Smart City Digital Twins Project
Workshop Assessment Report: GDANSK

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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.).
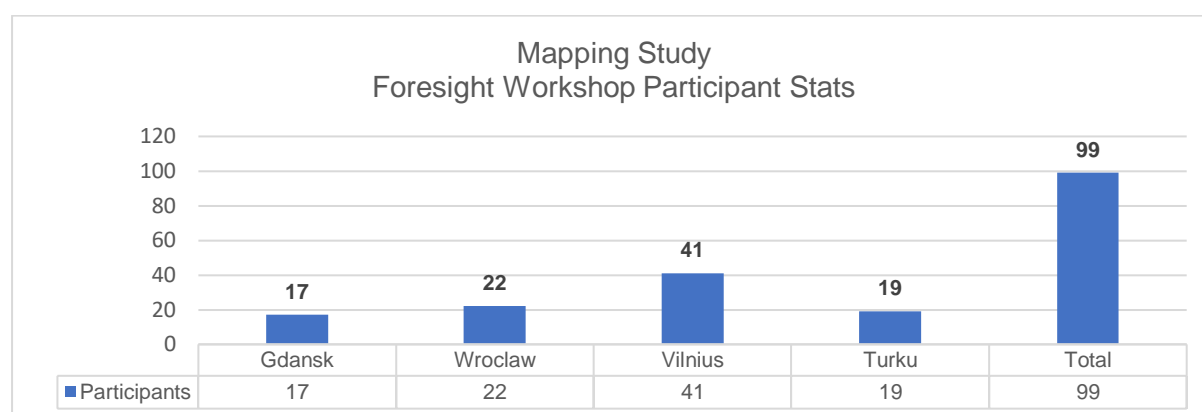

Figure 1 Foresight Workshop Participants in Number.

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.**).
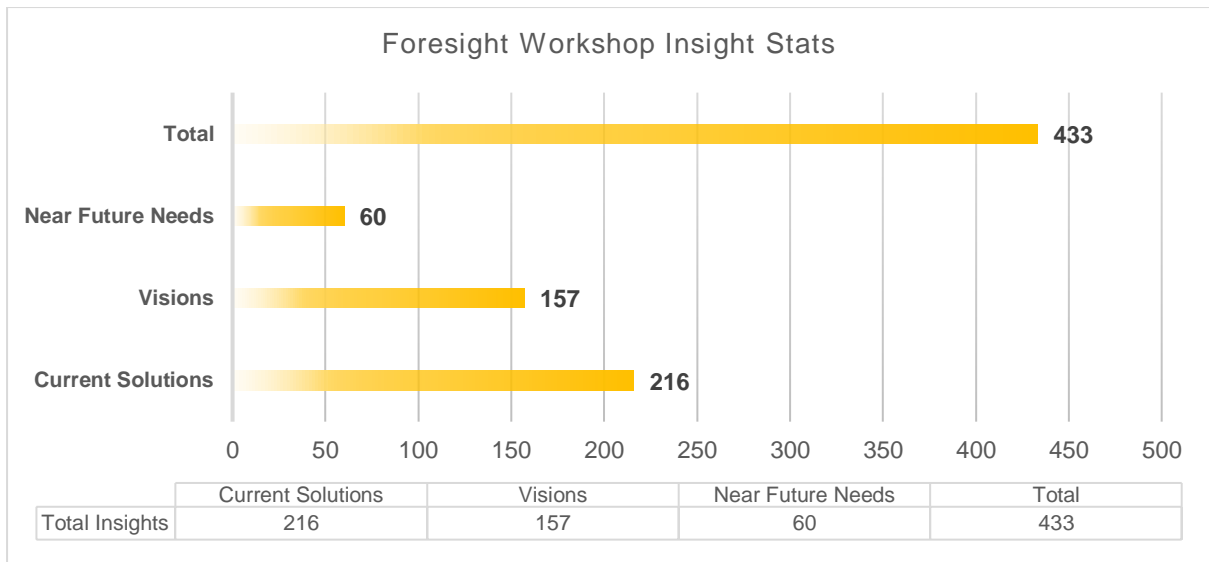
Figure 2 Total gathered insight numbers by workshop theme.

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

Re-designed by Manuchis.

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

- **Various Project Fundings:** Exploring different funding mechanisms for economic development projects.
- **Interizon:** Discussing the role and impact of the Interizon project.
- **EU Funding:** Addressing the significance of EU funding for local development.
- **Construction Investment:** Highlighting the importance of spatial data and knowledge in construction and planning decisions.
- **Industry 4.0/5.0 AI App:** Availability of AI applications for Industry 4.0/5.0.
- **Marketing Tools and Apps:** Various marketing tools and apps, including matching algorithms.
- **AI-Supported Innovation Processes:** Discussing how AI supports innovative processes.
- **AI Services for SME/Family Companies:** Availability of AI services for small and medium-sized enterprises and family companies.
- **Gdynia's Entrepreneur Center:** The presence of an entrepreneur center in Gdynia.
- **Business Incubation:** City companies organizing business incubation.
- **Joint Promotion of Regional Specialties:** Collaborative promotion of regional specialties by city companies.

Environment

- **Waste Management:** Discussing strategies and technologies for efficient waste management.
- **QR Tickets:** Implementing QR code-based ticketing systems for various services.
- **Air Monitoring Systems:** Addressing the significance of air quality monitoring, particularly in Polish cities with poor air quality.
- **Energy Sector Digital Twins:** Implementing digital twins in the energy sector to minimize CO_2 emissions.
- **Green Biodiversity Highway Project:** Discussing the Green Capital of the EU's project focusing on biodiversity and sustainability.

- **Air Quality Sensors:** Deploying air quality sensors across various locations in the city.
- **Plastic Recycling Building Industry Solution:** Presenting solutions for recycling plastic in the building industry.
- **Modern Waste Management:** Discussing modern methods of waste management.
- **Mobile Monitoring:** Exploring the use of mobile devices for environmental monitoring.

Mobility

- **Mevo Bikes:** Discussing the adoption and education on the proper use of shared transportation systems like Mevo Bikes.
- **Autonomous Buses:** Exploring the use of autonomous buses for public transportation.
- **Transport Behavior of Residents:** Analyzing the travel behavior and patterns of city residents.
- **E-Tickets:** Implementing electronic ticketing systems.
- **Metropolitan Ticket System:** Discussing the challenges and progress of adopting a unified ticketing system for metropolitan areas.
- **People Flow Monitoring:** Monitoring and optimizing the movement of people within the city.
- **Autonomous Boat:** Collaborative efforts to create a safe autonomous boat system.
- **Smart Traffic Lights:** Implementing smart traffic lights to optimize traffic flow.
- **Public Transport Data via API:** Providing public transport information through an API for easy access.
- **eScooter (eMOPD):** Introducing eScooters for urban mobility.
- **Autonomous Vehicle Pilots:** Conducting pilot programs for autonomous bus systems.
- **Digital Parking Payments:** Allowing for digital payment of parking fees.
- **Ticket Purchase Apps:** Discussing apps for buying tickets and paying for parking.
- **Parking Space Availability Signs:** Implementing signs showing available parking spaces.
- **eTicket FALA:** Introducing an electronic ticket system (being implemented).

- **City Bike MEVO:** Discussing city bike-sharing programs.

Governance

- **Energy Follow-up:** Discussing energy monitoring and management.
- **City Infrastructure 3D Model:** Exploring the development of 3D models for city infrastructure planning.
- **Open "Raw Data":** Addressing the importance of open access to raw data.
- **Construction Investment:** Discussing funding and investments in construction projects.
- **Geodetic and Cadastral Maps:** Highlighting the role of geodetic and cadastral maps in decision-making.
- **Spatial Data:** Emphasizing the significance of spatial data for city planning.
- **Transport Behavior for Mobility Strategy:** Analyzing the role of transport behavior data in shaping mobility strategies.
- **Security Component:** Considering the growing importance of security in urban planning and governance.
- **Digital Appointment Scheduling:** The ability to digitally schedule appointments with city government institutions.
- **Data Collected by Tristar:** Reference to data collected by a specific entity or program, Portal Tristar.

Living

- **City Card:** Discussing the benefits of a city card offering free museum access and other reductions for families.
- **Healthcare Booking Systems:** Analyzing the challenges related to healthcare appointment booking systems.
- **Digital Parking System:** Implementing digital systems for parking management.
- **Local Bus Trips, Schedules, Ticketing System:** Discussing systems and technologies for local bus transportation.
- **AI Service Family:** Exploring AI services that assist families in various aspects.
- **Improving Accessibility for Critical Infrastructure:** Initiatives to enhance accessibility to critical infrastructure.
- **Social Media Notifications for Cultural Events:** Using social media for event notifications.

People

- **Citizen Budget:** The concept of a citizen budget for allocating public resources.
- **Smart Food City:** Exploring systems that aid in the smart delivery of public food.
- **Rescue Food Distribution:** Highlighting initiatives like Too Good To Go in Gdansk for food distribution.
- **Childcare Apps:** Availability of apps for childcare.
- **Medical Digital Twins:** Availability of digital twins for medical purposes, potentially related to human spare parts.

2.3.2. Visions

Economy

- **Local Business Circular Economy:** Encouraging a circular economy within the local business ecosystem.

- **Shared Economy:** Promoting shared resource consumption.

- **Market Balance Improvement:** Using matching algorithms to maintain equilibrium between production and consumption in various markets.

- **Renewable/Nuclear Energy:** Addressing the need for better infrastructure for renewable energy while reevaluating outdated nuclear energy plans.

- **Offshore Wind Farming:** Identifying challenges and barriers to offshore wind farming in the region.

Environment

- **Zero Emissions City:** Focusing on the goal of a city with zero emissions.

- **3-30-300:** Implementing a sustainable plan for urban development. At your home you can see at least three trees you've got 30% of your neighbourhood covered with green areas and you are 300 metres maximum far to the closest public space that is nice to spend time at so either park or open space.

- **Dynamic Waste Pickup:** Adjusting waste pickup based on needs rather than a fixed schedule.

- **Bicycle "Bikomat" Bike Box:** Introducing secure bike storage solutions to prevent theft.

- **Increased Bicycles and Scooters:** Increasing the presence of bikes and scooters to reduce car usage.

- **Improved Air, Water, Noise, and Light Monitoring:** Enhancing monitoring systems for environmental quality.

- **Smart Nexus:** Creating a balance in the Water-Food-Energy relationship as the new normal.

- **BCF Packaging Reuse:** Encouraging the reuse of Bacterial Cellulose (BCF) packaging and favoring reusable packaging options.

- **Bottle/Waste Deposits:** Advocating for deposit systems for bottles and waste to promote recycling.

- **Environmental Monitoring:** Implementing air, soil, and water monitoring to address pollution and waste issues in the region.

Mobility

- **15-Minute City:** Developing urban planning that allows access to amenities within a 15-minute walk or bike ride.
- **Time-Traveling Possibility:** Enabling efficient and flexible transportation.
- **Self-Driving Green Taxis:** Implementing self-driving green vehicles for taxi services.
- **Integrated Public Transport:** Providing a unified ticket system for various modes of transportation.
- **AR/VR Business Visits:** Using augmented and virtual reality for business visits.
- **Enhanced City Connectivity:** Improving connectivity within the city.
- **Interconnected Transport:** Aiming to achieve interconnected transportation systems by 2040.
- **Parking Improvements:** Identifying areas where parking infrastructure needs enhancement.
- **Free Transport for Citizens:** Ensuring safe, reliable, and free public transportation for citizens, particularly the elderly and children.
- **Common Transport Tickets:** Promoting unified ticketing systems.
- **Reducing Traffic Jams:** Strategies to alleviate traffic congestion.
- **3D Model for Autonomous Drones:** Developing 3D flight route models for autonomous drones, considering the presence of military installations in Polish cities.

Governance

- **Digital Education:** Providing digital education for citizens.
- **Digital Government Institutions:** Transitioning government institutions to digital platforms.
- **Decentralized and Transparent Governance:** Embracing low-power structures and transparency.
- **Informed Decision-Making:** Ensuring decisions are well-informed.
- **Data-Driven City Management:** Utilizing city data for strategic decision-making within city management departments.
- **Public-Private Partnership (PPP) Collaboration:** Promoting wide-scale cooperation between public and private sectors.

Living

- **Digital Twins for Cars:** Implementing digital twins for each car in the city to manage collisions and insurance.

- **Health Monitoring at Home:** Monitoring vital signs at home to reduce hospital visits.

- **Free Parking System:** Implementing a city-wide free parking system.

- **Accessible Knowledge:** Promoting accessibility to knowledge and self-improvement.

- **Metaverse Marketplace:** Creating a marketplace within the metaverse.

- **Peaceful Living:** Focusing on a peaceful and harmonious living environment.

- **Smarter Matching Algorithms:** Enhancing algorithms to improve matches in various contexts.

- **Smart Lighting for Safety:** Implementing smart lighting to enhance safety in streets and public areas.

- **Healthcare System Integration:** Overcoming the lack of communication between healthcare systems and advocating for universal healthcare and remote appointments.

People

- **Virtual Amusement Park:** Introducing virtual amusement experiences through VR.

- **Super Nanny for Urgent Childcare:** Offering childcare solutions for working parents in urgent cases.

- **Community Initiatives:** Encouraging initiatives that bring neighbors together. **Citizen Involvement in Decisions:** Promoting increased involvement of citizens in the decision-making process.

- **Digitized Society:** Encouraging the adoption of digitalization and eliminating paper-based processes through a change in mentality.

2.3.3. Near Future Needs

Economy

- **Recycling 90% of Liquid Containers:** Increasing the recycling rate for liquid containers to 90% to reduce waste and support a circular economy.

Environment

- **Reusable Car Batteries:** Developing and implementing reusable car batteries to reduce environmental waste and promote sustainability.

Mobility

- **Safe Bike Parking (BIKEMAT):** Ensuring secure parking for bicycles, such as the BIKEMAT system, to encourage more people to use this eco-friendly mode of transportation.
- **Mobility of Services:** Expanding and enhancing the availability of services related to mobility, making it more convenient and efficient.

Governance

- **Decisions Through Simulations:** Leveraging simulations to inform and guide decision-making processes.
- **Communication:** Enhancing communication channels and strategies to engage citizens in governance.
- **Change Management:** Implementing effective change management practices for governmental decisions and initiatives.
- **Governmental Legislation Online:** Shifting towards digital government operations where almost all types of work are done online, offering a choice to citizens.

Living

- **Smart Destination Thinking:** Encouraging forward-thinking approaches to creating smart and sustainable destinations for residents.
- **Air-Material-Space Scenario Map:** Developing a map that considers the implications of air, material, and space scenarios for improved urban planning and living conditions.

People

- **Change of Mindset:** Promoting a shift in mindset among individuals to embrace new technologies and innovative solutions.
- **Strong Public Institute:** Strengthening the role of public institutions in shaping the future and ensuring effective governance.

3. Conclusion and Discussions

The findings from the Gdansk Workshop shed light on the city's present achievements as well as its future goals in relation to Smart City Digital Twins. Gdansk is firmly committed to leveraging digital technologies for urban development, as evidenced by the several projects it is presently pursuing to advance sustainability, innovation, and effective governance. The city's emphasis on environmental sustainability, enhanced mobility, efficient governance, and economic development is in line with the larger objectives of smart cities, which include using technology to improve the standard of living for citizens by Smart City Digital Twins.

The insights also show that Gdansk, like many other cities, struggles with planning for unexpected disruptions and imagining other possible futures. Gdansk needs to make investments in adaptive, flexible solutions that can flourish in a range of future scenarios if it is to fully realise the potential of Smart City Digital Twins. As the city acknowledges the enduring impact of a traditional Eastern European attitude, it is also imperative to address cultural and mindset adjustments. The key to effectively implementing digital transformations will be adopting a mindset that embraces innovation and the larger picture.

The discussions emphasized that in the near future, "mental change" will be the cornerstone of smart city digital twin projects. It is imperative to encourage a change in the way individuals view technology and the opportunities it offers for their everyday lives. The city can set the stage for a "smart city" where digital twin enabled digital solutions improve every area of life in the future Gdansk "smart society" by starting with "smart parents" who recognize the importance of technology in "smart home" and in "smart schools." Creating long-term plans that can adjust to changing conditions should be Gdansk's top priority to address the problem of narrow-mindedness and transient political goals. In doing so, the city can ensure that its journey towards becoming a smart city is characterized by adaptability, resilience, and a commitment to the well-being of its residents.

Furthermore, more insights for each dimension and each theme should be gathered. Current Solutions, Visions and Near Future Needs, In the context of Smart City Digital Twins in Gdansk, several key themes emerge to be pondered on in near future.

1. **Sustainability and Environmental Quality:**
   - Gdansk should continue its focus on sustainability, striving to reduce emissions, promote recycling, and improve air, water, and noise quality.
   - The city needs comprehensive monitoring systems to ensure the environmental goals are met and the local population enjoys a high quality of life.

2. **Efficient Mobility:**
   - Improving urban mobility is crucial, which includes expanding public transportation, implementing smart traffic solutions, and embracing sustainable transportation modes such as bikes and e-scooters.
   - Gdansk needs a comprehensive approach to transportation that offers unified ticketing systems and reduces traffic congestion, contributing to improved mobility for residents.

3. **Digital Transformation and Governance:**
   - The city should transition to digital government institutions, streamlining services, and providing efficient digital communication channels.
   - Ensuring a decentralized and transparent governance structure will be essential, allowing for well-informed decisions based on data-driven insights.

4. **Resilience and Future-Readiness:**
   - Gdansk needs to foster a culture of innovation and preparedness for unexpected disruptions, as evidenced by the need for more comprehensive responses to "what-if" scenarios.
   - The city should continue to develop flexible and adaptable solutions that can withstand and recover from various future uncertainties.

5. **Community Involvement:**
   - Encouraging the active involvement of citizens in decision-making processes is crucial. The "citizen budget" concept is a step in the right direction.

- o Promoting initiatives that bring neighbors and the community together will foster a sense of ownership and participation in the city's development.

6. **Digitalization and Change Management:**
   - o A "mental change" is needed to shift the mindset of both the population and political systems toward embracing digitalization.
   - o Strong public institutions and change management strategies are necessary to support the digital transformation.

7. **Interconnected Urban Planning:**
   - o The "15-Minute City" concept and the emphasis on interconnected urban planning are integral for creating walkable, convenient, and sustainable neighborhoods.
   - o Gdansk should focus on creating smart destinations that provide residents with easy access to essential amenities within a close radius.

8. **Public-Private-People Collaboration:**
   - o Encouraging wide-scale collaboration among all stakeholders, including politicians, companies, the public sector, volunteers, and citizens, is critical in the development of Smart City Digital Twins.

In summary, Gdansk needs to continue its efforts in sustainability, mobility, governance, and community involvement while fostering innovation and resilience to effectively transition to the era of Smart City Digital Twins. The city's focus should be on creating a sustainable, connected, and forward-looking urban environment that enhances the quality of life for its residents.

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