Needs of stakeholders related on SmUCS and Digital Twin

D2.2 Report on the comprehensive understanding of the challenges and needs of SmUCS stakeholders, along with the development of digital twin solutions that address these needs

EU-CONEXUS ENABLES

Version 1.0

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1. Executive Summary

This report presents an analysis of stakeholder needs and challenges concerning Smart Urban Coastal Sustainability (SmUCS) and the application of Digital Twin technologies across the EU-CONEXUS Alliance. The findings are based on responses from 37 stakeholders across diverse organizations, including universities, engineering firms, and professional associations.

Key Insights:

- **Familiarity with SmUCS:** Stakeholders showed varied familiarity levels with the SmUCS concept, with 22 respondents indicating some degree of familiarity and practical experience, highlighting a moderate baseline understanding.

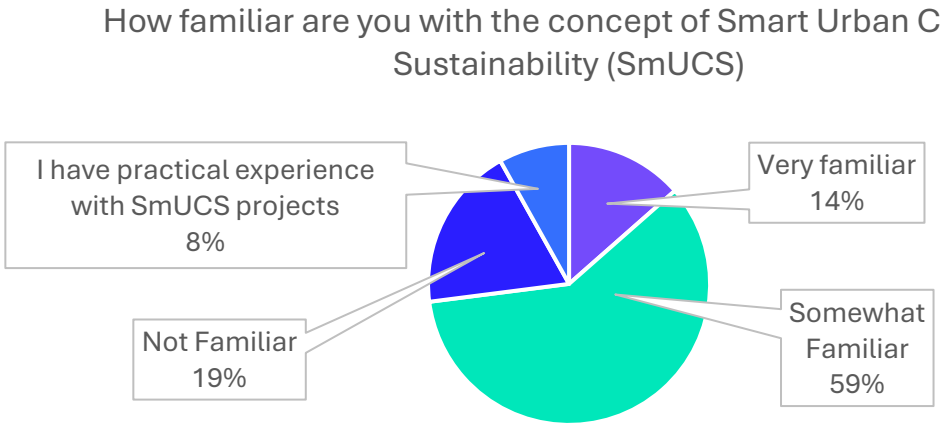


Figure 1. Familiarity with SmUCS

- **Experience with Digital Twins:** A significant portion of respondents (18) have indirect experience with technologies similar to Digital Twins, although only 7 have directly implemented Digital Twin solutions in their organizations. This indicates a broad interest but limited practical application, underscoring a gap in direct exposure to Digital Twin technology.

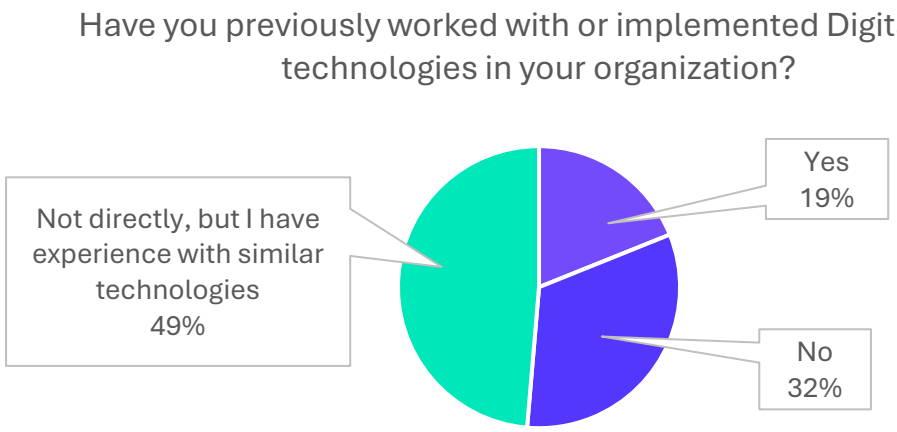


Figure 2. Experience with technologies like Digital Twins

- **Relevance of Digital Twins:** The majority of respondents (35 out of 37) perceive Digital

Twin technology as either very relevant or somewhat relevant for addressing challenges in coastal areas within SmUCS, suggesting strong support for its potential benefits.

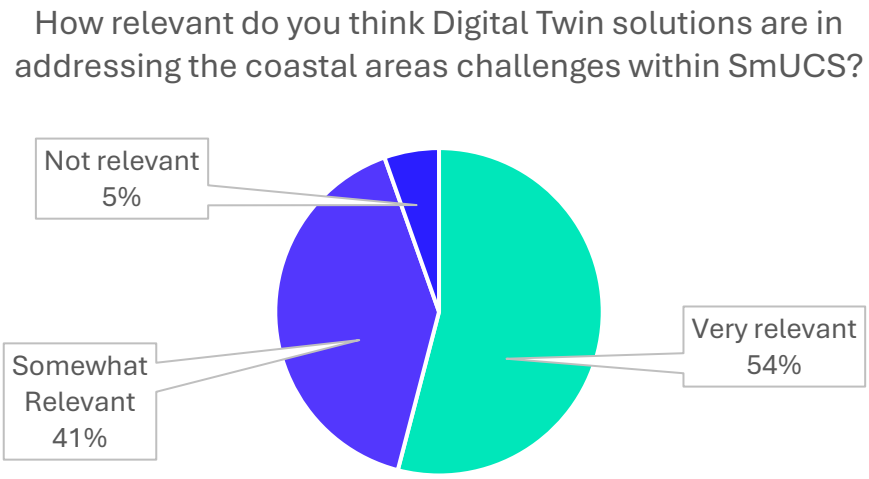


Figure 3. Digital Twin technology for addressing challenges in coastal areas

- **Primary Areas of Interest:** The challenges most relevant to stakeholders focus primarily on Buildings and Infrastructure, with 23 stakeholders indicating this as a top priority. Additional areas of focus include Agriculture, Life Sciences, and Medical Applications, reflecting the diverse applications within SmUCS.

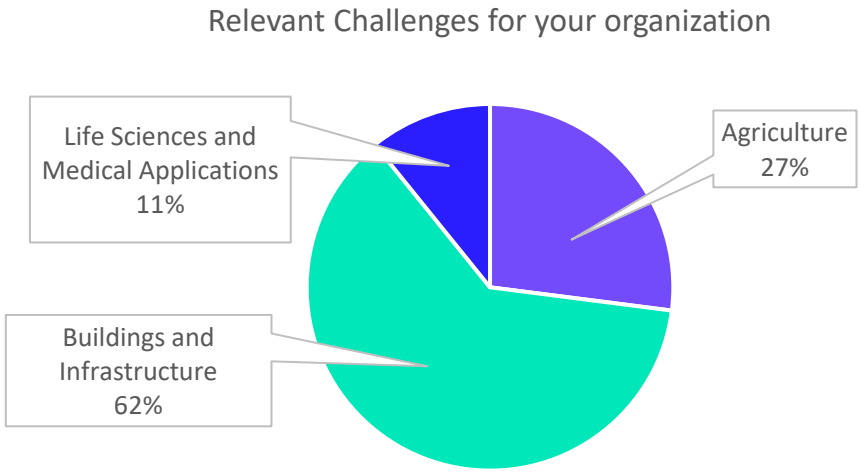


Figure 4. Primary Areas of Interest

These results indicate that stakeholders acknowledge the potential of Digital Twin solutions to address pressing issues in coastal urban areas.

2. Introduction

The EU-CONEXUS ENABLES project is a collaborative initiative involving nine European universities with a mission to foster excellence through innovative ecosystems focused on Smart Urban Coastal Sustainability (SmUCS). As part of this broader effort, **Task 2.2** plays a critical role in identifying and addressing the specific challenges faced by stakeholders in SmUCS areas. This task aims to leverage the capabilities of **Digital Twin technologies** to enhance SmUCS solutions. Digital Twins, as virtual representations of physical systems, offer advanced data-driven insights and predictive analytics that can be utilized to optimize urban coastal environments. Through engaging directly with stakeholders, Task 2.2 seeks to establish a comprehensive understanding of their needs and develop targeted Digital Twin applications that effectively address these needs. The results of this engagement will inform the development of integrated solutions, contributing to the broader EU-CONEXUS goals of advancing sustainable and resilient urban coastal ecosystems.

The purpose of this deliverable (D2.2) is to provide a detailed report on the identified needs and challenges of stakeholders involved in Smart Urban Coastal Sustainability (SmUCS), with a focus on the application of Digital Twin technologies. The deliverable aims to translate stakeholder feedback into actionable insights that can guide the development of tailored Digital Twin solutions. By systematically analysing input from diverse stakeholders, this report will present a clear understanding of priority areas and gaps, facilitating the design of innovative Digital Twin applications that address the challenges of SmUCS. Ultimately, the deliverable seeks to support the EU-CONEXUS ENABLES project in its objective to foster sustainable, technology-driven improvements in urban coastal regions.

3. Methodology

Objective: The primary aim of the survey is to gather insights from stakeholders involved in the EU-CONEXUS ENABLES project, focusing on the challenges and needs related to Smart Urban Coastal Sustainability (SmUCS) and the application of Digital Twin solutions.
Target Population: The survey targets stakeholders from various sectors, including agriculture, buildings and infrastructure, and life sciences and medical applications, who are engaged in or have an interest in SmUCS initiatives.
Survey Design: The survey consists of structured questions divided into sections:

- Section 1 collects general information about the respondent's organization and familiarity with SmUCS and Digital Twin technologies.
- Section 2 is dedicated to identifying challenge-based needs, where stakeholders will rate the importance of various challenges on a scale from 1 to 10 and provide multiple-choice answers regarding obstacles faced in implementing Digital Twin solutions. Follow-up questions are included to achieve detailed responses about specific challenges, knowledge gaps, data availability, tools, and funding needs.
- Sections 3 and 4 explore additional challenges and opportunities for collaboration, including interest in partnerships and PhD supervision related to SmUCS and Digital Twin technologies.

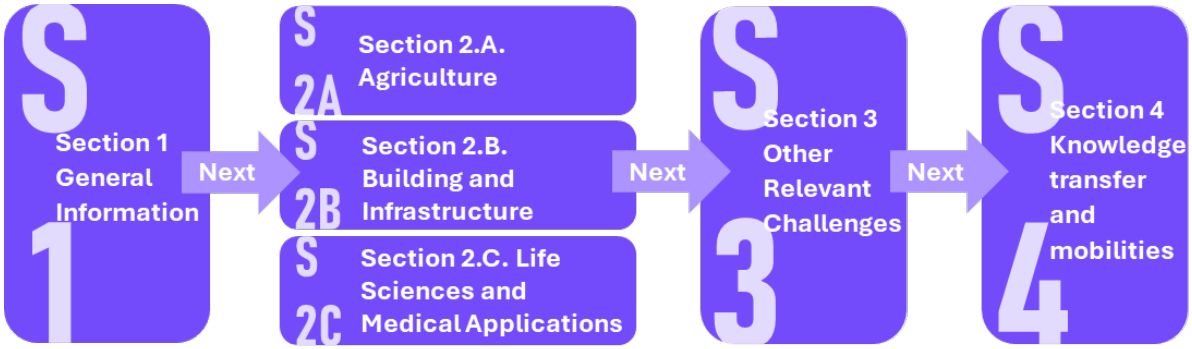


Figure 5. Survey design

Data Collection: The survey was conducted between 17 September 2024 and 25 October 2024 through various methods, including phone interviews, video calls, or physical meetings, allowing flexibility for stakeholders. Respondents provided their consent before starting the survey. Responses were recorded in a centralized spreadsheet for analysis.

Data Analysis: Quantitative responses (importance ratings) were used to prioritize challenges, while qualitative feedback provided deeper context and detailed explanations of stakeholder needs.

The analysis followed a thematic approach, identifying key trends and common issues across the three thematic areas. This dual method of quantitative scoring and qualitative insights allowed for a comprehensive understanding of the specific needs and challenges, forming the basis for the development of tailored Digital Twin solutions in the context of SmUCS.

4. Analysis of Stakeholder Needs and Challenges

4.1. Stakeholder profile

The stakeholder profile included a diverse set of participants, drawn from a range of organizations and industries, offering a wide spectrum of expertise relevant to Smart Urban Coastal Sustainability (SmUCS). The stakeholders were grouped into the following main categories:

Academic and Research Institutions

Participants included representatives from universities and research institutes specializing in architecture, computer science, mechanical engineering, civil engineering, agriculture, and bioeconomy, contributing insights from their respective fields of study.

Industry and Business Sector:

Key contributors came from the fields of digital technologies, agri-food sustainability, integrated agricultural production, business development, data analytics, and structural design, bringing practical industry perspectives and innovative solutions.

Public Sector and Government Bodies:

Engagement from public entities included representatives from city administration, seaport authorities, rural development agencies, and departments focused on agriculture, fisheries, and rural development, providing valuable input from a regulatory and governance standpoint.

Professional Associations:

Participants from various professional organizations included experts in energy auditing, photogrammetry, remote sensing, civil engineering, and building services, offering specialized

knowledge and professional standards relevant to the project.

Innovation and Technology Parks:

Stakeholders also included leadership from innovation hubs and science parks, bringing expertise in fostering technological advancements and supporting digital transformation initiatives.

This diverse group of participants ensured a well-rounded representation of perspectives, encompassing academia, industry, the public sector, and professional associations. The varied expertise was instrumental in identifying the complex needs and challenges of SmUCS, paving the way for the development of comprehensive Digital Twin solutions.

4.2. Stakeholders Needs Analysis

4.2.1. Analysis of the Agriculture Charts (Section S2.A)

The charts for the agriculture section present an overview of stakeholder ratings and needs for three key challenges: **Sustainable Farming Practices**, **Water Management**, and **Modelling and Environmental Surveillance**.

1. Sustainable Farming Practices (A.1)

- **High Priority**: This challenge received the highest average rating of **9.5**, indicating it is a top priority for interviewed stakeholders.
- **Key Needs**: The main needs identified include **Knowledge and Know-How Gaps**, **Data Availability**, and **Tools**, all rated at 90% or above. Funding availability is considered less critical, scoring 60%.
- **Issues**: The primary concern is a lack of knowledge and understanding of Digital Twin (DT) capabilities, followed by limited examples of successful DT applications.

2. Water Management (A.2)

- **Moderate Priority**: The average rating for this challenge is **5.3**, showing a lower level of urgency compared to sustainable farming practices.
- **Key Needs**: The identified needs include **Knowledge Gaps** (100%), **Data Availability** (80%), and **Tools** (80%). Funding availability was slightly higher, at 70%.
- **Issues**: The main barriers are limited experience with Digital Twins in water management and uncertainty about relevant DT parameters for monitoring water quality and quantity.

3. Modelling and Environmental Surveillance (A.3)

- **Moderate Priority**: This challenge has an average rating of **5.6**, similar to water management, suggesting a medium level of importance.
- **Key Needs**: High emphasis is placed on **Knowledge Gaps** (100%) and **Data Availability** (90%). Needs for tools and funding are also significant, at 90% and 80%, respectively.
- **Issues**: The main issue highlighted is the complexity of biological data and the challenges of integrating diverse environmental factors into Digital Twin models.

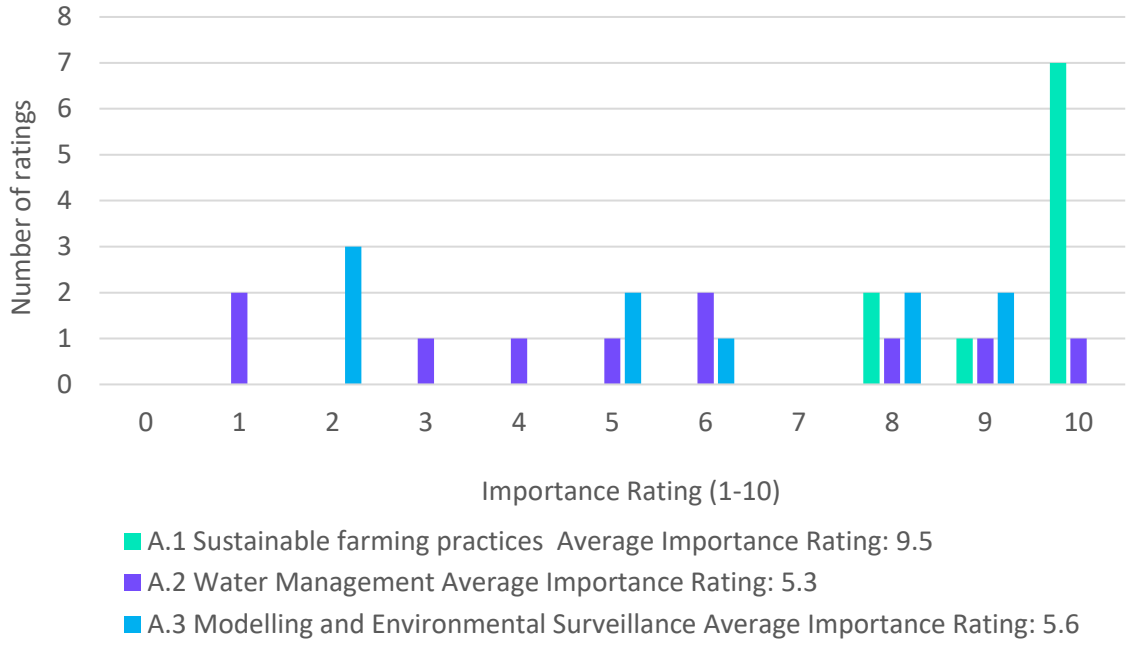


Figure 6. Stakeholder ratings for three key challenges: Sustainable Farming Practices, Water Management, and Modelling and Environmental Surveillance

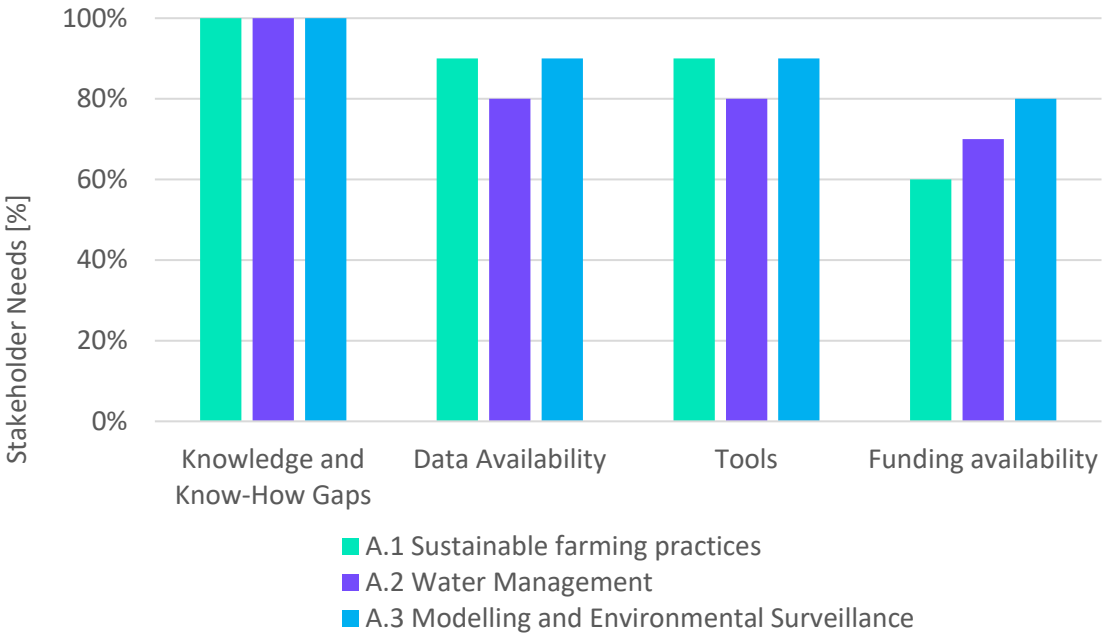


Figure 7. Agriculture key needs

The analysis shows that **Sustainable Farming Practices** is the highest priority, driven by significant gaps in knowledge and data needs. Both **Water Management** and **Modelling and Environmental Surveillance** have moderate priority but also indicate a strong demand for enhanced data capabilities and specialized tools to support Digital Twin applications. Overall, the focus is on addressing knowledge gaps and improving data quality to enable effective Digital Twin implementations in the agriculture sector.

Few insights from follow up questions - Agriculture

The responses to the first challenge, A.1 Sustainable farming practices, highlight several key needs and issues across the questions posed:

1. **Knowledge and Know-How Gaps**: There is a significant need for the development and adaptation of digital twins within the agrifood sector. Stakeholders emphasize the importance of interdisciplinary knowledge and collaboration among various stakeholders to effectively implement digital twin technologies. The integration of operational twins with existing systems and a better understanding of policy management are also critical for overcoming obstacles to digital transformation.
2. **Data Availability**: Data availability is identified as a barrier, with stakeholders noting that while some data is accessible from ongoing experiments, there is a lack of comprehensive datasets necessary for creating effective digital twins. The need for high-resolution data on various agricultural parameters, such as soil type and crop management, is emphasized, as well as the importance of integrating data from multiple platforms to enhance decision-making.
3. **Tools and Technologies**: Stakeholders express a lack of specific tools and technologies necessary for sustainable farming practices. There is a call for advancements in precision agriculture tools, smart irrigation systems, and software solutions that can facilitate real-time data processing and improve decision-making. The integration of AI with digital twin solutions is seen as a potential way to bridge these gaps.
4. **Funding Availability**: The responses indicate that if funding were available, investments would primarily focus on training, equipment, software, and human resources. Stakeholders believe that effective implementation of digital twin solutions could enhance their ability to secure funding, particularly from EU sources, by demonstrating the economic viability and benefits of smart farming practices.

The responses to the A.2 Challenge: Water Management, highlight several key needs and issues across the questions posed:

1. **Knowledge and Know-How Gaps**: Stakeholders emphasize the need for a combination of digital and agronomical skills to effectively manage water resources. There is a recognition that understanding the physical problems related to water management is crucial, and that more education and information about digital technologies could enhance decision-making in this area.
2. **Data Availability**: Data availability is identified as a significant barrier. Stakeholders note that while some data is available from their own experiments, there is a lack of comprehensive data on environmental conditions, such as micro-location factors and the chemical and physical state of the agroecosystem. Digital Twin solutions are seen as a potential means to focus on specific knowledge gaps and improve data management.
3. **Tools and Technologies**: There is a clear need for advanced tools and technologies, particularly in the area of smart irrigation systems and sensors. Stakeholders express that better sensor solutions and the integration of AI with digital twin technologies could enhance water management practices and decision-making processes.

4. **Funding Availability**: The responses indicate that if funding were available, investments would primarily focus on human resources, software, training, and equipment. Stakeholders believe that effective implementation of digital twin solutions could help secure funding by demonstrating the potential for improved water management and sustainable practices.

The responses to the A.3 Challenge: Crop Modelling and Environmental Surveillance reveal several key needs and issues across the questions posed:

1. **Knowledge and Know-How Gaps**: There is a significant need for combined knowledge in digital technologies and agronomy, particularly regarding crop physiology and development. Stakeholders emphasize the importance of understanding the interactions between crop growth and microclimate conditions, as well as the need for advanced modelling technologies to manage these relationships effectively.
2. **Data Availability**: Data availability is identified as a barrier, with stakeholders noting the lack of comprehensive data on environmental parameters and plant growth. There is a demand for diverse datasets that encompass various crops and climate zones, as well as chemical and physical data about the agro ecosystem. Digital Twin solutions are seen as a potential means to access and integrate this data, facilitating better decision-making and modelling.
3. **Tools and Technologies**: Stakeholders express a need for advanced tools and technologies, particularly in the areas of climate change modelling and data classification for crop growth. There is a call for the integration of AI and Digital Twin technologies to enhance predictions and simulations, which could improve the understanding of how different conditions affect crop development.
4. **Funding Availability**: The responses indicate that funding is crucial for acquiring necessary equipment, software, and training. Stakeholders highlight the importance of promoting their products and services through demonstrations of Digital Twin technologies, which could enhance their market penetration and secure funding for sustainable agricultural practices.

Overall, the analysis underscores the need for interdisciplinary knowledge, comprehensive data access, advanced technological tools, and adequate funding to effectively implement crop modelling and environmental surveillance through Digital Twin solutions.

4.2.2. Analysis of Buildings and Infrastructure Charts (S2.B)

The charts provide insights into three key challenges for the **Buildings and Infrastructure** thematic area: **Enhancing Energy Efficiency**, **Minimizing Environmental Impact**, and **Operational Effectiveness in Coastal Regions**.

1. **Enhancing Energy Efficiency (B.1)**
    - **High Priority**: This challenge received the highest average importance rating of **9.13**, indicating a critical focus area.
    - **Key Needs**: The main needs identified are **Tools** (70%), followed by **Data Availability** (65%) and **Funding** (61%). Knowledge gaps were slightly lower (52%).
    - **Main Issue**: The need for advanced tools and better data integration is evident, alongside funding support for implementation.
2. **Minimizing Environmental Impact (B.2)**

- **Significant Priority**: Rated at **8.43**, this challenge is also a high priority for stakeholders.
- **Key Needs**: Highest emphasis on **Data Availability** (70%), with strong needs for **Tools** (65%) and addressing knowledge gaps (57%).
- **Main Issue**: The focus is on improving data quality and integration to enable effective Digital Twin applications for reducing environmental impact.

3. **Operational Effectiveness in Coastal Regions (B.3)**
   - **Moderate Priority**: Scored lower at **7.43**, indicating a medium-level concern.
   - **Key Needs**: Emphasis on **Data Availability** (65%) and equal focus on **Tools** and **Funding** (57%).
   - **Main Issue**: The main challenge is integrating diverse data sources to enhance decision-making in coastal operations.

The analysis highlights a strong priority for energy efficiency and environmental impact reduction, driven by needs for better tools and data integration. Operational effectiveness in coastal regions, while slightly lower in priority, still requires significant improvements in data and resource availability.

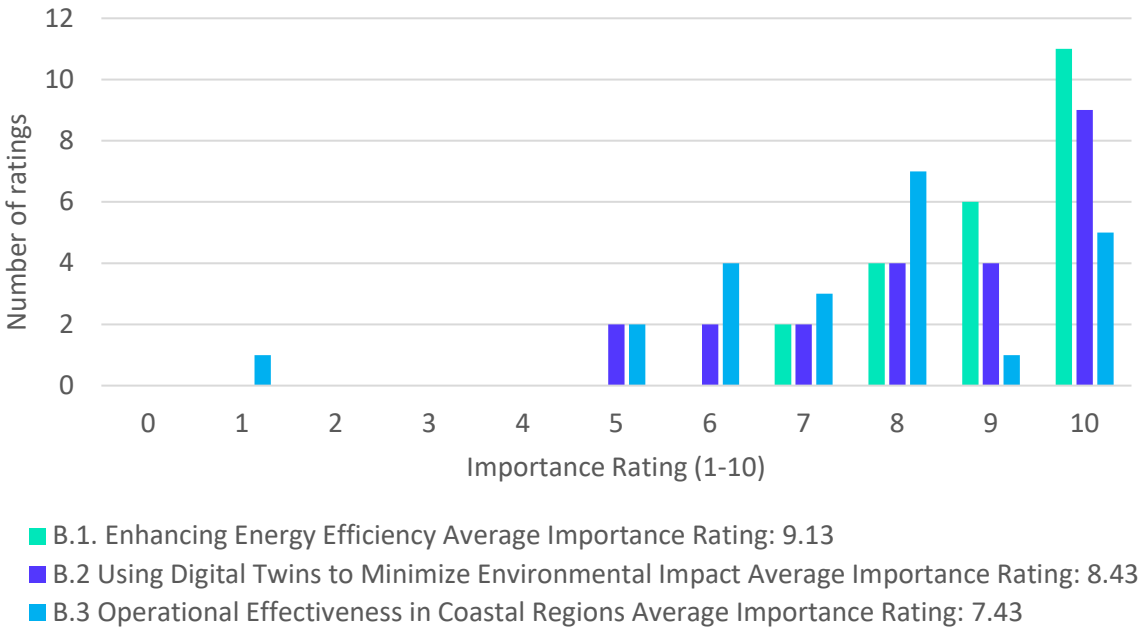


Figure 8. Stakeholder ratings for three key challenges: Enhancing Energy Efficiency, Minimizing Environmental Impact, and Operational Effectiveness in Coastal Regions

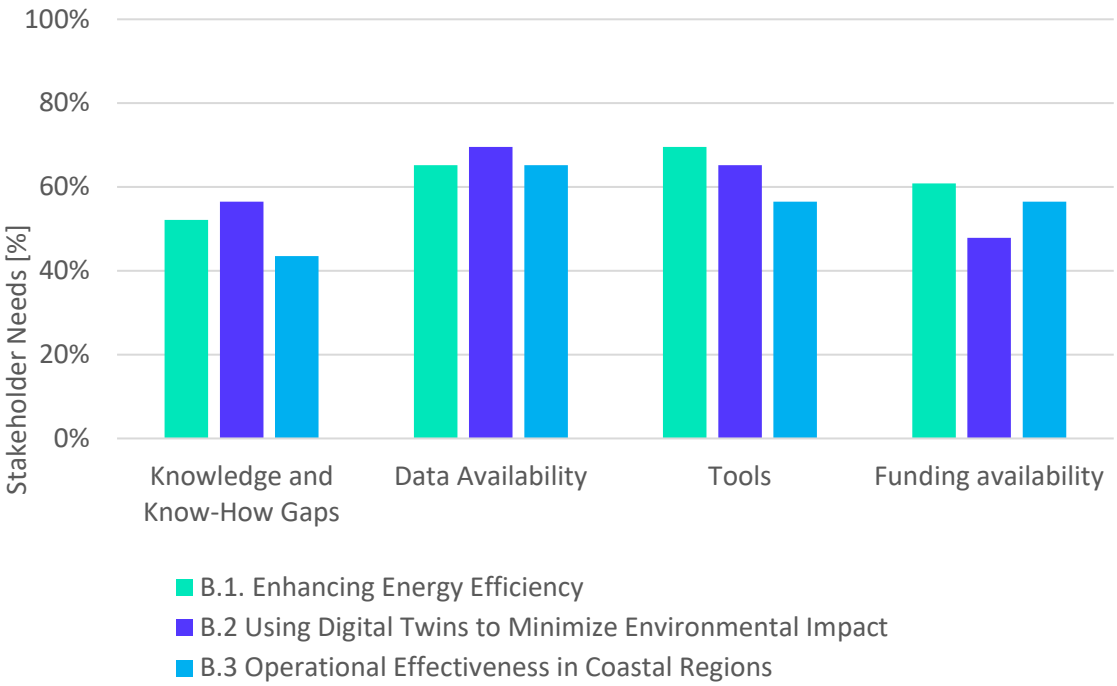


Figure 9. Buildings and Infrastructure key needs

Few insights from follow up questions – Buildings and Infrastructure

The main needs and issues identified in the answers related to the first challenge, B.1. Challenge: Enhancing Energy Efficiency, are summarized as follows:

1. **Knowledge and Know-How Gaps**: Respondents emphasized the necessity for a common understanding of technologies and access to modern tools for data retrieval. There is a significant need for upskilling in areas related to Digital Twins and energy efficiency, as well as a lack of instruments for Building Information Modelling (BIM). The integration of Digital Twins is seen as essential for improving knowledge bases and facilitating better decision-making.
2. **Data Availability**: Data availability was frequently cited as a barrier, with respondents noting the absence of granular, real-time data on energy consumption and building performance. The need for comprehensive datasets, including thermal data and energy demand assessments, was highlighted. Digital Twin solutions are viewed as a means to bridge these gaps by providing real-time insights and integrating various data sources.
3. **Tools**: The lack of specific tools and technologies, such as Building Information Modelling (BIM) and advanced Energy Management Systems (EMS), was identified as a significant issue. Respondents indicated that Digital Twin solutions could help centralize and analyse data, thereby enhancing energy efficiency and enabling better management of energy use across buildings.
4. **Funding Availability**: Respondents expressed that funding is crucial for investments in equipment, software, training, and human resources. They believe that Digital Twin solutions could help secure funding by demonstrating potential energy savings and

efficiency improvements, thus making a compelling case for sustainable city development initiatives.

In the context of B.2. Challenge: Using Digital Twins to Minimize Environmental Impact, the main needs and issues identified in the answers are as follows:

1. **Knowledge and Know-How Gaps**: There is a significant need for training to enhance personnel's ability to identify and optimize solutions that minimize environmental impact. Digital Twin solutions could serve as a repository for best practices and standard workflows, facilitating knowledge sharing and improving GIS analysis through advanced methodologies like machine learning and GeoAI.
2. **Data Availability**: Data availability is a critical barrier, with organizations lacking essential information on human mobility and vehicle usage. The fragmentation of data sources and issues related to data quality hinder the creation of accurate models. A Digital Twin solution could integrate multiple data sources, providing real-time monitoring and enabling predictive analytics to inform sustainable decision-making.
3. **Tools**: Organizations currently lack advanced data integration tools and sophisticated analytical software necessary for effective implementation of Digital Twins. The absence of these tools limits the ability to monitor and optimize environmental performance. Digital Twin solutions could bridge this gap by providing capabilities for real-time data integration and simulation, enhancing decision-making processes.
4. **Funding Availability**: There is a need for funding that supports tools and strategies aimed at preserving building integrity while enabling operational enhancements. Investments in human resources and technology are essential to carry out operations effectively, and Digital Twin solutions could help secure funding by demonstrating the potential for improved environmental outcomes and operational efficiencies.

In the responses to the B.3. Challenge: Operational Effectiveness in Coastal Regions, several key needs and issues were identified:

1. **Knowledge and Know-How Gaps**: There is a lack of clarity regarding what constitutes operational effectiveness in practice. This indicates a need for a better understanding of effective strategies and methodologies that can be applied in coastal regions to enhance operational outcomes.
2. **Data Availability**: The organization faces significant challenges related to data availability, including limited access to comprehensive and high-quality datasets, inconsistent data quality, and gaps in real-time monitoring. These issues hinder informed decision-making and operational effectiveness. A Digital Twin solution is seen as a potential means to integrate real-time monitoring and simulate ecosystem interactions, thereby improving operational capabilities.
3. **Tools**: There is a need for funding to acquire tools that enable operational effectiveness while preserving the integrity of historical or preserved buildings. This highlights the importance of balancing operational improvements with the conservation of cultural and historical assets in coastal regions.

4.2.3. Analysis of Life Sciences and Medical Applications Charts (S2.C)

The charts present stakeholder feedback for three key challenges: **Healthcare Innovation (C.1)**, **Personalized Medicine (C.2)**, and **Disease Modelling and Patient Care (C.3)**.

1. **Healthcare Innovation (C.1)**
   - **High Priority**: This challenge received an average importance rating of **8.0**, indicating strong interest but slightly lower than the other two challenges.
   - **Key Needs**: Major focus on addressing **Knowledge Gaps** (75%), with moderate needs for tools (50%) and funding (50%). Data availability was a lesser concern (25%).
   - **Main Issue**: The primary barrier is the lack of expertise in Digital Twin applications, which limits innovation in healthcare.
2. **Personalized Medicine (C.2)**
   - **Top Priority**: Rated higher with an average score of **9.0**, showing significant stakeholder interest in leveraging Digital Twins for personalized treatment solutions.
   - **Key Needs**: High emphasis on both **Knowledge Gaps** and **Tools** (75%), with balanced needs for data availability and funding (50% each).
   - **Main Issue**: The key challenge lies in the need for specialized tools and sufficient expertise to fully implement Digital Twin technology for personalized care.
3. **Disease Modelling and Patient Care (C.3)**
   - **Top Priority**: Also scored an average importance rating of **9.0**, indicating a critical focus on utilizing Digital Twins for advanced disease modelling.
   - **Key Needs**: Needs are evenly distributed across **Knowledge Gaps**, **Data Availability**, **Tools**, and **Funding** (50% each).
   - **Main Issue**: The balanced needs suggest a comprehensive requirement for enhancements in data, technology, and expertise to advance Digital Twin solutions in patient care.

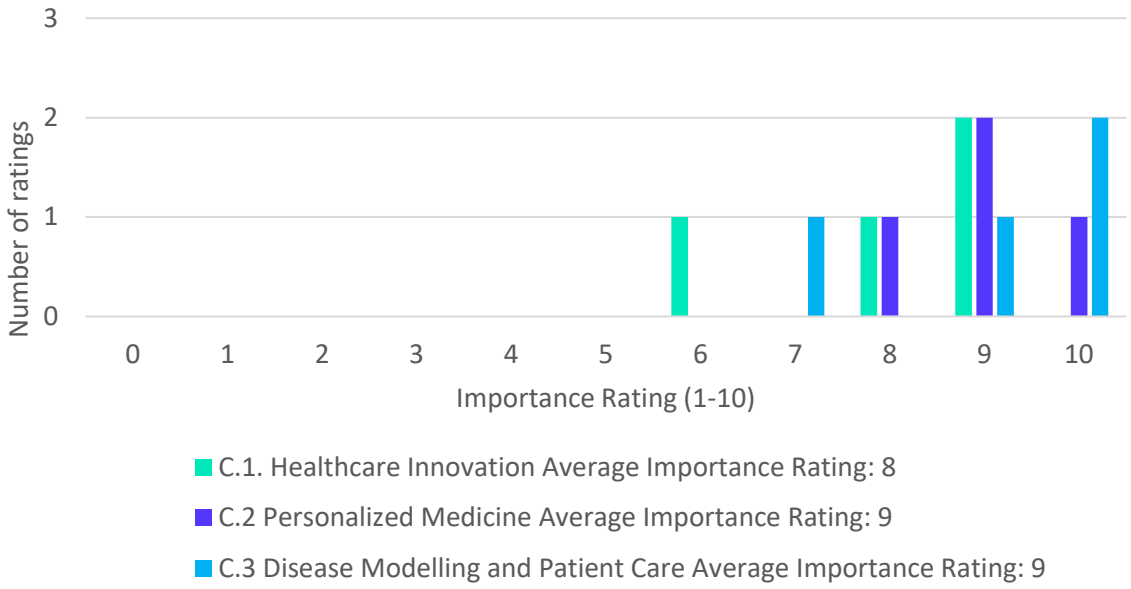


Figure 10. Stakeholder ratings for three key challenges: Healthcare Innovation, Personalized Medicine, and Disease Modelling and Patient Care

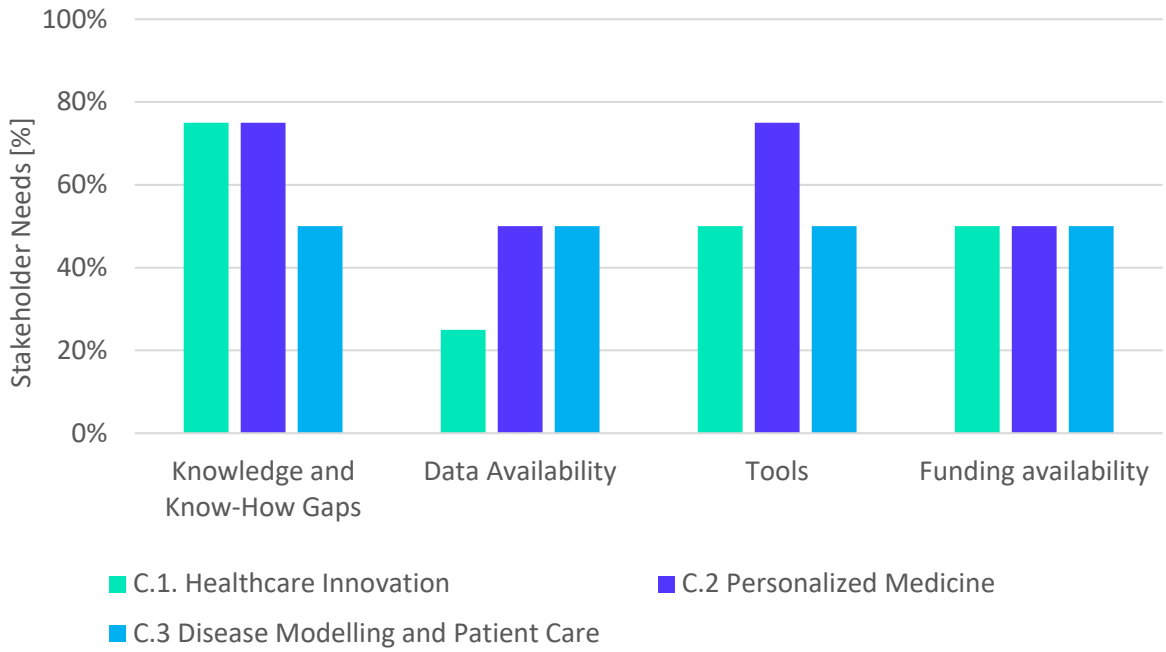


Figure 11. Life science and medical application key needs

The analysis highlights strong and consistent demand for Digital Twin applications in life sciences, particularly in **Personalized Medicine** and **Disease Modelling**, both rated as top priorities. Addressing gaps in knowledge and tool development is crucial for advancing healthcare innovation and improving patient outcomes through the use of Digital Twin technology.

Few insights from follow up questions – Life Sciences and Medical Applications

The main needs and issues identified in the answers related to the first challenge, C.1. Challenge: Healthcare Innovation, are summarized as follows:

1. **Knowledge and Know-How Gaps**: There is a significant need for increased biomechanical knowledge of animal anatomy and expertise in data integration and management. Organizations require training in modelling, simulation techniques, and healthcare analytics to effectively implement Digital Twin solutions. Interdisciplinary collaboration and understanding of regulatory standards are also essential for successful integration.
2. **Data Availability**: Data availability is a major barrier, with issues stemming from fragmented systems across departments, inconsistent data quality, and compliance with privacy regulations. The lack of real-time patient data and structured historical data hampers effective decision-making. A Digital Twin solution could integrate real-time data from various sources, enhancing operational efficiency and patient care.
3. **Tools**: Organizations currently lack essential tools such as measuring devices and data analytics platforms. There is a need for remote patient monitoring and engagement

tools to improve healthcare delivery. Digital Twin solutions could bridge these gaps by providing comprehensive data management and real-time monitoring capabilities.

4. **Funding Availability**: The main investments needed include equipment, software, training, and human resources. Digital Twin solutions could enhance funding applications by demonstrating efficiency gains and sustainable practices, thereby attracting more resources for technological advancements in healthcare.

In the context of the C.2. Challenge: Personalized Medicine, the main needs and issues identified in the answers are as follows:

1. **Knowledge and Know-How Gaps**: There is a significant lack of understanding and adoption of advanced analytics and machine learning techniques necessary for interpreting complex data sets. Healthcare professionals often lack the skills to analyse genomic and clinical data effectively, which hinders the translation of insights into actionable treatment plans. Proficiency in data integration and management is essential for consolidating various data sources into a cohesive system.
2. **Data Availability**: Data availability poses a barrier, particularly due to the inability to implant internal chips in animals, which complicates data validation. Organizations rely on external simulations and proxy variables, which may not provide accurate insights. There is a need for centralized data management systems to allow secure access and integration across departments, enhancing the ability to leverage available data for personalized treatment strategies.
3. **Tools**: Organizations currently lack essential tools such as data management platforms that can consolidate and integrate diverse data sources, including electronic health records and patient-reported outcomes. The absence of patient-centred platforms and wearable devices for real-time monitoring further limits the ability to provide personalized care.
4. **Funding Availability**: There is a notable lack of funding for addressing diabetes and related healthcare needs in Romania. Organizations emphasize the importance of lobbying national authorities to increase awareness and resources for managing the disease. When funding is received, it is often directed towards hiring staff to support various therapeutic and rehabilitative services, indicating a need for more comprehensive funding strategies.

The section on "C.3. Challenge: Disease Modelling and Patient Care" addresses several key aspects related to the implementation of Digital Twins in healthcare practices.

1. **Knowledge and Know-How Gaps**: There is a significant lack of data on patients due to species variability, which complicates the modelling of diseases. More species-specific analysis of the biomechanics of animals is necessary to enhance understanding and improve disease modelling practices.
2. **Data Availability**: The responses did not provide specific details regarding data availability issues for this challenge, but it can be inferred that the lack of comprehensive data on various species may hinder effective disease modelling and patient care.

3. **Tools**: Organizations currently lack essential data integration tools and simulation technologies that are crucial for effective disease modelling. The absence of these tools limits the ability to create accurate models and simulations necessary for patient care.
4. **Funding Availability**: The responses did not explicitly address funding availability for this challenge, but it can be inferred that securing funding for advanced technologies and tools would be critical for implementing effective disease modelling and improving patient care.

4.3. Challenges Identified in Section 3

Technical Challenges

1. **Incorporation of BIM into Licensing Processes**: There is a challenge in integrating Building Information Modelling (BIM) into existing licensing processes to streamline operations.
2. **Lack of Standardized Classification Systems**: The absence of a standardized classification system in the Architecture, Engineering, and Construction (AEC) industry hampers effective communication among project stakeholders.
3. **Insufficient BIM Tools**: Teams in Romania lack the necessary BIM tools to develop federated 3D models effectively.

Operational Challenges

1. **Dissemination of Information**: There is a challenge in effectively disseminating information regarding technological updates and the importance of certain technologies.
2. **Stakeholder Alignment**: Conflicting interests among communities and agencies hinder decision-making processes.
3. **Resource Limitations**: Funding and expertise are often insufficient, which limits the ability to develop Smart Urban Coastal Sustainability (SmUCS) initiatives.

Strategic Challenges

1. **Economic Viability Concerns**: The industrial sector's focus on economic viability and market volatility makes it difficult to promote wide-scale sustainable modernization.
2. **Public Perception and Acceptance**: There is a challenge in convincing the public to invest in sustainable solutions, especially when the industrial sector is perceived as the main contributor to pollution.
3. **Long-term Strategy for Education and Policy-making**: A long-term strategy is needed to educate and persuade stakeholders about sustainable goals, which is financially challenging in the short term.

These challenges highlight the multifaceted issues stakeholders face in the context of developing and implementing Digital Twin solutions and sustainable urban planning initiatives.

4.4. Needs of stakeholders independent by the clusters

The analysis identifies several key needs related to Smart Urban Coastal sustainability and the implementation of Digital Twin technology, independent of specific challenges. These needs can be summarized as follows:

1. **Knowledge and Expertise**: Stakeholders emphasize the necessity for enhanced knowledge in areas such as data integration, management, and the application of Digital Twin technology. There is a call for interdisciplinary training that combines technical skills with domain-specific knowledge relevant to coastal sustainability.
2. **Data Availability and Quality**: A significant need highlighted is the availability of comprehensive, high-quality data. Stakeholders' express concerns about fragmented data sources, inconsistent data quality, and the lack of real-time monitoring. Access to detailed environmental, ecological, and operational data is crucial for effective decision-making and the successful implementation of Digital Twins.
3. **Technological Tools and Infrastructure**: There is a demand for advanced tools and technologies, including data integration platforms, real-time monitoring systems, and simulation capabilities. Stakeholders recognize that these tools are essential for modeling environmental changes, assessing human impacts, and enhancing operational effectiveness in coastal regions.
4. **Collaboration and Stakeholder Engagement**: The need for improved collaboration among various stakeholders is frequently mentioned. Effective communication and partnerships are seen as vital for sharing knowledge, resources, and best practices, which are necessary for the successful implementation of Digital Twin solutions.
5. **Funding and Resources**: Stakeholders indicate a need for increased funding to support the acquisition of technology, training, and human resources. There is a recognition that securing financial resources is essential for implementing innovative solutions and enhancing sustainability efforts in urban coastal areas.
6. **Policy and Regulatory Support**: The need for supportive policies and frameworks that facilitate the adoption of Digital Twin technologies and sustainable practices is highlighted. Stakeholders call for regulations that promote data sharing and collaboration among different entities involved in coastal management.

These needs reflect a comprehensive understanding of the challenges faced by stakeholders in the context of Smart Urban Coastal sustainability and the role of Digital Twin technology in addressing these challenges.

Based on the stakeholder responses in the document, the following words and groups of words are identified as having higher frequency and relevance to the concept of needs:

1. **Digital Twin**: This term appears frequently as stakeholders discuss the implementation and benefits of Digital Twin technology in various contexts. (15 occurrences)
2. **Data**: Variations of this word, including "data availability," "data quality," and "data integration," are commonly mentioned, highlighting the importance of data in addressing challenges. (22 occurrences)
3. **Knowledge**: The term "knowledge" is often referenced, particularly in relation to gaps in understanding and the need for interdisciplinary expertise. (12 occurrences)
4. **Training**: This word is frequently mentioned in the context of the need for upskilling and education to effectively implement Digital Twin solutions. (10 occurrences)
5. **Funding**: The need for financial resources is a recurring theme, with stakeholders

discussing the importance of securing funding for equipment, software, and human resources. (10 occurrences)

6. **Tools/Technologies**: References to specific tools and technologies needed for sustainable practices and Digital Twin implementation are prevalent. (9 occurrences)
7. **Collaboration**: The need for collaboration among stakeholders is emphasized, indicating the importance of partnerships in achieving common goals. (5 occurrences)
8. **Sustainability**: This term is often associated with the overarching goals of the stakeholders, particularly in the context of urban coastal sustainability and agricultural practices. (6 occurrences)
9. **Implementation**: The word "implementation" is frequently used in discussions about putting Digital Twin solutions into practice. (7 occurrences)
10. **Support**: This term appears in the context of needing support for various initiatives, including decision-making and operational effectiveness. (5 occurrences)

Figure 12. Word map that visually represents the needs identified by stakeholders in relation to SmUCS and Digital Twin technology (created in wordcloud.com)

5. Digital Twin Solutions: Development and Alignment with Stakeholder Needs

The stakeholder feedback for each section has been analysed. The Stakeholder Needs have been weighed with the importance rating they assigned to each topic. The results are plotted in the following three graphs. This information will be used to determine which specific features digital twin solutions should cover, and how mobility opportunities related to DT development should be prioritised.

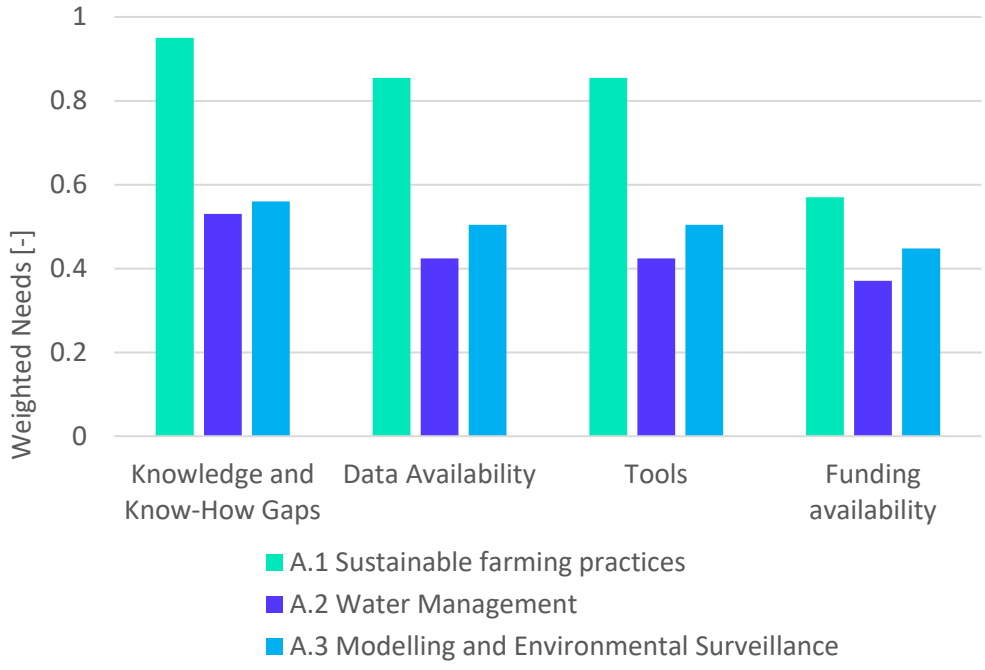


Figure 13. Agriculture – Weighted Stakeholder Needs

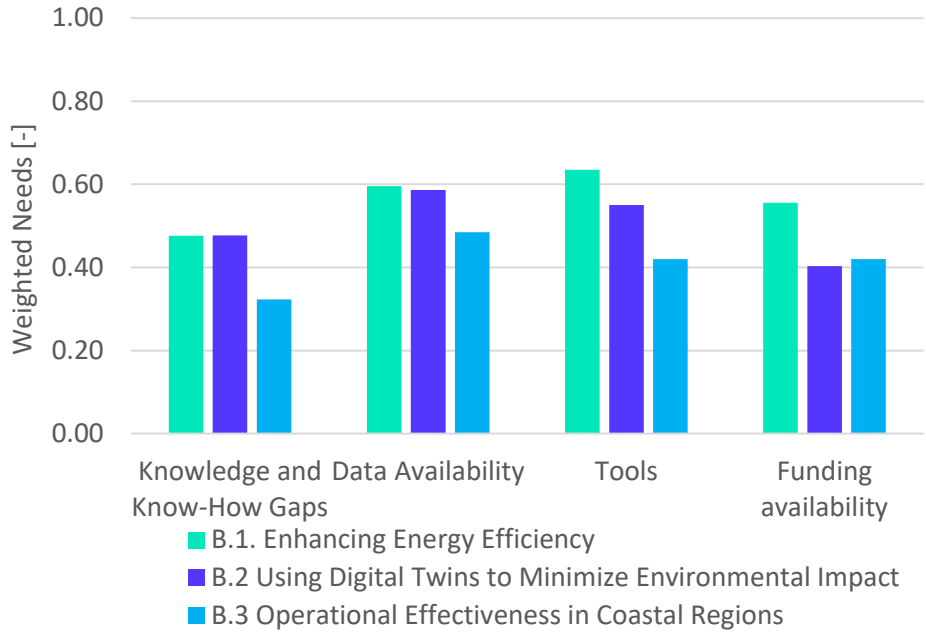


Figure 14. Buildings and Infrastructure – Weighted Stakeholder Needs

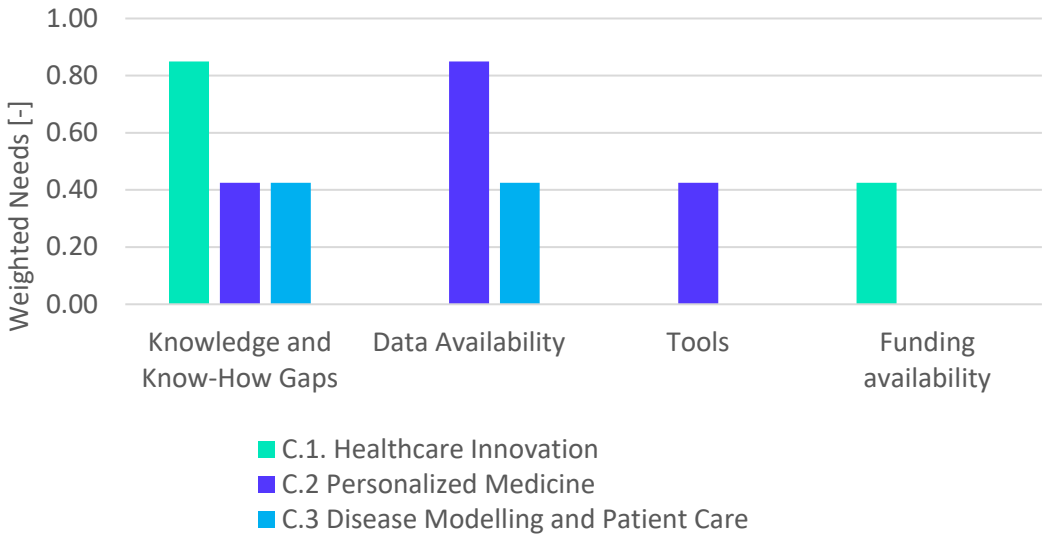


Figure 15. Life Sciences and Medical Applications – Weighted Stakeholder Needs

The results indicate that:

For Agriculture: DT solutions should prioritise Filling Know-How Gaps, providing data and tools to process said data with a focus on sustainable farming practices. Both water management and environmental modelling and surveillance take a back seat in the stakeholder's needs for this area.

For Buildings and Infrastructure: DT solutions should focus on providing data and tools to process said data with the aims of aiding funding opportunities. Energy efficiency and minimal environmental impact are at the forefront of this section's needs.

For Life Sciences and Medical Applications: DT solutions should prioritize data gathering and knowledge to further healthcare innovation. This is a starting point, and is a recommendation formulated which some caution based on the low number of stakeholders that have shown interest in this area.

Based on the analysis of stakeholder needs, several targeted Digital Twin solutions have been developed to address the key challenges identified in SmUCS areas. These solutions aim to enhance knowledge, improve data integration, provide advanced technological tools, and foster collaboration. Additionally, they consider the need for supportive policies and adequate funding. The proposed solutions are designed to deliver practical, impactful outcomes that align with stakeholders' priorities, enabling effective and sustainable management of urban coastal environments through innovative Digital Twin applications.

Solution A: Knowledge Hub and Training Platform

- **Description**: Develop a centralized digital platform for interdisciplinary training on Digital Twin technologies, integrating courses on data management, coastal sustainability, and simulation tools.
- **Benefits**: Enhances stakeholder knowledge and expertise, facilitates skill development across disciplines, and provides ongoing learning resources.
- **Challenges Addressed**: Tackles the lack of expertise and interdisciplinary knowledge integration, supporting stakeholder capacity building.

Solution B: Integrated Data Platform for Real-Time Monitoring

- **Description**: Establish a comprehensive data integration system that consolidates real-time environmental, ecological, and operational data from multiple sources into a unified Digital Twin model.
- **Benefits**: Improves data availability, enhances data quality, and provides a real-time view of coastal ecosystems for better decision-making.
- **Challenges Addressed**: Addresses fragmented data sources, inconsistent data quality, and the need for real-time monitoring capabilities.

Solution C: Advanced Simulation and Decision-Support Tools

- **Description**: Implement simulation tools within the Digital Twin platform to model environmental changes, assess human impacts, and support scenario planning for coastal management.
- **Benefits**: Provides stakeholders with predictive insights, enhances operational effectiveness, and aids in evaluating the impact of different strategies.
- **Challenges Addressed**: Meets the demand for advanced tools, supports technological infrastructure needs, and improves decision-making processes.

Solution D: Stakeholder Collaboration Portal

- **Description**: Create an online collaboration portal within the Digital Twin platform to facilitate communication, resource sharing, and joint project management among stakeholders.
- **Benefits**: Enhances stakeholder engagement, supports knowledge exchange, and promotes coordinated efforts for SmUCS initiatives.
- **Challenges Addressed**: Improves collaboration and communication, aligns with the need for stakeholder partnerships, and enhances resource sharing.

Solution E: Policy Integration and Compliance Module

- **Description**: Develop a policy and regulatory framework integration tool that ensures Digital Twin applications comply with local regulations and promote sustainable practices.
- **Benefits**: Facilitates regulatory compliance, encourages data sharing, and supports the adoption of Digital Twin solutions in urban coastal areas.
- **Challenges Addressed**: Addresses the need for supportive policies and regulatory frameworks, promoting sustainable practices.

Alignment with Stakeholder Needs

These solutions directly address the identified stakeholder needs:

- **Enhanced Knowledge and Expertise**: The training platform (Solution A) provides comprehensive skill development in Digital Twin technologies.
- **Improved Data Availability and Quality**: The integrated data platform (Solution B) ensures access to real-time, high-quality data for effective decision-making.
- **Technological Tools and Infrastructure**: Simulation tools (Solution C) enhance modelling and analysis capabilities, while the collaboration portal (Solution D) supports resource sharing.
- **Increased Collaboration**: The stakeholder portal (Solution D) fosters effective partnerships and communication.
- **Funding and Resources**: Solutions are designed to leverage existing resources efficiently, increasing the likelihood of attracting additional funding.
- **Policy Support**: The compliance module (Solution E) aligns Digital Twin implementations with regulatory requirements, facilitating broader adoption.

6. Conclusion

The analysis reveals a complex landscape of stakeholder needs and challenges, emphasizing the critical role of Digital Twin technologies in addressing key issues within urban coastal environments. Stakeholders demonstrated varying levels of familiarity with SmUCS and Digital Twins, indicating a clear need for enhanced education and training to bridge existing knowledge gaps. While there is strong interest in the potential of Digital Twin solutions, practical implementation remains limited due to barriers such as insufficient data, lack of specialized tools, and inadequate funding.

Many respondents showed a limited understanding of Digital Twin concepts, necessitating additional explanation efforts to ensure a comprehensive understanding of the subject. The responses also indicate diverse levels of interest and engagement, with some stakeholders actively participating while others felt disconnected from the themes presented. This disparity underscores the need for tailored communication strategies that satisfy to the specific concerns and knowledge levels of different stakeholder groups.

In conclusion, the stakeholder engagement process must focus on increasing awareness and understanding of Digital Twin technologies while fostering collaboration and addressing the unique needs of each stakeholder. By aligning Digital Twin applications with the identified challenges and priorities, the project can better meet stakeholder expectations, enhancing decision-making, optimizing resource management, and promoting sustainable practices. By doing so, the EU-CONEXUS ENABLES project can support the creation of sustainable and resilient urban coastal ecosystems, contributing to broader goals of environmental sustainability and community well-being.

List of figures

Acknowledgement of AI Assistance
This deliverable was developed with the assistance of AI-based tools, in compliance with the principles outlined in the EU Artificial Intelligence Act.

7. Detailed survey questions

Survey for EU-CONEXUS ENABLES Stakeholders

This survey is designed to gather input from stakeholders involved in the EU-CONEXUS ENABLES project, specifically focusing on Task 2.2/WP2 - Framework for knowledge transfer towards widening partners with focus on Digital Twins. Your responses will be instrumental in establishing challenge-based needs for SmUCS (Smart Urban Coastal Sustainability) with Digital Twin solutions and determining priority research topics for research mobilities and PhD theses in Cotutelle. Please take a few minutes to provide your valuable feedback.

The interview can be held on phone/ video call/ physical meeting. The questions are designed to be focused on a specific subject and should guide the interviewer on how to approach and further the interview with the associated partner/stakeholder.

Some key takeaways for interview preparation:

— The main purpose of the interview is highlighting the main challenges that the stakeholders face and what are their needs in order to address those challenges. To clarify, “challenges” are areas which each stakeholder seeks to develop in order to get closer to the concept of SmUCS and the “needs” are the specific obstacles which impede the sustainable development of said “challenges”.

— The interview is based around the challenges identified during Task 2.1/WP2, grouped together by their overarching themes (the overarching themes being: Agriculture, Buildings and Infrastructure and Life Sciences and Medical Applications). Each challenge has 3-4 multiple-choice answers (numbered a-d), each answer with a follow up question to attempt to focus the stakeholders on relevant issues for Digital Twin solutions for SmUCS.

— Additionally, the stakeholder will rate the importance of each question on a scale from 1-10 where 1 means irrelevant and 10 means crucial.

— The discussion with the stakeholders should be tailored to focus on how they think that the Digital Twin solutions can help them address the needs they identified for SmUCS development in their region.

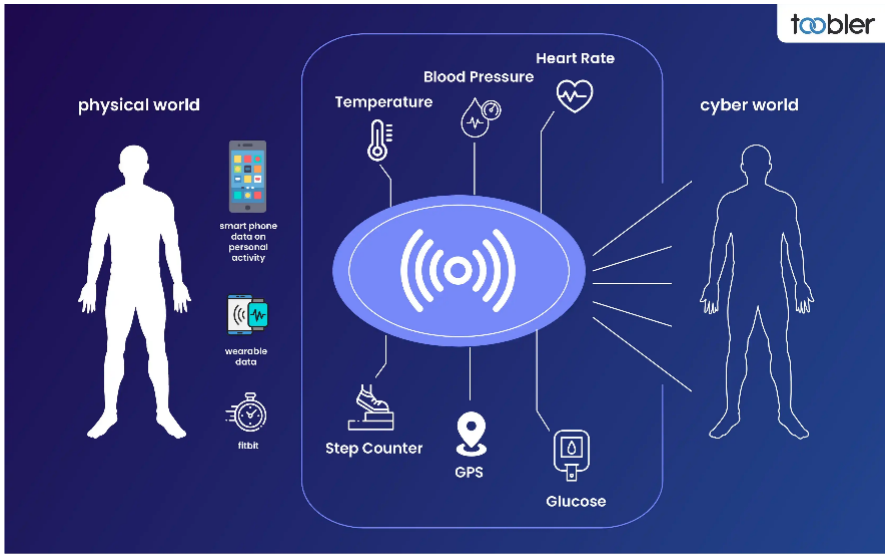
— **Do not hesitate to guide your stakeholders through the questionnaire** if they seem to be unclear as to what to respond. Remember, our goal is gathering information about how Digital Twin Solutions can be used to address SmUCS challenges.

Interview results will be centralized in a spreadsheet (which will be provided to the partners) where we will determine the needs based on the answers from the

stakeholders and by the degree of importance the stakeholders assigned to each answer.

Smart Urban Coastal Sustainability (SmUCS) is aimed at providing sustainable, nature-based solutions and smart solutions that rely on advanced technologies and materials for achieving key sustainability goals that reduce the impact of local populations on their environment. This is to be done through SMART (Specific, Measurable, Accepted, Realistic, Time-bound) metrics which can be implemented with the help of Digital Twins.

A **Digital Twin** is a virtual representation of a physical object, process, or system that is updated in real time. It uses data from sensors and other sources to simulate the performance and behavior of its real-world counterpart, enabling monitoring, analysis, and optimization. This technology helps improve decision-making, predict issues, and enhance efficiency across various industries like manufacturing, healthcare, and smart cities.



Digital Twin Applications

Dear …. (Stakeholder),

My name is [Interviewer's Name], and I hold the role of [Description of Your Role] at [Your University's Name]. EU-CONEXUS is an alliance of nine universities across nine different European countries, specifically focusing on Smart Urban Coastal Sustainability. This thematic area encompasses a range of social, cultural, and environmental challenges. The EU-CONEXUS Alliance invites you to participate in this short interview that we could use to identify how Digital Twin solutions for SmUCS can help your organization fulfill its sustainability needs.

Please answer the questions in the following interview by circling or highlighting the relevant answer(s) to your organization. All questions in Section 2 should be rated on an important scale ranging from 1-10 where 1 means that the issue is irrelevant for your organization and 10 means that the issue is of crucial importance. Please keep in mind for the follow-up questions that the focus is on Digital Twin solutions enabling SmUCS development and how this can help your organization.

Answering follow-up questions is optional but highly encouraged as it will increase the relevance and efficiency of the interview process.

Section 1: General Information

1. **Organization**:
2. **Position/Role**:
3. **Contact Email** (Optional):
4. **How familiar are you with the concept of Smart Urban Coastal Sustainability (SmUCS)?**
    A. Very familiar
    B. Somewhat familiar
    C. Not familiar
    D. **Additional Option:** I have practical experience with SmUCS projects
5. **Have you previously worked with or implemented Digital Twin technologies in your organization?**
    A. Yes
    B. No
    C. **Additional Option:** Not directly, but I have experience with similar technologies

6. **How relevant do you think Digital Twin solutions are in addressing the coastal areas challenges within SmUCS?**
    A. Very relevant
    B. Somewhat relevant
    C. Not relevant

7. **Relevant Challenges for your organization (multiple choice):**
    A. Agriculture (Section 2.A)
    B. Buildings and Infrastructure (Section 2.B)
    C. Life Sciences and Medical Applications (Section 2.C)

Section 2: Task 2.2 - Establishing Challenge-Based Needs with Digital Twin Solutions (complete the sections you selected as relevant to your organization in section 1, question 7)

Section 2.A. – Agriculture

A.1. **Challenge: Sustainable farming practices – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Sustainable farming practices**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

A.2. **Challenge: Water Management – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Water Management**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

A.3. **Challenge: Crop Modelling and Environmental Surveillance – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Crop Modelling and Environmental Surveillance**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

Section 2.B. – Building and Infrastructure

B.1. **Challenge: Enhancing Energy Efficiency – Importance Rating: (1…10)**

1. Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

    a. Knowledge and Know-How Gaps

    Follow-up questions:

    What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

    How could Digital Twin solutions help your organization with its knowledge base?

    b. Data Availability

    Follow-up questions:

    Is data availability a barrier for your organization in addressing this challenge?

    If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

    c. Tools

    Follow-up questions:

    What specific tools or technologies does your organization currently lack in relation to **Enhancing Energy Efficiency**?

    How do you believe a Digital Twin solution could bridge this gap?

    d. Funding availability

    Follow-up questions:

    If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

    How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

B.2. **Challenge: Using Digital Twins to Minimize Environmental Impact – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Using Digital Twins to Minimize Environmental Impact**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

B.3. **Challenge: Operational Effectiveness in Coastal Regions – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Operational Effectiveness in Coastal Regions**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

Section 2.C. – Life Sciences and Medical Applications

C.1. **Challenge: Healthcare Innovation – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Healthcare Innovation**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

C.2. **Challenge: Personalized Medicine – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Personalized Medicine**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

C.3. **Challenge: Disease Modelling and Patient Care – Importance Rating: (1…10)**

Identify the main obstacles your organization has faced when addressing the above challenge (multiple choice):

a. Knowledge and Know-How Gaps

Follow-up questions:

What specific knowledge do you believe would be necessary, and how should it be obtained, to help your organization implement Digital Twins in its practices?

How could Digital Twin solutions help your organization with its knowledge base?

b. Data Availability

Follow-up questions:

Is data availability a barrier for your organization in addressing this challenge?

If so, what types of data are missing, and how could a Digital Twin solution assist in filling these gaps?

c. Tools

Follow-up questions:

What specific tools or technologies does your organization currently lack in relation to **Disease Modelling and Patient Care**?

How do you believe a Digital Twin solution could bridge this gap?

d. Funding availability

Follow-up questions:

If you had funding, what would be the main investments of your organization? Equipment, software, training, human resources?

How could Digital Twin solutions help your organization secure funding for its sustainable cities' development?

Section 3: Task 2.2 – Other Relevant Challenges

If your organization faces any challenges related to SmUCS development which were not detailed above, you are free to detail them here. How could Digital Twin solutions for SmUCS enable your company to overcome these challenges? With which Challenge can the ENABLES project help your organization the most?

Section 4: Task 2.2 – Knowledge transfer and mobilities

1. Would your organization be interested in partnerships with the local EU-CONEXUS universities related to the mobility programs developed by the ENABLES project, which are aimed to facilitate the research and development of Digital Twin solutions for SmUCS?
    - Yes
    - No
2. Are you currently supervising or interested in supervising a PhD thesis related to SmUCS or Digital Twin technologies? Would you be interested in developing a PhD topic that aligns with your organization's scope, or could a doctoral stage be connected with your activities?
    - Yes
    - No
    - **If yes,** please provide a brief description of the potential research topic.
    - **Additional Question:** Would you be open to collaborating with other institutions on these topics?

Thank you for your time and input! Your feedback is crucial to the success of the EU-CONEXUS ENABLES project. We look forward to collaborating with you to address the challenges and opportunities within SmUCS through innovative Digital Twin solutions and impactful research.