



METACITIES Excellence Hub in South-Eastern Europe

**Quadruple Helix Driven Smart Cities
Development in SEE**

White paper

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1 Executive Summary

The METACITIES project aims to establish an Excellence Hub for future cities and regions in Southeast Europe, built upon Digital Twins (DTs) and metaverse technologies, through cross-border, innovation-driven collaboration engaging all different categories of actors of the Quadruple Helix (QH). The METACITIES Excellence Hub is viewed as a sustainable network that offers a common platform for collaboration, cross-fertilization, and best practices sharing across borders, sectors, and disciplines on knowledge production, circulation, and use.

Founded upon a joint R&I strategy, a nexus of collaborative links across sectors, joint research, innovation, and outreach activities, as well as business modelling and sustainability planning, the Excellence Hub aims to benefit all stakeholder types of the Quadruple Helix Model, regional ecosystems, and the whole SEE region.

The present document provides a comprehensive overview of the project's effort and achievements in the field of QH-based and innovation-driven collaboration for Smart Cities development. It defines the four stakeholder types and their roles in the Smart Cities context and models the Smart City as a brokerage platform through which values are exchanged among stakeholders. An analysis of the values exchanged is also performed and an illustrative example of a Smart City intervention with strong social footprint is presented to show-case the realization of the addressed collaboration in a real-life context.

2 Introduction

Excellence hubs are part of the European excellence initiative and complement the science-oriented schemes Teaming, Twinning, ERA Chairs and the European excellence initiative for universities by a dedicated innovation component. Excellence hubs focus on innovation by allowing innovation ecosystems in widening countries and beyond, to team up and create better linkages between academia, business, government and society. They are networks of place-based innovation ecosystems in widening countries involving larger communities of actors in a regional context based on the quadruple helix principle. The METACITIES project is an Excellence Hub in the area of Smart Cities and their transition to Meta Cities.

The project has elaborated and applies a participatory approach involving all four major actors (stakeholders) of the Quadruple Helix, namely, Academia (science), Public (policy), Business (industry), and Citizens (society) in its regional and cross-regional activities starting from the definition of (joint) R&I strategies, to the implementation of (joint) R&I projects and Proof-of Concepts, to the definition of business models and sustainability plans. The QH approach necessitates that the public and private sector, providers and consumers align their priorities for regional development.

In this document, which is based on work performed in Work package 2 of the METACITIES project and documented in Deliverable D2.1 [4], we provide an overview of the METACITIES QH-based model of collaboration, the types and roles of involved stakeholders and the values exchanged among the stakeholder types. The model is exemplified in a Smart Mobility type of Smart City intervention.

3 Smart City Stakeholder Types & Roles

Stakeholders are defined as agents who are interested, affected or have power to influence the development of Smart Cities. Application of the QH requires the establishment of a horizontal cooperative system among all stakeholders in each smart city intervention. The types of possible involvement of stakeholders are quite diverse ranging from deriving service demand to service supply and operation management. Identifying the needs and respecting the expectations of diverse stakeholders are important priorities of policy-makers and strategic planners. Following the Quadruple Helix model, four major types of stakeholders are identified, namely, the Public, Businesses, Citizens, and Academia, and exemplified in Table 1 [1, 3] for the Smart City context.

TABLE 1: SMART CITY STAKEHOLDER TYPES.

Public	Business	Academia	Citizens - NGOs
Portfolio level Policy makers who initiate, plan, execute smart city development e.g., Central, City & Local government such as Municipalities, city councils and city administrations, different government institutions Program level - Managers who are in charge of planning & implementing smart city domain programs. - Department directors in city and local government Project level Managers who are in charge of plan, execution, and delivery of solutions.	- Business firms in various industries that participate in smart city development such as construction, energy, healthcare, IT, transportation, etc., and services - Investors - Utility providers (e.g., for smart grid or smart water management) - Standardization Bodies	- University - Research Institute - Industry Associations - Experts who provide professional knowledge and advice for smart city development.	Beneficiaries and end-users of smart city services: - Existing and Prospective residents - Local businesspeople in the smart city - Societal Organizations involved in social sustainability initiatives.

Following the ITU-T Y.4000 series recommendation, Stakeholders can be categorized according to their role and participation in project(s) related to the development of smart cities into Influencers, Beneficiaries and Affected.

- Influencers include all stakeholders that have the authority and resources to influence the smart city research strategy and agenda. In the Quadruple Helix approach all four stakeholder types are considered influencers.
- Beneficiaries are the stakeholders who directly benefit from the smart city developments.
- Affected includes all stakeholders that are somehow affected by smart city developments and they can be either potential supporters or potential opponents.

The role and participation in smart city development of each of the four stakeholder categories are summarized in the following:

Public Sector:

The Public (policy) actor is present at several levels. The most active public level is the city government, but smart cities are also being supported on a regional level. In today's smart cities, the role of the public takes the form of pursuing a project promotion system through public-private or private-oriented cooperation. The central government and the public sector play the role of amending laws and providing budget support. Local governments supervise smart city-related policy projects in cooperation with the central government, establish and operate public services, and build infrastructure. The central government has several committees under its umbrella for the creation and diffusion of smart cities from a national strategic point of view to advise, deliberate, and adjust government policies such as legal systems, standardization, external cooperation, and smart city promotion strategies. Local governments also form a council between local governments that promote the construction and operation of smart cities to ensure mutual cooperation and strategies for the spread of smart cities and industrial promotion.

Businesses:

Private companies play an important role in providing a range of ideas related to smart city technology and developing comprehensive solutions to solve city-wide problems based on these ideas. They are the main agents of implementing various new technologies incorporating ICT in a wide variety of fields (e.g., transportation, safety, energy, medical care, education, tourism, etc.), provided as city services in smart cities. Therefore, the participation of innovative companies is recognized as an important success factor of smart city implementation. Private companies can also play a role in providing utilities and public services in areas such as safety and the environment, while also applying a sustainable profit business model. Through this, qualitative growth can be promoted as a part of corporate social responsibility (CSR) and environmental, social and governance (ESG) management required by companies these days.

Academia:

At the academic level, smart cities have been looked at from different scientific domains and backgrounds. The Smart City concept is a cross-disciplinary one which covers urban studies, economics, political studies, city planning, engineering, sociology, communications as well as user research and professional manpower training. The group supports smart city projects through various activities such as fact-finding, research and development, and policy discovery using professional manpower and facilities to activate smart city services. Another important role is to participate as the main body of the business that develops, tests, and demonstrates technologies and solutions provided as actual smart city services.

Citizens and Citizens' Organizations:

Citizens are the actual beneficiaries and users of all services and technologies provided by smart cities. The goal of a smart city is for citizens to participate as members with a sense of ownership. No matter how advanced technology is applied to a city, it is meaningless if it does not provide benefits or convenience to the citizens. This is why people-centered smart cities are gaining increasing importance and interest. The essence of a smart city is that citizens directly use and interact with smart technologies as they become familiar with them. Without citizen participation, the sustainability of smart cities cannot be guaranteed. A characteristic that can be seen in many examples of smart city

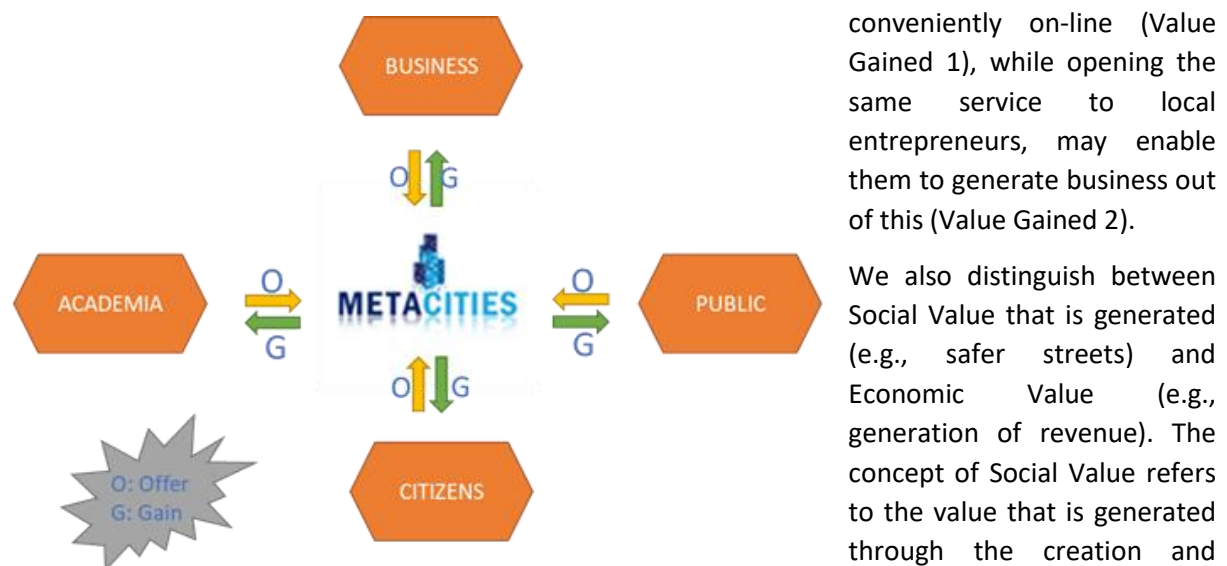
implementations today is that users' opinions are collected through citizen surveys, and citizens directly participate in the smart city development project. In the domain of new product development, R&D departments rely increasingly on user input and collaboration.

4 Collaboration Model and Value Flows Analysis

For the realization of a Smart City intervention, the identified stakeholder groups with their different goals and inclinations must work together and form a cross-functional team. It is challenging but also of crucial importance to coordinate the diverse stakeholder groups in the early stages of planning, to combine and align multiple and conflicting strategic choices and to systematically link the higher-level missions and visions with the lower-level strategic goals of the various functional areas of a smart city. For these diverse groups to collaborate and work effectively, they need a strategic framework in the initial joint planning stage, to bring them together and provide a clear sense of direction and focus on the form of vision and mission for smart city development projects. This process has the effect of achieving shared understanding of the core values among the members of the cross-functional teams. The perception of the goals, core values, and vision of a smart city intervention differs according to each person's interests and inclinations, so it is important to develop a common understanding of the strategic framework that is agreed upon.

Following the QH Collaboration Model, a smart city is envisaged as a collaborative ecosystem allowing for the co-creation of sustainable, future proof innovations that improve life in the city and boost the economy while capitalizing on technological advancements. These collaborative ecosystems promise to contribute to the facilitation of knowledge exchange among the ecosystem actors. Smart cities serve as an innovation broker, connecting different stakeholders, allowing for real-life ideation, co-creation and validation. In the smart city as a collaborative ecosystem conceptual model, values are offered and gained between the stakeholders (indicated with O and G in **Error! Reference source not found.**).

In our conceptual framework, values gained can be conceptualized as what a city system provides to its users, its citizens and other smart city stakeholders. An illustration in a smart city context could be the online co-creation of a city service, which enables citizens to interact with their city easily and



conveniently on-line (Value Gained 1), while opening the same service to local entrepreneurs, may enable them to generate business out of this (Value Gained 2).

We also distinguish between Social Value that is generated (e.g., safer streets) and Economic Value (e.g., generation of revenue). The concept of Social Value refers to the value that is generated through the creation and implementation of services

and technologies that adequately harness opportunities within the city, tackle societal challenges and/or realize policy goals [3]. It refers to, for example, reducing traffic jams, reducing pollution, increasing neighbourhood cohesion, etc. Economic Value on the other hand covers economic metrics

such as the annual economic growth of cities and companies within the city, a decrease in unemployment, the extent to which new businesses (start-ups) are being generated and able to survive, a reduction of bankruptcies, an increased competitive advantage, attracting existing businesses to the city, etc.

Analysis of Values Exchanged is facilitated with the use of **Error! Reference source not found.** which collects “Values Offered” and “Values Gained” by each stakeholder type and flowing among stakeholders in a smart city ecosystem. Most of the flows enable other stakeholders to perform certain tasks and can therefore be considered as Values gained. These Enabling Value Flows differ in nature, depending on the smart city intervention, and may include: enabling funding (financial support), enabling environments (a digital hub, an ecosystem or working space), enabling services (activities), enabling knowledge (data and expertise), enabling networks (brokerage) and enabling policy (stimulation by policy makers).

TABLE 2: VALUES OFFERED TO AND RECEIVED BY STAKEHOLDER TYPES.

QH Type1	Values Offered	Values Received
QH Type 2	• ...	• ...
QH Type 3	• ...	• ...
QH Type 4	• ...	• ...

Each chain of Values exchange starts with the instigation of the Public actor (regional and/or municipal authority) and evolves as follows:

- ⇒ The Public seeks enabling funding at the European level or local (regional and/or municipal) resources, brings together relevant smart city actors (enabling network or environment) and sometimes provides enabling information (e.g. open governmental data).
- ⇒ Cities pursue creation of Social and Economic value through implementing city improvements.
- ⇒ Citizens pursue creation of social value and contribute to the generation of Social value themselves (providing input such as new ideas and validation feedback, co-creating apps or services).
- ⇒ Businesses pursue creation of Economic value but also generate social value (co-creation of free apps, platforms and services).
- ⇒ Academia pursues creation of social value, but generate no direct social or economic value in the smart city context, as the role of this stakeholder is an enabling one.

Values in typical smart city contexts are citizen-centred, encourage public-private cooperation and alignment of priorities as well as citizen engagement and involvement. They relate to the quite exhaustive list of key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals of the Recommendation ITU-T Y.4903 [2]. The KPIs provided by the Recommendation are designed to evaluate the role and performance of information communication technologies (ICTs) in the three dimensions of a city: economics, environment, and society and culture. The indicators are uniquely coordinated to allow cities to measure their progress on reaching the ambitious targets set by the SDGs. The Recommendation provides a means to benchmarking and

disseminating best practices in utilizing ICTs and other technologies to enhance cities' sustainability and connect their smart strategies to the SDGs through an inclusive process.

5 An Illustrative Example

Smart mobility, fortified by the integration of digital and more specifically digital twin technology, establishes itself as a vital force propelling urban development into new dimensions. The utilization of digital twins in the context of smart mobility offers a dynamic platform for in-depth analysis and predictive capabilities. By mirroring the physical urban environment in a digital replica, decision-makers gain a comprehensive understanding of mobility systems. This becomes particularly potent when multiple data sources, interconnected with existing smart city projects, are brought into the fold. The interconnected web of data allows for a holistic examination of mobility patterns, enabling authorities to discern trends, anticipate challenges, and optimize transportation networks. The fusion of digital twin technology with diverse data sources not only enhances the efficiency of smart mobility solutions but also lays the groundwork for proactive, data-driven decision-making in the context of urban planning and development. This innovative approach underscores the commitment to leveraging cutting-edge technologies to create more sustainable, safe, efficient, and resilient urban landscapes.

Analysis of values exchanged among the four stakeholder types of the QH model in a Smart Mobility context is presented below.

Public Sector - Governmental Entities:

- **Values Offered:** The public sector brings forth a spectrum of values crucial to smart mobility initiatives. As the primary driver of urban policies and infrastructure development, the public sector contributes funding programs, regulatory frameworks, and strategic planning. Furthermore, its engagement in demographic considerations ensures that smart mobility solutions are inclusive, meeting the diverse needs of the local populace. Through technological integration and the implementation of healthcare advancements, the public sector introduces innovative solutions for medical transportation, emergency response systems, and telemedicine, thus generating social value. In economic terms, the public sector provides a stable and supportive environment, attracting businesses and fostering innovation through collaborations in the smart mobility sector.
- **Values Gained:** Conversely, the public sector reaps substantial benefits from the collaborative engagement within the Quadruple Helix. Through partnerships with academia, industry, and civil society, the public sector gains access to cutting-edge technologies, research insights, and innovative solutions. Collaboration with the academic sphere brings forth research findings and knowledge that inform evidence-based policymaking. Engaging with industry provides the public sector with economic insights, business innovation, and job creation opportunities. This reciprocal relationship results in a dynamic exchange of expertise, resources, and innovations, positioning the public sector as a key beneficiary in the collaborative ecosystem of the Quadruple Helix.

Businesses:

- **Values Offered:** Companies in the technology sector offer their technological expertise, resources, and innovative technologies in smart mobility projects. This might involve the design and implementation of sensor-based IoT networks, or the creation of user-friendly mobile applications. Additionally, businesses can also provide services related to the installation, maintenance, and troubleshooting of the deployed smart mobility technology.
- **Values Gained:** Businesses stand to gain significantly from their involvement in smart mobility projects. Not only do they get access to new business opportunities and markets, but they can

also utilize the data generated through the smart mobility systems for improving their products and services. Furthermore, their active involvement in public service initiatives allows them to have access to new data and customer bases, and benefit from enhancing their corporate image showcasing them as leaders in smart city solutions.

Academia:

- **Values Offered:** Academic institutions can leverage their research capabilities, scientific expertise and innovation potential to offer new ideas and theoretical models for smart mobility. They can also contribute state of the art relative infrastructures (sensors, actuators, backed platforms, car/driver simulators) to yield novel technologies, techniques, algorithms and end-to-end services for smart mobility. They can contribute with research on urban mobility, statistical analysis of parking demand, handling congestion in real time, drivers' behavioral analysis, traffic optimization, pedestrian and cyclists' flows, or even research on the social and environmental impacts of smart mobility.
- **Values Gained:** For academia, participation in smart mobility R&I activities offers an opportunity to apply their research knowledge, expertise and developments in practical, real-world scenarios, thereby enhancing the relevance and applicability of their research. This strengthens significantly their position in the respective ecosystems and enables them to pursue more actively additional collaboration, funding as well as dissemination to prestigious scientific forums and publications. Collaborations with public and business entities can also pave the way for more research funding and partnership opportunities. They also gain access to a wealth of new data, both from the public sector and from the implemented smart mobility systems, that can be utilized for further research particularly related to AI based techniques and algorithms development in relation to traffic management, increased traffic safety and others.

Citizens:

- **Values Offered:** The value offered by citizens that are involved in the city issues and are participating in the evolution of their city environment is very valuable to the smart mobility solution design and implementation. Citizens can offer their real-life experiences, insights, valuable feedback and local knowledge on the city's mobility situation and issues. They can participate in surveys and focus groups and can also be involved in the development and testing phases of new smart mobility interventions, offering for example their feedback on the user interface and functionality of smart mobility apps, and their overall experience with new systems. Engaged citizens can be involved in the co-design of specific pilots, in the specification of requirements and the initial proof of concept trials.
- **Values Gained:** In return, citizens benefit from improved mobility services and an inclusive, transparent mobility framework that has been co-designed by citizens. They can enjoy a more seamless and stress-free driving and parking experience, which can also reduce traffic congestion and contribute to a cleaner urban environment. Enabling citizens to influence the shape of their urban living, leads to increased civic satisfaction, a sense of ownership, and stronger community bonds. The most significant value citizens gain is the direct improvement to their living environment and the enhancement of public services, which can lead to a higher quality of life.

6 Conclusion

The METACITIES Excellence Hub is developed as a sustainable network that offers a common platform for collaboration, cross-fertilization, and best practices sharing both within place-based innovation ecosystems and across borders on knowledge production, circulation, and use. By following the participatory approach of the Quadruple Helix, goals and priorities can be aligned, resources can be shared, leveraging each other's strengths can be enabled, collaboration can be empowered and all these combined can create innovative solutions that address shared challenges and maximize the technological impact for social and economic good.

7 References

- [1] ITU-T Y.4000 series, “Smart sustainable cities - Setting the stage for stakeholders' engagement”.
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- [4] METACITIES Project Deliverable D2.1 “METACITIES Cross Border R&I Strategy”.