Competences for Open Data City Officer

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ODCO Curriculum

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Abstract:

Open data refers to the practice of making data freely available to everyone to use and republish without restrictions. For cities, this means publishing a wide range of municipal data, such as transportation patterns, public health statistics, budget allocations, and more. The presence of an open data city officer ensures that these practices are implemented effectively and that the data is used to its fullest potential. Open data and the role of an open data city officer are critical for cities for a number of reasons:

Firstly, open data fosters transparency and accountability. When cities publish their data openly, residents can see how decisions are made, how funds are allocated, and how services are performing. Transparency builds trust between the city administration and its citizens, encouraging greater civic engagement and participation in governance.

Secondly, open data drives innovation and economic growth. Entrepreneurs, developers, and researchers can use open municipal data to create new applications, services, and products. Transportation data, for instance, can be used to develop navigation apps, while health data can inform public health interventions. This not only stimulates local economies but also enhances the quality of life for residents through improved services and solutions.

Furthermore, open data supports better decision-making. City officials and policymakers can use data analytics to identify trends, measure outcomes, and make informed decisions. For example, analyzing crime data can help allocate police resources more effectively, while environmental data can guide sustainability initiatives.

Open data plays an essential roles in modern urban management inenhanceing transparency, stimulating innovation, improving decision-making, and ultimately contributing to the creation of smarter, more responsive cities.

Therefore, the role of an open data city officer is vital in city’s ecosystem. This officer is responsible for managing the city's open data initiatives, ensuring data quality, and facilitating access to data. They break down silos within the municipal government, promote a culture of data sharing, and engage with the community to understand their data needs. Additionally, the open data city officer collaborates with external stakeholders, such as tech companies, academic institutions, and non-profits, to leverage data for public benefit.

The OpenDCO project addresses this gap by offering a comprehensive approach to the professional development of trainees, particularly focusing on the emerging job profile of the Open Data City Officer (ODCO).

The ODCO curriculum, developed as part of the OpenDCO project, aims to equip professionals with the necessary skills to effectively address open data issues in the context of smart cities. By integrating innovative pedagogical models and self-assessment tools, the curriculum identifies competency gaps and provides flexible learning paths tailored to individual needs. It targets a diverse audience, including smart city authorities, existing municipal personnel, students of public administration, self-employed individuals, and sectoral organizations.

Key objectives of the curriculum include providing a structured framework for smart cities' education on resilience, developing innovative learning tools, closing competency gaps, promoting European collaboration on smart city education, and raising awareness among stakeholders about the complexities of smart city resilience. By addressing the shortage of knowledge and experience among prospective ODCOs, the curriculum aims to have a positive impact on smart city stakeholders.

The curriculum document outlines the educational intents and offers a dynamic framework for guiding teaching and learning processes to ensure quality control. It includes detailed descriptions of the ODCO job profile, the curriculum's objectives, competences in various categories, potential learning journeys, and competence content design.

Overall, the ODCO curriculum represents a significant step towards enhancing the resilience of smart cities by empowering professionals with the necessary skills and knowledge to navigate complex urban challenges effectively.

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2 Introduction

It is known that smart cities produce a high volume of data, originating from the urban environment, the use of public services, traffic noise levels, and population projections, among many others. During, the last years there is a growing global trend for systematically studying and opening data.

Handling open data is critically important for smart cities for several reasons. Firstly, it enhances transparency and accountability. By making data publicly available, cities allow residents to see how decisions are made, how funds are allocated, and how services are performing. This transparency fosters trust between the city administration and its citizens and encourages greater civic engagement and participation in governance. Secondly, open data drives innovation and economic growth. Entrepreneurs, developers, and researchers can use open municipal data to create new applications, services, and products. For example, transportation data can lead to the development of navigation apps, while health data can inform public health initiatives. This not only stimulates local economies but also improves the quality of life for residents through better services and solutions. Furthermore, open data supports better decision-making within city governments. By analyzing data on various aspects of urban life, city officials can identify trends, measure outcomes, and make informed decisions. For instance, analyzing traffic patterns can optimize transportation systems, while environmental data can guide sustainability efforts. Lastly, open data promotes inclusivity and collaboration. It allows different stakeholders, including government agencies, private companies, non-profits, and the general public, to collaborate and contribute to solving urban challenges. This collaborative approach can lead to more comprehensive and effective solutions that benefit the entire community.

In summary, the effective handling of open data is essential for cities to enhance transparency, drive innovation, improve decision-making, and foster collaboration, ultimately leading to more efficient, responsive, and inclusive urban environments.

The OpenDCO project focuses on improving digital, transferrable, and smart city-related competences of people interested in seeking job opportunities and careers as Open Data City Officer (ODCO) or as knowledge workers for urban settings and urban-related organizations. In response to this pressing need, the project introduces a novel job profile, the "Open Data City Officer (ODCO)", which outlines the essential competences required to address open data issues within smart city contexts.

The overarching objectives of the OpenDCO project include:

a) Establishing a structured framework for educating smart city staff on open data recognizing its paramount importance.
b) Developing an innovative curriculum tailored specifically for ODCOs.
c) Providing cutting-edge learning tools to facilitate the implementation of the curriculum.
d) Addressing competency and skills gaps among municipal officials.
e) Promoting collaboration across Europe in the field of smart cities education.

f) Enhancing awareness among member states, local authorities, municipalities, and other stakeholders about the complexity of building resilient smart cities and the challenges in acquiring relevant competencies.
g) Leveraging insights from previous ERASMUS+ projects, such as the CRISIS project, to inform and enrich the OpenDCO initiative.

The ODCO curriculum aims to delineate the essential competencies required for the emerging job profile titled "Open Data City Officer (ODCO)", focusing on open data challenges within smart urban contexts. It integrates an innovative pedagogical model that leverages a self-assessment tool to identify gaps in ODCO competencies. These insights are then amalgamated with recommendations on learning pathways (learning journey) and educational strategies, thereby offering flexible learning avenues through a modular structure.

This curriculum is specifically tailored to bridge the knowledge and experience gaps of prospective ODCOs. It targets a diverse array of stakeholders, including smart city authorities, existing municipal personnel, students of public administration-related sciences, self-employed and unemployed individuals with relevant backgrounds or experience, as well as sectoral organizations and smart city associations. With a focus on addressing imminent challenges in smart city resilience, the curriculum is anticipated to yield a positive impact among smart city stakeholders, facilitating the acquisition and development of pertinent foundational skills and key competencies.

Moreover, the curriculum document aims to clarify the content and methodology of instruction required to fulfill a set of educational objectives while also providing stakeholders with a dynamic framework to guide teaching and learning processes, and ensure a mechanism for quality control.

The rest of this document is structured as follows: Section 3 describes the ODCO Job Profile, Section 4 presents the objectives of the curriculum, Section 5 provides an outline of included competences in categories, Section 6 presents different learning journeys learners could follow and the dependencies among the modules while Section 7 describes the content design of competences.

3 ODCO Job Profile

The European Commission is supporting open data initiatives through data.europe.eu, where datasets are available under the category “regions and cities.” These datasets refer to a variety of issues (e.g., Parking slots, election results, quality of life, and environment).

At the skills development level, several organizations, higher education institutions’ (HEI) and vocational education and training’s (VET)providers are offering courses and eLearning resources on open data development and exploitation. For example, data.europe.eu is offering a large number of open data eLearning modules. Similarly, USA federal CDO council in its strategy is defining the Federal Chief Data Officer position.

Other organizations, such as Open Data Institute, are offering selected courses on the topic. These are a few of the many systematic training offerings available worldwide.

Even though educational offerings on open data are available, we are lacking:

- an occupational profile that is focusing on smart cities' open data at the European level
- a systematic curriculum able to cover all different aspects of an Open Data City Officer (ODCO).

The two factors above constitute the main contribution of this project, which is considered quite important, taking into account the impact open data may have on the economic growth of European cities. By integrating these imperatives into the ODCO job profile, the curriculum responds to the identified competencies unearthed through comprehensive research, focusing on the most competitive and highly valued relevant skills. The context of the competences revealed after the research was done for the most competitive and high valued relative skills considering:

i. a literature review in order to get an overall view of the competencies that have been developed in the context of open data for several case studies
ii. a market analysis to check which technical requirements are placed on open data platforms
iii. identified an initial catalog of competences and discussed them in a workshop with smart city stakeholders
iv. based on these findings, we created an online questionnaire and evaluated it in a total of five European countries
v. conducted several workshops with various stakeholders from the field of open data and smart cities to finalise the evaluation of competencies
vi. results from the observations were risen from discussion among project partners - focus groups- to decide for those that address the project's objectives

Above all, in the first step, we had to determine the necessary skills baed on a literature review to develop an understanding of the skills and the knowledge framework for progression to design the research. This helped identifying and analyzing training needs, resulting in better choices for structuring a specific need assessment. In the next step, we carried out a comprehensive market analysis and looked at a large number of existing open data platforms in order to check what technical requirements are placed on them, what scope they offer, and how they can be operated. We then discussed and evaluated the competences derived from these two steps in an initial workshop with decision-makers from a smart city.

In the subsequent phase, the project team undertook market research by administering a questionnaire to both public and private sector staff. This survey aimed to provide insights into their respective roles, responsibilities, educational backgrounds, skills, and competences deemed essential for inclusion in the ODCO job description. The collated data was then compared to relevant findings at the European level to compile a comprehensive study on European countries' needs. After this, we conducted several workshops with various stakeholders from the field of open data and smart cities to finalise the evaluation of competences.

Afterward, an updated literature review was elaborated to find recent trends and research done in the field. Finally, the consortium, after discussing the research results, selected the 20 competences that should be included in the ODCO curriculum. Additionally, it was outlined the ODCO curriculum by making strategic decisions about what courses and modules the curriculum will cover and

- module's aims and objectives
- how modules connect
- criteria for successful completion
- how in-depth lessons will be taught to achieve both breadth and balance within and across subjects
- learning paths
- weekly study time
- the training plans
- the course calendar and the distribution of modules and learning units throughout the calendar

3.1 ODCO curriculum learning objectives

In accordance with the European Qualifikatopm Framework, learning objectives are articulated as "statements delineating what a learner should comprehend, master, and demonstrate upon culmination of a learning endeavor." Broadly defined, the learning objectives of the modules encompassed in this curriculum aspire to cultivate competences across various cognitive domains, including knowledge acquisition, comprehension, application, analysis, synthesis, and evaluation, regarding:

- principles and fundamental concepts underpinning open data and open data management
- advocacy for sustainable open data initiatives
- utilization of tools aimed at enhancing a city's open data management
- comprehension and assessment of risks and challenges impacting open data
- adoption of standards and performance metrics for assessing open data
- formulation and implementation of open data strategies
- preparedness and response planning within the context of open data in smart cities
- strategic management approaches for enhancing open data in smart cities
- transitioning from conventional urban frameworks to create open data cases

3.2 Groups of Competences

With the goal of covering all areas of the ODCO body of knowledge, the consortium endeavored to classify competences, which resulted in three clusters. These three clusters are:

a) Smart City and Open Data fundamentals (e.g., stakeholder management, open data legal framework, infrastructure, etc.)

b) Open Data management fundamentals (e.g., artificial intelligence, programming, big data, open data standards and quality, etc.),

c) Open Data exploitation and application skills (e.g., data literacy, open data for health and mobility, etc.).

4 OpenDCO Job Profile's Competences

4.1 ODCO Competences

In the following chapters, we will introduce the essential competences of an Open Data city officer (ODCO). These chapters will cover the foundational skills required for effective open data management, smart city organization, and the exploitation and application of open data. By understanding these competencies, an ODCO can better harness the potential of urban data to drive innovation, enhance transparency, and improve the quality of life for city residents.

4.2 Smart City and Open Data fundamentals

Skills in this group are crucial for an ODCO. These skills equip the officer with the knowledge to effectively manage and utilize urban data essential for driving innovation and improving city services. Understanding smart city concepts allows the officer to integrate various technologies and data sources to create more efficient and sustainable urban environments. Additionally, proficiency in open data principles ensures that the officer can promote transparency, facilitate civic engagement, and foster collaboration with stakeholders. Ultimately, these skills enable the ODCO to harness the full potential of data to enhance city operations and improve the quality of life for residents.

No	Skill	
1	Stakeholder management	Smart cities and open data involve the active participation of several stakeholder categories. This course module focuses on the identification of the stakeholders, the provision of awareness on the topic and identify and provide methods and practices for the actual use of open data in relation with smart city framework. In addition, the module will define strategies on the engagement of stakeholders for the provision of data for the implementation and establishment of services as part of a smart city. This module provides an understanding of the stakeholders' profile, the basic and necessary knowledge for smart cities and open data and applying the principles and attributions needed for a functional smart city.
2	Services and Service Structures	As more and more communities embrace digital transformation, understanding the design, delivery, and optimization of services becomes paramount to create

		efficient, sustainable, and user-centric smart cities. In this module, trainees will dive into the realm of services and service structures tailored to the unique challenges and opportunities of smart cities. The module explores the intricacies of various services integral to smart city ecosystems, encompassing transportation, energy, healthcare, waste management, governance, and more. The module will emphasize the fusion of advanced technologies, data-driven insights, and citizen engagement to orchestrate seamless service delivery, contributing to a holistic and thriving smartcCity environment.
3	Smart City Business Models	This module examines the innovative business models for smart cities utilizing open data. The module analyzes existing business models, identifies the most relevant models for smart cities and presents best practices on open data utilization. Cities are challenged with increasing population and need to implement smart solutions. One such avenue for tacking urban issues is using open data.
4	Smart City Service Co-design and Generation of New Revenue	As cities worldwide seek sustainable and efficient solutions, the collaborative process of service co-design becomes instrumental in creating user-centric smart city services and new revenues. The module explores smart city service co-design and strategies to generate new revenue streams. Moreover, the module delves into the monetization potential of these services, enabling trainees to identify and capitalize on revenue opportunities within the context of smart cities.
5	Open Data Legal Framework, Privacy, and Ethics	This module explores the intricate intersection of open data, legal frameworks, privacy considerations, and ethical principles. Participants will delve into the rights, licenses, and data protection regulations that govern the openness, use, and dissemination of open data. The course will also examine the ethical and commercial interests tied to open data initiatives, particularly in the context of urban environments. Additionally, participants will gain insights into intellectual property law as it pertains to scientific projects involving collaborations with companies and other stakeholders within city ecosystems.
6	Open Data Vision, Strategy, Planning, and Communication	This module is designed to equip participants with the skills and knowledge needed to lead open data initiatives and effectively manage projects throughout their lifecycle. It covers a broad spectrum of

		competencies essential for success in the realm of open data, including strategic thinking, long-term planning, decision-making, transparency promotion, and data dissemination. Participants will learn how to work with diverse stakeholders, develop budgets and timelines, and employ various communication strategies to drive the use and understanding of open data in communities and organizations.
7	Smart City Infrastructure as a Supplier of Open Data	This module explores the pivotal role of smart city infrastructure in generating and supplying open data to foster innovation within the public sector. Participants will delve into the concepts of open data, open sensor networks, and crowdsourcing platforms, discovering how these elements can drive user-driven innovation. The course also covers cost management techniques specific to implementing open data programs and infrastructures, cibersecurity criterias for ensuring efficiency and budget compliance.

4.3 Open Data Management Fundamentals

Skills in the area of open data management fundamentals are crucial for an OPDC. These skills ensure the officer can effectively collect, curate, and disseminate municipal data. Proficiency in open data management enables the officer to maintain high data quality, ensure data security, and comply with relevant regulations. Additionally, these skills facilitate the creation of user-friendly data platforms, making data easily accessible to the public and other stakeholders. By mastering open data management fundamentals, the officer can promote transparency, drive civic engagement, and support data-driven decision-making, ultimately enhancing city services and improving residents' quality of life.

No	**Skill**	
8	Programming	This module presents an introduction to the fundamentals of programming using the Python language. Python is recognized as the appropriate programming language for beginners who aim to understand basic programming principles and cultivate their ability to solve problems due to its simplicity, ease of understanding, and flexibility. In this module, participants will learn how to harness the power of Python by introducing them to the fundamental concepts of programming, such as variables, data types, operators, control structures (conditional statements and loops) etc. Learners will also gain a comprehension regarding the execution of programs and the creation of fundamental Python code.

9	Big Data Analytics and Tools	Big data analytics and tools play an increasingly important role in the implementation of smart cities initiatives. Big data is an invaluable source of information and can be used to gain insights into what is happening in real-time in a city, in order to better optimize services and facilitate decision-making. It allows city planners to identify patterns and trends, as well as detect and analyze exceptions, in order to better equip cities to respond to upcoming needs. This module describes the basic data analytics techniques and how can be applied in open data in the context of smart cities. In detail, the first unit describes basic data analytics techniques. The second unit describes how big data analytics can be applied in smart cities context. The last unit describes the visualization and outlier detection methods and how can be applied in open data in the context of smart cities.
10	Artificial Intelligence and Open Data	Artificial intelligence (AI) is becoming increasingly important to the development of smart cities. AI can be used to help analyze data, detect patterns, and make predictions. In order for AI to have a meaningful and positive impact in smart cities, it must make use of open data. Open data provides citizens, developers, and researchers with access to data that can be used to develop applications and services that can improve the quality of life and increase the efficiency of city operations. This module describes the basic AI and machine learning techniques and how can be applied in open data in the context of smart cities. In detail, the first unit describes the machine learning classification method and how can be applied in open data in the context of smart cities. The second unit describes the regression and forecasting methods and how can be applied in open data in the context of smart cities. The last unit describes the clustering and recommendation methods and how can be applied in open data in the context of smart cities.
11	Open Data Governance	This module illustrates the concept of data governance. It presents the data governance functionality, processes, and control. It also describes the items of a data governance framework. The second unit of this module presents privacy and secure governance. It lists the FAIR principles for data and analyzes the need for trade-offs in designing data governance. It also describes the responsibilities of stakeholders. The last unit explains the functionality and characteristics of data governance frameworks for smart cities. Finally, it explains the

		functionality of some powerful data governance tools for smart cities.
12	Open Data Security	The module "open data security provides the following: Ensuring methods and techniques for the integrity, confidentiality, and availability of open data within smart cities. Furthermore, it provides guidelines for implementing access controls, data encryption, and secure APIs and addresses network security and user awareness. It also provides guidelines on how to develop an incident response plan, regular backups, and comply with regulations and provides guidelines on monitoring activities and enforces user accountability to safeguard against unauthorized access and breaches.
13	Open Data Standards	This module deals with the important topic of standards in open data, and particularly those related to smart cities. Open data standards play a significant role in enabling smart cities to gather, manage and share data, both within their own organizational structure and with other cities and entities, in a way that reinforces and enhances transparency, integrity, productivity and collaboration. In this module students will be introduced to the concept and advantages of standards in general, will focus on standards related to open data in particular, and appreciate the benefits and challenges of their use. Moreover, key open data standards will be presented and linked to smart cities' activities and services, while the important concept of data interoperability and data exchange will be explored. Lastly, best practices for implementing open data standards in smart cities will be discussed, and future trends will be presented.
14	Open Data Quality	This module illustrates the concept of data quality and emphasizes that poor-quality data can decrease the performance of smart cities. It presents basic data quality dimensions that indicate the overall quality level of data. Measuring data quality levels helps smart city stakeholders identify data errors that need to be resolved and assess whether the data in their IT systems is fit to serve its intended purpose. The second unit of this module presents the steps involved in the data quality management and metadata management processes. It also describes the dispositive data storage practices and the data virtualization approach. The last unit explains the functionality and characteristics of open data portals and presents some examples of well-known open data

		portals. Finally, it explains the functionality of powerful open data management platforms and presents some examples of such platforms.
15	Open Data Visualization, Sharing, and Distribution	Comprehending the complexity and dynamic nature of cities in order to foresee and guide their progress is important. The development of a smart city can benefit from the presence of relevant datasets showcasing diverse perspectives and methodologies capable of actively scrutinizing these datasets to uncover concealed patterns, correlations, and valuable data attributes. In this regard, data visualization, a widely recognized technique for shedding light on and enhancing the comprehension of data, emerges as a promising avenue for gaining fresh insights into data evidence. It is expected that the amount of data in smart cities will double approximately every 1.2 years. The relationships between the data must be shown after it has been analyzed in order to draw conclusions. Sometimes, rather than producing and capturing more data, the problem may be finding new ways to evaluate and make judgments regarding the existing data. By presenting some of the most popular methods to data visualization disciplines and contextualizing them within the most cutting-edge European efforts and projects, we hope to provide an overview of data visualization in this module.

4.4 Open Data Exploitation and Application Skills

Skills in Open Data Exploitation and Application are crucial for an oDCO. These skills enable the officer to analyze and utilize open data effectively, transforming raw data into valuable insights and applications. Proficiency in this area allows the officer to identify opportunities for innovation, optimize city operations, and improve public services through data-driven solutions. Additionally, these skills help the ODCO to collaborate with developers, researchers, and businesses to create impactful applications and tools that benefit the community. Ultimately, expertise in open data exploitation and application ensures that the city's data resources are leveraged to their full potential, enhancing transparency, efficiency, and quality of life for residents.

No	**Skill**	
16	Open Data Literacy	This module introduces Open Data Literacy. Firstly, it explains which areas are strengthened by open data literacy. The module shows which competences are required when using datasets.

17	Open Data Marketplaces (Open Data Platforms) and Open Data Business Models	This module introduces open data in the context of open data portals and marketplaces and the ability to generate revenue by offering open data in smart cities. First, relevant knowledge about open data portals, marketplaces and business models in the urban context is provided. After that, we show how to enable the use and offer of platforms and marketplaces. Finally, by looking at case studies, we derive implementation possibilities for smart city's based on.
18	Open Data for the City's Education and Health	This module introduces open data in the context of health and education in smart cities. First, the role of public health and education for smart cities is shown in general. After that, we review which data is collected and analyzed generally in the two domains. Finally, by looking at case studies, we derive the potential and challenges of open data for the education and public health sector.
19	Open Data For The City's Mobility/Logistics/Economy	This module introduces open data in the context of mobility, logistics, and economy in smart cities. First, the role of mobility, logistics, and economy for smart cities is shown in general. After that, we review which data is collected and analyzed generally in the three domains. Finally, by looking at case studies, we derive the potential and challenges of open data for mobility, logistics and economy in smart cities.
20	Open Data for City's Environmental Issues	The intent of this module is to explain the importance of open data and discuss opportunities and barriers in the context of environmental issues in smart cities. Based on this, in the module successful case studies in this area of application will be discussed and analyzed. Finally, various strategies for leveraging open data in the context of environmental issues in smart cities are evaluated and recommendations for the selection of the relevant stakeholders to design data-driven interventions and policies are provided.

5 Module Learning Objectives and Learning Outcomes

Module	Learning objectives	Module learning outcomes
1. Stakeholder management	• Identify relevant stakeholders • Provide awareness for smart cities and open data • Identify methods and practices for stakeholders' utilisation of open data • Define strategies to engage stakeholders in contributing to data provision for the use and reuse of services with respect to smart city.	• To define factors identifying relevance of stakeholders • To identify the stakeholders that impact open data and smart cities • To explore the benefits and challenges of open data and smart cities • To use and reuse the practices of open data for smart cities • To examine multi-stakeholders approaches for open data in smart cities • To create engagement strategies of stakeholders within the context of open data in smart cities
2. Services and Service Structures	• Understanding the foundations of smart cities services and service structures • Identifying key smart city service domains and their challenges • Analyzing service delivery models • Embracing data-driven service design • Fostering citizen-centric service innovation	• Define key services and service domains within smart cities • Identify service delivery models suitable for smart cities, considering factors like scalability, resource optimization, and user experience. • Articulate the principles and components that underpin services in smart cities. • Compare interdisciplinary approaches for designing and implementing smart city services. • Utilize data analytics, IoT integration and predictive modelling to inform data-driven service design in smart cities. • Implement innovative and user-centric service structures for smart cities, fostering efficiency, sustainability, and a higher quality of life.

	• Envisioning and strategizing the Future of smart city services based on best practices	• Adapt service structures based on real-world scenarios and case studies, understanding the implications of different strategies in diverse urban contexts.
3. Smart City Business Models	• To define a framework for understanding and describing innovative business models. • To understand the role of data analytics in transforming cities considering challenges and best practices. • To define a methodological approach to analyze business models. • To apply the methodological approach for selecting smart city business models.	• Describe the concept of a business model • Define five patterns to classify business models • Identify the nine building blocks of Business Model Canvas • Recognize the concepts and current debates around smart, sustainable and innovative smart cities using open data • Identify seven smart city conceptual models • Identify the connections between urban innovation, open data, enterprise, and smart city business models • Identify six challenges related to smart city business models • Explain the role and importance that ICT, data and urban analytics can play in addressing key urban challenges and key issues related to this • Apply the framework for the selection of smart city business models
4. Smart City Service Co-design and Generation of New Revenue	• Understanding the principles and benefits of service co-design • Identifying the role of key stakeholders in the co-design process • Mastering co-design methodologies and tools for smart city services • Applying empathy and user-centricity in service co-design • Generating actionable service prototypes and implementation	• Define service co-design and its numerous advantages in fostering innovative and user-centric solutions for smart cities • Articulate a clear understanding of service co-design principles and their application for smart city initiatives. • Identify the specific roles and contributions of key stakeholders in the co-design process, understanding their significance in shaping successful service outcomes. • Explore revenue generation models and best practices for smart city services. • Apply co-design approaches, ensuring that the needs and preferences of citizens are at the forefront of the process for designing smart city services.

	plans • Exploring revenue generation models for smart city services and identifying best practices.	• Utilize various co-design methodologies and tools, enabling effective collaboration and ideation for smart city services. • Apply service co-design knowledge and methodologies to generate actionable service prototypes and implementation plans, translating co-designed ideas into practical and well-defined smart city projects.
5. Open Data Legal Framework, Privacy, and Ethics	• Analyze and understand the ethical implications and commercial interests associated with open data access in urban contexts. • Identify and navigate the legal frameworks, rights, and licenses governing open data usage and distribution. • Understand the anonymization techniques related to the opening of data that contain personal or sensitive data, to evaluate the impact of personal data protection regulations on open data initiatives. • Comprehend intellectual property law as it relates to scientific projects involving external stakeholders within city ecosystems.	• Participants will recall and describe the ethical and commercial interests associated with open data in urban environments. • Participants will list the legal frameworks and rights relevant to open data. • Participants will summarize key aspects of data protection regulations. • Participants will explain the basics of intellectual property law in scientific projects involving stakeholders. • Participants will interpret the implications of open data on urban development and privacy. • Participants will explain how different licenses impact data usage. • Participants will differentiate between various legal frameworks governing open data. • Participants will illustrate the role of ethical considerations in data access and usage. • Participants will analyze real-world scenarios to determine the appropriate legal and ethical approaches to open data usage. • Participants will apply their knowledge of data protection regulations to assess compliance in open data initiatives. • Participants will draft recommendations for handling intellectual property issues in collaborative scientific projects within city ecosystems.

		• Participants will compare and contrast the ethical and commercial aspects of open data in diverse urban contexts. • Participants will assess the legal implications of data breaches and privacy violations in open data initiatives. • Participants will analyze the potential conflicts and challenges arising from intellectual property disputes in city-based scientific projects. • Participants will create comprehensive strategies for implementing ethical open data practices in urban development. • Participants will synthesize legal and ethical principles to develop a holistic approach to open data governance. • Participants will construct innovative solutions to address intellectual property challenges in collaborative scientific projects involving city stakeholders. • Participants will critique the effectiveness of different open data legal frameworks and licenses. • Participants will evaluate the ethical and commercial consequences of open data decisions within city environments. • Participants will assess the impact of data protection regulations on open data initiatives and propose improvements if necessary.

6. Open Data Vision, Strategy, Planning, and Communication	• Develop and manage project budgets and timelines while collaborating with diverse stakeholders. • Formulate and implement long-term strategic plans for effective data management and utilization. • Introduce decision-making processes and problem-solving approaches, including Decision Theory fundamentals. • Enhance transparency within cities to accelerate innovation and foster collaboration. • Define and implement transparent, accountable, and inclusive approaches to share publicly available data with citizens, businesses, researchers, and policymakers. • Utilize various engaged communication channels and strategies to promote open data usage, engage with different communities, and gather feedback and input.	• Participants will recall and explain the essential components of project budgeting and timeline management in open data initiatives. • Participants will describe the key elements of long-term strategic planning for data management and use. • Participants will list the fundamental principles and methods of decision theory. • Participants will define the concept of transparency and its significance in fostering innovation. • Participants will interpret the role of stakeholders in open data projects and how to effectively collaborate with them. • Participants will explain the process of formulating and implementing long-term plans for data management. • Participants will demonstrate an understanding of decision-making processes and problem-solving approaches. • Participants will apply project management skills to develop strategies and timelines for open data initiatives. • Participants will apply strategic thinking to develop comprehensive data management plans. • Participants will utilize decision-making techniques to address specific decision problems in open data contexts. • Participants will analyze the impact of transparency on innovation and collaborative work within cities. • Participants will assess the effectiveness of data dissemination approaches in reaching diverse stakeholders. • Participants will evaluate the communication strategies employed in promoting open data usage and engagement. • Participants will create comprehensive project plans for open data initiatives, including strategies, timelines, and stakeholder engagement strategies.

		• Participants will synthesize decision-making processes and apply them to complex decision problems in open data management. • Participants will design innovative communication campaigns to promote open data usage and gather feedback from diverse communities and stakeholders. • Participants will critique the transparency initiatives and their impact on accelerating innovation. • Participants will assess the inclusivity and accountability of data dissemination methods. • Participants will evaluate the effectiveness of communication channels and strategies in advancing open data understanding and engagement.
7 Smart City Infrastructure as a Supplier of Open Data	• Effectively manage costs in the implementation of open data programs and infrastructures within smart cities. • Explain the fundamental concepts of smart city infrastructures and their relationship with open data initiatives. • Analyze the role of open data in enhancing innovation and efficiency within city environments. • Develop a comprehensive understanding of cost management, including identifying areas for cost	• Participants will recall and describe the core elements of smart city infrastructure that contribute to open data generation. • Participants will define the concept of open data and its significance in public sector innovation. • Participants will list the factors that influence cost management in open data program implementation. • Participants will explain the relationship between smart city infrastructure and open data initiatives. • Participants will interpret how open data can drive user-driven innovation in the public sector. • Participants will summarize the principles of cost management in open data projects. • Participants will apply cost management techniques to identify areas for cost reduction in open data programs. • Participants will utilize open data concepts to propose innovative solutions for public sector challenges.

	reduction and prioritizing technical infrastructure, cibersecurity criterias, and human resources. • Calculate and track target and actual costs to ensure budget compliance throughout open data projects.	• Participants will employ cost management strategies to prioritize technical infrastructure, data security, and human resources in open data projects. • Participants will analyze the impact of smart city infrastructure on the availability and quality of open data. • Participants will assess the potential benefits and risks of open data initiatives within smart cities. • Participants will evaluate cost management approaches and their effectiveness in controlling open data program expenses. • Participants will create comprehensive cost management plans for open data program implementation within smart cities. • Participants will synthesize open data concepts to develop innovative solutions for public sector challenges. • Participants will design strategies for ensuring budget compliance throughout open data projects, including monitoring target and actual costs. • Participants will critique the efficiency and effectiveness of open data in driving public sector innovation. • Participants will assess the adequacy of cost management strategies in meeting budgetary goals for open data programs. • Participants will evaluate the alignment of open data initiatives with the goals and priorities of smart city infrastructures.
8. Programming	• Introduction to Python Programming: Understanding the concept and significance of the Python programming language and its popularity in data-related tasks.	• Learners will be able to define the fundamental concepts of the Python programming language. • Learners will be able to recognize different types variables and control structures . • Learners will be able to explain the significance of Python programming language in data-related tasks.

	• Setting up the appropriate environment: Installing Python and necessary libraries. • Definition of basic Python programming concepts: variables, data types and operators. • Comprehension of conditional statements and loops in Python language. • Demonstration of various examples related to data structures. • Creating graphs and charts to represent data insights. • Discussion of emerging trends in open data and programming.	• Learners will be able to identify and describe essential programming concepts such as variables, data types, and operators in Python, laying the foundation for writing and understanding basic code. • Learners will be able to use conditional statements giving appropriate examples. • Learners will be able to write code that makes decisions based on conditions (if-else) and perform repetitive tasks using loops (for, while). • Learners will be able to demonstrate examples of writing basic code using Python.
9. Big data analytics and tools	• Students learn about the taxonomy of big data analytics' techniques (Unit 1) • Students become familiar with Spark (Unit 2) • Students learn about visualization and outlier detection in data (Unit 3)	• Describe basic data analytics techniques. • Discuss how big data analytics can be applied in smart cities context. • Describe data analytics tools. • Describe visualization techniques. • Discuss outlier detection algorithm • Apply a spark in a smart city related problem. • Apply visualization in data related to smart cities. • Students will be able to apply an outlier detection algorithm in a smart city related problem.
10. Artificial Intelligence and Open Data	• Students learn about the machine learning classification methods in a smart city context (Unit 1)	• Describe different artificial intelligence methods. • Describe the basic artificial intelligence and machine learning classification techniques.

	• Students learn about the regression and forecasting Methods in a smart city context (Unit 2) • Students learn about the unsupervised learning and recommendation methods in a smart city context (Unit 3)	• Discuss the basic machine learning regression techniques. • List the basic unsupervised learning techniques. • Describe the basic recommendation techniques. • Apply a learning algorithm in a smart city related classification problem. • Apply a learning algorithm in a smart city related regression problem. • Apply a forecasting algorithm in a time-series smart city related problem. • Apply a clustering algorithm in a smart city related problem. • Apply a recommendation algorithm in a smart city related problem.
11. Open Data Governance	• Students learn about the concept of data governance and the items of a data governance framework (Unit 1) • Students dive into the data governance policies, and practices adopted to release and use publicly available data in a transparent, accountable, and inclusive manner process in a smart city context (Unit 2) • Students learn the functionality of data governance frameworks and tools for smart cities (Unit 3)	• By the end of this course, students will be able to understand the data governance functionality, processes, and control. • Students will be able to describe the items of a data governance framework. • Students will be able to describe privacy and secure governance. • Students will be able to list the FAIR principles for data and analyze the need for trade-offs in designing data governance. • Students will be able to describe the responsibilities of stakeholders to shape the data governance in a smart city context. • Students will be able to describe the functionality and characteristics of data governance frameworks for smart cities. • Students will be able to describe the functionality of powerful data governance tools for smart cities.

12. Open Data Security	• Understand Security Fundamentals: Explain the core principles of data security, including confidentiality, integrity, and availability, within the context of open data in smart cities. • Implement Access Controls: Describe the importance of access controls and demonstrate the ability to set up role-based access permissions and authentication mechanisms for open data. • Apply Data Encryption: Comprehend data encryption techniques and apply encryption methods to protect open data both in transit and at rest. • Ensure Compliance and Privacy: Recognize legal and regulatory requirements related to data protection and privacy, and outline strategies to maintain compliance when handling open data. • Establish Incident Response Plans: Develop an understanding of incident response procedures	• Learners will be able to define and differentiate the core principles of data security, including confidentiality, integrity, and availability, as they relate to open data within smart city contexts. • Learners will be able to explain the concept of access controls and identify key elements such as role-based permissions and authentication methods, illustrating their significance in safeguarding open data. • Learners will comprehend the principles of data security in-depth, including how confidentiality ensures restricted access, integrity maintains data accuracy, and availability guarantees timely access to open data within the dynamic environment of smart cities. • Trainees will demonstrate a comprehensive understanding of access control mechanisms, including the ability to design and implement tailored permissions for different user roles, and recognize the role of robust authentication methods in preventing unauthorized data access. • After this module, learners will be able to configure access controls for different user roles, ensuring that only authorized individuals can access specific open data resources within a smart city. • Learners will be able to identify potential security vulnerabilities within open data systems in smart cities and propose appropriate access controls and encryption methods to mitigate these risks effectively.

	and construct a plan to efficiently address and mitigate potential security breaches involving open data. • Monitor and Detect Anomalies: Demonstrate the ability to implement monitoring systems, track user activities, and identify anomalous behavior that could indicate security threats to open data. • Promote User Awareness: Illustrate the importance of user education in maintaining open data security, and design a user awareness program to promote best practices for safe data handling.	
13. Open Data Standards	• Learn about open data standards, their importance and relevance to smart cities • Be introduced to key open data standards and especially those related to the smart cities domain • Understand the challenges of implementing open data standards and explore best practices, tools and resources for that purpose	• Describe what open standards are compared to closed ones • Recognize the role of open data standards in smart cities • Differentiate between key open data standards used in smart cities' related services • Identify the benefits of standardization in data sharing • Discuss about the importance of interoperability in data sharing • Discuss about challenges, best practices and tools in implementing open data standards • Deliberate on future trends and challenges in open data standards

14. Open Data Quality	• Students learn about the data quality dimensions and the importance of a high data quality system in a smart city context (Unit 1) • Students dive into the data quality management process (Unit 2) • Students learn the functionality of open data portals and open data management platforms (Unit 3)	• By the end of this course, students will be able to describe the data quality dimensions. • Students will be able to describe how data quality differs with big data and why data quality for big data is important. • Students will be able to describe the steps of the data quality management process. • Students will be able to describe the steps of the metadata management process. • Students will be able to describe the dispositive data storage practices and the data virtualization approach. • Students will be able to explain the functionality and characteristics of open data portals and present some examples of well-known open data portals. • Students will be able to explain the functionality of powerful open data management platforms and present some examples of such platforms.
15. Open Data Visualization, Sharing, and Distribution	• Introduction to data visualization • Presenting suitable datasets illustrating several urban perspectives based on the availability of open data • Finding new ways to interpret and come to decisions about city data • Be aware about advanced European initiatives and projects regarding data visualization	• Define open data and its relevance in the context of smart cities • Recognize the potential benefits and challenges associated with using open data in smart city initiatives. • Understand essential data requirements • Explore various tools and platforms available for collecting urban data • Summarize exploitation ways of ppen data sources • Describe data visualization techniques and examples • Use visualization for data related to a smart city and come to decisions • Discover the benefits of data sharing in smart city

		• Hypothesize and recommend best practices, tools and resources for data related to a smart city problem.
16. Open Data Literacy	• Students get introduced to open data literacy (Unit 1) • Students learn how data users are able to understand the provided open data (Unit 2) • Students dive into how to understand open data and how open data literacy can be applied (Unit 3)	• By the end of this course, students will be able to describe the basic concept of open data literacy. • By the end of this course, students will be able to memorize the role of open data literacy. • By the end of this course, students will be able to discuss the importance of open data literacy. • By the end of this course Students will be able to summarize why open data literacy is needed for the usage of data data and what competences are required for the usage of data. • By the end of this course, students will be able to identify the required competences. • By the end of this course, students will be able to derive the required competences for different use cases. • By the end of this course, students will be able to use the required competences for various cases of open data.
17. Open Data Marketplaces (Open Data Platforms) and Open Data Business Models	• Students get introduced to open data marketplaces (Open Data Platforms) and business models in Cities (Unit 1) • Students learn about the Opportunities through open data marketplaces (Unit 2) • Students dive into open data Portals and how open data can be published, visualized, or identified and how to download different	• By the end of this course, students will be able to describe the basic concept of open data marketplaces. • By the end of this course, students will be able to memorize the role of open data business models for cities. • By the end of this course, students will be able to discuss the potential of open data marketplaces. • By the end of this course, students will be able to discuss the potential of open data business models. • By the end of this course will be able to summarize the usage of data platforms and data marketplaces and how their use facilitates and streamlines the publishing process

	datasets. (Unit 3)	• By the end of this course, students will be able to identify, publish and visualize open data • By the end of this course, students will be able to download different datasets • By the end of this course, students will be able to identify, publish and visualize open data. • By the end of this course, students will be able to download different data sets and analyze the data. • By the end of this course, students will be able to develop new business models of (on their own) open data platforms.
18. Open Data for the City's Education and Health	• Students learn about the importance of health and education in smart cities (Unit 1) • Students get introduced to data collected and analyzed in the education and health sector (Unit 2) • Students dive into the education sector and how open data may contribute to improving education (Unit 3) • Students dive into the public health sector and how open data may contribute to improving public health (Unit 4)	• By the end of this course, students will be able to describe the role and importance of health and education in smart city context. • By the end of this course, students will be able to recall the data collected and ways to analyze it in the fields of education and health. • By the end of this course, students will be able to discuss the potential and challenges of open data in the education sector. • By the end of this course, students will be able to discuss the potential and challenges of open data in the health sector. • By the end of this course, students will be able to explain why given data sources have potential for the education or the health sector. • By the end of this course, students will be able to critically inspect the feasibility of open data projects in education and public health sector. • By the end of this course, students will be able to determine the current situation in education and public health. • By the end of this course, students will be able to develop new scenarios for (their own) cities on how open data could be applied in education and the public health sector.

19. Open Data For The City's Mobility/Logistics/ Economy	• Students learn about the importance of mobility, logistics and economy in smart cities (Unit 1) • Students get introduced to data collected and analyzed in the mobility, logistics and economy sector (Unit 2) • Students dive into the three sectors and how open data may contribute to improving mobility, logistics and economy (Unit 3)	• By the end of this course, students will be able to describe the role and importance of mobility, logistics and economy in smart city context. • By the end of this course, students will be able to recall the data collected and ways to analyze it in the fields of mobility, logistics and economy. • By the end of this course, students will be able to discuss the potential and challenges of open data in the mobility sector. • By the end of this course, students will be able to discuss the potential and challenges of open data in the logistics sector. • By the end of this course, students will be able to discuss the potential and challenges of open data in the economy sector. • By the end of this course, students will be able to explain why given data sources have potential for the mobility, logistics and economy sector. • By the end of this course, students will be able to critically inspect the feasibility of open data projects in mobility, logistics and economy sector. • By the end of this course, students will be able to determine the current situation in mobility, logistics and economy. • By the end of this course, students will be able to develop new scenarios for (their own) cities on how open data could be applied in mobility, logistics and economy sector.
20. Open Data for City's Environmental Issues	• Understanding the importance of open data in the context of environmental issues in smart cities. • Discussion of opportunities and barriers related to open data in the context of environmental issues in smart cities.	• Identify and describe the importance of open data in the context of environmental issues in smart cities. • Summarize and outline the opportunities for open data in the context of environmental issues in smart cities. • Explain the barriers to open data in the context of environmental issues in smart cities. • Identify case studies on successful open data initiatives in environmental issues. • Analyze applications of open data in the context of environmental issues in smart cities

	• Discovering of basic case studies on successful open data initiatives in environmental issues. • Analysis and Evaluation of applications of open data in the context of environmental issues in smart cities. • Derive various strategies for leveraging open data in the context of environmental issues in smart cities and identify relevant stakeholders to design data-driven interventions and policies.	• Evaluate strategies for leveraging open data in the context of environmental issues in smart cities and • Choose relevant stakeholders to design data-driven interventions and policies.

6 Module designation and development

The curriculum designed to impart ODCO competences is structured into modules. Each competency covered in the course is allocated to one or more of these modules. Furthermore, each module comprises units, which in turn consist of learning objects. In pursuit of establishing a modular curriculum that facilitates diverse learning paths, it is crucial to have a universal designation technique for all modules across the various learning paths incorporated within the curriculum.

6.3 Module Designation

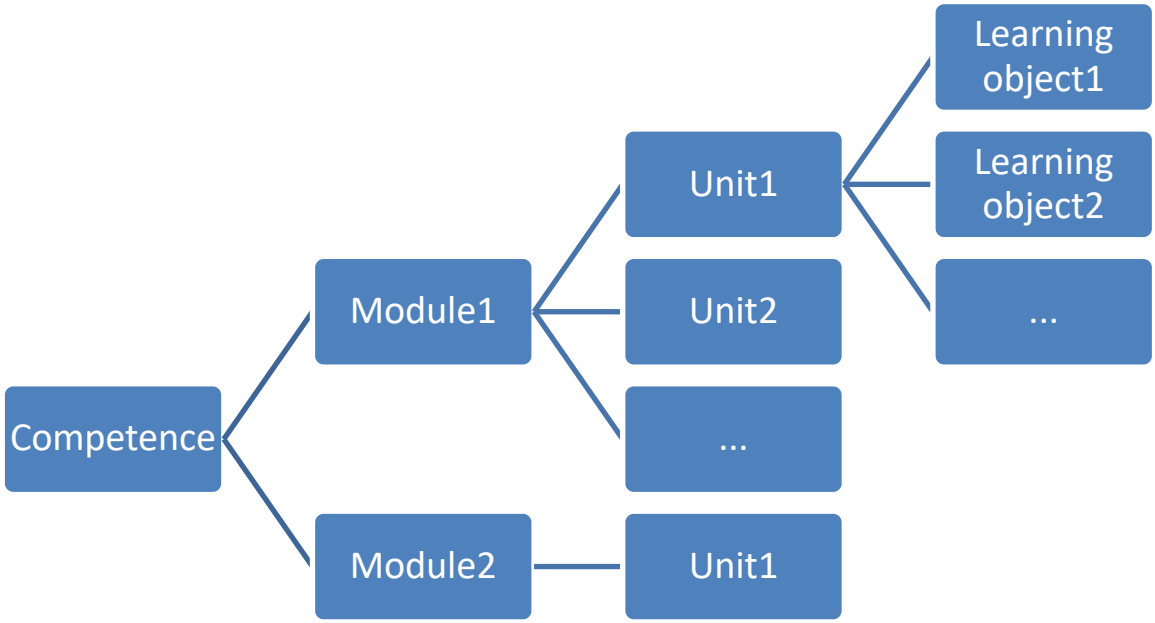

Figure 4.: Competence content hierarchy

6.4 Module development

6.4.1 Module specification - TB1 template

During the designation phase of each module, the following elements are defined: (i) learning objectives, (ii) learning activities, (iii) educational techniques, and (iv) the module's units along with their respective learning outcomes. To facilitate a systematic and consistent approach to the designation of all training modules, a template named TB1

has been developed. This template encompasses the aforementioned information, in addition to supplementary details necessary for its implementation. The template is structured to include the following fields: Table filename:

mm.TB1: MODULE TITLE SPECIFICATION *(mm: MODULE ID)*		
1	Module ID	*Module ID, the unique ID for each module according to the curriculum*
2	Module title	*Title of the module according to the curriculum*
3	Language	English
4	Module description	*Includes the description of the module, i.e., the training problem it addresses, the context of application, the learning goals, the learning objectives and the learners' needs that the module meets. (up to 100 words)*
5	Learning objectives	*LObj1. Learning objectives (4 up to 10) for the module*
Learning outcomes for the Cognitive domain+ (Bloom Taxonomy) *{The learning outcomes of the module assigned to Comprehension, Application, Analysis, Synthesis and Evaluation level according to the Bloom taxonomy* *please underline the verb and the concept of the knowledge domain used}* **Upon completion of this module, the learner will be able to:**		
1. Knowledge level		
LOut1	(Use verbs according to bloom taxonomy)	
LOut2		
2. Comprehension level		
Lout3		
3. Application level		
4. Analysis level		
5. Synthesis level		
6. Evaluation level		

***mm-u* TB2: UNIT SPECIFICATION**		
Module Units	**Unit ID***	**Unit title**
	mm-1	
	mm-2	
	mm-3	
	mm-4	

6.4.2 Unit specification – TB2 template

Each module is comprised of 3 to 4 units. Within the TB2 template, we specify the units included in the module, which correspond to learning objects.

mm-u TB2: UNIT SPECIFICATION		
Module Units	**Unit ID**	**Unit title**
	ModuleID.1	***mm-u (mm:MODULE ID, u UNIQUE UNIT ID from 1-4)***
	ModuleID.2	
	ModuleID.3	
	ModuleID.4	
The following are repeated for each different unit is included in the module		
1	Unit ID	***mm-u (mm:MODULE ID, u UNIQUE UNIT ID)*** *This corresponds to a unit of the module*
2	Unit title	The Unit title
3	Unit description	This unit content and what it in includes, in bullets
4	Educational strategy	*presentation, video, article*
5	Unit Learning outcomes	mm.LOUT1 mm.LOUT2, etc
6	Unit core material (Learning object (LO)) (code and title)	
7	Unit additional material (code and title)	
8	Assessment objects (projects, self-evaluation exercises, etc.) (code and title)	
9	Unit schedule	

6.4.3 Leaning Object Specification – TB3 template

Regarding the development process of the learning objects, the content of each module will adhere to the design established in the preceding phases. The learning objects are crafted in alignment with the learning outcomes delineated in the unit outlines. To systematically document all learning objects along with their respective outcomes for unit contents, an additional table template, TB3: Learning Object Description, is provided. For each distinct learning object included within a unit, the TB3 table is to be replicated.

mm-u-l - TB3: Learning Object Specification		
1	**Learning object ID**	***mm-u-l (mm:MODULE ID, u UNIQUE UNIT ID, UNIQUE LO ID)*** *This corresponds to a LO of the unit (presentation, video, article, etc)*
2	Learning object title	
3	Language	*English*
4	Learning object description	Learning objects of this UNIT
5	Learning outcomes (LOut)	
6	Learning recourse type (IEEE LOM)	*Presentation, video, article, etc*
7	Technical type (IEEE LOM)	Text
8	Workload (Estimated study time) (min)	XX minutes

6.4.4 Module assessment – TB4 template

Finally, the table **TB4-Module Assessment,** which outlines the assessment methods to be employed for each unit within the module. These methods may encompass a variety of formative assessments, such as multiple-choice questions, online forms, exercises, projects, and practical assignments. From a methodological standpoint, the assessment tests will be grounded in the learning outcomes approach, reflecting the specific learning outcomes associated with each unit of the learning module. The TB4 table will be utilized repeatedly to assess each individual unit.

mm-u-A TB4: Unit Assessment Object

1	Assessment Object ID	*mm-u-A (mm:MODULE ID, u UNIQUE UNIT ID)*	
3	Language	English	
4	Learning recourse type (IEEE LOM)	Multiple Choice Questions/ Report /	
5	Technical type (IEEE LOM)	*Text*	*Document*
6	Workload (Estimated study time) (min)	30	
7	Write down the assessment object (quiz)	*Use the template below as many times as needed and modify accordingly to specific question type (1 template for each question).*	

The Question template will be repeated *as many times as needed for all questions used for the unit assessment*

Question template	
Question ID	***XX-Y-A-ZZ (XX:MODULE ID, Y UNIQUE UNIT ID, ZZ UNIQUE QUESTION ID)***
Question	Text of the question
Possible answers	
Correct answer	
Response to correct answer	e.g. Your answer is correct. Congratulations!
Response to wrong answer(s)	e.g Not quite right. The correct answer is b
Times the question can be taken	Number

7 Competences Dependencies and Schedule

The assessment of competences will be conducted in three stages, encompassing the following training phases:

- Introductory modules
  - Stakeholder Management
  - Services and Service Structures

    - Smart City Business Models
    - Smart City Service Co-Design and The Generation of New Revenue
    - Open Data Legal Framework, Privacy, and Ethics
    - Open Data Vision, Strategy, Planning, and Communication
    - Smart City Infrastructure as a Supplier of Open Data
- Mandatory modules
    - Programming
    - Big data analytics and tools
    - Artificial Intelligence and Open Data
    - Open Data Governance
    - Open Data Security
    - Open Data Standards
    - Open Data Quality
    - Open Data Visualization, Sharing, and Distribution
- Specialization modules
    - Promote Open Data Literacy
    - Open Data Marketplaces (Open Data Platforms) and Open Data Business Models
    - Open Data For The City's Education And Health
    - Open Data For The City’s Mobility/Logistics/Economy
    - Open Data For The City's Environmental Issues

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OpenDCO is a consortium of five European Universities working together with esteemed colleagues on open data, a topic that is of great interest to each of us and to our communities.