Smart City Digital Twins Project
Workshop Assessment Report: VILNIUS

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Table Of Contents

Table of Figures

SUMMARY

The convergence of Smart Cities (SC) and Digital Twins (DTs) concepts emerges as a desirable alliance in the dynamic interplay of urbanisation and innovation enabled by Internet and Communication Technologies (ICTs), inspiring cities to an outstanding wisdom in the future. At city level operations DTs transforms standard public services into efficient real-time actions, and strategic precision uses cutting-edge ICTs. Amidst latest technological advances – Artificial Intelligence (AI), Machine Learning (ML), Data Analytics, Extended Reality (XR), Internet of Things (IoT), and sensor technologies, for example, the synergy between SC and DTs allows cities confidently navigate the complex landscape of urban transformation by using DTs as their visionary compass. Likewise, strategic use of DTs optimises public sector open data, promoting data-based economic growth, social well-being, and environmental sustainability.

While cities intensively pursue to explore the possible futures of SC with DTs and realizing the what-if scenarios could come to life, reveals a plausible future for their cities in which smart grids might flourish and traffic might move autonomously and seamlessly. While the ideal alliance of DTs and SC could open the door to a revitalised future urban landscape, this mission necessitates a systemic integration of ICTs, public awareness, talent & tech-skills, public-private-people partnership, and continuous strategic transitions in the city systems.
Thus, the project's main goals, which are in line with the Finland Digital Compass, Ecosystem Agreements and Smart Specialisation Strategy – 3S, were to advance sustainable public procurement, implement innovative strategies for regional development, and promote competency in DTs. Accordingly, the project emphasises the value of collaboration between the public, private, and people domains by highlighting the necessity of resolving the matching problem regarding SCDT development models.

With this motivation, the project designed as a one-year foresight research project spanning from February 1, 2023, to April 30, 2024, stands as a promising endeavour in the realm of urban innovation. In collaboration with esteemed partners, University of Turku, Turku University of Applied Sciences and Turku Science Park Ltd., this visionary project is co-funded by the European Regional Development Fund and fuelled by a total budget of EUR 241.399. This initiative completed wide-ranging up-to-date integrative literature review, mapping survey and engaged on-site workshops held within partner cities.

Mapping survey was publicly available via Webropol weblink and aimed to get insights of subject matter expert respondents on Smart City Digital Twins. In this regard, while the survey link has been provided to partner cities to distribute experts in their networks, it was also

accessible in project website. Eventually, the survey reached 982 potential respondents, and 22 of which 45 started responding, submitted their responds.

Aligning with project objectives, the foresight workshops were held in;

- September 19th 2023 Gdańsk Science and Technology Park,
- September 21st 2023 Wrocław Science Park,
- October 5th 2023 Vilnius Municipality Building,
- November 2nd EDUCity, Turku - Part 1 (Current Solutions)
- November 22nd 2023 EDUCity, Turku - Part 2 (Visions & Near Future Needs)

Participants registered to workshops via project website. Total foresight workshop participant number was 99 and according to registration records, city-based participants numbers are 17, Gdansk; 22, Wroclaw; 41, Vilnius and 19, Turku respectively (See, Error! Reference source not found.).

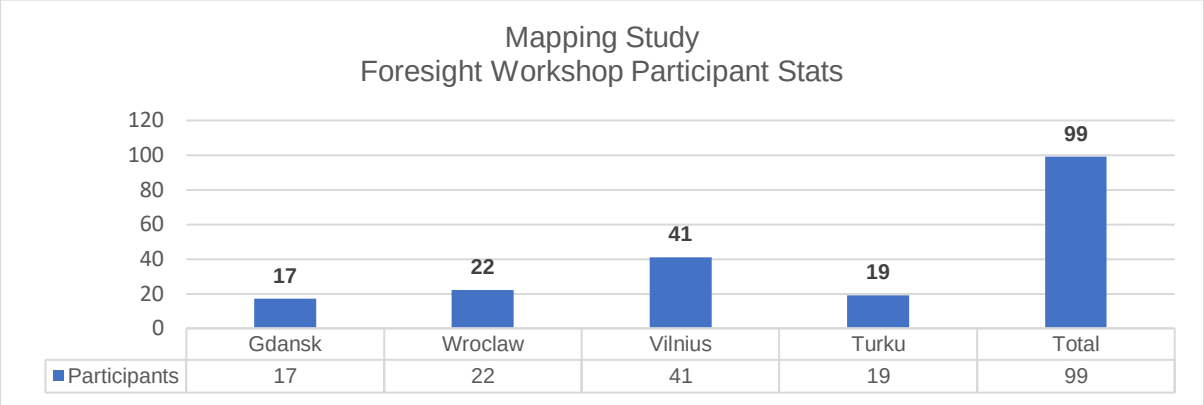


Figure 1 Foresight Workshop Participants in Number.

Project research team recorded 433 insights after completing workshops in four partner cities. According to the data, participants added 216 current solutions, 125 visions and 60 near future needs during workshop sessions (See, **Error! Reference source not found.**).

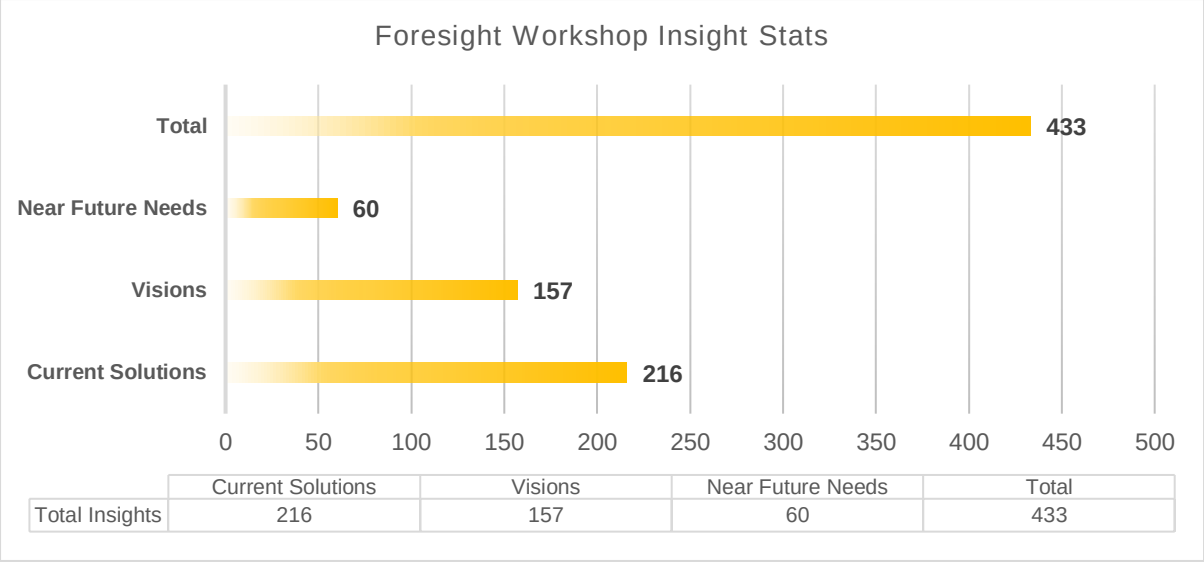


Figure 2 Total gathered insight numbers by workshop theme.

Notably, the project has initiated the creation of a marketplace for Smart City Digital Twin solutions, marking a pivotal step in its journey towards advancing the concepts of Smart Cities. In this sense, companies and start-ups running their business in partner cities had opportunity to pitch their business solutions before each foresight workshops held in four cities. Then there were able to publish their SCDT solutions in project marketplace.

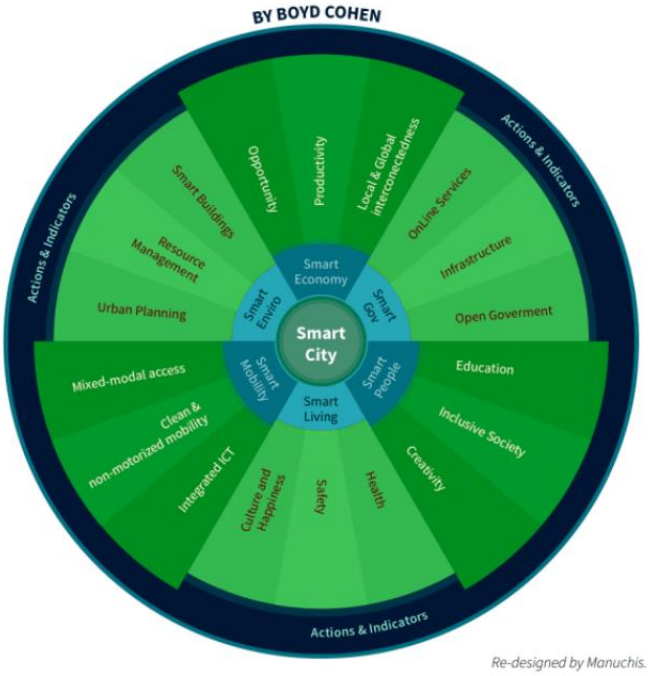
1. Introduction

Smart City Digital Twins are currently in an exciting phase of development. They offer vast potential for the advancement of Smart City initiatives, promising benefits to society, the economy, businesses, and the environment. The Smart City Digital Twins project is specifically dedicated to harnessing the power of public sector open data to foster sustainable economic growth within urban areas in Finland. This initiative explores the capacity of digital twins to facilitate the transition to environmentally friendly practices, support equitable working conditions, enhance citizen well-being, and promote the adoption of advanced technologies in larger subsequent projects.

The project actively contributes to the enhancement of research and innovation capabilities. The incorporation of advanced technologies into research and development, the project aspires through the following avenues as such strengthening expertise, foresight, and innovation activities by driving the development of digital twins, piloting their capabilities, and introducing potential commercial applications in line with the Public-Private collaboration model. This project serves as an implementation and development platform for the Research, Development, and Innovation (RDI) cooperation model, as it collaborates with the University of Turku, Turku University of Applied Sciences, and Turku Science Park. There are four cities Turku, Vilnius, Wroclaw, and Gdansk that operate in three countries, Finland, Lithuania, and Poland.

2. Mapping Study

2.1. Workshop Method



The Smart City Wheel (SCW) is an analytical tool for smart city ranking and benchmarking developed originally by Boyd Cohen. While it is applied by various scholars for case studies, city officials may find it a useful tool for self-analysis since indicators are easy to assess. Essentially, SCW is a framework for understanding six key components of a smart city: Smart Economy, Smart Government, Smart People, Smart Living, Smart Mobility and Smart Mobility. The rankings are done with mostly publicly available

data (i.e., secondary data) with data collected directly from eligible cities (primary data). Since 2014, SCW assess smart cities with 62 indicators in which 16 of them are also directly mapped to the ISO standards for Sustainable Cities and Communities (ISO 37120:2018). (To achieve indicators, please check **Bibliography**)

Within the SCW, each 6 dimension contains 3 sub-components.
Therefore, there are 18 total sub-components in the model, and with 62 indicators. Each of the 6 components are then assigned a maximum of 15 points and the results are transformed in a way that the highest performing city in each category is assigned 15 points. Thus, if one city is to lead in each of the six components, the city would obtain a maximum score of 90 points.

Moreover, it is clear from our foresight workshop on smart city digital twins that ISO standards are essential for directing the creation and evaluation of sustainable, resilient, and smart cities. For example, aligning with Boyd Cohen's Smart City Wheel including some vital ISO 37120:2018 indicators, our analysis will broaden the examination of existing SCDT solutions via ISO 37120:2018, which focuses on indicators for city services and quality of life. We emphasise the significance of evaluating and enhancing current urban SC services as well as the general well-being of inhabitants. Looking ahead, ISO 37122:2019, which focuses on indicators for smart cities, is extremely relevant to our data analysis about needs for the near future because it highlights the vital role that cutting-edge technology plays in fostering innovation via DTs, improving data-driven decision-making, and streamlining city operations. Finally, the indicators for resilient cities covered by ISO 37123:2019 are directly in line with project goals of developing urban settings that are resilient to a range of unpredicted landscape issues. By incorporating these ISO standards into our analysis, the project aims to ensure that cities are using smart technologies to their fullest potential while moving towards a sustainable and resilient direction. They also provide a foundational framework for measuring the success of smart city initiatives in partner cities Gdansk, Vilnius, Wroclaw, and Turku.

2.2. Workshop Objectives

Foresight workshops in partner cities aimed to find out type of SCDT current solutions cities have now. Also, by gathering insights about their visions and near future needs the project aimed to map different cities' current systems, current system providers, and their future visions. By conducting workshop in cities, project aims to assess:

Current Solutions: The workshops will find out how cities work now. By sharing the current situation of different cities, we find out current systems, current suppliers, and their abilities, what kind of data repositories currently exist, and environmental impact assessments.

The Needs of The Near Future: The analysis of near-future needs helps to understand what kind of fast-coming needs exist in different cities. This helps to target the development and possibly find common needs that can be met quickly: systems to be developed, challenges, interfaces, modularity and data, and assessments of environmental effects.

Visions: What kind of SCDT services can we expect in the future. Future opportunities and challenges are envisioned: different SCDT visions are described, what kind of research and education is needed to implement the visions, how standards, open-source codes, modularity, and data repositories can have an impact, and assessments of environmental effects.

2.3. Key Insights Gathered from Turku Workshop

2.3.1. Current Solutions

Economy

- **Space Startups:** Encouraging the growth of startups in the space industry.
- **Services Information System (IS):** Creating a centralized information system for various government departments, enhancing data-driven decision-making.
- **Participatory Budget:** Involving citizens in the budgeting process.
- **Maker Spaces Fab Labs:** Establishing spaces for creative making and innovation.
- **Issue Reposting Map for Citizens:** Providing a platform for citizens to report issues.
- **E-Applications for Documents:** Streamlining document-related processes with electronic applications.

Environment

- **City Lungs Air Quality Map:** Implementing an air quality map to monitor pollution and pollen concentrations.

Mobility

- **Parking:** Improving parking infrastructure and management.
- **Sharing Ecosystem (Car, Bike, Public Transport):** Promoting shared mobility solutions for cars, bikes, and public transportation.
- **E-Travel:** Implementing digital solutions for travel planning and booking.
- **Location-based Parking App:** Developing an app to help users find available parking spaces.
- **Digital Bus Schedules:** Providing digital schedules for bus services.
- **Bus Tracking (TRAFI):** Implementing a bus tracking system for improved public transportation services.

Governance

- **Vilnius KPI System:** Developing a Key Performance Indicator system for governance.
- **Vilnius Municipal Administration Data Dashboard:** Creating a data dashboard for municipal administration.
- **Vilnius Legislation:** Enhancing access to municipal legislation.
- **GIS Map Data:** Providing geographic information system (GIS) mapping data.

- **Online Services for People Dealing with Municipality:** Offering online services for interacting with municipal authorities.

Living

- **Drone for Roof & Trash:** Implementing drones for roof and trash monitoring.
- **E-Police:** Advancing digital policing methods.
- **Air Pollution Map:** Creating a map to monitor air pollution levels.
- **City Problem Registry Platform (Tvarkau Miesta):** Offering a platform for citizens to report city problems.

People

- **Participatory Budget:** Engaging citizens in budget decisions.
- **Maker Spaces Fab Labs:** Creating spaces for collaborative innovation.
- **Issue Reposting Map for Citizens:** Allowing citizens to report issues.
- **E-Applications for Documents:** Providing electronic applications for document submissions.

2.3.2. Visions

Economy

- **One-Stop Shops:** Establishing one-stop shops for various services.
- **VR Offices:** Incorporating virtual reality technology into office spaces.
- **Vilnius as Tech Hub:** Positioning Vilnius as the tech hub of the Baltics.
- **Architectural Competitions in 3D Map:** Conducting architectural competitions using 3D mapping technology.

Environment

- **Industrial Solutions for Air Flow and Flooding:** Implementing industrial solutions for air flow and flood prevention.
- **Green Unused Places:** Converting unused areas into green spaces.
- **Smart Waste-Management Solutions:** Implementing intelligent waste management solutions.

Mobility

- **Integrated Traffic Data:** Seamless integration of all traffic data with effective solutions.
- **Drone Food Delivery:** Implementing drone food delivery services to address transportation needs.
- **Self-Driving Public Transportation:** Introduction of self-driving public transportation services.
- **Self-Driving Cars and Scooters:** Promoting the use of self-driving cars and scooters.

Governance

- **Facebook Likes-Based Decision Making:** Using social media feedback for decision-making.
- **Transparent Administration Information:** Ensuring transparent and user-friendly administrative information.
- **Non-Political Debate:** Reducing political debates and focusing on solutions.
- **E-Voting:** Implementing electronic voting for greater convenience and accessibility.

Living

- **Monitored Energy, CO2 Footprint, Waste:** Monitoring energy consumption, CO2 emissions, and waste management.
- **One Chip for Everything:** Enabling a universal chip for various functions.

- **Industrial Simulations for Healthcare and Well-being:** Applying industrial simulations to enhance healthcare and well-being.
- **Matrix for Citizens of Vilnius:** Creating a comprehensive information matrix for Vilnius citizens.
- **Smart Communities:** Fostering active local communities to address local issues.
- **Smart and Small Living Areas:** Promoting smart and compact living environments.

People

- **AI-Based Chat for E-Services:** Centralizing e-services through AI-based chat systems.
- **VR Dating Facilities:** Providing virtual reality dating facilities.
- **Smart Health System:** Implementing an intelligent healthcare system.
- **Security Bot for Hospitality:** Utilizing security bots to enhance user hospitality.
- **Technology Education from Early Age:** Introducing technology education, including VR and DT, from an early age.

2.3.3. Near Future Needs

Economy

- Currently, the economy dimension is empty. To enhance the smart economy, Vilnius should consider initiatives such as fostering local startups, supporting innovation, and creating a business-friendly PPP environment. For instance, city officials could encourage the growth of tech companies and stimulate economic development through smart city investments.

Environment

- **Strategy and Implementation of Maximum Green City:** A sustainable and eco-friendly smart city, they could consider initiatives like improving waste management, expanding green spaces, and implementing clean energy sources via ICT investments and Digital Twins.

Mobility

- **City Digital Development Strategy based on Tech:** Developing a comprehensive digital strategy for the city's mobility infrastructure, leveraging technology.
- **Experiment Lab for Digital City Education:** Establishing an experiment lab for educating the public about the benefits of a digital city.
- **Digital Twin with Real-time Sensors:** Implementing a digital twin with real-time sensors for monitoring and optimizing the city's mobility systems.

Governance

- **Political and Technology Solution for Voting:** Implementing a political and technological solution for voting that enhances transparency and accessibility.

Living

- Currently, the living dimension is empty. To enhance smart living conditions, Vilnius could focus on improving the quality of life for citizens. In near future, they can consider initiatives such as smart healthcare solutions, affordable housing, cultural programs, and safety measures to ensure that residents have a comfortable and fulfilling life.

People

- **AI & Robots Integration with Community:** Introducing artificial intelligence and robotics to integrate with and support the community in various aspects.

- **General Discussion on Near Future Needs**: "Think Big, Plan Carefully, and Fund with EU" was a pragmatic approach to smart city development in workshop. It highlights the importance of ambitious thinking, careful planning, and securing adequate funding from the European Union for these smart city initiatives in near future. However, it's essential to fill the empty dimensions, such as the economy and living aspects, to create a comprehensive and well-rounded smart city digital twin strategy in Vilnius. This would address the diverse needs of the city and maximize the benefits of the EU funding.

3. Conclusion and Discussions

Important insights were obtained in Vilnius about many aspects of the development of SCDT. First, under the heading of "Current Solutions," Vilnius has projects pertaining to the environment, people, living aspects, economy, mobility, governance, and environment. These include supporting start-ups, centralised information systems, creative maker spaces, participatory budgeting, measuring air quality, improved mobility infrastructure, and technology developments in public services and governance.

Second, the "Visions" part outlines aspirational objectives for Vilnius in the areas of people, living, mobility, governance, and the environment. These include establishing one-stop shopping for services, utilising virtual reality technology for a range of purposes, and establishing Vilnius as a centre for technology. Alongside cutting-edge transportation systems, improvements in digital governance, improved quality of life, and the incorporation of AI and robotics into daily life, environmental preservation and sustainability measures are also envisaged. Finally, the "Near Future Needs" highlight areas that still need improvement and attention. Although Vilnius has achieved great progress in several areas, there is still opportunity for improvement in the areas of the economy, environment, mobility, governance, quality of life, and people. These categories include, but are not limited to, supporting digital living solutions, enhancing waste management, and encouraging local companies. The most important lesson is that to achieve these goals for smart cities, funding from the European Union, meticulous planning, and innovative solutions are essential.

It is necessary to investigate economic sector activities, such as promoting local entrepreneurs, encouraging innovation, and establishing a business-friendly climate through public-private partnerships, to further progress Vilnius as a smart city. By enhancing waste management, growing green areas, adopting clean energy sources, and paying close attention to pollution and air quality, environmental sustainability can be increased. Vilnius should create an experiment lab for digital city education, deploy real-time sensor-equipped digital twins, and develop a complete smart city digital twin plan for infrastructure. Voting should use both technological and political methods to increase accessibility and transparency. Vilnius can advance digital twin solutions, enhancing inhabitants' quality of life via smart housing, healthcare, cultural initiatives,

and safety measures. Vilnius is already skilled in several dimensions. Robotics and AI integration with the community can improve daily life even more for the locals. A "Think Big, Plan Carefully, and Fund with EU" strategy is considered as a requirement to achieve these aims to maximize the advantages of the European Union's help and acquire the resources that are required.

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