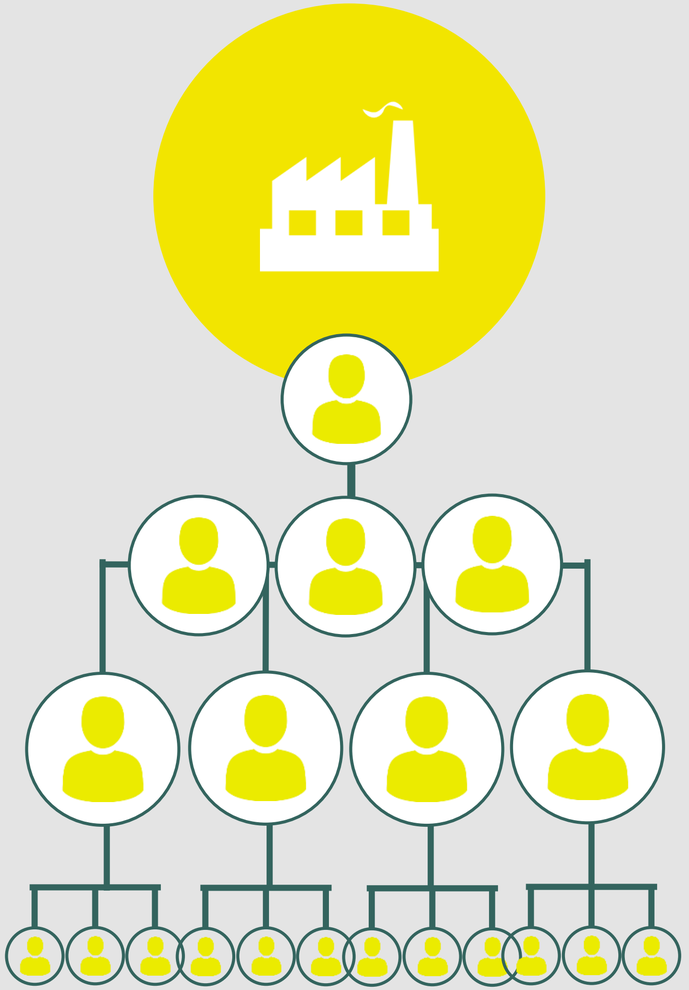
TRADITIONAL

DIGITAL

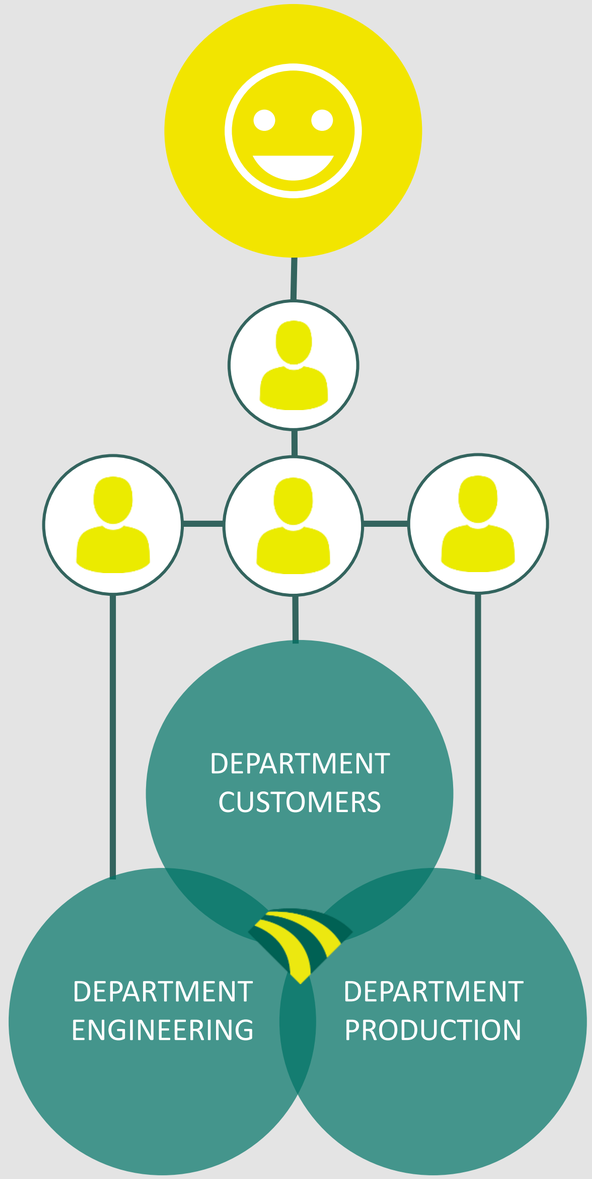
A22 Li
12,6

HORIZONTALLY ORGANIZED
FAMILY COMPANY
165 YEARS
2.500
EMPLOYEES
1,2
TURNOVER
BILLION
Division Building and Real Estate
750M
Division Infrastructure
450M
Division Advice and Services
35M

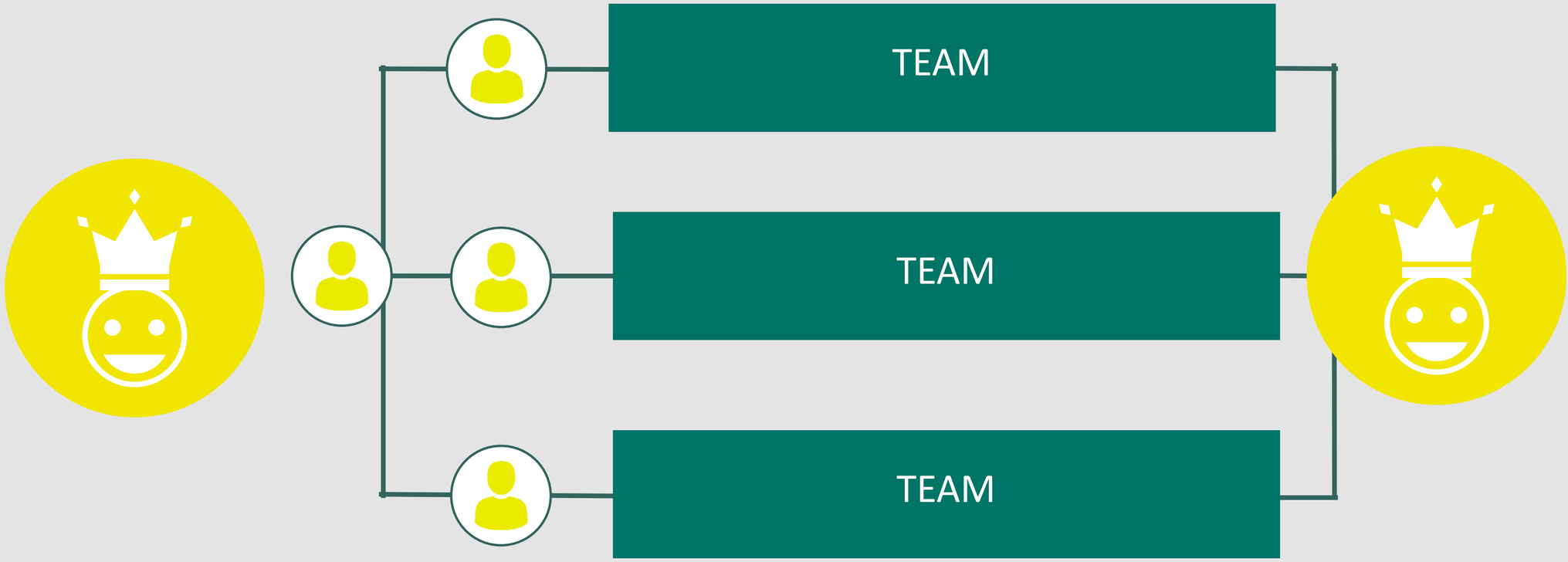
2008



2012


DEPARTMENT
CUSTOMERS
DEPARTMENT
ENGINEERING
DEPARTMENT
PRODUCTION

2016



OUR MISSION

MADE BY OUR OWN PEOPLE

REALIZING AMBITIONS, BY LETTING IDEAS GROW, BASED ON INSPIRATION, RESPECT AND CONNECTION.

OUR VISION

CONTRIBUTE TO INNOVATIVE SOLUTIONS AND EXTREME PREDICTABILITY, WITH THE ONLY GOAL; TO DELIVER VALUE TO OUR CUSTOMERS

STRATEGY

DURA VERMEER GROUP

MISSION

Realizing ambitions, by letting ideas grow. Based on inspiration, respect and connection. With people who work together based on happiness, joy and freedom.

VISION

- Contribute to innovative solutions
- Extreme predictability

LEAN AND HORIZONTALLY ORGANIZED

OPERATIONAL

2018	2018	2018	2018	2018
BIM	REAL ESTATE DEVELOPMENT	HITRATE	STRENGTHEN DESIGNING PROCESS	STRENGTHEN ORGANIZATION

STRATEGY

DURA VERMEER GROUP

MISSION

Realizing ambitions, by letting ideas grow. Based on inspiration, respect and connection. With people who work together based on happiness, joy and freedom.

VISION

- Contribute to innovative solutions
- Extreme predictability

LEAN AND HORIZONTALLY ORGANIZED

OPERATIONAL

BIM AS A PILAR

2018	2018	2018	2018	2018
BIM	REAL ESTATE DEVELOPMENT	HITRATE	STRENGTHEN DESIGNING PROCESS	STRENGTHEN ORGANIZATION

BIM IS
REALLY OUR
FOUNDATION

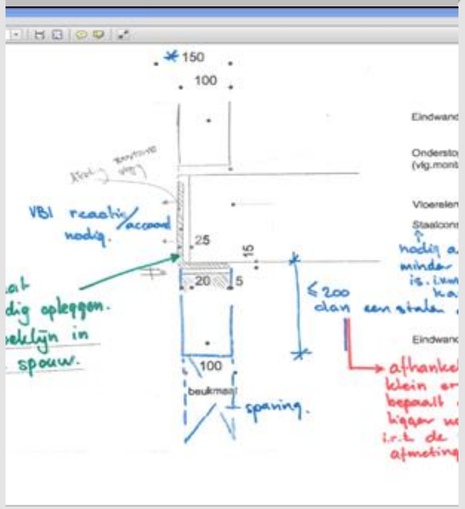
WHERE DID IT REALLY START?

“YOU HAVE TO INVEST TIME TO LEARN BIM FOR YOUR OWN FUTURE, AND OURS.”
2014 - RONALD DIELWART – BOARD OF DIRECTORS
THE
NEXT S

AND SO I DID..
THE OTHER WAY AROUND

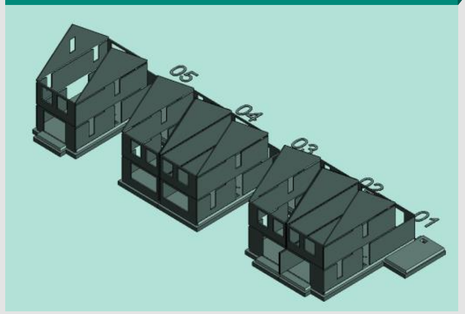
1

ENGINEERING



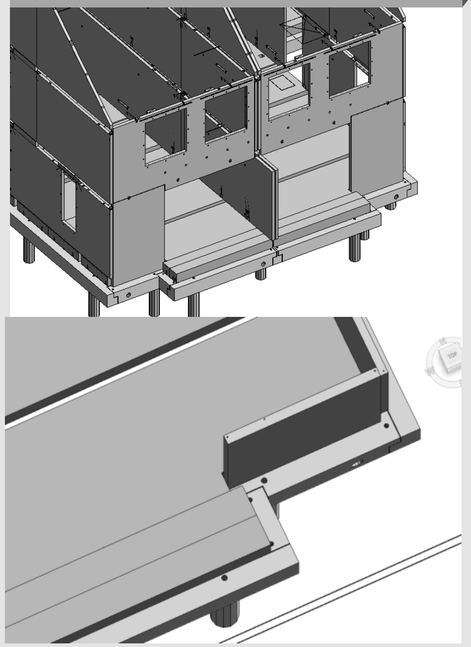
2

DESIGN MODEL



3

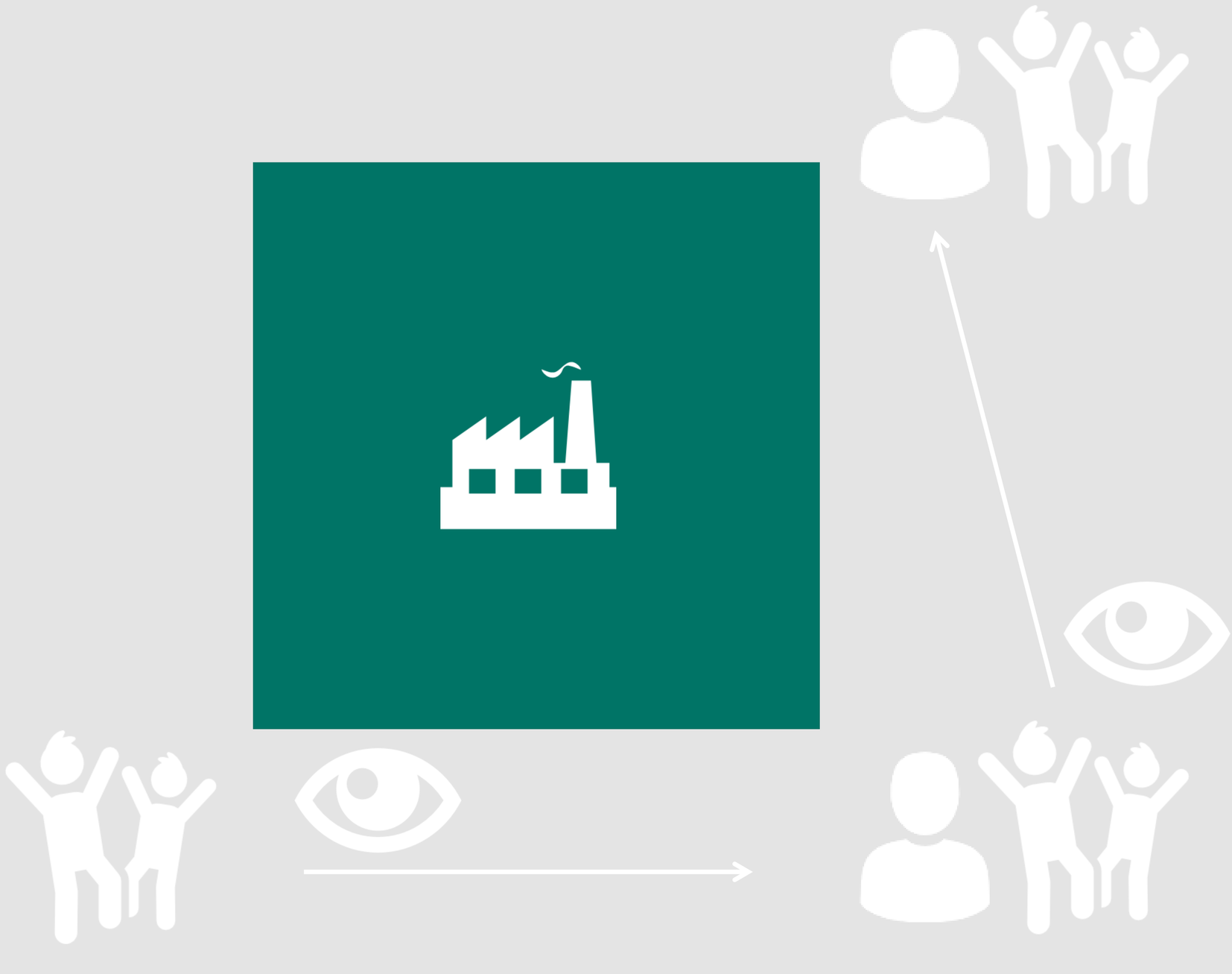
PRODUCTION MODEL

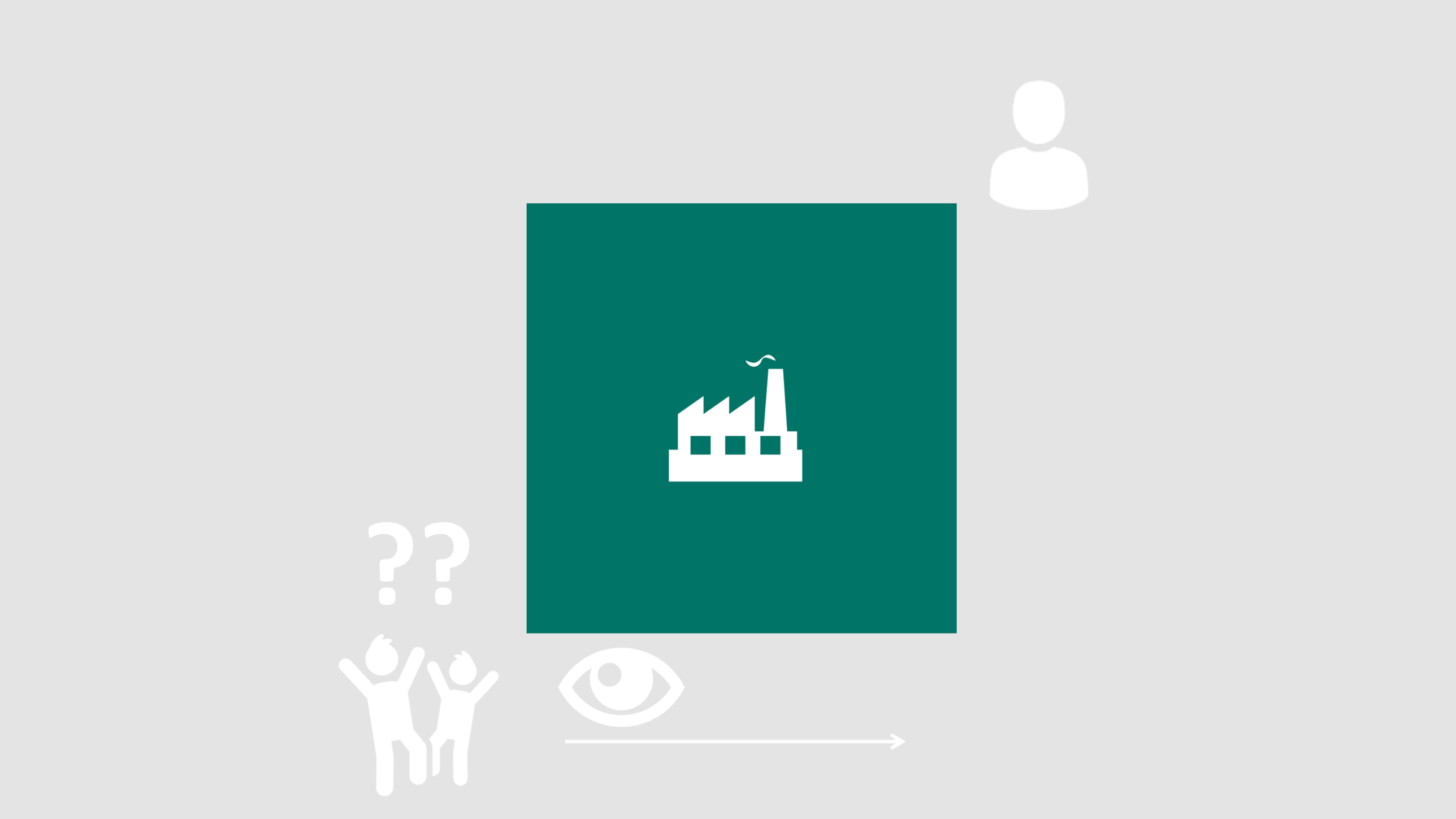


4

REALITY

BOARD GAVE ME THE TRUST AND TIME I NEEDED. MISTAKES WERE ALLOWED.

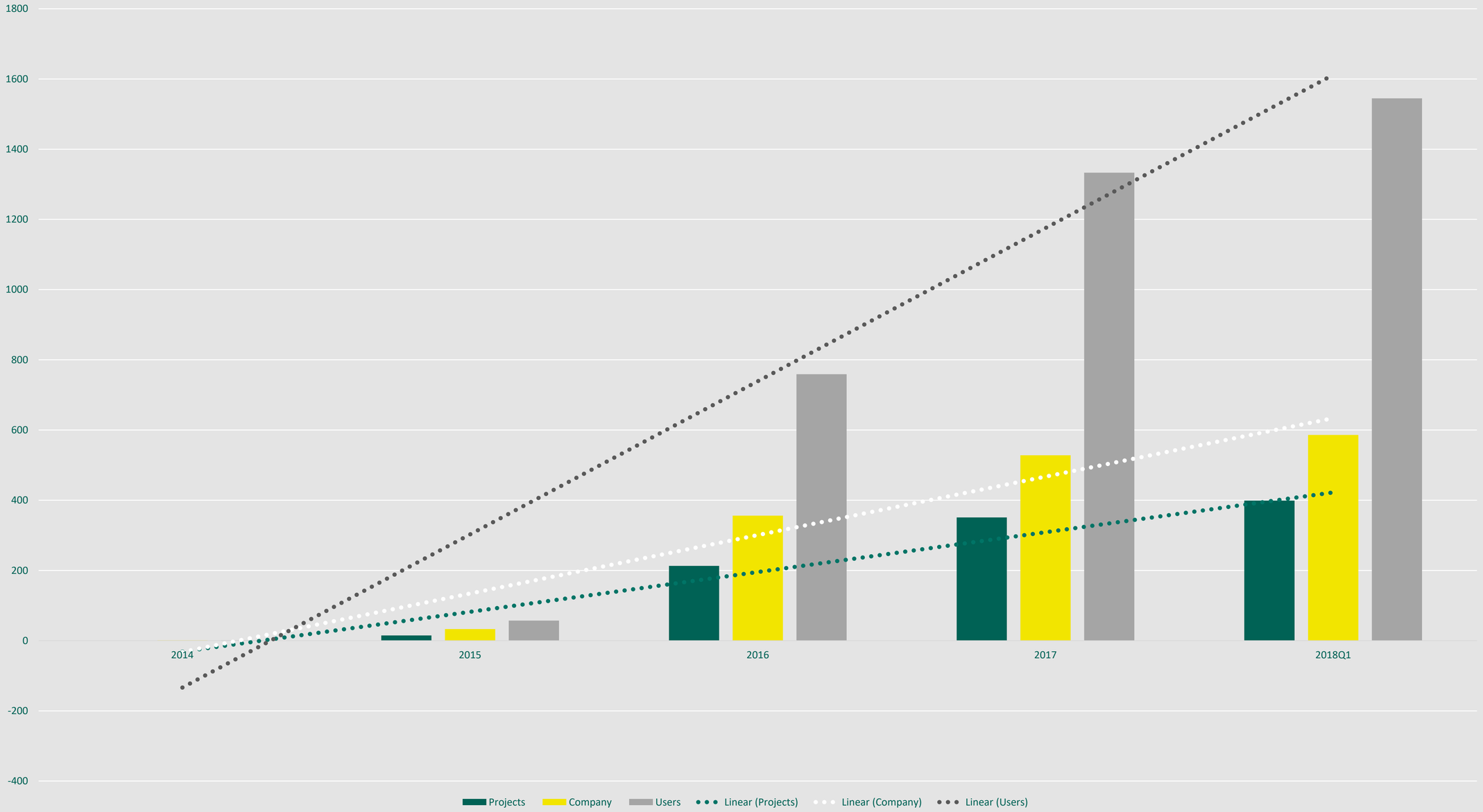




TRY
FAIL
LEARN
GROW
REPEAT
GROWTH
MINDSET

LEARNING BY DOING

STANDARD WAY OF WORK – BIM 360



THEY ARE IN THE CENTER OF OUR ORGANIZATION

KEYUSERS ARE DIRECTLY SUPPORTED

BY OUR BOARDMEMBERS

CONNECTING YOUNG WITH EXPERIENCED COLLEAGUES

IT FACILITATES
THE STANDARD WAY
OF WORK

CENTRALIZED BIM ENVIRONMENT

AUTODESK®

INTEROPERABILITY WITH OUR SUPPLY CHAIN

LEARNING BY DOING

COMPLETE TRUST OF OUR BOARD

HORIZONTALLY ORGANIZED

WORKING IN TEAMS

STEP BY STEP

YOUNG AND EXPERIENCED

STANDARD WAY OF WORK

IT ALLIGNED

WE TEACH OUR CHILDREN TO SHARE

COLLABORATE
EVEN WITH COMPETITORS

THANK YOU FOR COLLABORATING ON IFC!

Royal HaskoningDHV
Enhancing Society Together

ARCADIS

VINCI

ARUP

VolkerWessels

WILLEMEN

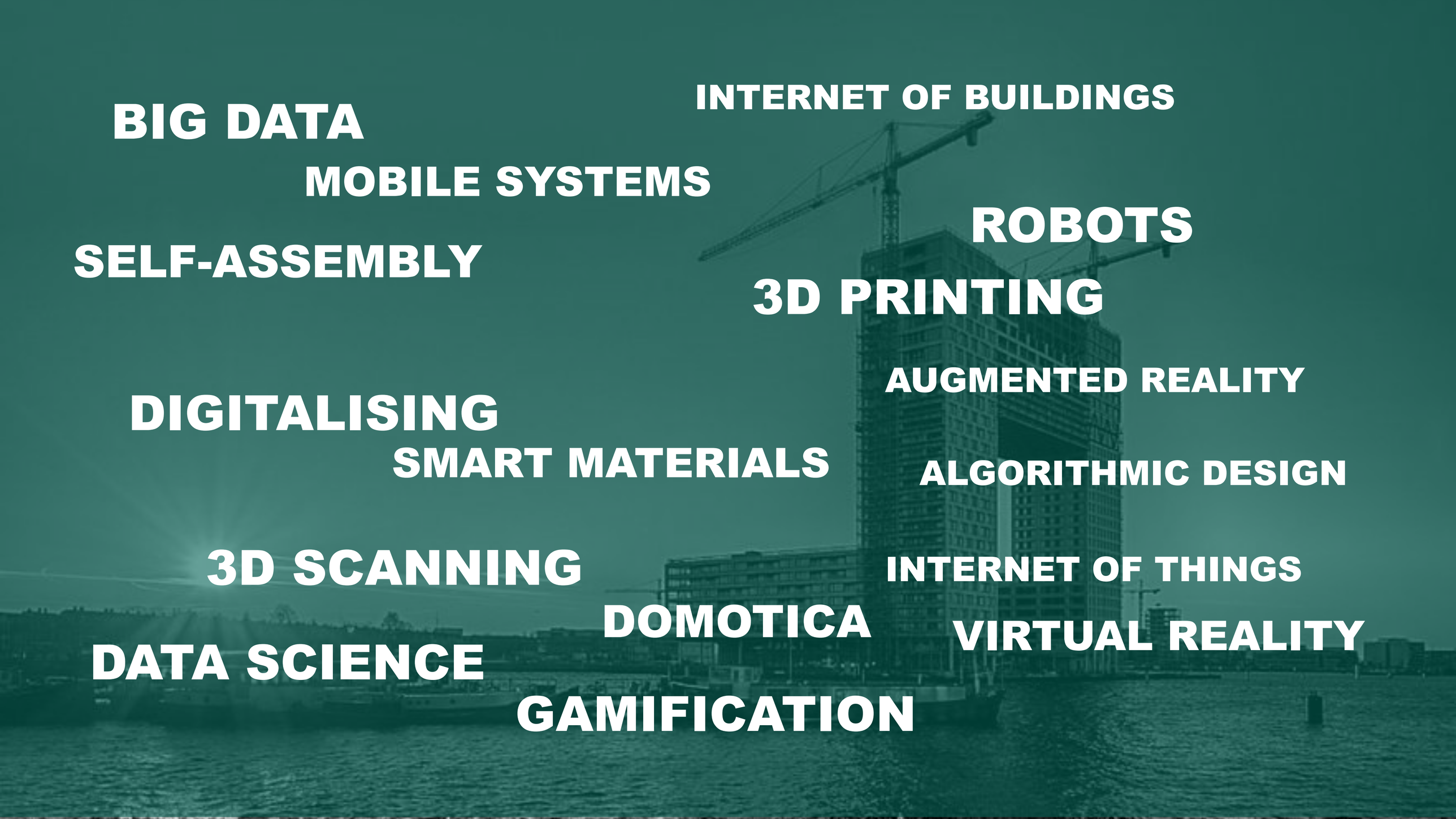
Schiphol Group

bam

STRABAG

BUILDING ON TOP OF THIS FOUNDATION IN 2018

WHAT’S NEXT?


INTERNET OF BUILDINGS
BIG DATA
MOBILE SYSTEMS
ROBOTS
SELF-ASSEMBLY
3D PRINTING
AUGMENTED REALITY
DIGITALISING
SMART MATERIALS
ALGORITHMIC DESIGN
3D SCANNING
INTERNET OF THINGS
DOMOTICA
VIRTUAL REALITY
DATA SCIENCE
GAMIFICATION

ONE THING WE KNOW
FOR SURE
GO FAST GO ALONE
DURA VERMEER
Waarmaken van ambities

GO FAR
GO TOGETHER

DURA VERMEER

Waarmaken van ambities

AUTODESK.
UNIVERSITY

CONNECT & CONSTRUCT SUMMIT

COFFEE BREAK

AUTODESK.
UNIVERSITY

CONNECT & CONSTRUCT SUMMIT

CONNECT & CONSTRUCT

Melanie Dawson

Graham Construction

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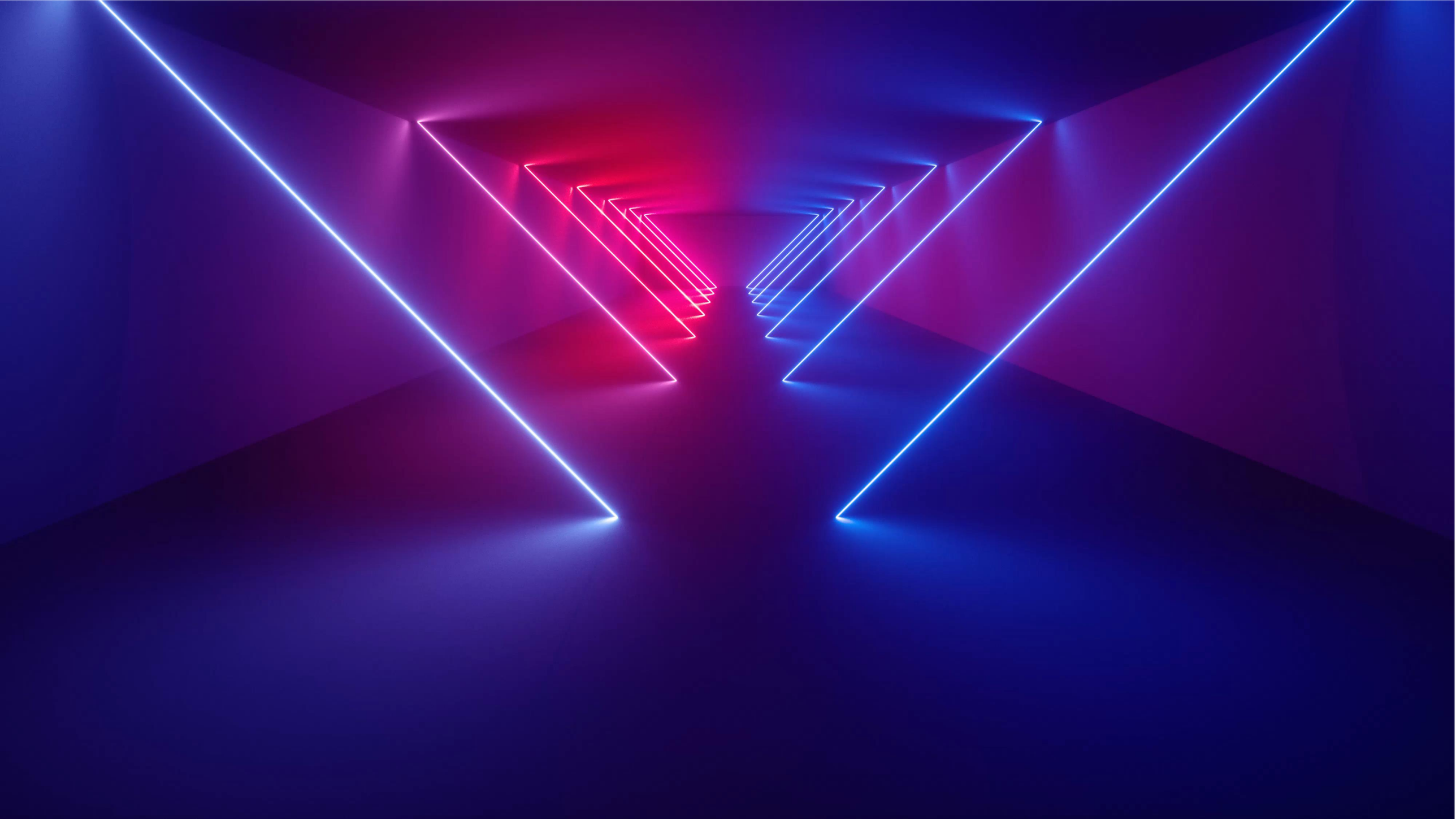
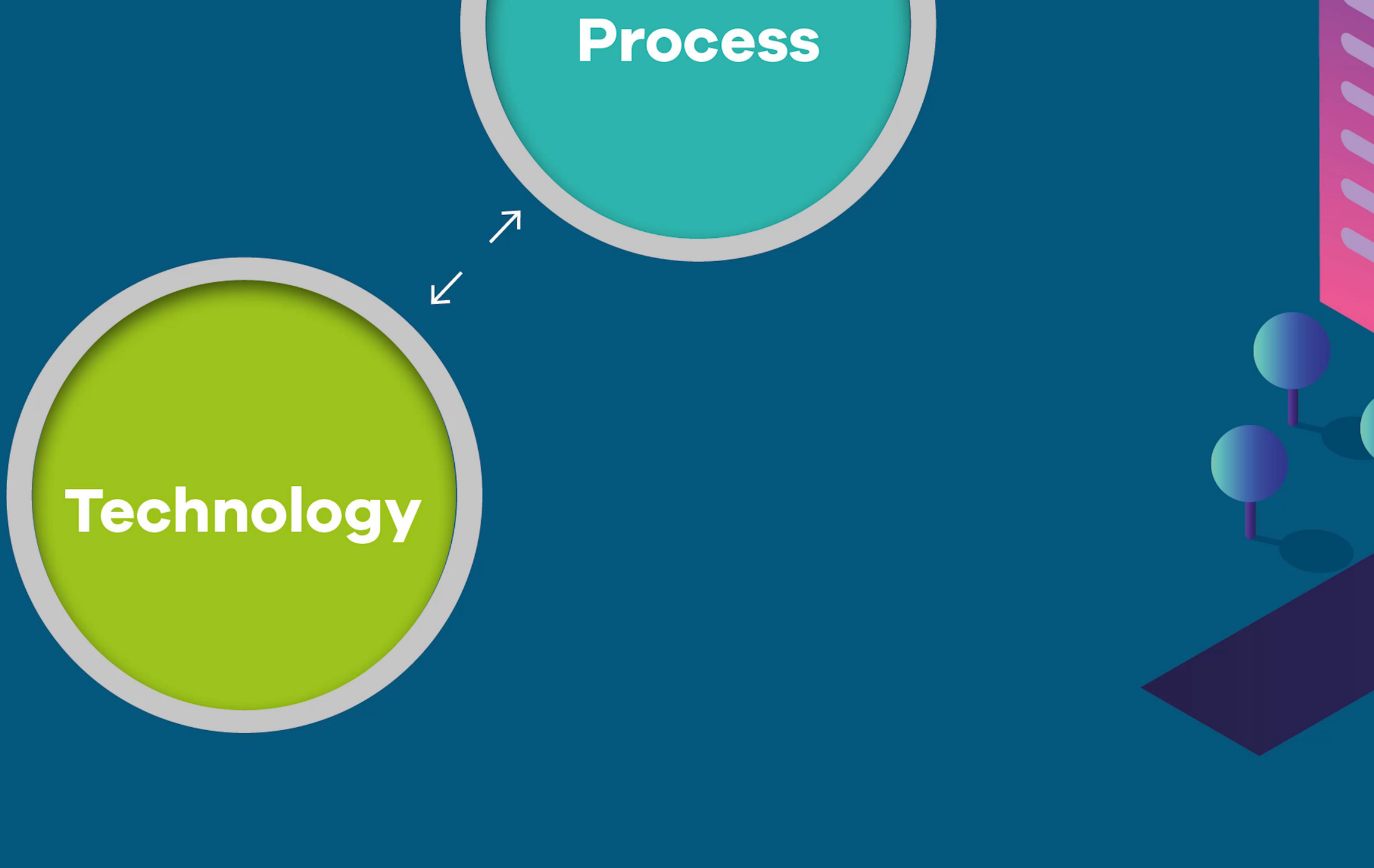
Join the conversation #CONNECT&CONSTRUCT

AUTODESK. UNIVERSITY




Process
Technology

People

Process

Technology

GTS

SMART BUILDINGS
GEOSPATIAL
INDUSTRY 4.0
BIM PROCESS
IMMERSIVE TECHNOLOGY
BIM E-LEARNING
BIM SOFTWARE

GRAHAM

SMART BUILDINGS
GEOSPATIAL
INDUSTRY 4.0
BIM PROCESS
IMMERSIVE TECHNOLOGY
BIM E-LEARNING
BIM SOFTWARE

GRAHAM

SMART BUILDINGS
GEOSPATIAL
INDUSTRY 4.0
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IMMERSIVE TECHNOLOGY
BIM E-LEARNING
BIM SOFTWARE

GRAHAM

SMART BUILDINGS
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INDUSTRY 4.0
BIM PROCESS
IMMERSIVE TECHNOLOGY
BIM E-LEARNING
BIM SOFTWARE

GRAHAM

SMART BUILDINGS
GEOSPATIAL
INDUSTRY 4.0
BIM PROCESS
IMMERSIVE TECHNOLOGY
BIM E-LEARNING
BIM SOFTWARE

GRAHAM

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UNIVERSITY

CONNECT & CONSTRUCT SUMMIT

Connect and Construct

Brian Roepke

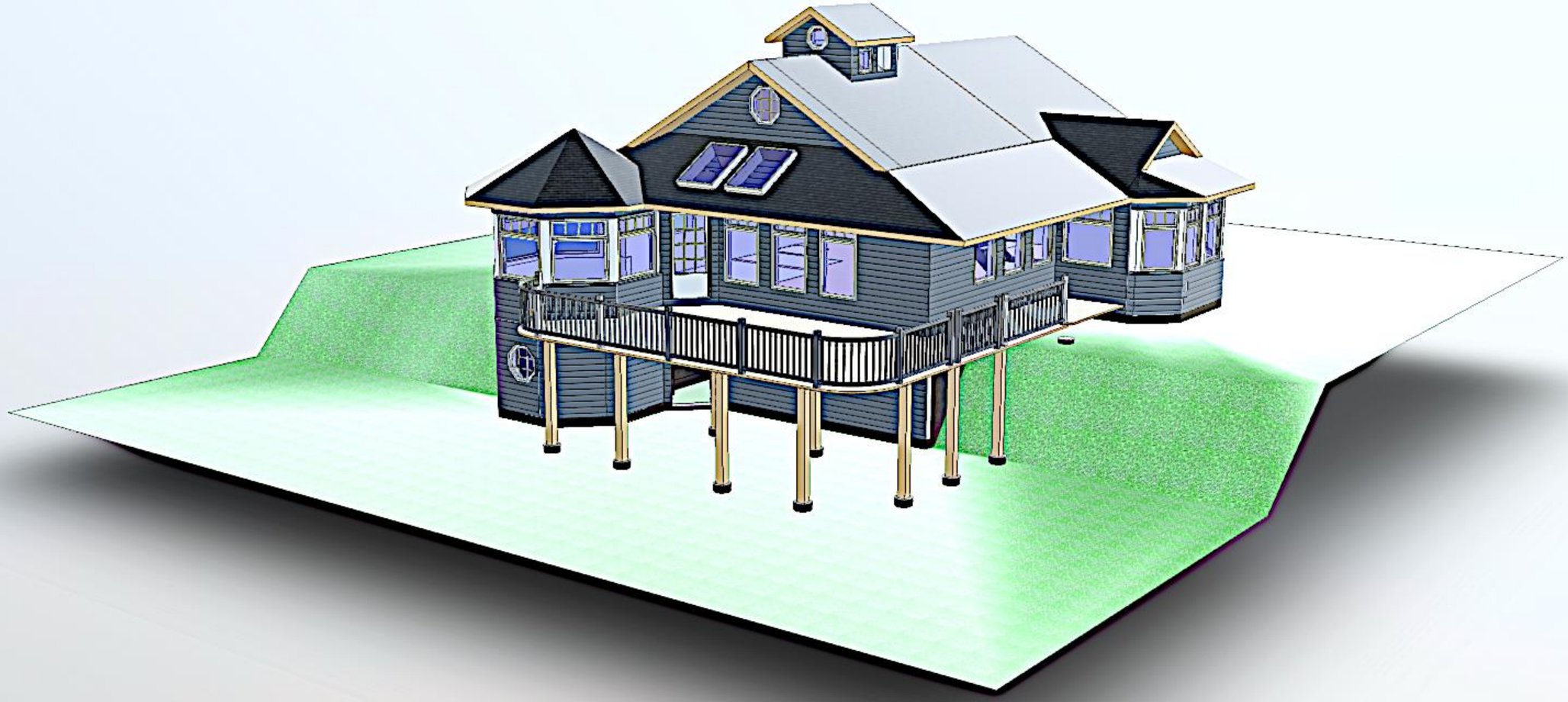
Senior Director, Forge Product Management

CONNECT & CONSTRUCT SUMMIT

AUTODESK. UNIVERSITY

AUTODESK® FORGE

THE FUTURE OF
MAKING THINGS



FORGE OFFERING

Data Management API

Reality Capture API

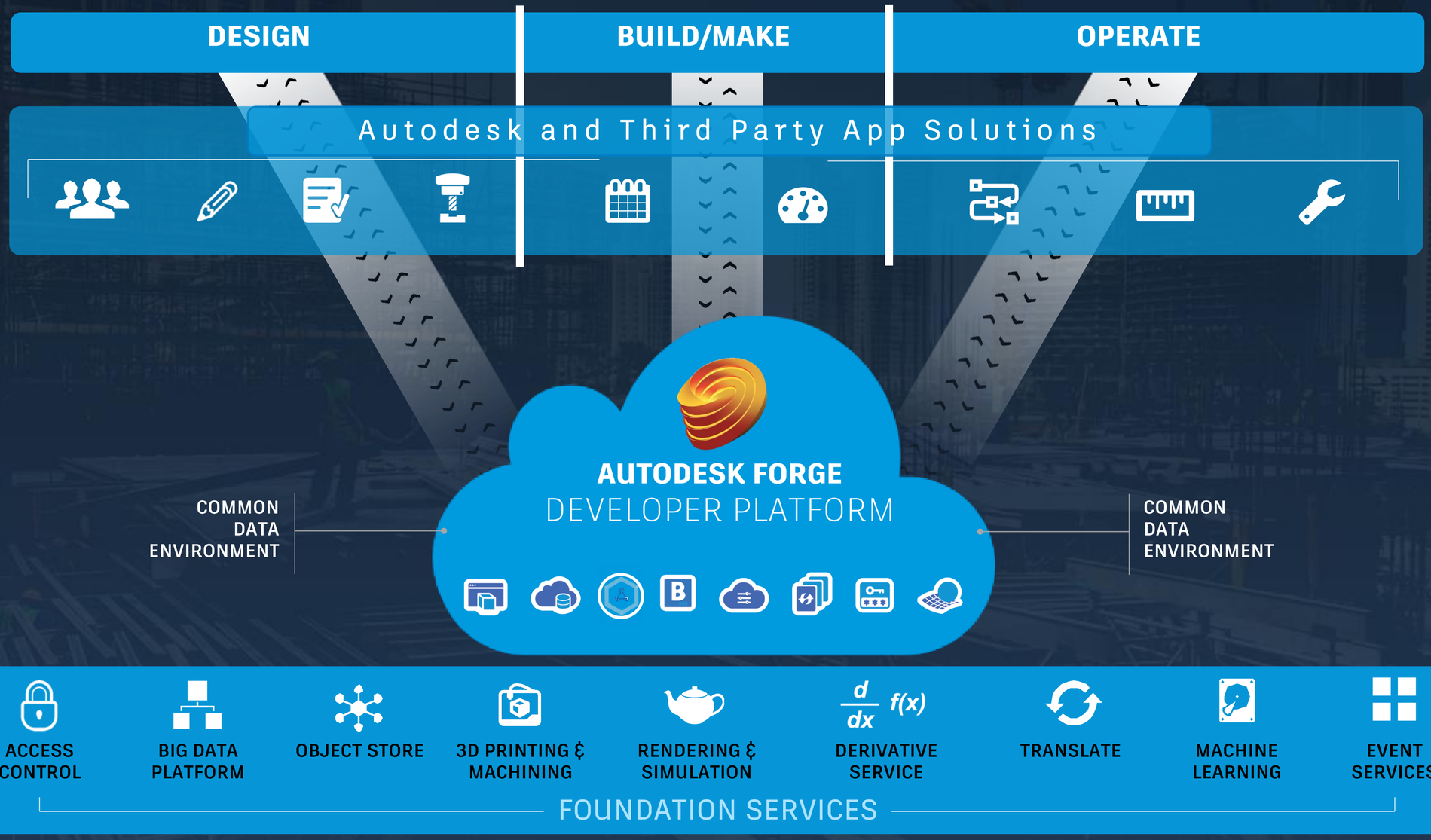
Design Automation API

BIM 360 API

Model Derivative API
& Viewer

Webhooks API

FORGE ECOSYSTEM


DESIGN
BUILD/MAKE
OPERATE
Autodesk and Third Party App Solutions
AUTODESK FORGE
DEVELOPER PLATFORM
COMMON DATA ENVIRONMENT
COMMON DATA ENVIRONMENT
ACCESS CONTROL
BIG DATA PLATFORM
OBJECT STORE
3D PRINTING & MACHINING
RENDERING & SIMULATION
DERIVATIVE SERVICE
TRANSLATE
MACHINE LEARNING
EVENT SERVICES
FOUNDATION SERVICES

FORGE COMMUNITY

FORGE APPLICATION DEVELOPERS

FORGE CUSTOMERS

SYSTEM INTEGRATORS

DESIGN
PRE-CONSTRUCTION
FIELD EXECUTION
HANDOVER & OPERATIONS
Authoring
Collaboration
Detailing
Scope
Cost / Schedule
Constructability
Quality / Safety
Progress Tracking
Work Coordination
Commissioning
Handover
Maintenance
ANALYTICS & INSIGHT
PROJECT DATA
AUTODESK FORGE

BUILD YOUR COMPETITIVE ADVANTAGE

AUTODESK®
FORGE

SWECO

SWECO

AUTODESK®
FORGE

SWECO

SMaRT

YASUI

Monitor temperature sensor information

Discomfort index+CO2 concentration

bam
Cadac Group

bam
AUTODESK®
FORGE
bam
BAM MEC

DPR
CONSTRUCTION
VUEOPS

Sanofi-Aventis Tucson Research Center

Lanier Technical College Medical Technology and Economic Development Center

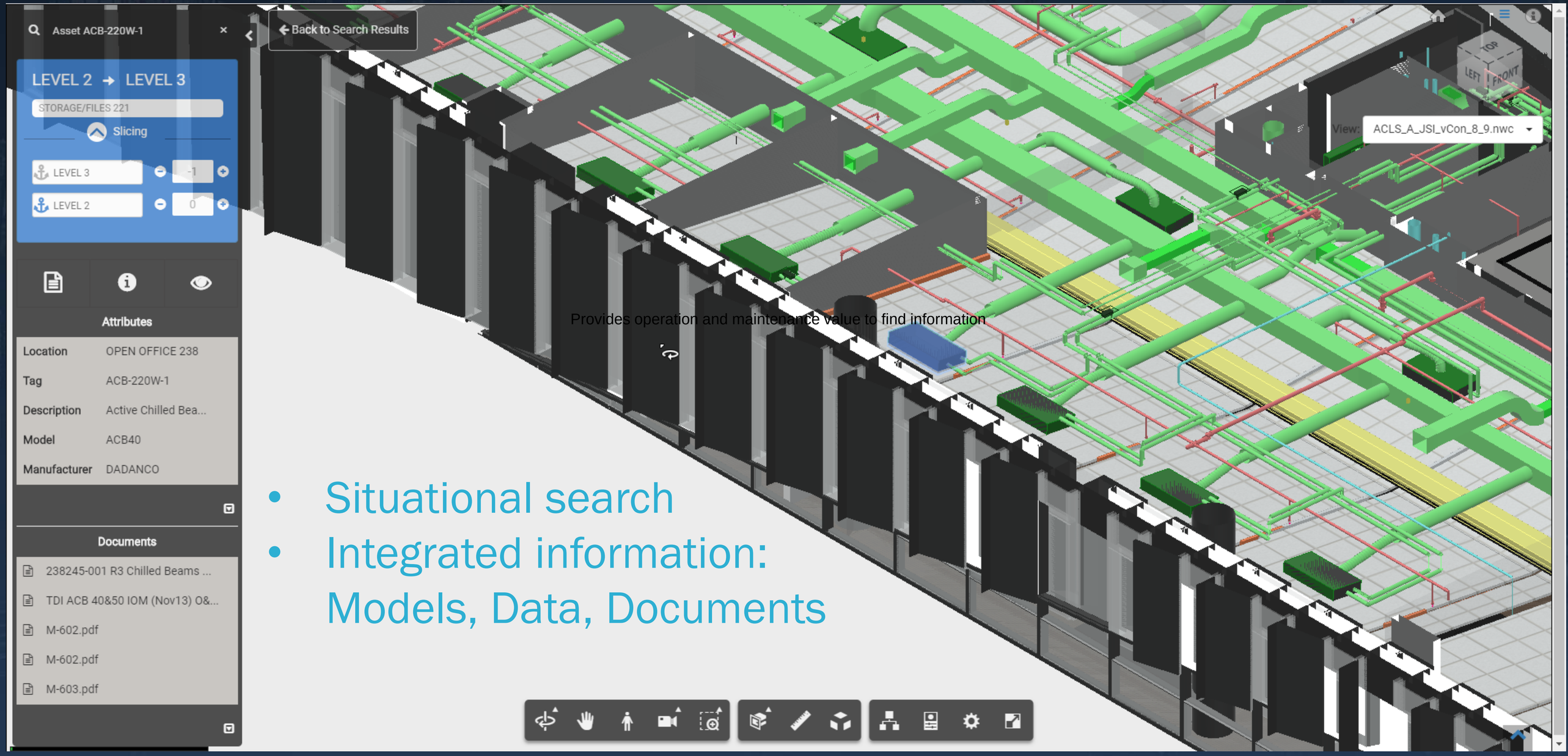
Databank ATL1 | High Performance Computing Center at Technology Square

Solano Community College District | Fairfield Science Building

CyrusOne Project Kincora Data Center

Clemson University Allen N. Reeves Football Complex

VUEOPS



- Situational search
- Integrated information:
  Models, Data, Documents

VUEOPS

Access to Situational Information – Asset attributes

VUEOPS

Access to Situational Information – Asset Documents

EXTENDING THE VALUE OF YOUR INVESTMENT

AUTODESK®
FORGE

NBS

NBS

AUTODESK®
FORGE

NBS

Nation BIM Standards Tootkit

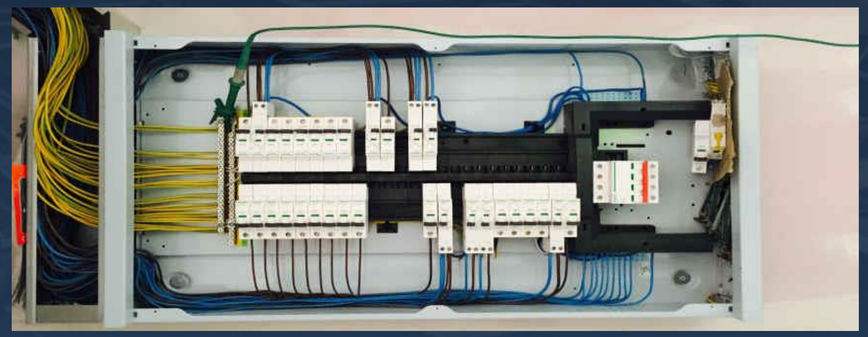
GTP

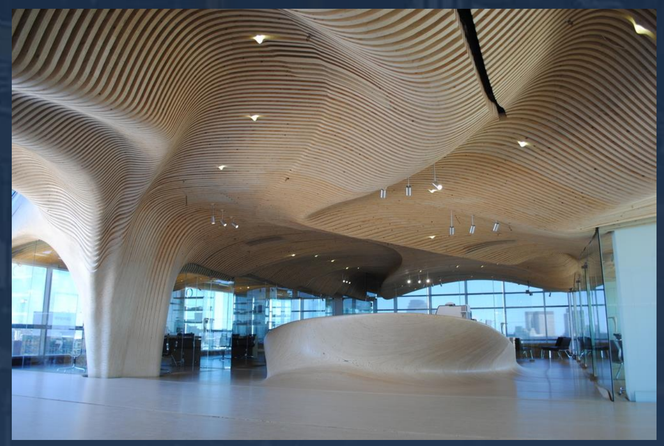
GTP Stratus

THE FUTURE OF FORGE
DATA & WORKFLOWS

AUTODESK
FORGE

Decoupled Systems: Design → Make

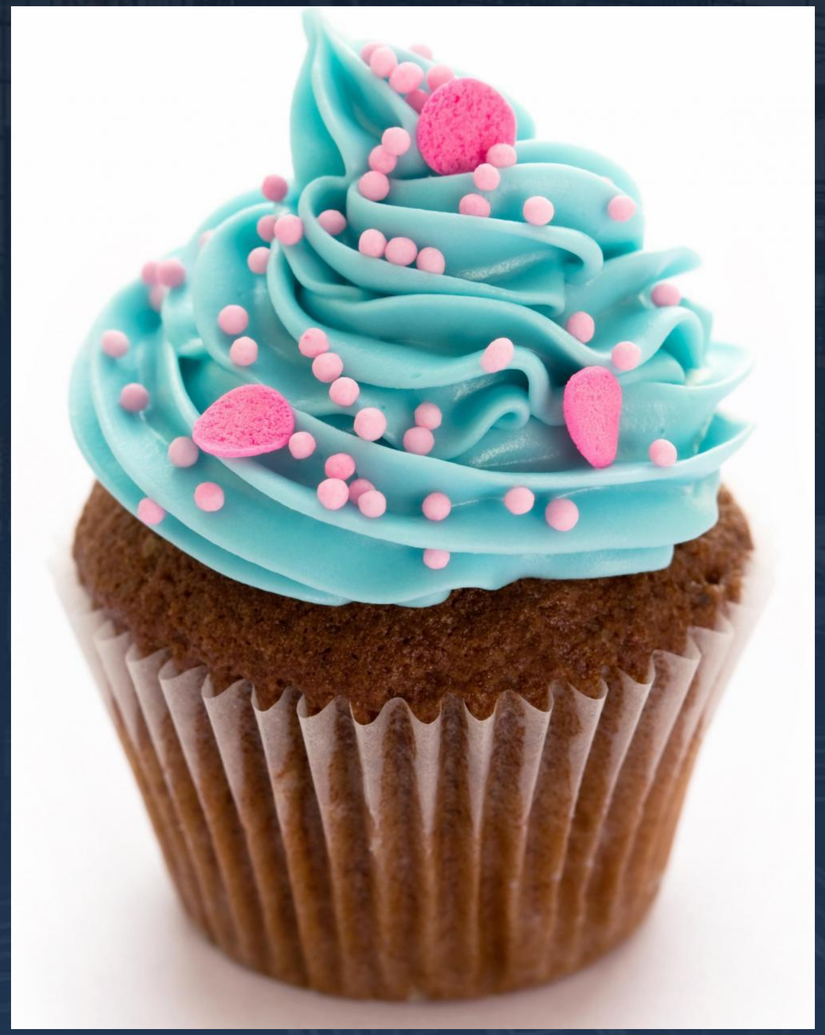


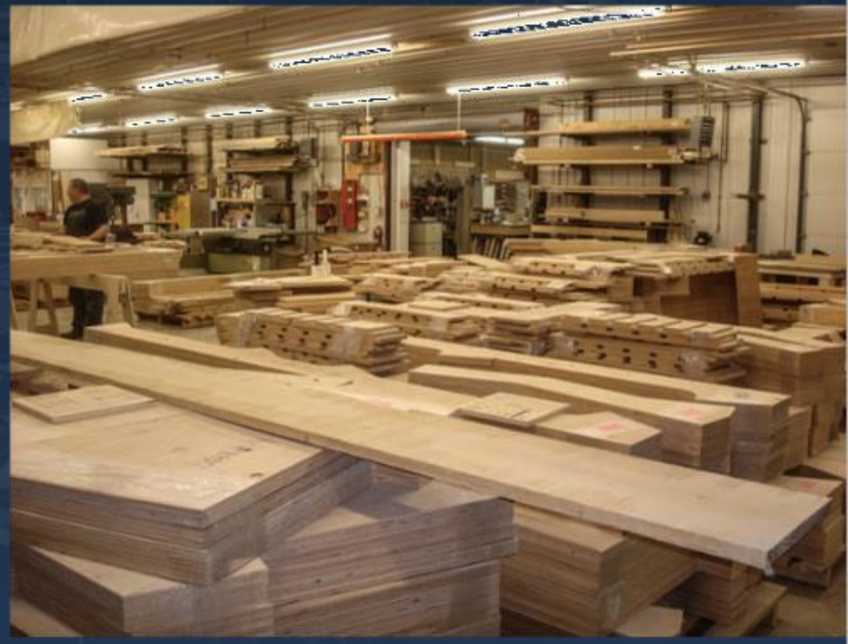


FROST SCIENCE

How it gets made is part of the design

Design / Make / Install





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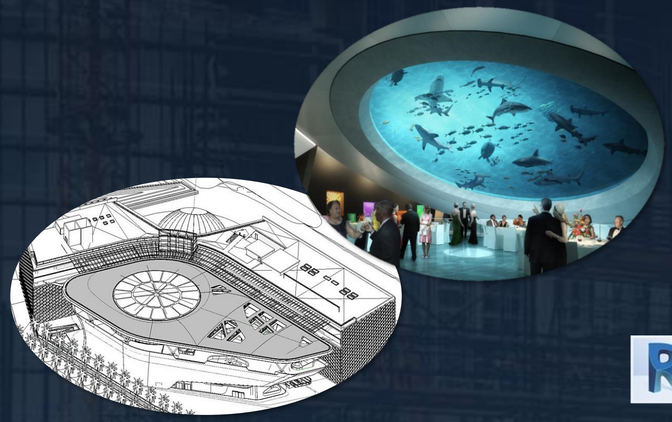
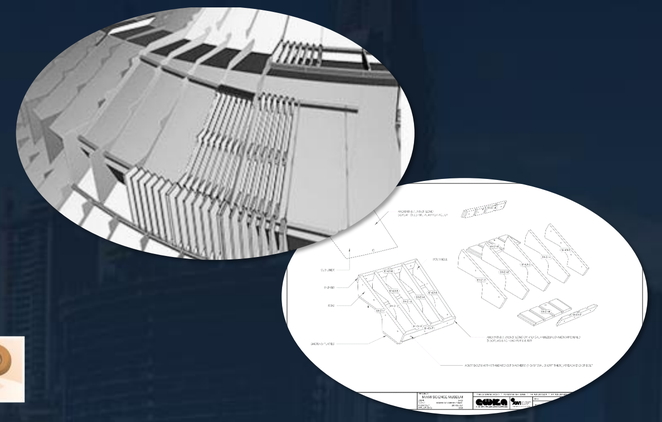
How it gets made is part of the design

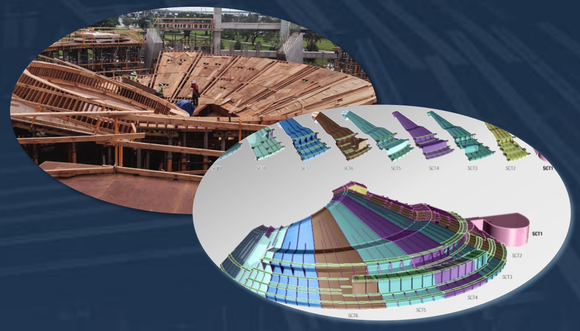


Design Criteria



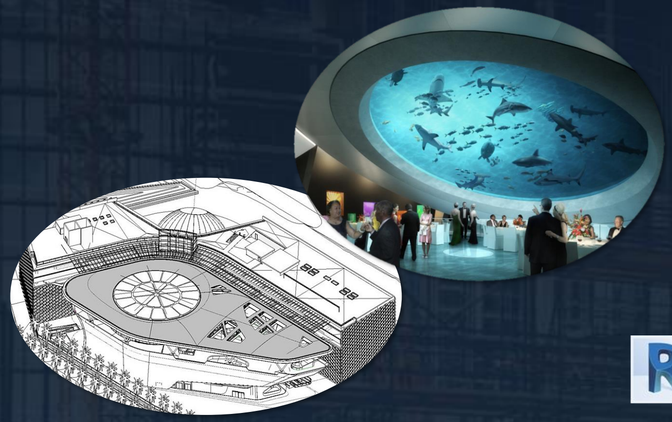
Fabrication Model

Fabrication and Installation Logic

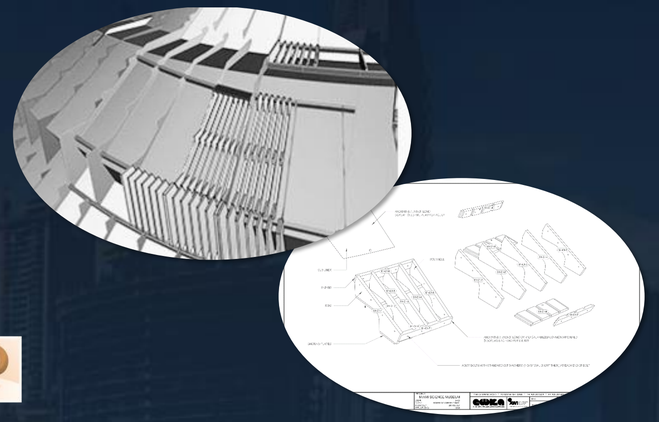


Fabrication

How it gets made is part of the design



Design Criteria

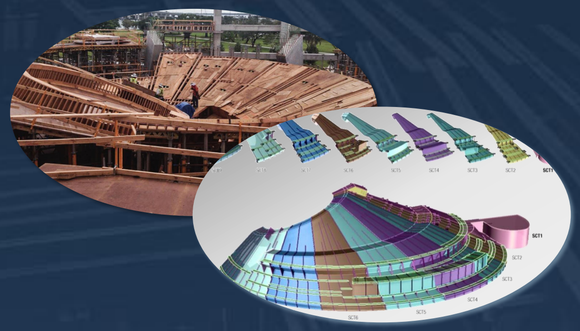


Fabrication Model

Data

Common Data Platform

Fabrication and Installation Logic



Fabrication

LEVERAGING DATA
FOR MACHINE LEARNING

AUTODESK®
FORGE

AUTODESK® BIM 360™
Project IQ

100
Trades

200
Models

5000
Issues

500
RFIs

50
Change Orders

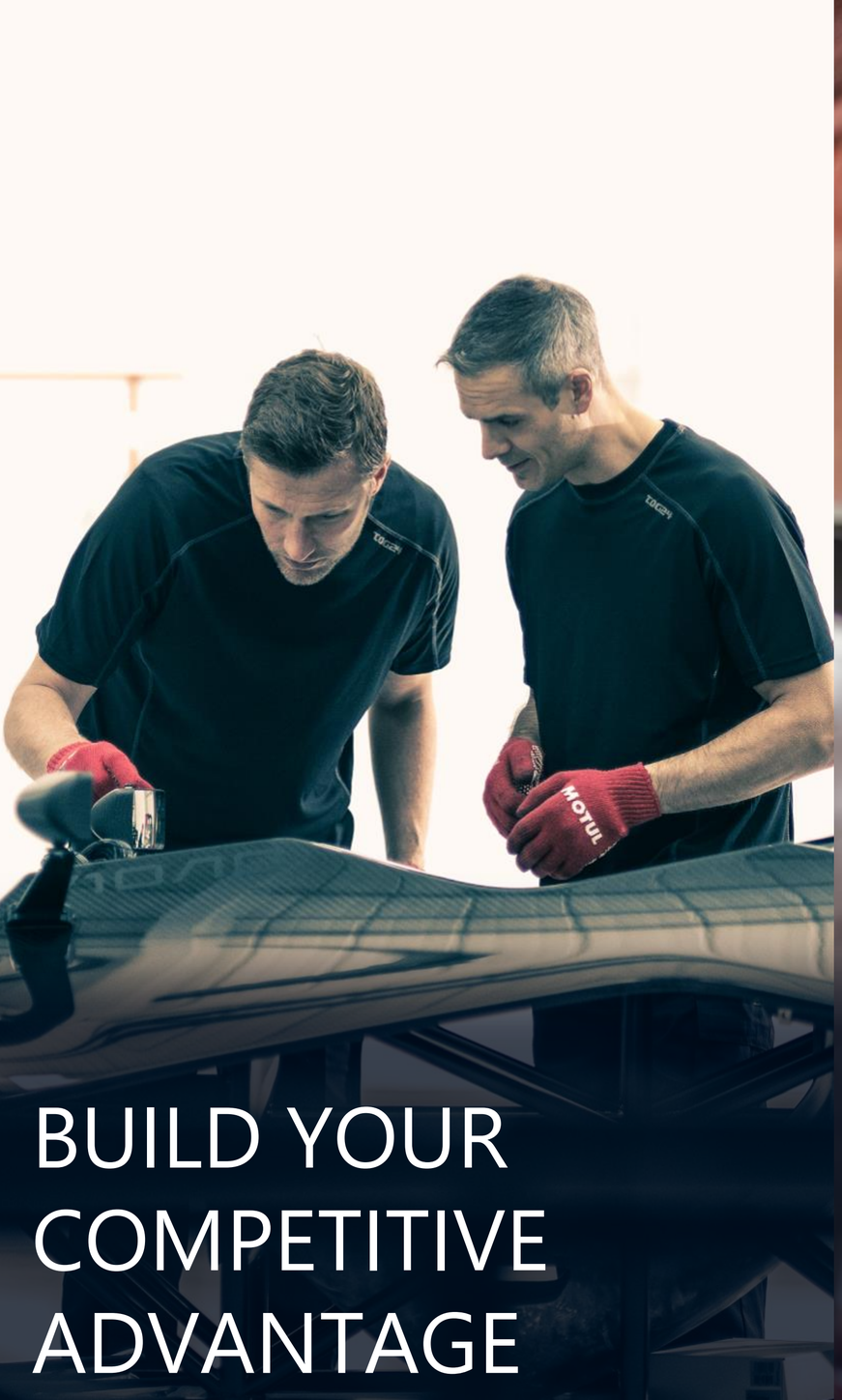
2000
Site photos

IQ

CONNECTED DATA

MACHINE LEARNING

PREDICTIVE INSIGHTS



BUILD YOUR COMPETITIVE ADVANTAGE

LEVERAGE FORGE PARTNERSHIPS

DATA & WORKFLOWS

GET STARTED FOR FREE
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Dr. Martin Fischer

CIFE/Stanford University

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Connect and Construct Summit:

Digitalizing construction management through industry-academia collaboration

Martin Fischer

Kumagai Professor in Engineering and Professor of Civil and Environmental Engineering

Director, Center for Integrated Facility Engineering (CIFE)

Stanford University

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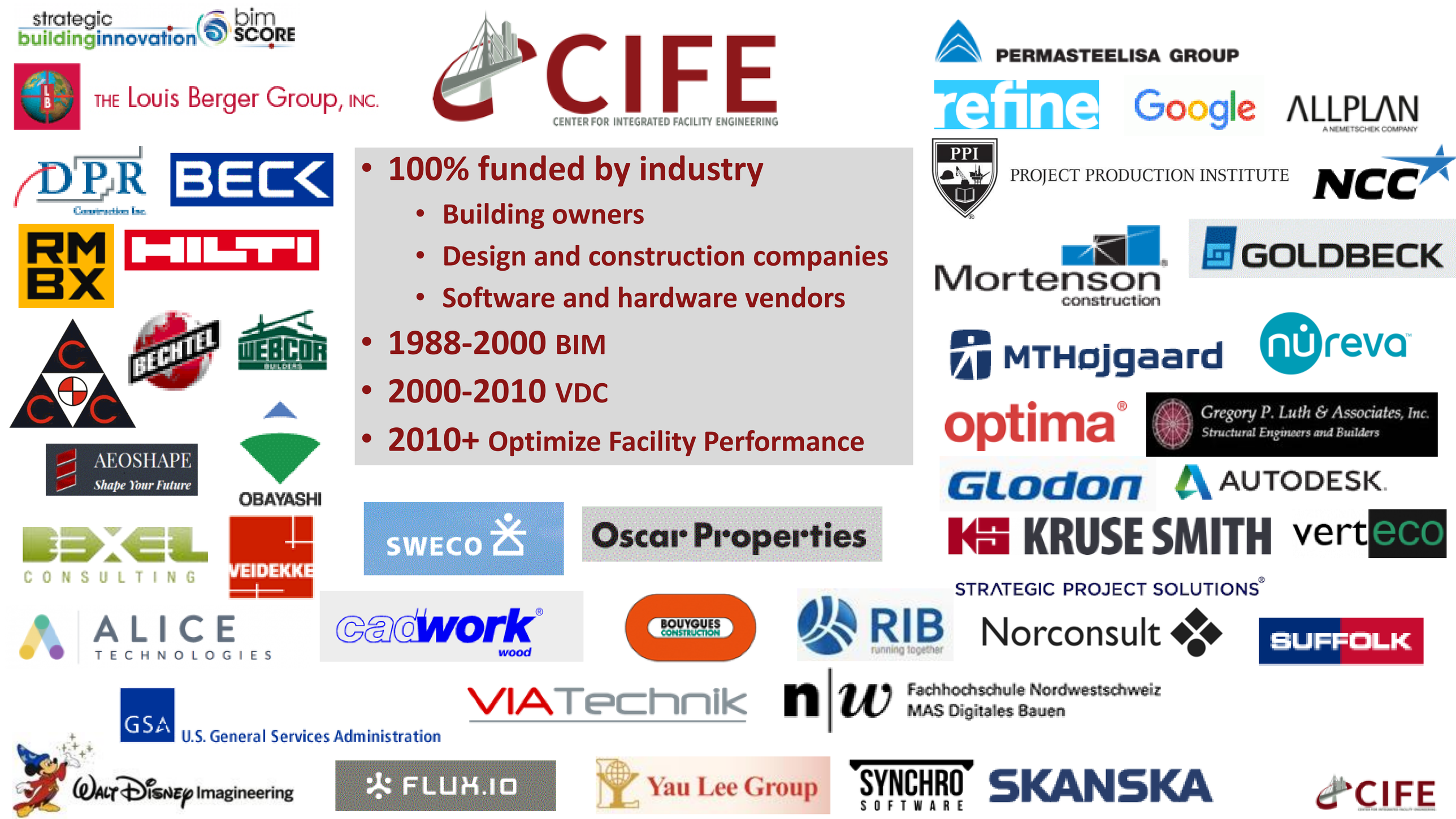

- 100% funded by industry
  - Building owners
  - Design and construction companies
  - Software and hardware vendors
- 1988-2000 BIM
- 2000-2010 VDC
- 2010+ Optimize Facility Performance

Vision –
A future I would like to make happen

Every workhour
builds the right product
safely and productively

Definition of Vision by Robert Burgelman, GSB, Stanford

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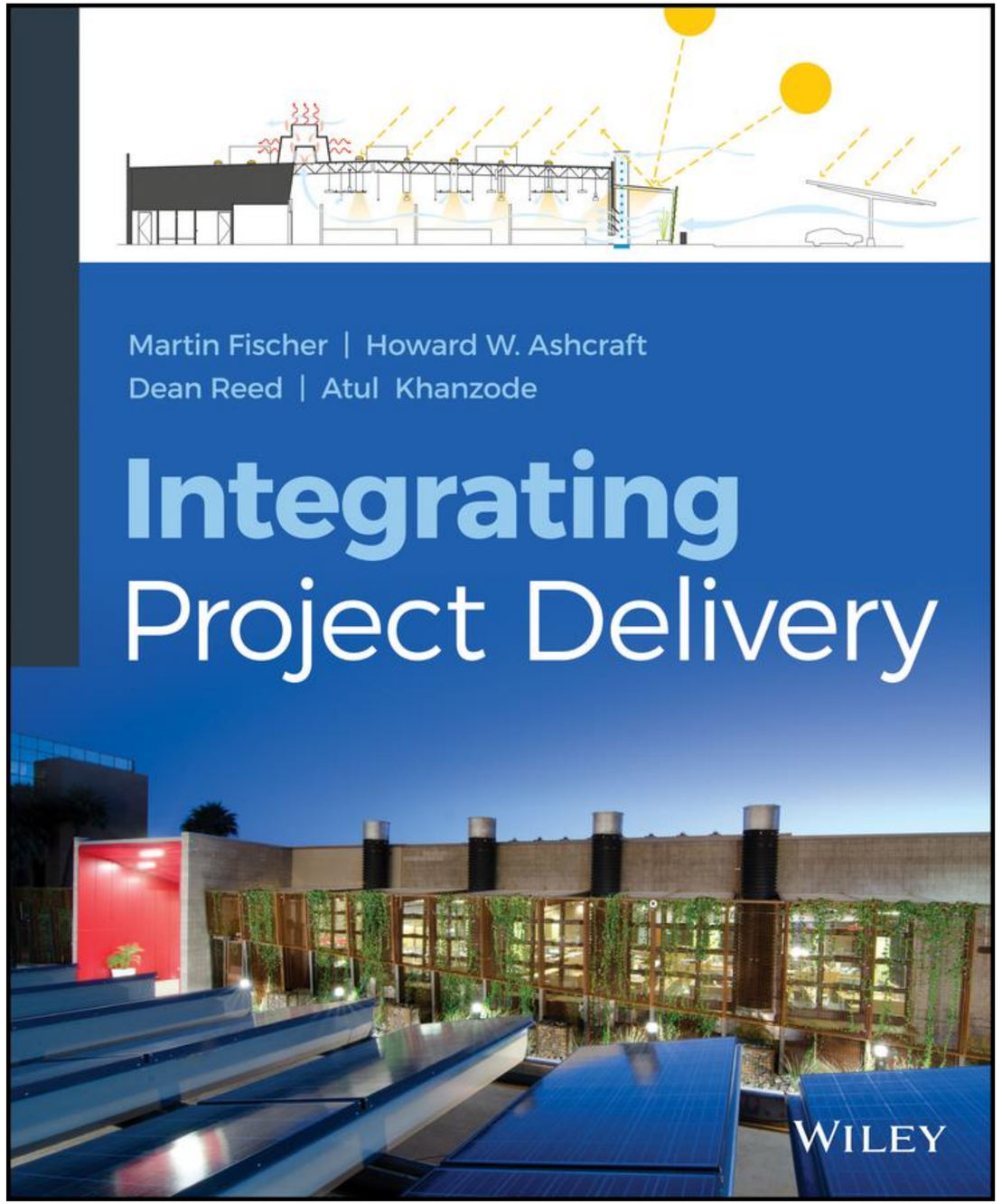
Integration is the key strategy for creating the right (high-performing) building



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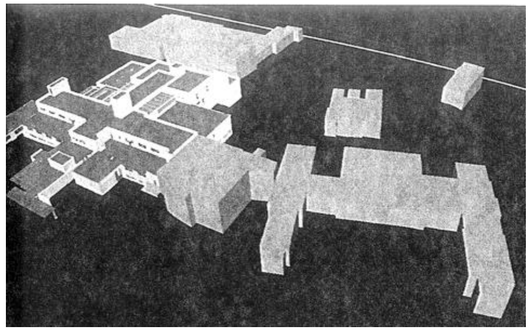
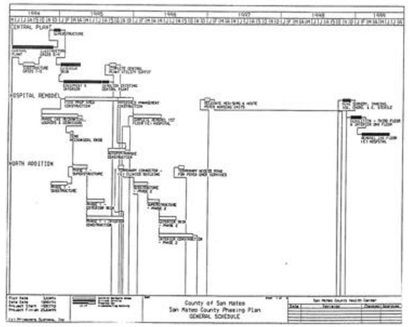
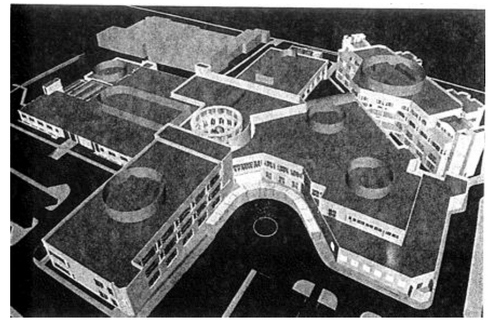
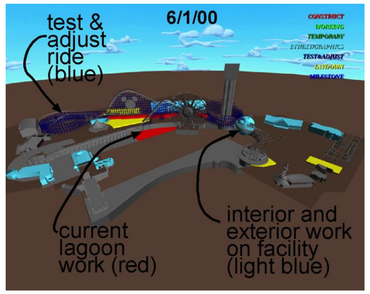
Samples from a long history of impactful industry-academia collaboration

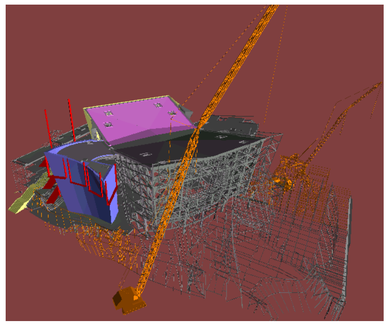
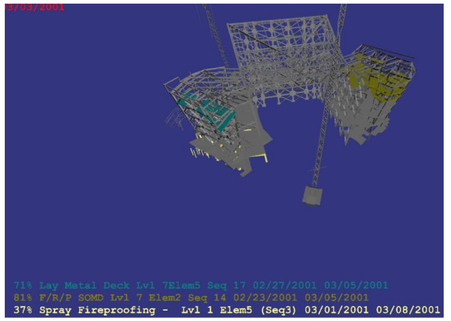
- 1993: San Mateo County Health Center Reconstruction 4D model
  Dillingham Construction

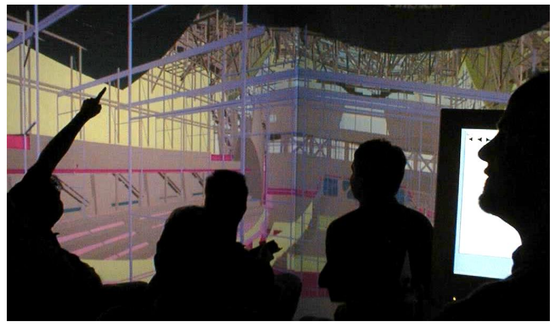




- 1998 Disney's California Adventure

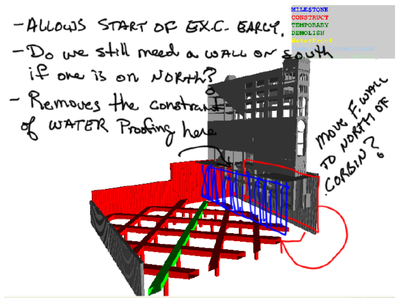


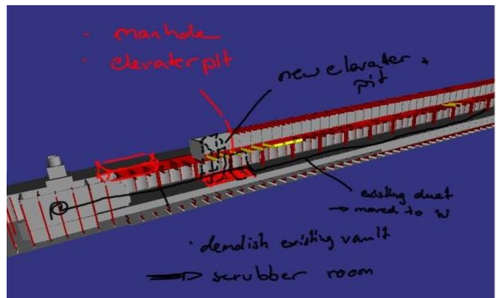
- 2000 Walt Disney Concert Hall
  Mortenson



- 2004 Fulton Street Transit Center
  Parsons Brinckerhoff





Current and recent CIFE-industry collaborations to connect and construct

- Dynamic look-ahead windows
  - Create digital feedback loops to learn on a project and across projects
  - CCC, Drees & Sommer, Autodesk, DPR, Mortenson, Suffolk, and othersSingle vs. multi-disciplinary design optimization of steel structures
- Automated construction scheduling
  - Find the best construction approach in the context of a project
  - Skanska
- Additive manufacturing of construction components
  - Determine the readiness and impact of new production methods
  - Permasteelisa
- Show the design impact of fabrication and construction costs
  - Arup, Herrick, SOM, Autodesk

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Loops

Dynamic Look-Ahead Windows based on project performance Feedback Loops

Martin Fischer
fischer@stanford.edu

Maximilian Schuetz
schuetz@stanford.edu

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Building on insights from current best practice

14 Case Studies

in **7** Countries
- Brazil
- England
- Germany
- Kuwait
- Oman
- Russia
- USA

on **4** Project types
- Residential
- Commercial
- Educational
- Industrial

4 Construction Planning cycles observed across all projects

Phase Planning	3 – 8 months ahead
Monthly Look-Ahead	4 – 8 weeks ahead
Weekly Work Plan	1 - 3 weeks ahead
Daily Check-In	1 - 3 days ahead

Fischer, M., Schütz, M. (2017) “Construction Planning and Feedback Loops – Analysis of Current Practice“ CIFE, Stanford University

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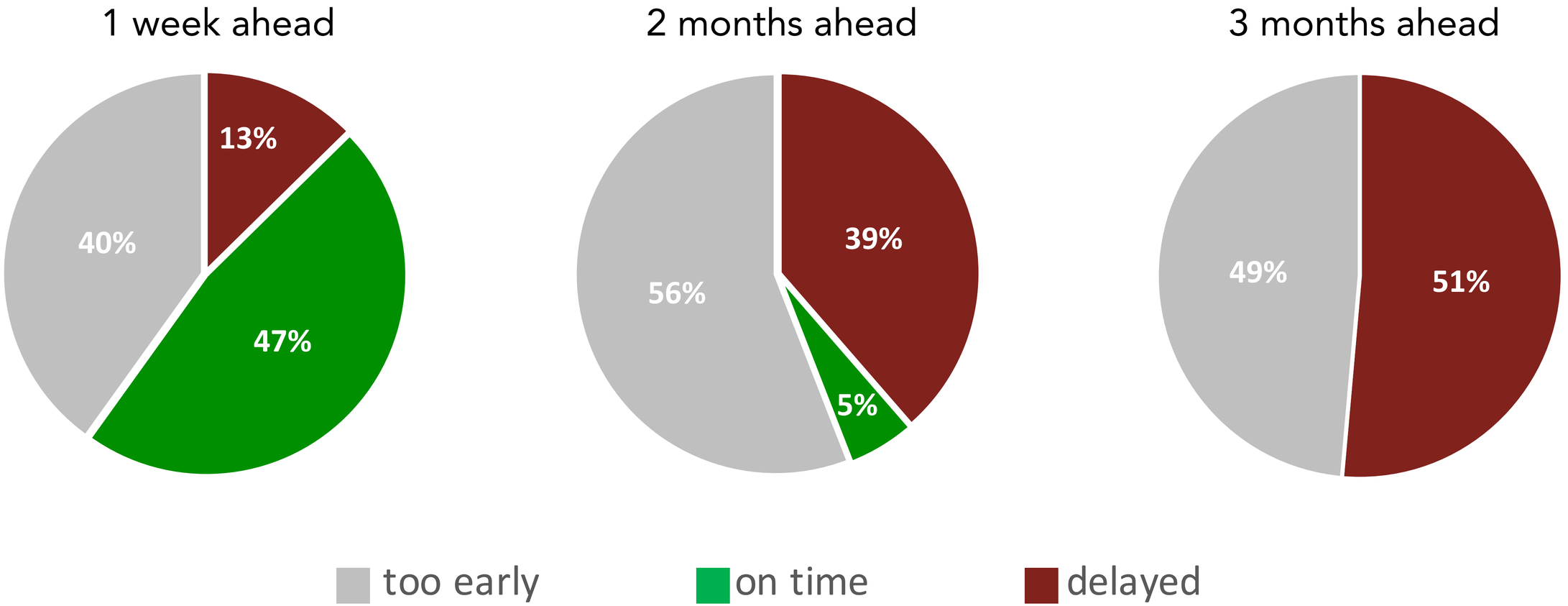
Today's planning methods don't lead to reliable plans

Reliability by Look-Ahead window



Fischer, M., Schütz, M. (2017) "Construction Planning and Feedback Loops – Analysis of Current Practice" CIFE, Stanford University

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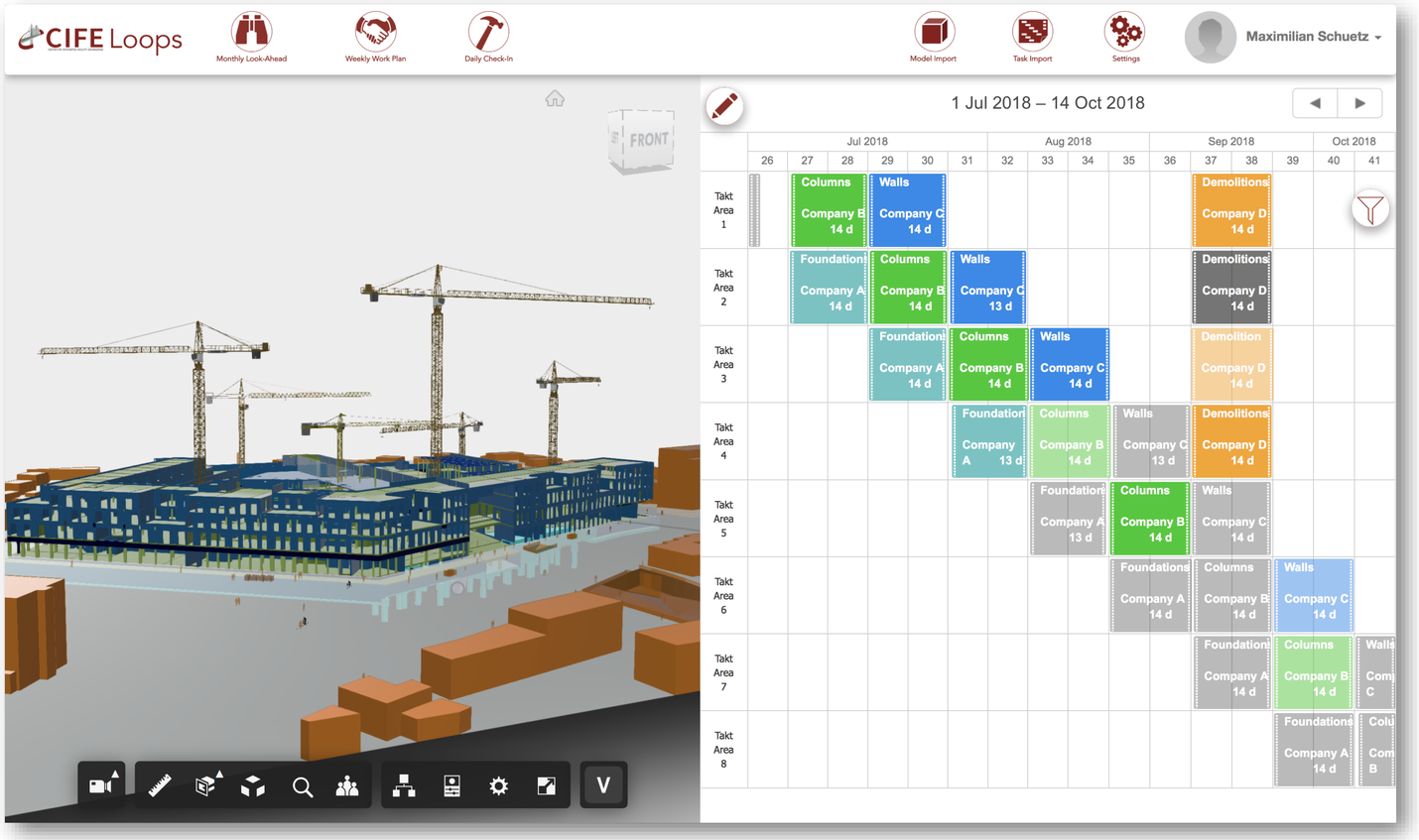
A web-based cloud platform that…

Loops

…accommodates and syncs all planning cycles

…integrates with other systems

…imports all common BIM formats



…is customizable to project needs

…is intuitive and easy to use

…is fully touch-enabled

…learns from past project performance

…imports your existing plans

…dynamically adapts your Look-Ahead windows

…integrates BIM and Lean methods

…supports location-based Takt Time Planning

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INTEGR ATE

Loops

- reads 68 3D model formats,
- imports existing schedules and plans, and
- uses the Autodesk ID for login

Manage all Look-Ahead windows with one platform

Monthly Look-Ahead **Weekly Work Plan** **Daily Check-In**

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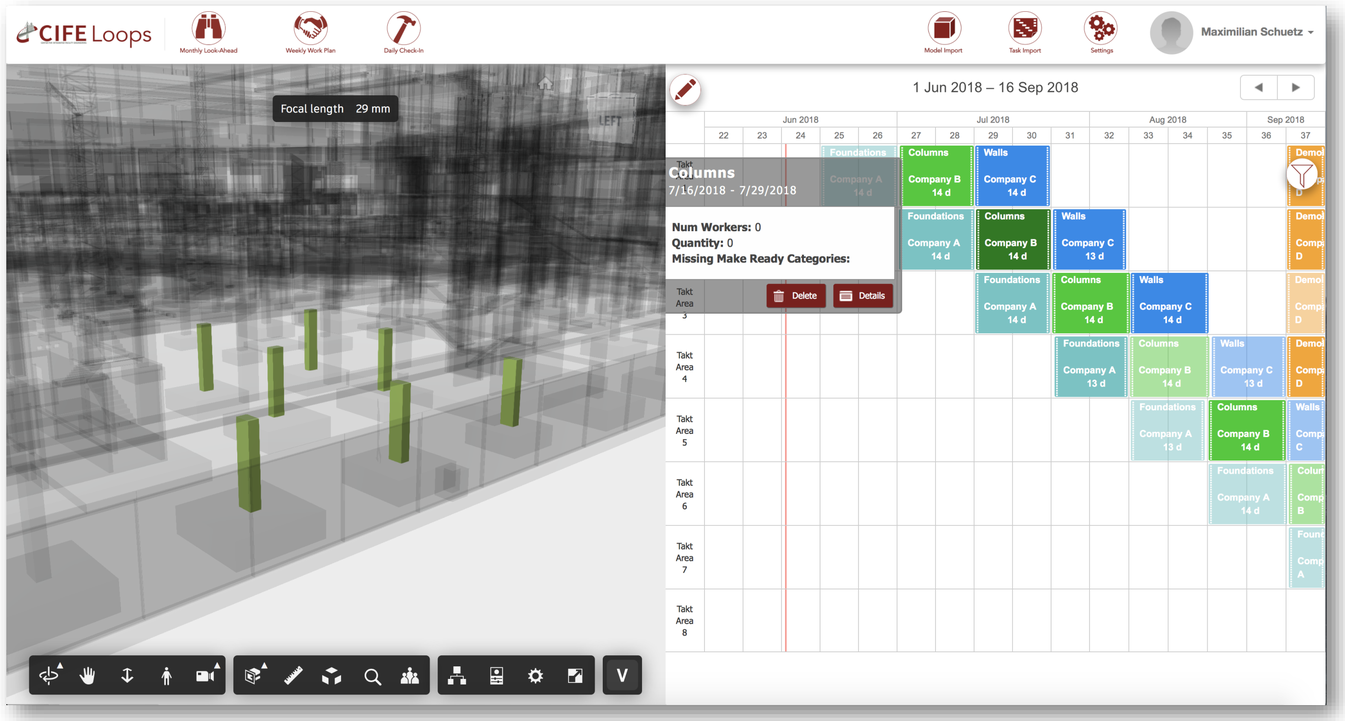
Plan what you see and see what you plan

Combine BIM and location-based Takt Time Planning.



Loops can detect Takt Areas, or locations, in the 3D model and in the plan and link them automatically.

Loops dynamically adjusts the view in the model and the plan when an area, a takt, or task is selected.

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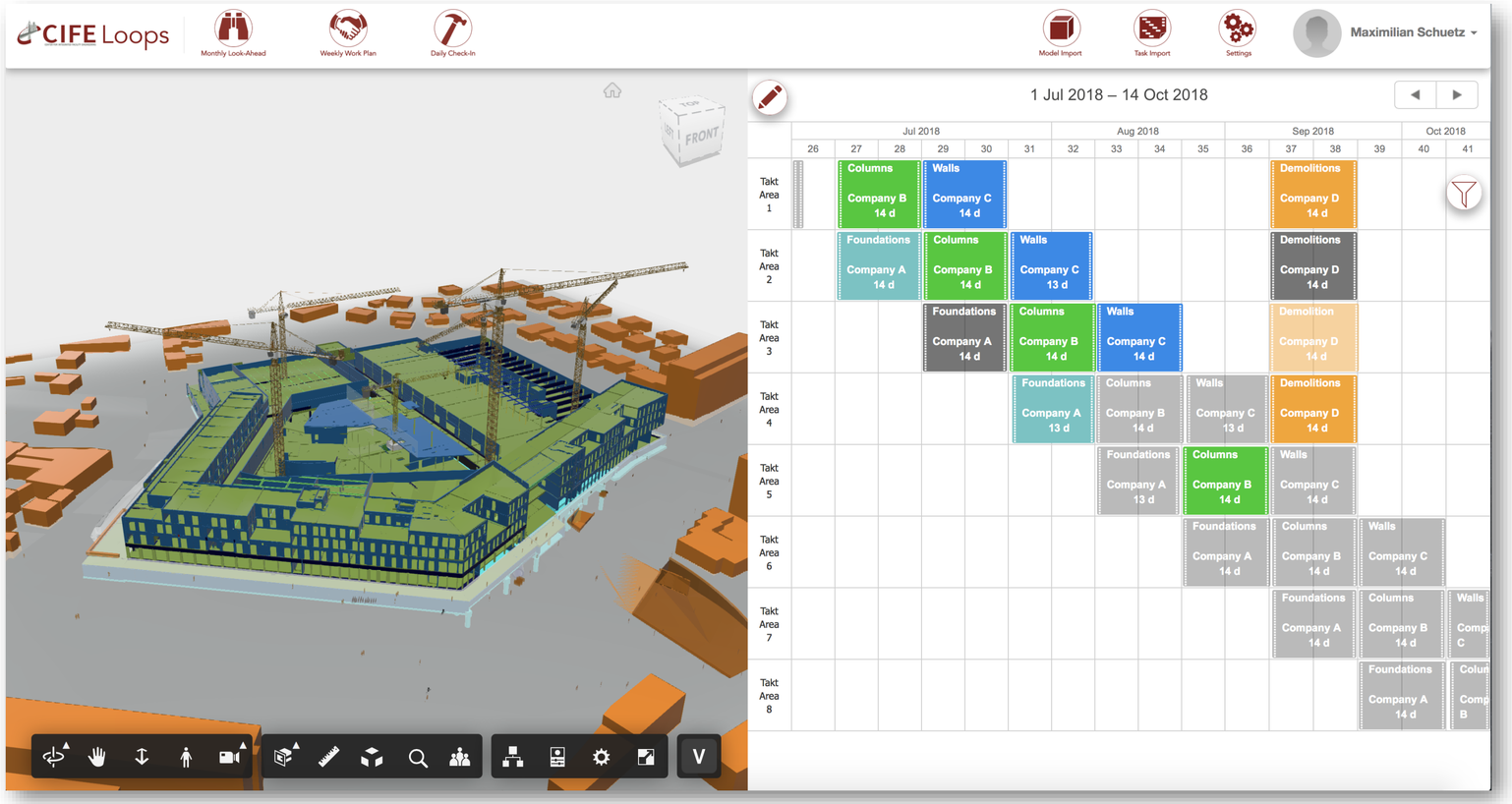
Use the right time horizon

Time horizons adapt depending on the tasks and supply chain.



Leave the limitations of static look-ahead windows behind. Loops learns about how the project has been going and adapts the look-ahead window to the time horizon needed to get ready for construction.

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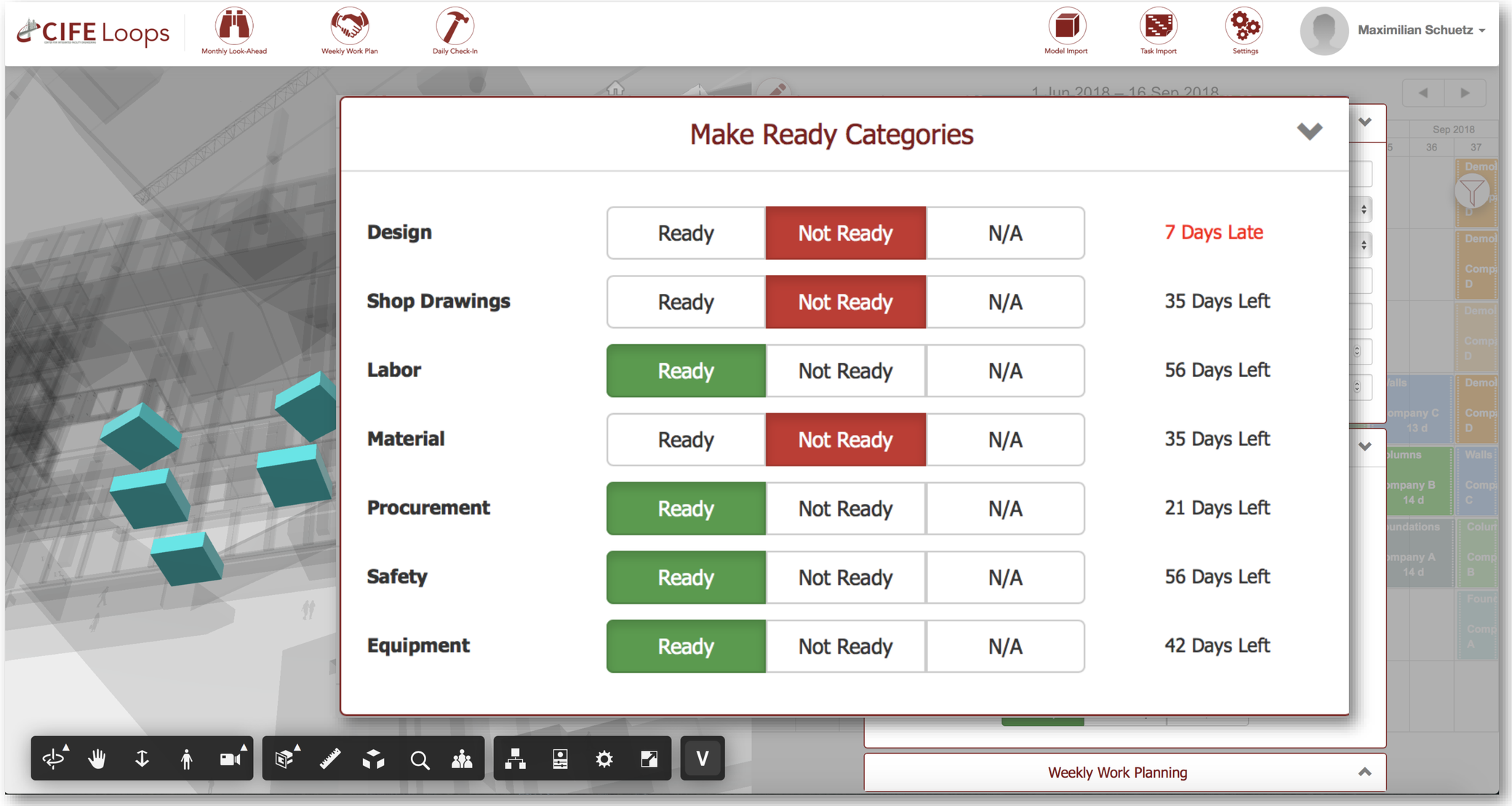
See what's missing for construction

Loops



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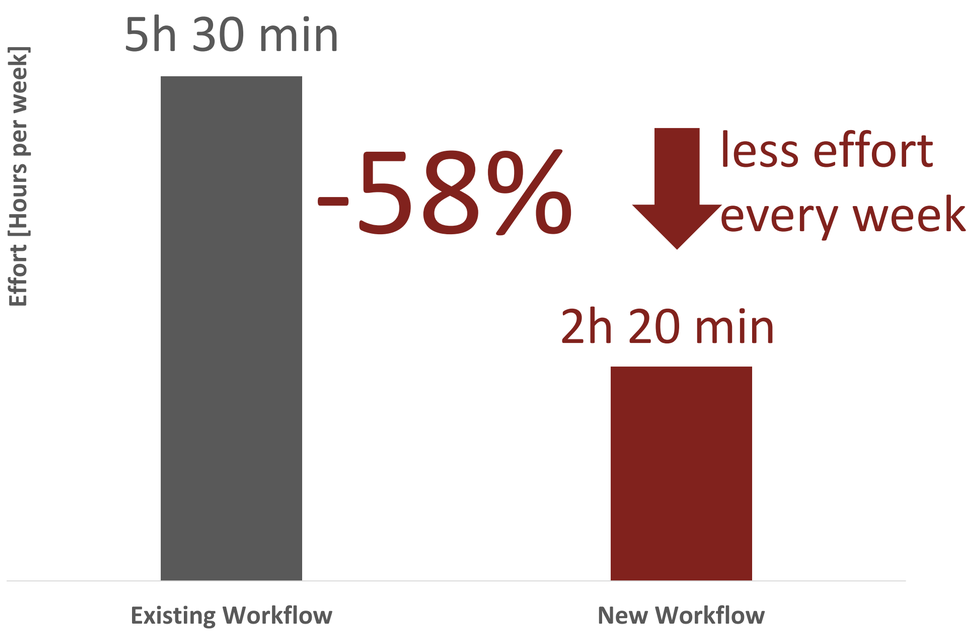
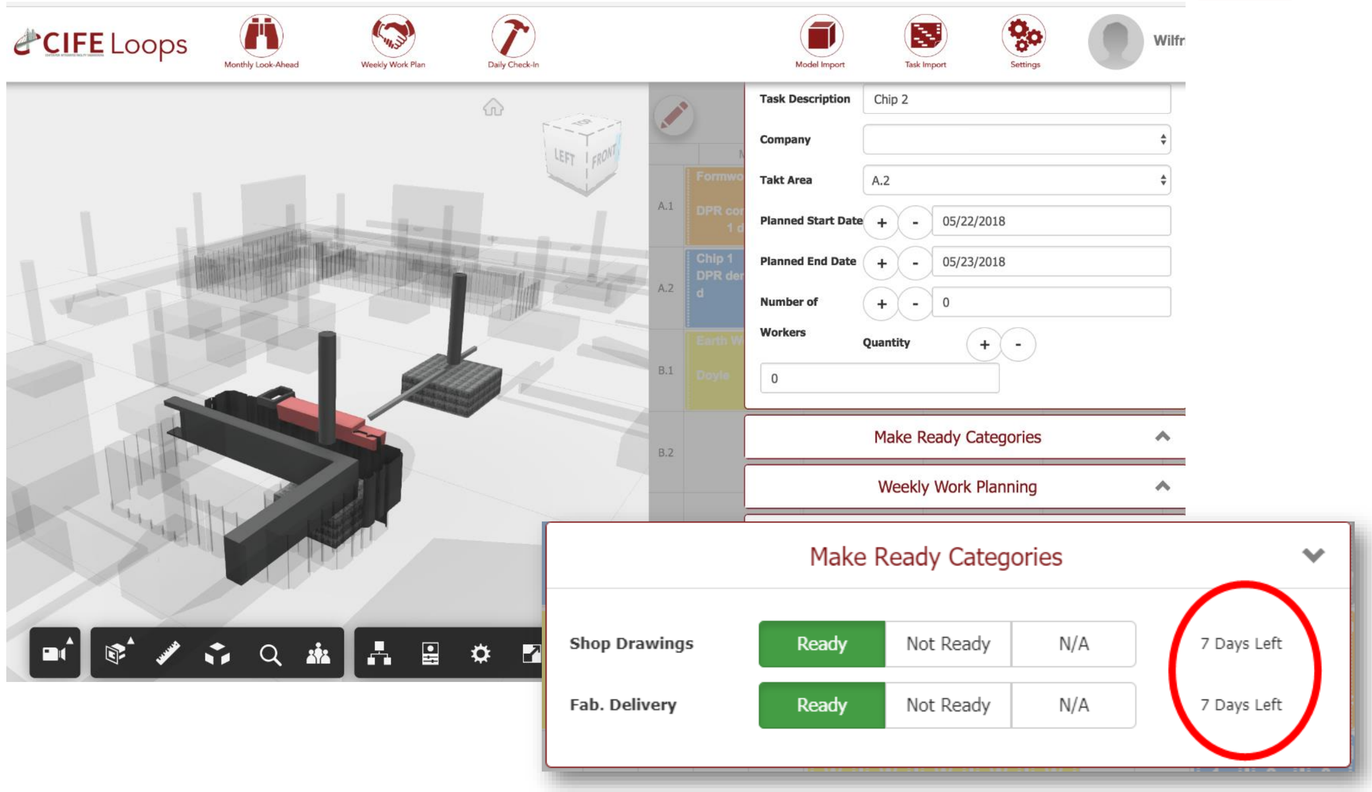
Efficient and effective planning





The owner approved a change order rapidly because, with Loops, he understood the supply chain implications and affected lead times of the change.

Independently implemented and tested by a separate research team on 3 case studies in California, USA

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Feedback from industry leaders

"Loops is how we envision to work in the future."
Jan-Hendrik Goldbeck, CEO and Owner, Goldbeck GmbH

"All I can say is WOW. This is my dream tool."
Erika Byse, Regional Scheduler, DPR Construction

"I can't wait to get my hands on this."
Gunnar Skeie, Head of VDC, Kruse Smith

"I was thrilled with this! All I could think is I want to help […] THAT is a game changer."
Gregory P. Luth, Ph.D., S.E., SECB, President GPLA

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Construction Schedule Workshop on May 25, 26, and 28, 2018

Find the “best” formwork and sequencing option for a high-rise building project

Participants:

- Skanska Property Development, Construction, and Quality Control
- ALICE
- CIFE-Stanford Researchers

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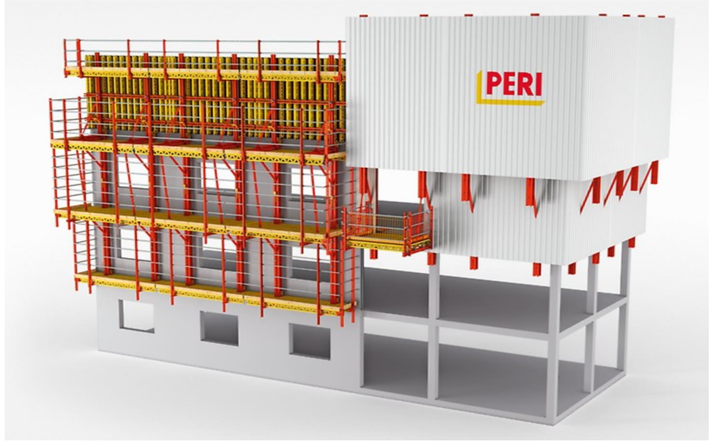
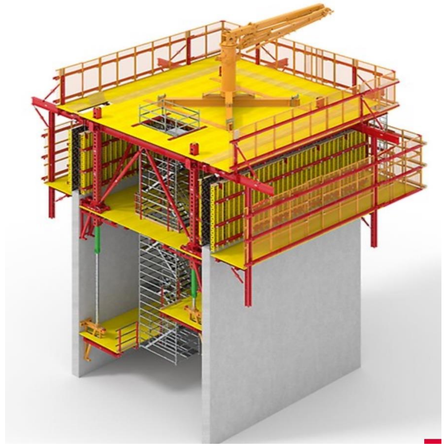
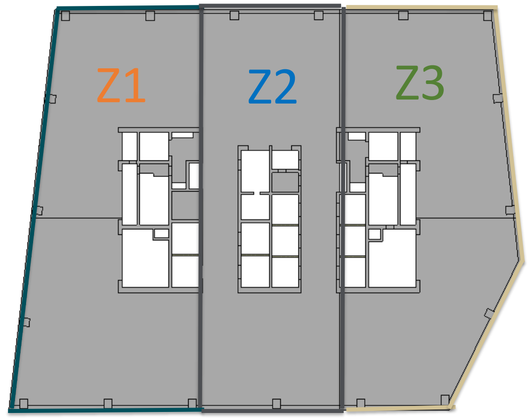
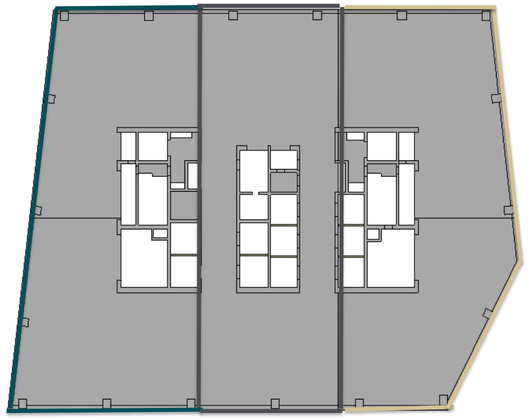
Key construction decisions: formwork and sequencing









- **Peri RCS Rail Climbing System**
- $165,000 / month
- Time to raise / set up formwork: 20 hours
- Time to close formwork: 6 hours
- Crane required to raise and close formwork

- **Peri ACS Core 400 Self-Climbing System**
- $295,000 / month
- Time to raise / set up formwork: 10 hours
- Time to close formwork: 2 hours
- No crane required to raise and close formwork

Z1 → Z2 → Z3

Sequential

Z1 ← Z2 → Z3

Parallel

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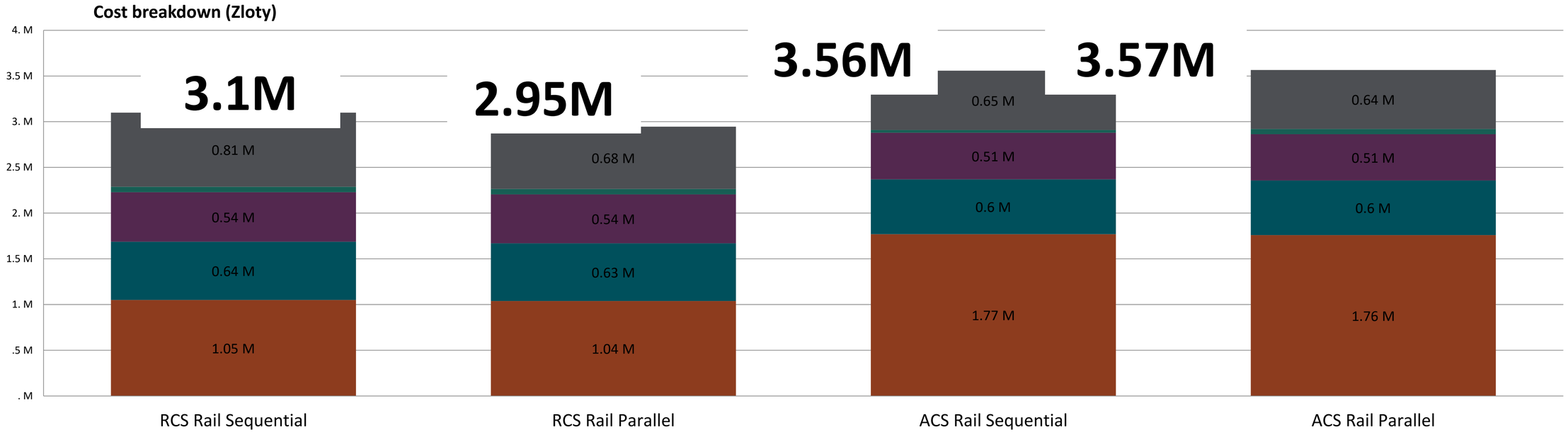
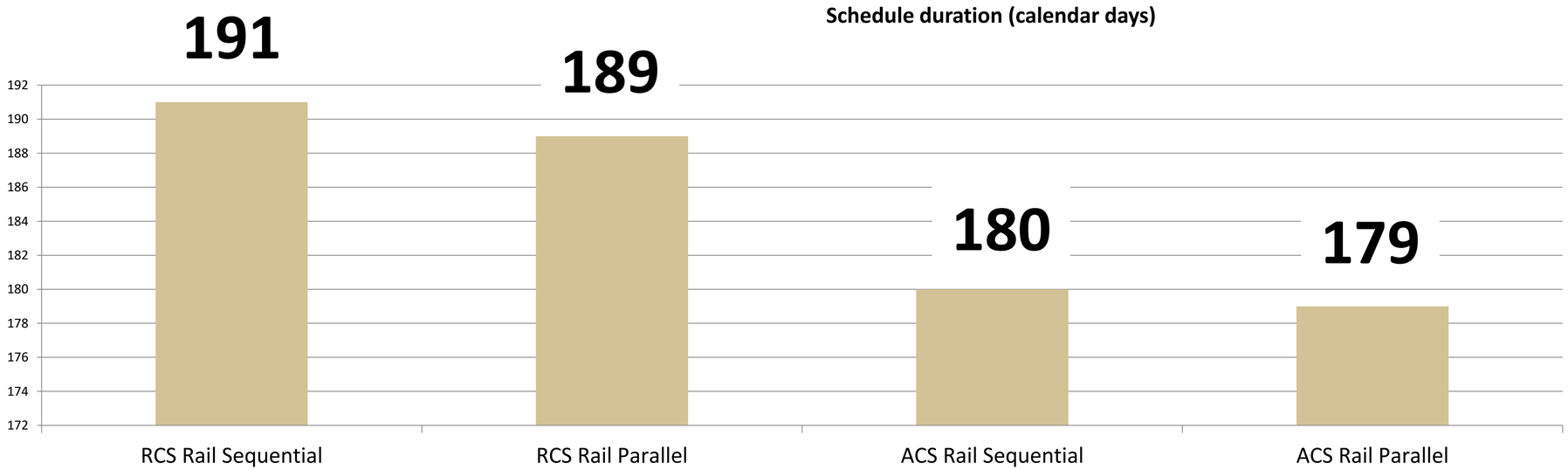
Results overview: cost and schedule





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Results Overview – Slab + Column Formwork

Find slab and column formwork required to achieve the “optimal” schedule for each option

RCS

ACS

Formwork Needed: **3,182 m2**

Formwork Needed: **2,701 m2**

Formwork Needed: **2,701 m2**

Formwork Needed: **2,701 m2**

Sequential

Parallel

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Key simulation and collaboration information

# Schedule scenarios generated	341
# Optimization runs	65
# Schedule scenarios used for analysis	24
Average time to reschedule	10 mins

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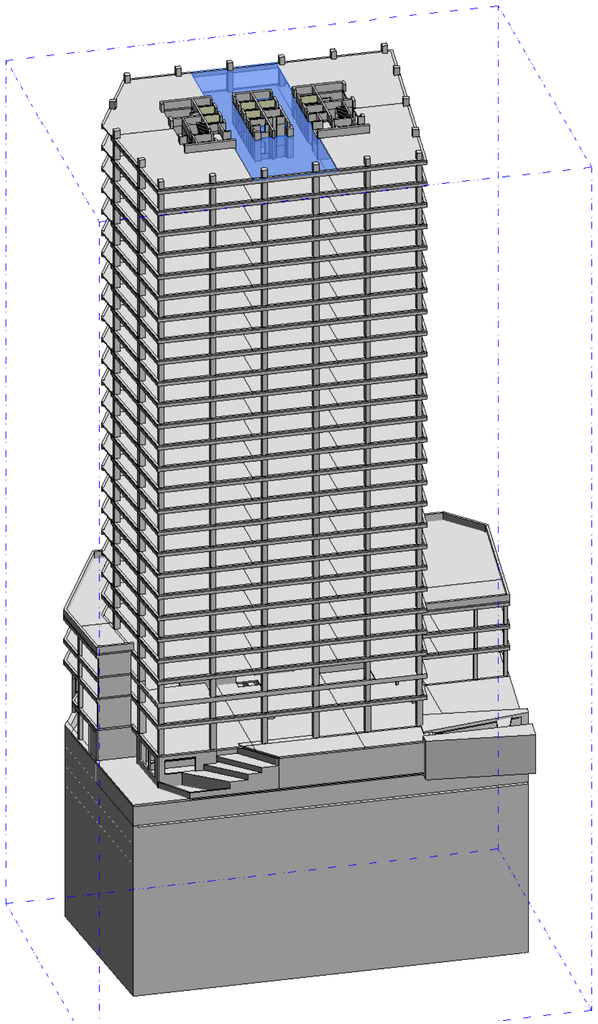
BIM simplification and zone breakdown

Input: Structural Model
Required Revit modeling time: 2 days

3,860 building components
344 construction elements



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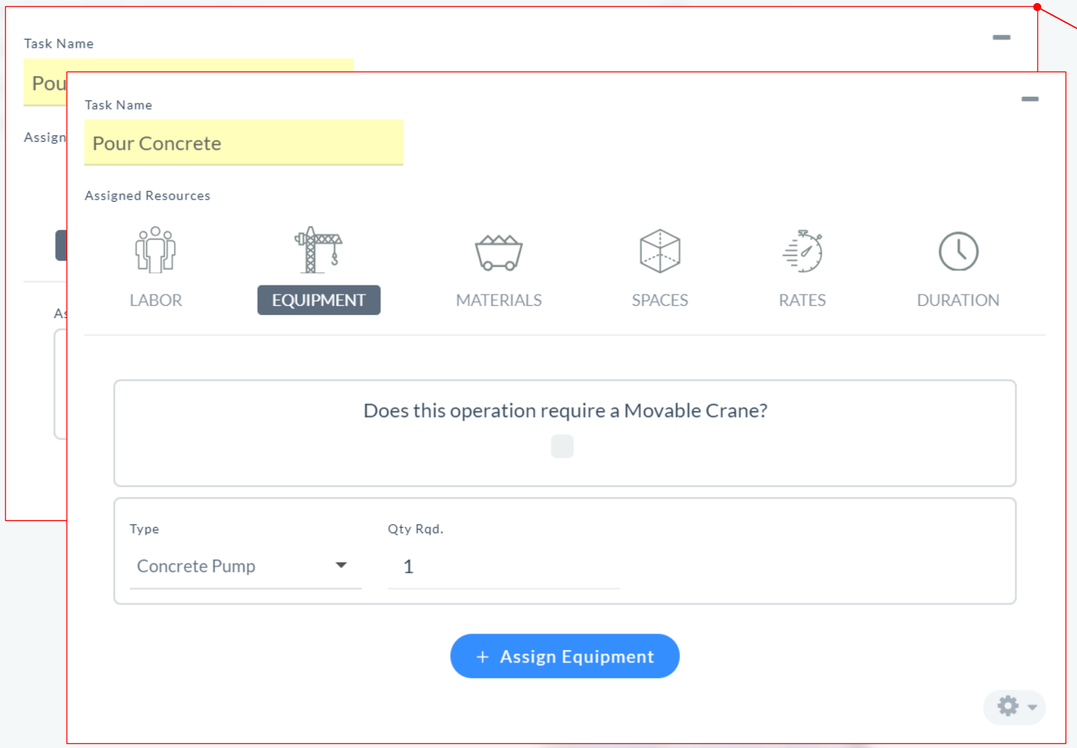
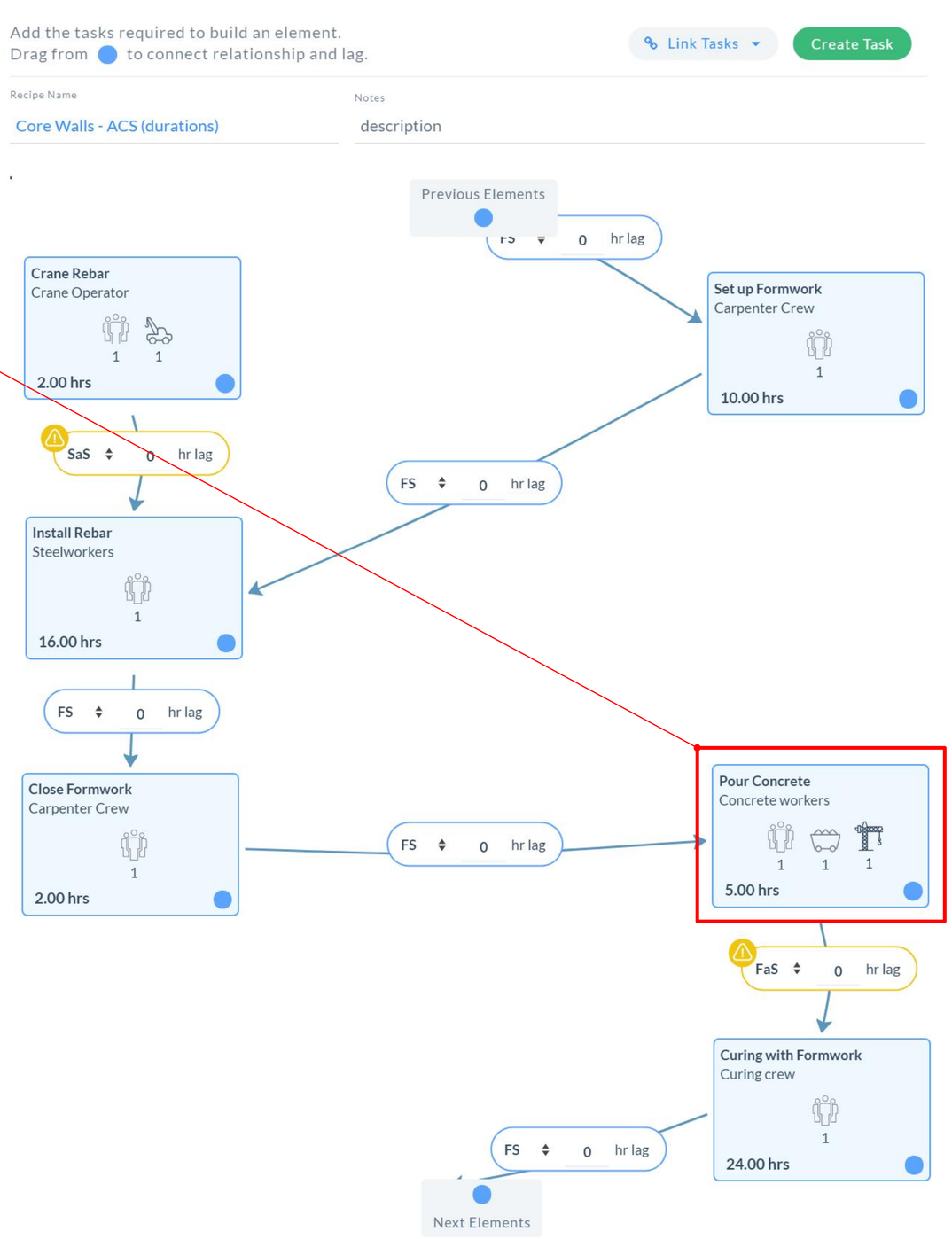
Construction recipes





Given the recipes and BIM, 4D models are generated automatically

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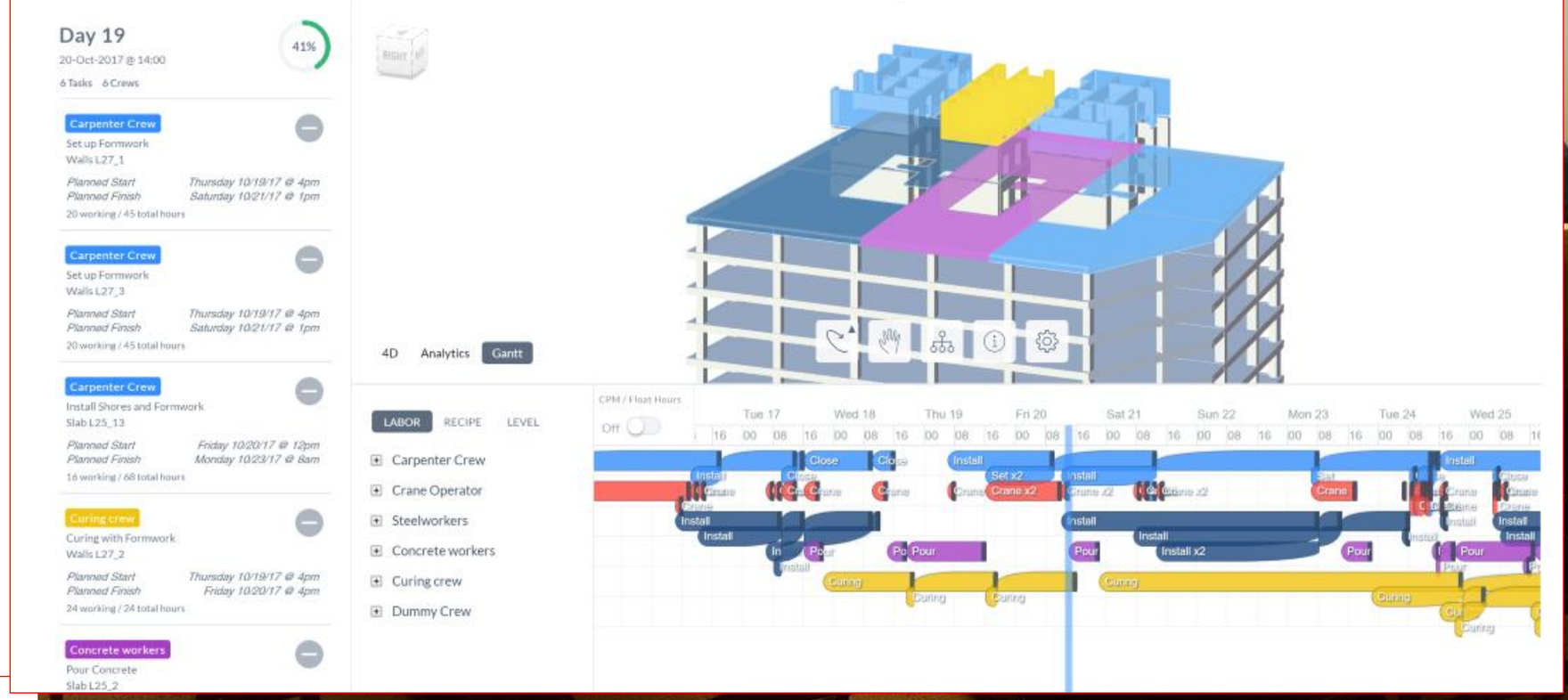
Develop calibrated schedules

Issue: Central core rising too fast, waiting for too long to start slabs on zone 1 and 3

Develop calibrated schedules

Issue: Central core rising too fast, waiting for too long to start slabs on zone 1 and 3

Issue: Zone 3 slab has not added rebar before zone 2 pour

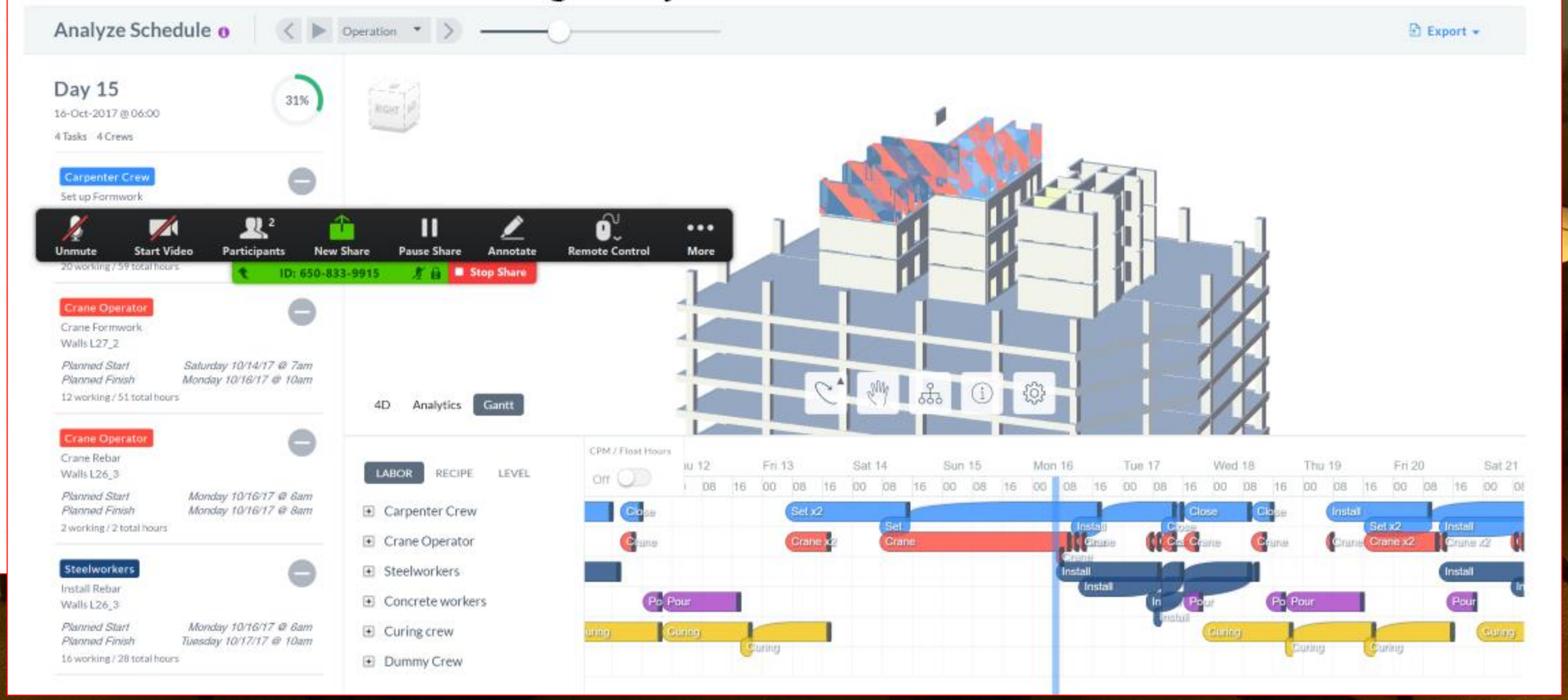


Develop calibrated schedules

Issue: Central core rising too fast, waiting for too long to start slabs on zone 1 and 3

Issue: Zone 3 slab has not added rebar before zone 2 pour

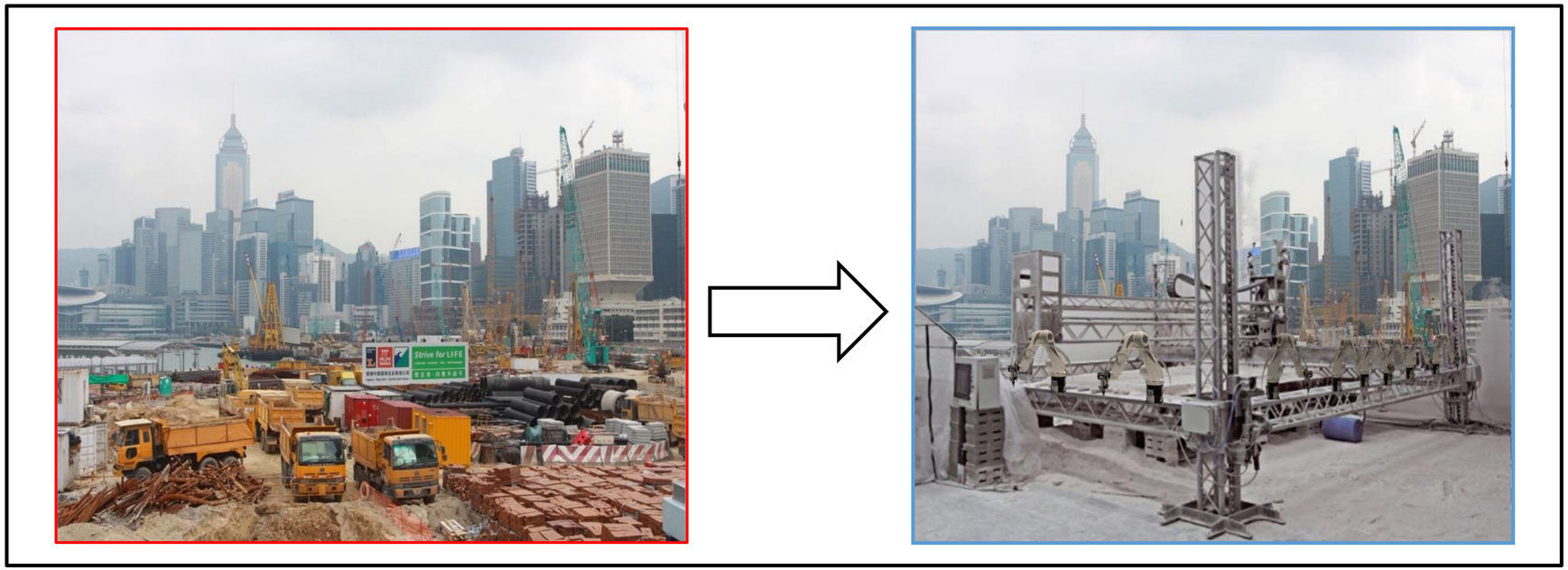
Issue: Cannot have cranes working on adjacent cores even on different levels.



Assessment Framework for Additive Manufacturing in the AEC Industry

Natasa Mrazovic, Ph.D. Stanford ‘18 (M.Arch.Eng., lic.arch., M.C.E.)

Senior R&D Project Manager, Permasteelisa Group



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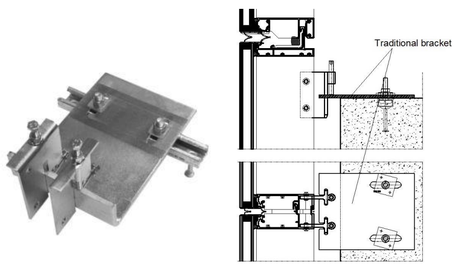
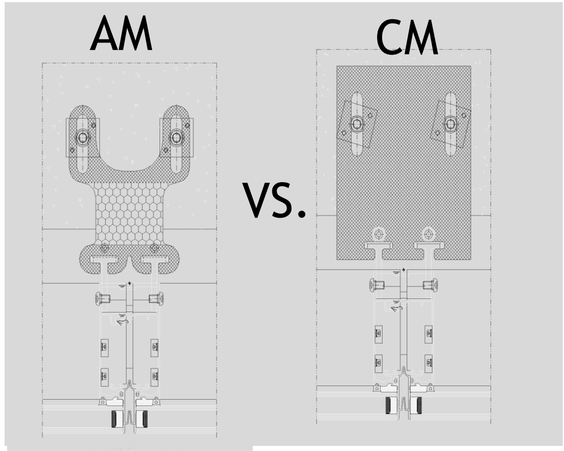
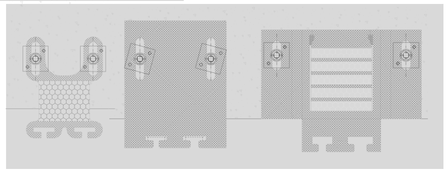
AM is (not yet) cost/schedule-competitive, but environmentally advantageous







CATEGORY		AM (EBM - DMLS)	CM
A	Technology Applicability	✓	✓
S	Schedule	5-17h	2h
E	Environmental impact (kg CO2)	18-47 (Steel); 25-55 (Al)	131 (Steel) - 141 (Al)
C	Costs	$411-$1,064	$95

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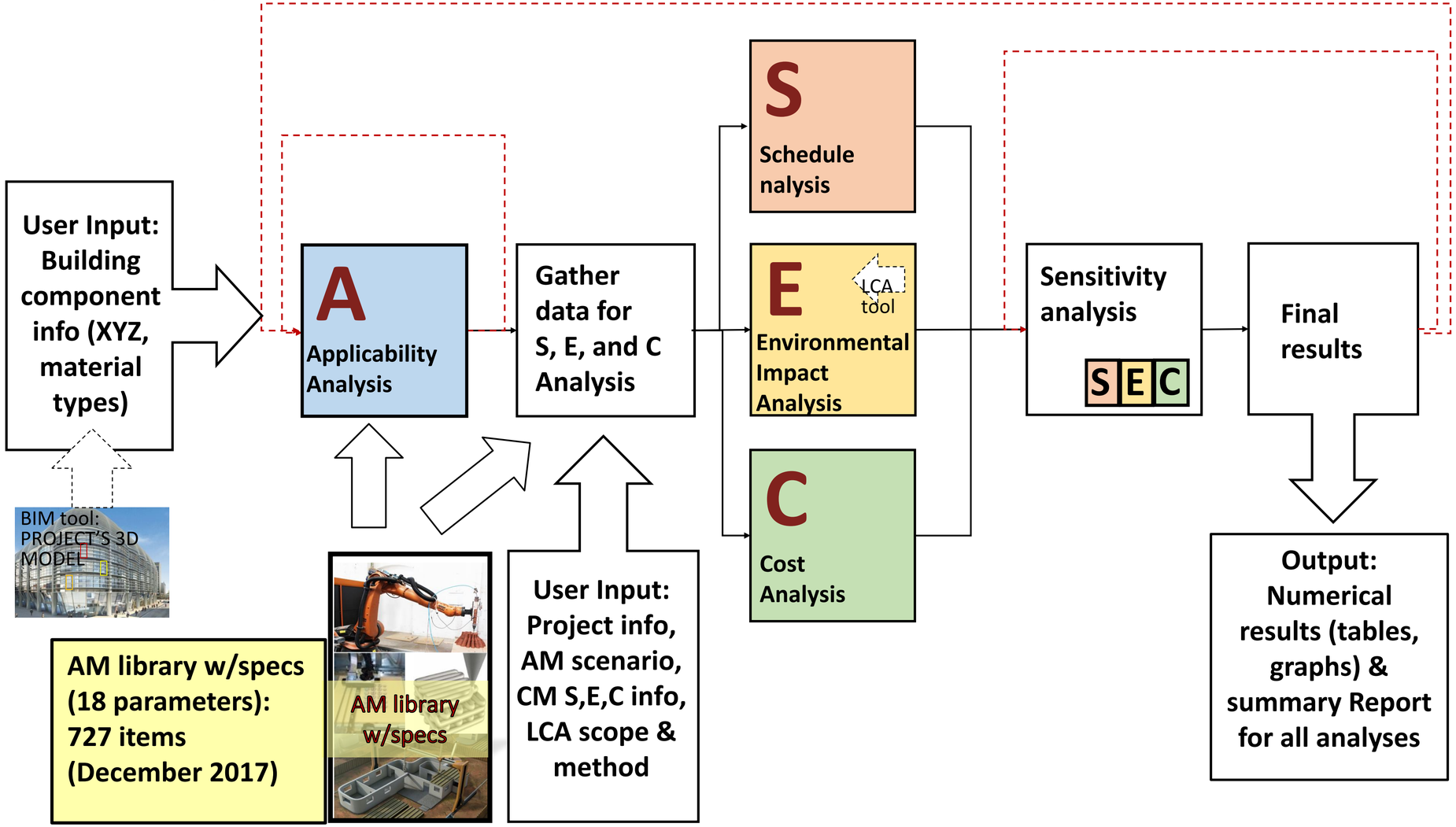
AM – Additive Manufacturing; CM – Conventional Manufacturing; ASEC – Applicability, Schedule, Environmental impact, Cost

Framework for Applicability, Schedule, Environmental Impact, and Cost analysis

7 activities; 19 functions



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AM – Additive Manufacturing; CM – Conventional Manufacturing; ASEC – Applicability, Schedule, Environmental impact, Cost

Impact of the framework on analyzing ASEC of AM vs. CM

- 97% less effort
- 4x more consistent across assessors
- 68% fewer inconsistencies

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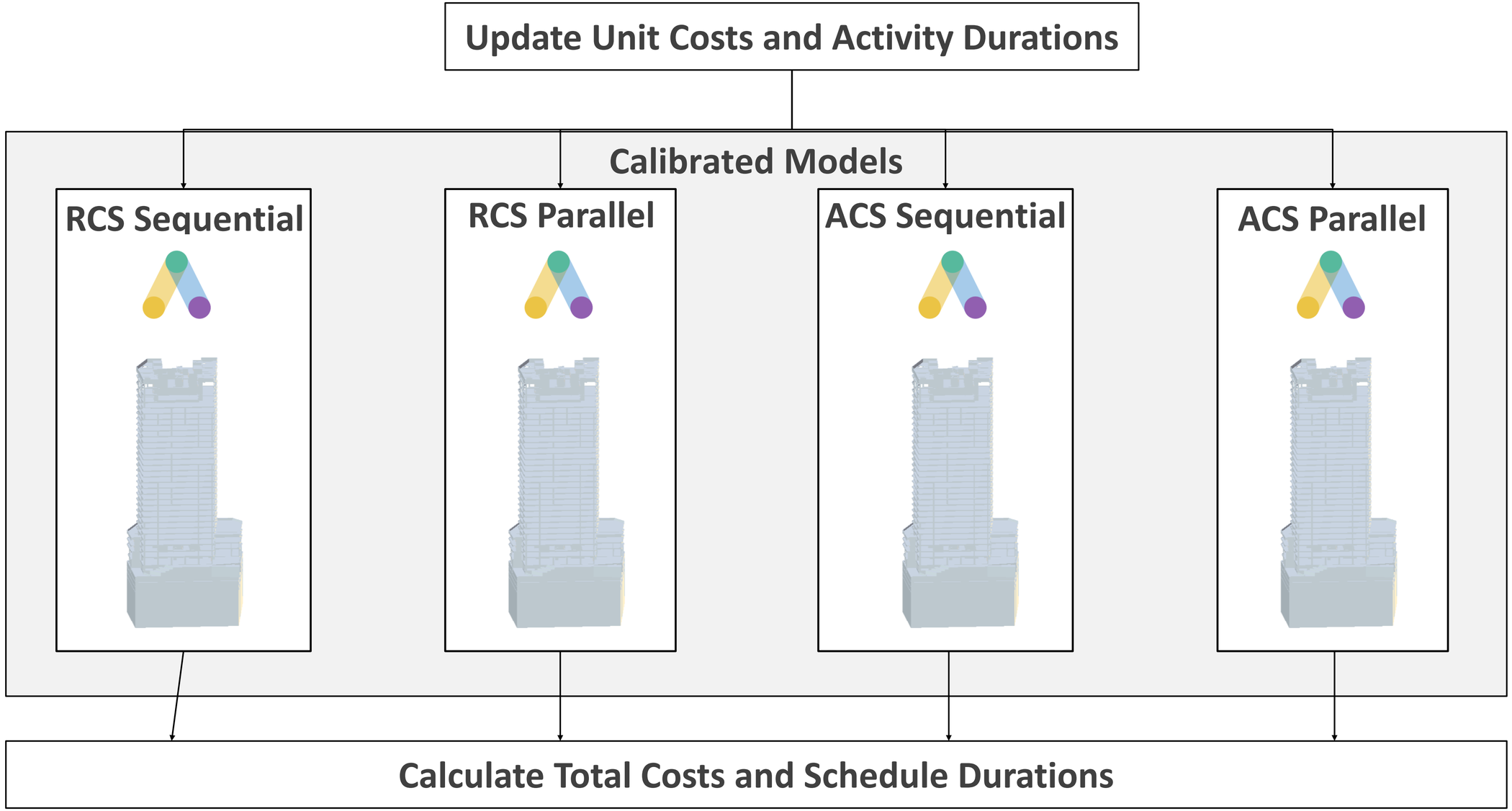
AM – Additive Manufacturing; CM – Conventional Manufacturing; ASEC – Applicability, Schedule, Environmental impact, Cost

ALICE allows set-based construction scheduling



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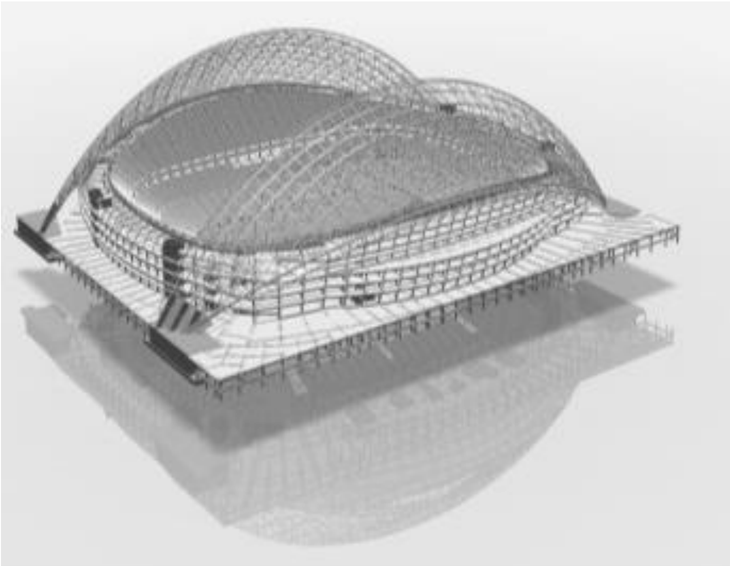
An engineer with today's tools cannot compete with an engineer with the same tools that are connected



	Engineer with today's tools	Engineer with connected tools
Total steel weight	**2,728 mt**	**2,292 mt**
Cost savings		$4M
# alternatives evaluated	39	12,800
Design time per alternative	4 hours	3 seconds
Total design time	~200 hrs	~200 hrs

Roof truss design for a soccer stadium in the Middle East
Work by Forest Flager and John Haymaker in collaboration with Arup Sports, London

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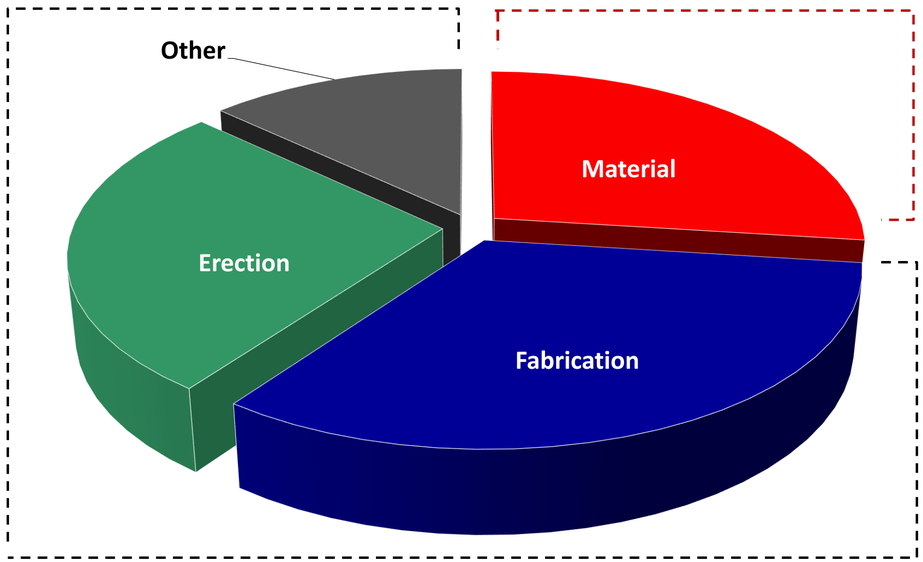
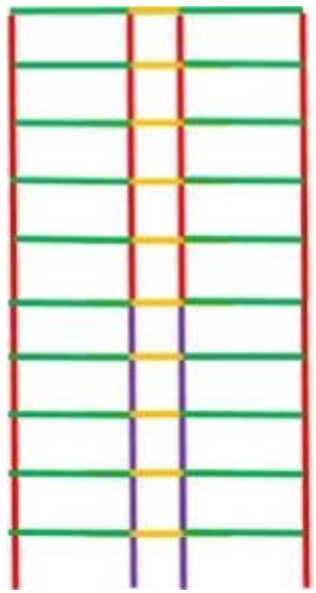
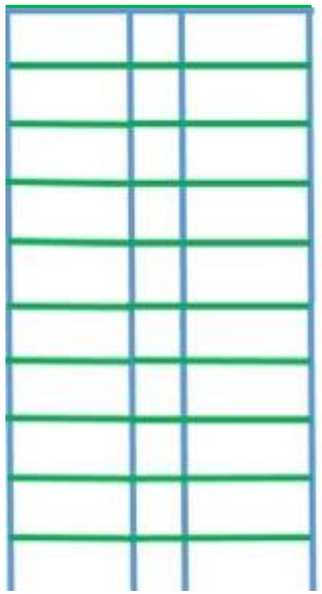
Optimize across all cost components of a steel frame

Design Cycle Time: 8-24 weeks







	Original Frame	Value-Engineered Frame
Steel Weight	-	+8%
Total Cost	-	-13%
Procurement Time	-	-20%

Work by Forest Flager, Pratyush Havelia, Henry Hamamji, Filippo Ranalli, Bo Peng, Thomas Trinelle with SOM, Herrick, Autodesk

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The Business Perspective

"The automated execution of processes changes everything."

(Alan Perlis, 1961)

The Scientific Perspective

"Science is knowledge which we understand so well that we can teach it to a computer; and if we don't fully understand something, it is an art to deal with it. Since the notion of an algorithm or a computer program provides us with an extremely useful test for the depth of our knowledge about any given subject, the process of going from an art to a science means that we learn how to automate something."

(Donald Knuth, Computer Programming as an Art, CACM, Dec. 1974)

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CEOs are proud of their people but wonders whether it’s enough

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I have made all my generals out of mud.

Napoleon

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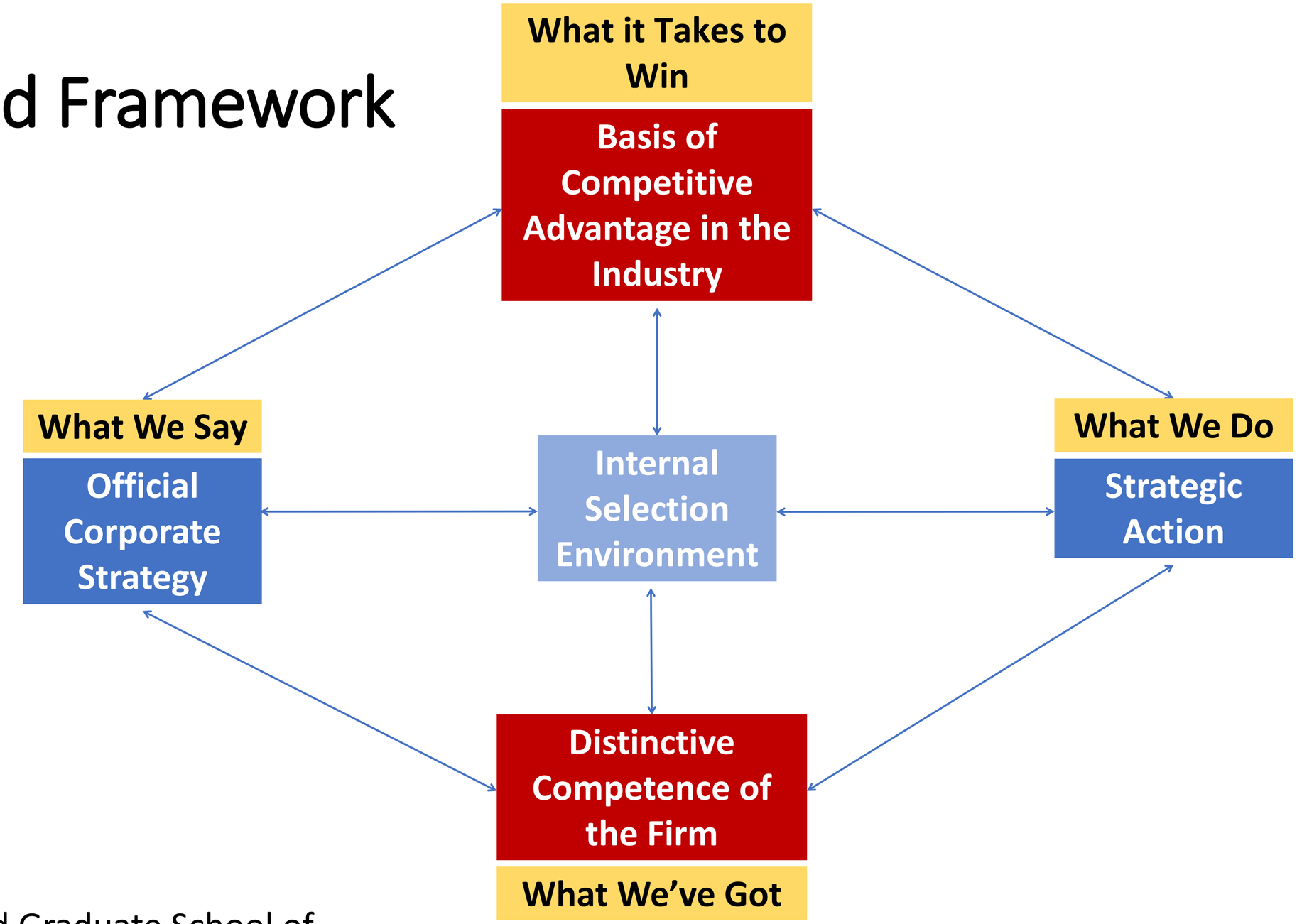
Strategy Diamond Framework



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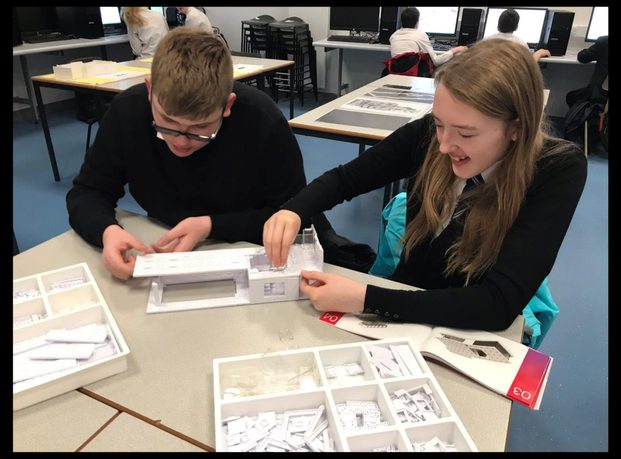

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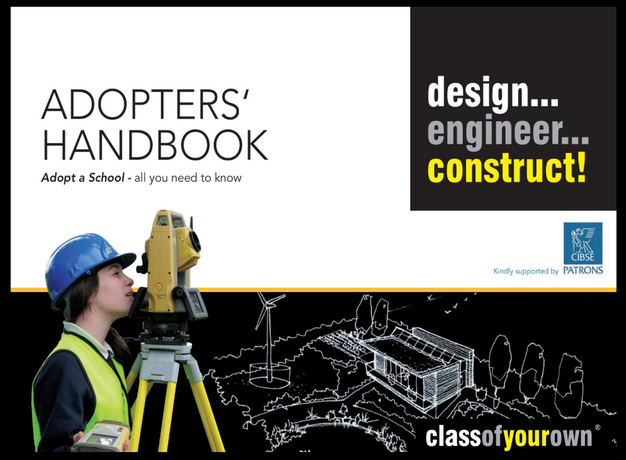

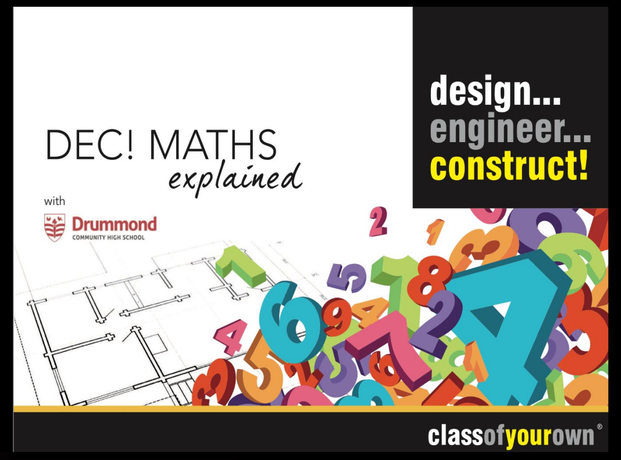

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