International Online Summer School

Digitalisation of Built Environment

13 – 21 August 2026 · Fully Online · Free of Charge · Individual modules or full programme

Module Descriptions

Organised by Dig-IT Lab, KTH Royal Institute of Technology · Qianwen Xu & Tobias Oechtering

Programme at a Glance

AM module: 8:15–12:30 CEST
PM module: 13:45–18:00 CEST

DATE		TOPIC	SPEAKER
Thu Aug 13	OPEN	Welcome & organisation 13:30-13:45	*Xu & Oechtering, KTH*
	PM	Smart microgrids for sustainable buildings	*Qianwen Xu, KTH*
Fri Aug 14	AM	Data driven simulation for control or anomaly detection in smart buildings	*Magnus Jansson, KTH*
	PM	Buildings as energy storage hubs for flexible sector coupling	*Saman Nimali Gunasekara, KTH*
Mon Aug 17	AM	Technology as a tool not a solution - Facilities Management example	*Carmel Margret Lindkvist, NTNU*
	PM	Integration of AI-based occupant prediction model with digital twins	*Farzin Golzar, KTH*
Tue Aug 18	AM	Sustainability challenges & opportunities of digitalisation in buildings	*Tove Malmqvist Stigell, KTH*
	PM	Value sensitive design for ethically informed & socially sustainable technology	*Barbro Fröding, KTH*
Wed Aug 19	FULL	Hands-on workshop: open-source energy management toolbox "batem"	*Stephane Ploix, INP Grenoble*
Thu Aug 20	AM	Digital maturity & data-driven decision-making	*Agnieszka Zalejska Jonsson, KTH*
	PM	Digital transformation in business networks	*Malena Havenvid, KTH*
Fri Aug 21	AM	Introduction to Privacy for Smart Buildings	*Tobias Oechtering, KTH*
	CLOSE	Closing ceremony 12:30-12:45	*Oechtering & Xu, KTH*

Module Descriptions

Thu 13 Aug
PM Module

Smart Microgrids for Sustainable Buildings

Qianwen Xu, KTH Royal Institute of Technology

Overview

Buildings are increasingly integrating distributed energy resources such as solar PV, battery storage, heat pumps, electric vehicles, and flexible loads. Smart microgrids provide an effective framework for coordinating these resources to improve energy efficiency, resilience, and grid flexibility.

This module introduces the fundamentals of smart building microgrids, covering energy management, control strategies, and grid interaction. Participants will explore how digital technologies such as AI and data-driven methods enable intelligent and sustainable building operation.

The second part consists of an interactive group exercise on energy management of a smart building microgrid. Participants explore how different operational strategies influence electricity cost, renewable energy utilisation, grid flexibility, and resilience.

Intended Learning Outcomes

- Understand the architecture and operation principles of smart building microgrids
- Explain the roles of distributed energy resources, including PV, battery storage, EV charging, heat pumps, and flexible loads
- Describe energy management strategies for optimising cost, emissions, and energy flexibility
- Understand basic control concepts for maintaining stable and resilient operation
- Analyse interactions between buildings and the power grid under different operating scenarios
- Discuss how AI, digital twins, and data-driven methods enable intelligent building energy systems

Prerequisites

- Basic knowledge of energy systems, electrical engineering, or smart buildings is helpful but not required
- Basic programming experience in Python is beneficial but not mandatory

Fri 14 Aug
AM Module

Data-Driven Simulation for Control and Anomaly Detection in Smart Buildings

Magnus Jansson & Aihui Liu, KTH EECS

Overview

Smart-building data can be viewed as a library of normal input-output trajectories. If a new trajectory can be reconstructed from this library, it can be used for prediction and simulation. If it cannot, the mismatch may indicate abnormal operation or a fault.

This lecture/lab module demonstrates how time-series data from smart buildings can be used for data-driven simulation, prediction for control, and anomaly and fault detection. The module shows how we go from historical trajectories to prediction, and from prediction mismatch to anomaly detection.

Intended Learning Outcomes

- Explain why smart buildings are difficult to model exactly
- Describe the idea of data-driven simulation from input-output data
- Understand the intuition behind Hankel matrices and trajectory libraries
- Explain, at a high level, how the Fundamental Lemma supports data-driven prediction

- Describe how prediction residuals can be used for anomaly detection
- Understand practical limitations caused by noise, missing data, closed-loop operation, and changing occupancy

Prerequisites

- Basic Python scripting using pandas, numpy, and matplotlib
- Introductory linear algebra (matrix–vector operations, least-squares estimation) and basic knowledge of linear dynamical systems

Note: Module will be cancelled if fewer than three participants register by 1 August.

Fri 14 Aug
PM Module

Buildings as Energy Storage Hubs for Flexible Sector Coupling

Saman Nimali Gunasekara, KTH

Overview

This session is based on Building Energy Systems and Storage for Flexible Sector Coupling, per the latest findings within the project BESSFlex. This includes defining concepts such as energy storage as relevant to buildings (including types of thermal energy storage and electrochemical energy storage), sector coupling and Flexible Sector Coupling (FSC), and technologies such heat pumps, chillers, district heating and cooling, solar photovoltaic (PV) systems etc. The session also discusses the relevance and significance of the building energy management and digitalization systems towards enabling flexible sector coupling of thermal and electrical sectors, with buildings as flexibility hubs.

Intended Learning Outcomes

- Explain the concept of sector coupling and the role of buildings as flexibility assets
- Identify energy storage mechanisms available in building systems
- Describe demand response strategies for cost and emission optimisation
- Evaluate trade-offs between flexibility provision and occupant comfort

Prerequisites

- Basic understanding of building energy systems or thermodynamics is helpful

Mon 17 Aug
AM Module

Technology as a Tool, Not a Solution — Facilities Management Example

Carmel Margret Lindkvist, NTNU

Overview

Digital technologies are often presented as straightforward solutions to complex organisational challenges. This module critically examines that assumption, using Facilities Management as a concrete case study.

Participants explore how the adoption of digital tools in building operations interacts with existing work practices, organisational structures, and professional roles — and why successful digitalisation requires more than technical implementation.

Intended Learning Outcomes

- Critically reflect on the relationship between technology adoption and organisational change
- Identify conditions under which digital tools add value in Facilities Management

- Recognise social and organisational factors that shape technology outcomes in built-environment contexts

Mon 17 Aug
PM Module

Integration of AI-Based Occupant Prediction with Digital Twins

Farzin Golzar, KTH ITM

Overview

Occupancy prediction is a key driver of efficient building operation. This module introduces how AI-based occupancy prediction algorithms can be developed and integrated with the digital twin platform IDA-ICE for realistic building simulation and control.

The first part covers digital twin concepts, AI tools, and occupancy prediction, followed by a live demonstration. The second part is a guided hands-on workshop in which participants develop and validate an AI occupancy prediction algorithm in Python.

Intended Learning Outcomes

- Understand the role of occupancy prediction in building energy management
- Explain key concepts behind digital twins and their application in buildings
- Implement a basic AI occupancy prediction algorithm in Python
- Validate prediction accuracy and interpret results
- Understand how occupancy models can be coupled with digital twin platforms

Prerequisites

- Basic programming knowledge in Python is required

Tue 18 Aug
AM Module

Sustainability Challenges and Opportunities of Digitalisation in Buildings

Tove Malmqvist Stigell, KTH

Overview

Digitalisation offers significant potential for improving the sustainability performance of buildings, but also introduces new environmental and social challenges. In this module, lectures first introduce the sustainability challenges of buildings and then zoom in on sustainability implications of digital technologies. In the second part, participants engage in discussions and conceptual mapping of sustainability aspects, benefits and risks linked to their individual research, professional interests or cases provided by teachers.

Intended Learning Outcomes

- Understand key concepts to be able to identify sustainability benefits and risks associated with digitalisation in buildings
- Assess sustainability aspects of digital technologies in buildings with help of a life-cycle perspective
- Discuss rebound effects and unintended consequences of digital solutions
- Integrate sustainability considerations into real-world applications of digital solutions in buildings

Prerequisites

- Basic programming knowledge in Python is required

Tue 18 Aug
PM Module

Value Sensitive Design for Ethically Informed Technology Development

Barbåro Fröding, KTH ABE

Overview

Value Sensitive Design (VSD) is a methodology that addresses human values in a structured and comprehensive manner throughout the technology design process, employing an integrative tripartite methodology of conceptual, empirical, and technical investigations.

The session opens with a lecture introducing VSD and a discussion of its main strengths and weaknesses. Participants then work in groups applying elements of VSD — including Envisioning Cards and Value Hierarchies — to a case study.

Intended Learning Outcomes

- Describe the core methodology and principles of Value Sensitive Design
- Apply Envisioning Cards and Value Hierarchies to a technology design scenario
- Identify and articulate stakeholder values relevant to built-environment technologies
- Critically evaluate the strengths and limitations of VSD as an ethics methodology

Prerequisites

- Compulsory pre-reading: Friedman et al. (2013), Value Sensitive Design and Information Systems
- Compulsory pre-reading: van de Poel (2013), Translating values into design requirements

Note: Module will be cancelled if fewer than three participants register by 7 August.

Wed 19 Aug
AM & PM Module

Open-Source Interactive Energy Management Toolbox ‘batem’

Stéphane Ploix, INP Grenoble Institute of Technology, France

Overview

This full-day hands-on module introduces the open-source batem toolbox for interactive energy management simulation. Participants work independently on lecture and workshop materials (lectures 1–10) with dedicated study support provided by Stéphane Ploix.

The day is structured as two parallel sessions, each combining a lecture with a practical workshop. Materials are available at: https://gricad-gitlab.univ-grenoble-alpes.fr/batem/tutorials

Intended Learning Outcomes

- Navigate and use the batem open-source energy management toolbox
- Apply batem to model and simulate building energy management scenarios
- Interpret simulation outputs and propose operational improvements

Prerequisites

- Basic Python programming experience is recommended

Thu 20 Aug
AM Module

Digital Maturity and Data-Driven Decision-Making

Agnieszka Zalejska Jonsson, KTH ABE · Rafael Gomez Garcia, RISE

Overview

This session explores the relationship between information quality, judgement, and decision-making. It examines how an organisation's digital maturity — how deeply data tools and processes are embedded in strategy and culture — as well as cognitive biases and noise, affect organisational decisions.

Participants learn conceptual frameworks, test real-world problems, and work together to identify what data, tools, and processes are needed to support informed decision-making.

Intended Learning Outcomes

- Define digital maturity and describe its dimensions in an organisational context
- Identify sources of bias and noise in data-driven decision processes
- Apply frameworks for evaluating information quality and decision reliability
- Recommend data and process improvements to support better organisational decisions

Note: Module will be cancelled if fewer than three participants register by 7 August.

Thu 20 Aug
PM Module

Digital Transformation in Business Networks

Malena Havenvid, KTH

Overview

Digital transformation does not occur in isolation — it is necessarily shaped by business relationships, interdependencies, and dynamics within business networks. This module examines how digitalisation and digital transformation unfolds in the built environment through the lens of the industrial network approach – an interactive network perspective. Participants explore how firms interact and co-evolve during digital transformations, and what this means for value creation, innovation, and business relationships in the built environment.

Intended Learning Outcomes

- A basic understanding of what an interactive perspective on business networks means
- The ability to explain core assumptions within the industrial network approach and their relevance to digital transformation
- The ability to identify and analyse potential opportunities and barriers to digital transformation within the built environment from an interactive perspective

Prerequisites

- Håkansson, H., & Ford, D. (2002). How should companies interact in business networks? Journal of Business Research, 55(2), 133–139. https://doi.org/10.1016/S0148-2963(00)00148-X
- Dubois, A., & Gadde, L. E. (2002). The construction industry as a loosely coupled system: implications for productivity and innovation. Construction Management and Economics, 20(7), 621–631.

Fri 21 Aug
AM Module

Introduction to Privacy for Smart Buildings

Tobias Oechtering, Arnaud Grivet Sebert & Ci Song, KTH EECS

Overview

Smart buildings collect continuous streams of data about occupants' activities, movements, and habits. This module introduces the privacy challenges that arise from such data and presents state-of-the-art privacy-enhancing methods for trustworthy implementation of smart building technology.

The lecture part covers why privacy matters, historical privacy breaches, GDPR basics, and privacy engineering fundamentals, including differential privacy and pointwise maximal leakage. The hands-on

activity challenges participants to identify and model concrete privacy threats and design privacy mechanisms.

Intended Learning Outcomes

- Understand the privacy risks associated with collecting occupant behavioural data
- Describe the basic legal framework for data privacy (GDPR) and its implications for building systems
- Explain the concept of differential privacy and its application in modern systems
- Identify and model concrete privacy threats in a smart building scenario
- Design simple privacy mechanisms and evaluate their trade-offs

Prerequisites

- Basic technical background is sufficient for the conceptual parts
- Basic probability theory knowledge helps for the technical approaches

> *Note: Module will be cancelled if fewer than three participants register by 7 August.*