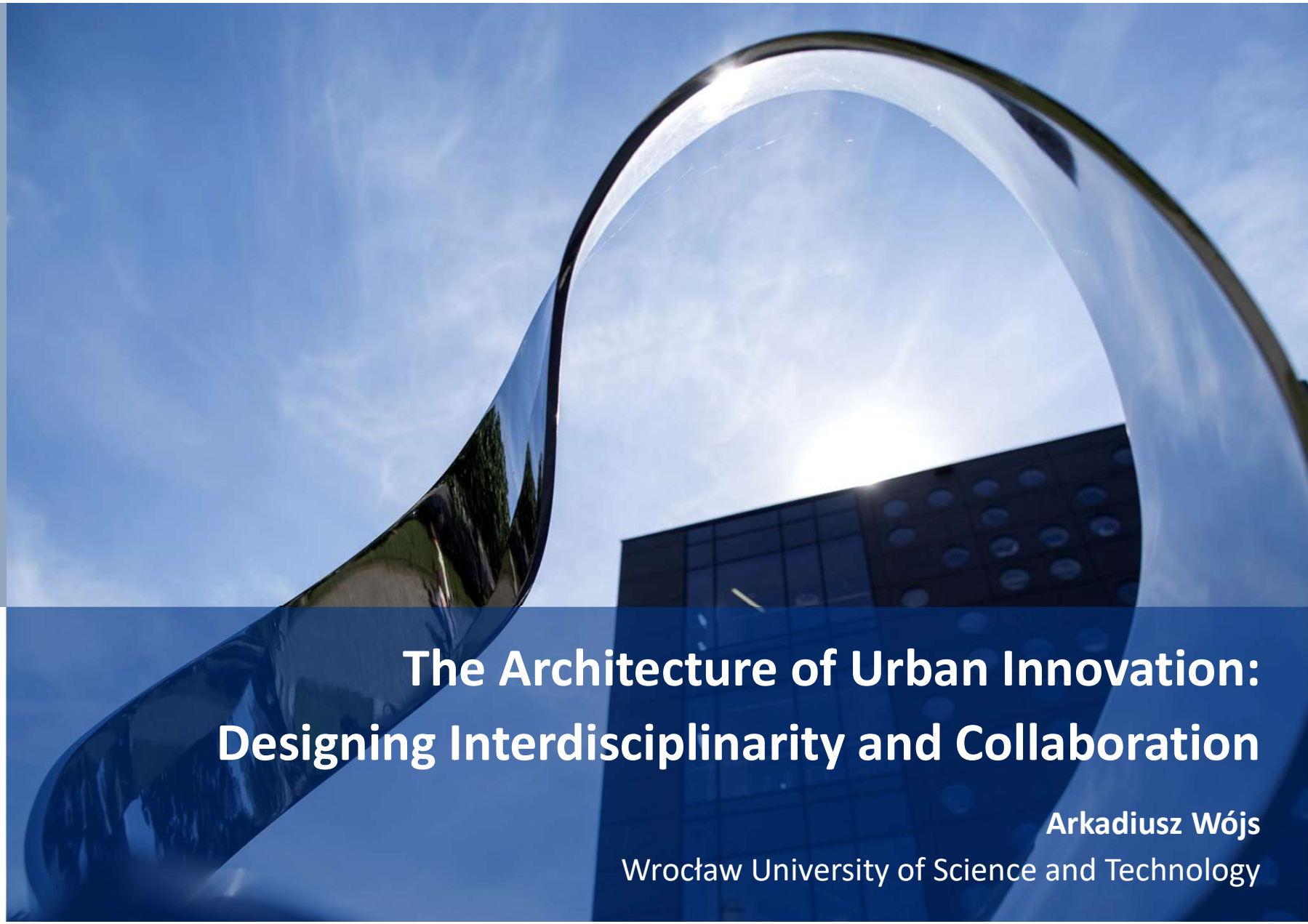

Wrocław University of Science and Technology

The Architecture of Urban Innovation: Designing Interdisciplinarity and Collaboration

Arkadiusz Wójs

Wrocław University of Science and Technology


WROC♥LOVE

LOCATION

Wrocław University of Science and Technology

WROCŁAW: CITY OF ACADEMIA

28
universities

> 100 000
students

> 25 000
graduates each year

Major universities:

- **Wroclaw Tech** (24 000 students = 24%)
- Wrocław University (23%)
- Wrocław University of Economics and Business (10%)
- Wrocław University of Environmental and Life Sciences (8%)
- Wrocław Medical University (6%)

Academia Europaea 19 88 The Academy of Europe Wrocław Knowledge Hub

Academia Europaea:

- 5 000 elected members: most eminent (mostly) European scholars
- 80+ Nobel Prize winners

Wrocław Knowledge Hub of **Academia Europaea:**

- operated by Wroclaw Tech and headed by Wroclaw Tech's Rector

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WROCŁAW: CITY OF (HI-TECH) BUSINESS

IT & ICT (bss)

IBM, Nokia, Atos, Volvo IT, Opera Software, Tieto, Dolby, Capgemini, Unit4, GlobalLogic

Chemical & pharmaceutical

3M, Hasco-Lek, US Pharmacia, Herbapol, MacoPharma, Fresenius

Modern business services (bss)

HP, Credit Suisse, BNY Mellon, UBS, Qiagen, Google, McKinsey

Mechanical engineering

UTC, Bombardier, Sauer-Danfoss, ABB, GE, Alstom, Balluff, Fanuc, XEOS

Automotive

Wabco, Volvo, Toyota, PGW, Autoliv, BASF, Daimler

White goods

Whirlpool, LG, Electrolux, BSH

center for academia-business cooperation

350k
employees in manufacturing and construction sector

50k
employees in modern services sector

60%
citizens in working age

Wrocław University of Science and Technology

GREAT PLACE TO LIVE

- best regional airport in Poland (direct flights to most European capitals)
- 40% people from other regions
- cultural life *(European Capital of Culture 2016, 33 museums, 19 theaters, National Forum of Music, Opera House)*
- Best European Destination 2018

& WORK

- 200+ companies in modern services
- 200+ startups (highest concentration in Poland)
- 100+ R&D and IT centers (IT, engineering, chemistry, pharma, biotech, nanotech)
- 60k+ ↑ foreign employees
- 3rd fastest growing city in the EU (CEE Investment Report 2019)

Wrocław University of Science and Technology

URBAN PROBLEMS & CHALLENGES

1. Flood risk and urban flooding

- Wrocław lies on the Oder River;
  despite major flood protection works, up to 1/3 of the city area is at risk of flooding.
- Extreme rainfall events and pluvial floods are expected to intensify with climate change.
- Sealed surfaces and insufficient green infrastructure increase vulnerability.

2. Algal blooms and water poisoning in the Oder River

- In 2022, toxic *golden algae* caused mass die-offs in the Oder,
  raising concerns about long-term water quality and ecosystem resilience.
- Likely contributing factors: low water levels and high temperatures (climate change), industrial discharges raising salinity, and nutrient runoff from agriculture.
- These events show the fragility of river ecosystems and the risks for biodiversity, public health, and regional water management.

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WROCŁAW'S PROBLEMS & CHALLENGES

3. Air quality and pollution

- Seasonal air pollution from traffic, industry, and residential heating affects health.
- Particulate matter and NO_2 levels periodically exceed recommended values.

4. Heat, drought, and climate change impacts

- Increasing frequency of heat waves and droughts worsens the urban heat island effect.
- Many districts have limited green spaces, intensifying discomfort and health risks.

5. Transport bottlenecks, congestion, and public transport challenges

- Traffic jams are consistently identified as one of Wrocław's top urban problems.
- Public transport struggles to compete with private car use (speed, reliability, comfort).
- Urban sprawl and sub-urbanisation put additional strain on transport infrastructure.

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WROCŁAW'S PROBLEMS & CHALLENGES

6. Urban sprawl and land-use pressures

- Rapid suburban development on greenfields contributes to soil sealing, increased flood risk, and traffic growth.
- Infrastructure and public services often lag behind new housing developments.
- Sprawl undermines efficient urban planning and increases environmental pressure.

7. Social inequalities and long-term crises

- Rising housing costs and unequal access to services create social tensions.
- The city must manage multiple overlapping challenges:
  post-pandemic effects, climate risks, integration of migrants, and economic pressures.

WROCŁAW UNIVERSITY OF SCIENCE & TECHNOLOGY

Wrocław
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TEACHING IN NUMBERS

24 000
students

1 500
international students

600
Erasmus+ international agreements

2 400
permanent academic staff

50
BSc/Eng fields of studies

50
MSc/Eng fields of studies

6
BSc/Eng programmes in English

50
MSc/Eng programmes in English

14 FACULTIES

- **Architecture**
- **Civil Engineering**
- **Chemistry** (incl. Chemical Engineering)
- **Information & Communication Technology**
- **Electrical Engineering**
- **Geoengineering, Mining and Geology**
- **Environmental Engineering**
- **Management**
- **Mechanical and Power Engineering**
- **Mechanical Engineering**
- **Fundamental Problems of Technology** (incl. Physics & Biomedical Engineering)
- **Electronics, Photonics and Microsystems**
- **Pure & Applied Mathematics**
- **Medicine**

Wrocław University of Science and Technology

- Doctoral School
- Academic High School
- Multiple Interdisciplinary Research Centers
- Networking and Supercomputing Center
- Entrepreneurship Incubator, Tech Transfer Centre, Business & Innovation Centre

3 BRANCHES

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WROCŁAW TECH STRATEGY 2023-2030

MISSION

Through research, teaching, and collaboration we inspire and support the development of individuals who, based on knowledge, ethical standards and displaying sensitivity to the needs of society and global challenges, shape the future with courage and responsibility.

VISION

As a European comprehensive technical university affirming freedom, truth, curiosity, and joy of science, we conduct interdisciplinary education and research in response to the aspirations and challenges of the society and economy.

VALUES

- *Excellence*
- *Collaboration*
- *Openness*

Wrocław University of Science and Technology

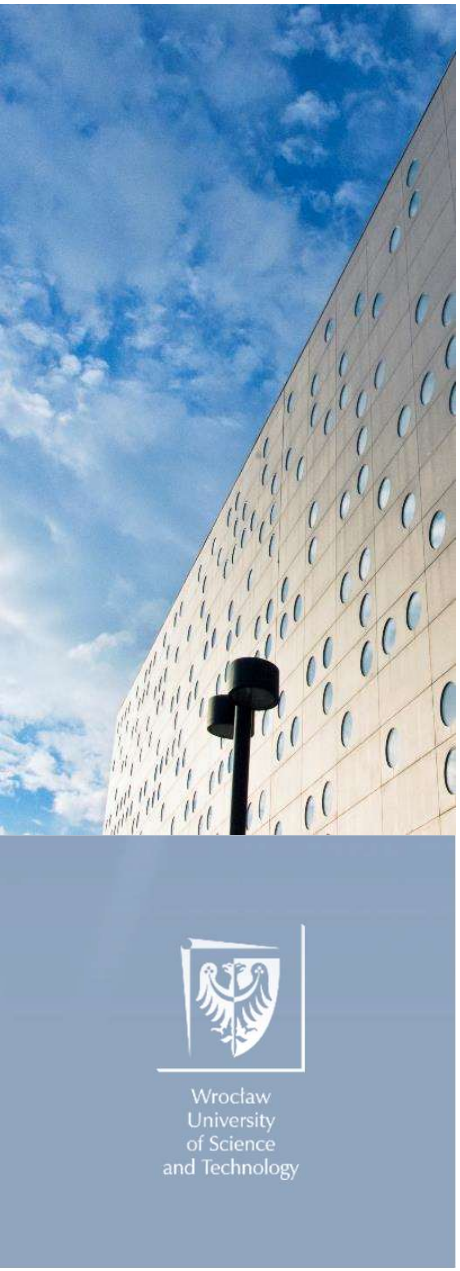
WROCŁAW TECH IN „UNITE!”

In 2022 Wrocław Tech joined the European university alliance „**Unite!**” (*University Network for Innovation, Technology and Engineering*):

1. **INP / Université Grenoble Alpes** (France) [ARWU 2025: #155 worldwide]
2. **Universidade de Lisboa** (Portugal) [#232]
3. **KTH Royal Institute of Technology** (Sweden) [#235]
4. **Technische Universität Darmstadt** (Germany) [#400]
5. **Aalto University** (Finland) [#437]
6. **Technische Universität Graz** (Austria) [#644]
7. **Politecnico di Torino** (Italy) [#671]
8. **Universitat Politècnica de Catalunya** (Spain) [#782]
9. **Wrocław Tech** (Poland) [#968]

Main goal: engineering education for modern world

unite! University Network for Innovation, Technology and Engineering



ACCREDITATION

EUROPEAN CONSORTIUM FOR MATHEMATICS IN INDUSTRY

Evaluated by
IEP INSTITUTIONAL EVALUATION PROGRAMME
www.iep-qaa.org

eua EUROPEAN UNIVERSITY ASSOCIATION

ENAEE European Network for Accreditation of Engineering Education

European Chemistry Thematic Network ECTN
EUROLABEL®

ies INTERNATIONAL EDUCATION SOCIETY LONDON

ICI International Certification Institute

RESEARCH & INNOVATION IN NUMBERS

180
new research grants/year
for **32M** EUR

6 000
registered inventions

14
scientific disciplines in
4 fields of science

38 000
JCR indexed publications
(~2000/year)

53
scientists on Stanford TOP 2% list of world's most influential researchers

2 600
patents

800+
PhD students

65
highly cited papers
(Web of Science)

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Wrocław University of Science and Technology

14 RESEARCH DISCIPLINES (IN 4 FIELDS)

ENGINEERING AND TECHNOLOGY:

- Architecture and urban planning
- Automation, electronics, electrical engineering and space technologies
- Biomedical engineering
- Chemical engineering
- Civil engineering, geodesy and transport
- Environmental engineering, mining, and energy
- Information and communication technology
- Materials engineering
- Mechanical engineering

NATURAL SCIENCES:

- Chemical sciences
- Mathematics
- Physical sciences

SOCIAL SCIENCES:

- Management and quality studies

MEDICAL AND HEALTH SCIENCES:

- Medical sciences

PRIORITY RESEARCH AREAS

1. Information Technology, Data Science and Artificial Intelligence
2. Innovative Materials and Advanced Manufacturing
3. **Sustainable Living Environment**
4. **Smart Cities and Future Society**
5. Health and Medical Technologies
6. Extreme Technologies
7. Basic Research for Technology and Innovation

Wrocław University of Science and Technology

All priority research areas are interdisciplinary and cross the structure of faculties.

They collectively represent every research topic in which Wrocław Tech either currently plays or aims to assume a leading role in Poland and the global impact.

SUSTAINABLE LIVING ENVIRONMENT (3/7)

Resource management, energy sources (conventional, renewable, and nuclear energy), energy system transformation, human- and environment-friendly technologies (e.g., electromobility), protection of climate as well as natural and cultural environment, water management, identification of environmental hazards and response to natural disasters, as well as all aspects of sustainable development, circular economy, and social acceptance of changes.

- Centre for Sustainable Development and Climate Protection
- Centre for Advanced Raw Materials and Energy Technologies
- Research Centre for Sustainable Built Environment (RoSE)

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SMART CITIES AND FUTURE SOCIETY (4/7)

Holistic design and construction of human-friendly buildings, estates, and cities using modern technologies, application of innovative and safe materials, broadly understood communication and mobility – including intelligent and autonomous transport systems, universal design, prevention and counteraction of social, energy and digital exclusion, research on human-machine interactions, as well as analysis, prediction, and management of social and economic processes.

- Centre for Urban Innovation: Architecture, Engineering, Technology, Mobility

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RELEVANCE OF URBAN INNOVATION

Cities are central to **Europe's climate neutrality goals**,

Urban innovation requires **more than engineering**

— also social sciences, policy, design, AI, energy, health, mobility, etc.

Urban innovation demands **new architectures**

— not just in concrete, but in structure of universities, knowledge, and partnerships.

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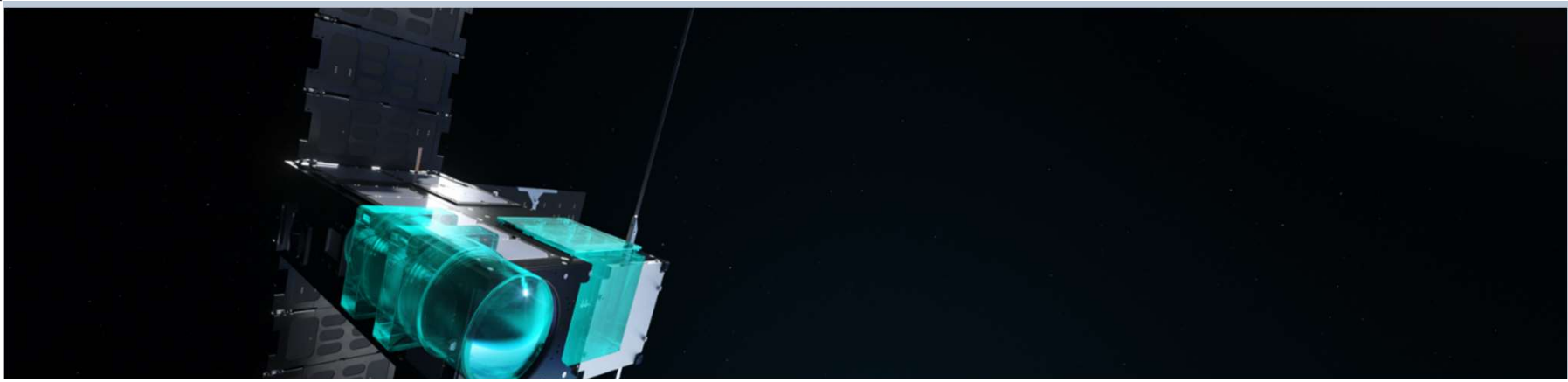

RELEVANCE OF URBAN INNOVATION

Urban areas as **innovation laboratories** for climate, mobility, energy, and inclusion.

Inadequacy of **traditional disciplinary silos**.

Need for universities acting as **platforms for innovation** (beyond providing knowledge).

Importance of **systems thinking** (city & university as systems) and **multi-actor ecosystems**.

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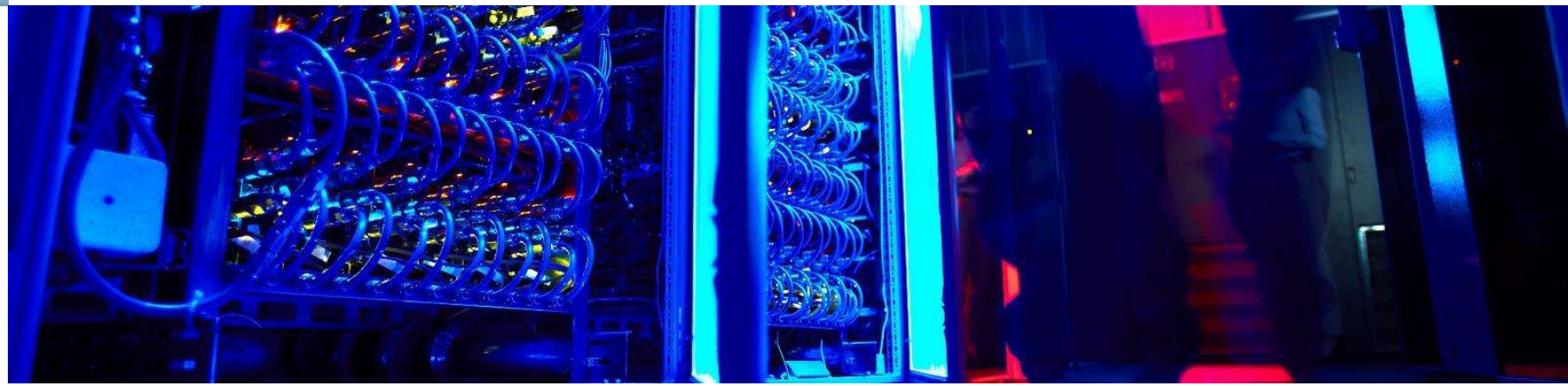

WROCŁAW TECH STRATEGY 2023-2030

Inter- & Multi-Disciplinarity – interaction of four pillars (SCI, ENG, SOC, MED)
for major challenges of society and economy
(interdisciplinary research centers)

Internationalization – European Alliance „Unite!”, partnerships & projects, Academia Europaea

Innovation Ecosystem – Academic Entrepreneurship Incubator, Technology Transfer Centre,
Business & Innovation Centre, Student Innovation Campus*
(partnerships with business, local government, city authorities, city institutions)

Impact, Excellence and **Social Responsibility**

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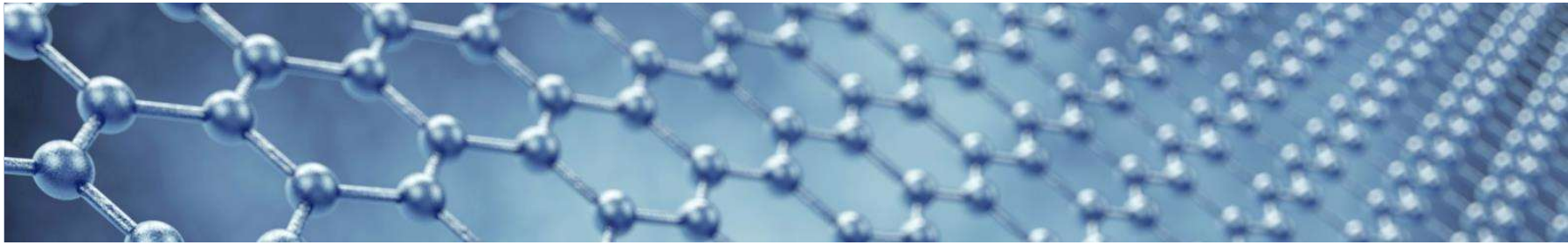

FOSTERING INTER-DISCIPLINARITY

New faculties & departments: Science & Engineering → Social Science, Humanities, Life & Health

Academia Iuvenum (young PhDs) – time, money, exposure, interaction, training of researchers

Academia Professorum Iuniorum (young DSc) – money, exposure, interaction, training of leaders

Research centers – interdisciplinary topics & teams, alignment with Research Priority Areas

Doctoral School – in English, growing & expanding (transition to young researchers & young teams)

Funding/rewarding programs – promoting new, young & excellent

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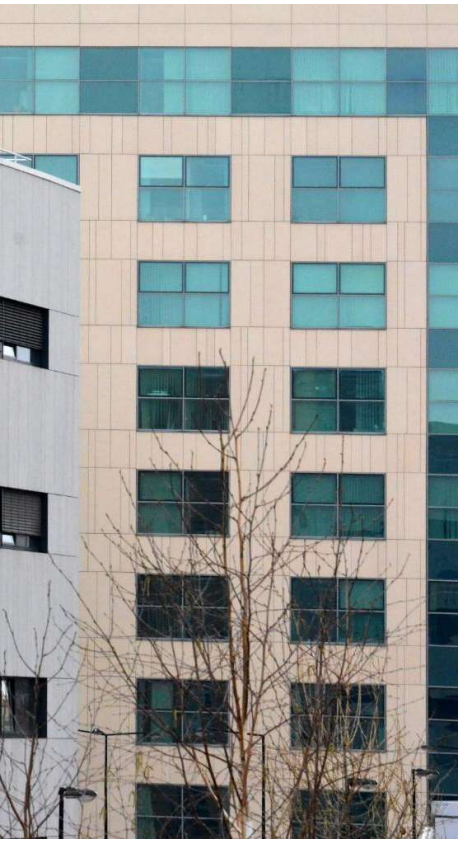

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

1. Architecture and Urban Planning

- Planning sustainable, multifunctional, and resilient urban structures.
- Designing sustainable, functional, and aesthetic built environments.
- Shaping accessible and sustainable habitats.
- Integrated design processes.
- Inclusive, self-sufficient, adaptive, participatory, multifunctional architecture (including with features of resilience and civil protection).
- Protection of cultural and natural heritage, including conservation, adaptation, and revitalization of the existing urban fabric.
- Spatial, social, and environmental relations between urban, suburban, and rural areas.
- Actions to improve housing and spatial–social conditions in developing countries.

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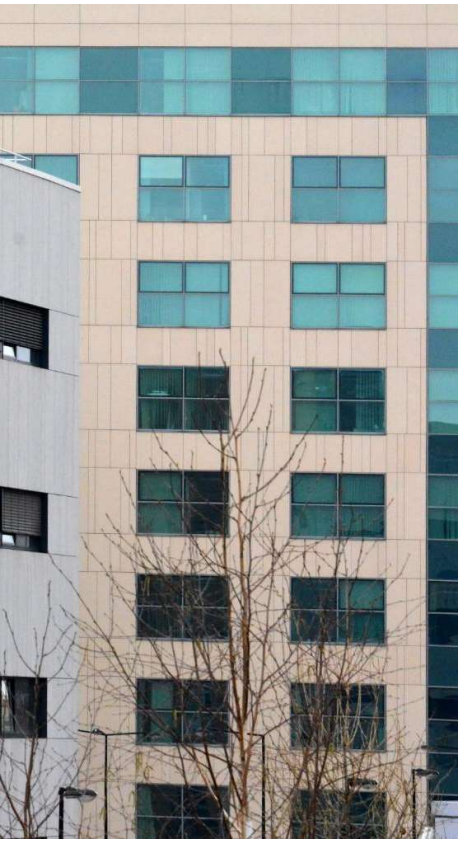

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

2. Civil Engineering and Advanced Materials

- Application of innovative materials and technologies.
- Design and construction of smart buildings.
- Safety and efficiency of construction processes, structural safety, and building standards.
- Life cycle of buildings and the use of renewable materials.
- Decarbonization and circular economy in the construction sector.
- BIM/geoBIM models and design coordination.
- Simulations of urban phenomena.
- Modern CDE (Common Data Environment) management platforms

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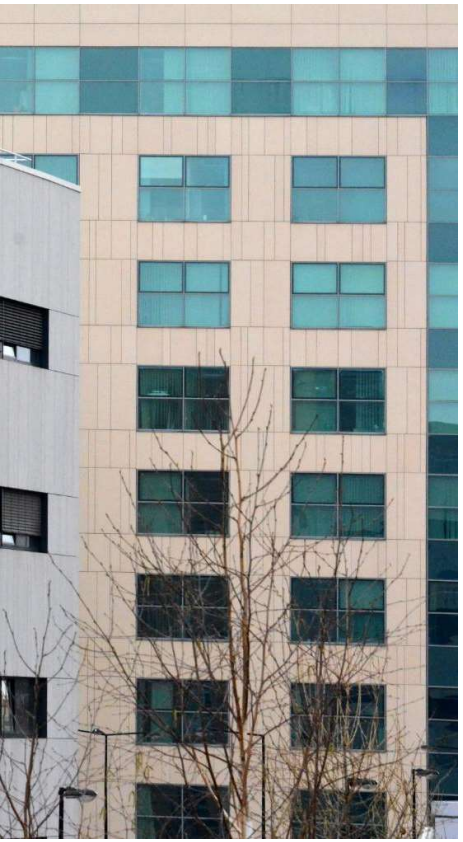

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

3. Urban Transport and Mobility

- Intelligent and autonomous transport systems.
- Zero- and low-emission transport.
- Accessible and safe public transport.
- Public transport solutions and Mobility-as-a-Service.
- Infrastructure for cyclists, alternative transport, and pedestrians.
- Transport policy, incl. park-and-ride systems, shared mobility, traffic-calmed, car-free zones.

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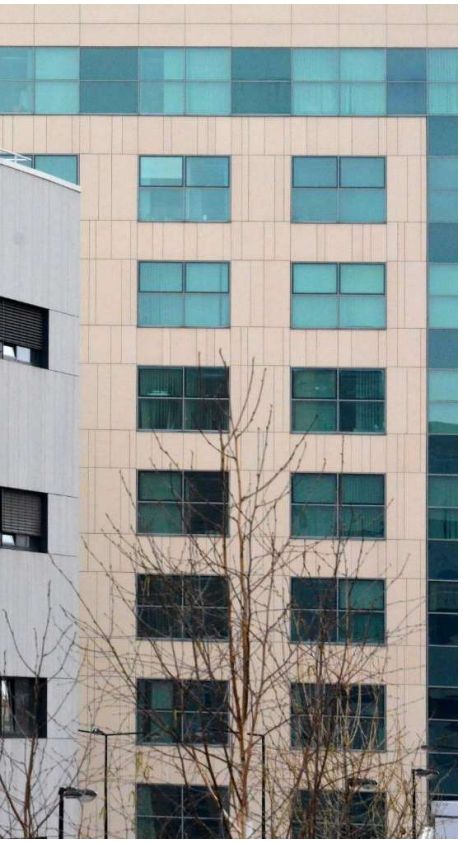

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

4. Information and Communication Technologies

- Development of smart city systems.
- Big Data and data analytics in city management.
- Cybersecurity and information-communication infrastructure.
- Digital twins of cities and geospatial technologies.
- E-services.
- IoT platforms.

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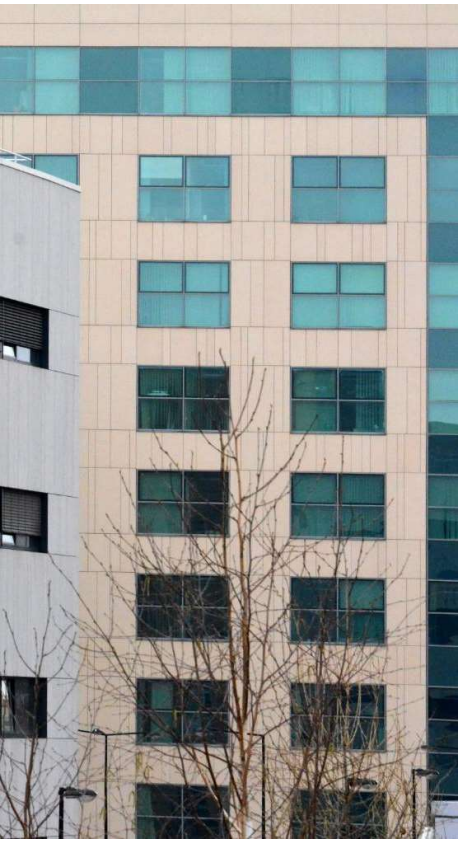

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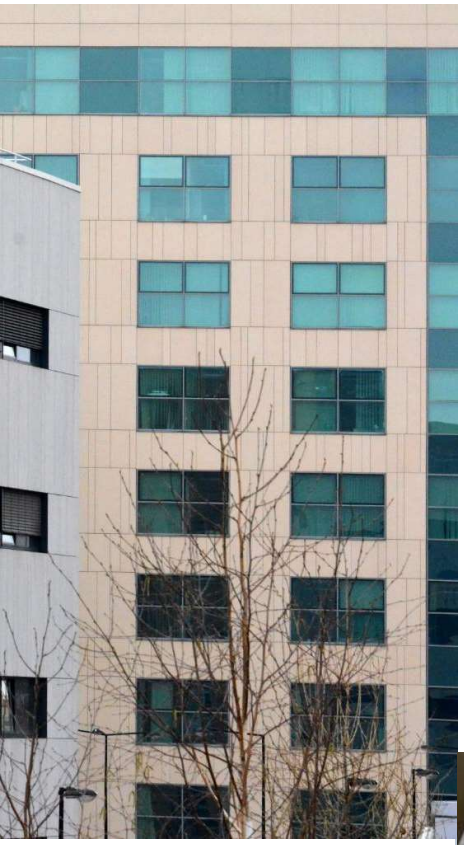
URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

5. Energy and Ecology

- Management of water resources and green areas; climate change adaptation.
- Management of critical infrastructure (including water, sewage, communications, energy).
- Reliable, secure energy supply for urban areas.
- Power infrastructure for the development of electromobility.
- Optimization of electricity use in public utility buildings.
- CO_2 and air pollution reduction strategies, climate neutrality, mitigation of urban heat islands, and microclimate regulation.
- Renewable energy.
- Thermal modernization and energy efficiency of buildings and systems.
- Prevention of energy poverty.
- Circular economy; resource recovery; waste management.



URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

6. River Ecosystems and Water Management

- Research on the interactions between rivers and the urban ecosystem.
- Protection against flooding, pollution, and ecological disasters.
- Integration of rivers into urban space.
- Adaptation of hydrotechnical infrastructure to river renaturation processes.

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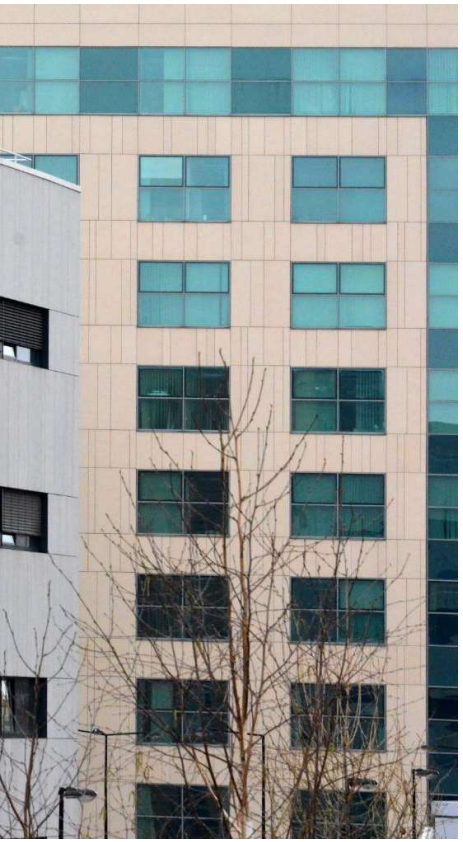

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

7. Quality of Urban Life

- Urban environmental parameters (noise and acoustics, light pollution).
- Electromagnetic pollution (including around energy and telecommunication facilities).
- Climate control (natural ventilation of cities, counteracting air pollution and atmospheric emissions).
- Designing spaces to reduce thermal stress risks.
- Designing resident-friendly spaces (including inclusive green areas and public spaces).
- Access to urban services and social infrastructure.
- Safety of residents and material goods.
- Social education. Spaces, architecture, and innovation fostering integration and counteracting exclusion.

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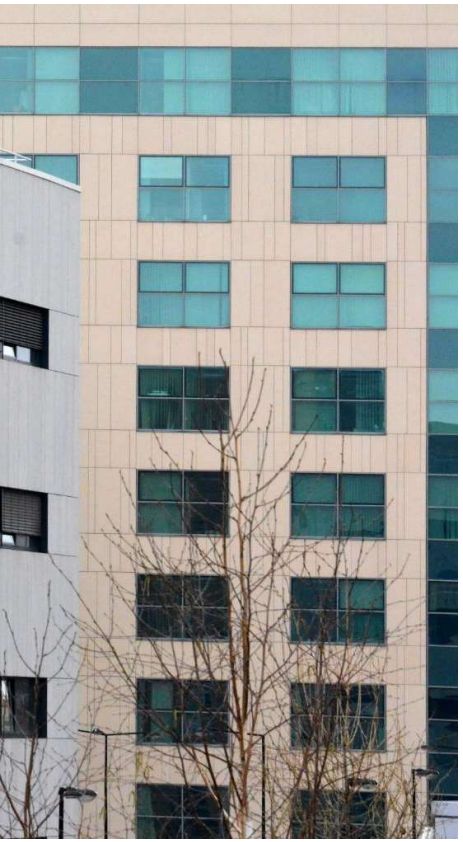

URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

8. Urban Policy and Governance

- Policies supporting well-being, innovation, and development.
- Engagement of local authorities, enterprises, and citizens in city management and shaping development directions (methods of social participation).
- Democratization of urban spaces.
- Initiatives for building local communities and social integration.
- Raising public awareness of sustainable development.
- Strategic planning and crisis management; early warning systems.

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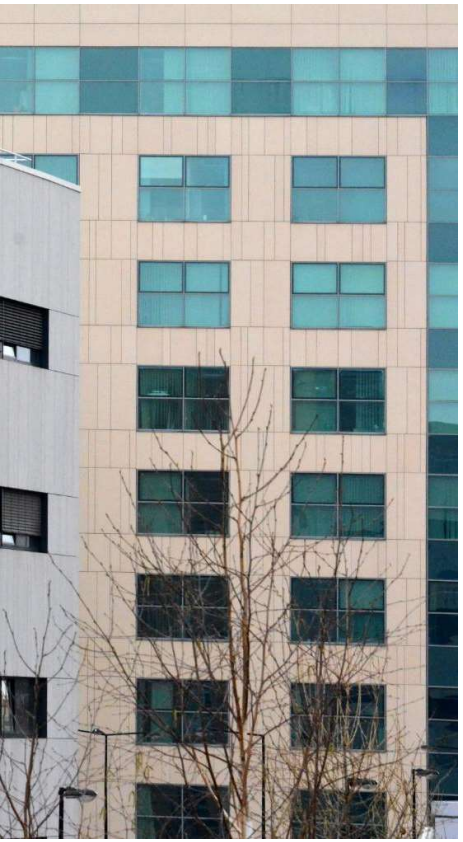

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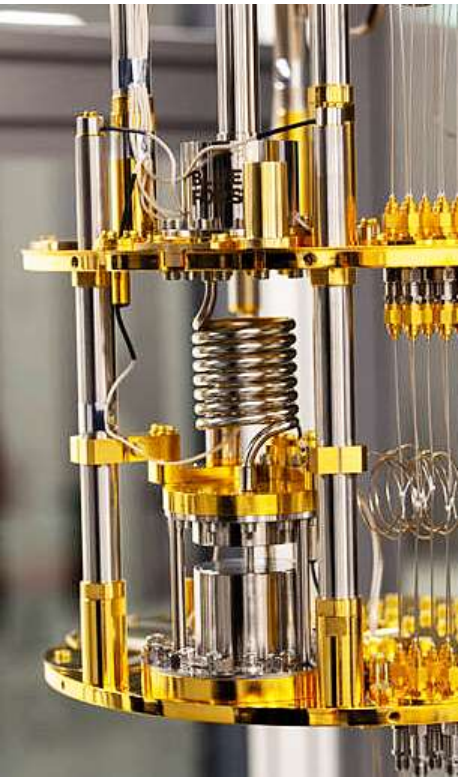
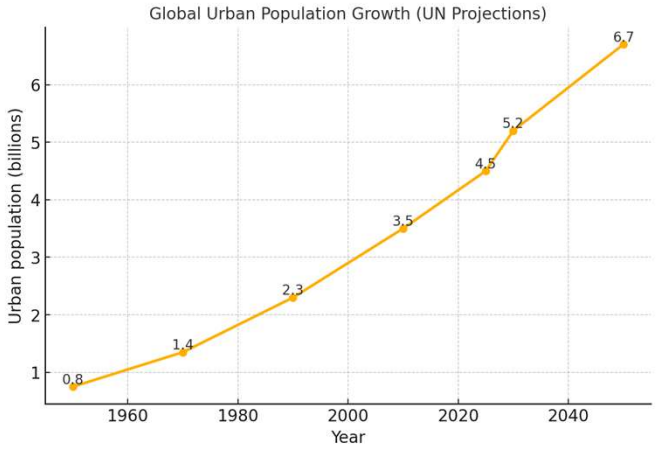
URBAN INNOVATION CENTRE:
ARCHITECTURE, ENGINEERING, TECHNOLOGY, MOBILITY

9. Urban Models Supporting Sustainability and Innovation

- Metropolitan city – integration of urban and suburban areas.
- The 15-minute city – accessibility of needs within walking or cycling distance.
- Smart city – use of technology in managing urban resources, mobility, safety, quality of life.
- Blue-green city – integration of natural and water elements.
- Climate-friendly city – strategies for climate change adaptation.
- Resilient city – strategies for coping with challenges (climate change, natural disasters, social crises) and building social capital.
- Creative city – the role of culture, art, and innovation in urban development.
- Inclusive city – accessibility of services and infrastructure for all social groups, including people with disabilities; universal design.
- Regenerative city – regeneration & restoration of built, social and natural environment.



FINAL MESSAGE



Cities are increasingly central to society and the economy.

They continue to grow:
4 billion urban residents in 2018 → 7 billion by 2050 (UN).

Cities face serious and pressing challenges.

While rapid urban growth will mostly occur outside Europe, cities like Wrocław already experience these problems today, reflecting global processes at a smaller scale.

These challenges are complex, interdisciplinary, and demand both technologies and ideas.

Modern technological universities have a responsibility to address these challenges.

To be effective, tech universities must go beyond mere engineering.

Interdisciplinarity and collaboration – internal and external – are essential.

Through structured interdisciplinarity and cooperation,
European universities of technology can reshape themselves — and in turn, our cities.

Wrocław University of Science and Technology

Wrocław University of Science and Technology

CONTACT US

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