T.E.A.M.
telematics
economy
architecture
management

Smart Cities and Communities – Climate Change and ESG

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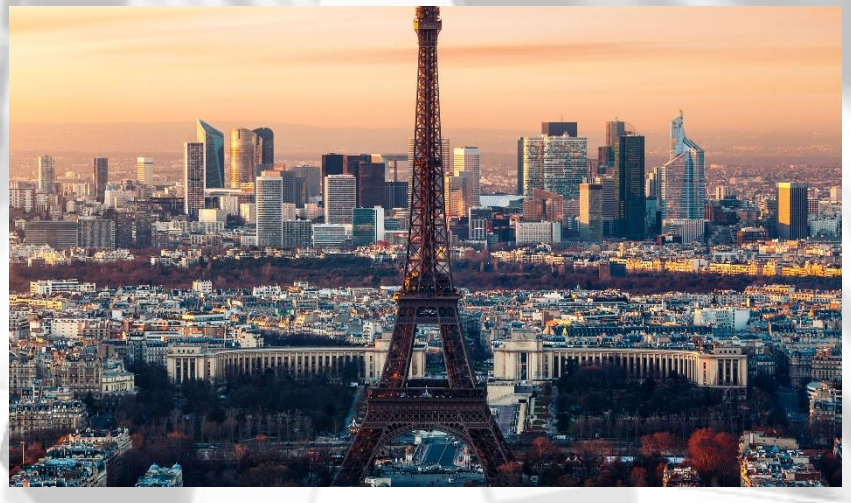
Smart Cities Course Description

Smart Cities Fundamentals

- Smart Cities Fundamentals: Characteristics of smart cities; citizen participation; specifics of the territory (history, cultural traditions, economic possibilities); communications across disciplines - urbanism, security, economy, agriculture, energy, environment, industry 4.0, legislation; system analysis tools (user needs, use case's specification, system alliances, system identity); business models for smart cities; smartness assessment and smart cities metrics.



Smart Cities Fundamentals

The objective of this course is to provide the technological, social, business and sustainability knowledge and skills that will allow graduates to act as enablers of smart cities with a local and global perspective.

Objectives:

1) Ability to understand citizens needs and to clearly identify priorities and outcome of projects with respect to individual citizens

2) Ability to apply system thinking and system engineering management principles in order to approach large interdisciplinary problems by defining clear tasks, priorities or by decomposing system into particular subsystems and their interfaces.

3) Ability to understand smart city processes

4) Ability to compare and evaluate different solutions from various perspectives including technical, legal, business or social impact.

5) Ability to use such interdisciplinary knowledge to solve problems of modern cities.




Smart Cities Fundamentals

- MODULE 1. SC introduction
- MODULE 2. SC technologies
- MODULE 3. SC components
- MODULE 4. SC integration
- MODULE 5. SC human aspects
- MODULE 6. SC assessment
- MODULE 7. SC case studies

Module Objectives

MODULE 1. SC introduction

Objectives:

- Provide basic definitions and terminology of smart cities
- Present short history of smart cities (EU, USA, Latin America, China)
- Give the basic introduction into architecture and city urbanism (different approaches to city urbanism)
- Summarize the current technological trends (smart phones, quantum and biological computers, 3D printers, drones, etc.)
- Present current activities in Industry 4.0 (vertical and horizontal integration of manufacturing processes, mass-individual production)
- Present different approaches to the concept of smart cities (problems identification, proposing different variants of solution, choice of best solution)
- Advanced design and implementation of smart city solution (3D territorial plan, simulations, documentation, BIM – building information modelling, CIM – city information modelling)

Module Objectives

MODULE 2. SC technologies

Objectives:

- Provide introduction of tools used for complex system analysis (interfaces, system architecture, UML – unified modelling language, SysML – system modeling language, MAS – multi agent systems, ASN.1 – abstract syntax notation No. 1)
- Define system performance parameters (reliability, safety, integrity, security)
- Provide overview of information technologies (IoT, cloud, fog, BigData, blockchain, IT platforms)
- Provide overview of satellite technologies (Satellite Navigation, Remote Sensing Satellite Systems, whether forecast)
- Overview of telecommunication technologies (LoRa, SigFox, LTM, 5G, satellite communication)
- Provide introduction to energy consumption with examples (consumption of individual devices, how to measure energy consumption, etc.)
- Overview of technologies in energy sector (renewable resources, batteries, transformers)

Module Objectives

MODULE 3. SC components

Objectives:

- Introduction to system approach to smart cities (decomposition, relations, major areas of smart cities)
- Description of smart transportation (ITS, C-ITS, advanced traffic control, public transportation, city logistics, e-mobility)
- Description of smart grids (omni-directional connectivity, graceful degradation, black-out reaction)
- Description of smart safety and security services (crisis management, terroristic attack, natural disasters)
- Description of smart government (resident participation, integrated planning, virtual office)
- Description of smart health (remote monitoring of patients, navigation of rescue vehicles, virtual doctor)
- Description of smart utilities and environment (water supply, waste management, advanced environmental sensors)

Module Objectives

MODULE 4. Integration of SC components

Objectives:

- Description of smart home (personal equipment, wearable technologies, tailor-made home environment)
- Description of smart buildings (private house, school, sport complex, offices, industrial buildings, historical buildings – different requirements, different solutions)
- Description of smart urban “furniture” (street lights, smart bins, smart benches)
- Interconnections of intelligent components into higher level units (smart street, smart square, smart village, smart city, smart region – optimal composition of smart elements with different functional and performance requirements)
- Introduction into existing smart city international standards (CEN, ISO, IEEE, etc.)
- Presentation of different solutions of city data platform (technologies of CISCO, Siemens, example from San Francisco, Prague, etc.)
- Future development of virtual (twin) city that enables different simulations of city processes (by means of virtual and augmented reality, SynopCity)

Module Objectives

MODULE 5. SC human aspects

Objectives:

- Focus on residents (quality of life concept - perception, decisions and others, sustainability of smart cities - environmental, economic and social)
- Introduction into legal rules and regulations (privacy, liability, personal data, responsibility)
- Introduction into new smart city business models (shared economy, crowdfunding, PPP, EPC)
- Presentation of different organizational models for smart city implementation (department at municipality, business company owned by municipality)
- Resident participation models (user forums, local referenda, communication with municipality)
- Design and assessment of human interfaces for smart city applications (solutions for different categories of users: seniors, children, disabled or handicapped people)
- Game-oriented training of city staff (simulated exercise of black-out, evaluation of the behavior of different actors, optimization of crisis scenarios)

Module Objectives

MODULE 6. SC assessment

Objectives:

- Introduction into assessment of city smartness (different approaches, context-oriented indexes, universal indexes)
- City resilience index (examples of assessment of different cities including El Paso)
- Fraunhofer approach to smart city assessment (German methodology used for Prague)
- EY approach to smartness measurement (this methodology was applied to assess the big Italian cities)
- Smart Prague Index (this approach is used to monitor progress in Smart Prague projects)
- Assessments of smart village and smart regions projects
- Information tools for on-line monitoring of smart city key performance indicators (KPI)

Module Objectives

MODULE 7. SC case studies

Objectives:

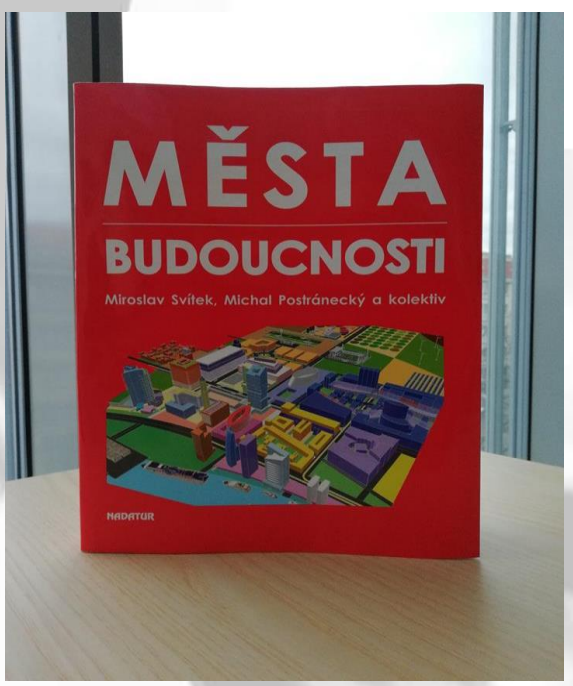
- Introduce case studies of different smart cities in USA, EU, China, Latin America.
- Smart Wien (Aspern, Tina Wien)
- Smart Barcelona (technical standards)
- Smart Chicago (data platform)
- Smart Singapore (advanced technologies)
- Smart Prague (ICT Operator)
- Smart El Paso (resilience)

Cities of the Future

The **first part** describes a smart city using system analysis tools and shows the different connections between *urbanism, security, economy, or the ongoing fourth industrial revolution*.

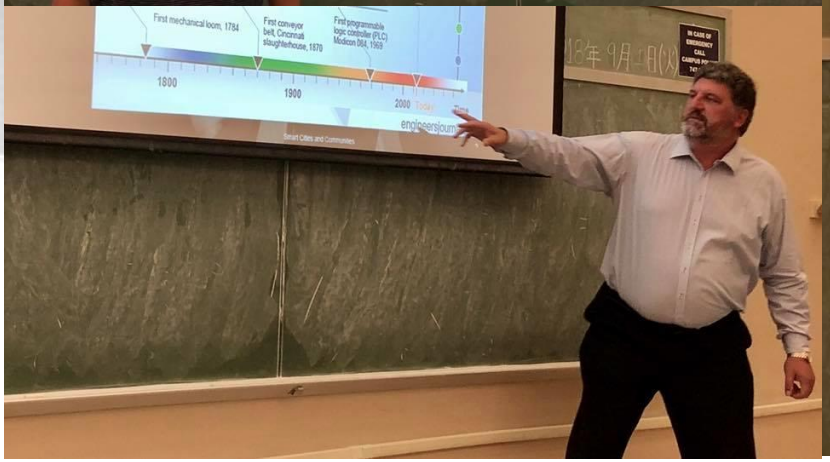
The **second part** focuses on examples of specific smart solutions in the field of *state and public administration, cyber and energy infrastructure, mobility, intelligent buildings and water management*. At the same time, this part of the book should be taken as a sample of several selected areas, which can be further extended, for example, in the area of *health, waste management, education, etc*.

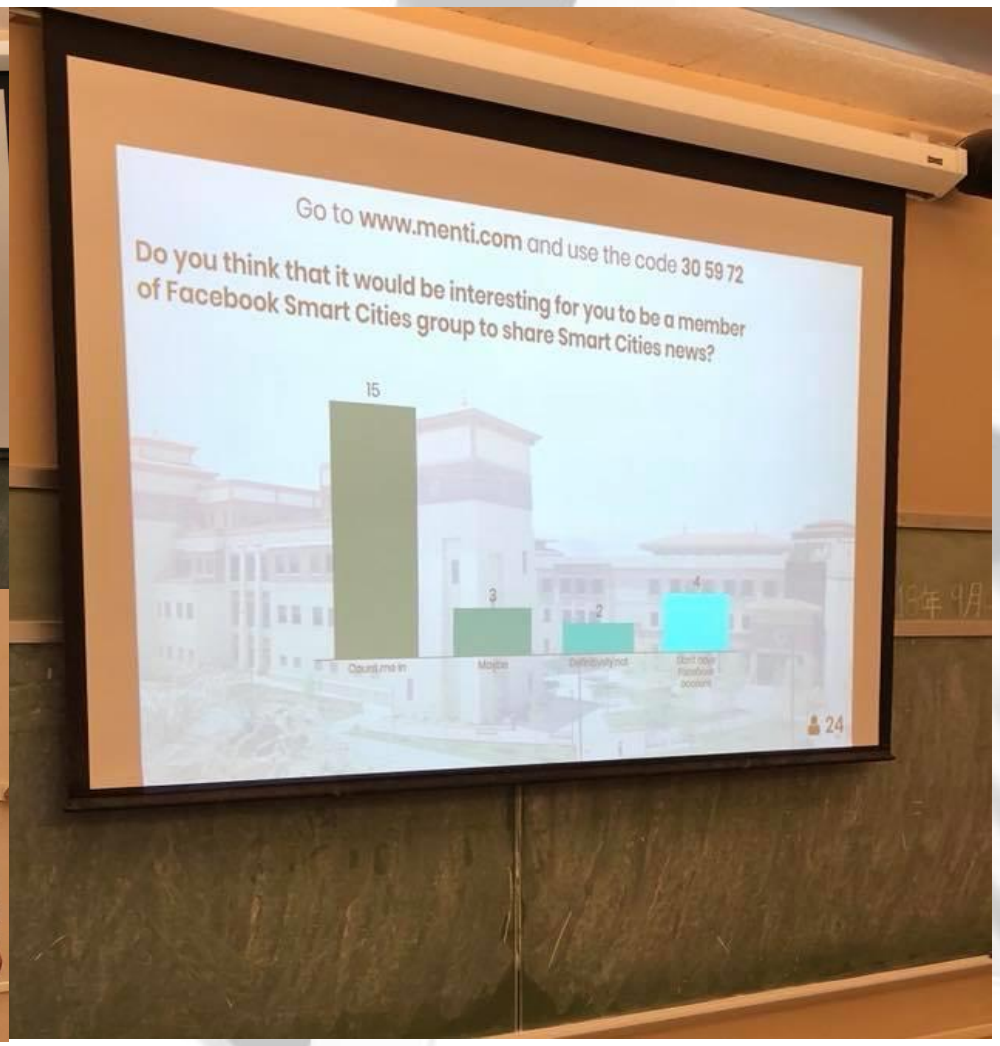
The **third part** includes the *methodology of smart city implementation*, as well as *the methodology of the assessment of the city's smartness* plus some *specific examples* of implementing the concept of smart cities.



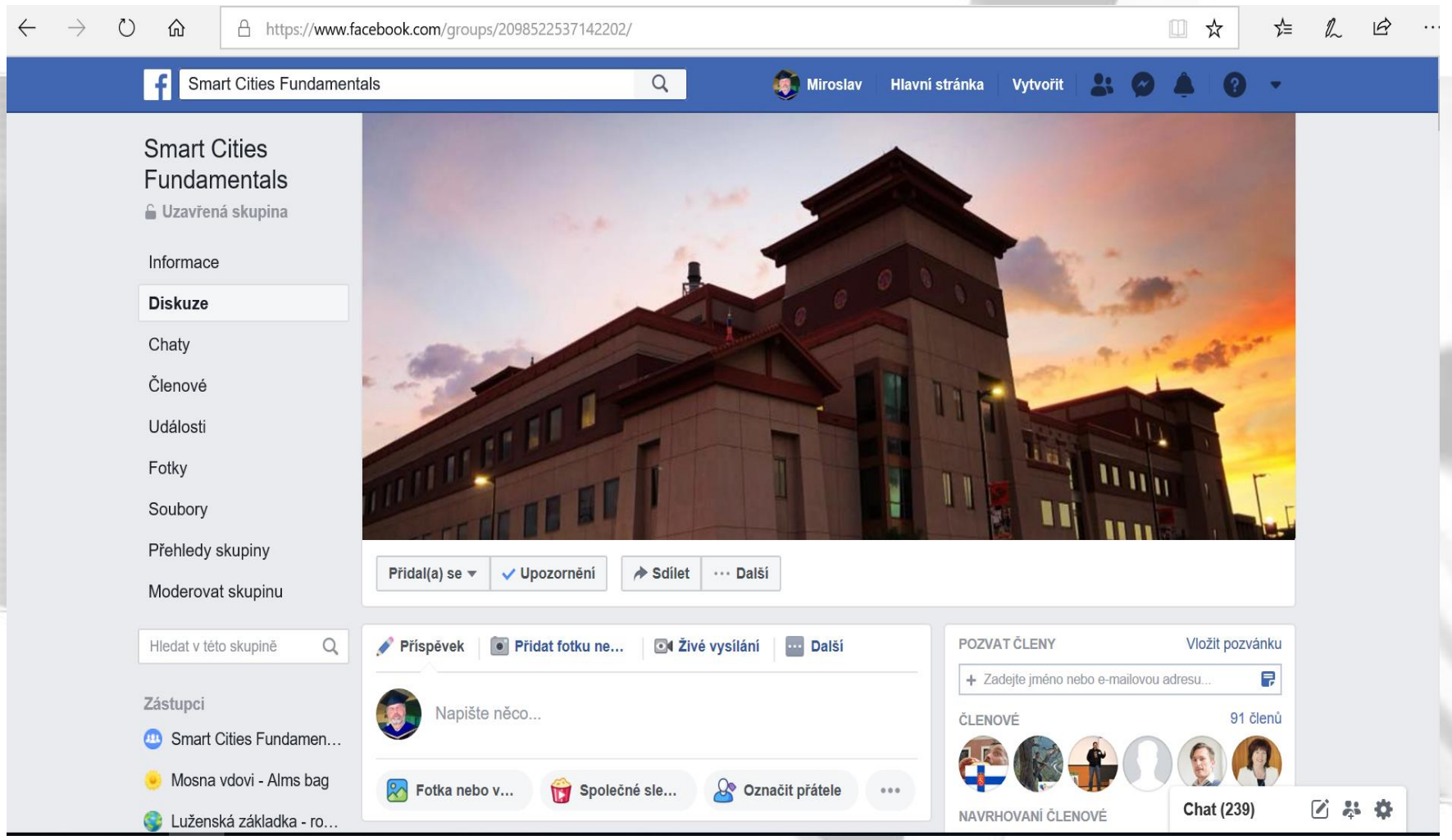
Innovative Teaching Methods

Smart Cities Fundamentals – menti.com





Smart Cities Fundamentals – Facebook group



Smart Cities Fundamentals – Students' homework

UNIVERSITY OF TEXAS AT EL PASO
College of Engineering
Master of Science in Construction Management
CE-5390-008 Special Topics
Smart Cities Fundamentals
Prof. Miroslav Vitek

XIONG'AN
雄安新区
SMART CITIES FUNDAMENTALS
HOMEWORK #2 – SMART CONCEPT

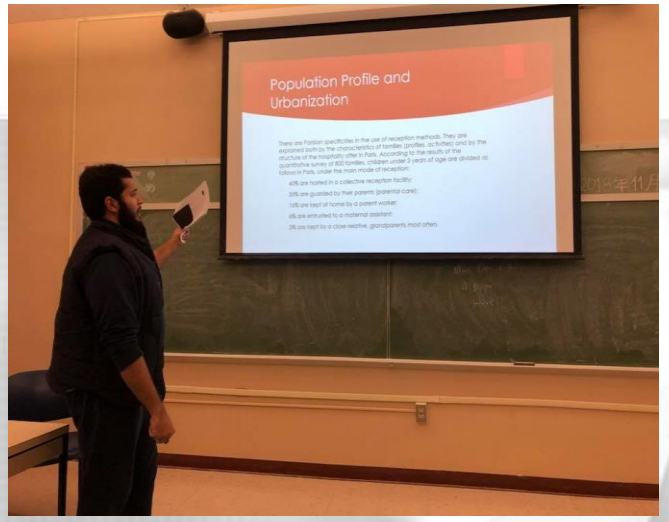
Laura C. Torre
UTEP ID: 8063029
Graduate Studer

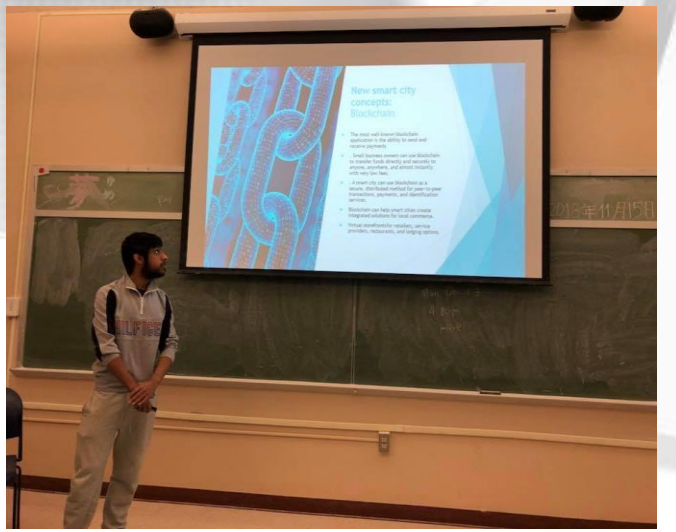
Masdar City

SHANGHAI
PARIS OF THE EAST

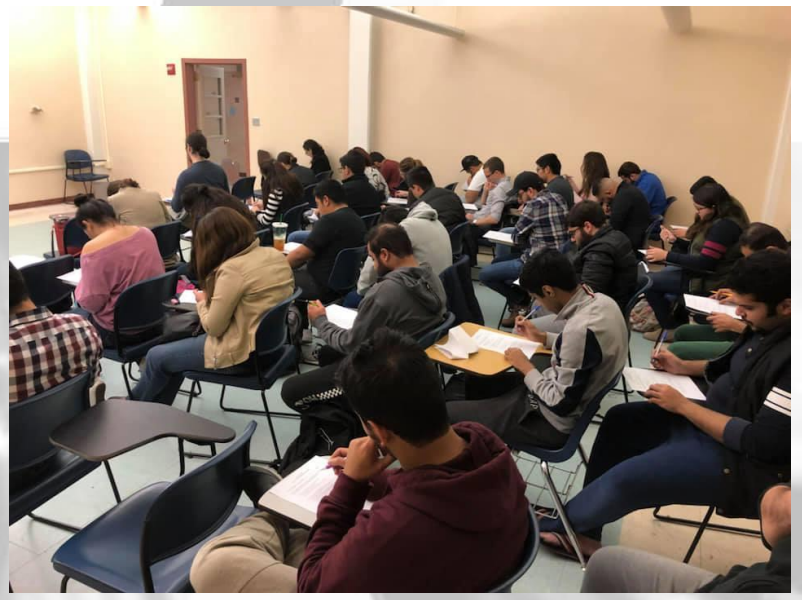
SANTO DOMINGO:
CAN IT BECOME
A SMART CITY?
EDUARDO CASTILLO FATULE
SMART CITIES FUNDAMENTALS

Smart Cities Fundamentals – Students' Presentation





Smart Cities Fundamentals - Exam



Smart Cities Fundamentals – Summer School in Prague

CTU-UTEP Faculty Led Study Abroad Program on Smart Cities

Eligibility Requirements:

- Engineering Major (all disciplines)
- Junior, Senior, Graduate Students
- Minimum G.P.A. 3.0

Summer Course:

- Engineering Elective Course (Special Topics or Individual Study)

About the Program:

- Learn the indicators used in the design of smart cities services.
- Gain knowledge on the principles and techniques for implementing smart cities projects.
- Participate in Smart City Symposium in Prague.
- Site visits & field trips.
- Experience the Czech culture.

Climate Change and ESG

Green Deal - Policy

Europe must lead the transition to a healthy planet and a new digital world. But it can only do so by bringing people together and upgrading our unique social market economy to fit today's new ambitions.

Policy Areas

- Climate Change
- Energy
- Industry
- Buildings
- Transport and Mobility
- Agribusiness & Food
- Ecosystems
- Biodiversity
- Forest
- Water
- Air
- Soil

Green Deal - Goals

It is a new growth strategy that aims to:

Become climate-neutral by 2050

Protect human life, animals and plants, by cutting pollution

Help companies become world leaders in clean products and technologies

Help ensure a just and inclusive transition

The EU has the collective ability to transform its economy and society to put it on a more sustainable path.

This upfront investment is also an opportunity to put Europe firmly on a new path of sustainable and inclusive growth. The European Green Deal will accelerate and underpin the transition needed in all sectors.

Green Deal - Energy

- Clean, Just and Smart Energy Transition
- Decarbonizing
- New Regulatory Framework (TEN-E Regulation)
- Deployment of Innovative technologies and Infrastructure

Secure and affordable EU energy supply

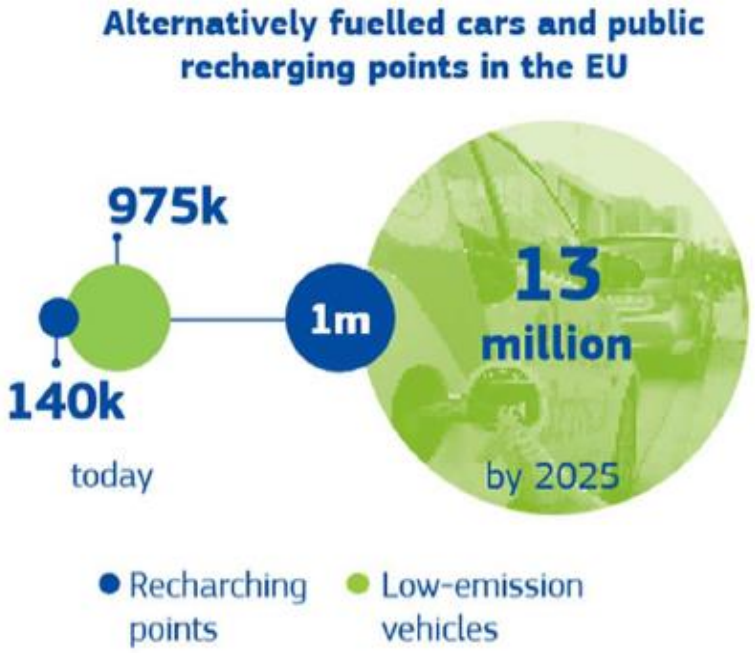
Prioritise energy efficiency and develop a power sector based largely on renewable sources

Fully integrated, interconnected and digitalised EU energy market

Further decarbonising is critical to reach climate objectives in 2030 and 2050.

Green Deal – Transport and Mobility

- Sustainable Transport
- Multimodal Transport
- Alternative Fuels
- Automated and Connected Multimodal Mobility
- Smart Systems
- Transport taxation



Ending subsidies for fossil-fuel

Effective road pricing in the EU

Extending emissions trading to the maritime sector

Reducing free allowances to airlines under emissions trading

EU Taxonomy

- The World Economic Forum released a set of universal **Environmental, Social and Governance (ESG)** metrics to measure stakeholder capitalism.
- Good to be aware of that there are currently six key standards + SDGs:
    1. Global Reporting Initiative (GRI)
    2. Sustainability Accounting Standards Board (SASB)
    3. Task Force on Climate-related Financial Disclosures (TCFD)
    4. Carbon Disclosure Project (CDP)
    5. WEF ESG metrics
    6. **EU Taxonomy for Sustainable activities**

EU Taxonomy

- All Companies receiving support should commit to undertake **environmental and social due diligence** in line with the minimum safeguards approach laid out in the Taxonomy, which builds in particular from the OECD Guidelines on Multinational Enterprises.
- Where the Taxonomy **sets objective criteria** for the avoidance of significant harm, companies can then demonstrate how these are met or are planned to be met alongside their due diligence.
- Due diligence considers an important **principle of proportionality**, meaning that SMEs should be able to comply in a way that is **consistent with their resources**.

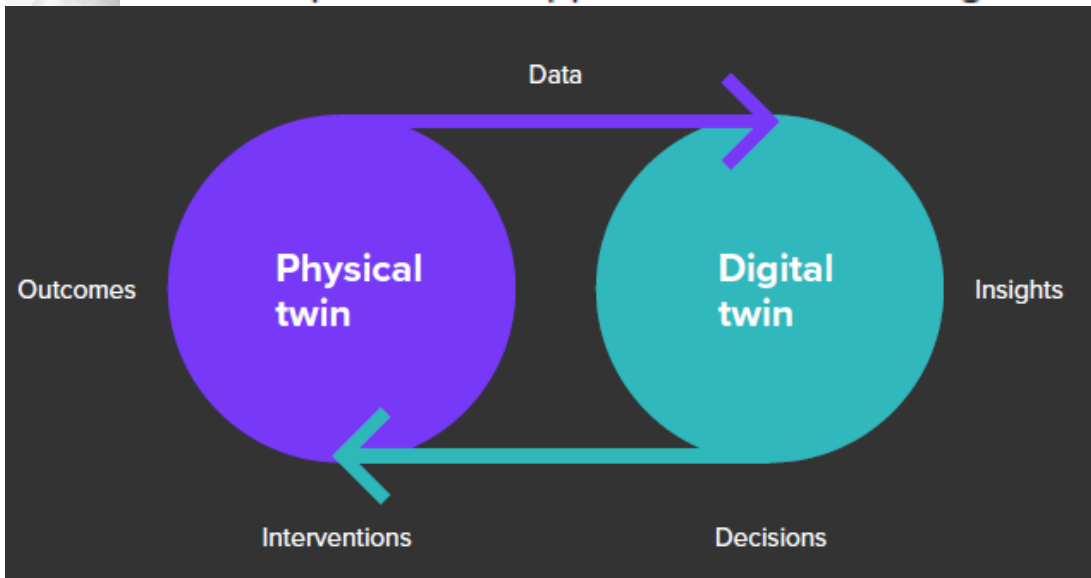
Digital Twin (Mott MacDonald approach)

Digital twins are realistic digital representations of physical things. They unlock value by enabling improved insights that support better decisions, leading to better outcomes in the physical world. What distinguishes a digital twin from any other digital model is its connection to the physical twin. Based on data from the physical asset or system, a digital twin unlocks value by supporting improved decision making, which creates the opportunity for positive feedback into the physical twin.

Appropriate detail

A digital twin must represent physical reality at a level of accuracy suited to its purpose. The extent of realism depends on three essentials:

- Data – the quality of the data on which the twin is based.
- Model – the fidelity of the algorithms, the validity of the assumptions and the competence of the code at the heart of the digital representation.
- Visualisation – the quality of presentation of the output. Digital twins may be developed for a range of purposes, operate at different scales or adopt different approaches to modelling.



Digital Twin Options

1. Variety of purposes

Digital twins can be used for many purposes:

a. Potential futures: Strategy and planning support, running 'what if?' scenarios, predictive and preventive maintenance regimes

b. Current state: Intervention management (operation and maintenance interventions or capital investment projects), real-time status monitoring and control, diagnostics and prognostics to optimise performance and safety of assets

c. History: Record-keeping and learning from the past

2. Variety of spatial scales

Digital twins may address a variety of spatial scales, including:

a. Asset or building scale

b. Network or neighbourhood scale

c. System, city or regional scale

d. National scale

3. Variety of temporal scales

Digital twins may represent any point in the lifecycle of assets, processes and systems. They can be static or dynamic and may address different temporal scales, including:

a. Operational timescale

b. Reactive maintenance timescale

c. Planned maintenance timescale

d. Capital investment timescale

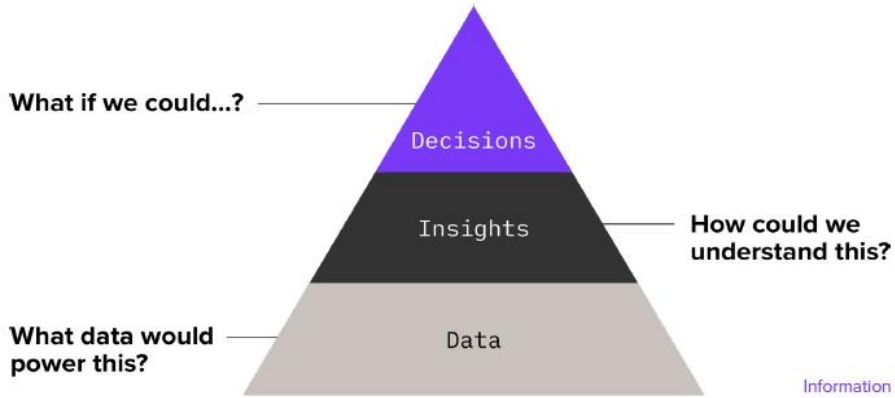
4. Variety of approaches to modelling

Digital twins may use different approaches to modelling, including:

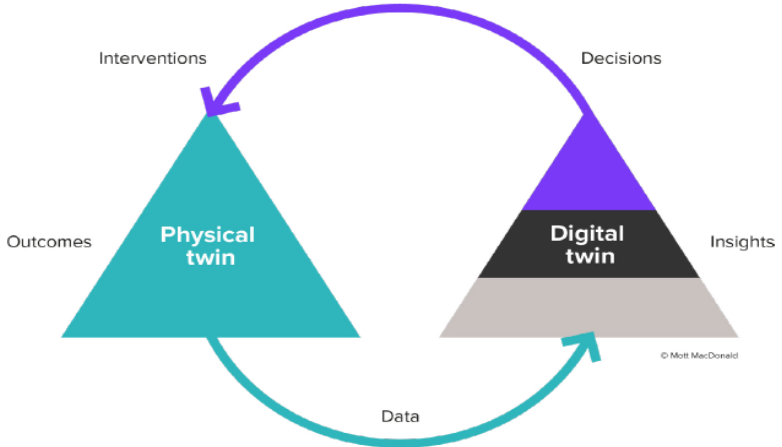
a. Geometric and geospatial modelling

b. Computational/mathematical/numerical modelling

c. Artificial intelligence and machine learning



Information value chain



ESG (Environmental Social Governance)

Explaining the Pressure-State Response Framework

Pressure indicators

These indicators are used to understand the factors that may be negatively impacting the environment, for example, increased urban sprawl reducing the availability of green spaces.

State indicators

These indicators are used to understand the quality of the city's environment (for example, soil quality). It also assesses the city's resource availability (such as water storage) and climate risk (such as exposure to flooding).

Response indicators

These indicators measure actions that have been or could be taken to address pressures and improve the state of the environment, for example, imposing planning restrictions to increase green spaces.

European Bank for Reconstruction and Development (EBRD)

Pressure indicators

Sector	Source of pressure		Indicator	Unit	Benchmarks			Source
TRANSPORT	Energy efficiency and type of energy used	10	Average age of car fleet (total and by type)	Years	< 6	6–12	> 12	IADB
		10.1	Percentage of diesel cars in total vehicle fleet	%	< 20	20–30	> 30	Based on EEA
		10.2	Fuel standards for light passenger and commercial vehicles	n.a.	EURO 6	EURO 5	EURO 4 or below	OECD / ICLEI
		10.3	Share of total passenger car fleet run by electric, hybrid fuel cell, Liquified Petroleum Gas (LPG) and Compressed Natural Gas (CNG) energy (total and by type)	%	> 3	1–3	< 1	Based on EEA
	Choice of transport mode	11	Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)	%	Private transport < 30%	Private transport = 30–50%	Private transport > 50%	OECD / ICLEI
		11.1	Transport modal share in total trips	%	Private transport < 30%	Private transport = 30–50%	Private transport > 50%	OECD / ICLEI
		11.2	Motorisation rate	Number of vehicles per capita	< 0.3	0.3-0.4	> 0.4	IADB
		11.3	Average number of vehicles (cars and motorbikes) per household	Number of vehicles per household	< 0.5	0.5-1	> 1	OECD / ICLEI
		11.4	Kilometres of road dedicated exclusively to public transit per 100 000 population	km	> 40	10–40	< 10	IADB
		11.5	Kilometres of bicycle path per 100 000 population	km	> 25	15–25	< 15	IADB
		11.6	Share of population having access to public transport within 15 min by foot	%	> 80	60–80	< 80	OECD / ICLEI

European Bank for Reconstruction and Development (EBRD)

State indicators

Topic		Indicator	Unit	Benchmarks			Source of benchmark	Additional indicator (example)
QUALITY OF ENVIRONMENTAL ASSETS								
AIR	1	Average annual concentration of $PM_{2.5}$	$\mu g/m^3$	< 10 (annual)	10–20 (annual)	> 20 (annual)	Based on WHO	• Sources of air pollution (in %) for each particle (PM_{10}, $PM_{2.5}$, SO_2, NO_x)
	1.1	Average annual concentration of PM_{10}	$\mu g/m^3$	< 20 (annual)	20–50 (annual)	> 50 (annual)		
	1.2	Average daily concentration of SO_2	$\mu g/m^3$	< 20 (24 hour)	20–50 (24 hour)	> 50 (24 hour)		
	1.3	Average annual concentration of NO_x	$\mu g/m^3$	< 40 (annual)	40–80 (annual)	> 80 (annual)		
WATER BODIES	2	Biochemical Oxygen Demand (BOD) in rivers and lakes	mg/L	< 2	2–4	> 4	Based on EEA	• Sources of water pollution (in surface and ground water)
	2.1	Ammonium (NH_4) concentration in rivers and lakes	µg/L	< 150	150–200	> 200		
DRINKING WATER	3	Percentage of water samples in a year that comply with national	%	> 97	90–97	< 90	IADB	

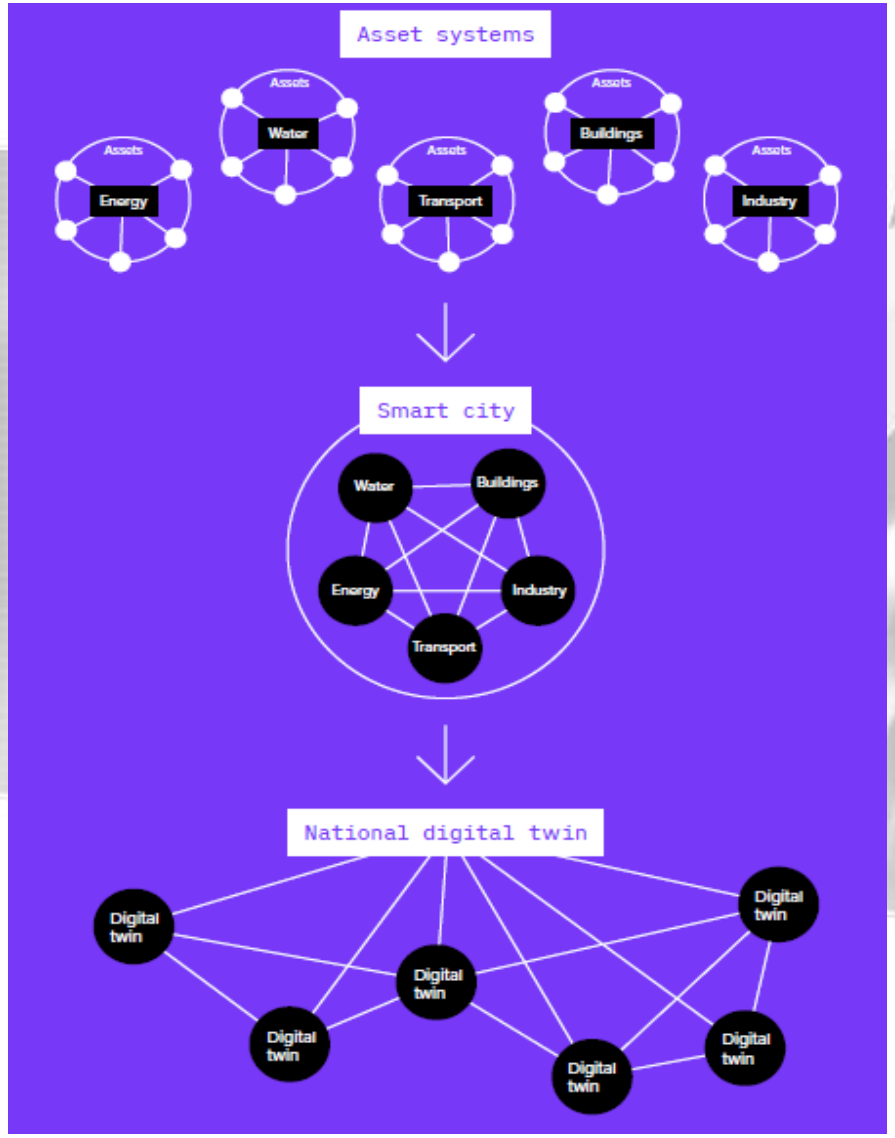
European Bank for Reconstruction and Development (EBRD)

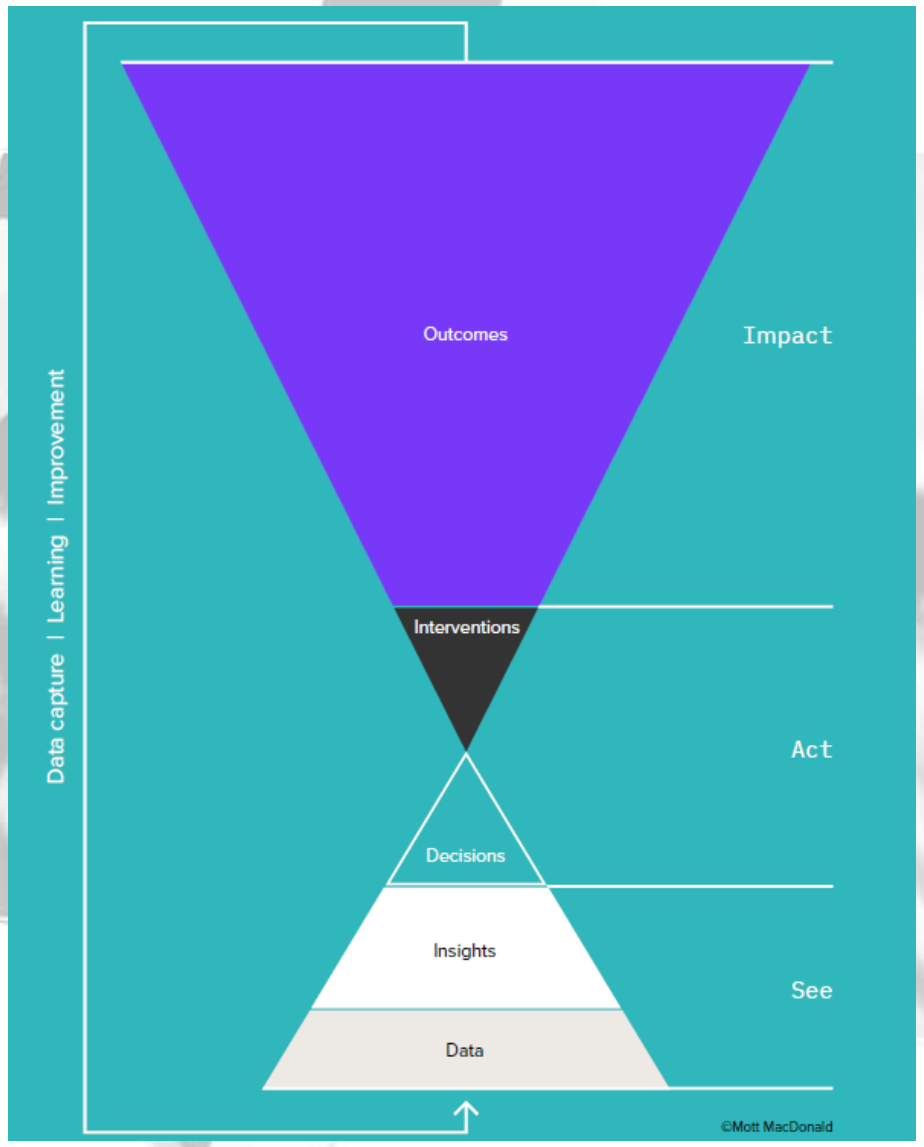
Response Indicators

Sector	Item	#	Indicator	Benchmarks		
TRANSPORT	Energy efficiency and type of energy used in transport	36	High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments	Existing and well implemented, and there is no significant need to further expand this type of response	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	Not existing
	Choice of transport mode	37	Extension and improvement of public and non-motorised transport is planned and supported through investment in place			
		38	Public and non-motorised transport is promoted through Information and awareness campaigns			
	Congestion	39	Traffic demand is managed (congestion charges, smart technologies)			
	Resilience of transport systems	40	Public transport emergency management (in publicly and/or privately run networks) is planned and tested			
BUILDINGS	Electricity and heat consumption	41	Green building is promoted through standards and fiscal incentives	Existing and well implemented, and there is no significant need to further expand this type of response	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	Not existing
		42	Public and private investment in energy efficiency in buildings			
		43	Metering and billing for personal energy use is regulated			
INDUSTRIES	Electricity and heat consumption / energy efficient industrial processes	44	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes)	Existing and well implemented, and there is no significant need to further expand this type of response	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	Not existing
		45	Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment			
	Industrial waste / material consumption	46	Material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments			
	Industrial wastewater	47	Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives			
ENERGY	Electricity and heat provision	48	Coverage and quality of electricity and heat supply is improved through investment	Existing and well implemented,	Existing, but implementation	Not existing

Systemic Approach to Clean City Transportation and Logistics

Digital Twin Application





Transport & Mobility Climate Tech Intelligence

ESG + GHG + EU ETS Transport / Mobility / Logistics

Related Elements / Issue	Transportation Services	Traffic Management	Modes of Traffic	Traffic Infrastructure
Battery / Electrification	MaaS: Mobility as a Service	Traffic Control	Road Transport	Transport Means
Hydrogen / Fuel Cells	Rescue / Ambulance Services	Integrated Public Transport	Railway Transport	Cargo / Passengers Identification
Gas to Power (G2P)	Safety /Quality / Comfort	City Logistics	Air Transport (aircraft /drone)	Traffic Roads
Digitization / AI	Sustainability / Resiliency	Supply Chain	Water Transport	Transport Terminals
Urban Production (I4.0)	Efficiency / Reliability	Intermodal Transport	Bicycle Transport	Parking Lots
Circular Economy	Individualized Services	Maintenance / Rescue / Waste Transport	Hyperloop / Pod-cars / Cableway	Refueling / charging Stations
Smart cities and neighborhoods		Transport Telematics	Shared / Autonomous Transport	
			Light Personal Transport	

Industry 4.0 in the Czech Republic

Czech Institute of Informatics, Robotics and Cybernetics (CTU)

- This institute is at the forefront of activities in the area of **Industry 4.0 in the Czech Republic**.
- It actively promotes international cooperation in the field and synergies between the private sector and academia.
- It has opened the **Testbed for Industry 4.0** as a new research and experimental workplace for **testing innovative solutions and processes for smart factories**.

Opening: Czech Institute of Informatics, Robotics and Cybernetics

Thank you for your attention