AI Eats Building Performance Simulation for Breakfast

Manuel Frey

Department Leader Digital Engineering & Performance Simulation

AUTODESK. UNIVERSITY

Manuel Frey

BIM, VDC & Performance Simulation

- 18 years in HVAC engineering and installation
- 10 years in Building Performance Simulations
- 5 years in virtual design & construction VDC / BIM

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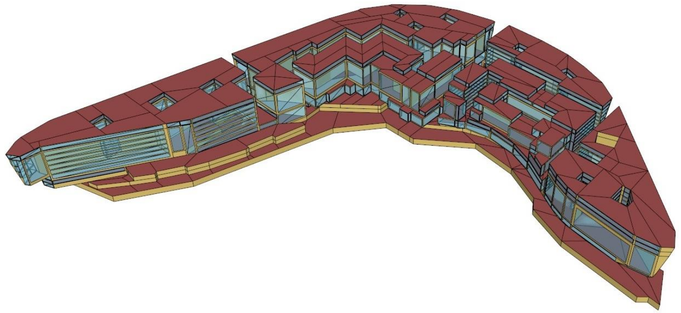
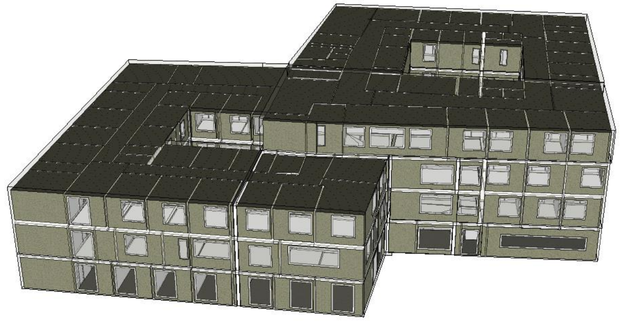
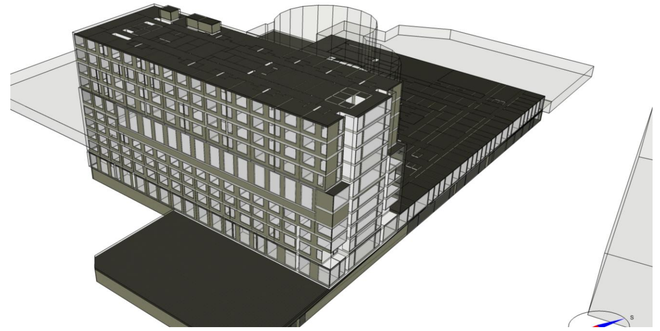
The Next Big Thing?!

Cost per Simulated Data







2013

Sketchup & Energy+

230'000 m2 / 2'480'000 sqft

113 simulated rooms

Cost per room: **$ 3'800.-**

2016

IFC & IDA ICE

5'600 m2 / 60'300 sqft

280 simulated rooms

Cost per room: **$ 29.-**

2019

RVT & IDA ICE

45'000 m2 / 480'000 sqft

1'700 simulated rooms

Cost per room: **$ 12.-**

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Cost per Simulated Data

$110	$14	$0.6	$0.02
2013	2016	2019	EXP. 2022
452 VARIABLES	560 VARIABLES	34'000 VARIABLES	10'000'000 VARIABLES
Sketchup & Energy+	IFC & IDA ICE	RVT & IDA ICE	TBD
	Cost factor **8**	Cost factor **20**	Cost factor **60**
	Variable factor **1**	Variable factor **60**	Variable factor **300**

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Palazzo & Venetian

Requirements

- Indoor Environmental Quality
- Energy Performance & Sustainability
- Operating Expenses

Digital Twin

What if…

- … each of the 7'128 rooms could act (not react) intelligently?
- … the building could optimize itself?
- … the predicted performance could be analyzed in real time?

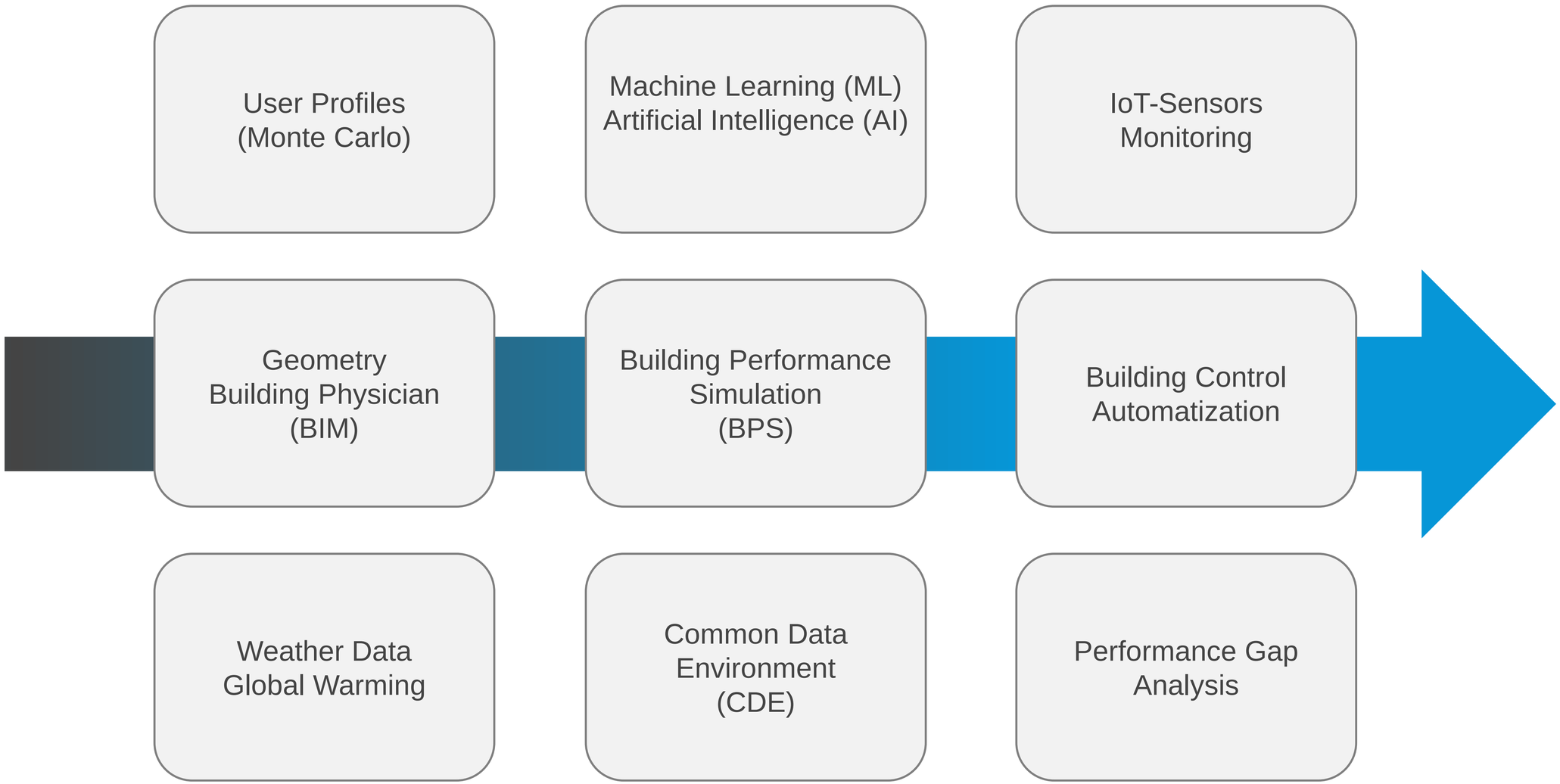
Living Digital Twin

As Planned

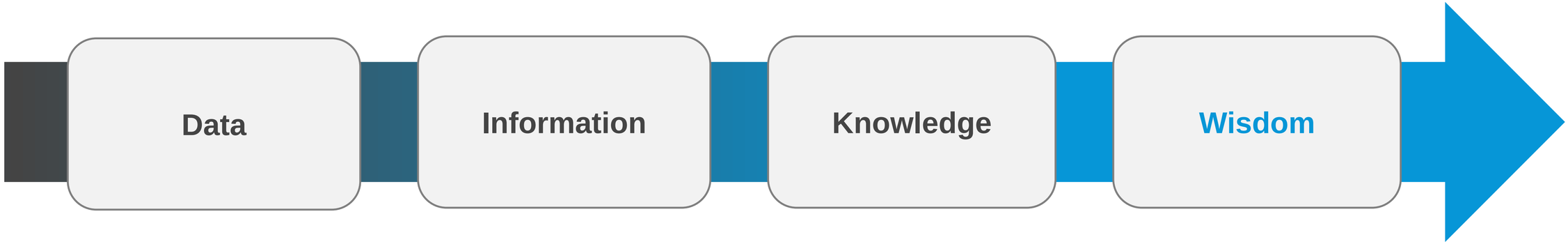
- Export simulation results
- Export boundary conditions
- Export control algorithms

As Built

- Uploading input to Building Management System (BMS)
- Virtual commissioning / hardware in the loop simulation
- Closing the gaps between engineering & construction


User Profiles
(Monte Carlo)
Machine Learning (ML)
Artificial Intelligence (AI)
IoT-Sensors
Monitoring
Geometry
Building Physician
(BIM)
Building Performance
Simulation
(BPS)
Building Control
Automatization
Weather Data
Global Warming
Common Data
Environment
(CDE)
Performance Gap
Analysis

Living Digital Twin



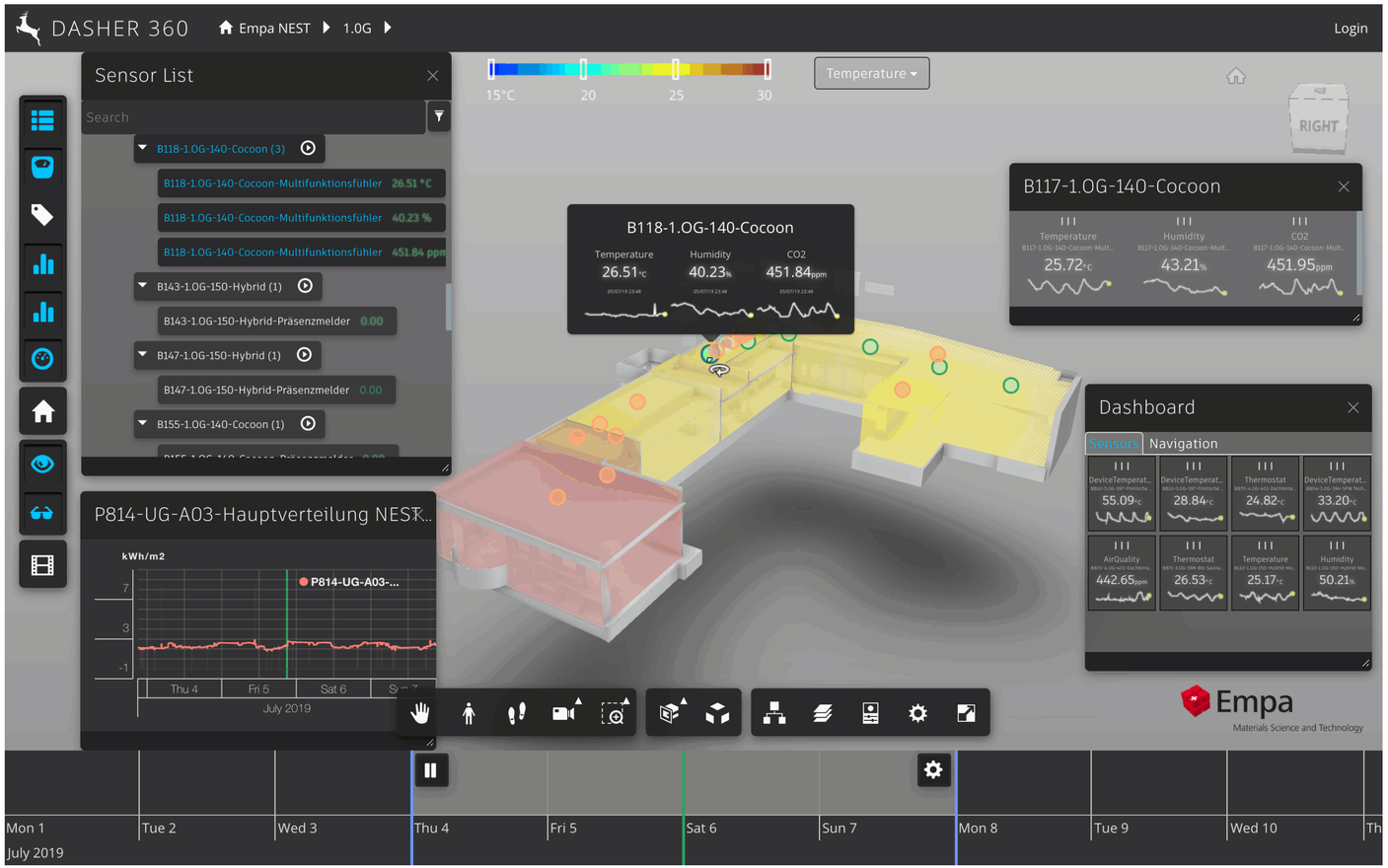
Data Generation

- High end BIM models
- Building performance simulation
- Process optimization in HVAC engineering

Data Processing

- Context data as high valuable resource
- Comparison of simulation results with measured data
- Virtually becomes reality

Living Digital Twin



Autodesk Forge – Dasher 360 – EMPA NEST

Source: Kean Walmsley - https://www.keanw.com/2019/09/a-major-update-to-dasher-360-now-showing-the-nest-building.html

Life Cycle Objective

AS ORDERED

OWNER / INVESTOR

AS PLANNED

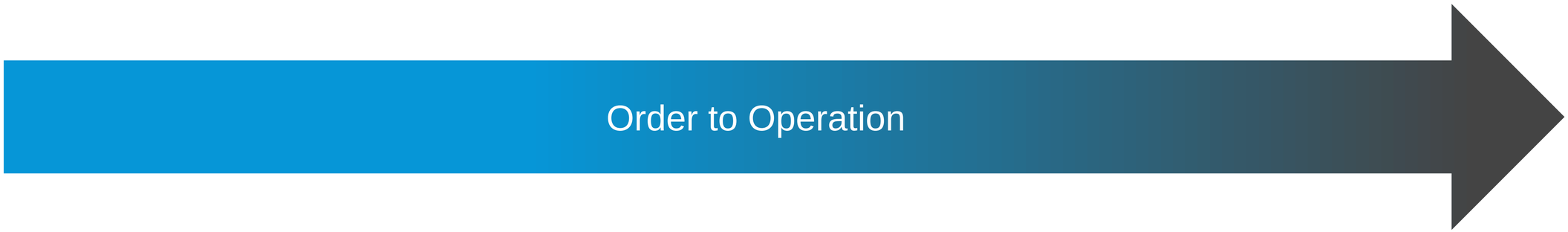
ARCHITECT / ENGINEER

AS BUILT

CONTRACTOR

AS PERFORMED

USER / FM



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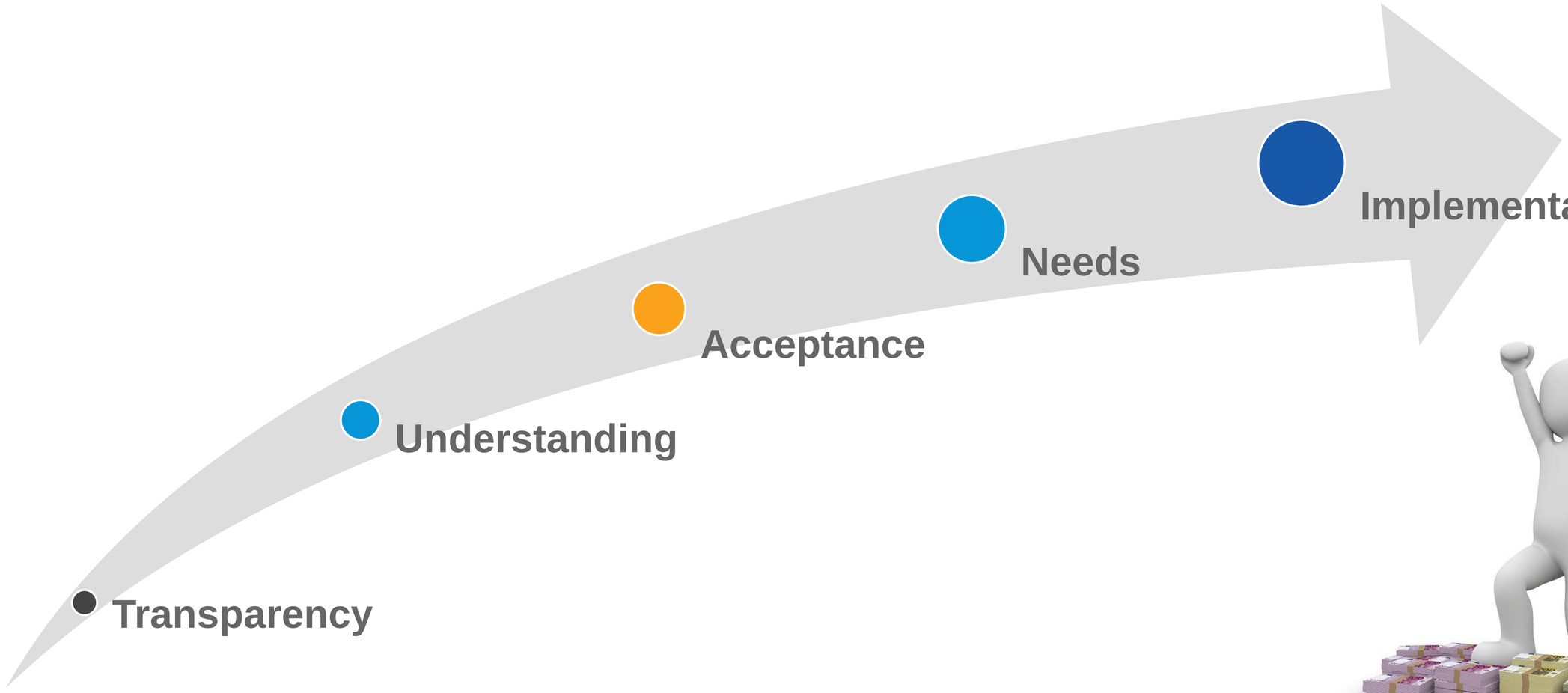
Change

Change Management



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Change Management

Vision	x	Skills	x	Incentive	x	Ressource	x	Action Plan	=	Change
	x	Skills	x	Incentive	x	Ressource	x	Action Plan	=	Confusion
Vision	x		x	Incentive	x	Ressource	x	Action Plan	=	Fear
Vision	x	Skills	x		x	Ressource	x	Action Plan	=	Partial Confusion
Vision	x	Skills	x	Incentive	x		x	Action Plan	=	Frustration
Vision	x	Skills	x	Incentive	x	Ressource	x		=	False Start

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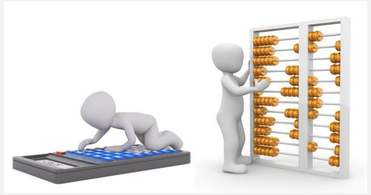
Simulation / BIM2SIM

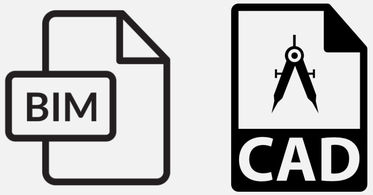


Data Management

ICE-Session

User Requirements

Drawing / Design



Construction / BIM2Field

Common Data Environment

Schedules

Costs

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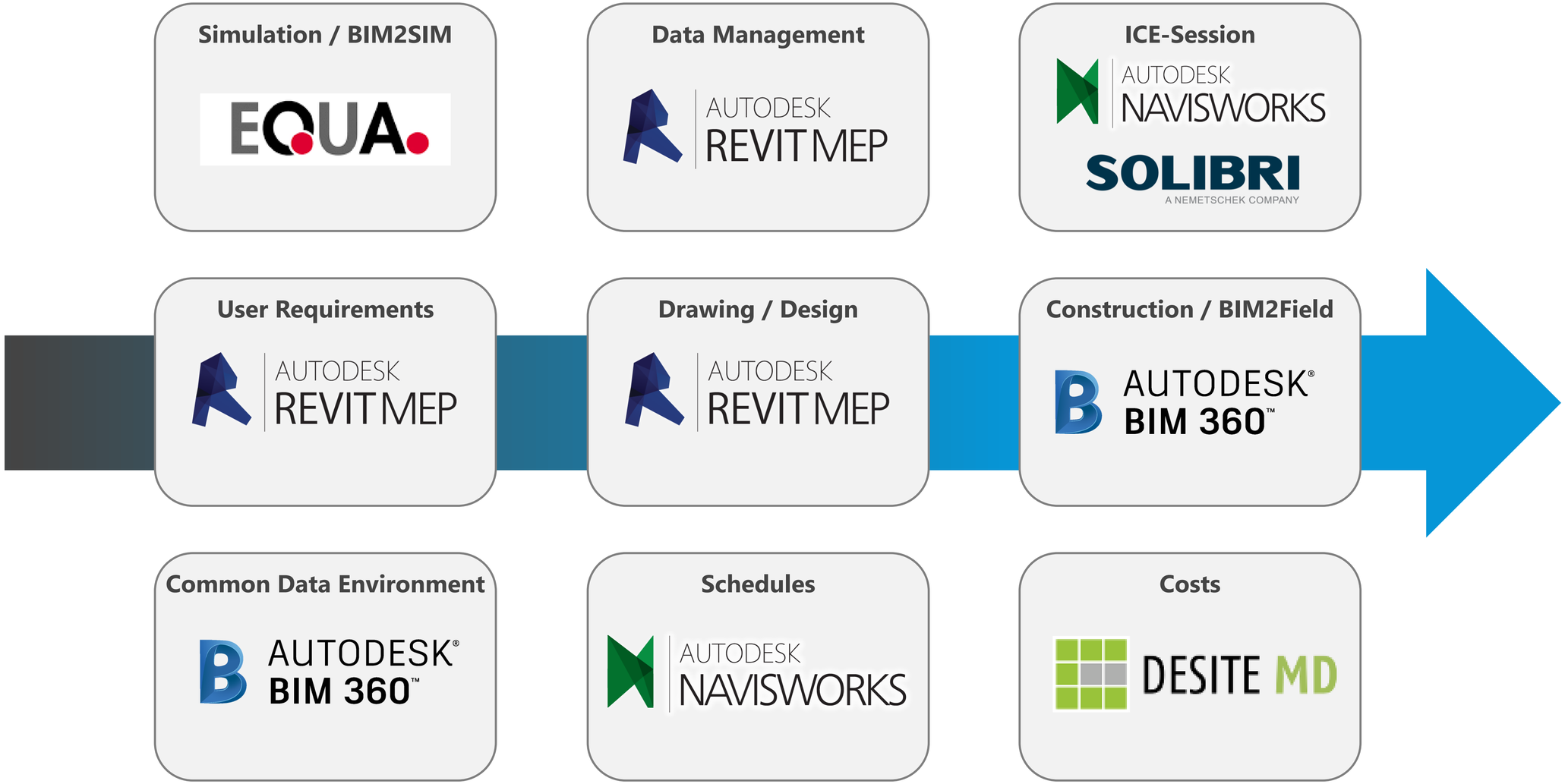
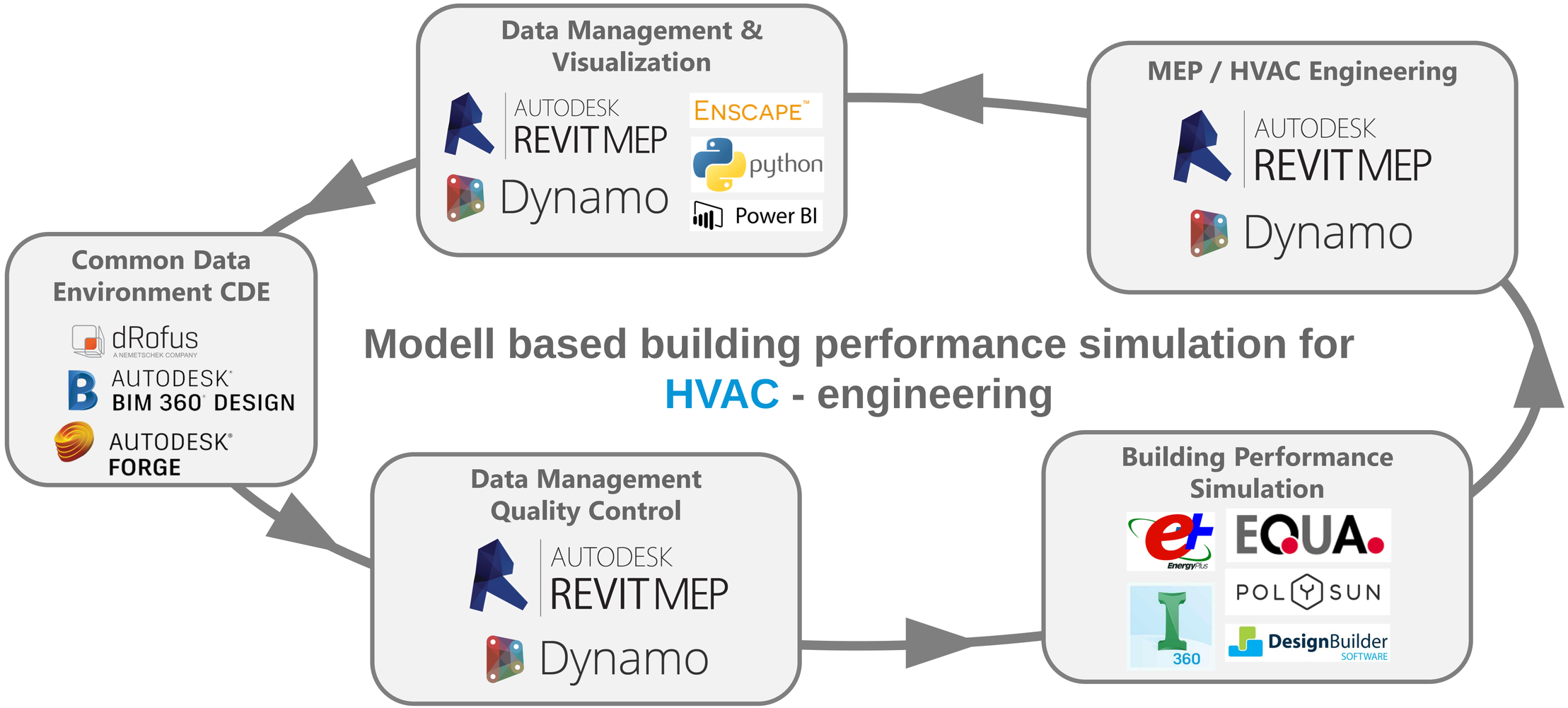

Simulation / BIM2SIM
EQUA
Data Management
AUTODESK
REVIT MEP
ICE-Session
AUTODESK
NAVISWORKS
SOLIBRI
A NEMETSCHEK COMPANY
User Requirements
AUTODESK
REVIT MEP
Drawing / Design
AUTODESK
REVIT MEP
Construction / BIM2Field
AUTODESK®
BIM 360™
Common Data Environment
AUTODESK®
BIM 360™
Schedules
AUTODESK
NAVISWORKS
Costs
DESITE MD

And now…?

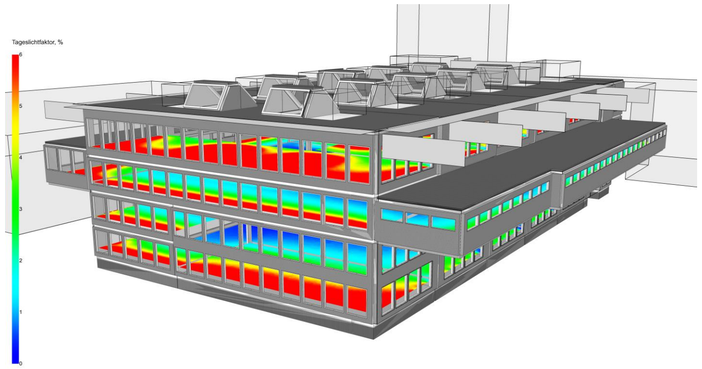

Data Management & Visualization
AUTODESK REVIT MEP
ENSCAPE
python
Dynamo
Power BI
MEP / HVAC Engineering
AUTODESK REVIT MEP
Dynamo
Common Data Environment CDE
dRofus
A NEMETSCHEK COMPANY
AUTODESK BIM 360 DESIGN
AUTODESK FORGE
Modell based building performance simulation for
HVAC - engineering
Data Management Quality Control
AUTODESK REVIT MEP
Dynamo
Building Performance Simulation
EnergyPlus
EQUA
POLYSUN
360
DesignBuilder SOFTWARE

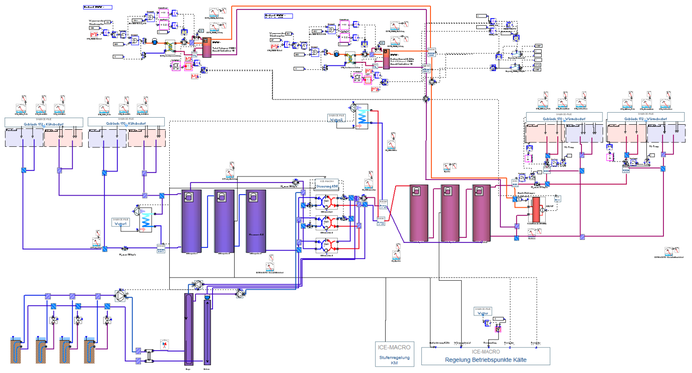
Use Cases

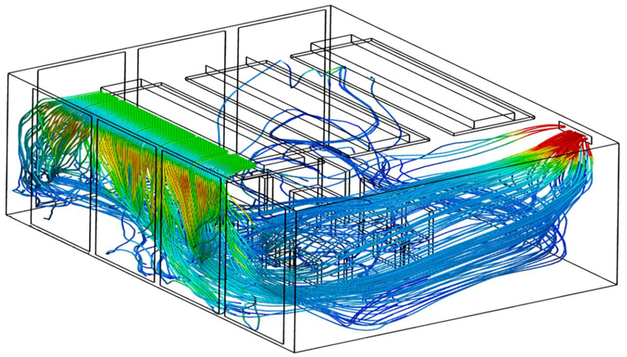
Modell based building performance simulation

for HVAC - engineering

- Analysis of primary energy demand & CO2 emissions
- Calculation of net & final energy demand
- Verification of thermal comfort (ISO 7730)
- Proof of summer thermal protection for application
- Proof of air-conditioning requirements for application
- Heating & cooling load calculation
- Model-based daylight calculations
- Model-based user agreement & user requirements







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Success Factor

RELIABILITY

Transparency and flexibility in project processing

MONETARY VALUE

Quick results and fast decision making

MARKETING & RECRUITING

Diversification to competitors

Success Factor

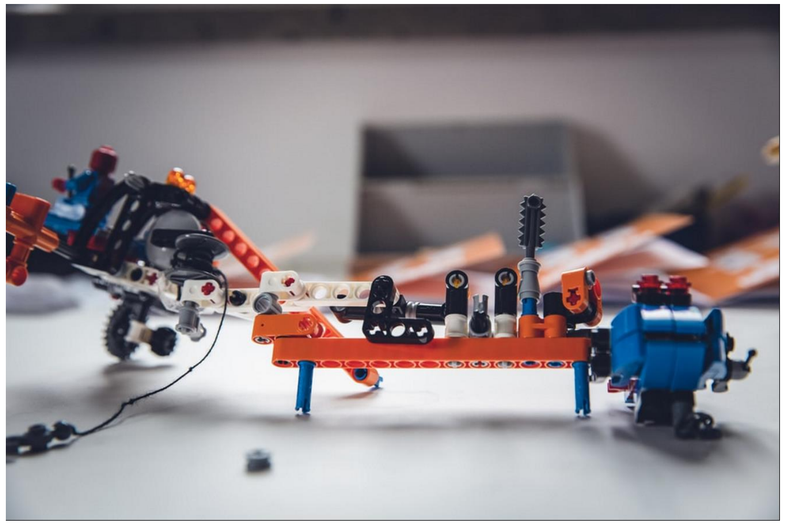
What you need

- Create an inspiring environment
- Employees as brand ambassadors
- Provide opportunities for development

Where you get it

- Be involved with students & talents
- Be active on social media (e.g. LinkedIn)
- Create your own brand (employer branding)

Success Factor



Imagination

- Believe in your ideas
- Go the extra mile
- Never give up

Multiplication & Synergies

- Reach a critical mass
- Become part of the workflow
- Generate added value for others

Thank You!

Gruner Roschi AG
Manuel Frey
Sägestrasse 73
CH-3098 Köniz
+41 31 917 20 90
manuel.frey@gruner.ch
www.gruner.ch
www.digital.gruner.ch

LinkedIn

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