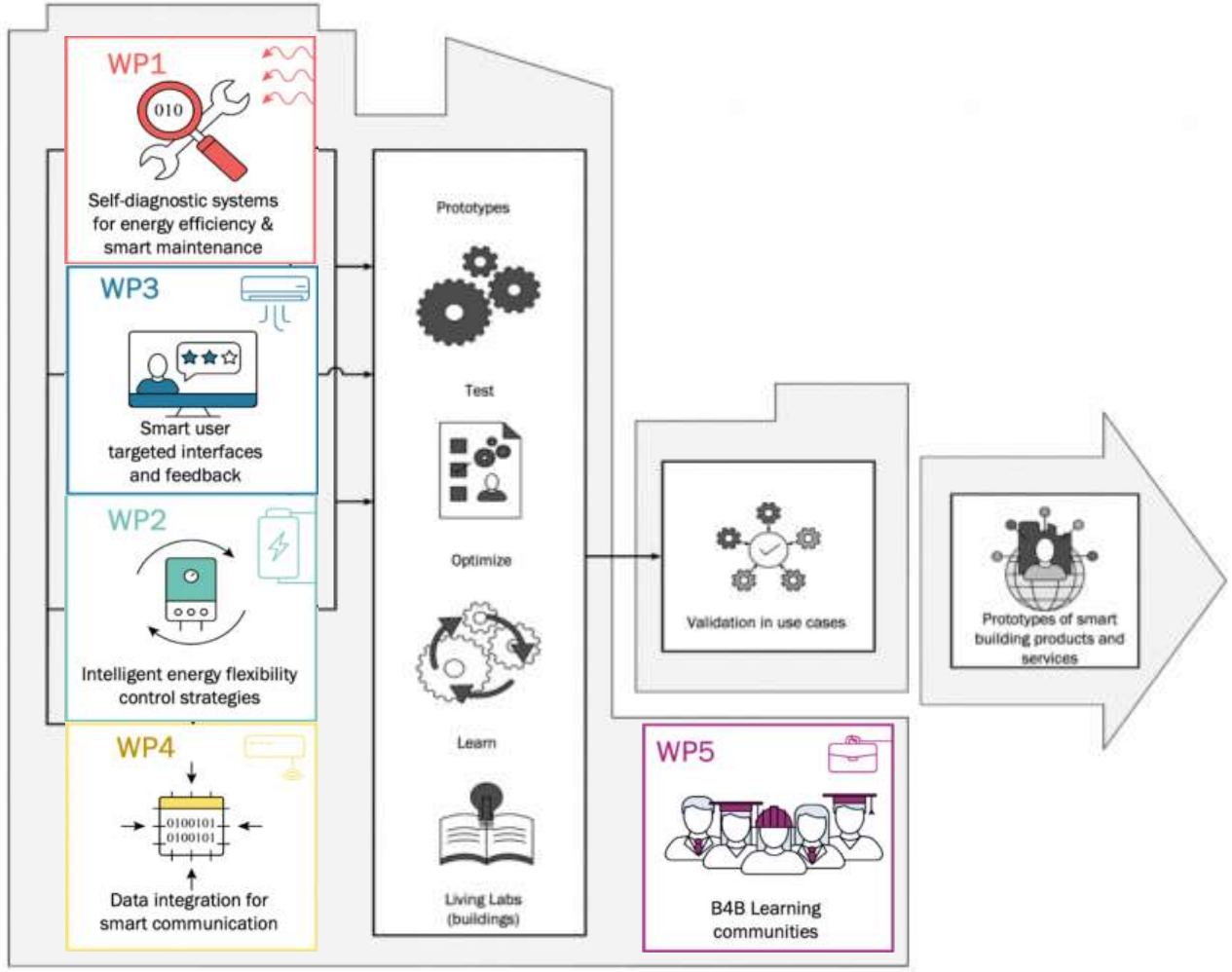
Brains4Buildings: Knowledge platform and Roadmap for leveraging Smart Buildings

Martín **Mosteiro Romero** (TU Delft)

25 June 2024

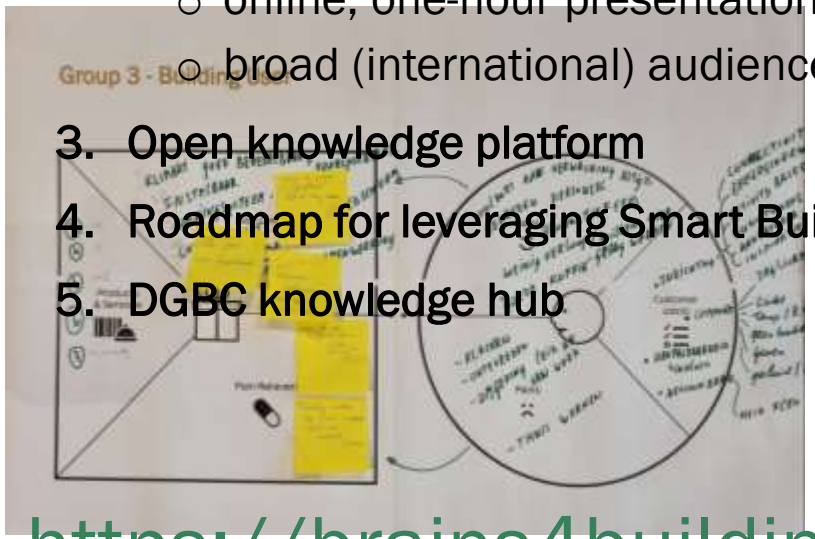
Brains4Buildings

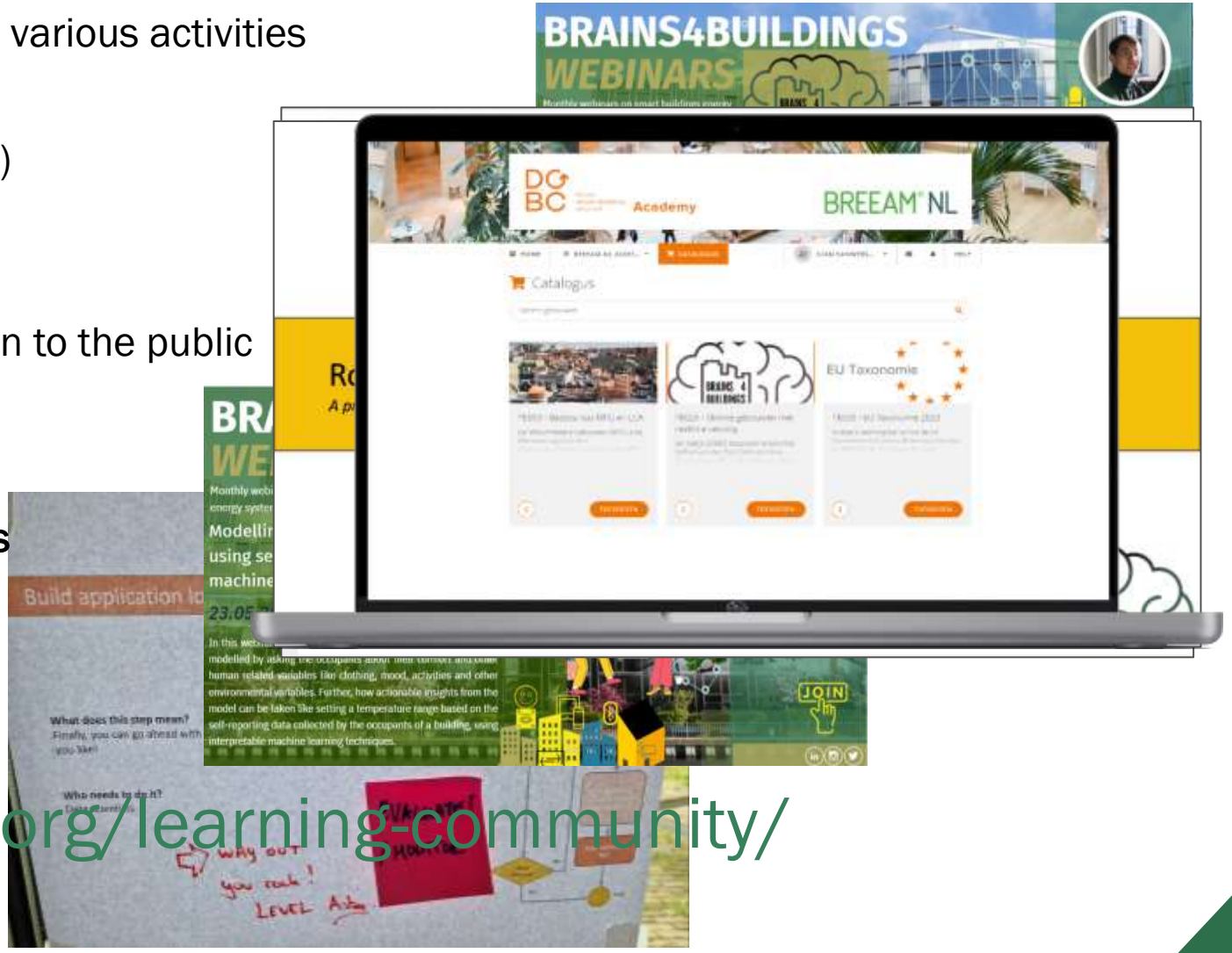


Learning Community

The B4B learning community encompasses various activities

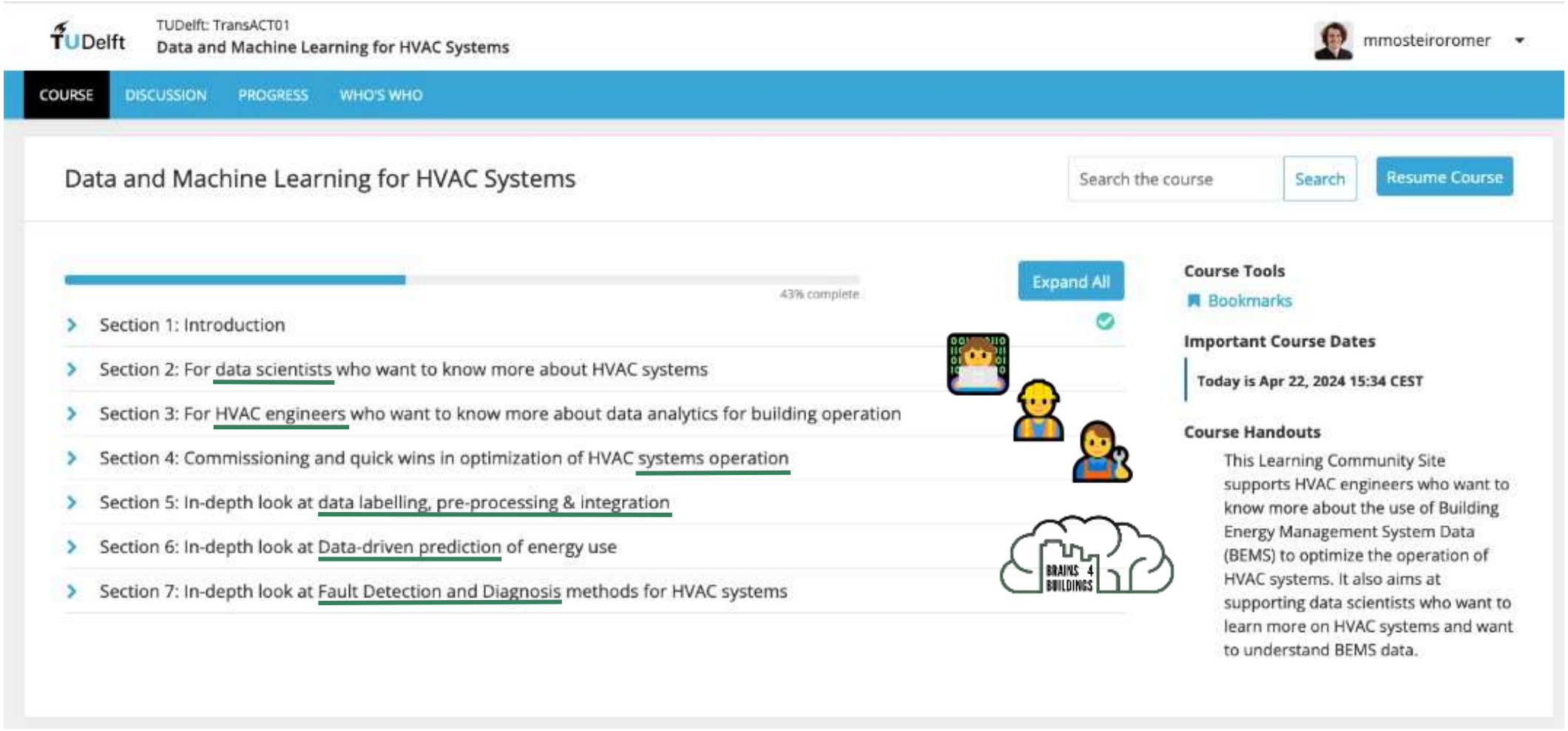
1. **Consortium meetings:**
   - 39 project partners (60–70 people)
   - presentations and workshops
2. **B4B webinar series:**
   - online, one-hour presentations open to the public
   - broad (international) audience
3. **Open knowledge platform**
4. **Roadmap for leveraging Smart Buildings**
5. **DGBC knowledge hub**





https://brains4buildings.org/learning-community/

Overview Open Knowledge Platform



Open Knowledge Platform

Section 2: HVAC knowledge for data scientists

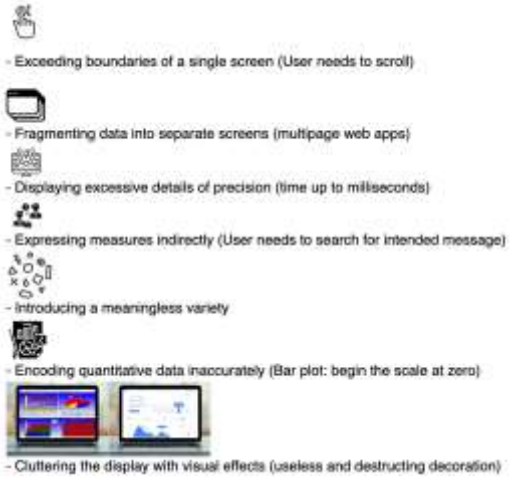
TUDelft MOOCs (4 weeks each)

ECObuild1x: Energy Demand in Buildings (started 16 April)
ECObuild2x: Energy Supply Systems for Buildings (23 April)
ECObuild3x: Comfort and Health in Buildings (starts 11 June)
ECObuild4x: Efficient HVAC Systems (16 April)

Examples
Standards
Data sources

Open Knowledge Platform

Section 3: Data science for HVAC Engineers



NUS MOOC (7 weeks)

Data Science for Construction, Architecture and Engineering

Examples:

- **Building energy prediction**
- **Fault Detection and Diagnosis**
- **Data labeling and preprocessing**
- **Data visualization**

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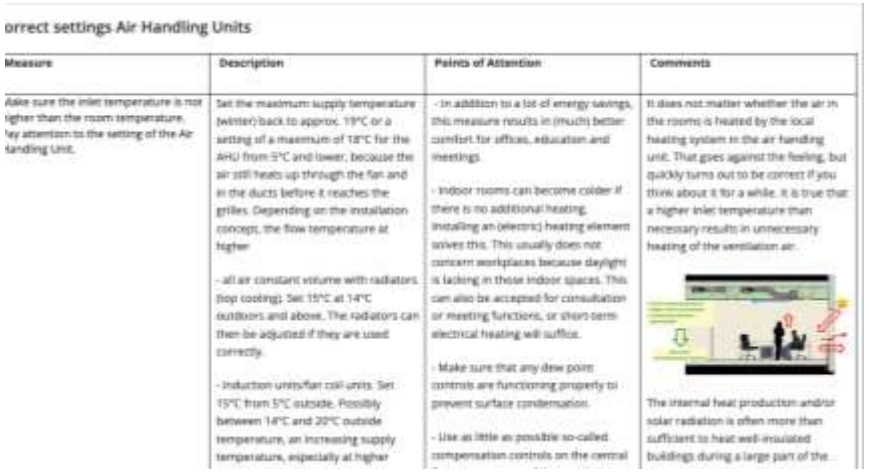
Section 4: Commissioning & Quick Wins



orrect settings Air Handling Units

Measure	Description	Points of Attention	Comments
Make sure the inlet temperature is not higher than the room temperature. Pay attention to the setting of the Air Handling Unit.	Set the maximum supply temperature (winter) back to approx. 19°C or a setting of a maximum of 18°C for the AHU from 5°C and lower, because the air still heats up through the fan and in the ducts before it reaches the grilles. Depending on the installation concept, the flow temperature at higher - all air constant volume with radiators (top cooling): Set 15°C at 14°C outdoors and above. The radiators can then be adjusted if they are used correctly. - Induction units/fan coil units: Set 15°C from 5°C outside. Possibly between 14°C and 20°C outside temperature, an increasing supply temperature, especially at higher	- In addition to a lot of energy savings, this measure results in (much) better comfort for offices, education and meetings - Indoor rooms can become colder if there is no additional heating. Installing an (electric) heating element solves this. This usually does not concern workplaces because daylight is lacking in those indoor spaces. This can also be accepted for consultation or meeting functions, or short-term electrical heating will suffice. - Make sure that any dew point controls are functioning properly to prevent surface condensation. - Use as little as possible so-called compensation controls on the central	It does not matter whether the air in the rooms is heated by the local heating system in the air handling unit. That goes against the feeling, but quickly turns out to be correct if you think about it for a while. It is true that a higher inlet temperature than necessary results in unnecessary heating of the ventilation air. The internal heat production and/or solar radiation is often more than sufficient to heat well-insulated buildings during a large part of the

Tips and Tricks about setpoints (Ed Rooijakkers)

Standards:

- ISSO 107

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Section 5: Data labelling, pre-processing and integration

Preprocessing examples.ipynb

File Edit View Insert Runtime Tools Help Changes will not be saved

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Connect

[ ]

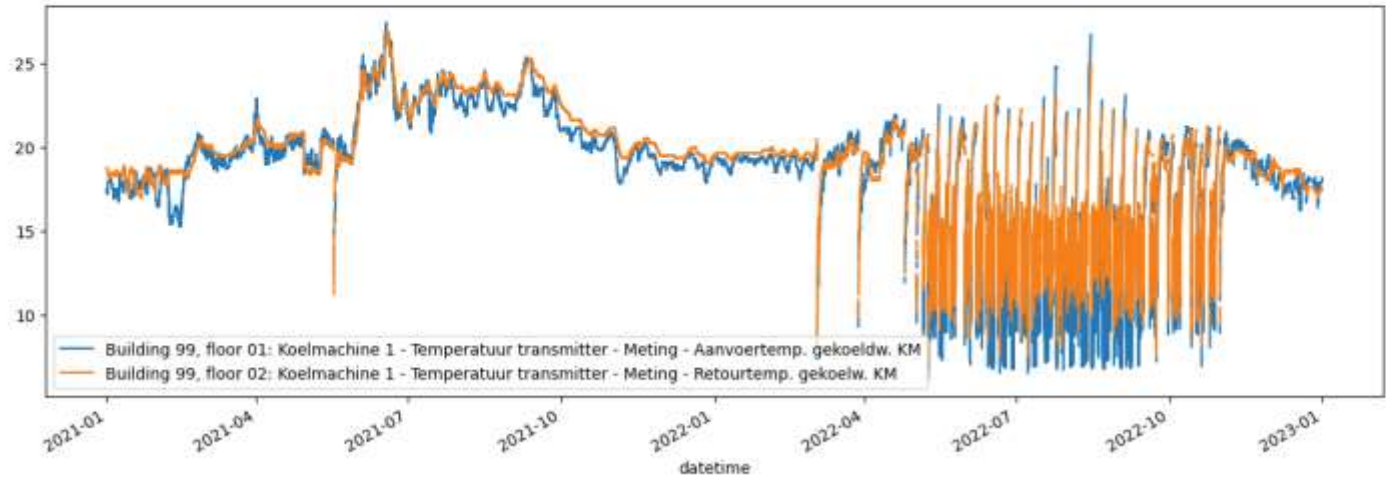
2021-01 2021-04 2021-07 2021-10 2022-01 2022-04 2022-07 2022-10 2023-01

datetime

Let's look at some temperature measurements

```
[ ] temperature_df = bms_df[['Building 99, floor 01: Koelmachine 1 - Temperatuur transmitter - Meting - Aanvoertemp. gekoeldw. KM',
                             'Building 99, floor 02: Koelmachine 1 - Temperatuur transmitter - Meting - Retourtemp. gekoelw. KM']]
    temperature_df.plot(figsize=(15,5))
```

```
<Axes: xlabel='datetime'>
```



There's a lot of strange behavior in 2022. Let's look at it closer.

→ B4B WP4

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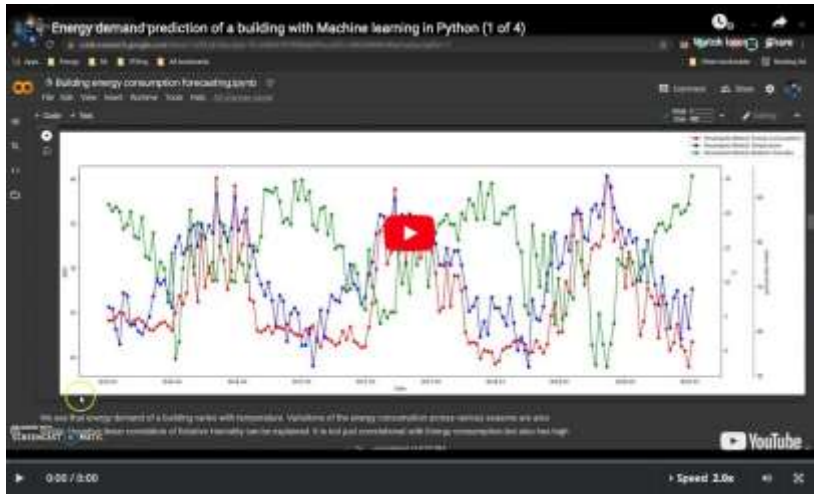
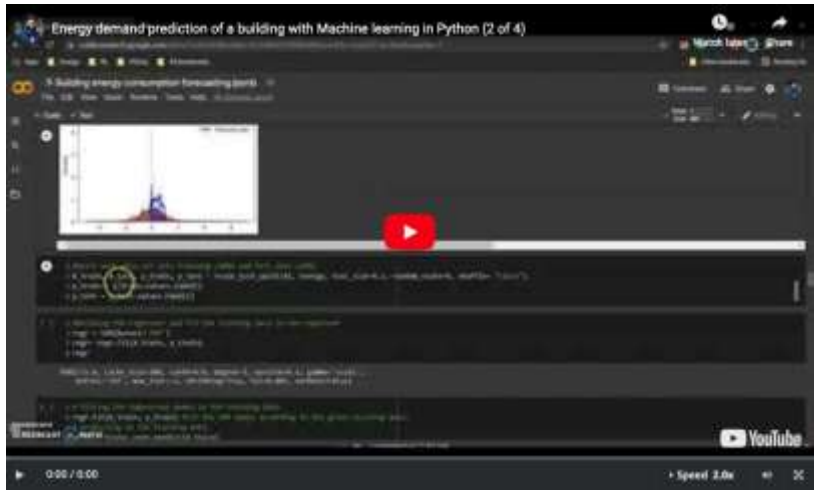
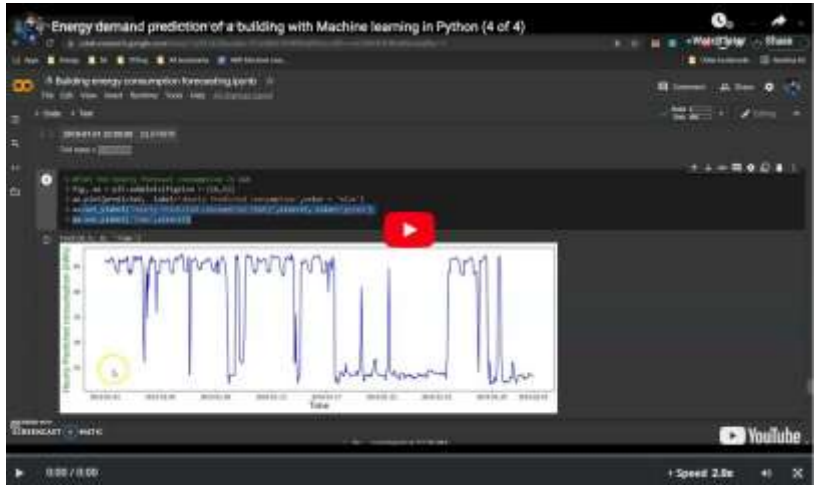
Section 6: Data-driven demand prediction







→ B4B WP2

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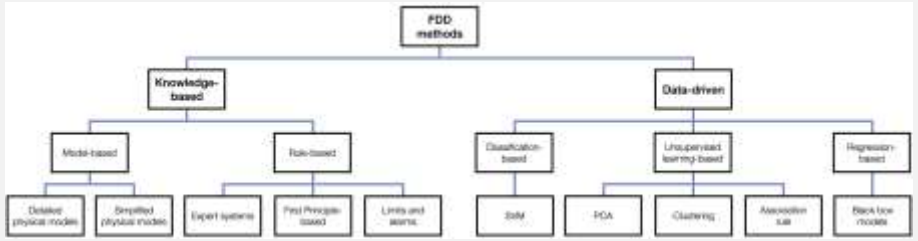
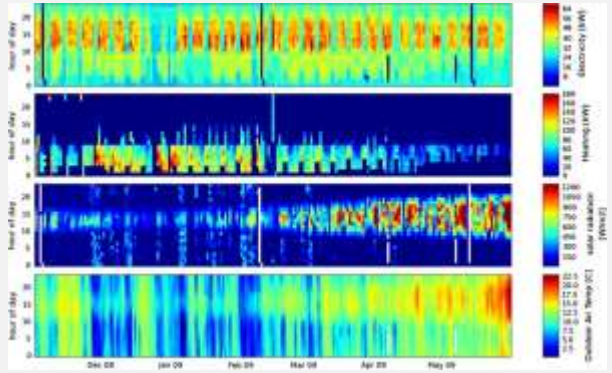
Section 7: Fault Detection and Diagnosis

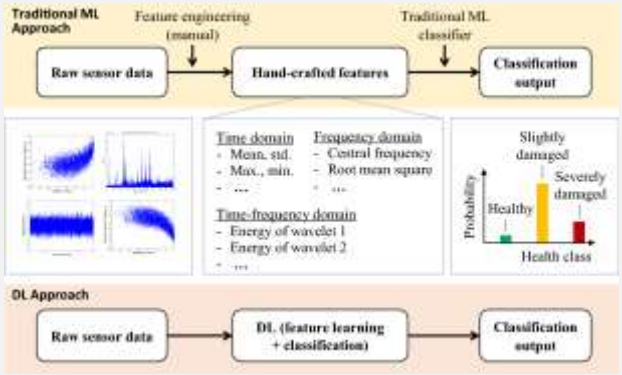
Classification



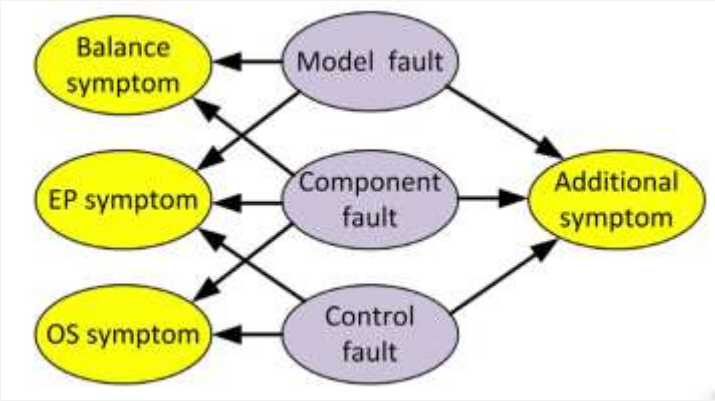
Pattern-based



ML-based



Bayesian networks



→ B4B WP1

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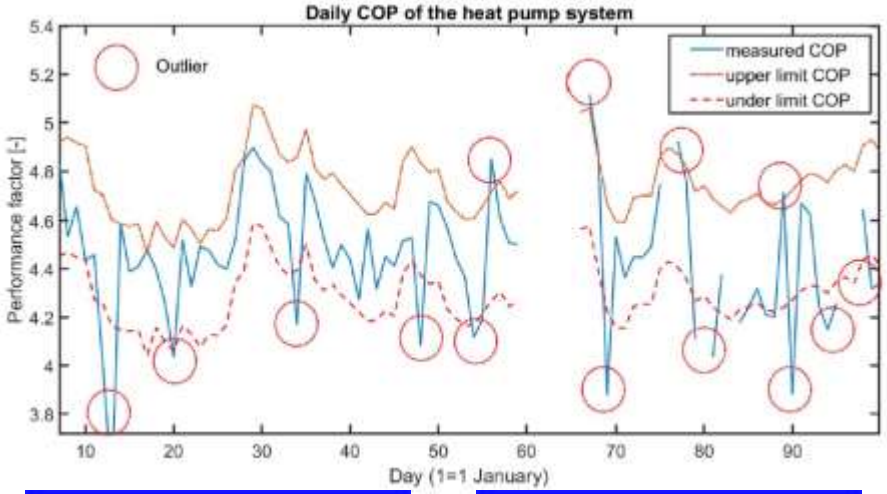
Section 7: Fault Detection and Diagnosis



Examples:

- Diagnostic Bayesian Networks
- 4S3F

Standards

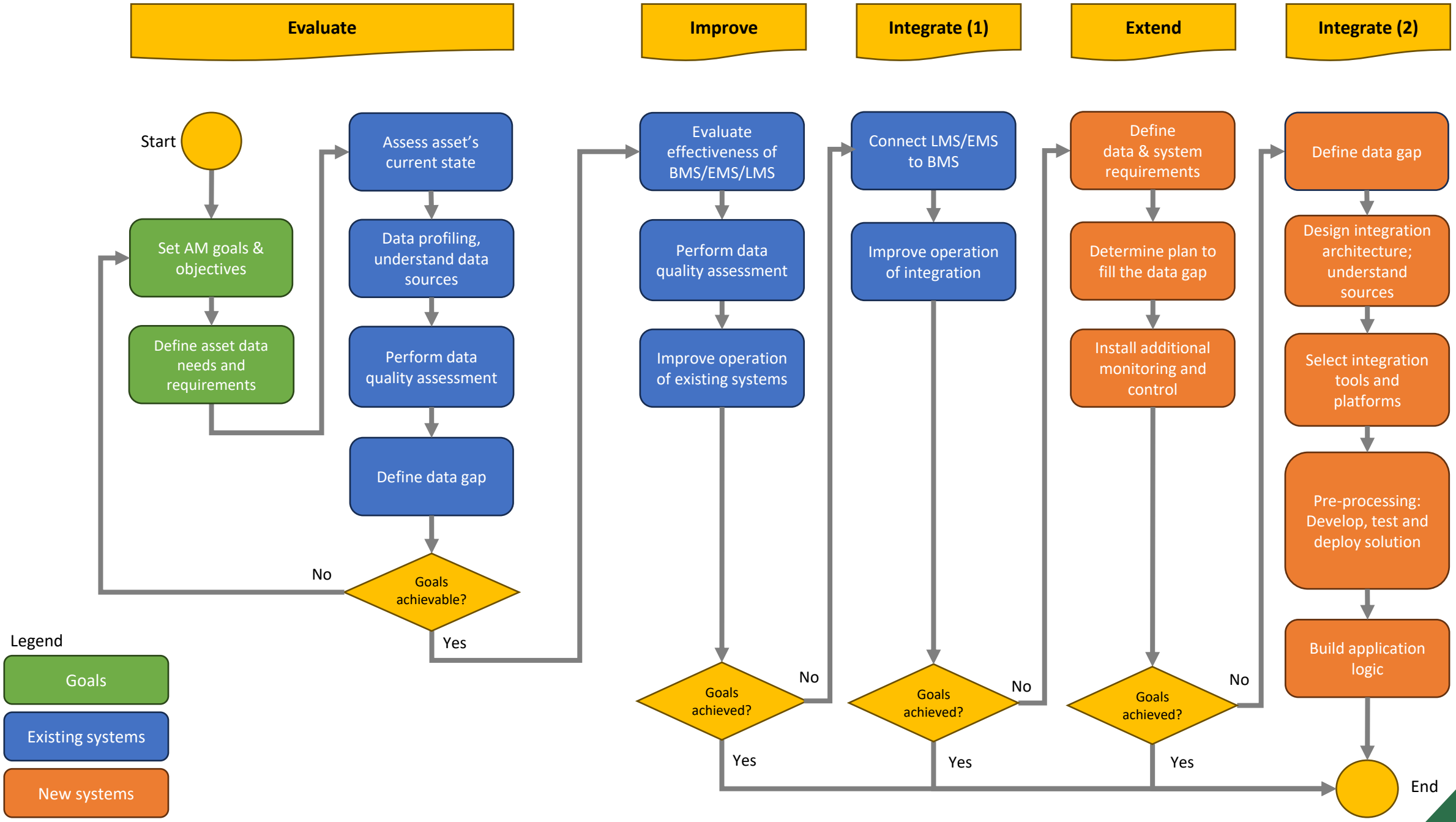
Data sources

Roadmap for leveraging Smart Buildings

A practical roadmap for achieving asset management goals through data-driven building solutions

The goal of this roadmap is:

1. create **awareness** about the current challenges in the industry and how they can be tackled with data-driven solutions, and alternatively, how they can be tackled with low-tech solutions
2. to **illustrate** that a smart building is a tool (and not a goal in itself) to achieve a (set of) predefined asset management goal(s)
3. to provide a **practical step-by-step guideline** for achieving data integration to the different stakeholders involved in the value chain of smart buildings


Evaluate
Improve
Integrate (1)
Extend
Integrate (2)
Start
Set AM goals & objectives
Define asset data needs and requirements
Assess asset's current state
Data profiling, understand data sources
Perform data quality assessment
Define data gap
Goals achievable?
No
Yes
Evaluate effectiveness of BMS/EMS/LMS
Perform data quality assessment
Improve operation of existing systems
Goals achieved?
No
Yes
Connect LMS/EMS to BMS
Improve operation of integration
Goals achieved?
No
Yes
Define data & system requirements
Determine plan to fill the data gap
Install additional monitoring and control
Goals achieved?
No
Yes
Define data gap
Design integration architecture; understand sources
Select integration tools and platforms
Pre-processing: Develop, test and deploy solution
Build application logic
End
Legend
Goals
Existing systems
New systems

Stakeholder reading guide

 **A**: Complex / high tech		Integrate		Integrate	
 **B**: Normal / mid-level	Integrate	Improve	Improve	Improve	Improve
 **C**: Simple / low tech			Evaluate	Evaluate	
	Academics & researchers	Product developers & consultants (Services & products)	Real estate owners (Strategic)	Building- & facility managers (Tactical)	Installers & technicians (Operational)

DGBC Knowledge Hub

Living Labs
Deliverables
Shared Resources
Website
Articles
Congresses
Webinars
…

Knowledge transfer

What's happening out there?

DGBC Knowledge Hub

Sustainable Construction Library — LIVE

Toolbox for CO_2 Reduction — LIVE

Knowledge Platform — LIVE

Learning Tracks — LIVE

Q1 2024 | Q2 2024 | Q3 2024 | Q4 2024 | Q1 2025 | Q2 2025 | Q3 2025 | Q4 2025

More information

B4B Webinars

https://brains4buildings.org/learning-community/

Open Knowledge Platform

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DGBC Knowledge Hub

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Roadmap

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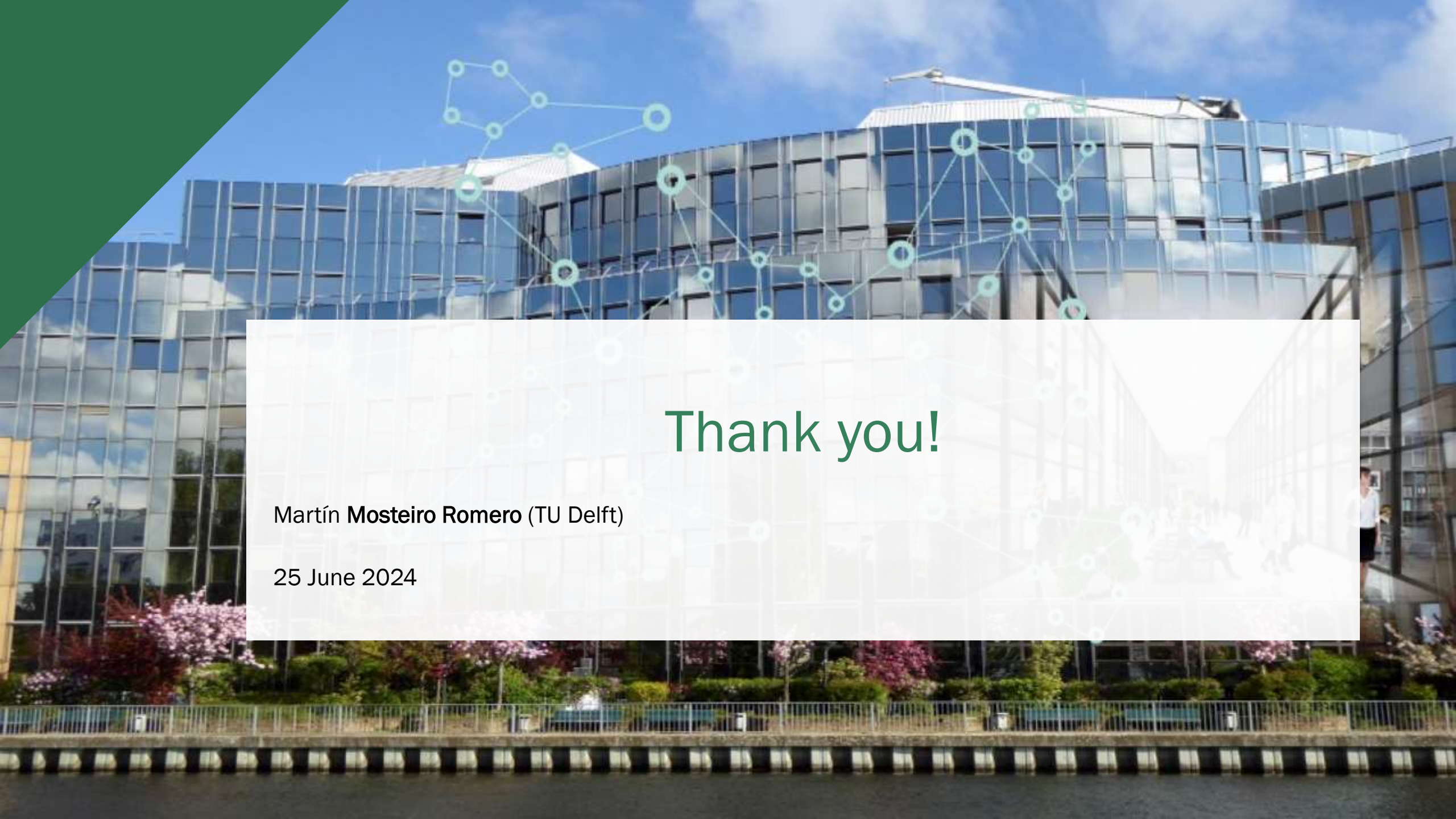

Thank you!

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