



Karelia

University of Applied Sciences

Ossi Laakkonen

Digital Twin

More than just Building Services and Civil Engineering



Centre for Economic Development,
Transport and the Environment

Leverage from
the EU
2014–2020



European Union
European Social Fund

Karelia UAS

Students
3800

Awarded degrees
2020
759

Student
satisfaction rate
78%

Staff
300

Turnover
28
€ million

Degree
Programmes
22

Joensuu

- 76 551 inhabitants
- 30% students

Internationality

- **160** international degree students
- **135** exchange students
- **200** international partners

Bachelor's Degrees

- Business Economics, Business Information Technology, International Business
- Energy and Environmental Engineering, Industrial Management, Mechanical Engineering, Civil Engineering, Building Services Engineering
- Forestry
- Physiotherapy, Nursing, Public Health Nursing, Social Services
- Communication
- Tourism

Master's Degrees

- Active Ageing
- Development and Management of Health Care and Social Service
- Technology Competence Management
- Renewable Energy
- Business Management and Leadership

Research, Development and Innovation Activity

Volume

8,0

€ million

Development activities with

800

companies

Projects

81

Staff

59

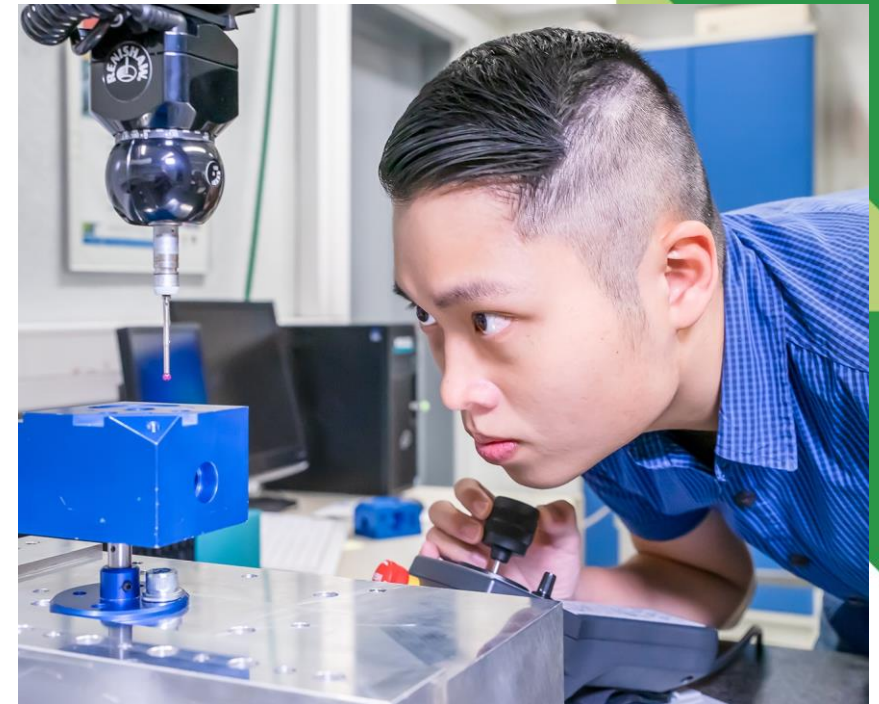
External financing

3,3

€ million

International partners

70



Strategic choices

- Vitality to working life through competence
- Education-based immigration and internationalisation
- Sustainable well-being in a sparsely populated area
- **Intelligent production and services**
- Carbon neutral solutions

Digital Twin – Sustainable Services and Knowledge Transfer in Real Estate and Building Technology

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Digital Twin

The Digital Twin of Building



Digital Twin is digital copy of a physical object, action or process. In Building Services concept the Digital Twin is a virtual model that consists of the building and the properties, functionalities and processes related to that.

The European Social Fund project "Digital Twin – Sustainable Services and Knowledge Transfer in Real Estate and Building Technology" makes Comprehensive analysis of current state of building information management use, what technologies are used and the future view. This Analysis is used to further improve Karelia UAS education.

Digital Twin – Sustainable Services and Knowledge Transfer in Real Estate and Building Technology

Duration: 1.1.2021 – 31.12.2023

Funding: Centre for Economic Development, Transport and the Environment

Contact: Ossi Laakkonen

[Rakentaminen.karelia.fi/projektit/digital-twin](https://rakentaminen.karelia.fi/projektit/digital-twin)

Smart city

- **Smart city** is a concept that integrates various data sources and city infrastructure together and provides different views, operations, and services to citizens
- **Smart Building** is one of the building blocks of **Smart City**
- And you can't have **Smart building** unless you can:
 - Collect, store, combine, analyze, visualize, etc. data



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The Free Encyclopedia



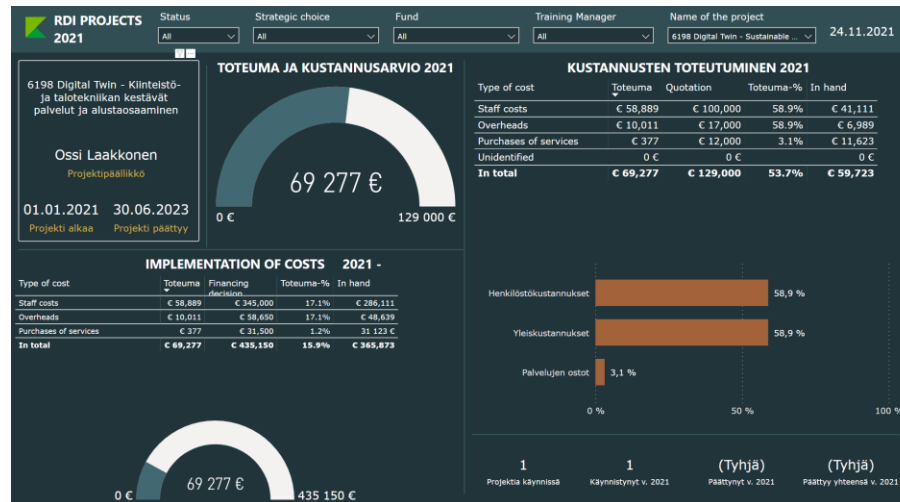
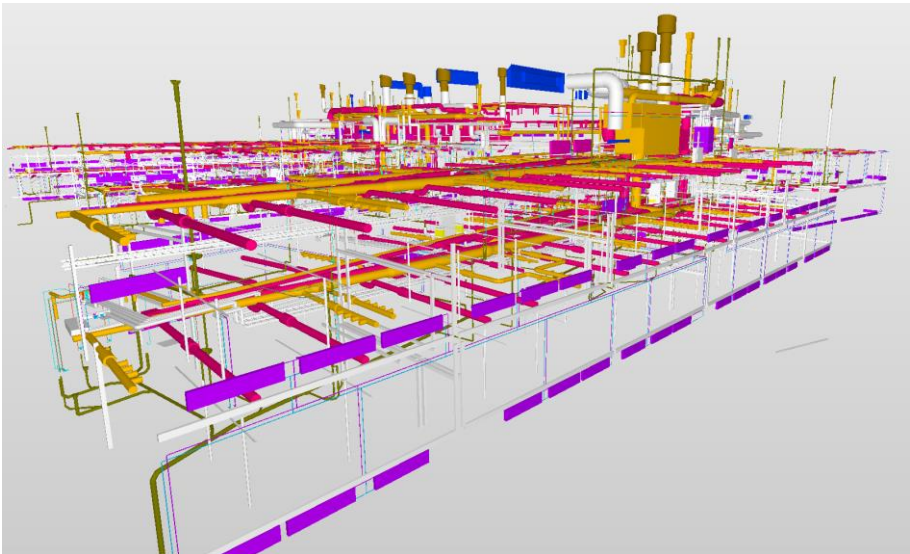
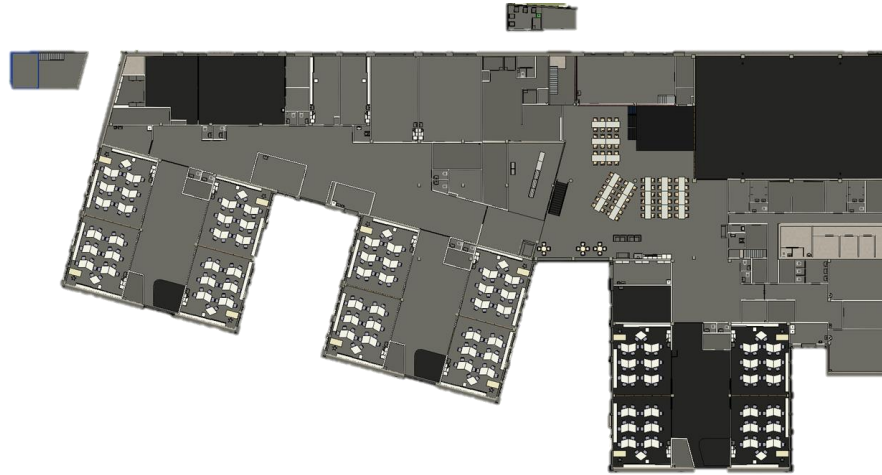
Digital Twin

- Gathers all types of data together
- Removes data silos
- Offers **Aspect of Objects**, different views for different users
- Enables development of new innovative and smart solutions
- Offers up-to-date information
- LCA simulations and verification

Types of Digital Twins (examples)

- **As-built**
 - Architecture, structural and mechanical, electrical, and public health models from design and construction
- **Building Services**
 - Components relevant to long term optimization of the buildings' technical systems
- **Interactive Floorplan**
 - 2D floor planning visualizing static and dynamic data
- **Business Intelligence Dashboard**
 - 2D map or floorplan together with business data

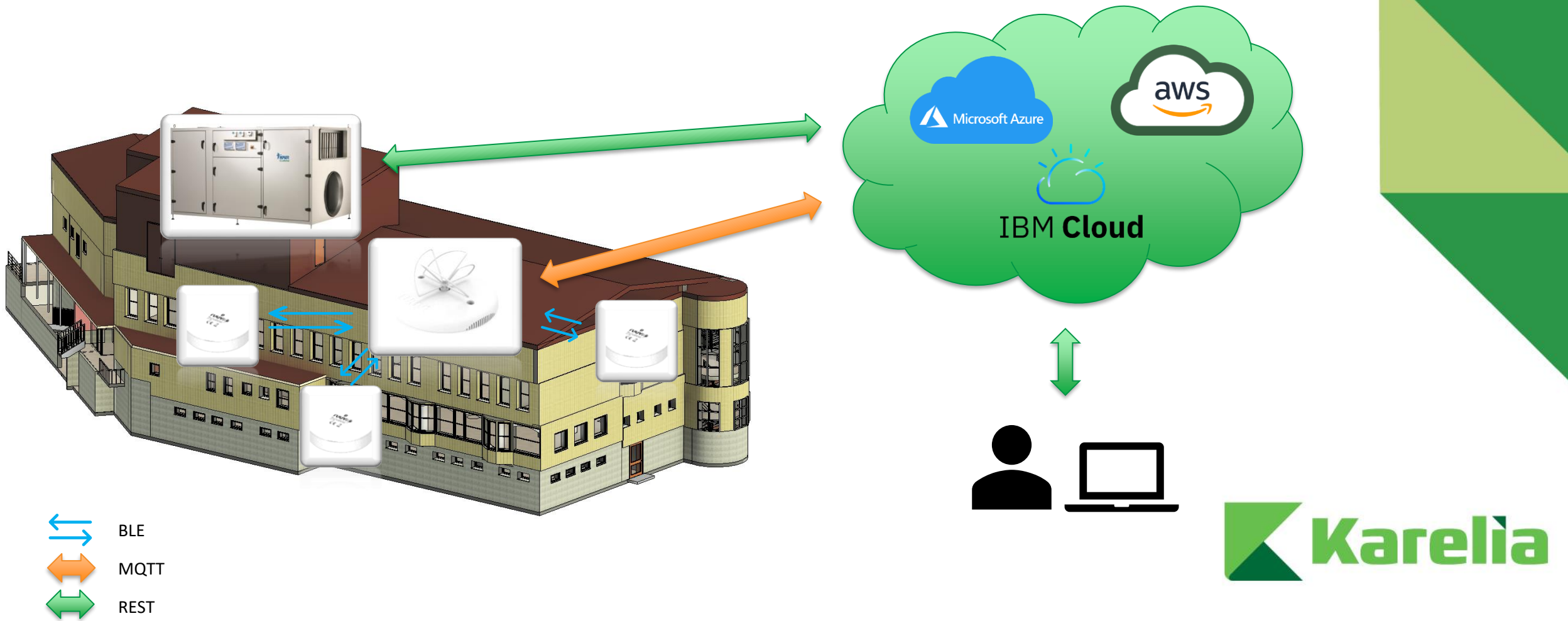
Examples of Digital Twin



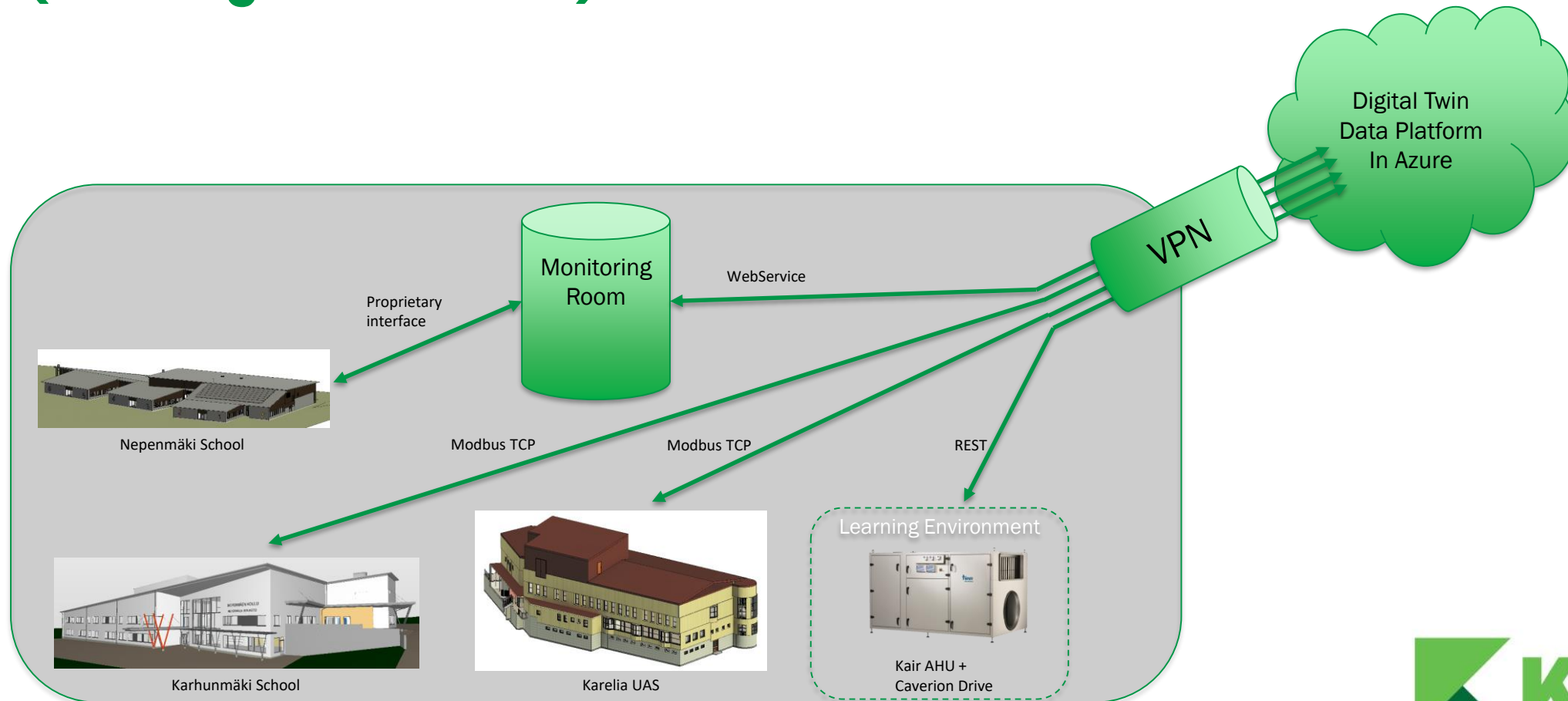
Digital Twin Demonstration Environments

- Wärtsilä campus
- Karhunmäki School
- Nepenmäki School

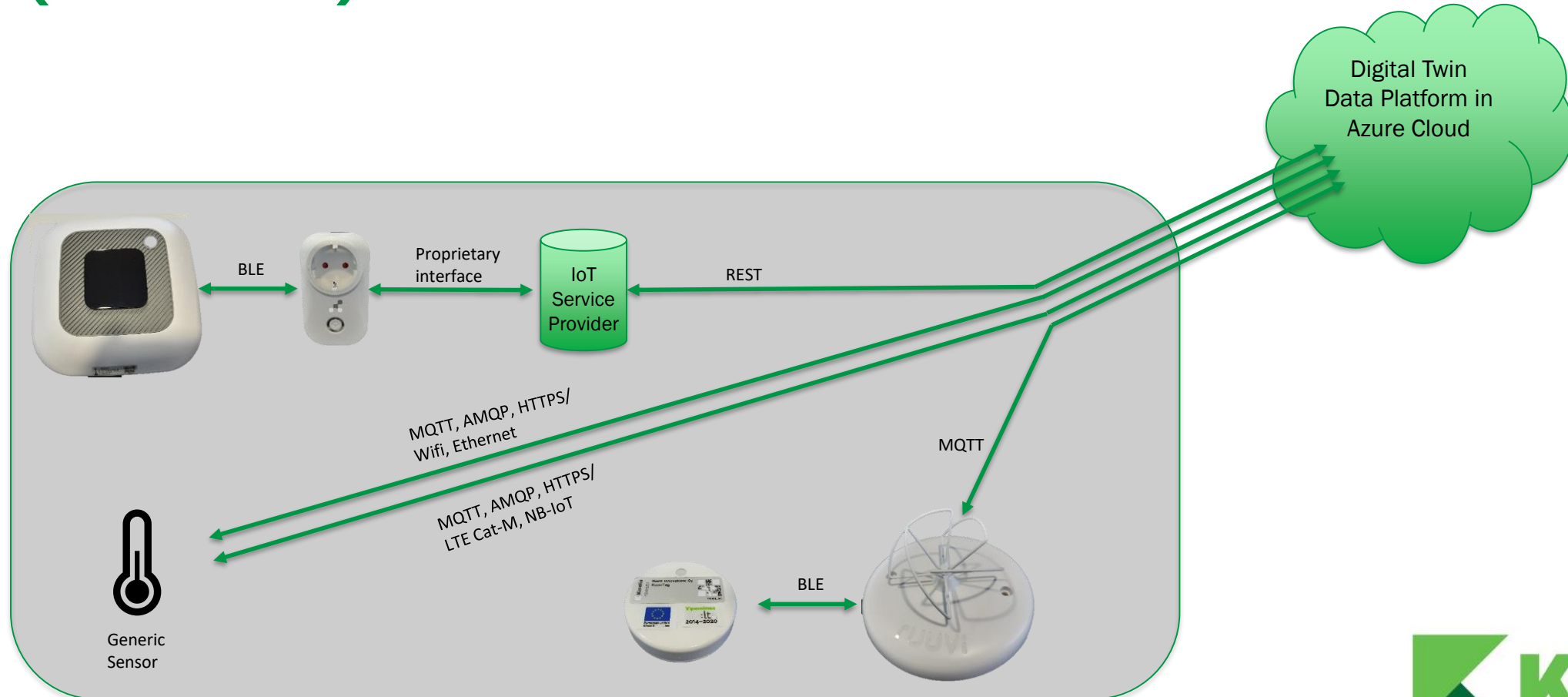
System Architecture



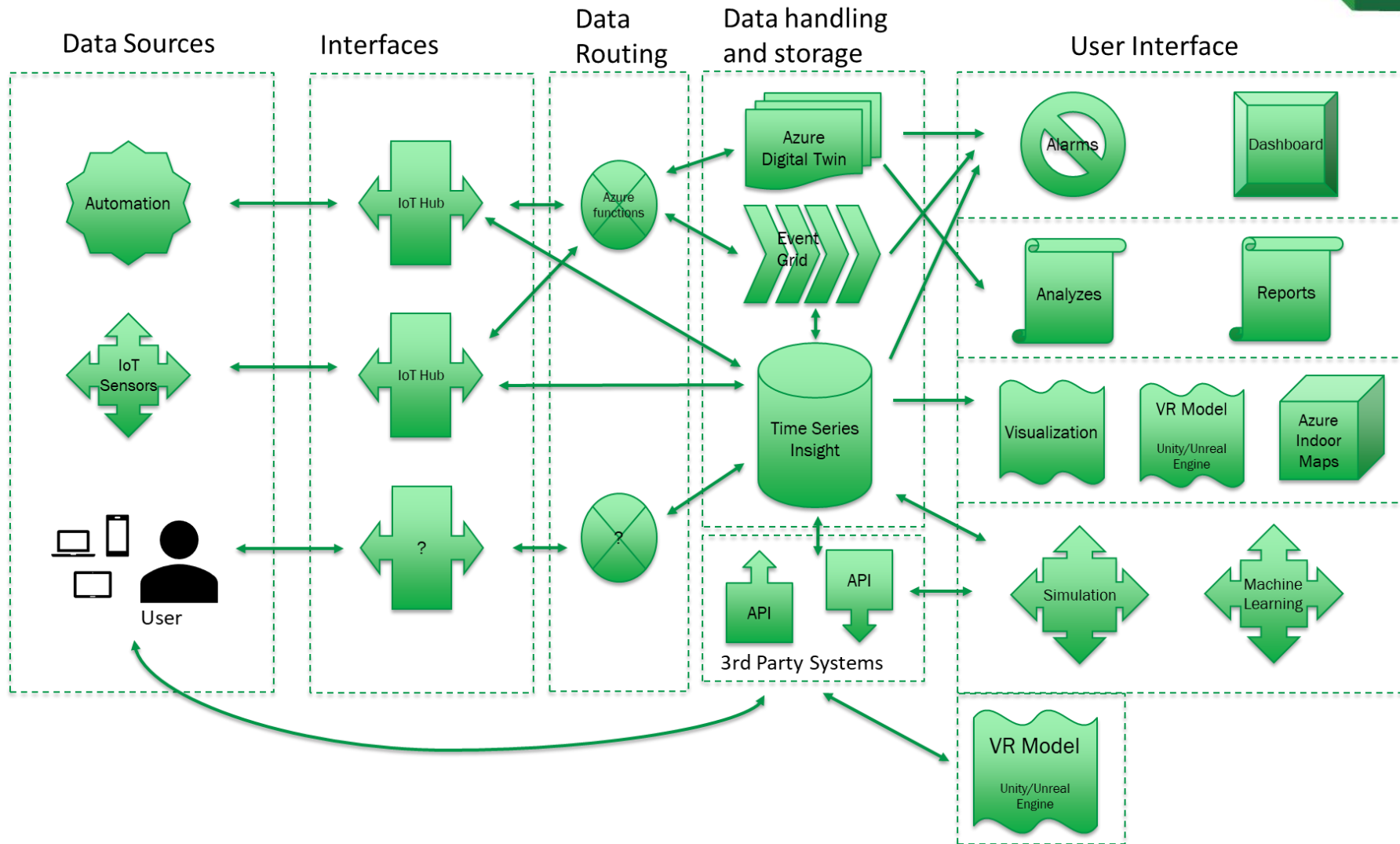
Communication Architecture (Building Automation)



Communication Architecture (IoT Sensors)



Cloud Architecture



Know How Requirements

- API
- Database
- Visualization
- Simulation
- Analysis
- Gamification
- Building Services Engineering
- Civil Engineering

API – Application Programming Interface

- An **application programming interface** (API) is a connection between computers or between computer programs. It is a type of software interface, offering a service to other pieces of software.



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Database

- A **database** is an organized collection of data stored and accessed electronically from a computer system
- A **time series database** (TSDB) is a software system that is optimized for storing and serving time series through associated pairs of time(s) and value(s)



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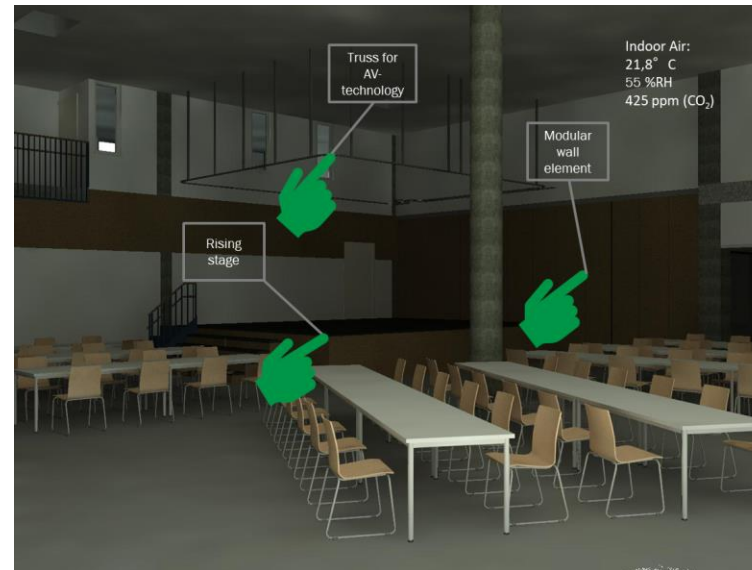


Visualization

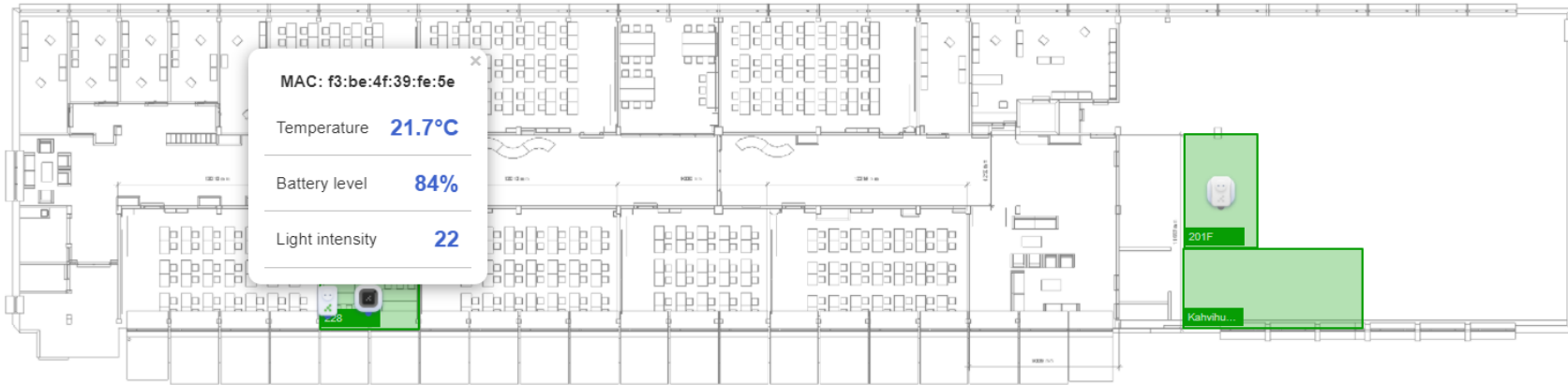
- Technique for creating images, diagrams, or animations to communicate a message



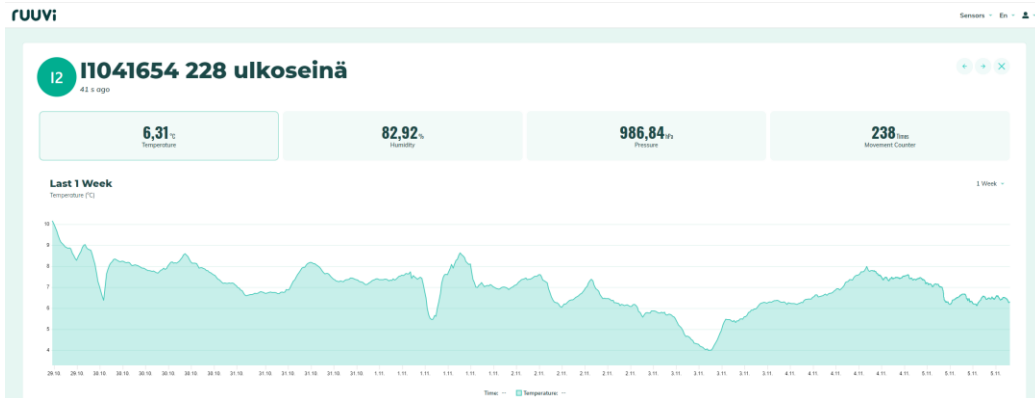
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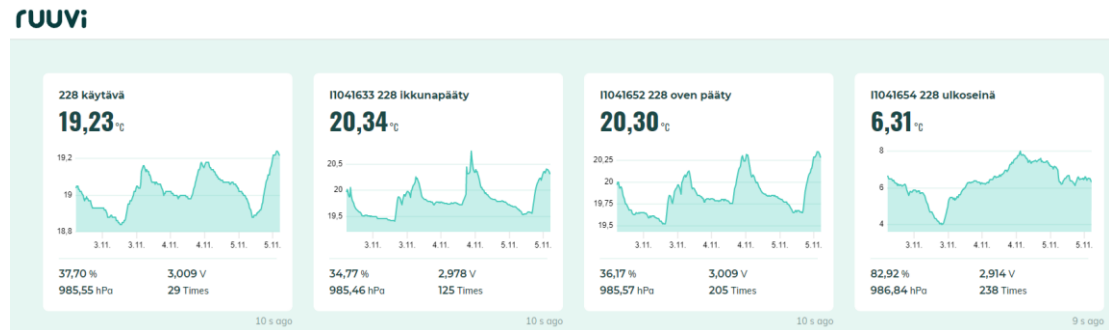
Visualization



<https://app.cloud.us.kontakt.io/smart-location/>

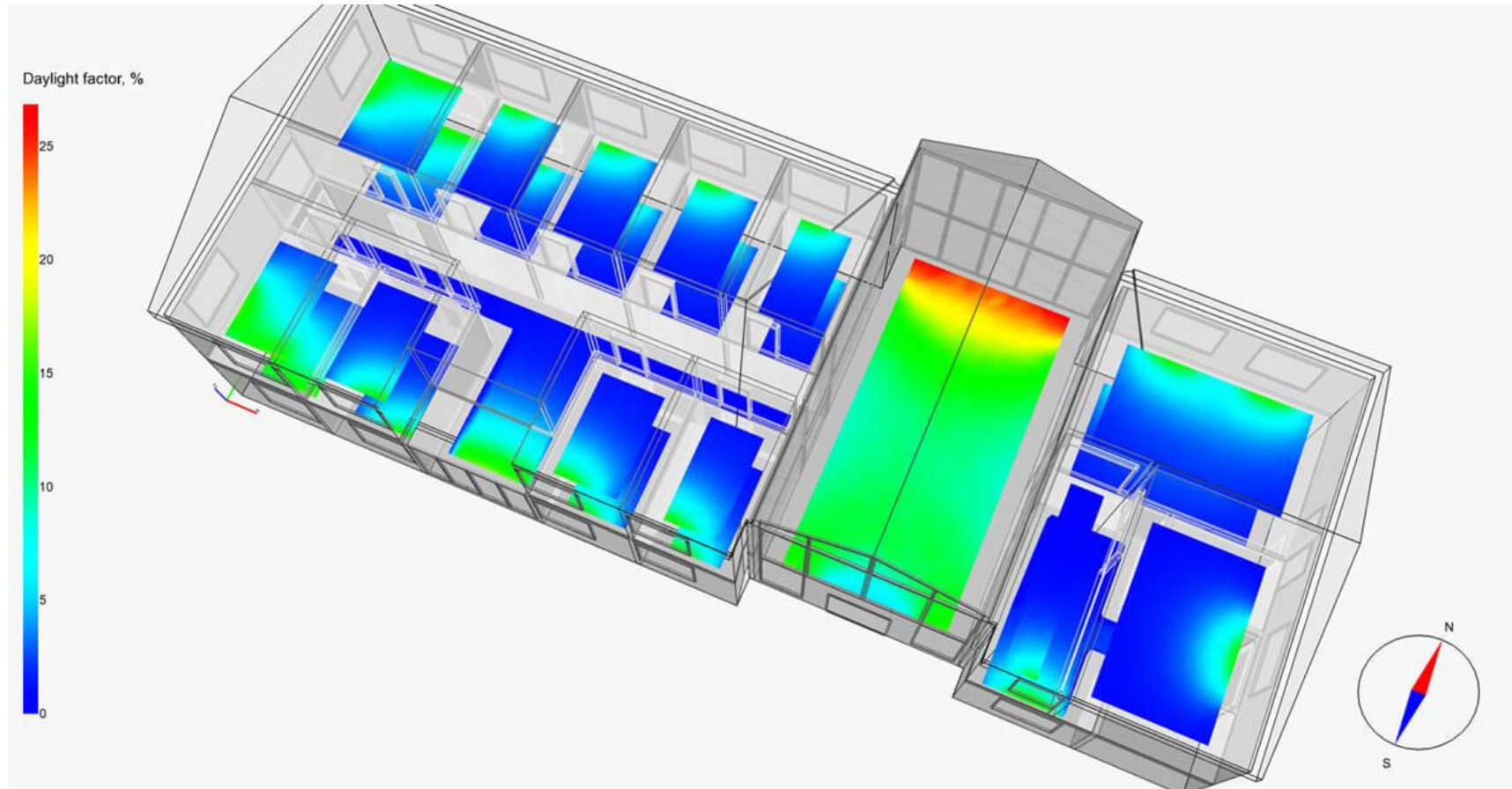


<https://station.ruuvi.com/#/>



Simulation

(e.g. luminous intensity)



Analysis

3. Building automation starts to correct situation

2. Air humidity starts to rise rapidly

1. Room pressure starts to drop

4. Room temperature drops rapidly

5. Room humidity within limits

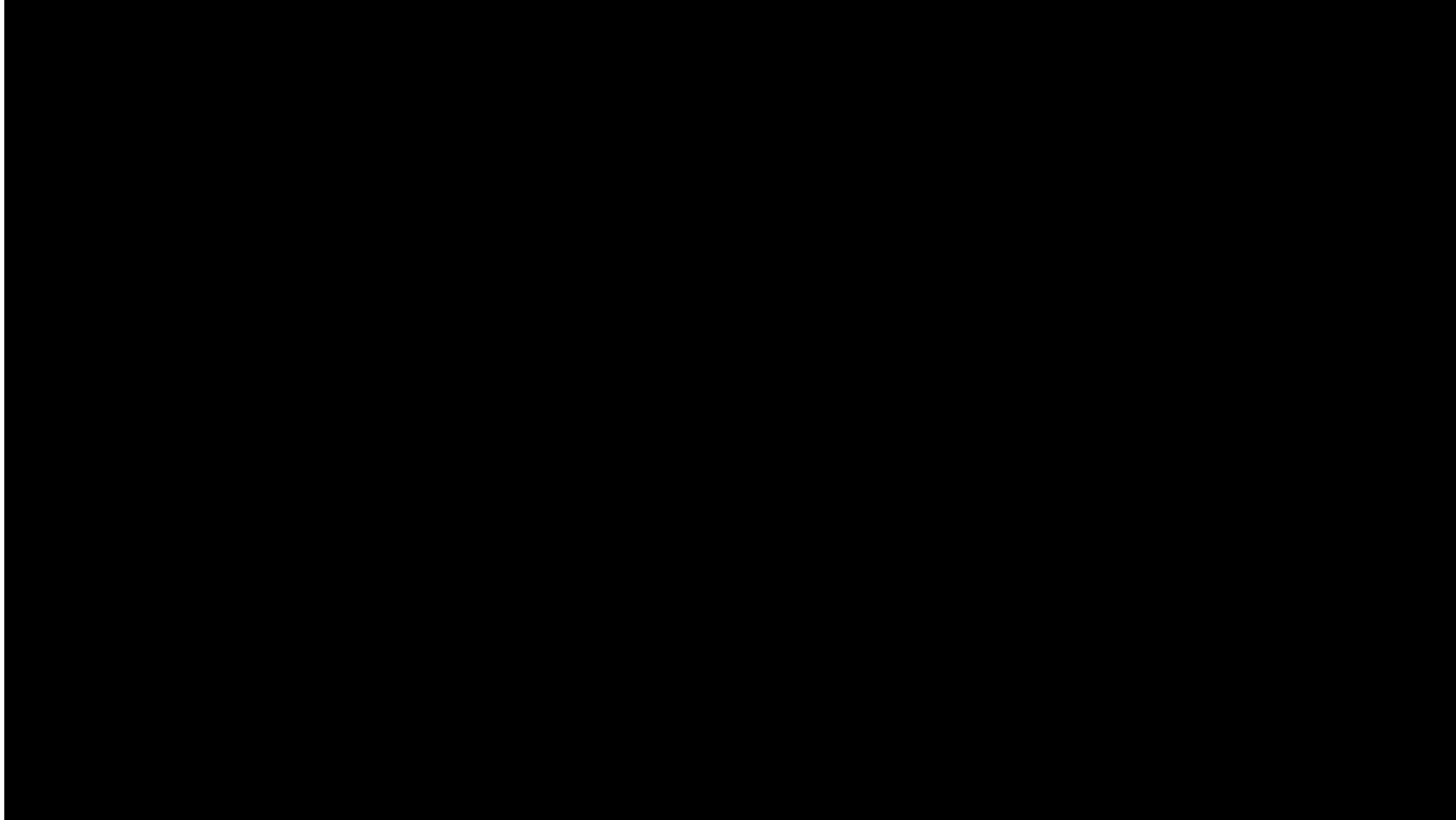
6. Room temperature within limits



Gamification




Digital Twin Example



<https://www.youtube.com/watch?v=cexMerL1MG8>



Conclusions

- Multitalented professionals are needed for development of **Digital Twins**
- Strong **Civil Engineering** and **Building Automation** knowledge forms the base
- Wide **ICT** understanding enables co-operation
- "Nerds" are needed 

**Let's craft a
better tomorrow.
Together.**



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