SMART DATA OFFICER FOR SMART CITIES
CURRICULUM
CDOA – Academia for Smart City Chief Data Officers

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Become the Next Generation of Smart City Data Leaders

Cities are changing fast. Public transport, energy systems, climate adaptation, housing, public services and citizen participation are increasingly shaped by data, artificial intelligence and digital technologies. But technology alone is not enough. Modern cities need people who can understand data, interpret urban challenges, work with stakeholders and support responsible, evidence-based decisions.

This is where **CDOA – Academia for Smart City Chief Data Officers** comes in. CDOA is an international Erasmus+ project created to prepare students, young professionals and future urban leaders for one of the most important emerging roles in smart city governance: the **Smart Data Officer / Chief Data Officer for cities**. The project connects universities, city experts, educational organisations and practitioners to develop a modern learning pathway focused on data-driven urban transformation.

What should you do next?

We invite you to take a closer look at the proposed structure of the CDOA training programme. Review the modules, learning topics and practical components to see how the programme connects urban governance, data, AI, GIS, smart city technologies and leadership skills.

Your opinion matters. After reviewing the programme, please complete a short evaluation survey (**the link to the survey**). Your feedback will help us improve the curriculum, make it more useful for students and ensure that the final training offer responds to real learning needs, career expectations and the challenges of modern cities.

The survey is short, but your input is highly valuable. By sharing your perspective, you are helping us shape a programme that can better prepare future smart city professionals.

CDOA is not only a training programme. It is an invitation to take part in the future of urban transformation. Review the programme, share your feedback, and help us design learning that matters.

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ADVANCED TRAINING PROGRAMME
SMART DATA OFFICER FOR SMART CITIES

Integrated Competencies for Urban Data Governance, AI-Supported Decision-Making and Digital Transformation

TARGET AUDIENCE

Primary Educational Audience

- Master's and postgraduate students in:
  - urban studies,
  - public administration,
  - smart city governance,
  - spatial planning,
  - GIS and urban analytics,
  - public policy,
  - sustainability and digital transformation
- Lifelong learners and early-career professionals seeking interdisciplinary competences in data-driven urban governance
- Participants interested in emerging professional roles related to Smart City and Chief Data Officer functions

Professional and Practice-Oriented Audience

- Municipal Chief Data Officers and Smart City Coordinators
- Public administration managers responsible for digital transformation
- Urban planners and mobility specialists
- GIS and urban analytics practitioners
- Smart city project managers
- Public-sector ICT and innovation teams
- Utility and infrastructure managers
- Regional and metropolitan governance institutions
- Data governance and interoperability officers
- Public-sector professionals transitioning into data-driven governance roles

The Smart Data Officer for Smart Cities programme is designed primarily for learners and professionals seeking interdisciplinary competences at the intersection of urban governance, digital transformation, data analytics and sustainable urban development. Developed within the framework of the Erasmus+ Higher Education programme, the curriculum responds to the growing demand for new professional profiles capable of operating in increasingly complex urban and institutional environments shaped by digitalisation, AI-supported

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governance and data-driven decision-making. The programme is particularly addressed to graduate students, postgraduate learners, lifelong learners and early-career professionals interested in smart city governance, urban innovation, public-sector transformation and applied urban analytics. It is also suitable for professionals already working in municipalities, public institutions, NGOs, urban consultancies and technology-oriented organisations who wish to expand their competences through a structured higher-education learning environment integrating academic knowledge with practical application.

The programme reflects the interdisciplinary character of contemporary urban challenges. Rather than focusing exclusively on technical or administrative skills, it combines perspectives from governance, data analytics, AI, GIS, sustainability, organisational transformation and stakeholder coordination. This responds directly to the needs identified during the project preparation phase, which revealed substantial gaps in interdisciplinary education related to smart city governance and urban data management. Existing educational offers were frequently described as fragmented, overly technical or disconnected from the realities of urban governance and institutional implementation. The CDOA curriculum therefore adopts a practice-oriented but academically grounded approach based on project-based learning, real-world case studies, interdisciplinary collaboration and cooperation with municipalities and external stakeholders. In line with the project objectives, the programme aims not only to provide technical knowledge, but also to prepare participants to critically understand the societal, organisational and governance dimensions of digital transformation in cities.

WHY THIS PROGRAMME

Cities increasingly rely on data-intensive systems to manage mobility, infrastructure, public services, environmental monitoring and strategic planning. At the same time, the growing availability of urban data does not automatically translate into better governance or more effective public decision-making. In many municipalities, data remains fragmented across departments and institutions, analytical capacities are uneven, and digital tools are often implemented without sufficient organisational integration or long-term governance strategies.

These challenges are further intensified by the rapid expansion of AI-supported systems, real-time monitoring technologies and integrated urban platforms. Public institutions are expected not only to adopt new technologies, but also to understand how to govern them responsibly, interpret analytical outputs critically and ensure that digital transformation contributes to broader public value and sustainable urban development.

The programme was developed in response to these challenges and to the growing need for professionals capable of operating across institutional, analytical and technological domains. The role of the Smart Data Officer reflects this shift. It represents an emerging interdisciplinary profile positioned between urban governance, data management, analytics, digital infrastructure and organisational transformation. Rather than focusing exclusively on technical competences, the programme addresses the broader governance and implementation context in which urban data and AI systems operate.

The curriculum combines perspectives from:

- urban governance and public administration,
- urban analytics and evidence-based decision-making,
- AI-supported governance systems,
- GIS and smart city technologies,
- data governance and interoperability,
- organisational transformation,
- and stakeholder coordination.

The programme has been designed as a competence-based higher education learning pathway integrating academic knowledge with practical application. It responds directly to the needs identified during the CDOA project preparation phase, particularly those related to fragmented smart city education, insufficient interdisciplinary competences and the limited integration of governance, analytics and technological perspectives within existing educational offers. The curriculum also reflects the results of the competency gap analysis conducted among representatives of municipalities and public institutions, which highlighted strong demand for competences related to data interpretation, AI-supported policymaking, GIS, interoperability, organisational coordination and evidence-based governance.

Particular importance is attached to practical learning and applied problem-solving. The programme therefore combines theoretical foundations with:

- real municipal case studies,
- urban datasets,
- governance simulations,
- stakeholder workshops,
- AI-supported analytical exercises,
- and project-based learning developed in cooperation with external partners and municipalities.

PROGRAMME STRUCTURE

The curriculum is organised into six integrated modules progressing from the foundations of smart city governance towards advanced analytical, organisational and implementation-oriented competences. The structure reflects the logic of the Smart Data Officer role itself,

combining governance understanding, data governance, urban analytics, infrastructure awareness and organisational leadership within a single interdisciplinary framework.

The programme is composed of:

- thematic modules,
- microlearning capsules,
- applied workshops,
- case-study analysis,
- analytical exercises,
- and a final Urban Data Lab and capstone project.

The learning process combines academic content with practical application through the use of real governance scenarios, municipal datasets and interdisciplinary project work. Particular emphasis is placed on the integration of analytical reasoning, institutional understanding and implementation-oriented thinking.

PROGRAMME RATIONALE

The Advanced Training Programme – Smart Data Officer for Smart Cities constitutes one of the core educational outputs of the CDOA project. The curriculum operationalises the project's central assumption that successful smart city transformation depends not only on technological innovation, but equally on institutional capacity, governance quality and the ability to integrate data into public decision-making processes in a responsible and meaningful way.

The curriculum reflects the understanding that contemporary urban governance increasingly requires professionals capable of combining analytical, organisational and strategic competences. For this reason, the programme integrates:

- governance perspectives,
- urban data management,
- AI-supported analytics,
- GIS and infrastructure awareness,
- organisational transformation,
- and collaborative governance approaches

within a coherent interdisciplinary educational framework.

An important assumption underlying the programme is that AI and advanced analytics should support, rather than replace, institutional responsibility and human judgement in public governance. The curriculum therefore places strong emphasis on critical interpretation of analytical outputs, responsible AI, transparency, public legitimacy and ethical governance. At the same time, the programme adopts a strongly practice-oriented

approach based on real urban challenges and cooperation with municipalities and external stakeholders.

The programme is aligned with broader European frameworks and priorities related to:

- responsible digital transformation,
- smart city governance,
- sustainable urban development,
- AI governance,
- and digital competences in higher education.

Its structure also reflects the interdisciplinary and transdisciplinary orientation promoted within the CDOA project, particularly the integration of governance, technology, sustainability and public-sector innovation within higher education learning environments.

Teaching and Learning Methods

The module is delivered primarily through online and blended learning formats that combine asynchronous learning activities with live interactive sessions. The teaching approach has been designed to support flexible participation while maintaining a strong focus on collaboration, applied learning and continuous engagement with real urban governance challenges.

The pedagogical model is grounded in challenge-based and problem-oriented learning. Rather than relying on traditional lecture-centred delivery, the module encourages participants to work with practical governance situations, urban datasets, analytical tasks and interdisciplinary case studies reflecting the realities of contemporary smart city environments.

Learning activities are implemented through the CityDataHub and Data-Driven Learning Lab environments developed within the CDOA project. These digital learning spaces support practice-oriented and learner-centred higher education by combining analytical exercises, collaborative work and interactive governance scenarios within an accessible online environment.

The learning process combines:

- short thematic video units and microlearning capsules,
- interactive analytical exercises,
- applied urban case studies,
- governance and policy simulations,
- virtual stakeholder workshops,
- digital collaboration tasks,
- self-paced learning activities,
- peer-learning sessions,
- and guided reflection exercises.

Particular emphasis is placed on connecting analytical and technological knowledge with institutional realities and governance processes. Participants work with examples derived from realistic urban contexts, including operational management challenges, strategic planning situations and interdisciplinary governance problems requiring both

Formal Curriculum Matrix

Advanced Training Programme – Smart Data Officer for Smart Cities

Module	Main Competence Area	Core Topics	Knowledge Outcomes	Skills Outcomes	Competence / Behavioural Outcomes	Teaching & Learning Methods	Main Assessment Methods
Module 1 Urban Governance and Smart City Transformation	Urban governance, digital transformation and public value	Smart city concepts, governance systems, digital transition, stakeholder ecosystems, sustainability, public value, evidence-based governance	Understand the institutional and strategic dimensions of smart city transformation and data-driven urban governance; recognise European approaches to digital and sustainable urban development	Analyse governance structures and digital transformation processes; assess governance challenges and stakeholder relations within urban systems	Develop the ability to operate within interdisciplinary urban governance environments and critically engage with evidence-based transformation processes	Case-study analysis, governance simulations, stakeholder mapping, collaborative workshops, scenario-based learning	Governance analysis report, stakeholder mapping exercise, smart city strategy proposal, reflective portfolio

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Module 2 Urban Data Governance and Interoperability	Urban data governance and institutional integration	Urban data ecosystems, interoperability, metadata, open data, data quality, governance frameworks, GDPR, ethical data management	Understand principles of urban data governance, interoperability and responsible data management within complex urban systems	Analyse urban data flows, evaluate interoperability challenges, assess data quality and governance structures	Develop the capacity to support transparent, ethical and integrated approaches to urban data governance across institutional contexts	Data-flow mapping exercises, interoperability workshops, governance simulations, dataset analysis, collaborative problem-solving	Data governance framework, interoperability assessment report, open data analysis, legal and ethics case study
Module 3 AI, Urban Analytics and Decision Intelligence	Urban analytics and AI-supported governance	Urban analytics, dashboards, KPI systems, predictive analytics, AI-supported decision-making, explainability, algorithmic bias	Understand the role of analytics and AI in contemporary urban governance and evidence-based decision-making	Interpret urban datasets, evaluate analytical outputs, analyse indicators and assess AI-supported governance scenarios	Develop the ability to critically evaluate analytical and AI-supported recommendations in urban governance contexts	Dashboard analysis, analytical workshops, predictive simulations, AI governance scenarios, collaborative analytical exercises	KPI design exercise, urban analytics case study, predictive governance assessment, AI ethics analysis

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Module 4 Urban Data Infrastructure, GIS and Smart City Technologies	Urban digital infrastructure and spatial intelligence	GIS, IoT systems, digital twins, sensor networks, urban monitoring systems, cybersecurity, integrated platforms	Understand the technological foundations of smart city ecosystems and the role of spatial and operational data in urban governance	Analyse spatial datasets, assess infrastructure interdependencies and evaluate integrated urban technology systems	Develop the capacity to connect technological infrastructures with governance, sustainability and operational challenges in urban environments	GIS exercises, infrastructure simulations, platform analysis, cybersecurity workshops, applied technology case studies	GIS analysis task, infrastructure evaluation report, cybersecurity assessment, smart city technology case study
Module 5 Leadership, Organisational Transformation and Stakeholder Coordination	Organisational transformation and collaborative governance	Leadership, organisational change, collaborative governance, stakeholder engagement, communication, negotiation, organisational learning	Understand organisational dynamics and governance challenges related to digital and data-driven transformation processes	Analyse institutional barriers, facilitate stakeholder communication and assess governance coordination challenges	Develop interdisciplinary collaboration, communication and leadership competences relevant to complex governance environments	Leadership simulations, stakeholder workshops, negotiation exercises, collaborative governance scenarios, reflective learning activities	Organisational analysis, stakeholder engagement strategy, negotiation simulation, reflective leadership portfolio

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Module 6 Urban Data Lab and Capstone Project	Integrated application of interdisciplinary urban governance competences	Applied urban governance projects, urban datasets, analytical reasoning, implementation pathways, responsible AI, interdisciplinary problem-solving	Understand relationships between governance, analytics, infrastructure and organisational processes in real urban contexts	Develop evidence-based recommendations, integrate analytical and governance perspectives, communicate complex findings effectively	Apply interdisciplinary competences to complex urban governance challenges through collaborative and inquiry-based project work	Project-based learning, interdisciplinary teamwork, urban labs, supervised workshops, applied governance projects	Capstone project, analytical and governance report, implementation pathway proposal, project presentation and reflective portfolio

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Programme-Level Intended Learning Outcomes Matrix

Programme Intended Learning Outcomes (PILOs)	M1	M2	M3	M4	M5	M6
Analyse governance structures, smart city ecosystems and processes of urban transformation	●●●	●	●	●	●●	●●
Apply principles of urban data governance, interoperability and responsible data management	●	●●●	●●	●●	●	●●
Interpret urban datasets, indicators and analytical outputs in governance contexts	●	●●	●●●	●●	●	●●●
Critically evaluate AI-supported governance systems and their societal implications	●	●	●●●	●●	●●	●●
Analyse relationships between urban infrastructure, spatial intelligence and governance processes	●	●	●	●●●	●	●●
Collaborate effectively in interdisciplinary and multi-stakeholder urban governance environments	●●	●●	●	●	●●●	●●●
Evaluate organisational and institutional dimensions of digital and data-driven transformation	●●	●●	●●	●	●●●	●●
Formulate evidence-based responses to complex urban governance challenges	●	●●	●●	●●	●●	●●●
Integrate sustainability, ethics and responsible AI principles into urban governance analysis	●●	●●	●●●	●●	●●	●●
Apply interdisciplinary knowledge and analytical approaches in practical urban governance contexts	●	●	●●	●●	●●	●●●

Legend

- ● = introductory level
- ●● = intermediate level
- ●●● = advanced / integrative level

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Suggested Programme Sequence

Stage	Module	Function in Competence Progression
Stage 1	Module 1	Foundations of governance and smart city transformation
Stage 2	Module 2	Urban data governance and interoperability
Stage 3	Module 3	Analytics, AI and decision intelligence
Stage 4	Module 4	Infrastructure, GIS and urban technologies
Stage 5	Module 5	Leadership and organisational transformation
Stage 6	Module 6	Integration and practical application through Urban Data Lab

Suggested Workload Structure

Module	Estimated Hours	Suggested ECTS
Module 1 Urban Governance and Smart City Transformation	30–35 h	1.5 ECTS
Module 2 Urban Data Governance and Interoperability	35–40 h	1.5 ECTS
Module 3 AI, Urban Analytics and Decision Intelligence	40–45 h	2 ECTS
Module 4 Urban Data Infrastructure, GIS and Smart City Technologies	35–40 h	1.5 ECTS
Module 5 Leadership, Organisational Transformation and Stakeholder Coordination	30–35 h	1.5 ECTS
Module 6 Urban Data Lab and Capstone Project	50–60 h	2 ECTS
Total	**220–255 h**	**10 ECTS**

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Module 1 – Urban Governance and Smart City Transformation

General Objectives

This module introduces students to the foundations of contemporary urban governance and the growing role of digital transformation in shaping cities and metropolitan regions. It examines how data, digital technologies and AI-supported systems influence public decision-making, urban management and the delivery of public services within increasingly complex socio-technical environments.

The module approaches smart cities not primarily as technology-driven projects, but as governance ecosystems in which institutional structures, stakeholder relations, sustainability priorities and data practices interact. Particular emphasis is placed on understanding how digital transformation affects organisational processes, public value creation and evidence-based policymaking across different urban contexts.

Students are introduced to the institutional and strategic dimensions of data-driven governance and develop the ability to critically analyse the opportunities and limitations associated with smart city development. The module also explores the changing relationships between governance, technology and society, including the ethical and organisational implications of AI-supported urban systems.

The curriculum reflects the interdisciplinary orientation of the CDOA project and responds to the growing need for higher education programmes capable of connecting governance, analytics, sustainability and digital transformation within coherent learning environments. The module also addresses competency gaps identified during the project preparation phase, particularly in relation to:

- understanding urban digital transformation processes,
- interpreting the governance implications of data and AI,
- analysing stakeholder ecosystems,
- and applying evidence-based approaches in urban governance contexts.

Specific Objectives

The module aims to enable students to:

- understand the governance logic of smart cities and metropolitan systems;
- examine the role of digital transformation in contemporary urban governance;
- analyse how urban data and analytics influence public decision-making;
- explore relationships between governance, sustainability and digitalisation;
- identify institutional and organisational challenges related to smart city transformation;
- understand the role of stakeholders within urban governance ecosystems;

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- develop systems thinking perspectives on complex urban challenges;
- critically assess opportunities and risks associated with AI-supported governance;
- explore European policy frameworks related to digital transition, sustainability and urban innovation;
- strengthen interdisciplinary collaboration and analytical reasoning in urban governance contexts.

Expected Learning Outcomes

Knowledge and Understanding

Students:

- understand the evolution of smart city concepts and data-driven urban governance approaches;
- understand the institutional structures and governance dynamics of contemporary urban systems;
- recognise the role of digital transformation in public-sector and urban governance environments;
- understand how urban data, interoperability and analytics support evidence-based governance;
- identify major European frameworks related to smart cities, AI governance and sustainable urban transition;
- understand the roles and relationships of stakeholders involved in urban governance ecosystems;
- recognise organisational, social and ethical dimensions of digital transformation processes.

Cognitive and Practical Skills

Students will be able to:

- analyse governance structures and institutional processes within urban environments;
- interpret relationships between governance, data and digital transformation;
- assess governance challenges related to interoperability, organisational coordination and digital maturity;
- map stakeholder ecosystems and evaluate institutional relationships;
- critically evaluate smart city strategies and data-driven governance approaches;
- apply systems thinking to complex urban governance challenges;
- formulate evidence-informed recommendations related to urban transformation processes;
- analyse ethical and societal implications of AI-supported governance systems.

Professional and Interdisciplinary Competences

Students will:

- develop the capacity to operate within interdisciplinary urban governance environments;
- strengthen collaborative and analytical competences relevant to data-driven governance contexts;
- be prepared to engage critically with digital transformation processes in cities and metropolitan regions;
- develop awareness of sustainability, public value and responsible innovation perspectives;
- strengthen the ability to connect governance, analytical and technological perspectives;
- be prepared to facilitate communication between policy, technical and analytical stakeholders.

Capsules

Capsule 1 Understanding Smart Cities and Urban Governance

Content Summary

- Evolution of smart city concepts from technology-centred models toward governance-oriented and human-centred approaches.
- Cities as complex socio-technical systems integrating mobility, environment, infrastructure, public services and digital technologies.
- Governance structures within urban and metropolitan environments.
- Relationships between political leadership, public institutions, infrastructure providers, universities, civil society and technology actors.
- Data as a strategic resource in urban governance.
- Transition from reactive governance toward evidence-informed and anticipatory governance models.
- International approaches to smart city development.
- Risks associated with fragmented or purely technology-driven urban transformation strategies.

Teaching and Learning Approaches

- Interactive lectures
- Governance mapping exercises
- Case-study analysis
- Scenario-based workshops
- Collaborative discussions
- Simulation-based learning activities
- AI-supported exploratory exercises

Intended Learning Outcomes

Students will be able to:

- distinguish between different smart city governance approaches;
- explain interactions between technological, institutional and social dimensions of urban systems;
- identify major actors involved in urban governance ecosystems;
- analyse the role of data in governance and decision-making processes;
- critically assess limitations of fragmented digitalisation strategies.

Capsule 2 Digital Transformation in Urban Governance

Content Summary

- Digital transformation as institutional and organisational change rather than technological implementation alone.
- Digitalisation of public services and governance processes.
- Data-driven approaches to service delivery and urban management.
- Organisational and institutional barriers affecting digital transformation.
- Digital maturity and organisational readiness within public-sector environments.
- Interoperability challenges, fragmented systems and institutional silos.
- Governance implications of technological change.
- European examples of digital transformation in urban governance contexts.

Teaching and Learning Approaches

- Digital maturity analysis
- Organisational mapping exercises
- Governance simulations
- Scenario-based workshops
- Reflective group discussions
- Comparative case analysis

Intended Learning Outcomes

Students will be able to:

- analyse institutional dimensions of digital transformation;
- identify barriers affecting digital governance processes;
- assess governance implications of fragmented digital systems;
- evaluate organisational readiness for digital transformation;
- formulate recommendations supporting integrated digital governance approaches.

Capsule 3

Data-Driven Governance and Public Value

Content Summary

- Evidence-based governance and data-informed policymaking.
- Public value creation through analytics and urban data.
- Dashboards, indicators and urban monitoring systems.
- Operational and strategic uses of urban analytics.
- Governance applications related to mobility, environment, public services and citizen engagement.
- Challenges associated with transforming data into actionable knowledge.
- Ethical and political dimensions of data-driven governance.
- Risks and limitations of algorithmic and data-intensive governance systems.

Teaching and Learning Approaches

- Urban dashboard analysis
- Dataset interpretation exercises
- KPI workshops
- Applied governance case studies
- Collaborative analytical activities
- Guided discussions on ethics and governance

Intended Learning Outcomes

Students will be able to:

- explain the role of data in evidence-based governance;
- interpret urban indicators and analytical outputs;
- evaluate relationships between analytics and public value creation;
- analyse opportunities and limitations of data-driven governance systems;
- critically assess the societal implications of data-intensive governance.

Capsule 4 Stakeholder Ecosystems and Collaborative Urban Governance

Content Summary

- Stakeholder ecosystems in smart city transformation.
- Roles of public institutions, universities, private-sector actors, NGOs, civic initiatives and technology providers.
- Collaborative and participatory governance approaches.
- Co-creation and citizen engagement in urban innovation.
- Governance coordination in multi-stakeholder environments.
- Data sharing and institutional collaboration.
- Trust, legitimacy and communication in digital governance systems.

Teaching and Learning Approaches

- Stakeholder mapping workshops

- Collaborative governance simulations
- Group-based scenario analysis
- Role-play exercises
- Urban ecosystem mapping
- Case-study discussions

Intended Learning Outcomes

Students will be able to:

- identify stakeholder groups within urban governance ecosystems;
- analyse stakeholder relations and governance dynamics;
- evaluate collaborative governance approaches;
- assess the role of participation and co-creation in urban transformation;
- develop basic stakeholder engagement strategies.

Capsule 5 European Smart City Policies and Sustainable Urban Transition

Content Summary

- European policy frameworks related to digital transition, smart cities and sustainability.
- European Green Deal and urban transformation.
- Responsible AI and ethical governance principles.
- Sustainability, resilience and public value in urban governance.
- Integration of green and digital transition strategies.
- Governance implications of AI-supported systems.
- European examples of sustainable and data-driven urban transformation.

Teaching and Learning Approaches

- Policy analysis exercises
- Comparative framework analysis
- Sustainability workshops
- AI ethics case studies
- Strategic scenario exercises
- Guided policy discussions

Intended Learning Outcomes

Students will be able to:

- identify major European policy frameworks shaping urban digital transformation;
- analyse relationships between sustainability and digital governance;
- critically evaluate ethical dimensions of AI-supported governance systems;
- assess governance implications of green and digital transitions;
- formulate recommendations aligned with European urban policy priorities.

Teaching and Learning Approaches

The module combines:

- challenge-based learning,
- case-study analysis,
- collaborative workshops,
- governance simulations,
- applied analytical exercises,
- reflective discussions,
- stakeholder mapping activities,
- and scenario-based learning.

The pedagogical approach integrates theoretical understanding with applied inquiry and interdisciplinary collaboration. Particular emphasis is placed on analytical reasoning, systems thinking and critical engagement with contemporary urban governance challenges.

Assessment Methods

Assessment methods are aligned with the module learning outcomes and focus on analytical understanding, applied reasoning and interdisciplinary problem-solving.

Assessment components may include:

- governance analysis reports,
- stakeholder ecosystem mapping,
- digital transformation analysis,
- policy briefs,
- case-study presentations,
- analytical reflections,
- and strategy-oriented project work.

Assessment emphasises:

- critical analysis,
- interpretation of governance processes,
- evidence-informed reasoning,
- interdisciplinary understanding,
- and the ability to connect theoretical and applied perspectives within complex urban governance contexts.

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Module 2 – Urban Data Governance and Interoperability

General Objectives

This module examines the governance, organisational and ethical dimensions of urban data ecosystems. It introduces students to the principles of data governance and interoperability within contemporary urban environments, with particular attention to the institutional, technological and societal conditions shaping the use of data in public governance.
Cities and metropolitan regions increasingly rely on large volumes of operational, spatial and behavioural data generated across multiple systems and institutions. At the same time, urban data environments are often characterised by fragmentation, inconsistent standards, limited interoperability and organisational silos. The module therefore approaches urban data governance not only as a technical issue, but as a broader governance challenge involving coordination, accountability, transparency and responsible management of public information.
Students explore how data circulates across urban systems and how governance structures influence the quality, accessibility and usability of information in public-sector contexts. The module also examines the role of open data, metadata standards, interoperability frameworks and responsible AI governance within evolving smart city ecosystems.

Particular emphasis is placed on:

- urban data ecosystems and institutional coordination,
- interoperability and integration of urban systems,
- data quality and metadata management,
- open data and transparency,
- legal and ethical dimensions of data governance,
- and responsible approaches to data-intensive governance.

The module reflects the interdisciplinary orientation of the CDOA project and responds to competency gaps identified during the project preparation phase, especially in relation to:

- understanding urban data governance,
- interpreting interoperability challenges,
- coordinating data-related processes across institutions,
- and critically assessing ethical and legal implications of data-driven governance.

Specific Objectives

The module aims to enable students to:

- understand the structure and dynamics of urban data ecosystems;

- analyse relationships between governance structures, data flows and interoperability;
- examine organisational and institutional challenges related to urban data integration;
- explore governance approaches to data stewardship and accountability;
- assess the role of metadata, standards and data quality in evidence-based governance;
- understand legal and ethical dimensions of urban data management;
- critically evaluate open data initiatives and public-sector transparency practices;
- analyse the role of interoperability in smart city and AI-supported governance systems;
- strengthen interdisciplinary understanding of data governance in urban contexts;
- develop analytical perspectives on responsible and sustainable urban data practices.

Expected Learning Outcomes

Knowledge and Understanding

Students:

- understand the principles of urban data governance and data stewardship;
- understand how urban data ecosystems function within complex governance environments;
- recognise organisational, technical and semantic dimensions of interoperability;
- understand the role of standards, metadata and data quality in urban governance;
- identify legal and ethical principles related to public-sector data management and AI-supported governance;
- understand the strategic importance of open data for transparency, innovation and public participation;
- recognise risks associated with fragmented, opaque or poorly governed urban data systems.

Cognitive and Practical Skills

Students will be able to:

- analyse urban data flows and institutional dependencies;
- assess interoperability challenges across urban systems and organisations;
- evaluate governance approaches related to data stewardship and accountability;
- assess data quality, metadata structures and data accessibility practices;
- critically evaluate open data initiatives and data-sharing approaches;
- analyse legal and ethical implications of data-intensive governance systems;
- formulate recommendations supporting integrated and responsible data governance;
- communicate governance and data-related challenges across interdisciplinary contexts.

Professional and Interdisciplinary Competences

Students will:

- develop the ability to operate within interdisciplinary urban data governance environments;
- strengthen analytical and organisational competences related to data governance and interoperability;
- be prepared to engage critically with governance implications of digital transformation and AI-supported systems;
- develop awareness of ethical, legal and societal dimensions of urban data use;
- strengthen the ability to connect governance, analytical and technological perspectives;
- be prepared to contribute to transparent, responsible and evidence-informed urban governance practices.

Capsules

Capsule 1 Urban Data Ecosystems and Data Flows

Content Summary

- Urban data ecosystems as interconnected socio-technical environments.
- Main sources of urban data:
  - mobility systems,
  - GIS platforms,
  - environmental monitoring,
  - utilities,
  - public administration systems,
  - digital public services,
  - IoT infrastructure,
  - and external datasets.
- Relationships between operational, strategic and public information systems.
- Institutional and organisational dimensions of data circulation.
- Fragmentation, duplication and limited accessibility of urban data.
- Data dependencies within urban governance environments.
- Introduction to urban data architecture and ecosystem thinking.

Teaching and Learning Approaches

- Data-flow mapping exercises
- Urban system simulations
- Case-study analysis
- Collaborative workshops
- Ecosystem visualisation activities
- Guided analytical discussions

Intended Learning Outcomes

Students will be able to:

- identify major sources of urban data;
- analyse relationships between urban systems and datasets;
- interpret institutional dimensions of data circulation;
- identify risks related to fragmented data environments;
- explain how governance structures influence urban data ecosystems.

Capsule 2 Data Governance Frameworks and Data Stewardship

Content Summary

- Data governance as an organisational and institutional process.
- Governance structures supporting evidence-based urban management.
- Roles and responsibilities related to:
  - data ownership,
  - stewardship,
  - analytics,
  - IT management,
  - and public decision-making.
- Accountability and governance mechanisms in urban data environments.
- Data lifecycle management and governance frameworks.
- Institutional coordination and governance maturity.
- Practical approaches to urban data stewardship.

Teaching and Learning Approaches

- Governance framework workshops
- Role-mapping exercises
- Governance simulations
- Collaborative problem-solving activities
- Scenario-based learning
- Applied case-study analysis

Intended Learning Outcomes

Students will be able to:

- distinguish between technical and governance dimensions of data management;
- identify institutional roles within urban data governance structures;
- analyse governance risks related to fragmented accountability;
- evaluate governance frameworks supporting urban data ecosystems;
- formulate basic approaches to urban data stewardship.

Capsule 3 Interoperability and Integration of Urban Systems

Content Summary

- Interoperability as a foundation of integrated urban governance.
- Technical, organisational and semantic interoperability.
- Integration challenges related to:
  - legacy systems,
  - institutional silos,
  - external providers,
  - and fragmented digital infrastructures.
- Standards, APIs and data exchange mechanisms.
- Interoperability in mobility, environmental management, public services and infrastructure systems.
- Governance implications of disconnected urban technologies.
- Relationships between interoperability, analytics and AI-supported governance.

Teaching and Learning Approaches

- System integration workshops
- Interoperability simulations
- Urban architecture exercises
- Comparative case analysis
- Collaborative scenario activities
- Guided analytical discussions

Intended Learning Outcomes

Students will be able to:

- explain different dimensions of interoperability;
- analyse barriers affecting integration of urban systems;
- evaluate interoperability challenges in governance contexts;
- assess consequences of fragmented digital infrastructures;
- formulate recommendations supporting integrated urban data environments.

Capsule 4 Data Quality, Metadata and Open Data

Content Summary

- Data quality as a prerequisite for evidence-based governance.
- Common problems related to:
  - incomplete datasets,
  - inconsistent formats,
  - duplication,
  - outdated information,
  - and limited standardisation.
- Metadata principles and documentation standards.
- Data catalogues and inventory systems.

- Open data ecosystems and public-sector transparency.
- Public accessibility and reuse of urban information.
- Open data as a driver of innovation, participation and collaborative governance.
- Tensions between openness, privacy and security.

Teaching and Learning Approaches

- Data quality assessment exercises
- Metadata workshops
- Open data platform analysis
- Dataset evaluation activities
- Collaborative analytical tasks
- Applied case-study discussions

Intended Learning Outcomes

Students will be able to:

- assess dimensions of urban data quality;
- identify governance risks associated with poor-quality data;
- interpret the role of metadata in urban data management;
- critically evaluate open data initiatives;
- analyse opportunities and limitations related to data openness and transparency.

Capsule 5 Legal, Ethical and Responsible Urban Data Governance

Content Summary

- Legal foundations of urban data governance.
- GDPR principles and public-sector data responsibilities.
- Privacy, trust and legitimacy in data-driven governance.
- Ethical challenges related to:
    - surveillance,
    - profiling,
    - algorithmic bias,
    - and automated decision-making.
- Responsible AI principles in urban governance contexts.
- Transparency and explainability in AI-supported systems.
- Governance risks related to external technology providers and platform dependency.
- Balancing innovation with legal and ethical responsibility.

Teaching and Learning Approaches

- Ethics case studies
- GDPR analysis exercises
- Governance dilemma scenarios
- Structured debates

- Risk-analysis workshops
- Reflective group discussions

Intended Learning Outcomes

Students will be able to:

- identify major legal principles related to urban data governance;
- analyse ethical implications of data-intensive governance systems;
- critically evaluate responsible AI approaches in public governance;
- assess risks related to privacy and algorithmic decision-making;
- formulate recommendations supporting transparent and responsible data practices.

Teaching and Learning Approaches

The module combines:

- challenge-based learning,
- governance simulations,
- applied analytical exercises,
- collaborative workshops,
- case-study analysis,
- dataset interpretation activities,
- reflective discussions,
- and scenario-based learning.

The pedagogical approach integrates conceptual understanding with applied inquiry and interdisciplinary collaboration. Particular emphasis is placed on analytical reasoning, governance awareness and critical engagement with contemporary urban data challenges.

Assessment Methods

Assessment methods are aligned with the module learning outcomes and focus on analytical understanding, applied reasoning and interdisciplinary problem-solving.

Assessment components may include:

- urban data ecosystem analysis,
- interoperability assessment reports,
- governance framework proposals,
- open data evaluation exercises,
- legal and ethics case analyses,
- analytical reflections,
- and collaborative scenario-based assignments.

Assessment emphasises:

- critical analysis,

- interpretation of governance and interoperability challenges,
- evidence-informed reasoning,
- interdisciplinary understanding,
- and the ability to connect governance, technology and societal dimensions within urban data ecosystems.

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Module 3 – AI, Urban Analytics and Decision Intelligence

General Objectives

This module develops practical competences related to the use of analytics, artificial intelligence and data-driven decision-support systems in urban governance and municipal management.

The module is not designed as a technical AI course for programmers or data scientists. Its purpose is to prepare future Smart Data Officers to understand how analytical tools and AI systems can support operational and strategic decision-making in cities, while maintaining human oversight, institutional accountability and public trust.

Particular emphasis is placed on:

- urban analytics,
- KPI systems,
- dashboards,
- predictive models,
- operational intelligence,
- and AI-supported governance processes.

The module directly responds to competency gaps identified in the CDOA survey, especially regarding:

- analytical competences,
- operational use of urban data,
- dashboard management,
- and evidence-based decision-making.

The module also reflects one of the core assumptions of the CDOA project: AI should support public-sector decision-making without replacing institutional responsibility or human judgement.

Specific Objectives

- Understand how urban analytics supports operational and strategic city management.
- Develop competences in interpreting urban datasets and performance indicators.
- Understand the practical use of AI in public administration and smart city systems.
- Explore predictive analytics and scenario modelling in urban governance.
- Learn how dashboards and KPI systems support decision-making processes.
- Analyse opportunities and limitations of AI-supported governance tools.
- Strengthen critical interpretation of analytical outputs and algorithmic recommendations.
- Develop awareness of risks related to bias, explainability and overreliance on automation.
- Support evidence-based policymaking through analytical reasoning.

Expected Learning Outcomes

Knowledge

Participants:

- understand the role of urban analytics in municipal management;
- know the principles of KPI systems, dashboards and operational monitoring;
- understand basic concepts related to AI and machine learning in public-sector contexts;
- recognise the main applications of predictive analytics in smart city governance;
- understand the limitations and risks of AI-supported decision systems;
- know the principles of responsible and explainable AI in public administration;
- understand how data visualisation supports interpretation and communication of complex information.

Skills

Participants will be able to:

- interpret urban datasets and analytical outputs;
- analyse trends and patterns in operational city data;
- evaluate dashboards and KPI systems;
- identify appropriate indicators for urban management processes;
- assess AI-supported recommendations critically rather than automatically;
- formulate evidence-based conclusions from analytical material;
- communicate analytical findings to decision-makers and non-technical stakeholders;
- support scenario modelling and predictive governance exercises.

Competencies

Participants will be:

- capable of supporting evidence-based urban governance processes;
- prepared to use analytics as part of operational and strategic municipal management;
- able to connect analytical outputs with governance priorities and institutional realities;
- capable of critically evaluating AI-supported recommendations;
- prepared to promote responsible and transparent use of AI in public administration;
- able to bridge communication between technical analysts and public decision-makers.

Capsules

Capsule 1 Urban Analytics and Evidence-Based Governance

Content Summary

- From reactive administration to data-informed governance.
- Urban analytics as a tool supporting operational management and strategic planning.
- Sources of analytical data in cities:
  - mobility systems,
  - environmental monitoring,
  - public transport,
  - utilities,
  - citizen services,
  - and administrative platforms.
- Types of urban indicators and their role in decision-making.
- Evidence-based policymaking in municipalities.
- Operational versus strategic analytics.
- Common problems in municipal analytics:
  - low data quality,
  - fragmented indicators,
  - limited interpretation capacity,
  - and weak institutional integration.
- Risks of making decisions without analytical validation.

Possible Tools & Methods to Deliver Contents Through the Microlearning Methodology

- Urban analytics workshops
- Dashboard interpretation exercises
- Municipal data case studies
- Indicator mapping exercises
- Problem-solving simulations
- Interactive data visualisation activities

Intended Learning Outcomes

Participants will be able to:

- explain the role of analytics in urban governance;
- distinguish between operational and strategic indicators;
- interpret basic analytical outputs from urban systems;
- identify weaknesses in municipal monitoring systems;
- formulate evidence-based conclusions using urban datasets.

Capsule 2 KPI Systems, Dashboards and Urban Performance Monitoring

Content Summary

- Designing performance-monitoring systems for cities.
- KPIs in:
  - mobility,

    - sustainability,
    - public services,
    - infrastructure,
    - and environmental management.
- Dashboard logic and visual communication of urban data.
- Real-time monitoring systems.
- Choosing indicators that support decision-making rather than administrative reporting only.
- Risks of poorly designed KPI systems.
- Balancing operational efficiency with public value and sustainability goals.
- Practical examples of municipal dashboards and monitoring centres.

Possible Tools & Methods

- Dashboard analysis exercises
- KPI design workshops
- Urban monitoring simulations
- Real municipal case studies
- Interactive visualisation tasks
- Comparative city benchmarking

Intended Learning Outcomes

Participants will be able to:

- identify appropriate KPIs for selected urban governance areas;
- assess the usefulness of dashboard systems;
- interpret visualised urban data correctly;
- identify misleading or poorly constructed indicators;
- support development of basic urban monitoring frameworks.

Capsule 3 Artificial Intelligence in Urban Governance

Content Summary

- Practical applications of AI in smart cities and public administration.
- AI-supported systems in:
    - mobility management,
    - environmental monitoring,
    - public safety,
    - urban planning,
    - citizen services,
    - and infrastructure management.
- Difference between automation, analytics and AI-supported decision systems.
- Machine learning in urban contexts — practical understanding rather than technical modelling.

- Opportunities related to:
  - forecasting,
  - anomaly detection,
  - resource optimisation,
  - and operational coordination.
- Institutional limitations of AI in public governance.
- Human oversight and accountability in AI-supported systems.

Possible Tools & Methods

- AI governance case studies
- Scenario-based simulations
- Urban AI demonstrations
- Interactive decision exercises
- Policy analysis workshops
- AI-supported governance scenarios

Intended Learning Outcomes

Participants will be able to:

- identify practical applications of AI in urban governance;
- distinguish between different forms of AI-supported systems;
- assess opportunities and limitations of AI implementation in municipalities;
- analyse operational implications of AI-supported governance;
- explain why human oversight remains necessary in public-sector AI systems.

Capsule 4 Predictive Analytics and Scenario Modelling

Content Summary

- Predictive governance and anticipatory urban management.
- Forecasting urban trends using operational and historical data.
- Predictive analytics in:
  - transport,
  - energy,
  - public services,
  - environmental management,
  - and emergency response systems.
- Scenario modelling for urban resilience and crisis management.
- Understanding uncertainty in predictive systems.
- Limitations of predictive models in complex urban environments.
- Combining analytical forecasts with institutional and political judgement.

Possible Tools & Methods

- Predictive scenario workshops

- Trend analysis exercises
- Crisis simulation activities
- Urban forecasting case studies
- Risk analysis exercises
- AI-assisted modelling demonstrations

Intended Learning Outcomes

Participants will be able to:

- interpret basic predictive analytical outputs;
- analyse urban trends using historical datasets;
- assess strengths and limitations of forecasting models;
- support scenario-based planning processes;
- integrate predictive insights into governance discussions responsibly.

Capsule 5 Responsible AI, Bias and Explainability in Public Decision-Making

Content Summary

- Responsible AI principles in public governance.
- Risks related to:
  - algorithmic bias,
  - discrimination,
  - opacity,
  - and overreliance on automated systems.
- Explainability and transparency in AI-supported decisions.
- Public trust and legitimacy in algorithmic governance.
- Ethical implications of predictive urban systems.
- Human-in-the-loop governance models.
- Evaluating AI-supported recommendations critically.
- European approaches to trustworthy AI.

Possible Tools & Methods

- Ethical dilemma workshops
- AI bias case studies
- Governance simulations
- Explainability exercises
- Structured debates
- Policy evaluation scenarios

Intended Learning Outcomes

Participants will be able to:

- identify ethical risks related to AI-supported governance;

- assess transparency and explainability challenges;
- analyse examples of algorithmic bias in public systems;
- evaluate AI-supported recommendations critically rather than automatically;
- formulate principles supporting responsible use of AI in municipalities.

Teaching and Learning Methods

The module combines:

- practical analytical exercises,
- dashboard interpretation,
- urban case studies,
- scenario-based simulations,
- AI-supported demonstrations,
- collaborative workshops,
- and applied problem-solving activities.

The teaching approach prioritises:

- operational relevance,
- analytical reasoning,
- interpretation rather than coding,
- and application of AI and analytics to real municipal governance contexts.

Assessment Methods

Assessment is focused on practical analytical reasoning and the ability to apply urban analytics and AI-supported insights in governance contexts.

Assessment components may include:

- dashboard analysis report,
- KPI design exercise,
- urban analytics case study,
- predictive scenario assessment,
- AI governance analysis,
- policy recommendation brief,
- analytical interpretation presentation.

Assessment evaluates:

- interpretation of analytical outputs,
- quality of reasoning,
- ability to connect analytics with governance challenges,
- understanding of AI limitations,
- and evidence-based problem-solving.

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Module 4 – Urban Data Infrastructure, GIS and Smart City Technologies

General Objectives

This module introduces students to the technological infrastructures and digital systems supporting contemporary urban governance and smart city development. It examines how spatial data, connected infrastructures, sensor networks and integrated digital platforms shape the functioning of cities and influence decision-making processes across urban governance environments.

The module does not aim to provide technical engineering or software development training. Instead, it develops conceptual and analytical understanding of how urban technologies operate within broader governance, organisational and societal contexts. Students explore relationships between digital infrastructure, spatial intelligence, data integration and public governance, with particular attention to the growing role of real-time monitoring and interconnected urban systems.

The module focuses on how operational data is generated, transmitted, interpreted and integrated across urban environments. It also examines the governance implications of emerging technologies such as IoT systems, digital twins and cloud-based urban platforms, as well as challenges related to cybersecurity, interoperability and technological dependency.

Particular emphasis is placed on:

- GIS and spatial intelligence,
- IoT systems and urban monitoring,
- integrated digital infrastructures,
- digital twins and simulation environments,
- cybersecurity and digital resilience,
- and governance challenges associated with urban technologies.

The module reflects the interdisciplinary orientation of the CDOA project and responds to the growing importance of spatial intelligence, integrated infrastructures and data-driven urban systems within contemporary governance environments. It also addresses competency gaps identified during the project preparation phase, especially in relation to:

- understanding smart city infrastructures,
- interpreting spatial and operational data,
- analysing technological interdependencies,
- and critically evaluating governance implications of urban digital systems.

Specific Objectives

The module aims to enable students to:

- understand the technological foundations of smart city ecosystems;

- analyse the role of GIS and spatial data within urban governance;
- explore IoT systems and real-time monitoring infrastructures;
- examine relationships between operational data, digital infrastructure and decision-making;
- understand the logic and governance implications of digital twin environments;
- analyse cybersecurity and resilience challenges affecting urban digital systems;
- critically evaluate integration challenges within interconnected urban infrastructures;
- explore governance implications of emerging urban technologies;
- strengthen interdisciplinary understanding of infrastructure, governance and analytics;
- develop systems-thinking perspectives on digital urban environments.

Expected Learning Outcomes

Knowledge and Understanding

Students:

- understand the role of digital infrastructure within smart city and urban governance systems;
- understand basic principles of GIS and spatial data management;
- recognise how IoT systems and urban sensing infrastructures operate;
- understand the role of real-time monitoring and integrated urban platforms;
- understand the logic and applications of digital twin environments;
- identify major cybersecurity and resilience challenges affecting urban systems;
- recognise relationships between infrastructure, analytics and governance processes.

Cognitive and Practical Skills

Students will be able to:

- interpret spatial and operational urban datasets;
- analyse GIS-based information and spatial visualisations;
- assess relationships between infrastructure systems and governance processes;
- evaluate operational and governance implications of sensor-based monitoring systems;
- analyse interoperability and integration challenges within urban infrastructures;
- identify cybersecurity risks affecting interconnected urban systems;
- critically evaluate technological solutions used in smart city environments;
- communicate infrastructure-related governance challenges across interdisciplinary contexts.

Professional and Interdisciplinary Competences

Students will:

- develop interdisciplinary understanding of urban digital infrastructures and governance systems;

- strengthen analytical competences related to spatial intelligence and urban technologies;
- be prepared to critically engage with governance implications of smart city technologies;
- develop awareness of organisational, ethical and resilience-related dimensions of digital infrastructures;
- strengthen the ability to connect technological, spatial and governance perspectives;
- be prepared to contribute to responsible and integrated approaches to urban digital transformation.

Capsules

Capsule 1 GIS and Spatial Intelligence in Urban Governance

Content Summary

- Spatial data as a foundation of urban governance and planning.
- GIS applications in:
  - mobility,
  - spatial planning,
  - environmental governance,
  - infrastructure management,
  - emergency response,
  - and public services.
- Spatial analysis, georeferencing and visualisation.
- Relationships between spatial and operational datasets.
- GIS as a decision-support and analytical tool.
- Spatial intelligence in strategic and operational governance.
- Risks associated with fragmented or outdated spatial information.
- Examples of GIS-supported urban governance systems.

Teaching and Learning Approaches

- GIS visualisation exercises
- Spatial analysis workshops
- Urban mapping activities
- Applied case-study analysis
- Infrastructure mapping exercises
- Collaborative spatial problem-solving

Intended Learning Outcomes

Students will be able to:

- explain the role of GIS in urban governance;
- interpret spatial datasets and visualisations;

- analyse relationships between infrastructure and spatial information;
- assess governance applications of spatial intelligence;
- evaluate limitations and opportunities related to GIS-supported governance systems.

Capsule 2 IoT Systems and Urban Monitoring Infrastructure

Content Summary

- Internet of Things ecosystems in urban environments.
- Urban sensing systems related to:
  - transport,
  - environmental monitoring,
  - utilities,
  - smart lighting,
  - parking systems,
  - and public safety.
- Real-time data collection and transmission.
- Integrated urban monitoring platforms.
- Reliability, maintenance and scalability challenges in sensor networks.
- Governance implications of large-scale urban monitoring.
- Data integration and operational coordination within connected urban infrastructures.

Teaching and Learning Approaches

- Smart city infrastructure simulations
- Sensor-network mapping activities
- Monitoring dashboard analysis
- IoT case-study discussions
- Infrastructure coordination exercises
- Collaborative analytical workshops

Intended Learning Outcomes

Students will be able to:

- identify major components of urban IoT systems;
- explain how monitoring infrastructures support urban governance processes;
- analyse operational uses of sensor-generated data;
- evaluate integration and maintenance challenges affecting urban monitoring systems;
- assess governance implications of real-time urban sensing environments.

Capsule 3 Digital Twins and Integrated Urban Platforms

Content Summary

- Digital twins as integrated representations of urban systems.
- Relationships between:
  - GIS,
  - IoT systems,
  - operational data,
  - analytics,
  - and simulation environments.
- Applications of digital twins in:
  - mobility,
  - infrastructure management,
  - urban planning,
  - resilience,
  - and crisis response.
- Scenario modelling and simulation-based governance.
- Data integration requirements for digital twin environments.
- Governance and organisational challenges associated with integrated urban platforms.
- Opportunities and limitations of digital twin approaches in public governance contexts.

Teaching and Learning Approaches

- Digital twin demonstrations
- Urban simulation workshops
- Scenario-modelling exercises
- Integrated platform analysis
- Comparative case studies
- Reflective governance discussions

Intended Learning Outcomes

Students will be able to:

- explain the concept and functions of digital twins;
- analyse relationships between monitoring systems and simulation environments;
- evaluate organisational and governance dimensions of digital twin implementation;
- assess opportunities and limitations of integrated urban platforms;
- critically examine the role of simulation technologies in urban governance.

Capsule 4 Cybersecurity and Digital Resilience in Smart Cities

Content Summary

- Cybersecurity risks affecting urban digital infrastructures.
- Vulnerabilities of interconnected urban systems and platforms.
- Risks related to:
  - ransomware,

    - unauthorised access,
    - infrastructure disruption,
    - and data breaches.
- Cybersecurity governance and institutional responsibility.
- Operational resilience and continuity planning.
- Dependencies between critical urban infrastructures.
- Human and organisational dimensions of cybersecurity.
- Balancing interoperability, openness and digital security.

Teaching and Learning Approaches

- Cybersecurity scenario exercises
- Infrastructure risk mapping
- Crisis-response simulations
- Threat-analysis workshops
- Case-study analysis
- Reflective governance discussions

Intended Learning Outcomes

Students will be able to:

- identify major cybersecurity risks affecting urban systems;
- analyse vulnerabilities within interconnected infrastructures;
- assess resilience challenges related to smart city environments;
- evaluate governance implications of cybersecurity strategies;
- analyse relationships between interoperability, openness and digital resilience.

Capsule 5 Urban Technology Procurement and Infrastructure Governance

Content Summary

- Procurement and governance challenges in smart city development.
- Relationships between public institutions and technology providers.
- Vendor lock-in and platform dependency risks.
- Evaluation of urban technology solutions from governance and sustainability perspectives.
- Interoperability requirements in infrastructure procurement.
- Long-term governance implications of digital investments.
- Coordination challenges within integrated infrastructure projects.
- Balancing innovation, institutional capacity and operational stability.

Teaching and Learning Approaches

- Procurement case studies
- Technology evaluation exercises
- Comparative vendor analysis

- Governance simulations
- Infrastructure planning workshops
- Stakeholder coordination activities

Intended Learning Outcomes

Students will be able to:

- analyse governance implications of urban technology procurement;
- identify risks related to fragmented infrastructure investments;
- assess interoperability requirements within digital infrastructure projects;
- critically evaluate technological solutions used in smart city environments;
- analyse relationships between infrastructure governance, sustainability and institutional capacity.

Teaching and Learning Approaches

The module combines:

- challenge-based learning,
- GIS and spatial analysis exercises,
- infrastructure simulations,
- applied case-study analysis,
- collaborative workshops,
- urban technology demonstrations,
- reflective discussions,
- and scenario-based learning activities.

The pedagogical approach integrates conceptual understanding with applied inquiry and interdisciplinary analysis. Particular emphasis is placed on systems thinking, spatial reasoning and critical engagement with technological infrastructures shaping contemporary urban governance.

Assessment Methods

Assessment methods are aligned with the module learning outcomes and focus on analytical interpretation, interdisciplinary reasoning and applied understanding of urban digital infrastructures.

Assessment components may include:

- GIS analysis exercises,
- urban infrastructure mapping tasks,
- smart city technology evaluation reports,
- cybersecurity and resilience analyses,
- digital twin scenario assessments,
- procurement and governance case studies,

- and analytical presentations.

Assessment emphasises:

- interpretation of spatial and operational data,
- understanding of infrastructure interdependencies,
- critical evaluation of urban technologies,
- systems thinking,
- and the ability to connect technological infrastructures with governance, sustainability and organisational challenges within contemporary urban environments.

Module 5 – Leadership, Organisational Transformation and Stakeholder Coordination

General Objectives

This module examines the organisational, leadership and collaborative dimensions of digital transformation within contemporary urban governance environments. It focuses on the institutional and human factors shaping smart city development and explores how organisational cultures, governance structures and stakeholder relations influence the implementation of data-driven and technology-supported transformation processes.
The module approaches smart city transformation not primarily as a technological challenge, but as a complex organisational and governance process requiring coordination across institutional, disciplinary and societal boundaries. Students analyse how leadership, communication and organisational learning affect the capacity of public institutions to respond to technological change, integrate evidence-based approaches and manage increasingly complex governance ecosystems.

Particular attention is given to:

- leadership in interdisciplinary governance environments,
- organisational adaptation and institutional change,
- collaborative governance and stakeholder coordination,
- communication and negotiation in data-driven environments,
- and organisational learning in the context of digital transformation.

The module also explores practical governance challenges related to:

- institutional fragmentation,
- organisational resistance,
- competing stakeholder interests,
- limited organisational capacity,
- and tensions between innovation, accountability and operational continuity.

The curriculum reflects the interdisciplinary orientation of the CDOA project and responds directly to competency gaps identified during the project preparation phase, especially in relation to:

- organisational coordination,
- communication between governance and technical actors,
- leadership in digital transformation processes,
- and collaborative approaches to smart city governance.

Specific Objectives

The module aims to enable students to:

- understand organisational and institutional dimensions of digital transformation;

- analyse leadership challenges within data-driven governance environments;
- explore collaborative governance and stakeholder coordination approaches;
- examine organisational resistance and barriers affecting transformation processes;
- strengthen communication and negotiation competences in interdisciplinary settings;
- analyse relationships between organisational culture and evidence-based governance;
- develop systems-thinking perspectives on institutional adaptation;
- critically evaluate governance challenges related to innovation and organisational change;
- strengthen collaborative and reflective problem-solving competences;
- develop awareness of public value, legitimacy and trust within governance processes.

Expected Learning Outcomes

Knowledge and Understanding

Students:

- understand organisational dynamics within public-sector and urban governance environments;
- recognise major approaches related to organisational change, leadership and collaborative governance;
- understand the role of stakeholder coordination in digital transformation processes;
- identify barriers affecting institutional adaptation and evidence-based governance;
- understand communication challenges in interdisciplinary governance settings;
- recognise the importance of organisational culture and trust in transformation processes;
- understand relationships between governance, leadership and public legitimacy.

Cognitive and Practical Skills

Students will be able to:

- analyse organisational barriers affecting digital transformation initiatives;
- assess stakeholder relations and governance dynamics;
- evaluate communication and coordination challenges within interdisciplinary environments;
- facilitate collaborative problem-solving and stakeholder engagement processes;
- communicate analytical and governance-related information to diverse audiences;
- analyse tensions between innovation, accountability and institutional stability;
- formulate recommendations supporting organisational learning and adaptation;
- critically assess governance approaches related to leadership and transformation.

Professional and Interdisciplinary Competences

Students will:

- develop collaborative and leadership competences relevant to complex governance environments;

- strengthen the ability to operate within interdisciplinary and multi-stakeholder settings;
- be prepared to engage critically with organisational dimensions of digital transformation;
- develop awareness of institutional, societal and ethical dimensions of governance processes;
- strengthen communication and negotiation competences in data-driven environments;
- be prepared to contribute to evidence-informed, collaborative and adaptive governance cultures.

Capsules

Capsule 1 Leadership in Data-Driven Urban Governance

Content Summary

- Leadership challenges in contemporary urban governance.
- Leadership in conditions of institutional complexity, uncertainty and technological change.
- Strategic and operational dimensions of governance leadership.
- Public trust, legitimacy and accountability in transformation processes.
- Leadership roles in interdisciplinary and data-driven governance environments.
- The evolving role of governance professionals acting between technical, analytical and policy domains.
- Leadership approaches supporting innovation and organisational adaptation.
- Balancing transformation processes with operational continuity and institutional stability.

Teaching and Learning Approaches

- Leadership case studies
- Governance simulations
- Reflective exercises
- Decision-making workshops
- Scenario-based learning activities
- Collaborative peer discussions

Intended Learning Outcomes

Students will be able to:

- identify leadership challenges in digital governance environments;
- analyse relationships between leadership and organisational transformation;
- evaluate leadership approaches within interdisciplinary governance contexts;
- assess the role of trust and legitimacy in transformation processes;

- reflect critically on leadership responsibilities in data-driven governance systems.

Capsule 2 Organisational Transformation and Digital Change

Content Summary

- Organisational adaptation in digitally transforming governance environments.
- Institutional inertia, administrative silos and organisational resistance.
- Change-management approaches in public-sector organisations.
- Drivers and barriers affecting organisational transformation.
- Organisational culture and evidence-based governance practices.
- Incremental and systemic transformation strategies.
- Building institutional readiness for digital transition.
- Experiences and lessons from urban transformation processes.

Teaching and Learning Approaches

- Organisational diagnosis exercises
- Transformation simulations
- Applied case-study analysis
- Institutional mapping activities
- Collaborative problem-solving workshops
- Reflective governance discussions

Intended Learning Outcomes

Students will be able to:

- identify barriers affecting organisational transformation;
- analyse institutional resistance mechanisms;
- assess organisational readiness for digital change;
- evaluate governance implications of transformation processes;
- formulate recommendations supporting adaptive and evidence-informed organisational cultures.

Capsule 3 Stakeholder Coordination and Collaborative Governance

Content Summary

- Complexity of stakeholder ecosystems within smart city and urban governance environments.
- Relationships between:
  - public institutions,
  - infrastructure providers,
  - universities,
  - civic organisations,

    - private-sector actors,
    - and local communities.
- Collaborative governance approaches and partnership models.
- Stakeholder interests, influence and institutional tensions.
- Trust-building and communication in multi-actor environments.
- Citizen participation and co-creation in urban transformation.
- Coordination failures and governance fragmentation.
- Data-sharing and institutional collaboration challenges.

Teaching and Learning Approaches

- Stakeholder mapping workshops
- Collaborative governance simulations
- Negotiation exercises
- Role-playing activities
- Partnership case studies
- Interdisciplinary scenario analysis

Intended Learning Outcomes

Students will be able to:

- identify and analyse stakeholder relations within governance ecosystems;
- assess risks associated with weak coordination and fragmented governance;
- evaluate collaborative governance approaches;
- facilitate communication between institutional actors;
- develop stakeholder engagement and coordination strategies.

Capsule 4 Communication, Negotiation and Public Value

Content Summary

- Communication challenges in data-driven and technology-supported governance environments.
- Translating analytical and technical concepts into accessible governance language.
- Communicating uncertainty, risk and limitations in analytical systems.
- Negotiation processes in interdisciplinary governance contexts.
- Managing conflicting priorities between institutional actors and stakeholder groups.
- Public value, legitimacy and trust in digital governance.
- Transparency and responsible communication in AI-supported governance environments.
- Citizen trust and public accountability in transformation processes.

Teaching and Learning Approaches

- Communication workshops
- Negotiation simulations

- Stakeholder dialogue exercises
- Public-value case studies
- Presentation activities
- Conflict-resolution scenarios

Intended Learning Outcomes

Students will be able to:

- communicate analytical and governance-related information to diverse audiences;
- support negotiation processes in interdisciplinary settings;
- analyse relationships between transparency, trust and legitimacy;
- assess communication challenges related to AI-supported governance systems;
- evaluate the role of public value in governance decision-making.

Capsule 5 Organisational Learning and Innovation Capacity

Content Summary

- Organisational learning in urban governance environments.
- Knowledge-sharing and institutional memory.
- Cross-department and interdisciplinary collaboration.
- Innovation cultures in public-sector organisations.
- Experimentation, pilot initiatives and adaptive governance approaches.
- Learning from implementation failures and operational feedback.
- Institutional resilience and long-term transformation capacity.
- Continuous adaptation in digitally transforming governance systems.

Teaching and Learning Approaches

- Innovation workshops
- Organisational learning exercises
- Reflective governance sessions
- Pilot-project analysis
- Collaborative learning activities
- Adaptive-governance simulations

Intended Learning Outcomes

Students will be able to:

- identify factors supporting organisational learning and innovation;
- analyse barriers affecting adaptive governance cultures;
- evaluate collaborative and knowledge-sharing practices;
- assess strengths and limitations of pilot-based governance approaches;
- formulate recommendations supporting long-term institutional learning and resilience.

Teaching and Learning Approaches

The module combines:

- challenge-based learning,
- governance simulations,
- organisational case studies,
- stakeholder workshops,
- negotiation exercises,
- collaborative problem-solving,
- reflective learning activities,
- and scenario-based governance analysis.

The pedagogical approach integrates conceptual understanding with applied inquiry and interdisciplinary collaboration. Particular emphasis is placed on organisational reasoning, communication, stakeholder coordination and critical reflection on governance transformation processes.

Assessment Methods

Assessment methods are aligned with the module learning outcomes and focus on analytical understanding, collaborative reasoning and applied governance competences.

Assessment components may include:

- organisational transformation analyses,
- stakeholder coordination strategies,
- governance communication exercises,
- negotiation simulations,
- institutional barrier assessments,
- collaborative governance case studies,
- and reflective portfolios.

Assessment emphasises:

- organisational and institutional analysis,
- stakeholder reasoning,
- communication quality,
- interdisciplinary understanding,
- and the ability to connect leadership, governance and organisational transformation within complex urban environments.

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Module 6 – Urban Data Lab and Capstone Project

General Objectives

The Urban Data Lab and Capstone Project module constitutes the integrative component of the programme. Its purpose is to connect the analytical, governance and interdisciplinary competences developed throughout previous modules with complex urban challenges situated in realistic governance contexts.

The module is structured around inquiry-based and project-oriented learning. Students work individually and collaboratively on applied urban governance problems that require the integration of:

- governance analysis,
- urban analytics,
- spatial and infrastructure perspectives,
- stakeholder coordination,
- ethical evaluation,
- and evidence-informed decision-making.

The module reflects one of the central educational assumptions of the CDOA project: learning should combine theoretical understanding with applied inquiry and should prepare students to operate critically and responsibly within increasingly data-intensive urban governance environments.

Particular emphasis is placed on:

- interdisciplinary problem-solving,
- analytical reasoning,
- evidence-informed governance,
- collaborative learning,
- responsible use of analytics and AI,
- and critical reflection on implementation challenges within complex institutional environments.

The Urban Data Lab also creates a space for experimentation, applied analysis and interdisciplinary cooperation. Students are encouraged to explore relationships between technological systems, governance processes, organisational realities and societal implications of urban transformation.

Specific Objectives

The module aims to enable students to:

- integrate competences developed throughout the programme;
- apply interdisciplinary analytical approaches to complex urban governance challenges;
- strengthen evidence-based reasoning and problem-framing capacities;

- develop collaborative and project-based working competences;
- critically evaluate governance, organisational and technological dimensions of urban transformation;
- formulate evidence-informed and context-sensitive recommendations;
- strengthen communication and presentation competences in interdisciplinary environments;
- analyse implementation challenges affecting smart city and digital governance initiatives;
- reflect critically on ethical, societal and institutional implications of proposed solutions;
- develop confidence in working with complex datasets and governance scenarios.

Expected Learning Outcomes

Knowledge and Understanding

Students:

- understand the complexity and interdependence of contemporary urban governance environments;
- recognise relationships between governance, analytics, infrastructure and organisational processes;
- understand implementation challenges affecting smart city and digital transformation initiatives;
- identify the roles and influence of different stakeholders within urban governance ecosystems;
- recognise limitations of purely technological approaches to urban transformation;
- understand ethical and societal implications of data-driven and AI-supported governance systems.

Cognitive and Practical Skills

Students will be able to:

- analyse complex urban governance challenges using interdisciplinary approaches;
- work with real or simulated urban datasets and analytical materials;
- integrate governance, analytical and organisational perspectives within project-based work;
- formulate evidence-informed recommendations and strategic responses;
- assess implementation challenges and institutional constraints;
- communicate analytical findings and governance recommendations effectively;
- collaborate within interdisciplinary teams;
- critically evaluate governance implications of technological and analytical solutions.

Professional and Interdisciplinary Competences

Students will:

- develop the capacity to operate within complex and multi-stakeholder governance environments;
- strengthen interdisciplinary collaboration and analytical reasoning competences;
- be prepared to engage critically with data-driven urban transformation processes;
- develop awareness of ethical, institutional and societal dimensions of governance innovation;
- strengthen the ability to connect analytical insights with governance realities and public value considerations;
- be prepared to contribute to responsible, evidence-informed and sustainable urban governance practices.

Capsules

Capsule 1 Urban Challenge Identification and Problem Framing

Content Summary

- Identification of operational and strategic urban governance challenges.
- Distinguishing between symptoms and structural governance issues.
- Problem framing in complex governance environments.
- Defining realistic and analytically meaningful project scopes.
- Mapping institutional, organisational and stakeholder dimensions of urban problems.
- Working with incomplete, uncertain or fragmented datasets.
- Selecting analytical and governance approaches appropriate to project contexts.
- Building interdisciplinary perspectives on urban transformation challenges.

Typical thematic areas may include:

- mobility,
- environmental governance,
- public services,
- spatial planning,
- infrastructure coordination,
- energy transition,
- urban resilience,
- and citizen participation.

Teaching and Learning Approaches

- Problem-framing workshops
- Urban challenge mapping
- Governance diagnostics
- Stakeholder analysis activities
- Collaborative scenario exercises
- Guided analytical discussions

Intended Learning Outcomes

Students will be able to:

- define urban governance challenges clearly and analytically;
- distinguish between operational symptoms and structural governance problems;
- identify relevant stakeholders, governance dimensions and data sources;
- formulate analytical questions and project objectives;
- develop coherent interdisciplinary problem-analysis frameworks.

Capsule 2 Applied Urban Analytics and Decision Support

Content Summary

- Working with urban datasets within governance contexts.
- Integration of:
  - operational data,
  - spatial information,
  - KPI systems,
  - and monitoring indicators.
- Selection of analytical approaches appropriate to governance needs.
- Dashboard interpretation and communication of analytical outputs.
- Using analytics to support evidence-informed recommendations.
- Relationships between quantitative evidence and institutional realities.
- Limitations and uncertainties within urban datasets and predictive systems.

Teaching and Learning Approaches

- Urban dataset workshops
- Dashboard interpretation exercises
- Analytical problem-solving activities
- GIS-supported analysis
- Collaborative interpretation sessions
- Scenario-based governance exercises

Intended Learning Outcomes

Students will be able to:

- analyse urban datasets in relation to governance challenges;
- interpret operational and strategic indicators critically;
- formulate evidence-informed conclusions;
- identify limitations and uncertainties in analytical materials;
- evaluate the role of analytics in governance and decision-support processes.

Capsule 3 Stakeholder Coordination and Governance Implementation

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Content Summary

- Translating analytical findings into governance-oriented recommendations.
- Stakeholder coordination in interdisciplinary governance environments.
- Organisational barriers and implementation challenges.
- Governance pathways for digital and smart city initiatives.
- Building institutional and stakeholder support for transformation processes.
- Communication strategies in governance and policy contexts.
- Balancing strategic objectives with organisational feasibility and institutional capacity.

Teaching and Learning Approaches

- Stakeholder workshops
- Governance negotiation exercises
- Implementation-planning activities
- Role-playing scenarios
- Interdisciplinary teamwork
- Institutional case analysis

Intended Learning Outcomes

Students will be able to:

- formulate governance-oriented recommendations based on analytical findings;
- identify organisational and institutional implementation challenges;
- assess stakeholder coordination dynamics;
- evaluate feasibility of governance interventions;
- communicate recommendations effectively within interdisciplinary contexts.

Capsule 4 Responsible AI and Governance Evaluation

Content Summary

- Ethical and governance evaluation of proposed urban solutions.
- Assessment of:
  - transparency,
  - accountability,
  - inclusiveness,
  - sustainability,
  - and public legitimacy.
- Critical evaluation of AI-supported recommendations.
- Risks related to:
  - bias,
  - exclusion,
  - surveillance,

    - and technological dependency.
- Responsible AI principles in urban governance.
- Balancing innovation, governance responsibility and public trust.
- Evaluation of governance implications of technological choices.

Teaching and Learning Approaches

- Ethics-review workshops
- Governance evaluation exercises
- AI-risk assessment scenarios
- Structured debates
- Public-value analysis
- Reflective policy discussions

Intended Learning Outcomes

Students will be able to:

- assess ethical and societal implications of governance solutions;
- identify risks related to AI-supported systems;
- evaluate public value and legitimacy dimensions of urban innovation;
- critically analyse governance implications of technological choices;
- formulate recommendations supporting responsible and transparent urban governance.

Capsule 5 Final Capstone Project and Professional Presentation

Content Summary

- Development of an interdisciplinary urban governance project integrating:
    - governance analysis,
    - analytics,
    - stakeholder coordination,
    - ethical evaluation,
    - and implementation considerations.
- Preparation of analytical and governance-oriented outputs.
- Communication of complex findings to interdisciplinary audiences.
- Reflection on institutional feasibility, sustainability and governance implications of proposed solutions.
- Presentation and defence of project outcomes.

Projects may involve cooperation with:

- municipalities,
- metropolitan institutions,
- public agencies,
- NGOs,
- research centres,
- urban innovation ecosystems,

- and external stakeholders connected to smart city governance.

Teaching and Learning Approaches

- Capstone supervision workshops
- Project consultations
- Peer-review sessions
- Professional presentation exercises
- Interdisciplinary teamwork
- Expert-feedback discussions

Intended Learning Outcomes

Students will be able to:

- develop integrated urban governance projects;
- combine analytical, organisational and governance perspectives coherently;
- communicate project findings and recommendations professionally;
- justify governance and implementation decisions critically;
- demonstrate interdisciplinary problem-solving competences in realistic urban governance contexts.

Teaching and Learning Approaches

The module is based primarily on:

- project-based learning,
- interdisciplinary teamwork,
- applied analytics,
- governance simulations,
- collaborative inquiry,
- stakeholder interaction,
- and supervised problem-solving activities.

The pedagogical approach prioritises integration of competences, analytical reasoning, institutional awareness and reflective engagement with complex governance challenges. Particular emphasis is placed on interdisciplinary collaboration and the application of evidence-informed approaches within realistic urban contexts.

Assessment Methods

Assessment methods are aligned with the module learning outcomes and focus on interdisciplinary integration, analytical reasoning and applied governance understanding.

Assessment components may include:

- urban governance project reports,
- analytical outputs and dashboard interpretations,

- governance and implementation analyses,
- stakeholder coordination assessments,
- ethics and responsible AI evaluations,
- project presentations and defences,
- and reflective portfolios documenting the project process.

Assessment emphasises:

- analytical quality,
- governance understanding,
- interdisciplinary integration,
- stakeholder awareness,
- communication competences,
- ethical reflection,
- and the ability to connect evidence-informed analysis with practical urban governance challenges.

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