SMARCO

SMARt COmmunities Skills Development in Europe

Green Transition and Sustainability' in Smart Communities – UNIT 1

P. Fitsilis (fitsilis@uth.gr)
University of Thessaly

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Key objectives

By the end of the course, participants will be able to:

- **Define and explain** the concepts of *smart*, *sustainable*, and *green* communities and cities, and how they interconnect.
- **Describe** the major frameworks, standards, and policy initiatives guiding smart urban transformation (e.g., SDG 11, EU Green Deal, ISO 37122, SCBoK).
- **Recognize** the technological building blocks of smart cities (IoT, AI, data analytics, digital twins) and their role in sustainable operations.
- **Understand** how sustainability principles (resource efficiency, circular economy, resilience) apply at community and city scales.
- **Identify** governance models, citizen participation approaches, and innovation ecosystems that enable human-centered smart development.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Unit 1 – Foundations of Smart, Sustainable, and Green Communities

- This foundational unit introduces the principles, frameworks, and paradigms that shape the development of smart, sustainable, and green communities. It emphasizes the integration of technology, ecology, governance, and citizen participation as interconnected pillars of modern urban and regional ecosystems.
- Learning Objectives. By the end of Unit A, participants will be able to:
  - Explain the fundamental concepts of sustainability, green transition, and smart community development.
  - Understand the interrelation between digital transformation and sustainable urban growth.
  - Recognize key international and European frameworks that guide smart and sustainable community development.
  - Apply systems thinking to interpret how environmental, social, economic, and technological dimensions interact within communities.
  - Identify the enabling factors (data, technology, governance, citizen engagement) that drive community transformation.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Key terms

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Sustainable Development

Definition: Meeting present needs without compromising the ability of future generations to meet theirs.

Example: Example: Implementing renewable energy systems in local communities.

Link: https://sdgs.un.org/goals

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Green transition

Definition: The shift toward a climate-neutral, resource-efficient, and sustainable economy.

Example: The EU Green Deal's goal to achieve climate neutrality by 2050.

Link: https://commission.europa.eu/strategy/priorities-2019-2024/european-green-deal

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Circular Economy

Definition: An economic model focused on reuse, repair, recycling, and waste elimination.

Example: Amsterdam's circular city strategy reduces construction waste.

Link:
https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Smart Community

Definition: A local network where citizens, government, and businesses collaborate through digital innovation for sustainable growth.

Example: Helsinki’s citizen engagement platforms for urban planning.

Link: https://smart-communities.org/

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

ESG (Environmental, Social, Governance)

Definition: A framework for evaluating sustainability and ethical impact in organizations or cities.

Example: Example: A city reporting CO_2 emissions and social inclusion metrics under ESG.

Link: https://www.unpri.org/esg-issues

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Life Cycle Assessment (LCA)

- **Definition:** A method for assessing environmental impacts across all stages of a product's life.
- **Example**: Evaluating carbon emissions from building materials to demolition.
- **Link:** https://www.iso.org/standard/37456.html

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Ecodesign

Definition: Designing products with minimal environmental impact throughout their life cycle.

Example: Philips designing energy-efficient, recyclable LED bulbs.

Link: https://ec.europa.eu/environment/ecodesign

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Resilience

- **Definition:** The capacity of a community or system to recover and adapt after disruptions (e.g., climate events).
- **Example:** Copenhagen's flood-resilient urban design.
- **Link:** https://resilientcitiesnetwork.org

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Why “Smart” and “Sustainable” Matter Together

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Smart, Sustainable, and Green Communities: A Unified Vision

Modern communities must balance **technological innovation**, **environmental protection**, and **social inclusion**.

- Smart" means *data-driven efficiency*; "Sustainable" means *long-term ecological and social balance*.
- The **smart + green = resilient** approach ensures both digital and ecological transformation.

Integration builds **livable, equitable, and future-ready communities**.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

The Evolution of Urban Development

- **The evolution**
  - **Smart City 1.0 – Digital City (1990s–2000s):** Focused on ICT infrastructure — broadband, e-government, online services.
  - **Smart City 2. 0 – Smart City (2010s):** Integration of data, IoT, and analytics for efficient urban operations.
  - **Smart City 3.0 – Sustainable Smart Community (2020s–):** Combines digital innovation with social inclusion and ecological goals.
- The focus shifts from **technology itself** → to **how technology empowers people and protects the planet**.

https://www.smartcitieslibrary.com/the-3-generations-of-smart-cities/

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Core Principles Guiding Smart Community Development

Connectivity: Seamless digital infrastructure linking citizens, services, and devices.

Inclusion: Equal access to technology and opportunities for all social groups.

Innovation: Continuous experimentation and adaptation through data and collaboration.

Participation: Active citizen involvement in decision-making and co-creation of solutions.

Sustainability: Integrating environmental, social, and economic goals into digital initiatives.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Balancing People, Planet, and Prosperity

The **Triple Bottom Line (TBL)** expands success measurement beyond profit — adding **social** and **environmental** dimensions.

People: Social well-being, inclusion, equity, and quality of life.

Planet: Environmental protection, climate action, and resource efficiency.

Prosperity: Economic viability and innovation supporting sustainability goals.

Smart communities integrate these three pillars into all digital and policy initiatives.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

The thin balance

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Short Assignment #1

Task:

Identify **one sustainability challenge** faced by your city, town, or community (e.g., waste, mobility, energy use, social inequality).

Propose **one digital or smart solution** that could help address it (e.g., sensor-based recycling, community app, open data dashboard).

Explain briefly **how your idea aligns** with the principles of *connectivity, inclusion, and sustainability*.

Quick examples:

Traffic congestion → smart public transport app.

High energy consumption → IoT-enabled smart meters.

Low civic engagement → mobile platform for participatory budgeting.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Understanding Interconnected Urban Systems

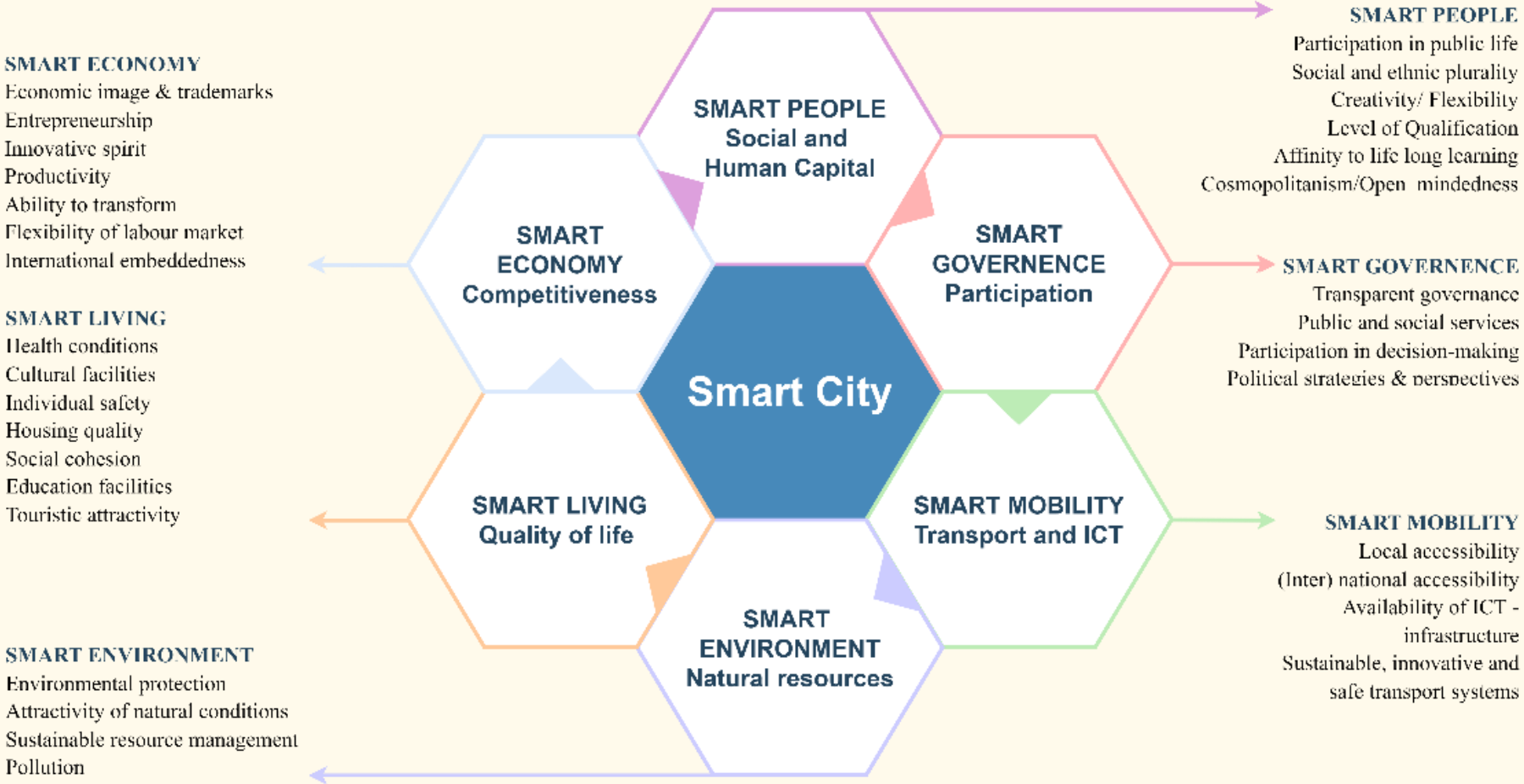
- **Systems thinking** views a community as an **interconnected network** of social, economic, environmental, and technological subsystems.
  - Actions in one domain (e.g., transport, housing, energy) influence outcomes in others.
- Promotes **holistic problem-solving** rather than isolated interventions.
- Helps identify **feedback loops**, **dependencies**, and **unintended consequences** in policy design.
- Core idea: A sustainable solution in one area should **benefit the entire system**, not create new problems elsewhere.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Giffinger's six-dimensional model



Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Digital Innovation as the Engine of Smart Communities

- **Data** is the foundation for understanding and optimizing urban systems.
- **IoT (Internet of Things)** connects sensors, buildings, and vehicles for real-time monitoring.
- **Open data** enables transparency and citizen-driven innovation.
- **AI and analytics** transform raw information into actionable insights for sustainability.
- Digital tools help track progress toward **energy efficiency, waste reduction, and social inclusion**.

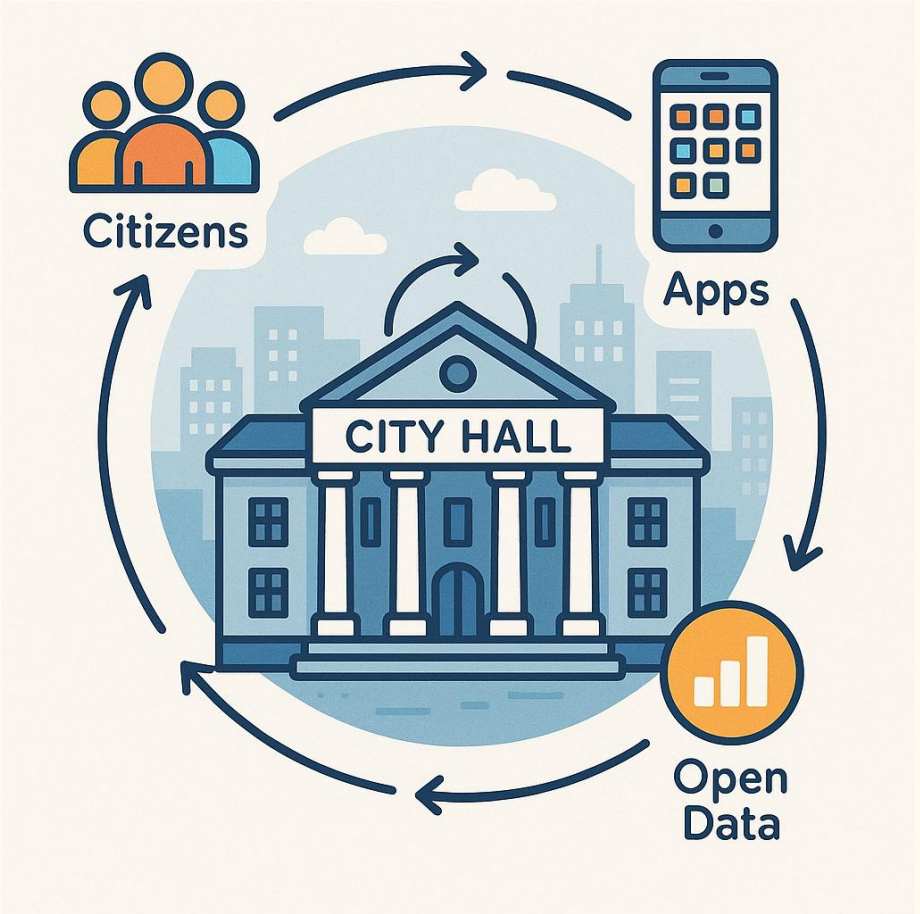
Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Empowering People Through Digital Governance

- **Smart governance** promotes transparency, accountability, and open decision-making.
- **Citizen participation** turns residents from service consumers into *co-creators* of solutions.
- **Digital tools** (e-participation, open data, online consultations) expand democratic engagement.
- Effective governance aligns **policy, technology, and citizen needs**.
- Builds trust and ensures sustainability efforts reflect real community priorities.

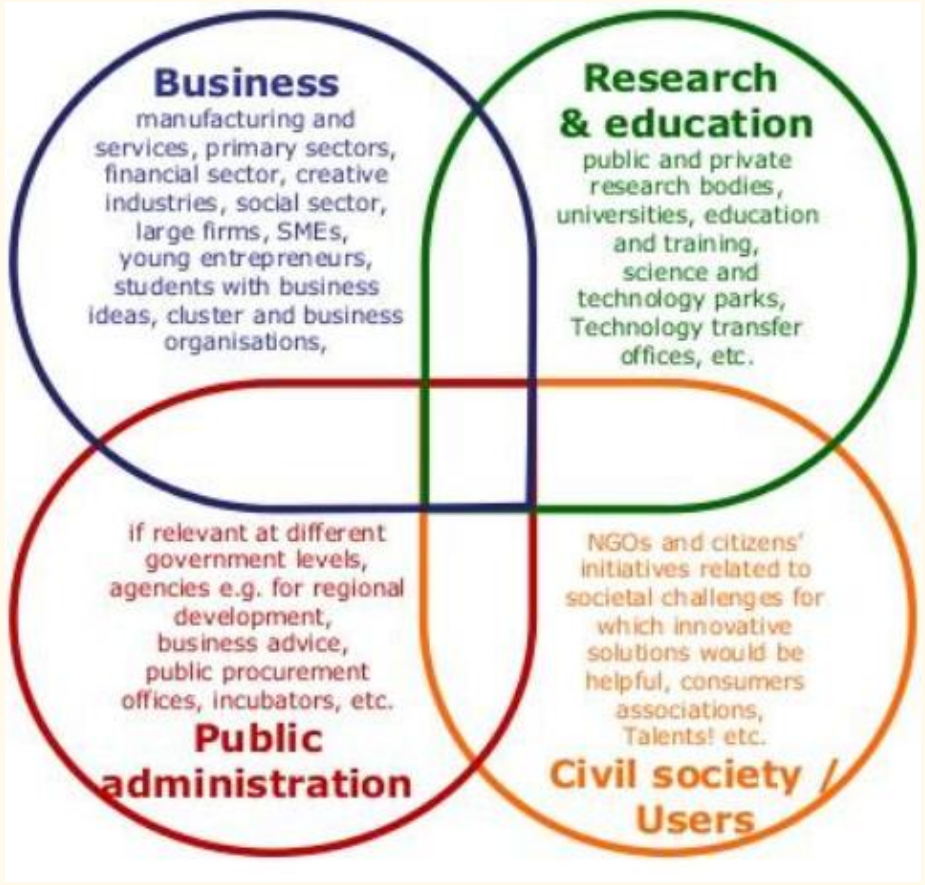


Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Innovation Ecosystems in Smart Communities



- A **smart community ecosystem** connects **universities, startups, local government, and citizens**.
- Innovation emerges through **cross-sector collaboration** and shared challenges.
- **Living labs** and **urban innovation hubs** test and scale new digital and green solutions.
- Public–private partnerships (PPPs) accelerate technology adoption and investment.
- The ecosystem approach builds **local capacity** and supports continuous learning.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

From Sustainability Theory to Green Action

Sustainable Development: Meeting present needs without compromising future generations' ability to meet theirs (Brundtland Report, 1987).

The Green Transition translates sustainability into practical systemic change—clean energy, circular economy, and resource efficiency.

Central idea: decoupling economic growth from environmental degradation.

Governments and organizations adopt green strategies to achieve climate neutrality and inclusive prosperity.

Smart communities act as local engines of this global transformation.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Circular Economy in Communities

The **circular economy** replaces the *"take–make–dispose"* model with *"reuse–repair–recycle."*

Focuses on **resource efficiency**, **waste minimization**, and **product longevity.**

Encourages **local loops**—sharing, repairing, and reusing within communities.

Supports new business models such as **product-as-a-service** and **material recovery.**

Smart communities use **data and digital tools** to optimize circular flows (e.g., smart waste management).

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

The R in circular economy

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Building Sustainability into Every Design Decision

Ecodesign integrates environmental and social criteria into the design process.

Minimizes energy use, emissions, and material waste across a product's life cycle.

Encourages **innovation that aligns with circular principles** — durable, repairable, and recyclable products.

Supports both environmental performance and economic competitiveness.

Regulation example: EU Ecodesign Directive guiding sustainable product design.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Resilience in Urban Systems

Resilience is the capacity of a community to **absorb shocks**, **recover**, and **adapt** to future challenges.

Addresses risks from **climate change, economic crises, and social disruption.**

Builds on diversity, redundancy, and flexibility in urban systems.

Smart tools (e.g., sensors, early-warning dashboards) improve preparedness and response.

Resilience combines **physical robustness** with **social cohesion and governance capacity.**

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Case Study: Helsinki Smart Community Model

Helsinki, Finland, aims to be **carbon-neutral by 2030** while ensuring digital inclusion.

Uses **open data portals** for transparency and citizen-led innovation.

Employs **smart mobility solutions**—electric buses, integrated transport apps.

Circular economy pilots reduce construction and food waste.

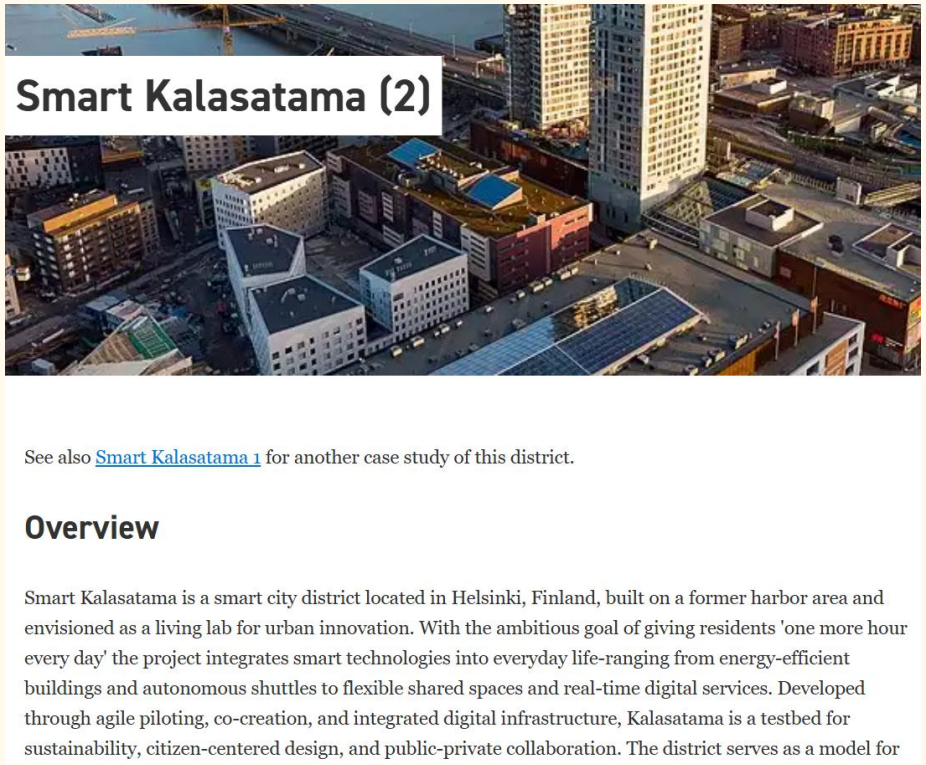
Strong emphasis on **citizen co-creation** through the *Helsinki Lab* and participatory budgeting.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Case study – Smart Kalasatama



- https://atlasofurbantech.org/cases/fin-helsinki-kalasatama-2
- https://www.computerweekly.com/feature/Helsinki-The-trailblazing-smart-city

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Uniting Technology, Ecology, and Society in Practice

True progress lies in **integrating digital innovation with sustainability planning**.

Smart and green strategies must be developed **together**, not sequentially.

Example synergies:

Smart grids → Renewable energy optimization.

Smart mobility → Lower emissions and better accessibility.

Digital twins → Eco-efficient urban planning.

Integration ensures that technology supports **environmental goals** and **social equity**.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Indicators of Success for Smart Communities

Common frameworks:

ISO 37122: Smart City Indicators.

UN SDGs: global sustainability metrics.

SCBoK: Smart City Body of Knowledge by Fitsilis et al.

Key dimensions: **Environment, Economy, Governance, Technology, People, Mobility.**

Transparent data reporting enhances accountability and learning.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Overcoming Obstacles to Smart–Sustainable Development

- **Data silos:** fragmented systems prevent integration and sharing.
- **Limited digital skills** among staff or citizens.
- **Funding and investment gaps** for long-term sustainability projects.
- **Regulatory or bureaucratic barriers** slowing innovation.
- **Lack of trust** in data use and privacy protection.
- Solutions: capacity building, partnerships, transparency, and co-creation.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Reflection Exercise: What Makes a Community Truly Smart?

- **Reflection prompts:**
  - Beyond technology, what social or cultural factors make a community “smart”?
  - How can sustainability and digital innovation reinforce each other?
  - What lessons from Helsinki or your local context stand out most?
  - In one sentence, define *“a sustainable smart community.”*

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Further reading / 1

- **Key Frameworks & Policy Documents**
  - European Commission (2023) – The European Green Deal https://commission.europa.eu/strategy/priorities-2019-2024/european-green-deal_en
  - United Nations (2015) – Sustainable Development Goals (SDG 11 & SDG 13) https://sdgs.un.org/goals
  - ISO 37122 (2019) – Indicators for Smart Cities (International Organization for Standardization)

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Further reading / 2

- **Academic sources**
  - Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., & Meijers, E. (2007). *Smart cities: Ranking of European medium-sized cities*. Vienna University of Technology.
  - Fitsilis, P. (2021). *Smart Cities Body of Knowledge (SCBoK).* https://www.researchgate.net/publication/355186850_Smart_Cities_Body_of_Knowledge
  - UN-Habitat (2022). *World Cities Report: Envisaging the Future of Cities.*
  - Savolainen, O. (2023). *5 ways the Helsinki Smart Region is building citizen-centric and sustainable cities.* https://govinsider.asia/intl-en/article/5-ways-the-helsinki-smart-region-is-building-citizen-centric-and-sustainable-cities-ossi-savolainen
- **Optional Exploration**
  - Atlas of Urban Tech: *Smart Kalasatama, Helsinki* https://atlasofurbantech.org/cases/fin-helsinki-kalasatama-2/

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Unit Completed - What's Next?

To consolidate your learning and reflect on the key concepts covered, please take a moment to complete this quiz.

Your feedback and results will help you track your progress and support continuous improvement of the training experience.

By completing this quiz, you will also become eligible to receive a certificate of successful training completion.

Click the link to begin the quiz!

Co-funded by the European Union

Panos Fitsilis bio page

University of Thessaly

fitsilis@uth.gr

UNIVERSITY OF THESSALY

- **Professor Dr. Panos Fitsilis** is a full Professor at Business Administration Dept. of the University of Thessaly, Greece., Director of Research Lab for "Management, Digital and Educational Skills" (MANDEIS) of UTH, and academic coordinator of the module "Software Design" at Hellenic Open University.
- He has extensive project management experience with the development and deployment of large IT systems and extensive management experience in various senior management positions. His research interests include Smart Cities, Smart Factories, Industry 5.0, Business Information Systems, Social Systems, Educational Technology, Software Project Management, etc.

Co-funded by the European Union

smarco

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

SMARCO

SMARt COmmunities Skills Development in Europe

www.smarco.eu

info@smarco.eu

We are social! Follow us on:

@smarcoproject

@smarcoproject

@smarcoproject

Co-funded by the European Union

smarco

Project 101186291 — SMARCO