Faculty of Business and Economics

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Digital Twins

Currently submitted projects, research, upcoming publications ...

Mendel University in Brno

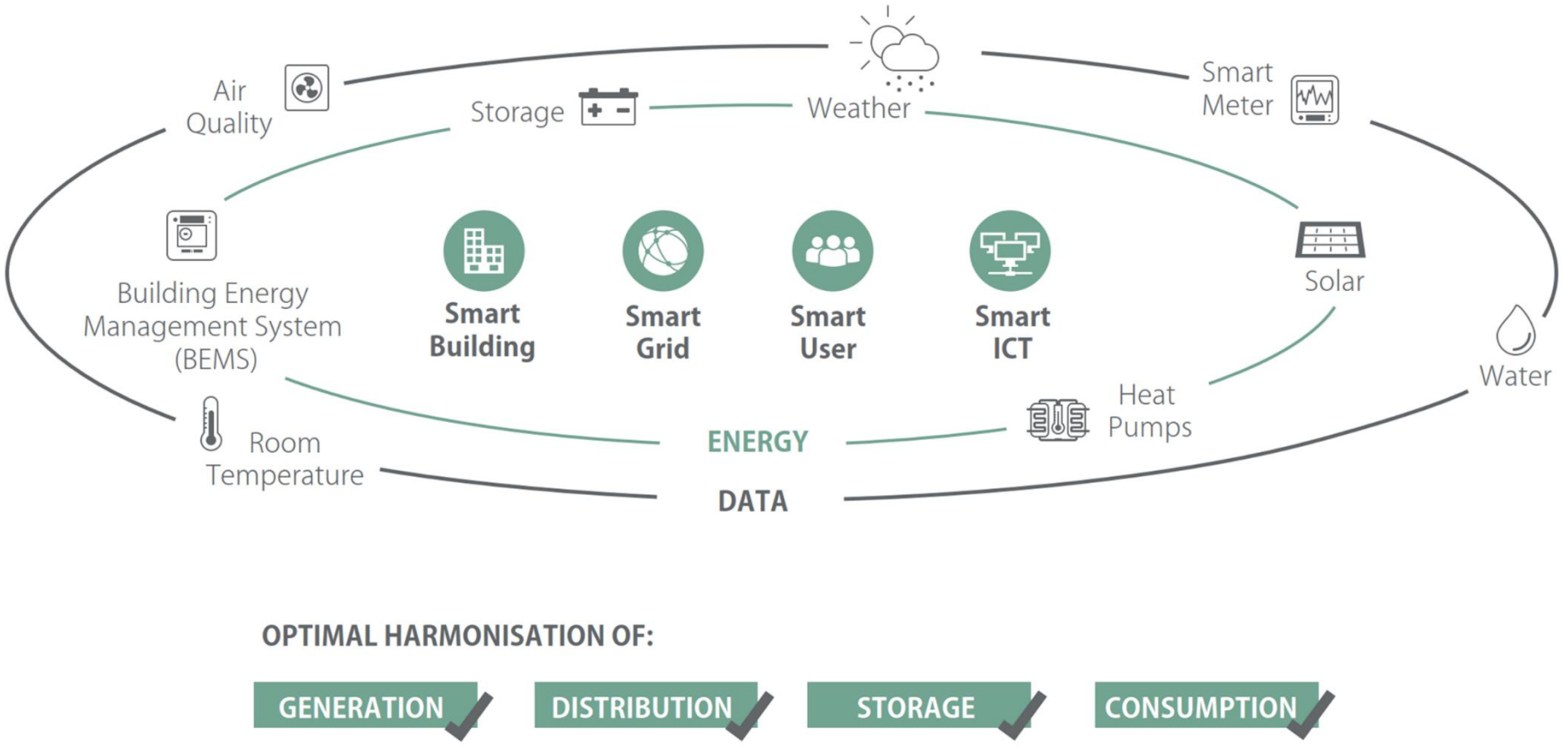
Department of Informatics

Aspern Smart City in Vienna

- Living laboratory for research into the future of urban energy
- In Europe’s most innovative energy-efficiency project
- Smart energy systems and intelligent buildings operate together in a real urban subcenter
- Smart system reduces buildings’ carbon footprint
- Siemens is industrial partner involved in the project

Aspern Smart City in Vienna

- At the end of 2016, there were already 2,600 housing units for some 6,100 people, a shopping street, an underground/metro and tram links.
- By 2028 Aspern is scheduled to have around 10,500 apartments, 20,000 jobs, a school campus, an industrial park and a research centre
- Reducing operating costs even more by **Digital Twins**
- **Research through 2023 will focus on continuing to minimize operating costs for buildings and network infrastructure. For example, through predictive maintenance. Building data from the digital twin will become a hub that links data, users, and specific applications**
  - Solutions developed on this basis should be self-configuring as much as possible and easy to operate


Air Quality
Storage
Weather
Smart Meter
Building Energy Management System (BEMS)
Smart Building
Smart Grid
Smart User
Smart ICT
Solar
Water
Heat Pumps
Room Temperature
ENERGY
DATA
OPTIMAL HARMONISATION OF:
GENERATION
DISTRIBUTION
STORAGE
CONSUMPTION

Plantation (H2020)

- dee**P** machine **L**earning **AN**alysis of sa**T**ellite and clim**A**tic data for the adap**T**ation of crop product**IO**n to climatic cha**N**ges
- Project submitted 2/2020
- The overarching objective of PLANTATION is to improve the resilience of crop farming to climatic changes and extreme weather events by correlations between climatic and meteorological patterns with biomass growth and yield in support of better soil and water management policies and agronomic practices

Project content

- Consortium of 13 partners (EU)
- Budget 4 million euros/ 3 years
- Input archive of global multi-spectral satellite imagery dating back 30+ years ranging from Landsat data onwards to modern-day Sentinel and Copernicus
- Utilizing 50+ years of high resolution distributed climatic observations that cover basic measurements including temperature, relative humidity, precipitation, cloud cover, wind speed etc.
- Identifying correlations and causalities between climatic events and biomass productivity, creation of descriptive models, reduction of agricultural costs

Project content

Selected areas for implementation

- Semantic metadata system building for discovery of EO, IoT, meteorological, soil, water and other data services
- Analysis of crop detection algorithms and their selection
- Field boundaries detection
- Comparison and selection of best ML algorithms for spatio-temporal correlation analysis in time series data of multi-spectral space imagery and meteorological observations

DT-GAEA (ESA – Theme 2: Food Systems)

- **D**igital **T**win **G**reen **A**gricultural **E**arth **A**ccelerator
- ESA Tender Digital Twin Earth Precursors: Objectives & Basic elements
- Project submitted 6/2020
- The goal of the Digital Twin Earth shall provide a leading-edge capability to “visualize, monitor and forecast natural and human activity on the planet in support of sustainable development thus supporting Europe’s efforts for a better environment as set out in the Green Deal”

Project content

- Consortium of 6 partners (EU)
- Budget 0.45 million euros/ 1 year
- DT-GAEA project is connecting the l community with experts from the agriculture domain (modelling, analysis), water and climate modelling, market modelling, Earth Observation and ICT experts
- The input data are images from Sentinel and Copernicus, data from sensors
- The definition of the end-to-end architecture and functional elements of Digital Twin Earth is in its early stages. The project provides only an initial high-level overview of the potential functional components required to develop such a system

Planned publications (2020)

- A systematic literature review of languages used for Digital Twins description
  - Discovery of classification criteria
  - Classification of modelling languages used in Digital Twins

Planned publications (2020)

- A review of cloud platforms supporting Digital Twins
  - Investigation of cloud platforms supporting Digital Twins
  - Evaluation of characteristics of the cloud platforms

Dissertation topic (Štěpán Hošek)

Digital Twins in technology with support of smart solutions

- Introduction into Digital Twins
- Description of current state
- Evaluation of the existing formal languages intended as description of Digital Twins
- Implementation of the modelling framework – creation of practical example

Dissertation topic (Štěpán Hošek)

Creation of practical example

- Smart city model
  - Collect data from sensors in the city (smart phones)
  - Manage traffic, water supply, power plants, waste disposal etc.
  - Inhabitants cooperation necessary

Photo by Takashi Watanabe on Unsplash

Dissertation topic (Štěpán Hošek)

Creation of practical example

- Autonomous vehicle in a smart city
  - Digital twin gets data from other cars as well as from its own sensors
  - Traffic should be safer and more fluent
  - Routes could be calculated/altered according to data gotten from other cars navigation systems

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Thank you for your attention

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