

Leveraging Modular Construction Principles

Jaco Prins

Team leader BIM Engineers

Desmond Laeyendecker

Business Development Manager

Join the conversation #AUCity #AU2018



Leveraging Modular Construction Principles

Jaco Prins

Team leader BIM Engineers

Desmond Laeyendecker

Business Development Manager

Join the conversation #AUCity #AU2018



Today's Agenda

TRENDS CHALLENGES OPPORTUNITIES

WHY

What trends and challenges do we see in the construction industry and within BAM today and what opportunities can explore

MODULAR CONSTRUCTION

WHAT

What can Modular Construction mean for us in addressing the industry challenges and opportunities

BAM MEC

HOW

Demonstrating how we have achieved our goals

BEHIND THE SCENES

THE TECHNOLOGY

Explaining the technology behind the success and Cadac Modules



About the speakers

Jaco Prins - BAM

Team leader BIM Engineers

Studied Construction Technology @ TU Eindhoven
Thesis: automation of ordering frames, doors, hinges,
and locks from a BIM model without any errors.

Automating the Construction Industry

Trends & Opportunities

Why



Royal BAM Group nv



Revenue 2017: € 6.6 billion



Adjusted result before tax € 63.3 million



Orderbook at year-end 2017 € 11.6 billion



Employees (average; in FTE) 19,720



Operating companies 10



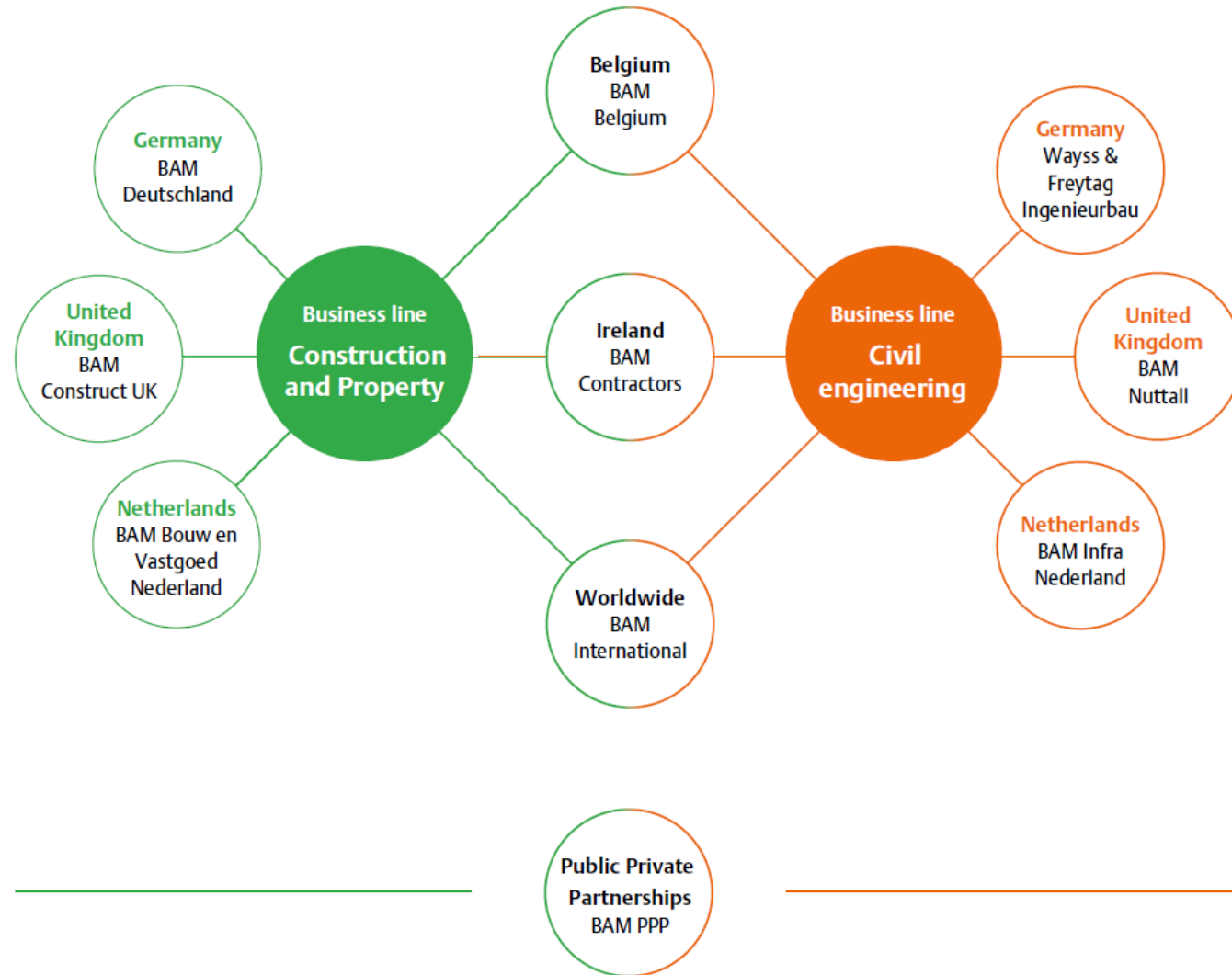
Countries 40 worldwide; 5 European home markets



Shares 275 million



Royal BAM Group NV | organisation





Museum V&A Dundee
BAM Construct UK



ABN AMRO Pavillion (circular building), Amsterdam
BAM Bouw & Vastgoed



Art Depot Museum Boijmans van Beuningen, Rotterdam
BAM Bouw & Vastgoed



Museum of the Future, Dubai
BAM International and BAM Ireland



Construction
represents

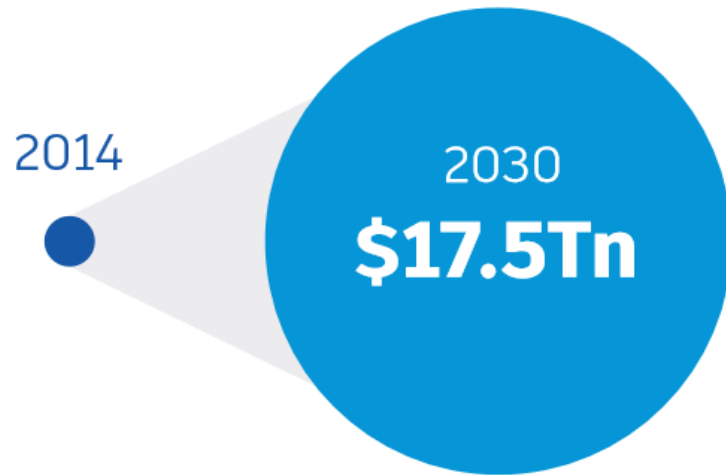
6%
of global GDP

Source: World Economic Forum²

In the UK, every £1 invested in construction
delivers £2.84 of **economic activity**



Source: LEK Consulting³



By 2030, worldwide **construction output** is
forecast to reach \$17.5Tn (\$2014), some 85%
greater than 2014 levels

Source: Global Construction 2030⁴

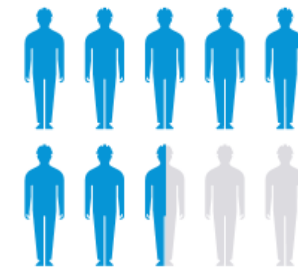
There are up to

180
million

construction workers
worldwide



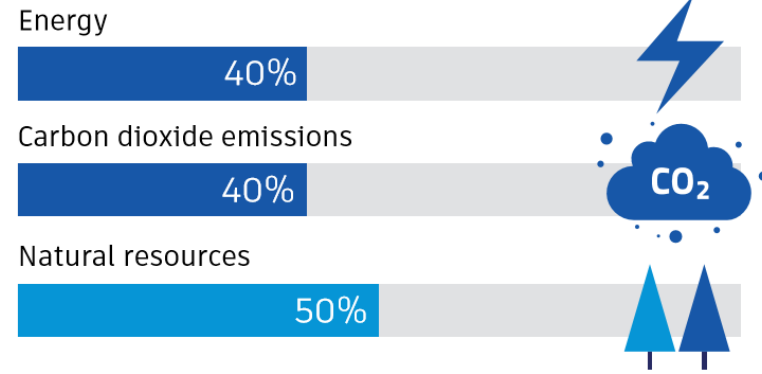
75%



are in developing
countries

Source: Building and Woodworkers International, accessed <http://www.bwint.org/pdfs/WCProcurementFiona.pdf>

Today, our **built environment** utilises the world's:



Source: [Global Construction 2030⁴](#)

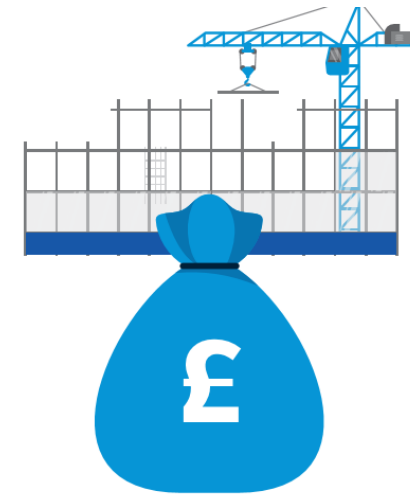


Skills shortage is common in many construction markets, with only the above **four** having excess labour due a downturn in those markets

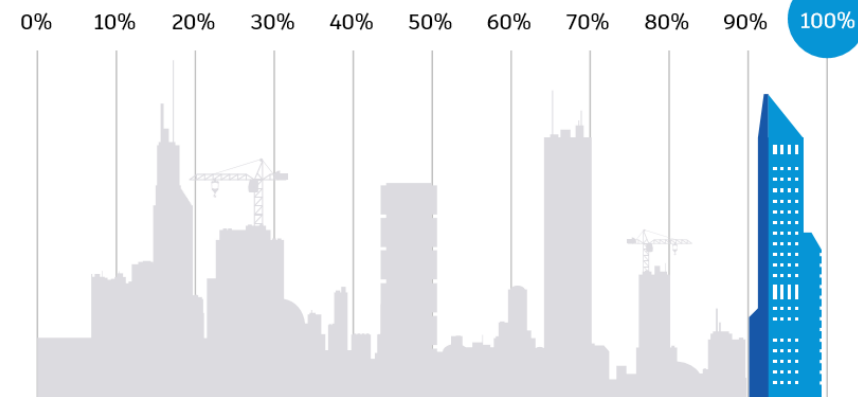
Source: [Turner and Townsend International Construction Market Survey 2016](#)

Average global construction **project margins** fell from an already low 6.3% in 2015 to

6.1%
in 2016



Source: [Turner and Townsend International Construction Market Survey 2016](#)

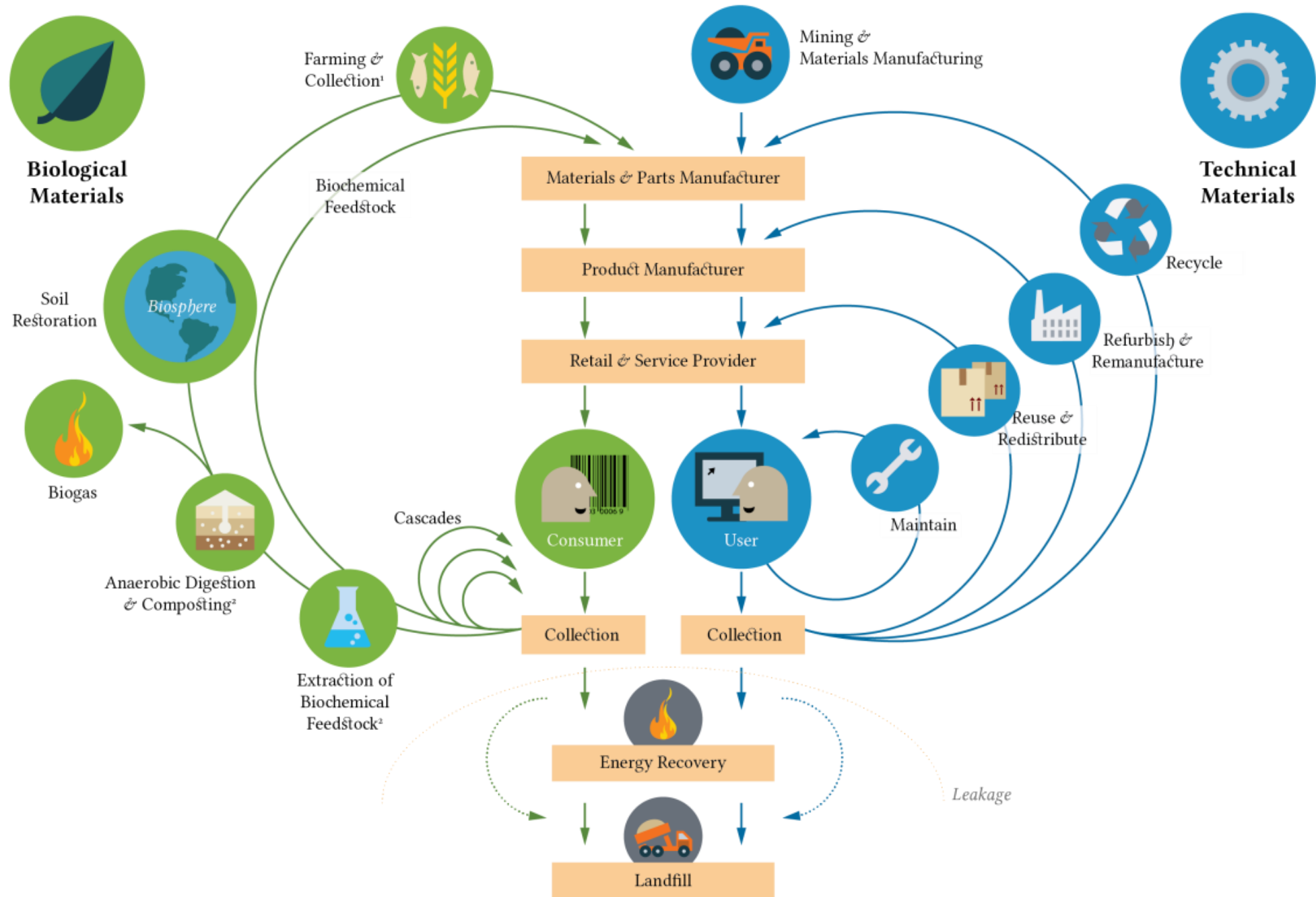


Just a **quarter** of construction projects in the last three years came **within 10%** of their original deadlines

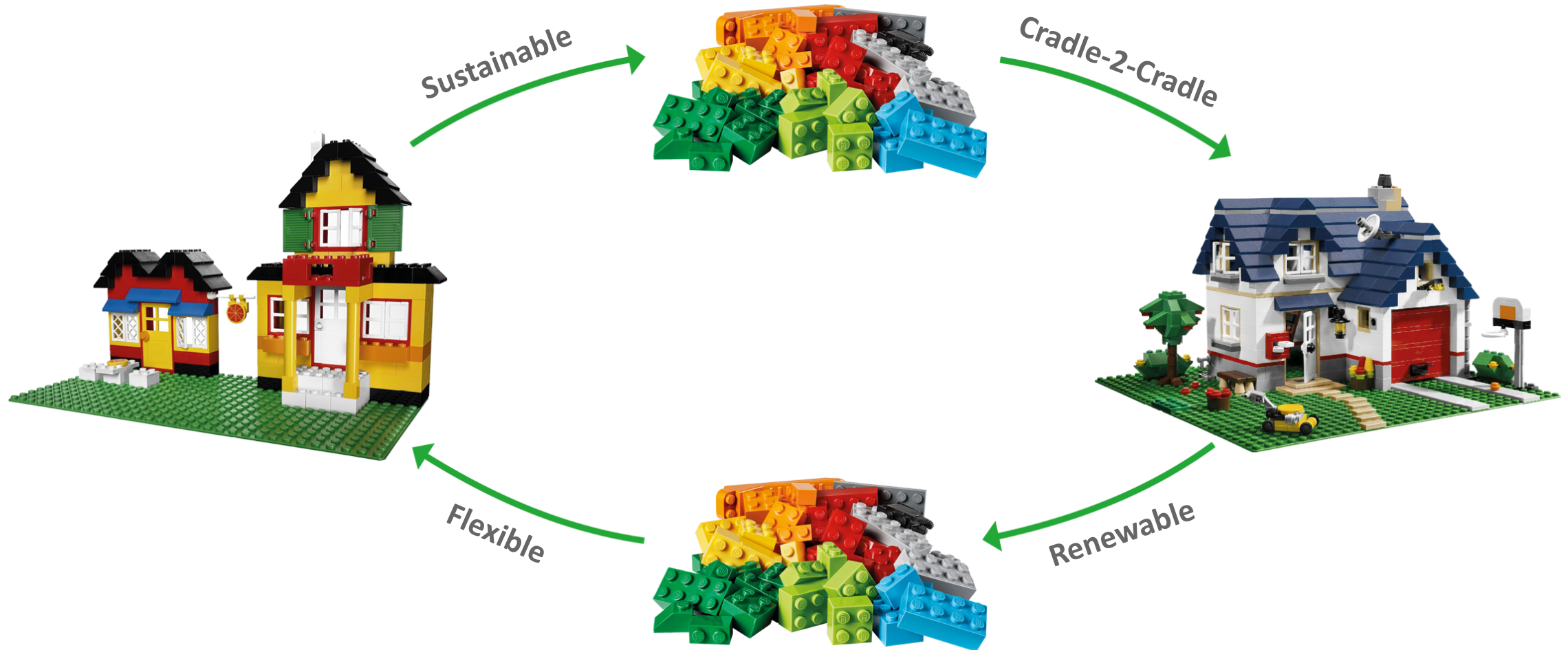
Source: [KPMG, Climbing the Curve, 2015 Global Construction Project Owner's Survey](#)



A closed system...



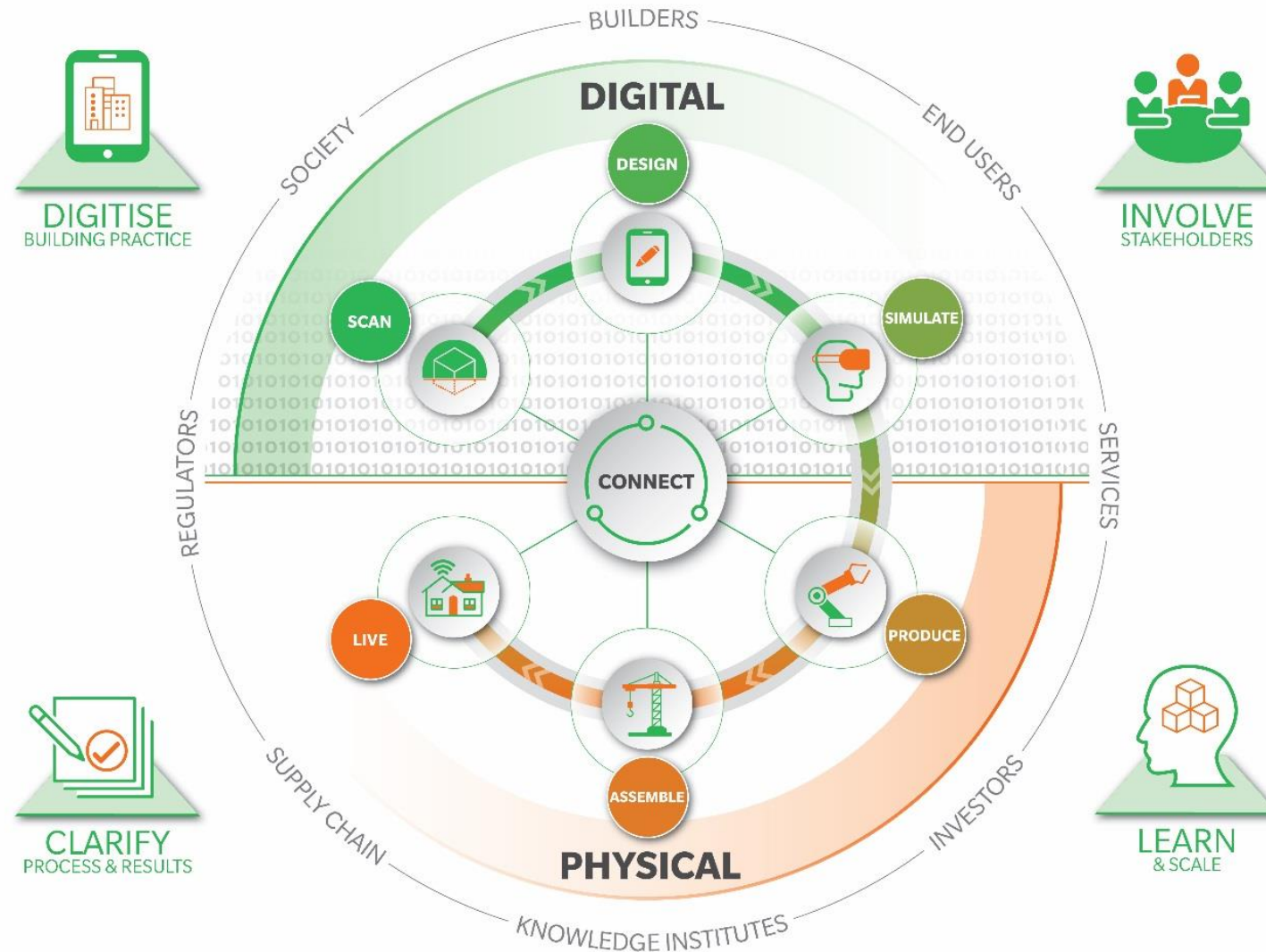
Today's modularity = Tomorrow's Circularity



A photograph of two construction workers on a rooftop. They are wearing white hard hats and high-visibility yellow safety vests over dark clothing. They are standing next to a large, multi-tiered metal rack filled with long, cylindrical HVAC coils. The coils are wrapped in silver insulation and have red and white caps on their ends. The workers are positioned on a concrete rooftop with a yellow safety railing. In the background, a modern building with a grid of windows is visible, along with a cityscape under a cloudy sky. The text "The world of construction is changing" is overlaid in white on the lower half of the image.

The world of construction
is changing

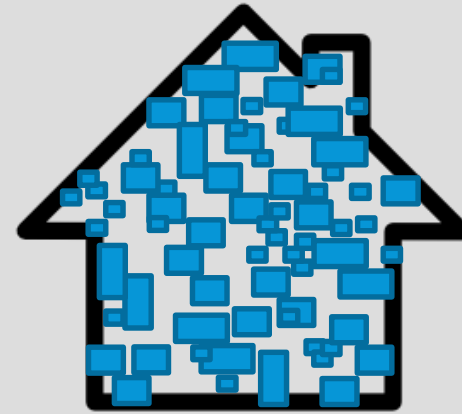
Royal BAM Group's Digital Transformation



A new building can be up to 80% modular



100% different,
80% similar on Element Level



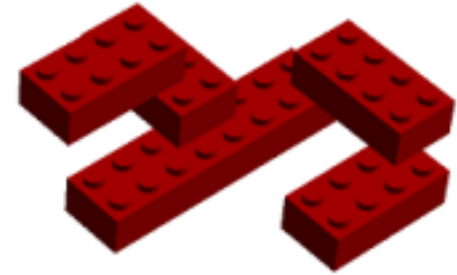
Standardising building Elements

=


Quality UP + Cost DOWN

Modular Construction

- The LEGO© concept

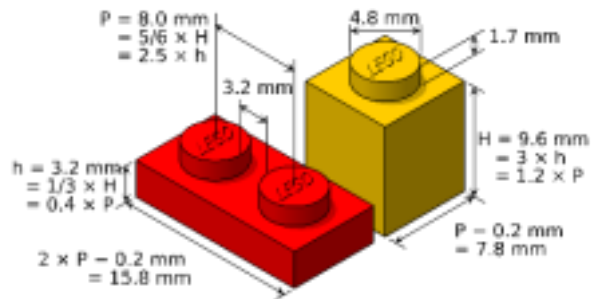


- Standardised blocks – multiple configurations

-  6 blocks > 915.000.000 configurations

Modular Construction

Standard LEGO® configuration rules



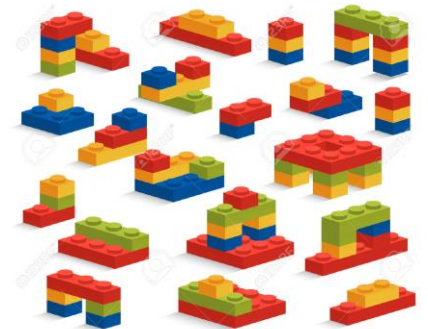
Block type specific parameters

keyword	parameter_name	config_string
DATA_DICTIONARY	B_CLUSTER_ROWID	0
DATA_DICTIONARY	B_CLUSTER_USER	0
DATA_DICTIONARY	B_INDEX_ROWID	WITH FILLFACTOR = 75
DATA_DICTIONARY	B_INDEX_USER	WITH FILLFACTOR = 75
DATA_DICTIONARY	B_STORAGE	
DATA_DICTIONARY	MVTABLES_MODIFIED_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	MVTABLES_MODIFIED_TABLE	
DATA_DICTIONARY	STATE_LINEAGES_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	STATE_LINEAGES_TABLE	
DATA_DICTIONARY	STATES_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	STATES_TABLE	
DATA_DICTIONARY	VERSIONS_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	VERSIONS_TABLE	
DATA_DICTIONARY	XML_INDEX_TAGS_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	XML_INDEX_TAGS_TABLE	
DATA_DICTIONARY	XML_TAGS_PK_INDEX	WITH FILLFACTOR = 75
DATA_DICTIONARY	XML_TAGS_TABLE	
DATA_DICTIONARY	XML_TAGS_UK_INDEX	WITH FILLFACTOR = 75

Element Generator



Various Configurations





BAM MEC Modular Element Configurator

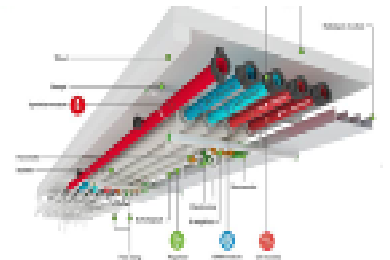
What is BAM MEC

- Various standard modules
- Numerous variations by combining modules
- 1.000.000.000+ configuration possibilities
- Some combinations are allowed, others are not

Clean Walls

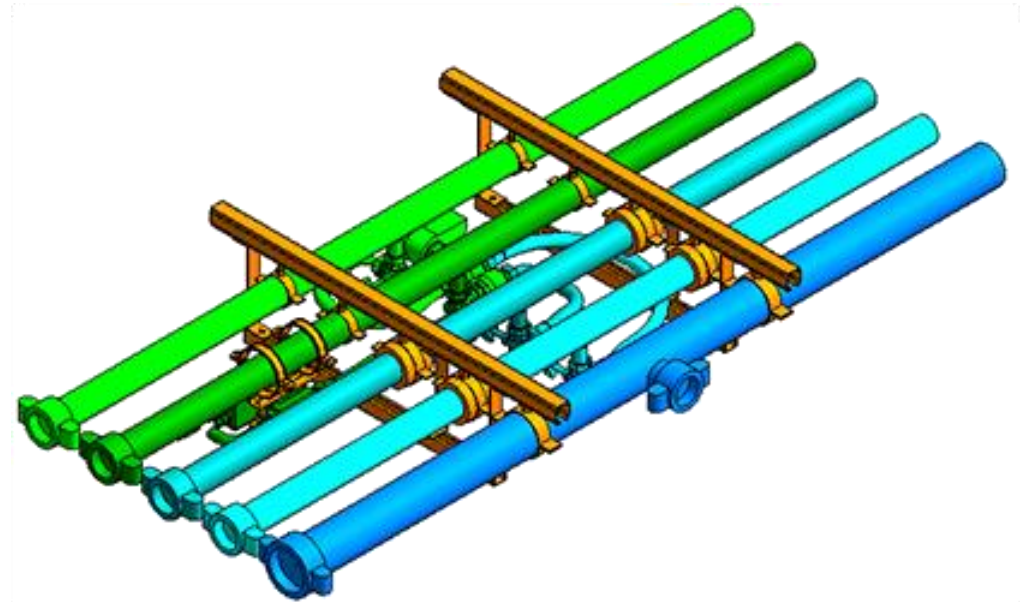


Distribution rack



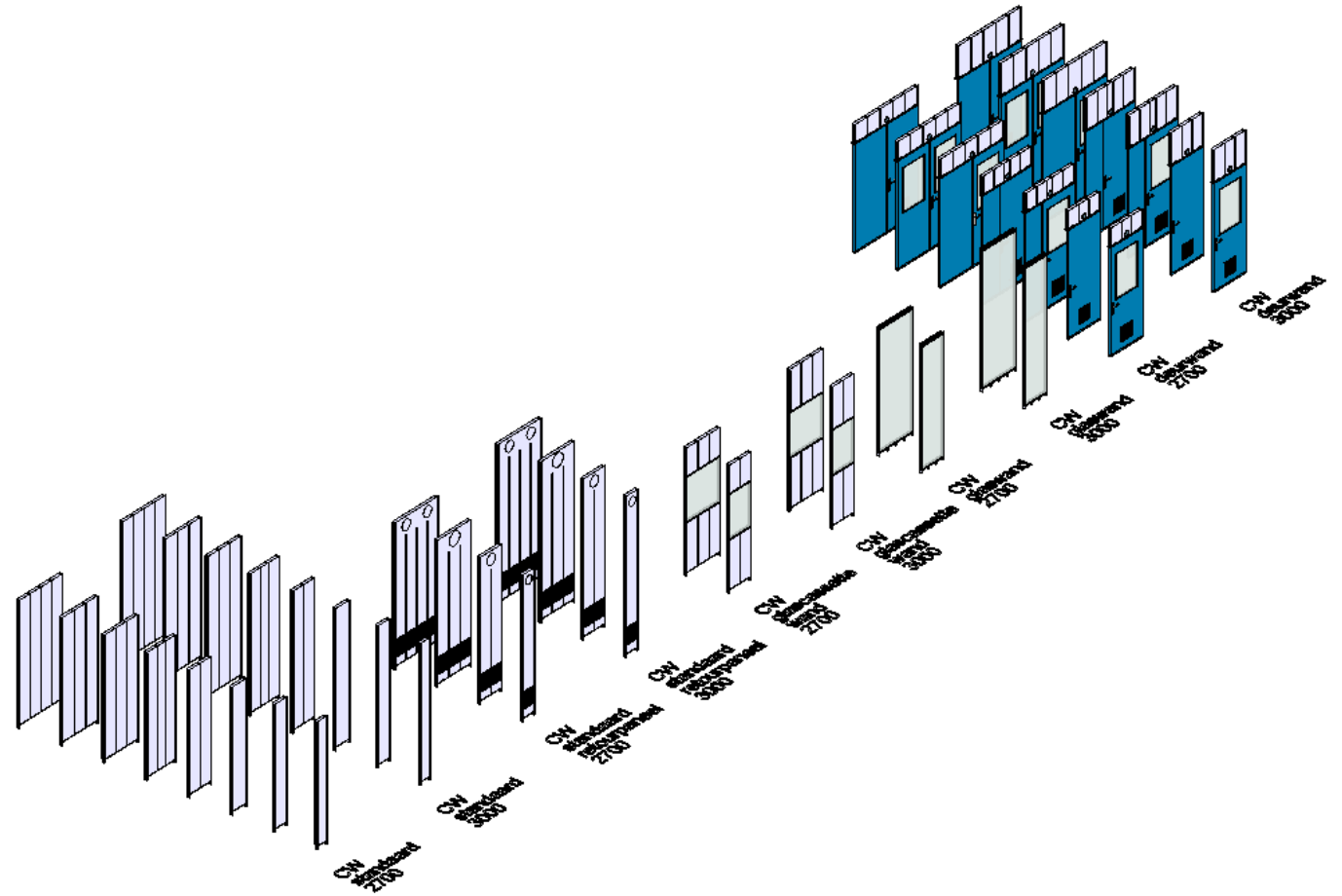
Why BAM MEC?

- Elements are 100% correctly configured, in one take!
- Generated elements only require correct placement within the model
- Consistent data & status across all projects




Application: Concepts



- Clean Walls
- Element types



BAM MEC

- How we configure the modules

Modulaire Elementen Configurator

Bill Designer

PROJECTS » WORLD TRADE CENTE... (2018-03-1006) » CONFIGURATIONS » ??? (DISTRIBUTIEBAAN16)

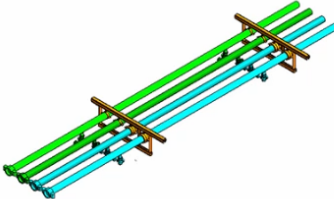
Save Save as Export Export JSON

KEUZEMENU *

ELEMENT TYPE ▶

MODULES ▼

CV *	<input checked="" type="checkbox"/>
GKW *	<input checked="" type="checkbox"/>
Kabelgoot *	<input checked="" type="checkbox"/>
Sprinkler *	<input type="checkbox"/>



AFMETINGEN ▼

CV *	DN50
GKW *	DN50


LEIDINGISOLATIE ▼

CV leidingen	<input type="checkbox"/>
--------------	--------------------------

Home


Concepts

Projects




Welcome Bill Designer


WTC - Utrecht



Shell - Den Haag:



Océ - Venlo



Powered by Cadac Modules

BAM MEC

- How we load the configuration into Autodesk Revit



Project Browser - WTC.rvt

- Views (TheModus (discipline))
 - 1. Modelling
 - Architectural
 - Coördinatie
 - 3D Views
 - CADAC Modules
 - CADAC Modules Coordination**
 - Mechanical
 - CV-installatie
 - Floor Plans
 - Level 10
- 1. Werk
- 2. Plot
- Legends
- Schedules/Quantities (all)
- Sheets (all)
- Families
- Groups
- Revit Links

Properties

3D View
LOD 000 Modelleren coördinatie 3D

3D View: CADAC Modules Coordination Edit Type

Graphics

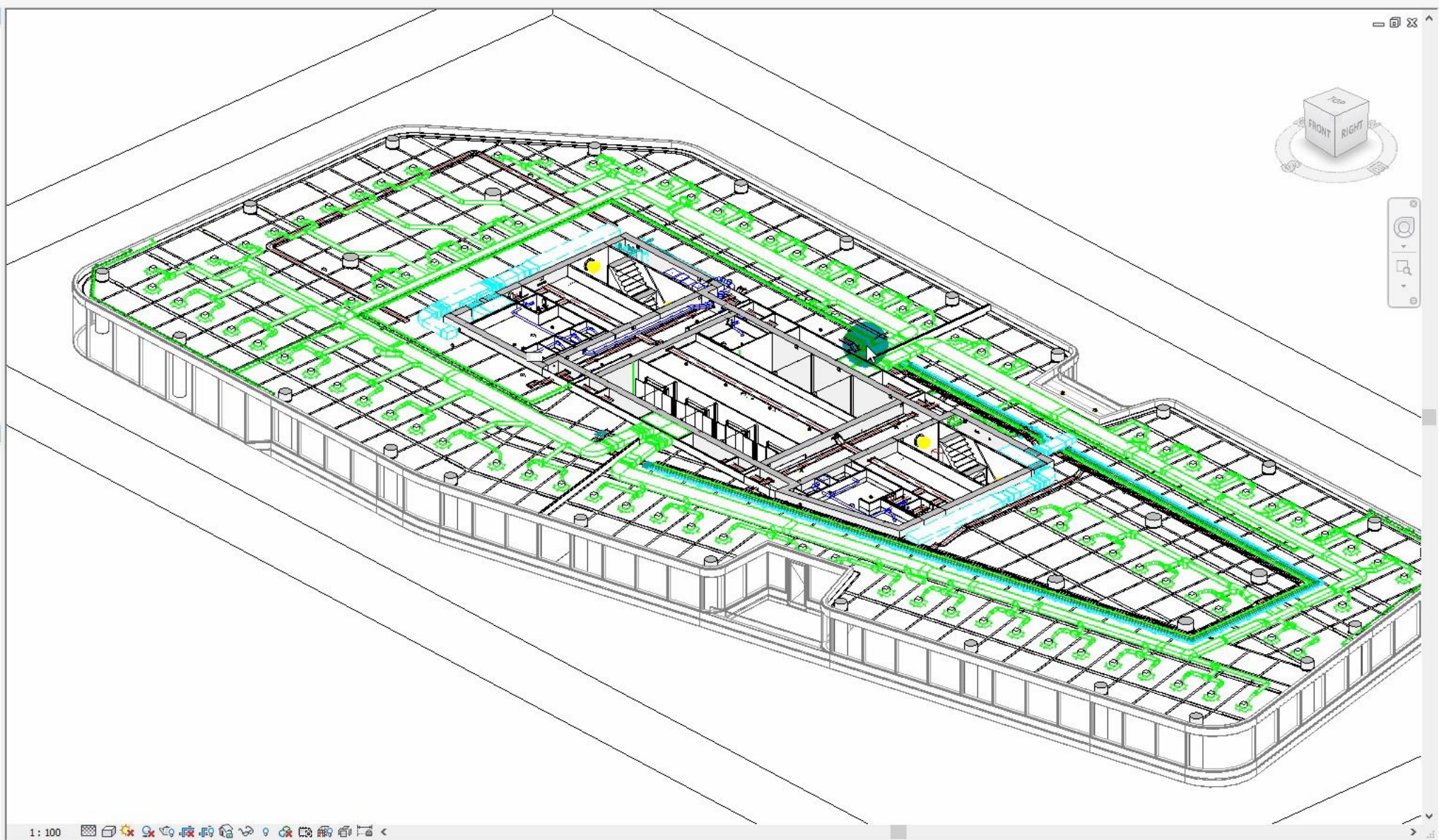
View Scale	1 : 100
Scale Value 1:	100
Detail Level	Fine
Parts Visibility	Show Both
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Discipline	Architectural
Show Hidden Lines	By Discipline
Default Analysis Display Style	None
Visible In Option	all
Sub-Discipline	Coördinatie
view soort	1. Modelling
Sun Path	<input type="checkbox"/>

Text

Verdieping doorsnede

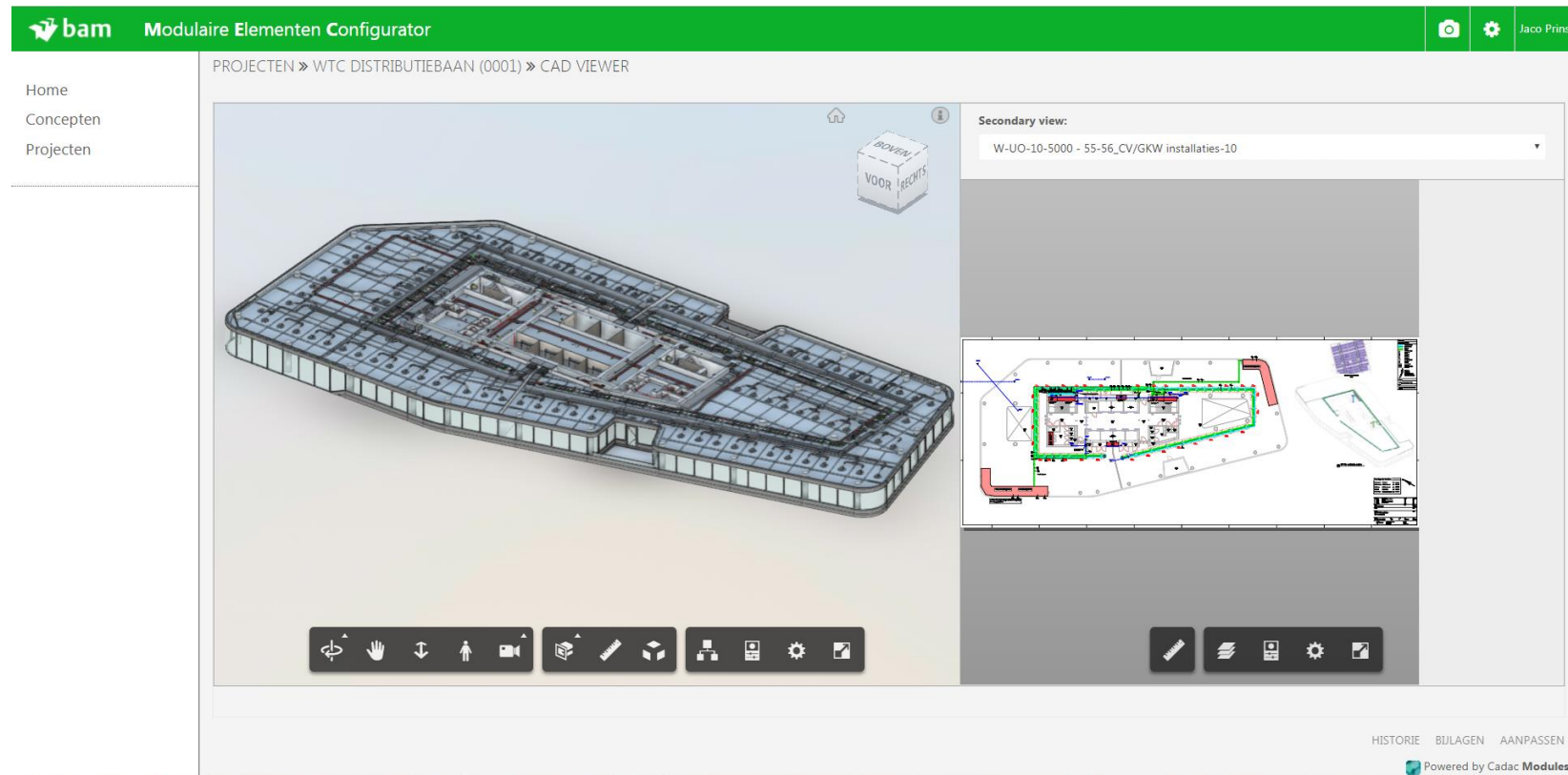
Properties help

Apply



BAM MEC

- Accessing the model through the online portal



[Home](#)[Concepts](#)[Projects](#)

Welcome Bill Designer

WTC - Utrecht



Shell - Den Haag:



Océ - Venlo



Cadac Modules Portal

Google

https://modulesaccept.cadac.com/portal?projectId=3b020b74-70aa-41a1-9b46-3ac78d5f2d81&Language=en#/projectpublications

Modulaire Elementen Configurator

Bill Designer

Home




Concepts

Projects

PROJECTS » WORLD TRADE CENTE... (2018-03-1006) » PUBLICATIONS

+ New publication

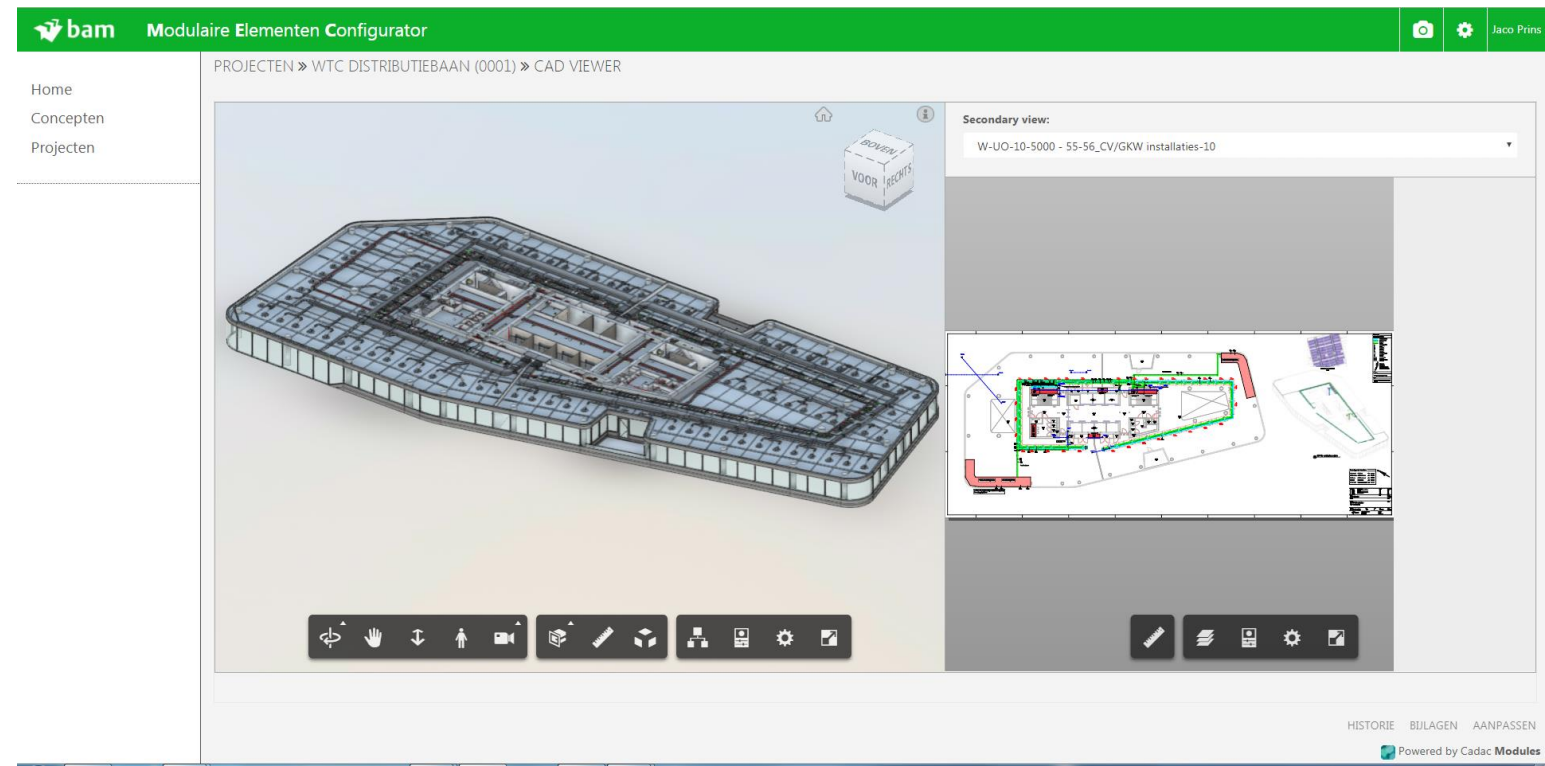
Search

	DISCIPLINE	PHASE	PUBLISHER	TIMESTAMP	FILE NAME	TYPE	VERSION	STATE	
<input type="checkbox"/>	 Coordination	New	bramaekers@cadac.com	14-6-2018 11:06	WTC.rvt	Publish	1.0		

Powered by Cadac Modules

BAM MEC; Online Portal

- Status always accessible
- Four-eyes principle [Peer Review]
- Full Element History available



MODEL

WTC.rvt (14/06/2018 11:06:49)

ELEMENT TREE STRUCTURE

By Lifecycle

▼ 01. Engineering

▼ 10

▼ NLRS_50_ME_LB_bochtelementbinnen_mob_BAM
BE41_CV50RW30_GKW50AF2_KG24_DVD

▼ NLRS_50_ME_LB_distributieelement_mob_BAM
DE01a_CV50RW30_GKW50AF2_KG24_DVD_3600
DE01b_CV50RW30_GKW50AF2_KG24_DVD_3600
DE02a_CV50RW30_GKW50AF2_KG24_DVD_2700

▼ 02. Production

▼ 10

▼ NLRS_50_ME_LB_aftakelementbinnen_mob_BAM
AE61_CV50RW30_GKW50AF2_KG24_DVD



Cadac Modules Portal

Google

←

→

↺

🏠

https://modulesaccept.cadac.com/portal?publishId=2d13d8d9-345b-4d95-aa34-94ab253af6e6&projectId=3b020b74-70aa-41a1-9b46-3ac78d5f2d81&Language=en#/projectpublications

📖

☆

☆≡

🖋

🔗

⋮

bam

Modulaire Elementen Configurator

Home




Concepts

Projects

PROJECTS » WORLD TRADE CENTE... (2018-03-1006) » PUBLICATIONS

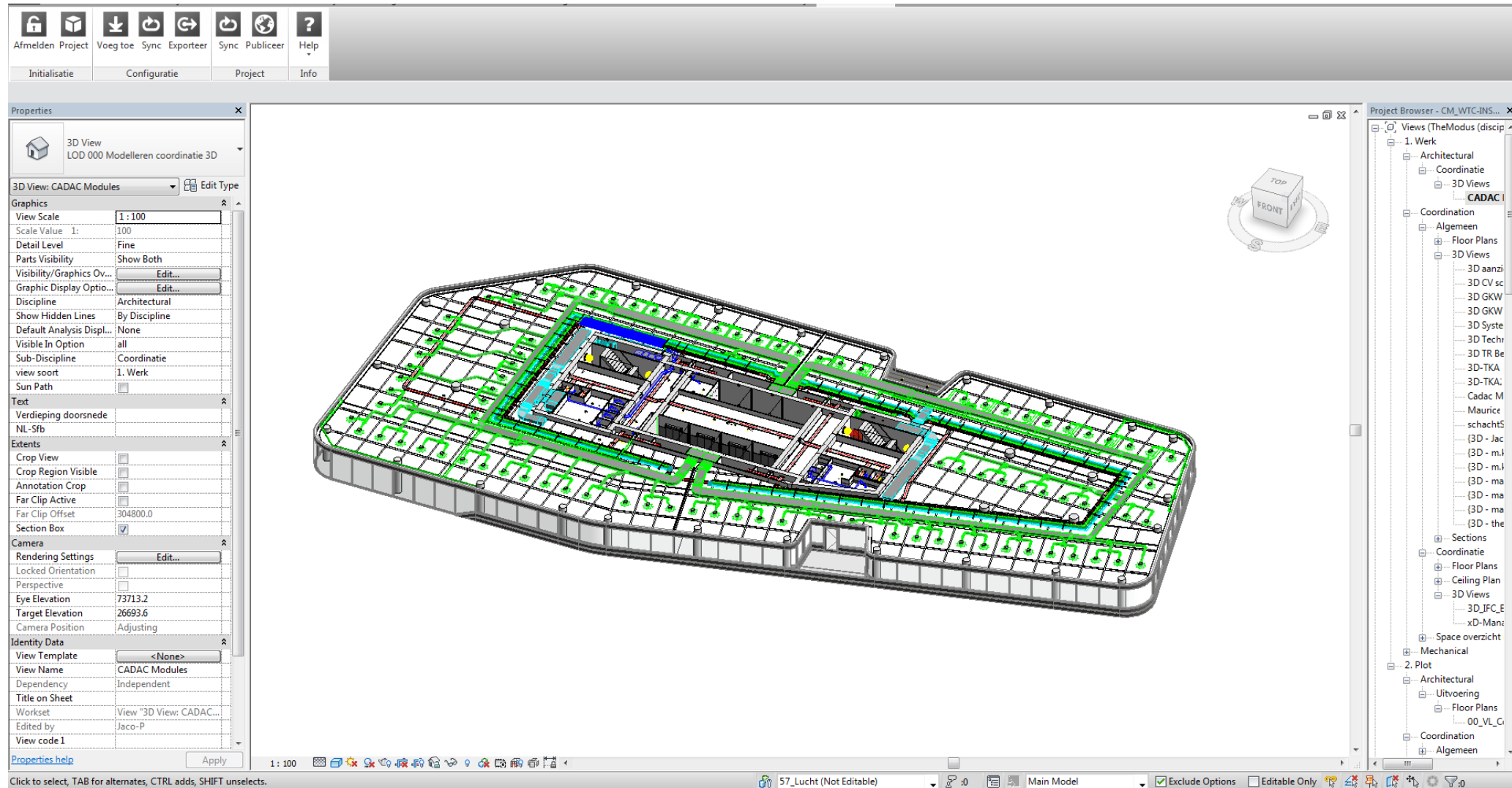
+ New publication

Search

	DISCIPLINE ⬇	PHASE ⬇	PUBLISHER ⬇	TIMESTAMP ⬆	FILE NAME ⬇	TYPE	VERSION ⬇	STATE	
<input type="checkbox"/>	 Coordination	New	bramaekers@cadac.com	14-6-2018 11:06	WTC.rvt	Publish	1.0		

Powered by Cadac Modules

Status in model



Project Browser - WTC.rvt

- Views (TheModus (discipline))
 - 1. Modelling
 - Architectural
 - Coördinatie
 - 3D Views
 - CADAC Modules**
 - CADAC Modules Coordination
 - CADAC Modules Lifecycle
 - Mechanical
 - CV-installatie
 - Floor Plans
 - Level 10
- 1. Werk
- 2. Plot
- Legends
- Schedules/Quantities (all)
- Sheets (all)
- Families
 - Air Terminals
 - Annotation Symbols
 - Cable Tray Fittings
 - Cable Trays

Properties

3D View
LOD 000 Modelleren coördinatie 3D

3D View: CADAC Modules Edit Type

Graphics

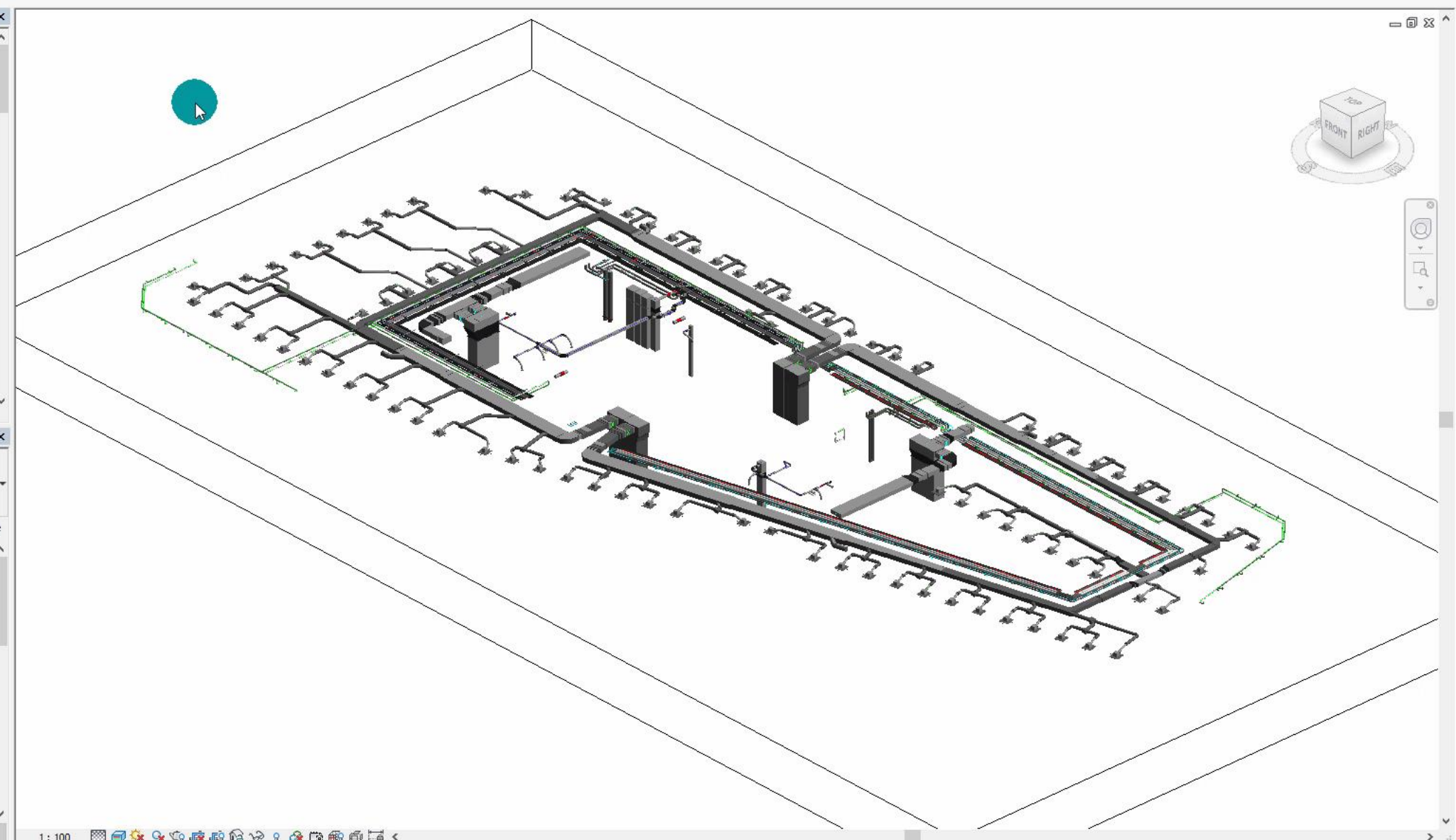
View Scale	1 : 100
Scale Value 1:	100
Detail Level	Fine
Parts Visibility	Show Both
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Discipline	Architectural
Show Hidden Lines	By Discipline
Default Analysis Display Style	None
Visible In Option	all
Sub-Discipline	Coördinatie
view soort	1. Modelling
Sun Path	<input type="checkbox"/>

Text

Verdieping doorsnede

Properties help

Apply



BAM MEC | Behind the scenes

Desmond Laeyendecker

Business Development Manager – Cadac Group



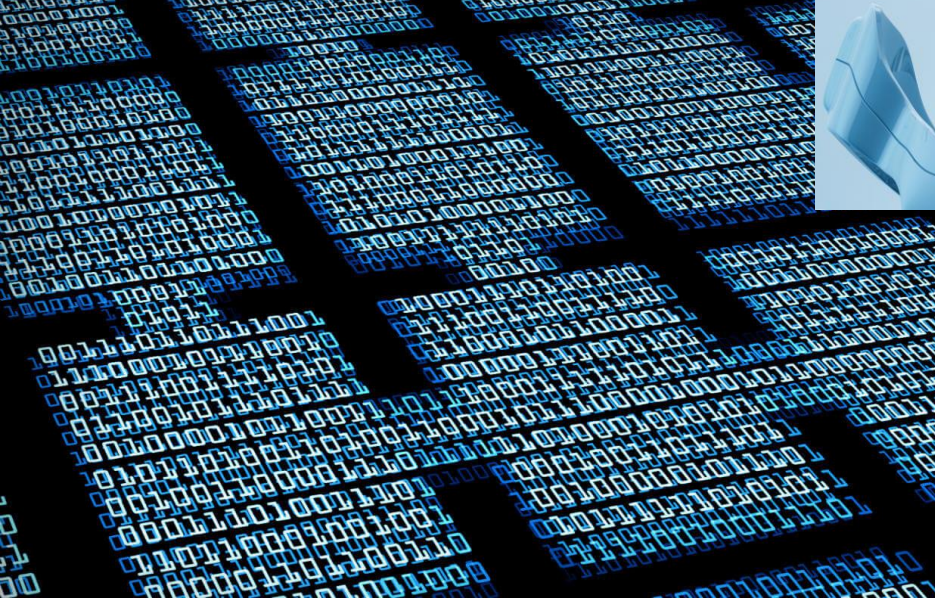
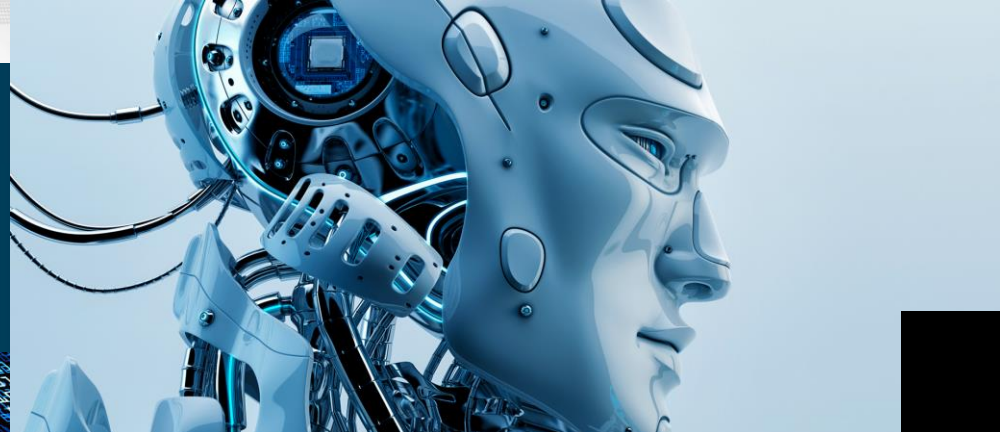
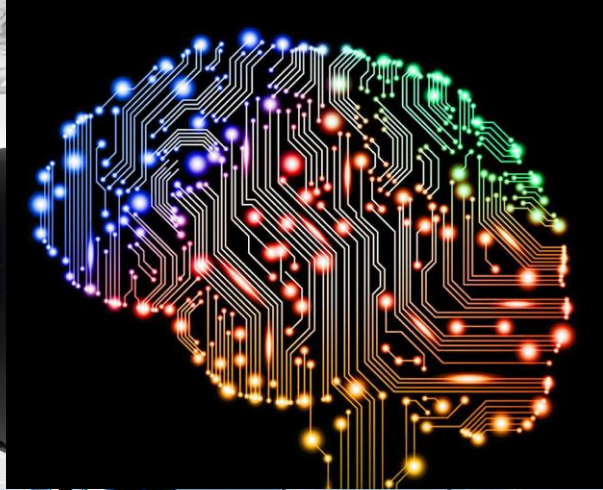
About the speakers

Desmond Laeyendecker – Cadac Group

Business Development Manager

Always looking to improve our customers
business processes using the latest innovations
and software solutions

Supporter of MORE | BETTER | LESS



Enabling Digital.

- Autodesk Platinum & Microsoft Gold Partner
- 30+ years of expertise
- Cadac. Enabling Digital.
 - Supporting businesses in their digital transition
 - Integrate Processes and Solutions
 - Optimise processes to help achieve business goals
 - Your digital design as a single source of truth

“ We translate your objectives into a structured and manageable process.”

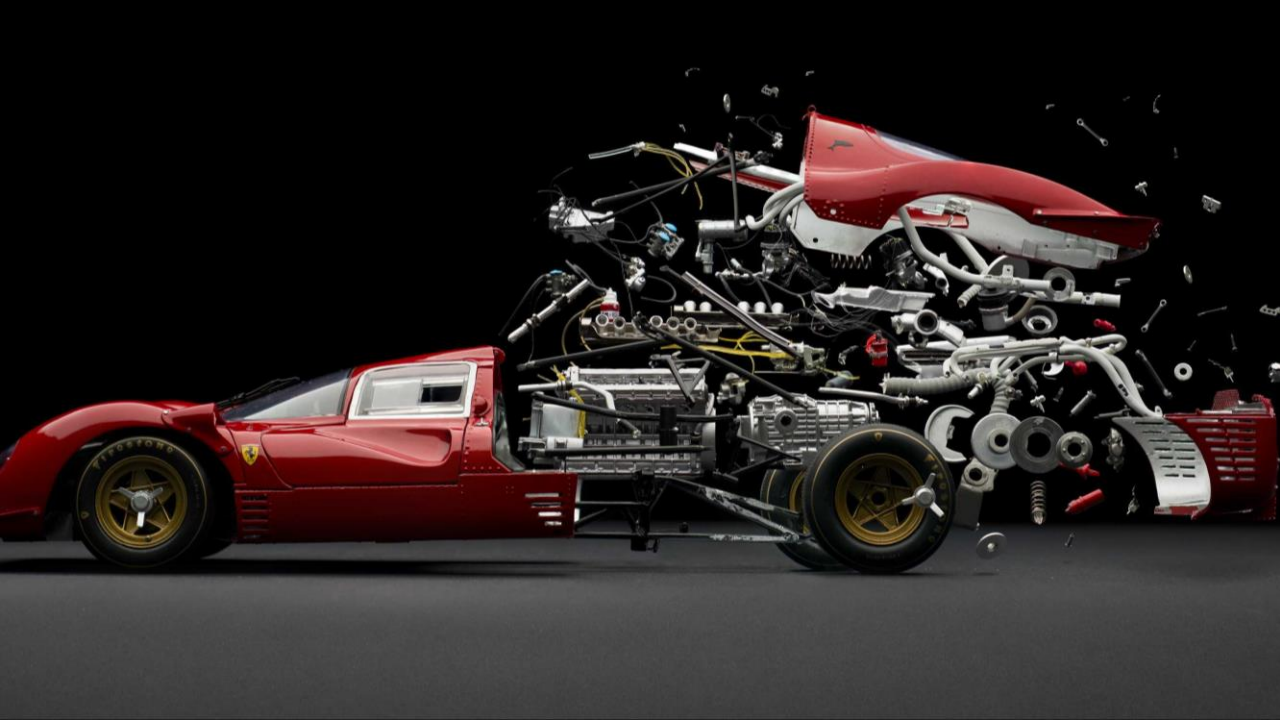


Jan Baggen
Chief Executive Officer
Cadac Group Holding



Cadac Group

www.cadac.com



PROJECT: Hannover Hbf
MODEL: Gesamtkoord

A linked SharePoint document is
opened in a filtered view.

From here a user can open the file.

Electrical Inc. - 03 - All Files

← → ↻ <https://cad...>

Apps Ziggo Sport Totaal ...

Office 365 SharePoint

BROWSE CADAC ORGANICE APPS FILES LIBRARY

SHARE FOLLOW

Hannover Hbf EDIT LINKS

Stahlbauarbeiten

Home

Libraries

Betonarbeiten

Stahlbauarbeiten

Lists

Assets

Locations

Contacts

Recent

Recycle Bin

EDIT LINKS

New Upload Sync Share More

01 - All Deliverables 03 - All Files 04 - All Documents Find a file SAVE THIS VIEW

✓	📄	Name	DocumentDescription	Document Type	Asset	Description	Modified	Modified By
	📄	P170825-SKELETT-00001-02	Testreport 12-08-2017	Test report	2342 - Skelettbau - STB unterzug - STB 17x30 - Höhe Bahnsteig A	HVAC System	August 29	Miel Scheepers

Drag files here to upload

31 ALU BI H0-V0 A [2345253]

File View

P170825-SKELETT-000273.pdf Certificate

P170825-SKELETT-000274.pdf Certificate

P170825-SKELETT-00001-02.pdf Testreport 12-08-2017

P170825-SKELETT-000276.pdf Certificate

P170825-SKELETT-000234.pdf Test report 12-12-2016

P170825-SKELETT-000567.pdf Test report 14-12-2016

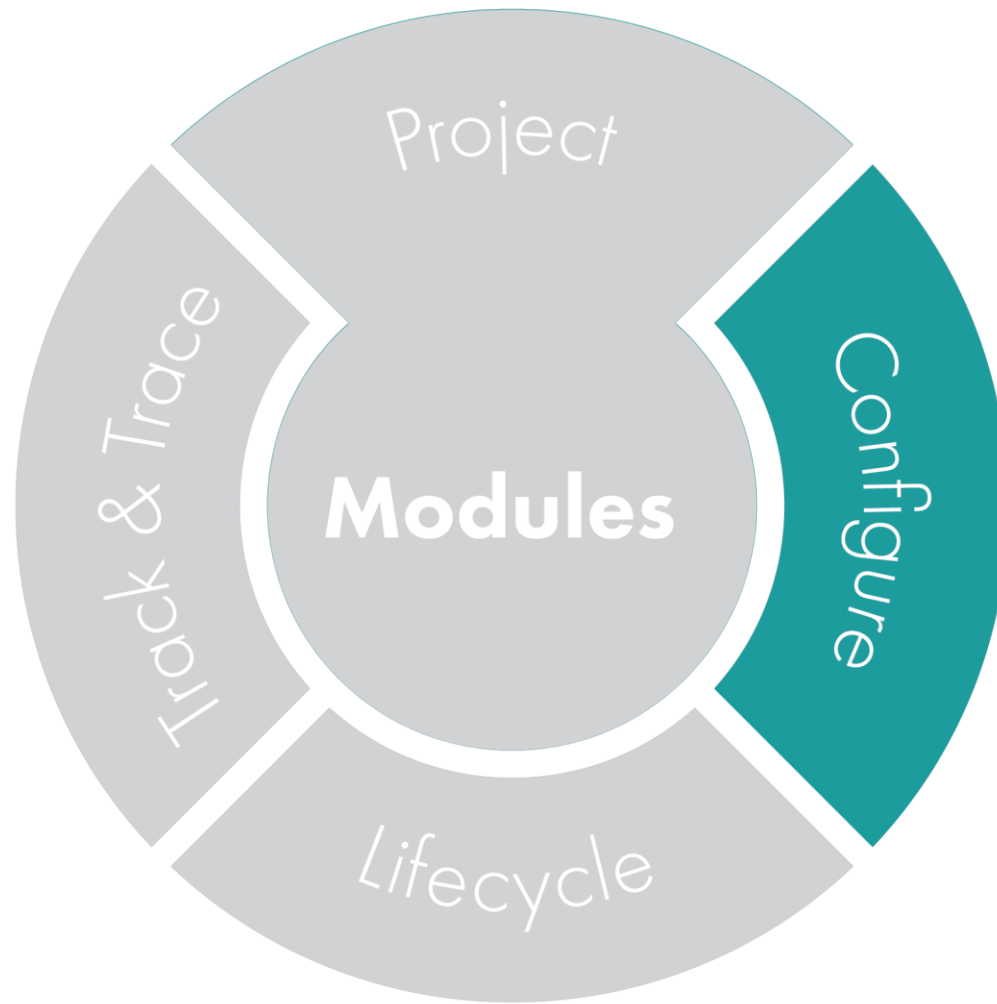
P170825-SKELETT-000567.pdf Certificate

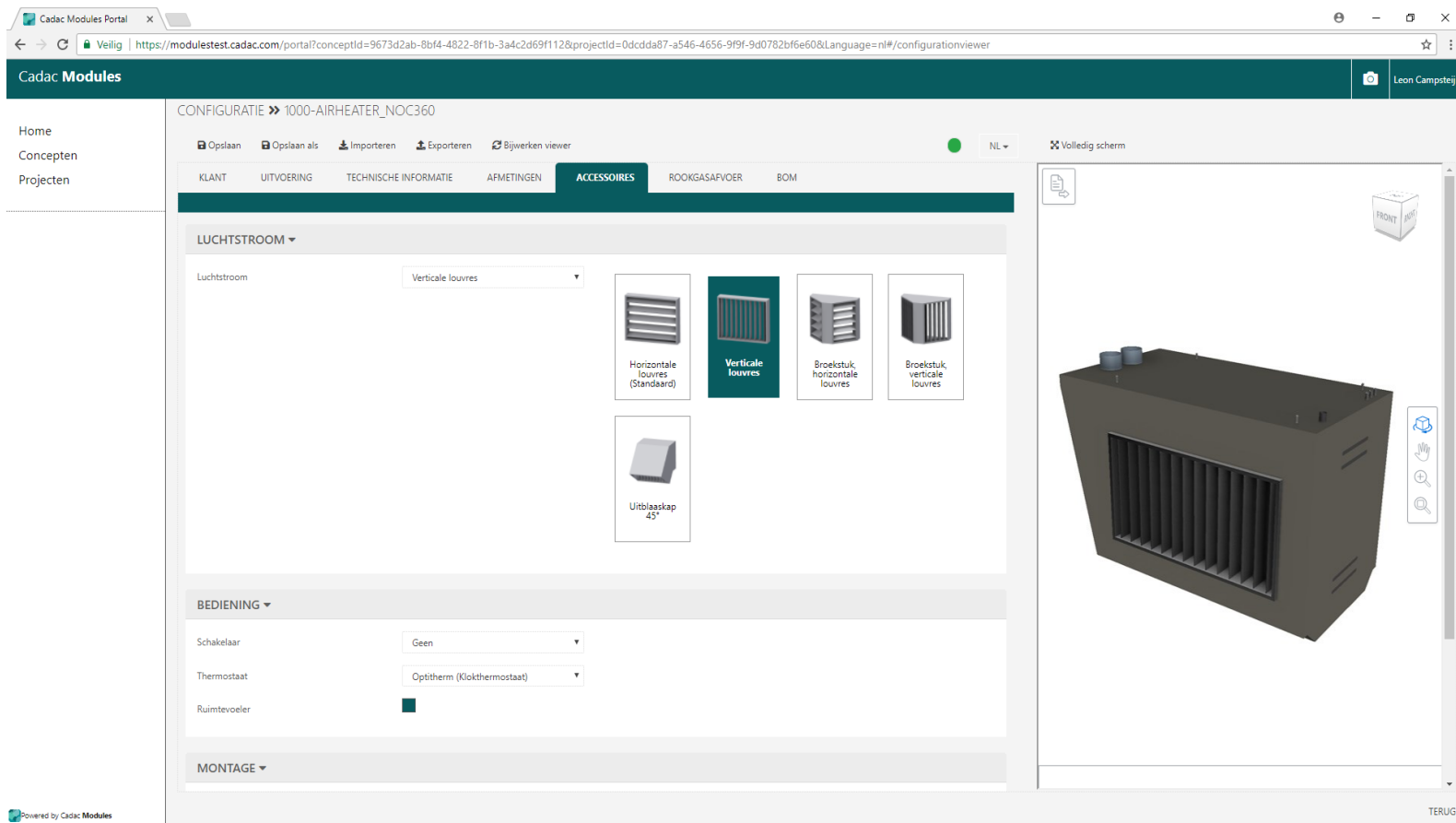
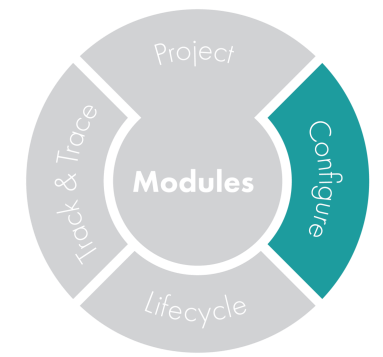
P170825-CONS-000678 version new 02-04-2017.pdf Certificate

P170825-CONS-000456.pdf Specification

P170825-SKELETT-000457.pdf Specification

P170825-CONS-000458.pdf Specification

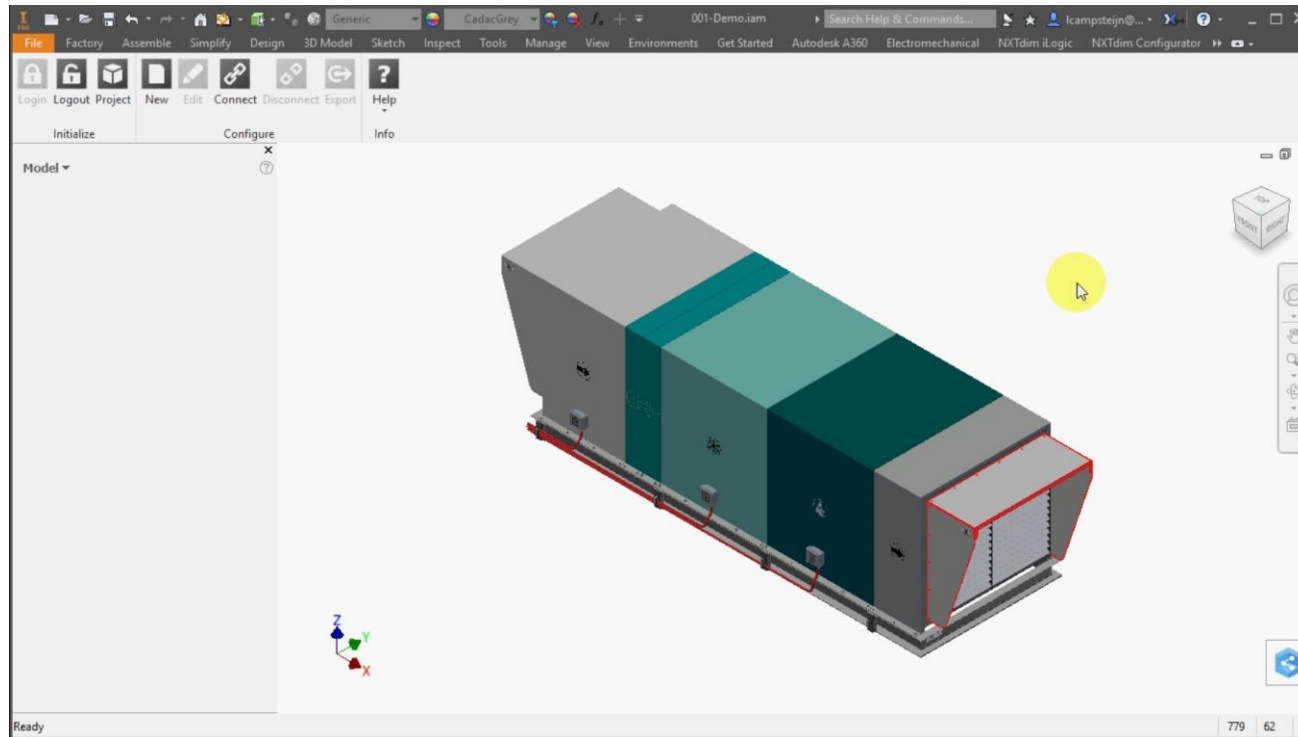
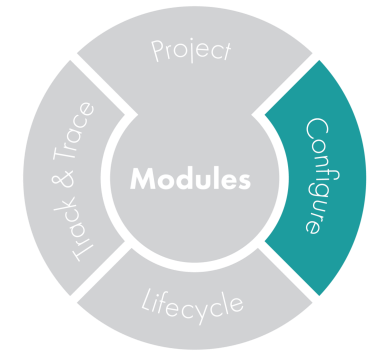




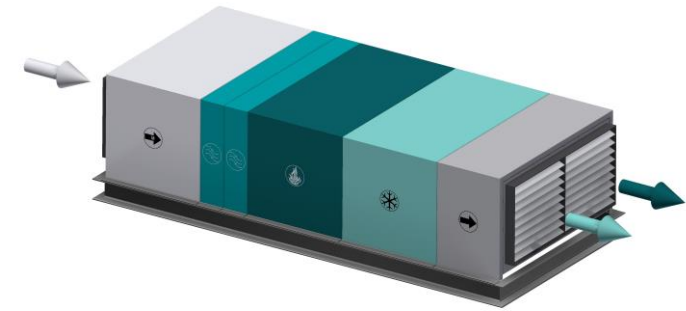
Features

- Configuration Management
- Configure Elements Online
- Configuration Import & Export
- Connect & Sync 2 CAD
- Create Documents

Configure Elements or Assemblies



Geometry + Product data



Tools:



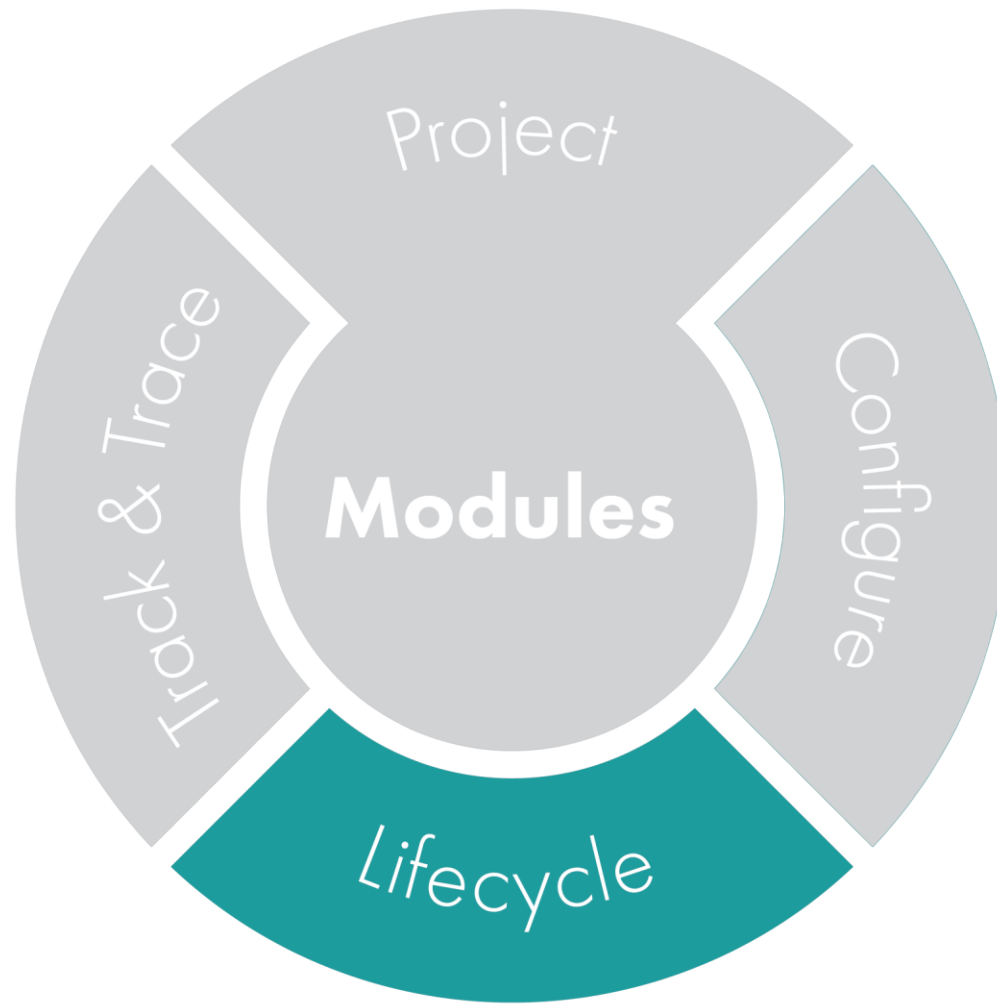
Role: Revit Modeller
BIM Manager

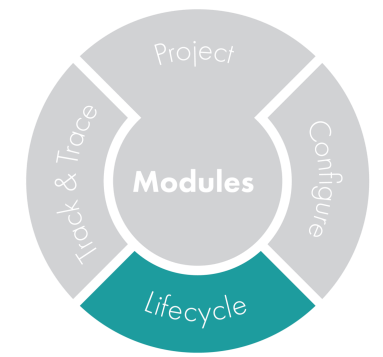
Tools: Cadac Modules Configure

Role: Product Manager
Manufacturer

Sync Configuration code

Powered by **Configit**





Cadac Modules Portal

modules.cadac.com/portal?publishid=2c237ae0-ab9e-434f-acfb-2c11b4f395e&projectId=0ba514b7-6c51-4b06-b637-1953e651bdf&Language=en-us/#elementhistory

Cadac Modules for JB Construct.

Bjorn Ramaekers (Admin)

PROJECTS > CADAC AEC MAIN OFFICE (2017-203) > ELEMENTS > 1062 X 2396 FIXED (31 ALU BI H1-V0 A) > ELEMENT HISTORY

Home
Concepts
Projects

► Element Details
▼ Element History

TIMESTAMP	PREVIOUS STATE	ACTION	CURRENT STATE	EXECUTED BY	COMMENT	CHECK STATE	CHECK LIST
2-6-2017 10:50:18	05. Commission	Checksum Invalid	05. Commission	bramaekers@cadac.com		Invalid	
1-6-2017 15:14:48	04. Construct	Approved	05. Commission	bramaekers@cadac.com	Thanks for the good work. Enjoy the building!	Valid	Open
1-6-2017 15:13:38	04. Construct	Properties edited	04. Construct	bramaekers@cadac.com	Marked for review		
1-6-2017 15:11:14	03. Order	Approved	04. Construct	bramaekers@cadac.com		Valid	
1-6-2017 15:08:32	03. Order	Properties edited	03. Order	bramaekers@cadac.com	Marked for review, Delivery Date, Construction date		
1-6-2017 15:04:28	02. Procurement	Approved	03. Order	bramaekers@cadac.com		Valid	
1-6-2017 13:34:21	02. Procurement	Properties edited	02. Procurement	bramaekers@cadac.com	Marked for review, Supplier, Construction company		
1-6-2017 13:29:09	01. Design	Approved	02. Procurement	bramaekers@cadac.com	Well done as well!	Valid	
23-5-2017 13:11:59		Lifecycle started	01. Design	bramaekers@cadac.com			
23-5-2017 12:46:39		Published		bramaekers@cadac.com			

► Element Properties

GO BACK

Powered by Cadac Modules.

Reject

Reject

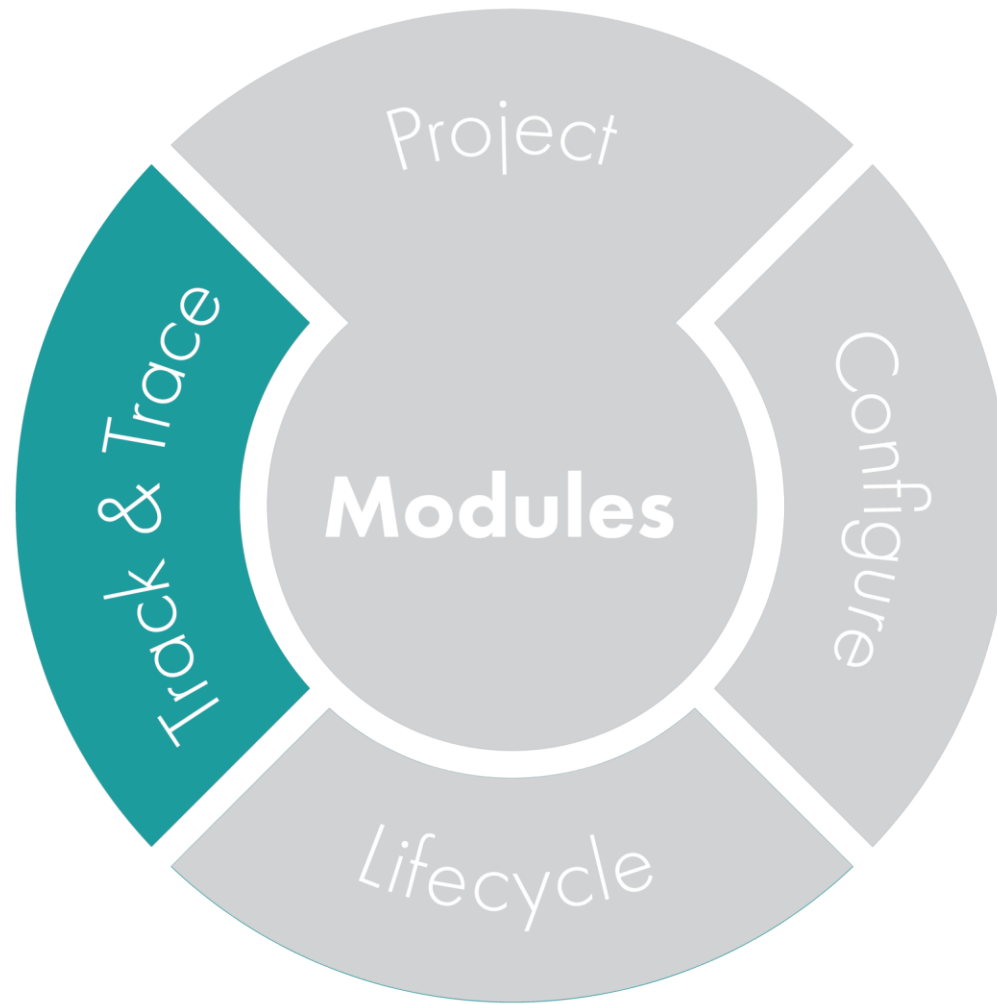
Reject

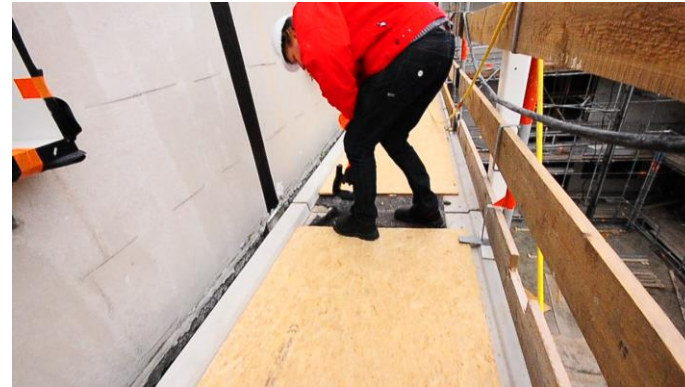
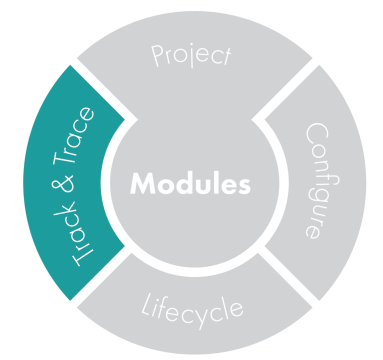
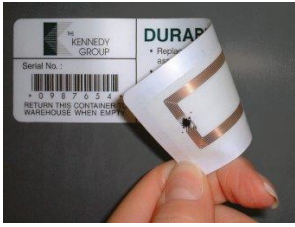
Reject

Reject

Features

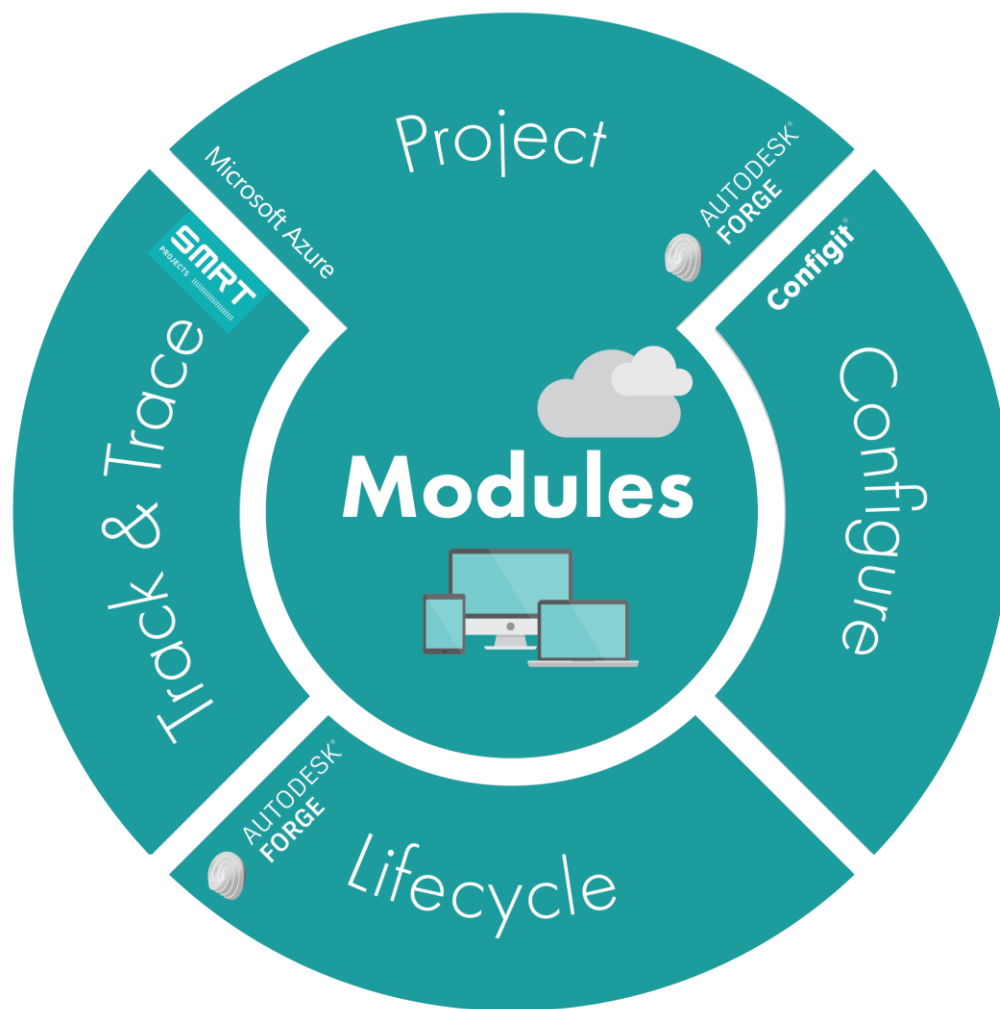
- Element Lifecycle (BIM level 3)
- CAD Integration
- Element Audit Trail
- Lifecycle State Interference
- Connect-2-Autodesk Revit
- Connect-2-AR+





Features

- Connect 2 Lifecycle
- ID Management
- QR-code | RFID
- Element Validation
- Checklist
- Attachments

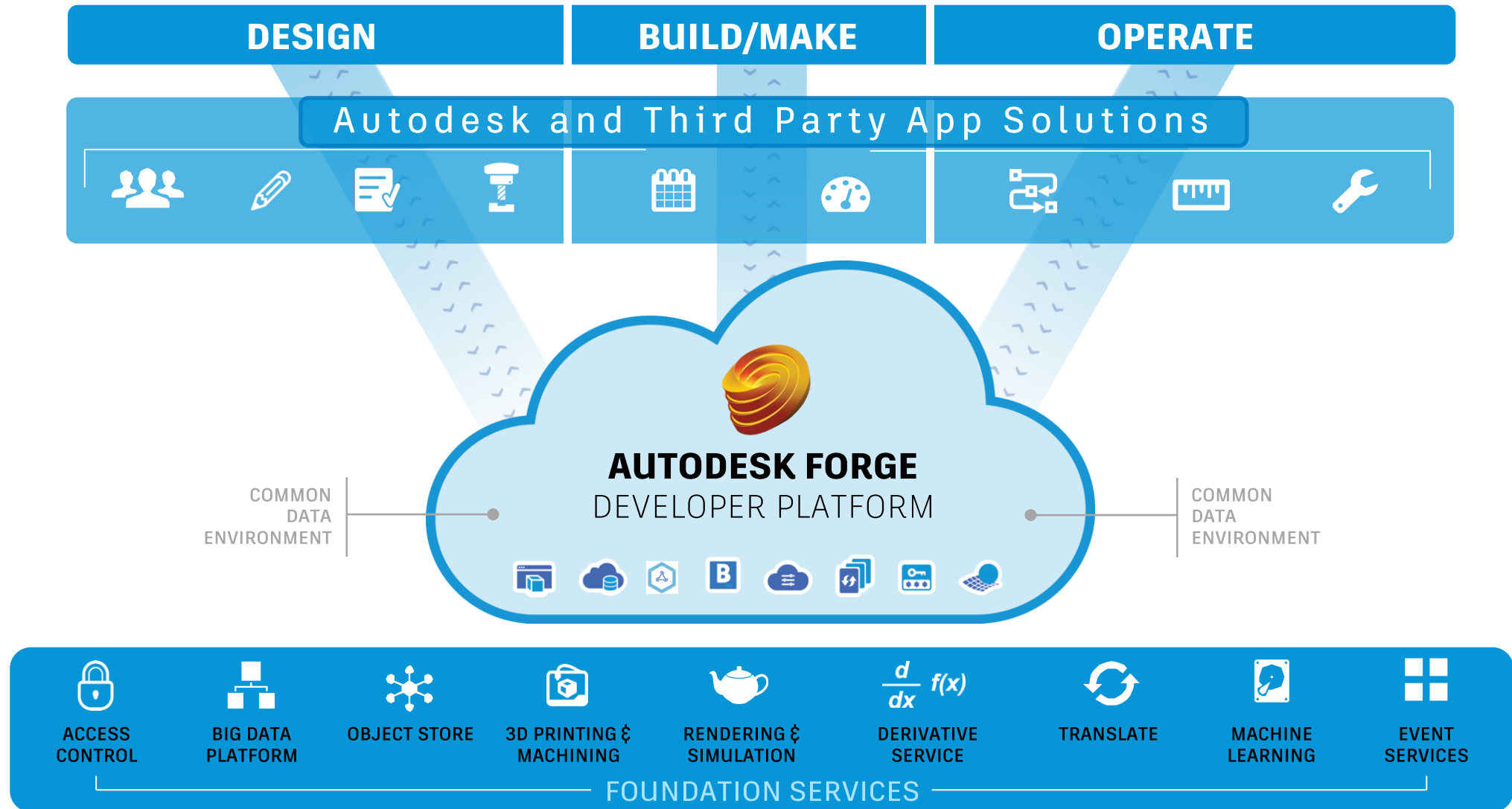




AUTODESK[®] FORGE

With Autodesk Forge
you can do pretty
much anything!

The Forge Ecosystem



Autodesk Forge – Main Services



Viewer

VIEWER API

- 2D /3D viewer for Web browser or Mobile device
- Smooth Model navigation and Interactions (Section, Measure, Walk, Explode)
- Review object meta data
- Extension Framework for Search, Markup and Hyperlinks



Model
Derivative

MODEL DERIVATIVE API

Share designs in different formats, and extract valuable metadata

- Converts 2D/3D files to web and mobile viewable format
- Converts designs into formats (.stl, .step, .iges & .obj)
- Extract object hierarchy trees, properties
- Create different-sized thumbnails
- Conversion of Revit to IFC and DWG

DATA MANAGEMENT API

Access and move files and data unified and consistently within Autodesk or with 3rd party environments

- Get project, folder & file lists
- Navigate : Folders, files versions & relationships
- Search & Filter project & file lists
- Upload and download files



Data
Management
API

AR/VR API [BETA]

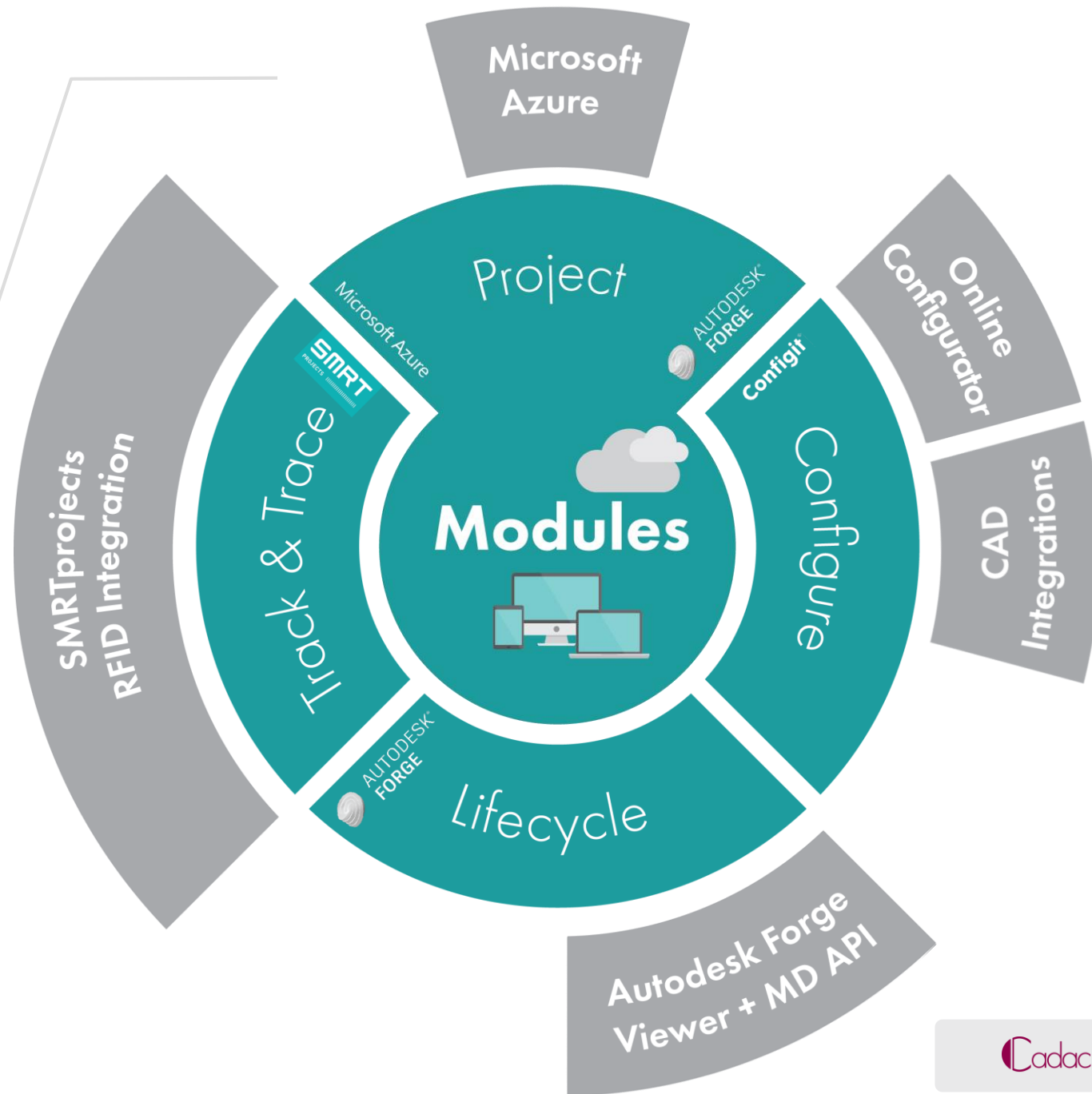
Automate publishing of CAD content into your AR/VR Authoring pipeline

- Unity / Unreal / WebVR



AR/VR
API

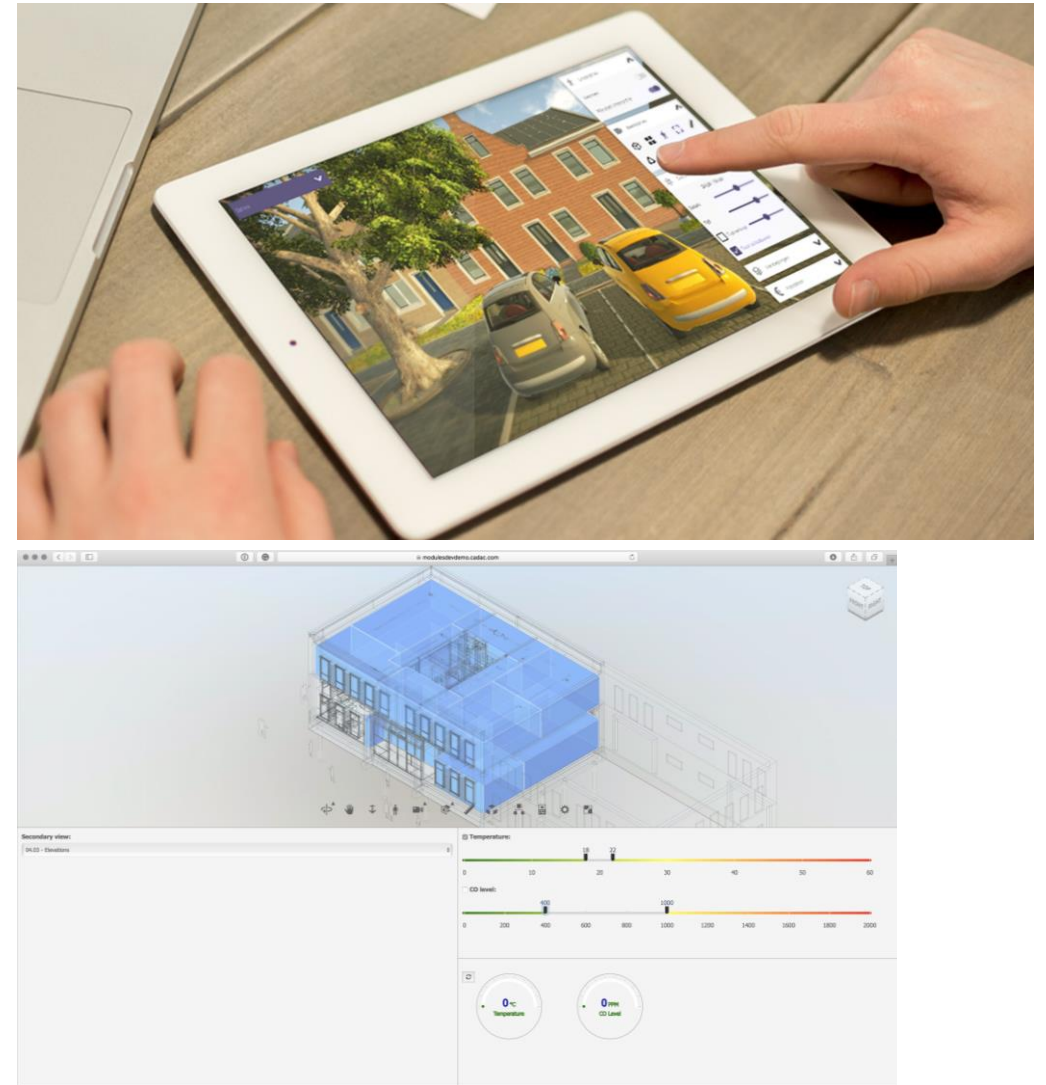
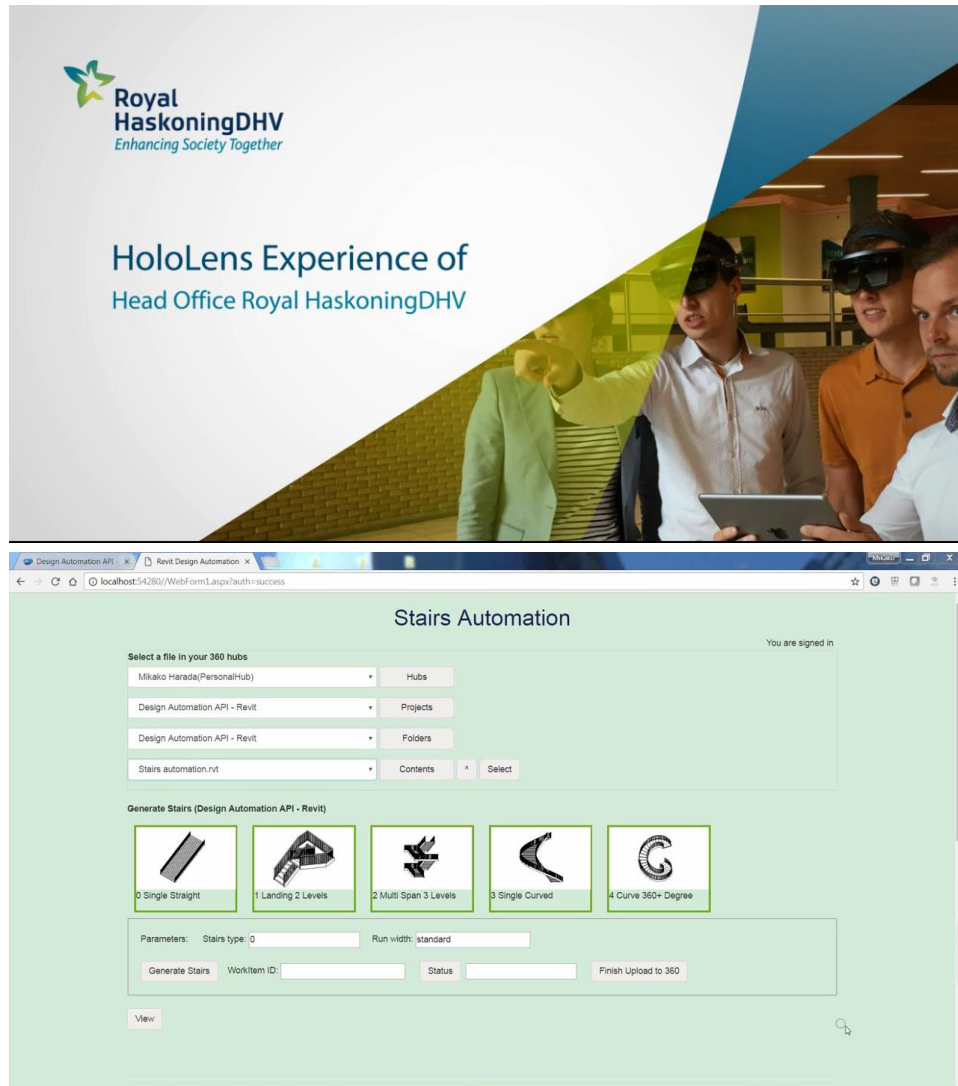
- ERP
- MS SharePoint
- BIM 360 API's
- FMIS
- Estimation
- Planning
- Innobrix
-




Platform Features

- Modular
- SaaS
- Single Sign-on
- AD integration
- Custom UI
- Secure 256 bits Encryption
- ISO 27001

What we are also doing

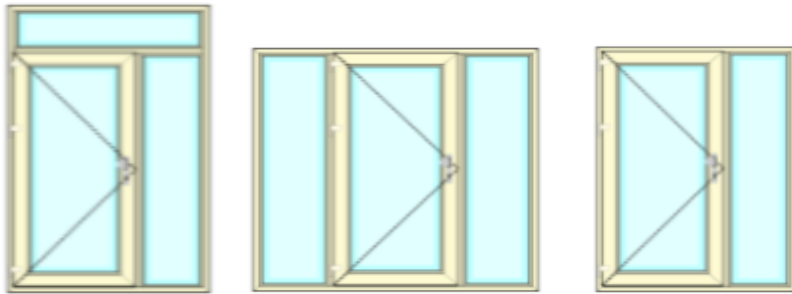


A full-page background image showing a person running on a paved road that curves through a hilly landscape. The sun is low on the horizon, creating a warm, golden glow. The sky is filled with soft, wispy clouds. In the distance, a town is visible through a light haze. A few birds are flying in the sky. On the left, a grassy hillside rises, with a few people standing on its crest. A metal guardrail runs along the right side of the road.

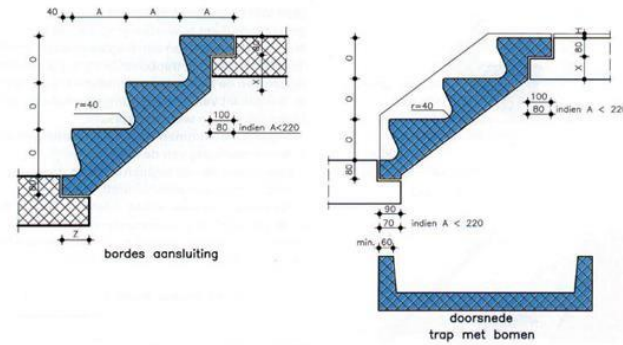
What else will
we do in the future?

What else will we do in the future?

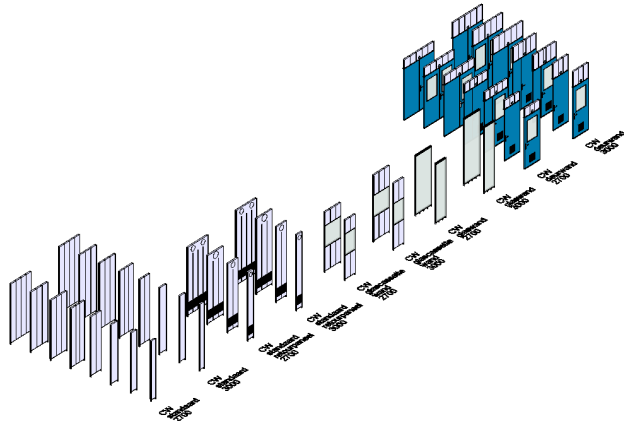
DOORS



PRECAST STAIRS



CLEAN WALLS



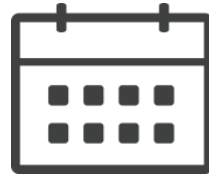
STANDARIZED HOUSING



To sum up: the value for BAM



Involve Everyone



Instant Pricing



Swift realisation



Quick Start!



More than
30%
shortened
Engineering lead time

More than
80%
faster
construction

Daily > 16 elements

Uniform assembly

Better Safety

What have shown you today

MODULAR CONSTRUCTION PRINCIPLES

- Standardize to Modules
- Configure to Elements
- Various and Numerous

BAM MODULAR ELEMENTS CONFIGURATOR

- Configure the elements
- Design with the elements
- Construct and track the elements

THE CADAC MODULES PLATFORM

- Innovative technology platform
- Current and Future capabilities
- Endless possibilities for integration with other platforms [e.g. Autodesk BIM 360]

An aerial view of a city skyline, likely London, featuring a prominent tower with a spherical top (the Shard) rising above a dense cluster of skyscrapers. The sky is filled with soft, wispy clouds, and the overall color palette is muted, with blues, greys, and a hint of yellow from the tower's top.

WOULD YOU LIKE
TO KNOW MORE?

www.cadac.com/AULondon

The background of the slide features a silhouette of two hikers on a mountain peak. One hiker, wearing a backpack and a cap, is assisting the other hiker as they climb. The scene is set against a dramatic sky with a sunset or sunrise, showing a gradient from deep blue to orange and red near the horizon. The overall mood is one of teamwork and achievement.

Thank you for your attention!

Any questions?

Jaco Prins

Team Manager Department BIM Engineering
jaco.prins@bam.com | +31 6 52 55 28 89 [MOB]

Desmond Laeyendecker

Business Development Manager
dlaeyendecker@cadac.com | +31 6 21 89 12 78 [MOB]



Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product and services offerings, and specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2018 Autodesk. All rights reserved.

