Euro-CASE Annual Conference 2024
European Engineering for Sustainability: New Solutions for
Environmental, Urban and Health Systems
Budapest University of Technology and Economics
Budapest, 23 September 2024

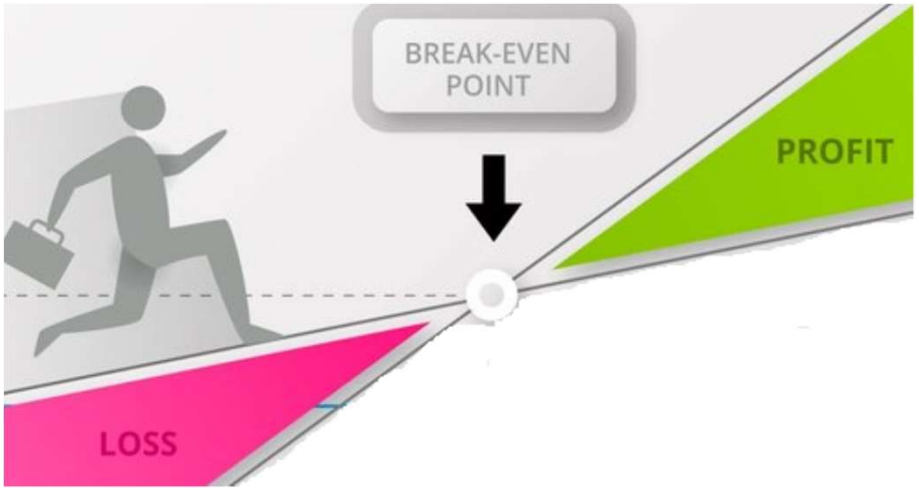
ENGINEERING SUSTAINABILITY INSPIRATION FOR SMARTER AND GREENER TRANSPORTATION SOLUTIONS

Prof. Dr hab. C. Eng. Janusz SZPYTKO
AGH University of Krakow,
UNESCO Chair for Science, Technology, and Engineering Education

We are in the process of evolution

laws of physics,
ethos,
changes,
dreams and vision,
ethos,

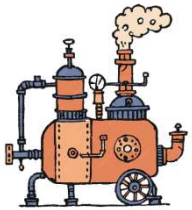
evolution



biology, cosmology, societies, knowledge, lifestyle, systems subject to natural selection,

freepik.com

Technical evolution



(01) age of steam and electricity;

(02) age of computer and Internet;

(03) period of globalization;

(04) period of information and the green environment;

freepik.com

The concept of sustainable development and resilience

(03) Resilience strategy concept;

(02) Agenda 2030 for Sustainable Development, UN, 2015;

(01) Our Common Future, UN, 1987;

(00) The only constant thing in life is change, by Heraclitus of Ephesus;

https://pl.wikipedia.org/wiki/Komisja_Brundtland
http://www.un.org.pl/files/170/Agenda2030PL_pl-5.pdf

freepik.com

Sustainable cities and communities as complex engineering system from transport engineering perspectives

Transport engineering

In November 2022, the world's population reached the 8 billion with approximately 55 percent of this population projected to be living in cities or urban areas. This urban trend is expected to rise to 70 percent by 2050.

Public transport is key for inclusive urban participation.

Since 2015 the global population without water, sanitation and hygiene services has decreased in rural but increased in urban (2022).

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.

UN: The sustainable development goals report 2024

Transport engineering evolution on the example of cities

Transport essential for growth in cities.

Observed existing state.

EU Mobility Strategy.

Intelligent transport engineering:
1. electronics, IT, transport technology;
2. data analysis in real time, connectivity, management;
3. technologies focused on SMART solutions;
4. sustainable transport engineering integration;

People and goods transportation solutions:
1. clean mobility;
2. renewable energy;
3. autonomous shared vehicles;
4. intelligent transport infrastructure;
5. mobility as a service;

Self-Monitoring, Analysis and Reporting Technologies

Mobility Strategy. A fundamental transport transformation: Commission presents its plan for green, smart and affordable mobility. Sustainable and Smart Mobility Strategy – putting European transport on track for the future. EC, 2020, COM/2020/789 final.

freepik.com

Digital Twin for transport engineering and evolution

Multi-scale simultaneous acquisition of data from sensors (01) (2002 NASA);

Digital representation of the physical world (02) in a model with time, space, logic attributes for identification, tracking and monitoring (2022, NASA and others).

Digital twin makes it possible
1. virtual-real mapping;
2. real-time synchronization;
3. symbiotic evolution;
4. closed-loop optimization;

For the operation of a digital twin, the following are necessary:
1. Data acquisition and transmission technology in real time.
2. Lifecycle data management.
3. High-performance computing.
4. Virtual modelling and simulation technology.
5. Artificial intelligence techniques.
6. Other expected key technologies.

freepik.com

link.springer.com/article/10.1186/s42492-023-00137-4#Tab1

Techniques related with the digital twin models

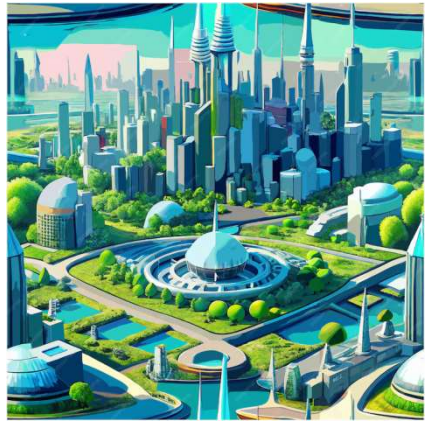
1. Computer-Aided Technology;
2. Virtual Simulation Technology;
3. Extended Reality Technology;
4. An online virtual environment of the Metaverse type;

freepik.com

link.springer.com/article/10.1186/s42492-023-00137-4#Tab1

Cities of the future with smart transport solutions

Cities of the future should be as:
energy self-sufficient;
zero-emission as possible;
function in a closed loop;
offer acceptable costs of living;



freepik.com

Complex and dynamic transport processes concern e.g.:
people and cargo;
supply systems with media;
agriculture business;
environment;
ensuring resistance to environmental threats

gazetalubuska.pl/tag/powodz; 30.09.2023, 3:51

Possible scenarios for future cities with modern transportation system

Scenario 1. Cities compete for residents; multi-functional buildings; online activities; water for plants on the building; autonomous vehicles; rest in virtual space;

Scenario 2. Population concentration; zero-emission buildings; water under strict control; zero-emission vehicles; rest if we have time;

Scenario 3. Significant climate change; energy and water prices are high; buildings with a zero carbon footprint; water that cools and heats; rail vehicles; life in cities very difficult;

Scenario 4. Metaverse; virtual worlds in which users represented by avatars interact, usually in 3D and focused on social and economic connection.

Scenario ..... ?????????

Polskie Miasta Przyszłości 2050, Saint-Gobain, 2022, saint-gobain.pl freepik.com

Jun 7, 2023, plug and play. The City of the Future: This is How Cities are Becoming Smart.; en.wikipedia.org/wiki/Metaverse; Others resources;

Urban transportation of the future

What will the city of the future look like, especially with its transport infrastructure?

Possible scenarios.

freepik.com

Urban transportation of the future

What will the city of the future look like, especially with its transport infrastructure?

Possible scenarios.

sustainable development growth concept + digital twin model of system + engineering vision, wise and practice = smart cities with grid transportation system

freepik.com

Thank for your kindly attention

Wybrane

W zakresie