



The class will
start at 16h15

Also part of :



sia

Schweizerischer Ingenieur- und Architektenverein
Société suisse des ingénieurs et des architectes
Società svizzera degli ingegneri e degli architetti
Swiss society of engineers and architects

■ Dimitrios Terzis



Innovation for construction & the environment

Dr. Dimitrios Terzis

29/10/2024

Today's class

CIVIL-424 Innovation for construction and the Environment / Fall 2024

Tuesdays 16:15-18:00 pm
Tuesdays 18:00 - 19:00 pm
Office hours:

Lectures
Project discussions and continuous reporting
Tuesdays morning (upon email request and confirmation)

Room GCA331

Title

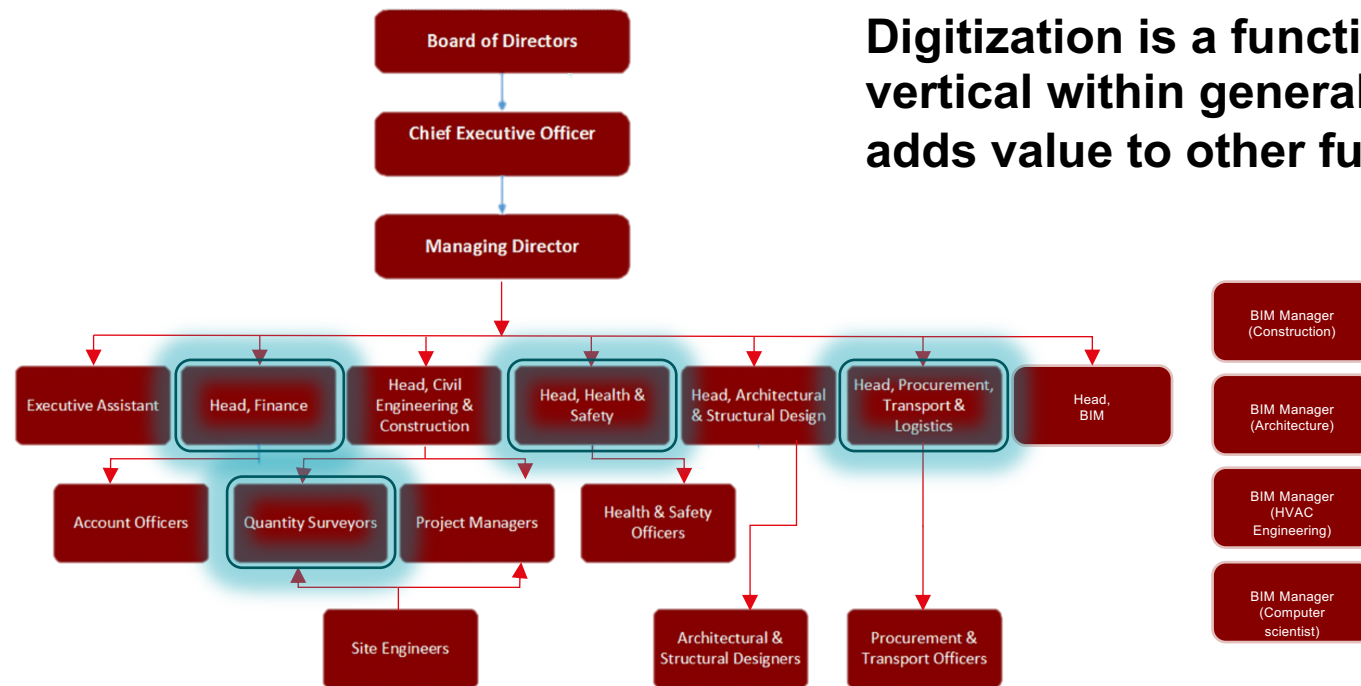
Week 1	10.Sep 45 mins 45 mins	Introduction to the course Disruptive, Incremental Innovation and Research, Projects from last year and takeaways
Week 2	17.Sep 45 mins 45 mins	Cement-free concrete Cement-free concrete
Week 3	24.Sep 45 mins 45 mins	Circular economy, Impact and Life Cycle Assessment Sustainalytics
Week 4	01.Oct 45 mins 45 mins	Data-driven structural health monitoring and damage detection for smart infrastructure and buildings Data-driven structural health monitoring and damage detection for smart infrastructure and buildings
Week 5	08.Oct 45 mins 45 mins	Monitoring and surveillance GIS and BIM for construction and risk management
Week 6	15.Oct 45 mins 45 mins	Project preparation / Paper reading Project preparation / Paper reading
Week 7	29.Oct 45 mins 45 mins	Industrial innovation from the perspective of a construction giant Industrial innovation from the perspective of a construction giant
Week 8	05.Nov 45 mins 45 mins	Sustainalytics Sustainalytics
Week 9	12.Nov 45 mins 45 mins	Traffic Operations, Unmanned Aerial Systems (UAS) and Data Science for smart mobility Traffic Operations, Unmanned Aerial Systems (UAS) and Data Science for smart mobility
Week 11	19.Nov 45 mins 45 mins	Harnessing renewables for buildings Harnessing geo-energy for buildings
Week 12	26.Nov 45 mins 45 mins	Nature-based innovations Nature-based innovations
Week 13	03.Dec 45 mins 45 mins	Parametric design Robotic construction
Week 14	10.Dec 45 mins 45 mins	Project presentations - schedule to be announced Project presentations - schedule to be announced
Week 15	17.Dec 45 mins 45 mins	Synthesis of Innovation project and takeaways Synthesis of Innovation project and takeaways

Today's class

1) Innovation as a function that applies across an institution's operations

2) Innovation from the perspective of a construction giant
With special thanks to K. van Eechoud / Senior innovation manager at Implenia

How to integrate innovation into "business as usual": The example of digitization



Today's class

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CHF 3,765 bn

2021 revenue



7,653

Total workforce
as at 31.12.2021



CHF 7,148 bn

Order backlog half year 2022



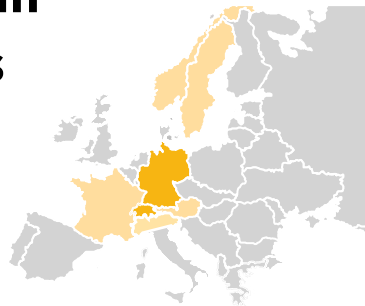
Sustainability

Industry leader in Sustainalytics rating, AAA rating by MSCI and gold status by EcoVadis

Positive outlook in relevant markets

CAGR¹⁾ 2022-24

Buildings +1.6%
Civil Engineering +2.7%



¹⁾ Compound annual growth rate (Euroconstruct)

© Implenla

4 Divisions



Real Estate



Buildings



Civil Engineering



Specialties

IMPLENIA





DIVISION CIVIL ENGINEERING

**DESIGNING AND
BUILDING MODERN
INFRASTRUCTURE**

Expert for complex Civil Engineering projects in Switzerland and Germany as well as Tunnelling and related infrastructure in further markets

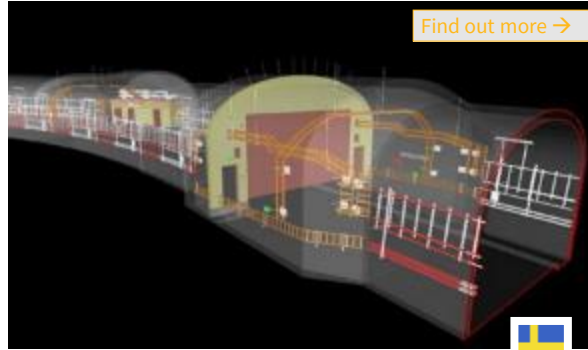
- Leading international position in tunnelling, special foundations and civil engineering
- Development of project-specific solutions thanks to in-house technical design office
- End-to-end management of large hybrid projects

DIVISION CIVIL ENGINEERING: DESIGNING AND IMPLEMENTING MODERN INFRASTRUCTURE



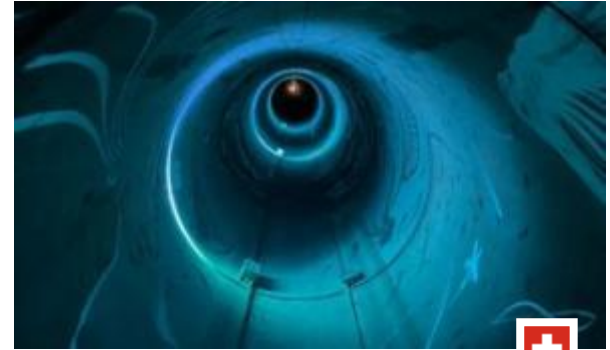
U81 Stadtbahnlinie, Lot 1&2 Düsseldorf, Germany

Construction of a new light rail line to link the airport and trade fair center to Düsseldorf city center, including an underground station. Logistically challenging construction site in a very confined space, right next to the airfield.



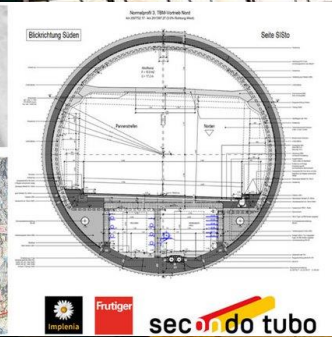
Connecting tunnel metro Stockholm, Sweden

Connecting tunnel to a metro depot under densely populated urban area, in close proximity to other railroad tracks. Planning and realization on the basis of a BIM model, entirely executed according to Lean Construction.



District heating microtunneling Wallis, Switzerland

Technically complex district heating tunnel for a modern, ecological energy supply for an entire region. The new channel runs directly under the Rhone River.



Secondo tubo San Gottardo

- **Lot 243**, Implenla builds access tunnels and logistics excavations using TBM
- **Main tunnel northern lot – Lot 241** stretching 7.9km using TBM and drill & blast



**PROJECT
2ND GOTTHARD
TUNNEL**

INNOVATION AS ONE OF OUR STRATEGIC PRIORITIES



Portfolio

Strong, differentiated
businesses



Profitable growth

Higher market share
and higher margins



Innovation

Rapid scaling
of innovation



Talent and organisation

Right people in the right
roles

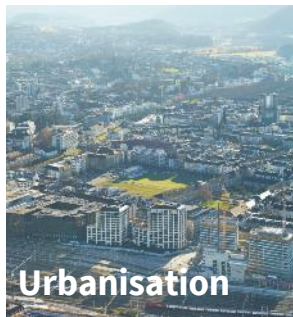
MEGATRENDS AND INDUSTRY SHIFTS CONTINUE TO OFFER ATTRACTIVE OPPORTUNITIES FOR INNOVATION AND NEW BUSINESS MODELS

Megatrends



- Increasing demand for **living space**
- Sustainable use of **resources**

→ **10 billion people by 2059¹⁾**



- **Densification**
- **Smart Cities**
- **Sharing Economy**

→ **81.2% in urban areas by 2025²⁾**



- **Modernization** of infrastructure
 - Further **expansion** and **networks**
- **EUR 10.7 billion infrastructure-investments in Europe by 2040³⁾**

Industry shifts



Sustainability

Increasing focus on environmentally and socially sustainable solutions



Consolidation & internationalisation

Increasing importance of economies of scale, risk diversification and innovation investments



Industrialisation

Increasing productivity through factory-based production of modules



Digitalisation

Increasing need of systems and solutions, e.g. Building Information Modeling (BIM), artificial intelligence, data analytics, metaverse, virtual reality

FIELDS OF INNOVATION AND GLOBAL INDUSTRY SHIFTS



Rising importance of **factory-based production modules**. Increasing productivity potential through **standardisation, automation** as well as **prefabrication**



Scalable solutions through modular capability and **productisation** ahead of competition



Increasing need of systems and solutions, e.g. Artificial Intelligence, data analytics, Virtual Reality, automation, **Building Information Modeling** (integrative, transparent and collaborative planning)



Integration of more **cutting-edge technologies** along entire project lifecycle and roll-out **faster** than competition



Focus on **environmentally and socially sustainable** solutions, driven by government and ESG regulations as well as changing mindset



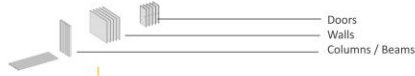
Sustainable construction and development including decarbonisation strategy

INNOVATION OPPORTUNITIES

FROM TRADITIONAL MODELS TO INDUSTRIALIZED CONSTRUCTION

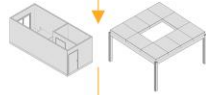
Kit of Parts

Set of interoperable standard components



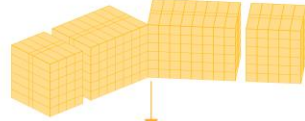
Platforms

Volumetric modules and/or parts assembled according to ruleset



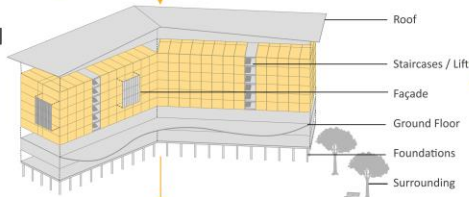
Reference Design

Integration of platforms using standard components



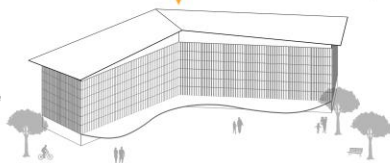
Supplemental Design

Portions of the building and activities not scalable

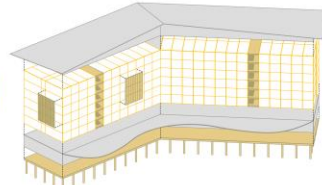


Physical Asset

Integration of reference and supplemental design



Standardisation increases with product versions



Identification of opportunities for future standardization to increase the reference design % (by developing platforms for staircases and lifts, façade, foundations, etc.)



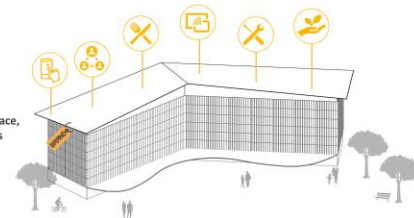
Virtual Asset

Integration of services



Product

Integration of space, location, services and brand



Real Estate Products

In-House Development of Real Estate Products, Co-Creation: Product Development as a Service

DIGITALIZATION & BIM

- Company wide process standardization and digitalization: **INSPIRE** transformation
- Increased adoption of **BIM & reality capturing**
- Several technology **pilots & implementations**
 - FIELD2BIM / BIM2FIELD
 - Artificial intelligence
 - Virtual- and Augmented Reality
 - Common data environments
 - Real estate development & marketing



IMPLENIA

SUSTAINABILITY

Empa and Eawag Research Campus



- Implenia as **preferred partner** for the implementation of **customer-driven, sustainable developments**
- Innovative **laboratory building, parking garage** as timber-concrete hybrid construction, ecologically focused workplaces at the **office building**
- **Applied research results of the Empa and Eawag laboratories** for energy generation and storage as well as wastewater treatment and recycling

Implenia leading in ESG



Sustainalytics and Ecovadis for assessment period 2021; MSCI ESG rating of AAA as of Dec 2021

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SUSTAINABILITY

12 AMBITIOUS GOALS IN FIVE PRIORITIES UNTIL 2025

SUSTAINABLE PRODUCTS AND SERVICES

1. SUSTAINABLE DEVELOPMENT & REALISATION

Highest standards
in projects

2. SUSTAINABLE SUPPLY CHAIN

Cooperation with
sustainable
partners

3. ECO CON- STRUCTION SITE

Project-specific
sustainability
concepts

RESPECT FOR THE ENVIRONMENT

4. CO₂-REDUCTION

2050 target: net zero
CO₂-emissions.
2025 target: reduce
CO₂-emissions
by 15%

5. ENVIRONMEN- TAL PROTECTION

Professional
environmental
management in all
projects

6. CIRCULAR ECONOMY

New circular
business models
promote closing of
material cycles

SOCIAL COMMITMENT & COMPLIANCE

9. IMPLERIA WITHOUT BORDERS

Engagement in
social partnerships

10. ETHICAL GOVERNANCE

Business aligned
with ethical
principles

ATTRACTIVE WORKING ENVIRONMENT

7. SUSTAINABIL- ITY IN OUR DNA

Sustainability in
our daily actions

8. ENGAGED EMPLOYEES

Aim for 0 accidents
& high employee
satisfaction

FINANCIAL & OPERATIONAL EXCELLENCE

11. SUSTAINABLE FINANCE

ESG-criteria are
integrated in our
business & invest-
ment decisions

12. DIGITAL & INTEGRATED PROCESSES

Operational excel-
lence & high-
quality standards

FUTURE OF CONSTRUCTION?

THE FUTURE OF CONSTRUCTION WILL BE LARGELY BASED ON THE FUTURE OF LIVING, WORKING AND MOBILITY

Future of living

Future of work

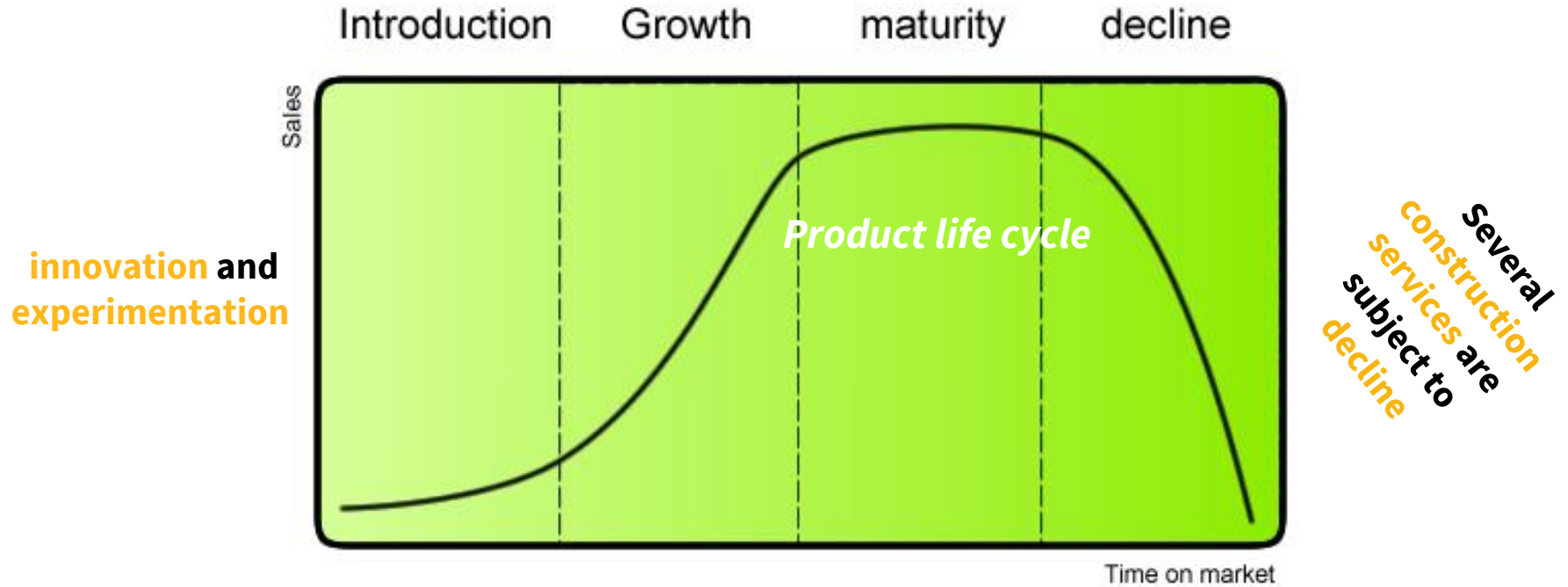
Future of energy

Future of mobility

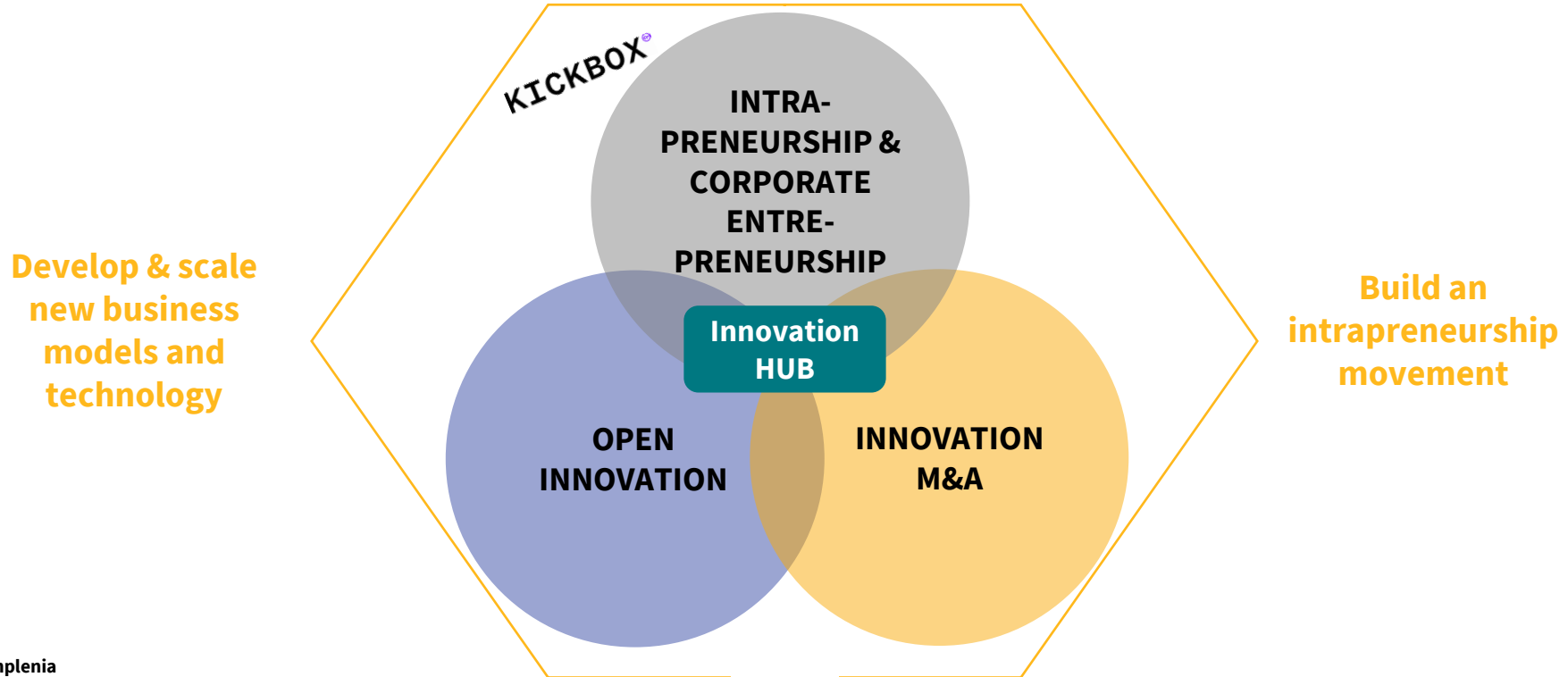


WHY WE INNOVATE?

INVESTMENTS IN SUSTAINABILITY, INDUSTRIALIZATION AND DIGITALIZATION ARE NOT A GUARANTEE FOR LONG TERM SUCCESS..



ACCELERATING INNOVATION AND INTRAPRENEURSHIP TO DEVELOP & SCALE NEW BUSINESS MODELS



WE MOBILIZE OUR EMPLOYEES TO BECOME INTRAPRENEURS WITH KICKBOX AND START DOING

91

Digital
Platform

Red Box



Sponsor

Validate

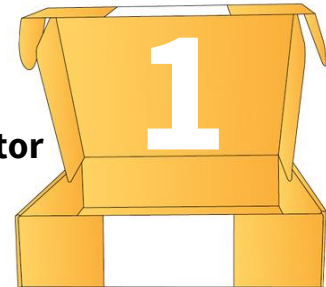
Blue Box



Investor

Pilot

Gold Box



Implement

- **Support** Innovation Hub team, innovation **coaching**, e-mail coaching
- **Network** of internal and external experts
- **Tools** (E.g. Kickbook, Kickmap, eLearning, IT, piloting)

INTRAPRENEURSHIP

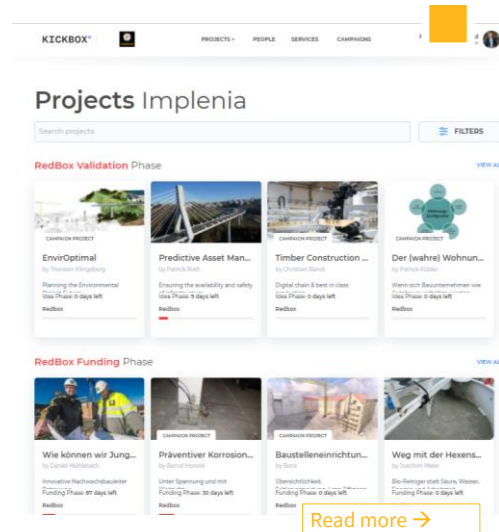
91 IDEAS SUBMITTED AND A GROWING COMMUNITY OF INTRAPRENEURS AT IMPLENIA



EVENTS LIKE PITCH EVENTS, COMMUNITY MEETUPS, FUTURE TALKS & SCREWUP NIGHTS

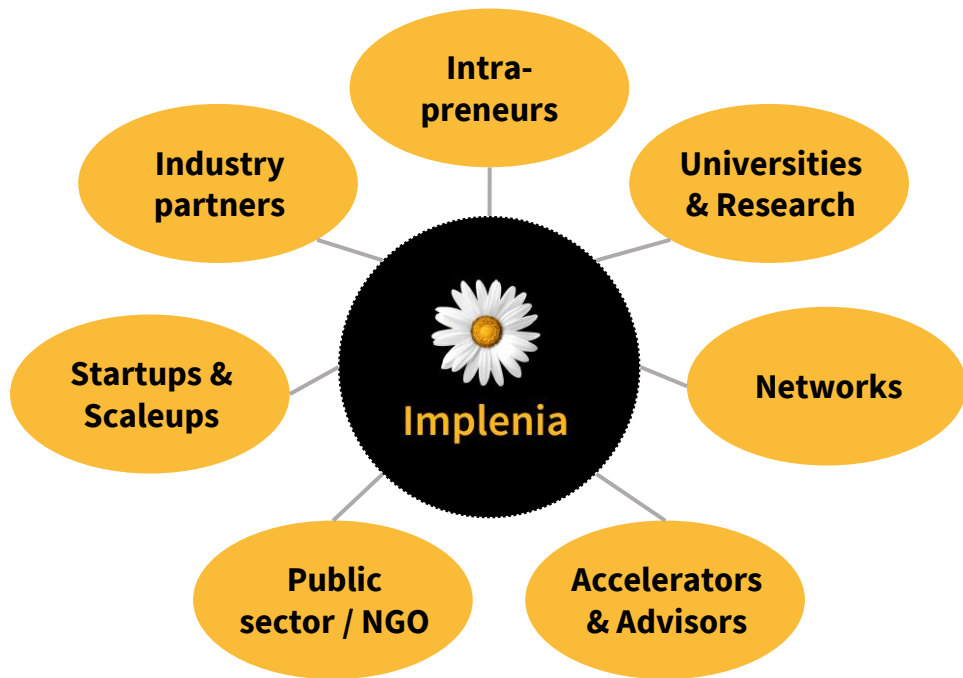
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DIGITAL PLATFORM WITH INNOVATION PROJECTS AND A COMMUNITY OF +900 EMPLOYEES



WORKSHOPS AND SUPPORT FROM PROFESSIONAL COACHES AND INNOVATION EXPERTS TO TEST IDEAS

INNOVATION IN CONSTRUCTION SERVICES, NEEDS A STRONG ECOSYSTEM OF PARTNERS



Innovation partners



INNOVATION OPPORTUNITY SPACES WHERE IMPLENIA PRIORITIZES PARTNERSHIPS AND INVESTMENTS TO SCALE NEW OFFERINGS

Opportunity spaces

**Underground space
concepts, streets 2.0,
future energy
infrastructure**



**Predictive asset
management of
infrastructure**



**Innovative
construction and
engineering services**



**Modular construction
systems and
industrialized
modernization**



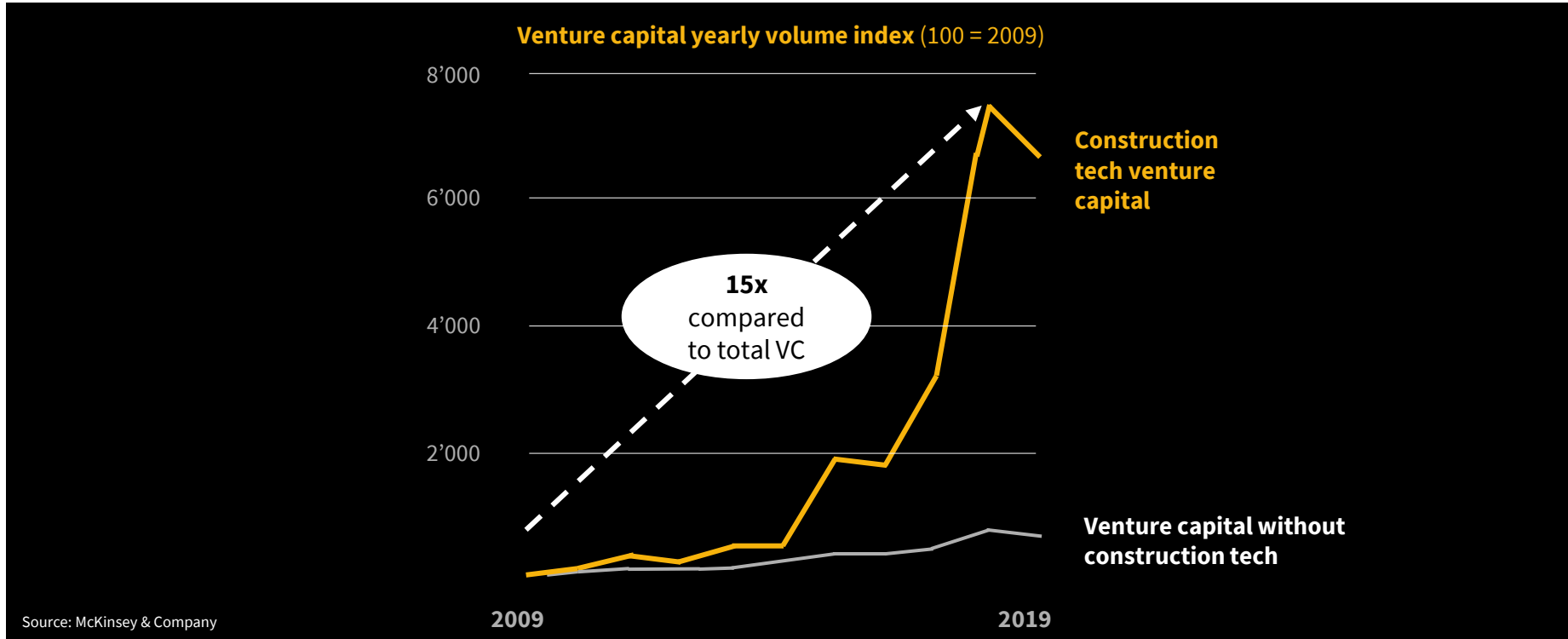
**Digital development,
planning and real
estate services**



**Circular construction
solutions**



RULES OF THE GAME IN THE INDUSTRY START TO CHANGE: NEW INNOVATIVE STARTUPS INCREASING JUMP ON OPPORTUNITIES



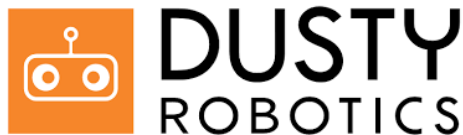
OPEN INNOVATION

SOME OF THE LARGEST DEALS IN CONSTRUCTION AND PROPTech STARTUPS IN 2022 SO FAR



60M USD

Series C



45M USD

Series B



30M USD

Series B

OPEN INNOVATION

SELECTED STARTUPS IN THE CONTECH AND PROPTECH SPACE WE SCREENED AND TESTED LATELY



IRE



ROCKETHOME



Archilyse



HEGIAS
building imagination



One Click LCA



RAUM
PIONIERS



ormera



IBU



ALICE
TECHNOLOGIES



Scaled
Robotics



imerso



GAMMA AR VISUAL LIVE



FRAME NCE



ICE



CORRUX



medusoil



INNOVATED BY PALFINGER VCE ANGST



terryx



TERAKI



ISP



ANERDGY



DES



DURAMON



incon.ai



PlanRadar



INNOVATION OPPORTUNITY SPACES WHERE IMPLERIA PRIORITIZES PARTNERSHIPS AND INVESTMENTS TO SCALE NEW OFFERINGS

Opportunity spaces

**CONSTRUCTION
SOFTWARE & DATA
ANALYTICS**



**PREDICTIVE ASSET
MANAGEMENT OF
INFRASTRUCTURE**



**INNOVATIVE
CONSTRUCTION
SERVICES**



**MODULAR &
INDUSTRIALIZED
CONSTRUCTION
SERVICES**



**SMART BUILDINGS &
REAL ESTATE
SOLUTIONS**



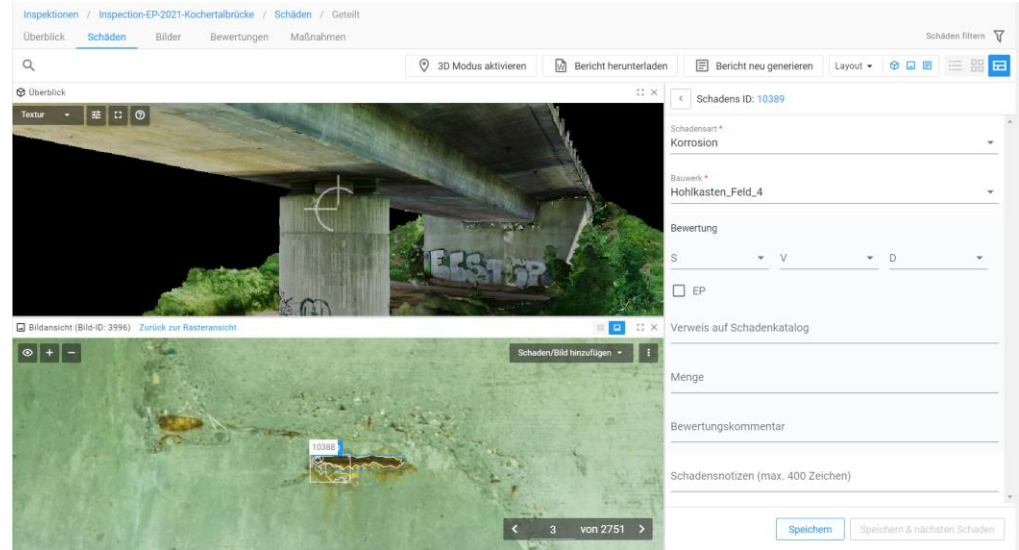
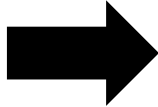
**CIRCULAR BUSINESS
MODELS &
MATERIALS**



A person wearing an orange high-visibility safety vest with reflective silver stripes and a logo on the chest is holding a tablet. The vest has a logo that includes a white flower and the text "THE FUTURE". The person is wearing a black glove on their right hand. The background is a blurred warehouse or industrial setting with metal shelving. A semi-transparent white box is overlaid on the left side of the image, containing the text "CORPORATE INNOVATION IN ACTION". A solid orange square is positioned above the white box.

CORPORATE INNOVATION IN ACTION

TECHNOLOGY PILOTS AND CUSTOMER VALIDATION TO DEVELOP NEW SERVICES ALONG THE ASSET LIFE CYCLE OF BRIDGES

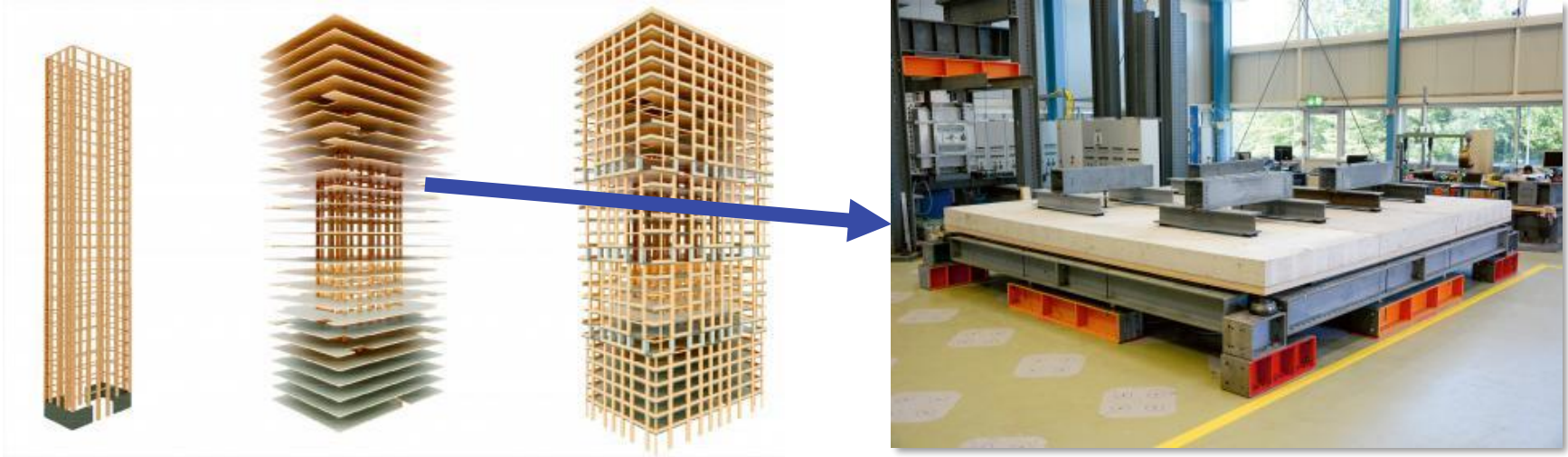


Pilot STRUCINSPECT: Evaluation of two providers of AI based automated defect detection for concrete bridges

TIMBER CONCRETE SLAB WITH INTEGRATED SPRINKLER

APPLYING A NEW TIMBER CONCRETE SLAB IN ONE OF THE HIGHEST TIMBER BUILDINGS (80M) IN EUROPE

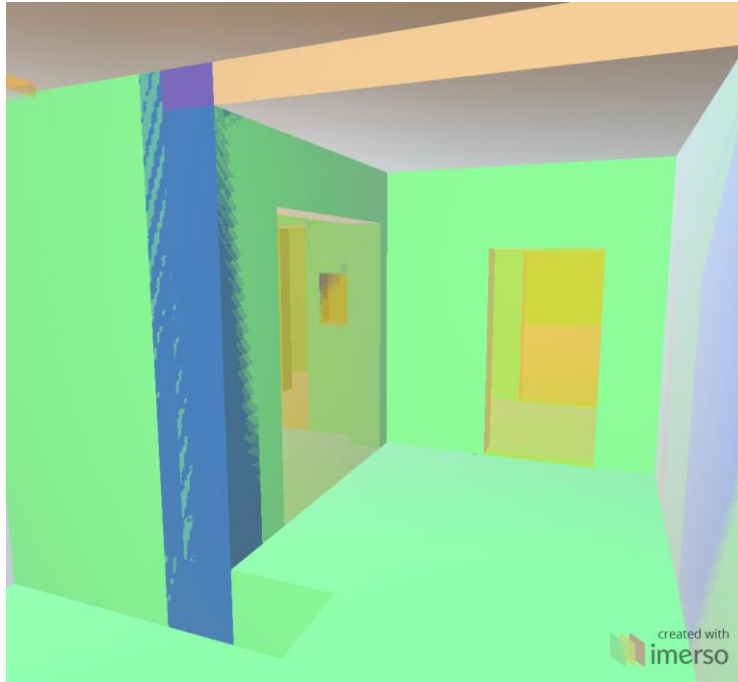
PATENT PENDING



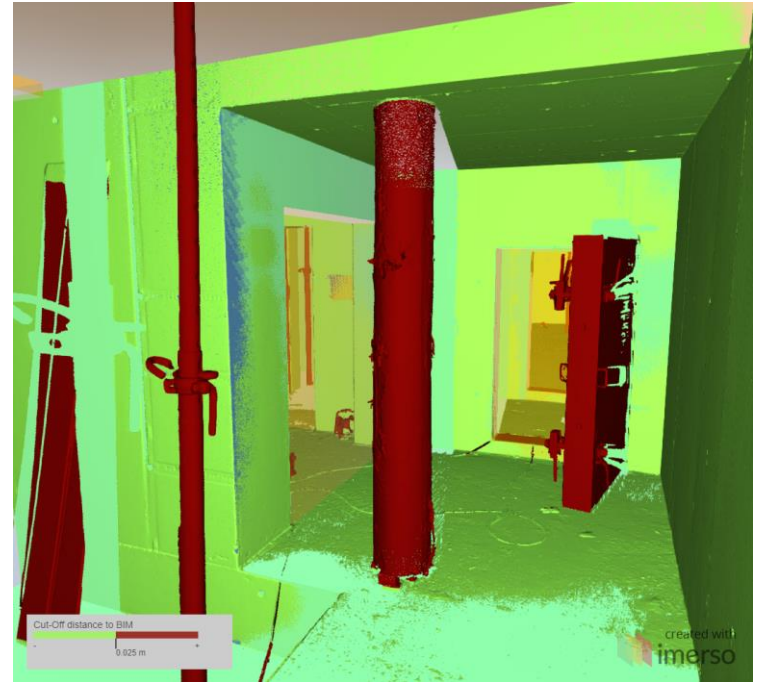
Pi Holzhochhaus, Zug: designed and planned for our client Techcluster Zug

CLASH DETECTION USING BIM, REALITY CAPTURING AND AI

AS PLANNED BIM Model



AS BUILT BIM Model with point cloud overlay



A photograph of a modern building facade with a grid of balconies. The balconies have dark metal railings and some have small plants. The building is made of light-colored concrete or stone. The sky is blue with some clouds. There are some trees visible on the left side.

DIGITIZING THE REAL ESTATE MARKETING JOURNEY



CASE STUDY

DIGITIZING THE REAL ESTATE MARKETING JOURNEY

PAINS IN REAL ESTATE MARKETING

Käuferblatt Tender

WOHNUNG	EHEMANN ODER KÄUFER 1	EHEFRAU** ODER KÄUFER 2
Name(n) **		
Vorname(n) gemäss Pass		
Strasse, Nr.		
PLZ, Ort		
Geburtsdatum		
Zivilstand		
Bürgerort(e)		
Beruf		
E-Mail		
Telefon-Nr.	P: G:	P: G:

**Bitte zusätzlich ledigen Namen (bzw. Doppelname) angeben.

Falls Sie Ausländer sind: Ausländerausweis A, B oder C

Ehemann oder Käufer 1 ☐ A ☐ B ☐ C
Ehefrau oder Käufer 2 ☐ A ☐ B ☐ C

Die unterzeichneten Ehegatten bestätigen, folgendem Güterstand zu unterstehen:

- ☐ Errungenschaftsbeteiligung (ordentlicher Güterstand, kein Ehevertrag, keine Beibehaltungserklärung)
- ☐ Güterverbindung nach altem Recht gemäss Ehevertrag oder Beibehaltungserklärung (Kopie bitte Notariat vorlegen)
- ☐ Gütergemeinschaft gemäss Ehevertrag (Kopie bitte Notariat vorlegen)
- ☐ Gütertrennung gemäss Ehevertrag (Kopie bitte Notariat vorlegen)

und beabsichtigen, das Grundstück zu erwerben als

- ☐ Alleineigentümer ☐ Ehemann oder Käufer 1
- ☐ Miteigentum je zur Hälfte ☐ Ehefrau oder Käufer 2
- ☐ Gesamteigentum ☐ infolge Gütergemeinschaft
- ☐ infolge einfacher Gesellschaft

Ort und Datum: Unterschrift(en)

Stand Mai 2020

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lokstadt®

51006	Easy	00 CHF	830'000.00 CHF	245'000.00 CHF
		00 CHF	943'000.00 CHF	282'000.00 CHF
		00 CHF	830'000.00 CHF	248'000.00 CHF
		1'286'000.00 CHF	990'000.00 CHF	296'000.00 CHF

A man in a tunnel wearing a hard hat and high-visibility jacket. The background is a blurred tunnel interior with some equipment visible. The man is smiling and looking towards the camera. He is wearing a white hard hat with a headlamp and the name 'M. ENTFELLNER' on it. He is also wearing an orange high-visibility jacket with reflective white stripes and a logo that says 'Implenia' with a daisy flower. There are some decorative elements: a solid orange square in the upper left and a white square containing the text 'CASE STUDY' in the upper right.

REALIZING A NEW TUNNEL YIELDING ELEMENT

**KICKBOX IDEA FROM MANUEL
ENTFELLNER**
IMPLENIA TUNNELLING AUSTRIA

CASE STUDY

HS-EPS TUNNEL ELEMENTS

AN EXAMPLE OF ADDED VALUE THROUGH INNOVATION AND INTRAPRENEURSHIP



KICKBOX IDEA: SUBMITTED OCTOBER 2019

IMPROVE SAFETY & HANDLING OF TUNNEL ELEMENTS IN ONE OF EUROPE'S MOST COMPLEX PROJECTS



Field test Semmering Base Tunnel
Austria

PATENT PENDING



[HS-EPS Tunnel Elements - Implenia AG](#)

MOTIVATED EMPLOYEE

+

VALIDATED PROBLEM

+

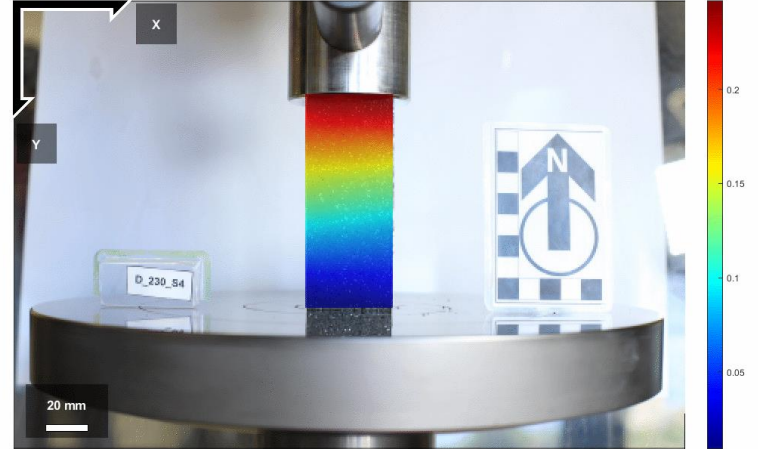
SUPPORTIVE MANAGER

+

EARLY FEASIBILITY TESTS

+

KICKBOX FOR AWARENESS



REDBOX



**RIGHT PARTNERS
+
PATENT FILING (NEAR MISS..)
+
FIRST FIELD TEST
+
CONVINCING AND BE BOLD
+
CO-SPONSORING HUB &
MANAGER**

**VALIDATION: -15 minutes time
saving per installed element!**

BLUEBOX

Q&A AND DISCUSSION

LET'S DISCUSS THE FUTURE OF CONSTRUCTION!



HOW MIGHT WE **APPLY**
ROBOTICS IN CIVIL
ENGINEERING?

HOW MIGHT WE **BUILD** THE
MOST SUSTAINABLE CIVIL
INFRASTRUCTURE?



HOW MIGHT WE **DEVELOP** NEW
SERVICES FOR UNDERGROUND
SPACE USE, **MOBILITY** AND
LIVING?

TALENTS MAKE A STRONG FOUNDATION

VISIT OUR CAREER PAGE



A GOOD WORKING ENVIRONMENT

We invest in an attractive, modern working environment for our 8,000 employees from 85 nations. We promote progressive working models, diversity and a safety culture in all areas of the company.



RESEARCH AND DEVELOPMENT

We offer attractive prospects for a long-term career, encouraging employees in all phases of life through our talent management system and our extensive training and development offering.

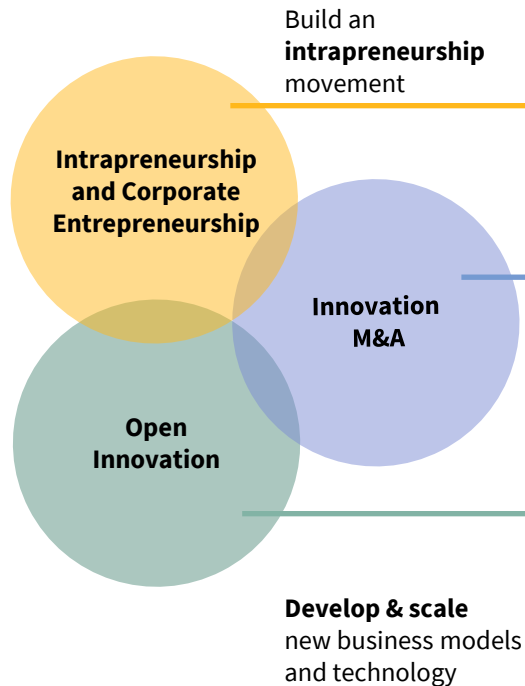


INNOVATION AS PART OF OUR CULTURE

We work in strong teams and actively uphold values such as collaboration and agility. With our Innovation Hub, we encourage our employees to contribute and develop their ideas for innovative solutions.

INNOVATION FOCUS PURSUED WITH THREE-FOLD INNOVATION STRATEGY

Three-fold strategy



Fast stage-gate innovation

Innovation Hub

Incubation platform >940 users, 91 ideas, 14 pilots in market test

Innovation opportunity spaces

Implenia prioritises partnerships and investments to scale new offerings

- **Industrialisation**
- **Digitalisation & BIM**

Research & Innovation partnerships

- Network with Fraunhofer Institut, EPFL and ETHZ
- Bauen Digital CH, SwissPropTech, Innohack, X-Innovation Lab Hamburg

HS-EPS¹⁾ tunnel element

A **performance material product** creating a safe, lightweight, and flexible solution that revolutionises how to handle squeezing ground and complex geological conditions in tunnelling

- **Lab and field tested**
- **>2'000 pieces sold**
- **Patent pending**, go-to-market defined and ramped up





EPFL

Also part of :



E4S
Enterprise for Society



sia

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■ Dimitrios Terzis



Innovation for construction & the environment

Dr. Dimitrios Terzis

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