BUILDSPACE

Enabling Innovative Space-driven Services for Energy Efficient Buildings and Climate Resilient

D5.2 - Updated business and exploitation plan, and report on the viable business models and links with EGNSS/Copernicus

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Abbreviations and acronyms

Acronym	Description	Acronym	Description
AI	Artificial Intelligence	**IPCC**	Intergovernmental Panel on Climate Change
AR	Augmented Reality	**IPR**	Intellectual Property Rights
BG	Background	**IoT**	Internet of Things
BIM	Building Information Modelling	**KER**	Key Exploitable Result
C3S	Copernicus Climate Change Service	**KPI**	Key Performance Indicator
CAGR	Compound Annual Growth Rate	**LiDAR**	Light Detection and Ranging
CAMS	Copernicus Atmosphere Monitoring Service	**MIT**	Massachusetts Institute of Technology
CEMS	Copernicus Emergency Management Service	**PV**	Photovoltaic
CLT	Cloud-based Learning Technologies	**PaaS**	Platform as a Service
DT	Digital Twin	**RANSAC**	Random Sample Consensus
ECMWF	European Centre for Medium-Range Weather Forecasts	**RGB**	Red Green Blue (imaging system)
EGNOS	European Geostationary Navigation Overlay Service	**SAM**	Software Asset Management
EGNSS	European Global Navigation Satellite System	**SE**	Service
EO	Earth Observation	**SLAM**	Simultaneous Localisation and Mapping
EUSPA	European Union Agency for the Space Programme	**SME**	Small and Medium-sized Enterprises
FG	Foreground	**TRL**	Technology Readiness Level
GIS	Geographical Information Systems	**UAV**	Unmanned Aerial Vehicle
GOVSATCOM	Governmental Satellite Communications	**UCZ**	Urban Climate Zones
ICT	Information and Communication Technologies	**UHI**	Urban Heat Island
IFC	Industry Foundation Classes	**VR**	Virtual Reality
IP	Intellectual Property	**WP**	Work Package

Table of Contents

List of Figures

Annexes

List of Tables

Executive summary

This deliverable, D5.2, forms part of Work Package 5 (WP5) within the BUILDSPACE project and focuses on updating the business and exploitation plans for key exploitable results (KERs). The purpose of this deliverable is to outline strategic pathways for the commercialization, scalability, and long-term sustainability of the project's results, which include both individual KERs and joint exploitation schemes.

The deliverable details a refined exploitation framework that includes services (SEs) at both building and city scales, covering the use of digital twins, climate scenario simulations, and urban resilience tools. It further explains how individual KERs, each contributing specific innovations to urban planning and building management, will be brought to market and sustained beyond the project's lifespan. Additionally, joint exploitable schemes are defined to maximize the collaborative potential across partners, ensuring that BUILDSPACE solutions are market-ready and aligned with the strategic goals of EU priorities for sustainable urban development.

By addressing the commercial potential of BUILDSPACE's services and developing a clear exploitation strategy, this deliverable ensures that the project's innovative solutions will extend beyond the project's timeline, providing lasting value in addressing the critical issues of energy efficiency and climate resilience in European cities. The deliverable also sets a roadmap for future developments, partnerships, and market expansions, ensuring that BUILDSPACE's outcomes continue to align with EU priorities and provide economic, environmental, and societal benefits.

1. Introduction

This document builds on the initial deliverable, focusing on the updated identification and exploitation strategies for the BUILDSPACE project's key exploitable assets, and outlines viable business models and links with EGNSS/Copernicus services. As the project progresses into its mid-stages, this deliverable elaborates on the refined exploitation plans and strategies designed to ensure the sustainability and scalability of the BUILDSPACE solutions.

The BUILDSPACE project, aimed at enabling innovative space-driven services for energy-efficient buildings and climate-resilient cities, offers five core services grouped into two main categories: building scale and city scale. These services target the built environment market, which includes construction companies, facilities management, real estate, and the emerging digital twin market, as well as the urban planning software and services market, which caters to urban planning companies, local and regional authorities, national ministries, and agencies. The project also provides a comprehensive set of methodological assets focusing on stakeholder engagement, best practices, and viable business models for the replication and upscale of the BUILDSPACE solutions.

This updated document is structured as follows: Section 2 provides an updated market background for the BUILDSPACE project, highlighting recent market trends and the project's competitive positioning. Section 3 outlines the BUILDSPACE exploitation framework, detailing the exploitation strategy and phased approach. Sections 4 to 14 delve into the key exploitable results (KERs), describing their value propositions, exploitation plans, risk assessments, and intellectual property rights. Section 15 presents the joint exploitation schemes, defining roles and strategies for the collaborative exploitation of the project's outcomes. Finally, the document concludes with strategic insights and future directions for the BUILDSPACE project. By detailing these elements, the document aims to provide a clear roadmap for the continued development, exploitation, and sustainability of the BUILDSPACE project's innovative solutions, ensuring their impact extends beyond the project's duration.

2. BUILDSPACE Project Market Background update

The importance of Earth Observation (EO) data has expanded significantly, driven by advancements in satellite technology and data analytics. Recent reports indicate a robust growth trajectory for EO applications, with the market projected to grow from USD 4.04 billion in 2024 to USD 5.54 billion by 2029. Smart city initiatives are driving the demand for satellite-based EO technology. These initiatives utilize satellite data for urban planning, infrastructure management, environmental monitoring, and disaster response. As smart cities strive for efficiency and sustainability, satellite-based EO provides real-time data and insights for informed decision-making and effective resource allocation[1]. Recent studies highlight the integration of high-resolution multispectral and hyperspectral satellite imagery, drone data, and geotagged social media inputs to examine urban landscapes, facilitating more accurate modelling and prediction of urban changes (Yu & Fang, 2023)

BUILDSPACE utilises cutting-edge technologies, combining satellite data analysis, digital twins (DT), and augmented and virtual reality (AR/VR), and drones to deliver beyond state-of-the-art services. These services include in-depth simulations of climate scenarios at both building and city scales, which are crucial for informed decision-making. By utilizing EO data, BUILDSPACE can provide unparalleled insights into environmental impacts, infrastructure vulnerabilities, and potential areas for development, thereby supporting sustainable urban growth.

2.1. Market Analysis & Trends Update

Digitalisation in Built-Environment Market: Rapid urbanisation is driving global investments in smart city projects and intelligent infrastructures, aiming to enhance government-citizen interactions[2]. The global smart building market, valued at USD 96.96 billion in 2023, is projected to grow to USD 568.02 billion by 2032, with a **CAGR of 21.8% from 2024 to 2032** [3]. This growth is bolstered by the adoption of technologies like IoT, AI, and cloud computing, which enable energy-efficient solutions and smart infrastructure. For instance, ABB's smart building control system in the New Development Bank headquarters in Shanghai reduced energy consumption by 15%. Government initiatives, such as Singapore's Green Mark Scheme targeting 80% of buildings to be green certified by 2030, and Aragon's Zaragoza smart city project aiming for a 20% reduction in energy consumption, underscore the increasing focus on sustainable urban development[4]. Additionally, digitalisation is transforming construction firms in establishing and optimising their infrastructure delivery in a sector constrained by resource scarcity, inefficient procedures, material waste, schedule overruns, and cost overruns (Fagbenro et al., 2022). High-quality drone imagery can quickly gather large aerial data with GPS points in 2D and 3D, allowing for precise distance measurements and the creation of 3D models that can help analyse important construction-related data in various formats, such as volumes, surfaces, and altitudes (Aiyetan & Das, 2022; Onososen et al., 2023). Despite the benefits, construction firms face challenges in digital transformation, highlighting the need for strategic adaptation to ensure business continuity (Onososen et al., 2023).

1 Mordor Intelligence Research & Advisory. (2024, March). Satellite-Based Earth Observation Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029). Mordor Intelligence. Retrieved July 11, 2024, from https://www.mordorintelligence.com/industry-reports/global-satellite-based-earth-observation-market-industry

2 https://www.expertmarketresearch.com/reports/smart-building-market (Accessed on 17/07/2024)

3 https://www.fortunebusinessinsights.com/industry-reports/smart-building-market-101198 (Accessed on 17/07/2024)

4 https://www.fortunebusinessinsights.com/industry-reports/smart-building-market-101198 (Accessed on 17/07/2024)

Digital Twin Market: The digital twin market has seen substantial growth and is expected to continue its expansion in the coming years. As of 2023, the market size was valued at USD 12.91 billion and is projected to grow to USD 259.32 billion by 2032, exhibiting a CAGR of 39.8% during the forecast period from 2024 to 2032[5]. More specifically in Europe, the digital twin market in Europe is expected to grow at a CAGR of 38.1% from 2024 to 2030[6]. This rapid growth is driven by the increasing adoption of Industry 4.0 technologies and the industrial Internet of Things (IoT) across various sectors, including manufacturing, aerospace, automotive, healthcare, and energy[7]. Digital Twins in construction sector is a relatively new concept that is expected to increase its market penetration in the forthcoming years.

***Urban Planning Software and Services Market*:** The Urban Planning Software industry offers a range of solutions for city and regional planning, including geographical information systems, site topography modelling, map analytics, and building information modelling software[8]. In 2022, the global urban planning software and services market was valued at USD 148.5 billion and is projected to reach USD 213.32 billion by 2033, growing at a compound annual growth rate (CAGR) of 4.2% during the forecast period[9]. The Asia-Pacific region's urban planning software and services market was valued at more than USD 59.8 billion in 2021. In North America, the market is expected to grow at a CAGR of over 4.5% from 2022 to 2030. Among the various deployment methods, the cloud-based sub-segment accounted for 61% of the market share in 2021. Regarding end-users, the government sub-segment generated USD 93.3 billion in revenue in 2021[10].

Downstream Applications Market: The downstream applications market for Copernicus and EGNSS services is experiencing significant and dynamic growth, driven by the widespread adoption of geospatial data and services across multiple industries. The EUSPA 2024 Market Report indicates that global revenues from GNSS and EO technologies were about €260 billion and €3.4 billion respectively in 2023. These revenues are expected to rise substantially by 2033, reaching nearly €580 billion for GNSS and close to €6 billion for EO[11] [12]. This expansion is propelled by advancements in digital technologies, the increasing demand for sustainable and resilient solutions, and the integration of GNSS and EO capabilities into diverse sectors such as agriculture, aviation, climate monitoring, and emergency management. The GNSS downstream applications market alone is projected to generate over €4.5 trillion between 2023 and 2033[13]. The Copernicus program's Earth Observation services are also set to grow significantly, with revenues expected to more than double from €2.8 billion to over €5.5 billion over the next decade. This growth is driven by an increase in value-added services, essential for tackling complex societal challenges and improving business efficiencies[14] [15]. The combined use of GNSS and EO technologies, supported by initiatives like Galileo and EGNOS, enhances the precision and reliability of geospatial data, further

5 https://www.fortunebusinessinsights.com/digital-twin-market-106246 (Accessed on 17/07/2024)
6 https://www.grandviewresearch.com/industry-analysis/digital-twin-market (Accessed on 17/07/2024)
7 https://www.grandviewresearch.com/industry-analysis/digital-twin-market (Accessed on 17/07/2024)
8 https://www.ibisworld.com/united-states/market-research-reports/urban-planning-software-industry/ (Accessed on 17/07/2024)
9 https://wemarketresearch.com/reports/urban-planning-software-and-services-market/54 (Accessed on 17/07/2024)
10 https://www.acumenresearchandconsulting.com/urban-planning-software-and-services-market (Accessed on 17/07/2024)
11 European Union Agency for the Space Programme, (2024). *EUSPA EO and GNSS Market Report. 2024 / Issue 2*, Publications Office of the European Union. **https://data.europa.eu/doi/10.2878/73092** (Accessed on 17/07/2024)
12 https://www.euspa.europa.eu/pressroom/trending-topics/new-euspa-eo-and-gnss-market-report-out-time-know-more
13 https://newspaceeconomy.ca/2024/01/29/report-eo-and-gnss-market-report-euspa-2024/ (Accessed on 17/07/2024)
14 European Union Agency for the Space Programme, (2024). *EUSPA EO and GNSS Market Report. 2024 / Issue 2*, Publications Office of the European Union. **https://data.europa.eu/doi/10.2878/73092** (Accessed on 17/07/2024)
15 https://www.euspa.europa.eu/pressroom/trending-topics/new-euspa-eo-and-gnss-market-report-out-time-know-more

encouraging market adoption and innovation. Continued investment and support from the European Union, through programs such as GOVSATCOM and IRIS², are crucial in advancing the development and commercialization of space-based solutions[16]

2.2. BUILDSPACE Market Approach

The BUILDSPACE project offers a suite of services leveraging DT technology, AR/VR, and EO data to address the growing demand for climate resilience and energy efficiency in urban planning and building management. The services are organized into five core exploitable services (SEs), each designed to address key challenges within both the building and city scale environments, while aligning closely with Copernicus and EGNSS services.

SE1: Digital Twin Generation integrates automatic DT model creation with AR/VR technology, allowing users to visualize and interact with 3D models of buildings in real-world contexts. This service enables seamless building geometry and spatial data integration with precise positioning from satellite data, offering a unique competitive edge in the digital twin market.

SE2: Digital Twin Semantic Enrichment enhances the DTs created in SE1 by using 3D point cloud data from advanced photogrammetry and laser scanning methods. This service delivers a more detailed representation of both external and internal building environments, improving analysis and decision-making for construction and facility management.

SE3: Building Environment Climate Scenarios offers city-scale energy demand forecasting, incorporating the impacts of climate change. This service enables stakeholders to simulate the effects of various retrofitting measures on energy demand and identify strategies for future energy efficiency, contributing to long-term urban resilience.

SE4: Urban Heat Resilience focuses on identifying areas most vulnerable to urban heat islands, integrating social and environmental data to provide insights into heat risk exposure. This service supports decision-makers in planning effective mitigation strategies to counteract rising urban temperatures in the context of climate change.

SE5: Urban Flood Resilience utilizes satellite and public data to model and predict urban flood risks, providing visualizations and scenario assessments to support city-level planning. This service helps cities enhance flood resilience through the implementation of blue-green infrastructure and strategic building renovations.

These services are designed to be scalable, ensuring they meet the growing market demand for EO-driven, sustainable urban planning solutions. The BUILDSPACE platform positions itself at the intersection of the rapidly expanding digital twin and urban planning software markets, with potential links to EGNSS and Copernicus data to further enhance precision and usability across its solutions.

16 European Union Agency for the Space Programme, (2024). *EUSPA EO and GNSS Market Report. 2024 / Issue 2*, Publications Office of the European Union. https://data.europa.eu/doi/10.2878/73092 (Accessed on 17/07/2024)

3. BUILDSPACE Exploitation Framework

The BUILDSPACE exploitation strategy, initially presented in D5.1 Business and Exploitation Plan (*initial version*), has been further elaborated in this deliverable, along with a report on viable business models and links with EGNSS/Copernicus. The primary aim of the exploitation route is to define the necessary steps and prepare the groundwork for the future exploitation of the project's main results, both at the individual partners' level and the consortium level. The planned actions are summarized into three main phases: the Planning phase, the Development phase, and the Validation phase (*Figure 1*), accompanied by an Expansion phase that will cover the post-project period. This approach outlines the major steps towards establishing robust project results and their exploitation. These phases can also be viewed as success indicators within the overall exploitation process chain of BUILDSPACE project.

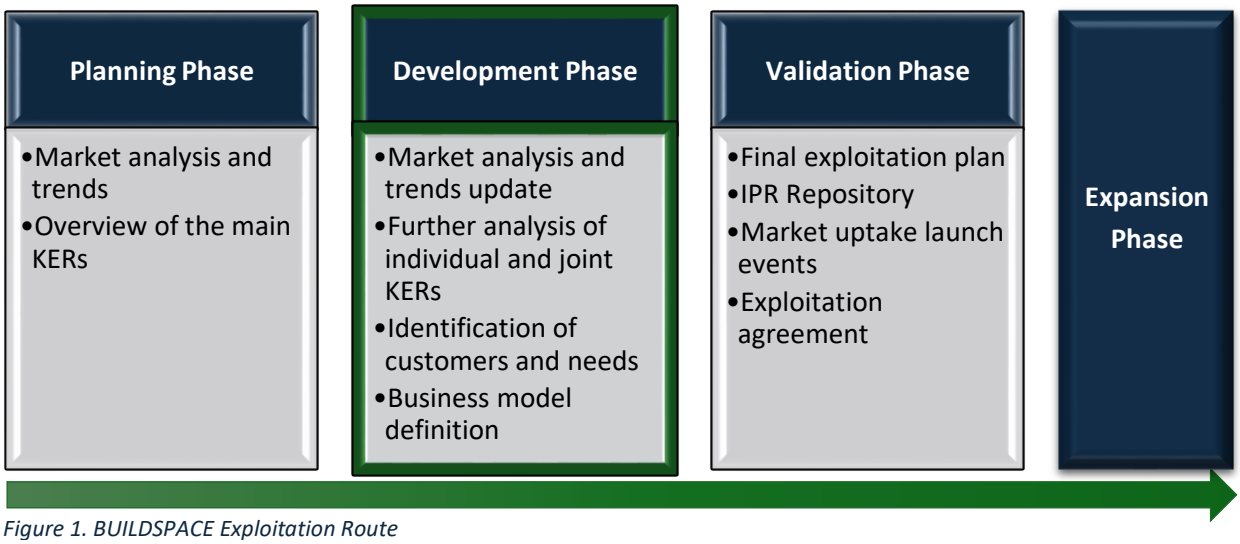


Figure 1. BUILDSPACE Exploitation Route

The project is currently in the development phase, where the initial exploitation strategy is being shaped into a preliminary exploitation plan and a joint exploitation strategy. This phase is driven by the development of the product or services and involves analysing potentially exploitable outcomes. The phase encompasses a detailed description of each individual KER, their value propositions, individual exploitation plans (including exploitation roadmaps, and additional impacts), risks and countermeasures, and their background and foreground IP rights.

Furthermore, the joint exploitation schemes, namely City Scale Services, Platform, and Building Scale Services, will be developed with agreed responsible partners. These schemes will outline the roles based on each partner's core competencies, and they will allow to describe each joint exploitation scheme, their unique value propositions, identify the market and competitors, and IP rights. The joint exploitation scheme will be analysed using a lean canvas approach, resulting in a lean canvas for each scheme, thereby providing a comprehensive overview and strategic direction for exploiting the project's outcomes.

This phase will extend into the validation phase, as the processes of service launch, trial evaluation, and organizational planning are crucial for the product's future success. In the final validation phase of the BUILDSPACE project, the focus will be on delivering an end-to-end service. This involves further developing individual and joint exploitation plans to advance beyond TRL 7 towards market-ready services. Additionally, the validation phase will encompass updated IPR management, the establishment of legal agreements, and the promotion of spin-off creation.

3.1. BUILDSPACE Exploitation Strategy

Table 1. BUILDSPACE Exploitation Strategy

Exploitable result		Owner(s)
Multi-stakeholder knowledge exchange and co-creation of innovative EGNSS and Copernicus based solutions alongside the buildings' life cycle (KER1)		CARTIF, ALDA, All Partners
BUILDSPACE core platform (KER2)		SLG
BUILDSPACE SE1: DT Generation (KER3)		UOC
BUILDSPACE SE2: DT Semantic Enrichment (KER4)		UOC, UPM
BUILDSPACE SE3: Building Environment Climate Scenarios (KER5)	Energy demand climate and retrofitting strategies scenarios (KER5.1)	CARTIF
	Solar PV potential mapping (KER5.2)	NTUA
BUILDSPACE SE4: Urban heat Analysis and resilience (KER6)		UPM, MOBICS
BUILDSPACE SE5: Urban flood analysis and resilience (KER7)		IMZI, NAZKA
Lessons learnt from BUILDSPACE demonstration in 4 real-world conditions (KER8)		Pilot partners
Multi-level interaction and alignment with Copernicus/DestinE (KER9)		ECMWF
Digital Educational Kit (KER10)		NTUA

The BUILDSPACE exploitation strategy outlined in Table 1 reflects a diverse and flexible approach to commercialization, incorporating various models such as open-source, fee-based, and licensing strategies. Each KER is structured to meet different market needs, from open-source offerings that promote wide accessibility and collaboration to fee-based services and enterprise packages aimed at specific professional sectors. Many KERs also offer additional services such as consulting, training, and support, ensuring that users can effectively implement and scale the solutions. This multifaceted strategy ensures that BUILDSPACE's innovations can reach a broad spectrum of users while providing pathways for both widespread dissemination and targeted commercial opportunities.

Following this, Table 2 elaborates on the specific exploitation routes for each individual KER, outlining the planned commercialization strategies, contract research opportunities, and educational applications. It details the actors responsible for the deployment of these results, with some KERs being led by individual partners and others through collaborative efforts. The table also covers additional routes such as spin-offs, licensing agreements, and contributions to new legislation or standards, ensuring that the KERs have a well-rounded plan for market entry, research applications, and academic dissemination. Together, these tables provide a clear roadmap for maximizing the impact of BUILDSPACE's outcomes across various sectors and stakeholders.

Table 2. Exploitation route for Individual KERs

Exploitation route for Individual KERs												
Selected route	**Implementing actor**	**KER1**	**KER2**	**KER3**	**KER4**	**KER5.1**	**KER5.2**	**KER6**	**KER7**	**KER8**	**KER9**	**KER10**
Commercialisation: deployment of a novel product/service (offered to the target markets)	A partner		X	X		X						
Contract research (new contracts signed by the research group with external clients)	A partner			X	X							
Contract research (new contracts signed by the research group with external clients)	A group of partners							X				
A new research project (application to public funded research programmes)	A partner	X		X	X	X	X				X	
A new research project (application to public funded research programmes)	A group of partners		X					X	X	X		
Implementation of a new university – course	A partner			X	X					X		X
Implementation of a new university – course	A group of partners							X				
Assignment of the IPR	A partner							X				
Licensing of the IPR	A partner			X	X							
Development of a new legislation/standard	A partner							X				
Spin- off	A partner			X								

4. Intellectual Property Rights (IPR) Management

Effective IPR management is essential for protecting and exploiting the project's Key Exploitable Results (KERs). This strategy safeguards innovations, defines ownership, and establishes clear access rights for both Background (BG) and Foreground (FG) IP. The main objectives are to identify and protect project IP, ensure partners have the necessary access for implementation and exploitation, facilitate commercial and research use through clear ownership guidelines, and prevent or resolve conflicts over IP rights.

4.1. IPR Matrix

The IPR Matrix serves as a tool for tracking and managing intellectual property throughout the project. It includes:

- **BG IP Identification**: BG IP documents the pre-existing knowledge and data brought into the project by partners, including protection mechanisms and conditions for use. Each KER's associated BG IP is first described in the "Individual KERs" section, and a more detailed table for partners is provided in Annex 1, which outlines the ownership, type of protection and the terms under which this BG can be accessed and utilised by consortium members.
- **FG IP Identification**: FG IP captures the intellectual property generated during the project, including details on ownership, protection mechanisms, and conditions for use. Each KER's Foreground IP is first described in the "Individual KERs" section and is presented in a detailed table for partners in Annex 2, which provides further information on how these innovations will be protected and shared within and beyond the consortium.
- **Exploitable Results**: The identification of exploitable results, such as their potential for commercialisation or further development, will be carried out in the Validation Phase and presented in upcoming deliverables. During this phase, the IPR Matrix will be expanded to include exploitation pathways and the relevant protections to ensure these results are market-ready or available for academic dissemination.

4.2. Access Rights

Access rights are defined for both Background and Foreground IP to facilitate project collaboration. Royalty-free access is provided for Background IP necessary for project implementation, while Foreground IP is shared under agreed-upon conditions to ensure that all partners can exploit the project results. Specific rules apply to joint ownership cases, ensuring clear agreements on shared IP.

4.3. Protection and Exploitation of Results

The protection of project results is essential for safeguarding their future exploitation. Depending on the nature of the result, different protection mechanisms are employed, including: **Patents** for technical innovations; **Copyrights** for software and publications; **Trade secrets** for proprietary know-how. Partners must ensure that their contributions are protected in line with the project's goals and that protection mechanisms are aligned with exploitation strategies outlined in the BUILDSPACE exploitation framework.

The identified Foreground IP and its associated KERs are assessed for their commercialisation potential. This includes the development of licensing agreements, patents, and spin-offs, depending on the nature of the result. The IPR Matrix helps guide partners through these processes, ensuring that all exploitable results are legally protected and ready for market entry or further development.

5. Individual KERs

This section provides a detailed overview of the individual KERs developed within the BUILDSPACE project. Each KER is detailed through a general description, which highlights its core objectives and relevance to the project. This is followed by a Value Proposition Canvas (VPC), which provides a visual framework connecting the customers' needs and challenges to the proposed solutions. Potential customer profiles presented in D5.1, are further detailed for each individual KER, along with the VPCs. The top part of the VPC focuses on the customer profile, describing their jobs (tasks they aim to achieve), pains (challenges or risks), and gains (desired outcomes or benefits). The bottom part addresses the value map, outlining the products/services offered, pain relievers, and gain creators to ensure alignment with customer needs. An exploitation plan is provided, outlining a phased roadmap for future scalability, market readiness, and long-term sustainability. The risk and countermeasures subsection evaluates potential challenges, categorizes them, and proposes mitigation strategies, with particular attention to interpolation and boundary risks. Finally, the IP rights section elaborates on the background and foreground IP associated with each KER, detailing ownership, protection measures, and access rights to ensure smooth and effective exploitation. This structured approach ensures that each KER is presented holistically, aligning with the project's strategic goals and providing actionable insights for future implementation.

5.1. KER1: Multi-stakeholder knowledge exchange and co-creation of innovative EGNSS and Copernicus based solutions alongside the building's life cycle

5.1.1. Description

Multi-stakeholder collaboration at different levels is becoming increasingly essential for sustainability and climate resilience. BUILDSPACE project has created a wide stakeholder community, engaging for the co-creation of solutions at both building and city level. More than 100 external stakeholders have been engaged in two co-creation sessions, laying the groundwork for their active involvement during and beyond the project's duration. This co-creation process aimed to involve stakeholders in the BUILDSPACE Services initial design phase, ensuring that the project results are of interest for them, easy-to-use and valuable for their day-to-day undertakes, solving some of their daily "pains". For the development of the project, it is important to involve its potential stakeholders from the design phase, so they actively contribute to the services design, increasing the feeling of ownership at later stages, during the implementation. Thus, this strong community has been established, interested in the sustainability of buildings and cities around Europe, prioritising environment in decision-making.

The co-creation sessions were organised to understand the needs of active stakeholders and tailor the service-offer based on current issues. The sessions gathered various types of stakeholders across Europe. Insights and ideas were gathered, crossing boundaries between disciplines and cultures. Participants were actively engaged in the discussions, exploring potential features and functionalities that BUILDSPACE can offer to meet their needs. Their enthusiasm and commitment to driving change has been truly inspiring throughout the project, so far.

The sessions were interactive and facilitated through innovative tools and platforms, encouraging open dialogue and fostering a sense of collective ownership. The input collected during the sessions was

carefully processed by the services' developers to define the services functionalities and visualisation, as well as the technical use cases based on the users' needs and challenges.

5.1.2. Value Proposition Canvas

The KER 1 has as main customer segments the **researchers and developers** from academia, research organisations or other organisations involved in similar projects where climate services are developed through co-creation processes.

KER1: Multi-stakeholder knowledge exchange and co-creation of innovative EGNSS and Copernicus based solutions alongside the building's life cycle			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	-Proven method to call and engage stakeholders. -Proven process for conducting effective co-creation sessions with stakeholders	-Community of stakeholders engaged with interest in project results -Collected knowledge on stakeholders (potential end-users) needs and challenges -Feedback gathered on services functionalities and visualisation	-Stakeholders engaged and interested in project results -Well-structured and interactive sessions, capturing stakeholders' interest without overwhelming them (low number of sessions, organised in advanced and in online format) -Development of services with the knowledge of potential end-users needs and challenges
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	-Engage stakeholders from the beginning of the services customization process to increase their ownership of the solutions -Need of interesting and engaging co-creation processes for stakeholders -Need of effective way to engage stakeholders -Need to know stakeholders needs and challenges to develop targeted services	-Collection of needs around potential services' functionalities and visualisation features -Stakeholders interested and engaged in co-creation sessions -Tailor solutions for their needs -Creative and participative spirit created during the co-creation sessions -Collection of feedback around initial design of services -Community of stakeholders interested in the project results (services)	-Difficulty in engaging stakeholders in co-creation processes -Lack of knowledge of the actual needs and challenges of the stakeholders -Lack of interest or time of stakeholders to participate in co-creation processes -Services that are not developed with the needs and challenges of potential end-users in mind -Difficulty in bringing together different stakeholders around the buildings' value chain to improve buildings' sustainability and decision-making processes.

Figure 2. KER1 Value Proposition Canvas

5.1.3. Exploitation Plan

5.1.3.1. Exploitation roadmap

Table 3. KER1 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Testing of the method for engaging stakeholders and the co-creation processes (through two sessions). Understand the best methods of interaction with potential stakeholders according to the level of the project implementation: local or international. In-presence reviews can highly contribute to the engagement of local stakeholders.
After 2 years	For further uptake, analyse the potential improvement and refinement of the methodology, with well-established processes and procedures, that maintains the stakeholder interested in network.
After 5 years	Where needed for exploitation purposes, increase the established basis for procedures to involve stakeholders and create communities of interest around a common topic (or project). Analyse

	the establishment of a collaborative scheme to strengthen the network and validate the work of the stakeholders engaged during this time.

5.1.3.2. Additional impacts

Stakeholder engagement allows individuals to build strong connections and strong, trust relations. It follows an inclusive communication approach, ensuring that stakeholders are effectively and actively involved and can enjoy a positive, fair and equal interactive experience.

The co-creation sessions consisted of several steps, both for planning and implementing the engagement process. The planning of the co-creation sessions followed a number of key principles, such as transdisciplinarity, flexibility, balance and recognition, to identify clearly the feedback needed in each co-creation session. The sessions have been condensed to minimise their number and avoid overwhelming stakeholders, while providing enough valuable content and insights to the project. The sessions were also developed in a joint way for the pilots and services, presenting the wider BUILDSPACE offer to all, creating synergies between the project and the stakeholders and finding possibilities to apply different functionalities.

The impact in terms of attendance in both sessions can be measured with the number of participants (148 in total), being 104 out of them external stakeholders. It is important also to consider the impact, based on the feedback received from the stakeholders during the two sessions. Stakeholders' feedback has been reported in the corresponding deliverables (D2.2 & D2.3), including the way it has been applied in each service. Service providers incorporated this feedback, based on their understanding of the stakeholders' needs and challenges, as well as their suggestions for additions and changes in the services functionalities and visualisation.

Stakeholder engagement becomes the ground for the success of any initiative, the stakeholders engaged actively disseminates the project's services and products to other audiences, increasing the outreach of these results. Similarly, the co-design of the services increases the likely support for the project through the participation and it lays the ground for future collaboration.

5.1.4. Risk & Countermeasures

Table 4. ***KER1 Risk Assessment Map***

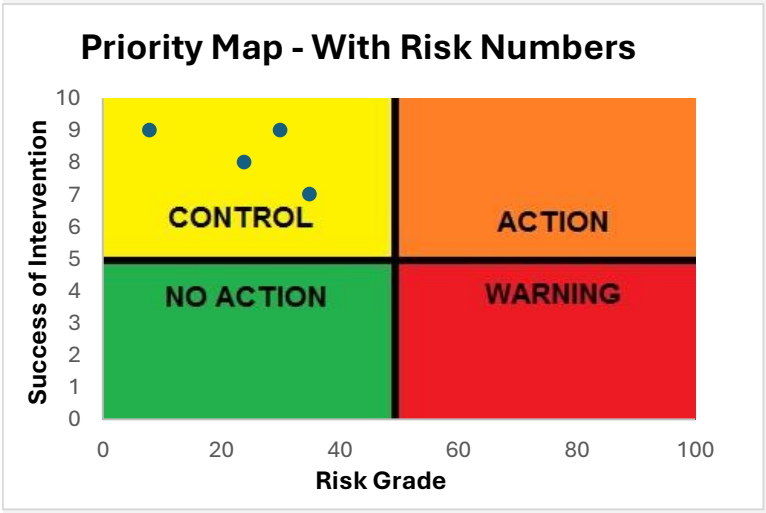
(The ***Risk Grade*** *is calculated by multiplying the* ***Degree of Criticality*** *by the* ***Probability of Risk Happening*** *(both rated 1–10 based on preliminary estimations by partners). The* ***Estimated Success of Intervention*** *(rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility/ Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Disagreement between partners on further usage of the methodology and processes	4	2	8	Clear rules established between partners. The methodology can be used by all partners involved under these rules, as the deliverables where it is reported are public.	9	Control

Technological Risk Factors						
A more effective methodology is tested in other projects	7	5	35	Methodologies can be combined and complement each other, bringing the best outcome and greater success for the respective projects that are implemented.	7	Control
Financial/Management Risk Factors						
Inadequate communication among partners: same stakeholder contacted by several partners	6	5	30	Ensure a good communication between partners on which stakeholders are being contacted. For example, through a live shared document where the contacted institutions are reported.	9	Control
Multiple changes to original objectives: partners have different objectives for stakeholder engagement	4	6	24	Align the communication with the partners continuously to understand the role of the stakeholders in the activity, the potential outputs and the methodologies for intervention.	8	Control

Table 5. KER1 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	4
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0

Number of Risks Between Control & Action	0	

5.1.5. IP right

5.1.5.1. Background

In the context of KER 1, there is no specific requirements regarding IP rights concerning Background.

5.1.5.2. Foreground

In the context of KER 1, there is no specific requirements regarding IP rights concerning Foreground.

5.2. KER2: BUILDSPACE core platform

5.2.1. Description

Serving as the backbone of the BUILDSPACE ecosystem, the core platform is a software solution designed to revolutionise data sharing among application providers and external stakeholders. The platform is built with a robust three-layer architecture comprising an Identity Management Layer, Storage Layer, and Integration Layer. This architecture ensures management of user identities, access to group authorized content, data storage, and service integrations. The components of the platform are deployed as microservices within a Kubernetes cluster, offering the scalability, resilience, and high-availability that the cloud-native architecture provides.

The Core Platform interfaces with internal services and external systems through a publicly exposed REST APIs or the use of a publicly available Python Client. This platform ensures the secure and reliable exchange of diverse data sets, including Copernicus data and other site-specific information, through a unified API. Key features include scalable and secure storage, data sovereignty that allows providers to control access and sharing. Built on a cloud-native architecture, the platform offers scalability, resiliency and high availability, making it accessible to organizations of all sizes without requiring significant upfront investments.

5.2.2. Value Proposition Canvas

KER2: BUILDSPACE core platform			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	-Enables secure data storage -Allows flexible data sharing based on user organizations -Unified access through a common API to Copernicus data and other data collected on-site; -Storage of data in binary format	-Scalability, secure storage of heterogeneous data sets; - Seamless integration of various APIs, providing access to a wide range of data sources; -Data sovereignty, allow data provider to control data access/sharing;	-Cloud native solution enabling scalability and accelerated data operations by parallelization of processes; -Data sovereignty, allow data provider to control data access/sharing; - Support storage for diverse data formats;
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	-A typical customer is a building facility manager or construction company who generates data regarding the building lifecycle (e,g,, BIM models, IoT data, etc.) or an ESCO who collects data related to energy services. The data owner utilizes the data to improve the construction and/or maintenance of the building. Urban planners could also be data consumers, since they need reliable data for improving their service. Another case, is a service provider, SME or application developers, who are seeking high quality data to train their models and deliver data-driven services.	-No upfront investment in local infrastructure and platforms; Potential creation of data value models (e.g., data monetization); Join an evolving data ecosystem; Discoverable data sets	-Lack of platform infrastructure to ensure sustainability of data; -Inability to control the sharing of data with different stakeholders

Figure 3. KER2 Value Proposition Canvas

The customers of the core platform could be ESCOs, the data owners/providers and data consumers. In the context of BUILDSPACE, the data providers could be the facility managers who may control the data collection and ICT services at building level. The data consumers could be SMEs or software developers, who seek for reliable data to develop new data-driven services for the built environment.

5.2.3. Exploitation Plan

5.2.3.1. Exploitation roadmap

Table 6. KER2 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Core platform will constitute a backbone platform for data exchange to be enhanced and extended as part of the strategic goals of the company to offer and sustain data ecosystem. We aim to offer the backend of the platform as open source and explore potential synergies with other research projects to extend the datasets.
After 2 years	Explore the release of a data portal that will facilitate data exchange among different stakeholders in the broader context of the Green Deal data space.
After 5 years	Grow the data ecosystem in terms of data providers and data consumers and sustain a viable business model for the maintenance and support of data exchange services.

5.2.3.2. Additional impacts

The implementation of the BUILDSPACE core platform promises significant benefits and has measurable impacts across various dimensions. Its emphasis on data sovereignty fosters trust and confidence in data

sharing practices. By enabling organizations to control access and sharing of data, the platform enhances data privacy and security, mitigating risks and reinforcing confidence. This increased trust encourages greater participation in data-sharing practices, leading to enhanced collaboration and knowledge exchange within the community.

Furthermore, the platform's scalable and secure storage capabilities facilitate the management of diverse data sets, unlocking opportunities for innovation and economic growth. Businesses and entrepreneurs can leverage this high-quality data to develop new products and services, stimulating job creation and attracting investments from both public and private sectors. This, in turn, drives economic activity and regional development, fostering resilience.

Moreover, the platform's cloud-native architecture eliminates the need for on-site infrastructure, reducing barriers to entry and enabling organizations of all sizes to participate in the data ecosystem. By democratizing data access, the platform empowers SMEs to compete effectively, thereby fostering inclusivity and diversity within the industry.

5.2.4. Risk & Countermeasures

Table 7. KER2 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

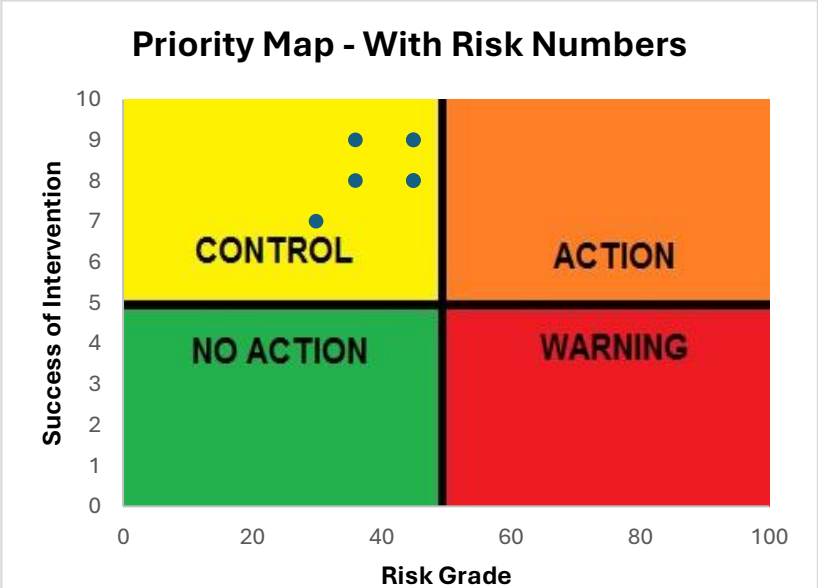
Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Lack of interests for partners to contribute to the platform	9	4	36	Create a feedback mechanism where partners can provide input on platform development, ensuring their needs and suggestions are considered in future updates, making them feel valued and invested in the platform's success.	9	Control
Technological Risk Factors						
Clients do not like the platform/out of interest	10	3	30	Continuous user engagement through feedback loops, iterative updates based on client needs, and personalized user experiences. Regularly introduce new features and improvements that align with market trends and client expectations.	7	Control
The software has bugs frequently (lack of scalability)	9	4	36	Invest in scalable architecture improvements and establish a dedicated team for proactive monitoring, quick bug resolution, and regular performance optimization to maintain software quality and scalability.	8	Control
Market Risk Factors						

Nobody buys the product	9	5	45	Implement targeted marketing strategies, including demos, trials, and customer testimonials, to showcase value and build trust. Offer flexible pricing models and promotions to lower the entry barrier and incentivize initial purchases.	8	Control
Descending new users rate	9	5	45	Optimize the onboarding experience with personalized support and clear value demonstrations to quickly engage new users. Regularly analyse market trends. and customer feedback to adjust offerings and maintain relevance, ensuring continued appeal to potential customers.	9	Control
Financial/Management Risk Factors						
Marketing and distribution fail due to a weak strategy	9	5	45	Refine the marketing approach by leveraging data-driven insights to target the right audience segments effectively. Continuously evaluate and adjust the strategy based on performance metrics and market feedback to ensure alignment with business goals and audience needs.	9	Control
Marketing and distribution fail due to a lack of resources	9	5	45	Prioritize high-impact, low-cost marketing tactics such as social media campaigns, content marketing.	8	Control

Table 8. KER2 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	7
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0

Number of Risks Between Control & Action	0



5.2.5. IP rights

5.2.5.1. Background

In the context of KER 2, there is no specific requirements regarding IP rights concerning Background.

5.2.5.2. Foreground

SLG will take part in the creation of data integration frameworks that will allow for the efficient aggregation and harmonization of diverse datasets related to energy efficiency and urban resilience. Furthermore, SLG is designing the overall platform architecture to ensure it is scalable, secure, and capable of handling large volumes of data across different applications. The IP generated during this process, classified as foreground IP, is owned by SLG, with exploitation rights retained by the company. Access to these results for non-commercial purposes will be granted to other partners under fair and reasonable terms. Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as FG codes FG.3.6.1, FG.3.6.2, FG.3.6.3, FG.3.6.4, FG.3.6.5.

5.3. KER3: BUILDSPACE SE1: DT Generation

5.3.1. Description

Our solution encompasses advanced digital twin generation tools and methodologies derived from point cloud data, utilizing both laser and image sources. These tools facilitate the precise and efficient creation of digital twins, capturing intricate details of physical structures. This comprehensive service integrates state-of-the-art methods for generating digital twins of buildings from locally sourced geometry data. It includes the development of intuitive interfaces for human-information interaction within mixed reality environments. By linking the digital twins with EGNSS data, our service supports integration into city-scale models, allowing users to visualize these twins interactively on screens, and through VR and AR interfaces. This enables practical applications at construction sites and provides detailed 3D visualizations for existing buildings.

Additionally, we offer a specialized course focused on point cloud data processing and digital twin generation using the IFC format. The course emphasizes understanding spatial relationships among building elements, ensuring participants gain the skills necessary for accurate and functional digital twin creation. Our research and developments have been presented in conference papers at influential summits and published in high-impact SCI journals, contributing to the academic and professional discourse on digital twin technology.

5.3.2. Value Proposition Canvas

The key customer groups of SE1 supports are municipalities, regional policy makers and city planners, facilities manager and research groups and academia.

For the municipalities, regional policy makers and city planners, they will visualise their build asset with accurate dimension digitally. For the facility managers, the outcome of DT generation will offer the spatial information of the building in operation and support for further FM decision-making. In addition, the methodology that convert the point cloud data to digital twin that used in multiple real-world cases provides the valuable insights to the research groups and academia.

KER3: BUILDSPACE SE1: DT Generation			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	-PCD processing algorithm -visualisation for the digital twin -generation of digital twin with the spatial relationship information -looking for the existing dataset and self-creation	-various method to process the different building PCD -digital twin generation algorithm -AI/DL algorithm to process the PCD -visualisation tools for digital twin	-reliable data for the laser/ image scanning results -software and hardware for the visualisation tools -open-sourced algorithm for the sample digital twin generation -open-sourced algorithm for the fundamental PCD processing
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	-have a standard working process to collect the existing building data -have one/ several clear requirements of the expected functions of digital twin information	-Point cloud data segmentation -building element identification in PCD -point cloud data processing	-lack of AI/DL training dataset for identifying various building elements -various data sources/ data collection method of different pilot projects make the data processing process complicated lack of efficient ifc interpretation tools

Figure 4. KER3 Value Proposition Canvas

5.3.3. Exploitation Plan

5.3.3.1. Exploitation roadmap

Table 9. KER3 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Investigate and develop geometric digital twin construction methods for various building types, including building envelopes and indoor environments. Establish a comprehensive workflow to transform point cloud models into digital twins in IFC format, incorporating spatial relationship information. Develop and integrate VR/AR tools for visualizing digital twins, enabling immersive interaction with the digital representations of buildings. Create prototypes and conduct extensive testing to ensure accuracy, usability, and reliability of the digital twin generation process.

After 2 years	Transform the developed methods into a market-ready software product, ensuring it meets industry standards and customer needs. Enhance the software with additional features and functionalities, such as real-time collaboration tools, and enhanced user interfaces. Launch marketing campaigns, establish sales channels, and form strategic partnerships to promote the software in the construction and real estate industries.
After 5 years	Integrate the software with other industry tools and platforms, such as BIM and facility management systems, to provide a seamless user experience. Extend the software's capabilities to support advanced applications, including predictive maintenance, energy management, and urban planning. Promote widespread adoption of the software across various industry sectors, becoming a standard tool for digital twin creation and management. Invest in ongoing research and development to keep the software at the forefront of technological advancements, incorporating new technologies and addressing emerging industry needs.

5.3.3.2. Additional impacts

The digital twin generation software will significantly impact society by creating high-skilled jobs in software development, data analysis, and VR/AR integration, driving employment growth in tech and construction sectors. Its commercialization will attract substantial private and public investments, further spurring economic growth.

The technology will enable construction companies to optimize processes, reduce costs, and increase profitability, resulting in higher turnover. Additionally, by promoting sustainable building practices and efficient urban management, digital twins will contribute to smarter, more resilient cities, enhancing residents' quality of life and fostering a sustainable future.

5.3.4. Risk & Countermeasures

Table 10. KER3 Risk Assessment Map

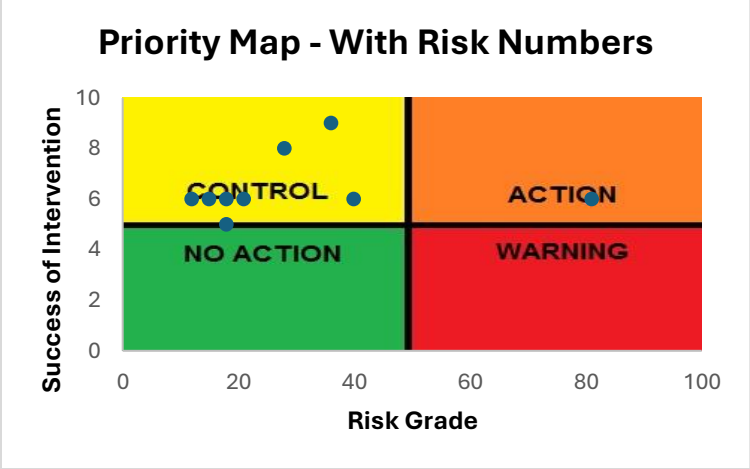
*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Clients do not like the platform/out of interest	9	4	36	Conduct market research and gather user feedback for continuous improvement. Invest to enhance user satisfaction and engagement.	9	Control
Some partners may leave	7	4	28	Strengthen relationships through regular communication and provide competitive incentives. Enhance value proposition, offer robust support, and foster a collaborative culture to ensure partner loyalty.	8	Control

Technological Risk Factors						
Data accuracy and reliability issues	9	9	81	validate the data quality to match the pilot requirements	6	Action
The existing algorithms/open-sourced tools are no longer maintained.	8	5	40	find the other alternative methods	6	Control
Market Risk Factors						
The tool is not useful for the customer	5	3	15	Try to resolve problems and adapt the platform to the needs	6	Control
Performance lower than market needs	6	3	18	Try to resolve problems and adapt the platform to the needs	6	Control
Financial/Management Risk Factors						
Data confidentiality issues (not signed documents from Pilot side)	9	2	18	Assess legal issues and consult an expert	5	Between Control & No Action
Environmental/Regulation/Safety risks						
Regulation changes	6	2	12	Adapt the service to changes	6	Control.
Introduction of new regulation	7	3	21	Adapt the service to new regulation	6	Control.

Table 11. KER3 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	7
Number of "Action" Risks	1
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	1
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0

Number of Risks Between Control & Action	0	

5.3.5. IP rights

5.3.5.1. Background

The service is developed by the UOC team, and some steps of the workflow depends on the open-sourced tools.

3D point cloud processing: Utilizes open-sourced method of RANSAC, PointNet and PointNet++. These advanced techniques ensure high accuracy and efficiency in processing point clouds, crucial for detailed 3D modeling and analysis.

Image processing: Employs X-Anylabeling for data labeling and YoLoV8 for computer vision training. Leveraging these powerful tools enhances the precision of image data interpretation. The applied dataset for the building element detection is the public dataset from research paper.

Point Cloud processing for the construction monitoring: Self-developed solution for the construction monitoring workflow and Digital Twin updates refering to the construction status.

Digital Twin generation: Based on the open-sourced Python Library, mainly the IfcOpenShell. Utilizing IFCOpenShell allows for the creation of comprehensive digital twins, providing a dynamic, real-time representation of physical assets for enhanced management and decision-making.

Basic point cloud processing and visualisation: CloudCompare and MeshLab. These tools offer robust capabilities for basic point cloud processing and visualization, enabling clear and detailed 3D representations critical for analysis and planning.

Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as BG codes BG16 and BG17.

5.3.5.2. Foreground

The foreground IP rights will focus on the Digital Twin generation with the inner UOC team.

The digital twin generation based on the point cloud data will be embedded into an integrated toolkit. The initial developed algorithm and the testing prototype will be public online. The mature product will be commercialized by user description.

Please refer to Annex 2, for the specific foreground intellectual property associated with this KER, identified as FG codes FG.3.1.1, FG.3.1.2, FG.3.1.3, FG.3.1.4

5.4. KER4: BUILDSPACE SE2: DT Semantic Enrichment

5.4.1. Description

The Digital Twin Enrichment is responsible for providing additional information to the geometrical digital twin developed by the service: Digital Twin Generation. This information will be based on RGB and thermal imagery using UAVs for the outer envelope and SLAM-based point clouds for the inner envelope.

The service aims, through the information obtained from indoor scanning and drone flights, to identify and analyse areas with thermal disturbances in the building envelope (critical areas and envelope quality) and to monitor and detect faulty cells in rooftop solar installations; both processes will be carried out using artificial intelligence.

In buildings that are prone to intervene, this allows prioritisation of the areas of a building that need intervention, as well as gaining insight into the quality of the building envelopes in buildings to be refurbished.

In the case of new buildings, it allows to observe the differences with the proposed design and to evaluate the mistakes made in the construction of the thermal envelope.

5.4.2. Value Proposition Canvas

The key customer groups that SE2 supports are Municipalities and Regional Policy Makers, City Residents and Building/House Owners, Companies in the Rehabilitation Sector, Research Groups and Academia, Urban Planners.

KER4: BUILDSPACE SE2: DT Semantic

Value Proposition	Products & Services	Gain Creators	Pain Relievers
	-RGB information linked to the DT platform -Thermal information linked to the DT platform -Algorithm for semi-automated thermal bridges detection -Algorithm for semi-automated cracks detection -Algorithm for semi-automated dampness detection -Algorithm for semi-automated malfunctional solar panels detectio	-Identification of thermal bridges -Typological dentification of thermal bridges -General overview of the building envelope behaviour -Identification of cracks -Identification of malfunctional solar panels -Downloadable report of: Thermal bridges and typology, Cracks, Dampness, Solar panels -Identification of dampness -Ability to visualise the thermal and RGB building envelope in a Digital Twin	-Reliable data on building's dampness status -Reliable data on building's cracks status -Reliable data on building's thermal bridges status -Reliable data on building's solar panels status -Knowledge to prioritise areas of intervention -Information about critical areas (report) -Knowledge of the quality of the envelope
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	- Tool to visualize thermal envelope behaviour -Tool for critical areas detection on building's envelope -Tool to obtain a report of critical areas -Tool to detect malfunctional solar panels -Tool to visualize a thermal and RGB model	-Comprehensive thermal envelope analysis -Knowledge on critical areas impact on buildings envelope -Knowledge to have a better-informed decision-making on envelope behaviour -Knowledge of the rehabilitation areas to be prioritised in your building -Knowledge of malfunctioning solar panels for repairs	- lack of parameters to calibrate images -lack of thermal bridges datasets -lack of accurate datasets -lack of data capturing protocol

Figure 5. KER4 Value Proposition Canvas

SE2 provides substantial value to diverse users. For municipalities, regional policymakers, and urban planners, this system's data-driven insights into building conditions enable more strategic resource allocation, informed decision-making, and effective prioritization of renovation and energy efficiency

initiatives. This evidence-based approach ultimately contributes to more resilient and sustainable urban environments.

City residents and building owners gain tangible benefits from accessible, clear information offered by SE2. By identifying issues such as cracks, moisture, and thermal bridges, property owners are guided toward targeted maintenance and upgrades, resulting in increased comfort, enhanced safety, and improved long-term property value.

Companies within rehabilitation sector and research groups benefit significantly. For rehabilitation firms, SE2 provides reliable data supporting development of precise, data-driven renovation proposals, reducing costly rework and improving client satisfaction. Research entities leverage datasets to advance innovative solutions in construction quality, energy efficiency, and urban resilience. SE2 functions as a comprehensive tool elevating decision-making, supporting well-informed interventions, and fostering sustainable progress across diverse urban contexts.

5.4.3. Exploitation Plan

5.4.3.1. Exploitation roadmap

Table 12. KER4 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	**Assessment and Planning:** Identify the critical areas and parameters to monitor. Define the scope and objectives of the digital twin and imaging system. **Critical Area Detection:** Implement basic algorithms for detecting anomalies using thermal and RGB images. Set up alert systems for immediate notification of detected issues. **Initial Analysis:** Conduct initial analysis to validate the system and refine detection algorithms. Establish a baseline for normal operating conditions.
After 2 years	**Enhanced Data Integration:** Improve the resolution and accuracy of thermal and RGB imaging systems. Integrate additional sensors (e.g., humidity, vibration) for more comprehensive monitoring. **Predictive Analytics:** Develop and implement predictive analytics algorithms to foresee potential issues before they occur. Use machine learning to improve anomaly detection and prediction accuracy. **User Interface and Reporting:** Create advanced user interfaces and dashboards for easier interaction with the digital twin. Implement automated reporting systems for regular updates and insights. **Validation and Optimization:** Regularly validate the system's performance and accuracy. Optimize detection algorithms and data processing workflows based on feedback and new findings.
After 5 years	**Full Automation:** Automate the entire process from data acquisition to anomaly detection and reporting. Implement self-healing mechanisms where possible (e.g., automated alerts to maintenance teams, automated shutdown of failing systems). **Scalability:** Scale the system to cover more areas or additional infrastructures. Ensure the digital twin can handle large amounts of data and multiple data streams efficiently.

	Advanced Analytics and AI: Use AI and deep learning to continuously improve the accuracy and capability of the detection system. Implement advanced analytics for deep insights into the system's health and performance.

5.4.3.2. Additional impacts

Semi-automated identification of critical areas within building envelopes using advanced 3D point cloud technology, along with RGB and thermal data, significantly improves building maintenance and safety protocols. This approach enables precise detection of structural defects, points of water ingress, and thermal inefficiencies, thereby reducing risks related to structural integrity and enhancing overall building durability and safety.

Additionally, integrating 3D point cloud data streamlines construction and renovation projects by providing detailed insights into building conditions. This data-driven approach facilitates informed decision-making for builders and architects, optimizing resource allocation and project schedules. By boosting efficiency in project execution, it supports economic growth in the construction sector, creating opportunities for job growth and skills development in areas such as construction management and building inspection. Accurate assessment of building envelopes using 3D point cloud technology also attracts investments in infrastructure and real estate markets. By certifying buildings for optimal condition and identifying areas for improvement, this technology enhances property values and encourages investments in sustainable building practices. It contributes to energy efficiency initiatives by pinpointing thermal inefficiencies and promoting environmentally conscious building practices, thus reducing energy consumption and carbon footprints. Moreover, automated detection and assessment strengthen efforts in regulatory compliance and elevate public safety standards. By ensuring buildings conform to safety codes and regulations, this technology enhances public health and safety, fostering healthier and more secure living environments. It supports regulatory compliance for insurers and stakeholders, mitigating legal risks and enhancing overall community well-being.

In conclusion, the integration of 3D point cloud data with RGB and thermal information revolutionizes building envelope analysis, yielding substantial benefits in safety, efficiency, sustainability, economic growth, and public welfare.

5.4.4. Risk & Countermeasures

Table 13. KER4 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Clients do not like the platform/out of interest	9	3	27	Get feedback and apply it to the platform	7	Control.
Hard collaboration between pilot - service	7	3	21	Changes on Gantt Charts and objectives (adaptation)	4	No Action'
Pilot may leave	10	1	10	Find other pilot/case of study	5	Between Control & No Action
Technological Risk Factors						
Delays with the development of activities	4	4	16	Delete tasks or reorganize Gantt Chart	4	No Action'
Data accuracy and reliability issues	5	5	25	Implement data validation and verification processes	8	Control.
Problems with the algorithm development and application to detect critical areas (AI)	7	5	35	Manual detection of critical areas	9	No Action'
Insufficient data resolution	7	6	42	Repeat data capturing	8	Control.
Market Risk Factors						
The tool is not useful for the customer	5	3	15	Try to resolve problems and adapt the platform to the needs	6	Control.
Performance lower than market needs	6	3	18	Try to resolve problems and adapt the platform to the needs	6	Control.

IPR/Legal Risk Factors						
Patent problems (rejected)	9	2	18	Assess patentability and consult an expert	4	No Action'
Data confidentiality issues (not signed documents from Pilot side)	9	2	18	Assess legal issues and consult an expert	5	Between Control & No Action
Financial/Management Risk Factors						
No resources (human and/or financial) secured to make the next step	8	1	8	Find resources	2	No Action'
Environmental/Regulation/Safety risks						
Regulation changes	6	2	12	Adapt the service to changes	6	Control.
Introduction of new regulation	7	3	21	Adapt the service to new regulation	6	Control.

Table 14. KER4 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	4
Number of "Control" Risks	8
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	2
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0

5.4.5. IP rights

5.4.5.1. Background

3D point cloud and mesh reconstruction (Methodology): Structure from motion reconstruction and SLAM (simultaneous location and mapping). **Photogrammetric reconstruction (Software):** Structure from motion software to 3D reconstruction from a set of images. **Integration of 3D point clouds (Software)**: CloudCompare. 3D data processing software specifically designed for handling point clouds, which are sets of data points in a three-dimensional space. It is primarily used for comparing, processing, analysing, and visualizing these data in various applications such as surveying, archaeology, civil engineering, and

other geospatial-related fields. **Calibrate images (Software)**: Calib.io. Software to obtain distortion parameters to calibrate images obtained from drone. **Register 3D point clouds (Software):** SLAM manufactured software **Semi-automated detection (Code library**): Yolo. YOLO (You Only Look Once) is a state-of-the-art, real-time object detection system. It is known for its speed and accuracy in identifying and localizing objects within an image.

Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as BG codes BG8, BG9, BG10.

5.4.5.2. Foreground

3D point cloud and mesh reconstruction (Methodology): Digital image processing, multimodal registration (RGB and thermal) and PNP, perspective-n-point estimation (camera location in drone flights). **Image calibration and projection (Software):** Self-developed software for thermal image calibration (radiometric and geometric). It also includes pre-processing of the images and texture projection (from RGB to thermal) **Critical areas detection (Methodology):** deep learning for object detection (YOLO architecture) and matching learning for building classification (random forest), principal component analysis (PCA), connected components and gaussian mixture. **Critical areas detection (Software):** Self-developed software to integrate AI for supporting critical areas detection. Algorithm for each critical area.

Please refer to Annex 2, for the specific foreground intellectual property associated with this KER, identified as FG codes FG.3.2.1, FG.3.2.2, FG.3.2.3, FG.3.2.4, FG.3.2.5, FG.3.2.6, FG.3.2.7.

5.5. KER5: BUILDSPACE SE3: Built environment climate scenarios

KER5 pertains to service 3, which is designed to provide a comprehensive web tool for visualising and forecasting the energy demand of residential building stocks within a city. This service integrates advanced capabilities for urban and energy planners and decision-makers by offering visual insights through maps, future energy demand forecasts under different climate scenarios (based on CMIP6 standards) and the evaluation of retrofitting strategies and their impacts. It also provides solar PV potential map of building rooftops in the city.

Given the multifaceted nature of SE3, the **KER5 has been divided into two distinct sub-KERs**: KER5.1 and KER5.2. This division is strategically justified based on the specialised contributions and expertise of the leading institutions involved (CARTIF and NTUA), being **KER5.1** related to the core functionality of the SE3, which includes the visualisation of the current energy demand of the residential building stock, the forecasting of energy demand under various climate scenarios, and the evaluation of retrofitting strategies. This component leverages CARTIF's expertise in energy performance analysis and user-friendly GUI development to deliver actionable insights for urban and energy planners. **KER5.2** is dedicated to the additional functionality of providing a solar photovoltaic (PV) potential map for building rooftops. NTUA brings its specialised knowledge in solar energy assessment and geographic information systems (GIS) to accurately identify rooftops suitable for PV deployment, thereby enhancing the overall value of the SE3.

By delineating KER5 into these two sub-KERs, each institution can independently exploit their specific contributions while also enabling potential joint exploitation plans. The division ensures clarity in responsibility and ownership, optimises the commercialisation potential of each component and aligns with the specialised capabilities and strategic objectives of CARTIF and NTUA.

This structured approach not only enhances the manageability and marketability of the BUILDSPACE project's outcomes but also fosters a collaborative yet focused exploitation strategy, ultimately maximising the impact and reach of the innovative solutions developed.

5.5.1. KER5.1 Energy demand climate and retrofitting strategies scenarios

5.5.1.1. Description

It is a service in the form of a web tool that provides the current energy demand of the residential building stock of a city, providing visualisation capabilities through a map, as well as additional information under a user-friendly GUI. It also provides the energy demand forecast of the buildings considering different climate scenarios, as defined in the standard accepted CMIP6 (SSPs-RCPs).

The service allows to evaluate the effects of different climate scenarios on the energy performance of building stocks, providing an understanding of how building stock energy demand will be affected in the future by climate change, thus providing advanced capabilities to urban and energy planners and decision-makers.

The service integrates an additional functionality related to the calculation of relevant KPIs for retrofitting strategy gains, which will be conducted by defining different retrofitting strategies selected by the user, in order to recognise the effects of future scenarios on the buildings' energy performance. This functionality enables users to obtain insights on the costs and benefits of potential interventions.

5.5.1.2. Value Proposition Canvas

The KER5.1 has three main customer segments: **Urban stakeholders** (real estate developers and managers, policy makers, construction companies, etc.), **Citizens** (residents and building owners) and **ESCOs**.

KER5.1: Energy demand climate and retrofitting strategies scenarios

Value Proposition

Products & Services	Gain Creators	Pain Relievers
-Tool to visualise trustable data on residential building stock energy demand -Tool to aggregate residential buildings' energy demand data by districts -Tool to compare current and future energy demand of the residential building stock under climate change scenarios -Tool to evaluate energy renovation measures applied to different residential buildings -Calculated KPIs on energy retrofitting gains according to selected measures to residential buildings -Visual tool with maps and ready-to-use data in a user-friendly way	-Trustable data on energy demand of residential building stock -Data on evolution of the energy demand of the residential building stock according to climate change future scenarios -Ability to visualise the energy demand data in a coloured map and also aggregated in districts -Ability to evaluate the effectiveness of energy retrofitting scenarios in residential buildings	-KPIs on retrofitting strategies applied to a residential building to evaluate their effectiveness -Data on energy demand of residential building stock grouped in districts -Climate change scenarios to evaluate the effects of climate change in the energy demand of the residential building stock in the future Reliable data on energy demand of residential building stock

Customer Segments

Customer Jobs	Gains	Pains
-Urban stakeholders: need to make informed decisions on the highest priority residential buildings for energy renovation (to promote it through available funding) **-Urban stakeholders:** need information/data on how the energy demand of the residential building stock will change in the future due to climate change **-Urban stakeholders:** need to evaluate energy renovation measures in residential buildings -Urban stakeholders: need aggregated data per districts of the energy demand of the city's residential building stock **-Citizens:** tool to know the energy demand of their building and compare it with that of their neighbours **-Citizens:** tool to simulate different energy retrofits in their building and evaluate their effectiveness for energy and economic savings **-ESCOs:** identify residential buildings or districts with the highest potential for energy savings through retrofitting. **-ESCOs:** evaluate and simulate the cost-effectiveness and impact of energy-saving measures under different climate scenarios.	**-Citizens:**knowledge on retrofitting measures to apply to their building (cost-effectiveness assessment) **-Citizens:**knowledge on own building energy performance **-Urban stakeholders:**knowledge on residential buildings' energy demand in the whole city **-Urban stakeholders:**knowledge on how the energy performance of the residential building stock will evolve in the future taking into account climate change scenarios **-Urban stakeholders:** knowledge on different energy retrofitting scenarios to apply to residential buildings **-ESCOs:** access reliable and high-quality data to support detailed energy performance contracting and retrofitting strategies. **-ESCOs:** streamline decision-making with user-friendly tools to assess and optimize retrofitting plans and their energy and economic benefits.	**-Urban stakeholders:** lack of knowledge and reliable data on the energy demand of residential buildings (city-wide) **-Urban stakeholders:** inability to know how climate change will affect the building stock's energy demand **-Urban stakeholders:** lack of knowledge/data of the energy demand of the building stock grouped in districts **-Citizens:** lack of awareness of the energy demand of their buildings **-Urban stakeholders:** lack of tools to analyse the effectiveness of energy retrofitting measures **-Citizens:** lack of knowledge of the economic and energy savings that the energy retrofitting measures entail **-ESCOs:** lack of centralized and reliable data on current and future energy demand of residential building stocks. **-ESCOs:** difficulty assessing the long-term impact of retrofitting measures due to uncertainties in climate change and energy demand projections.

Figure 6. KER5.1 Value Proposition Canvas

5.5.1.3. Exploitation Plan

5.5.1.3.1. Exploitation roadmap

Table 15. KER5.1 Exploitation Activities Plan

Exploitation Activities Plan (KER5.1 Energy demand climate and retrofitting strategies scenarios)	
During the project	**Development and testing** the SE3 functionalities in Riga city (related pilot) across the three technology releases, incorporating stakeholder feedback to ensure the effectiveness and usefulness of the service; and finally delivering the features in a user-friendly web-tool including coloured maps.
After 2 years	Analysing the development of **additional service functionalities** to provide added value to the service (e.g. inclusion of non-residential buildings in the energy demand estimation). Potentially testing and exploitation of the service in different neighbourhoods and cities.
After 5 years	Evaluate the possibility of **further updating and refining** the functionalities and **scaling it** to more neighbourhoods and cities across Europe.

5.5.1.3.2. Additional impacts

The service 3 of Built Environment Climate Scenarios (KER5.1) could be utilised by urban stakeholders as well as by city residents. The **urban stakeholders** encompass real estate developers and managers, policy makers and construction companies, among others. These urban stakeholders could utilize the service for **informed decision-making processes**, with the knowledge on the energy demand of the residential building stock as well as how it will evolve in the future considering climate change scenarios. With this information they can decide on priority areas of the city that need more urgent energy renovation. In addition, further information related to different renovation measures is available at building level, with the option to compare different retrofitting scenarios. Municipalities can promote the energy renovation of the most needed areas or districts in the city (worst energy performance values) through available funding or other incentives to the building owners. The construction companies specialised in energy retrofitting can use the information to approach building owners with higher need of energy renovation and increase their competitive advantage in the market.

City residents can use the service to know the energy demand of their building and compare it with that of their neighbours. They also can simulate different energy retrofitting in their building and evaluate their effectiveness for energy and economic savings, encouraging them to make a safe investment in their own building.

5.5.1.4. Risk & Countermeasures

Table 16. KER5.1 Risk Assessment Map

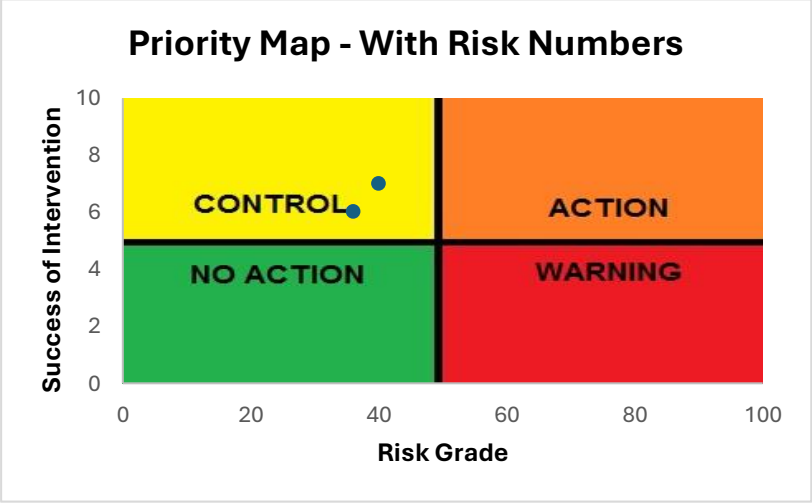
*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Market Risk Factors						

Already existing tools for estimating the energy demand	6	6	36	Make the tool competitive in terms of price and functionalities by offering personalisation options tailored to clients' specific challenges and needs. BUILDSPACE will stand out by providing not only energy demand estimation but also advanced features like future demand forecasting under climate scenarios and tailored retrofitting evaluations. The tool's intuitive interface and personalised insights for citizens, combined with seamless integration with local data and standards, will ensure adaptability to national contexts and deliver distinct value for both citizens and urban planners.	6	Control.
Financial/Management Risk Factors						
People responsible for developing SE3 have moved on	8	5	40	Knowledge transfer to other people	7	Control.

Table 17. KER5.1 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	2
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0



5.5.1.5. IP rights

5.5.1.5.1. Background

The background of CARTIF used for the service (KER5.1) development is:

- Related with the characterisation of the building stock at city level, previous knowledge for city level modelling, as well as geometrical analysis based on cadastral knowledge and the INSPIRE directive.
- Related with the estimation of the energy demand and representation in a map with the characterised building stock, the GIS4ENER tool, developed by CARTIF under the TEC4ENERPLAN project, including the tool architecture, the logic, data and results. It primarily performs energy calculations for buildings using algorithms based on the EPBD. Its development has continued being used and improved by CARTIF under different related services in the following projects: MUSEGRIDS; MATRYCS; I-NERGY; and BD4NRG.
- Related with the modelling of future climate change scenarios, knowledge on Copernicus EO data analysis, general processing and downscaling of climate models, gained through the development of climate change adaptation strategies in different Spanish regions.
- For the user-friendly web-tool development, general ICT knowledge and experience in the development of conceptual platform architectures, ICT services development, implementation, etc. Development of similar services' web-tool in the projects mentioned for the energy demand estimation and visualisation.

Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as BG codes BG1, BG2, BG3, BG4.

5.5.1.5.2. Foreground

The foreground generated by CARTIF related with the KER5.1 is:

- Refined algorithms and method for the characterisation of the building stock, generating buildings' geometries and estimating the energy demand.
- Refined and further uptake of the knowledge, method and algorithms for the modelling of future climate change scenarios.
- Knowledge and developed method for the analysis of retrofitting strategies applicable to buildings, as well as generation of relevant KPIs to assess the related gains.
- Increased knowledge and practice for the development of web-tool with maps and including the diverse functionalities of the service.

Please refer to Annex 2, for the specific foreground intellectual property associated with this KER, identified as FG codes FG.3.3.1, FG.3.3.2, FG.3.3.3, FG.3.3.4.

5.5.2. KER5.2 Solar PV potential mapping

5.5.2.1. Description

It is the dedicated functionality that provides a solar PV potential map of the building stock (in particular, rooftops with availability for PV deployment). It is a dedicated, additional, functionality of SE3 that provides a solar PV potential map of the building stock, implementing rooftops suitability measurements.

5.5.2.2. Value Proposition Canvas

The KER5.2 has three main customer segments: **Urban stakeholders** (real estate developers and managers, policy makers, construction companies etc.), **Citizens** (residents and building owners) and ESCOs.

KER5.2: Solar PV potential mapping			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	- Tool to identify, analyze and visualise the suitable roofs of the building stock for PV installation Tool to calculate and visualise the PV potential in the suitable roofs of the building stock	-Data on suitable roofs of the building stock to install PV -Trustable data on PV potential of the suitable roofs of the building stock -Ability to visualise the PV potential in a coloured and interactivemap	- Data on suitable roofs for PV installation in the building stock -Reliable data on PV potential of the building stock roofs
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	- Urban stakeholders: need to know which roofs are suitable for PV installation - Urban stakeholders: need to find out the PV potential of the roofs of the building stock (to make informed decisions on PV deployment) - Citizens: tool to find out the suitability of their building roof for PV installation and its potential for electricity and economic savings -ESCOs: Tool that fosters tailored energy solutions that align with customer and market needs -ESCOs: Need to access a multi-building, city scale PV potential, for informed decision-making and strategic planning	-Citizens: knowledge on own building's roof suitability for installing PV and PV potential -Urban stakeholders: knowledge on suitable roofs where to deploy PV and its potential -ESCOs: Access to multi-building PV potential on a city scale	- Urban stakeholders: lack of information on roofs suitable for PV installation and its potential at city level - Citizens: lack of knowledge of the PV potential of the roofs of their buildings -ESCOs: Lack of specified rooftop information, on a multi-building analysis

Figure 7. KER5.2 Value Proposition Canvas

The PV potential map can deliver significant value across the aforementioned three key customer segments. In specific, for **urban stakeholders**, including real estate developers, policymakers, and construction companies, it provides actionable insights into optimal solar deployment zones, streamlining planning and compliance processes while promoting sustainable urban development. **Citizens**, such as residents and building owners, benefit from localized, user-friendly information about their rooftops' solar potential, enabling cost-effective decisions on solar investments and energy independence. For **ESCOs**, the service supports targeted project development by identifying high-yield solar areas, optimizing resource allocation, and fostering tailored energy solutions that align with customer and market needs. The map is a comprehensive tool that enhances decision-making and accelerates solar adoption across diverse urban landscapes.

5.5.2.3. Exploitation Plan

5.5.2.3.1. Exploitation roadmap

Table 18. KER5.2 Exploitation Activities Plan

Exploitation Activities Plan (KER5.2 Solar PV potential mapping)	
During the project	**Development and testing** the solar PV potential mapping functionality in Riga city (related pilot) across the three technology releases, incorporating stakeholder feedback to ensure the effectiveness and usefulness of the service; and finally delivering the features in a user-friendly web-tool including coloured maps.
After 2 years	**Add more features**, such as suitability of roof areas, cost reduction, payback period of investment, carbon emissions reduction etc. as well as exploit Solar PV potential in different neighbourhoods, cities and energy community initiatives
After 5 years	**Further updates** on features and use of the Solar PV potential map in different neighbourhoods/cities and energy communities

5.5.2.4. Additional impacts

KER5.2 could be utilised by urban stakeholders as well as by city residents. The Solar PV potential functionality is of great interest for **urban stakeholders** in the decision-making processes, for the strategic deployment of solar PV technology in the most suitable rooftops. In addition, municipalities can promote the most high-production public buildings as pilots for the creation of energy communities, giving the opportunity to citizens to invest and actively participate in the energy transition, and thus, enhancing energy democracy. Companies specialized in PV installation could also take advantage of the service to approach building owners with high potential PV production, enhancing their competitive advantage in the market.

With the information of the suitability of their roof for PV installation and the potential production, **city residents** could also be encouraged to make an investment considering the PV installation cost and payback period of the initial investment.

5.5.2.5. Risk & Countermeasures

Table 19. KER5.2 Risk Assessment Map

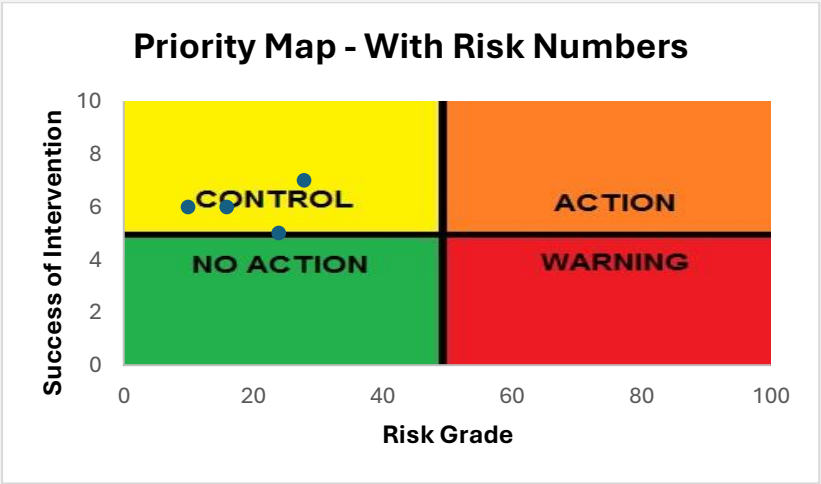
*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Technological Risk Factors						
ArcGIS software updates that cannot comply with the organisations/institutions standards and regulations or cannot be supported	5	2	10	When informed about updates to cross-check with DPM and EPU-NTUA administrators to find possible alternatives in case updates do not comply with the institution's standards and hosting technologies	6	Control.
Market Risk Factors						
Already existing Solar PV potential tools	6	4	24	Identify users that based on their resources, standards and regulations, would prefer to utilise a publicly available Solar PV potential tool, with an easy to grasp, user-friendly interface. Compared to other PV potential tools in the market, users will have the ability to utilise a multi-building PV potential map, for informed decision-making on a city scale.	5	Between Control & No Action
IPR/Legal Risk Factors						

ArcGis software's license is revoked by the production company or expired	8	2	16	Extract all information in pdf format	6	Control.
Financial/Management Risk Factors						
People responsible for developing SE3 have moved on	7	4	28	Knowledge transfer to other people	7	Control.

Table 20. KER5.2 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	3
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	1
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0



5.5.2.6. IP rights

5.5.2.6.1. Background

No background IP identified.

5.5.2.6.2. Foreground

NTUA is the creator of the Solar PV potential map, but there are no foreground intellectual property rights arising. The development of the map was based on pre-existing software (ArcGIS), and the result is planned to be openly accessible to the public.

5.6. KER6: Urban heat Analysis and resilience

5.6.1. Description

The Urban heat analysis and resilience service will analyse urban heat at high resolution and will combine demographic data to calculate the so-called urban heat risk and assess social vulnerability to heat. The service will combine the high-resolution urban heat analysis with socio-economic and demographic data to evaluate the impact of Urban Heat Islands (UHI) and other microclimatic phenomena on the energy performance of buildings. The service also includes the creation of long-term temporal series of temperature and relative humidity for different Urban Climate Zones (UCZ) within the city. This will enhance urban assessments for current and future climate

scenarios, such as weather files for the energy performance of buildings. UCZs are based on sub-municipal climate zoning according to climate severity. Furthermore, the service is designed to facilitate its replicability on a European scale. This service also includes an analysis of the energy performance of the building stock from a demand perspective, enabling visualization of the impact of urban heat on buildings. As a final functionality, the tool will provide solutions to mitigate and adapt to climate change, considering the potential of intervention according to the characteristics of the urban fabric and specific aspects related to vulnerability.

5.6.2. Value Proposition Canvas

The main customers for KER 6 are the following: from the public sector policy makers, municipality technicians, private sector such as real estate and construction companies. Also, citizens and the academia sector.

KER6: Urban heat Analysis and resilience

Value Proposition	Products & Services	Gain Creators	Pain Relievers
	-Solutions for mitigating urban heat effects on buildings and public spaces. -Visualization tools for urban heat impacts on buildings' energy demand. -Comparison of urban heat risk and urban heat hazard in different future climate scenarios -Weather files that incorporates the urban heat effect	- Tools for informed decision-making regarding urban heat mitigation strategies. -Hotspots identification to prioritize areas of intervention -Access to comprehensive and long-term data for accurate urban heat assessments. -Urban heat metrics and comparison between them Identification of areas with higher urban temperatures -Identification of most vulnerable areas based on socio-economic indicators	- Urban heat maps for different climate change scenarios. -Enhanced assessments for both current and future climate scenarios. -Buildings energy demand information -Mitigation and adaptation solutions adapted to the urban characteristics -GIS urban heat risk available data for download -Report on the urban heat metrics and solutions for mitigation and adaptation
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	- Improve urban planning and resilience against climate change -Need to evaluate the energy performance of buildings using an accurate weather file. -Need to know where to prioritize the implementation of mitigation and adaptation strategies in the city. -Need to analyse the building energy demand performance in the city. -Implement effective urban heat mitigation strategies.	- Visualization tools for assessing urban heat impacts on building energy performance. -Comprehensive urban heat analysis incorporating socio-economic data -Long-term temporal data series for urban climate zones -Tools for informed decision-making on climate resilience and adaptation -More accurate energy simulations in the current and future climate context.	- Limitations on availability of conventional meteorological networks. -Some urban areas have a low-density temperature measurement points -Lack of urban weather files that integrates the urban heat. -Building energy simulations often do not incorporate the effect of urban heat in cities as a climate context. -Lack of comprehensive and integrated urban heat mitigation strategies.

Figure 8. KER6 Value Proposition Canvas

The KER6 can meet the needs of a wide range of customers. The functionalities integrated in the SE4 Urban Heat analysis and Resilience will facilitate informed decision making for policy makers and urban stakeholders through accurate results on urban heat and its distribution in cities, as well as identify priority areas for action based not only on urban heat but also on their socio-economic and demographic situation. In addition, the analysis will not only serve the current climate context but also the future, thus becoming a powerful planning tool for the medium and long term that can be in line with the EU's climate neutrality objectives.

The integration of the analysis of the energy demand of buildings will allow the prioritisation of neighbourhoods with a greater need for renovation, which, in conjunction with an analysis at the urban scale, will pave the way for comprehensive interventions not only of buildings, but also for their immediate surroundings. In this regard, on one side Municipalities, real estate and constructions

companies can benefit from this KER identifying potential customers for retrofitting strategies that could apply for EU and national funding or for the private sector. Also, citizens can be raised awareness of the energy performance of their buildings, helping them to take the initiative to improve their buildings. Academic customers will have the possibility to obtain the results of the service in formats that will allow to promote new studies in the field or to use it as complementary information for other research work or related projects.

5.6.3. Exploitation Plan

5.6.3.1. Exploitation roadmap

Table 21. KER6 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	**Partnership Building:** Establish robust partnerships with key urban stakeholders, including municipalities, urban planners, and real estate developers. Engage these stakeholders in pilot projects to demonstrate the tool's value and gather continuous feedback for iterative improvement. **Tool Development and Updates:** Focus on continuous development and refinement of the urban heat analysis tool, integrating stakeholder feedback and incorporating the latest data to ensure the tool remains user-friendly and effective. **Training and Support: I**mplement comprehensive training programs, including workshops, webinars, and detailed user manuals, to ensure stakeholders are proficient in using the tool. Provide ongoing technical support to address any issues promptly.
After 2 years	**Expansion and Scaling:** Broaden the user base by targeting additional cities and regions, leveraging successful pilot projects and case studies to attract new users. Scale the tool's deployment to maximize its impact. **Feature Enhancement:** Introduce advanced features and premium services based on evolving user needs and feedback. Ensure these enhancements align with the latest urban heat analysis/climate resilience requirements.
After 5 years	**Ongoing Collaboration**: Maintain and strengthen existing partnerships while exploring new opportunities for collaboration. Engage with academic institutions and research organizations to stay at the forefront of urban heat analysis technology.

5.6.3.2. Additional impacts

Economic Growth: Job Creation: Stimulate job creation through the development, maintenance, and enhancement of the tool. Attract investments by showcasing the tool's potential to improve urban resilience and planning. Innovation and Entrepreneurship: Foster innovation by providing high-quality data and analysis tools to entrepreneurs and businesses, enabling them to develop new products and services that address urban heat and climate resilience.

Social Benefits: Quality of Life: Improve residents' quality of life by providing tools to mitigate urban heat risks and enhance public spaces. Promote health and well-being by reducing heat-related risks. Public Awareness: Increase public awareness and engagement in climate resilience and urban planning through educational initiatives and community involvement. Empower citizens with information and tools to take proactive measures against urban heat.

Environmental Benefits: Sustainable Development: Support sustainable urban development and climate adaptation strategies. Help cities reduce energy consumption through effective heat mitigation measures. Climate Resilience: Enhance the ability of cities to withstand and adapt to the impacts of climate change by providing actionable data and insights. Contribute to global efforts to combat climate change by promoting resilient urban planning.

5.6.4. Risk & Countermeasures

Table 22. KER6 Risk Assessment Map

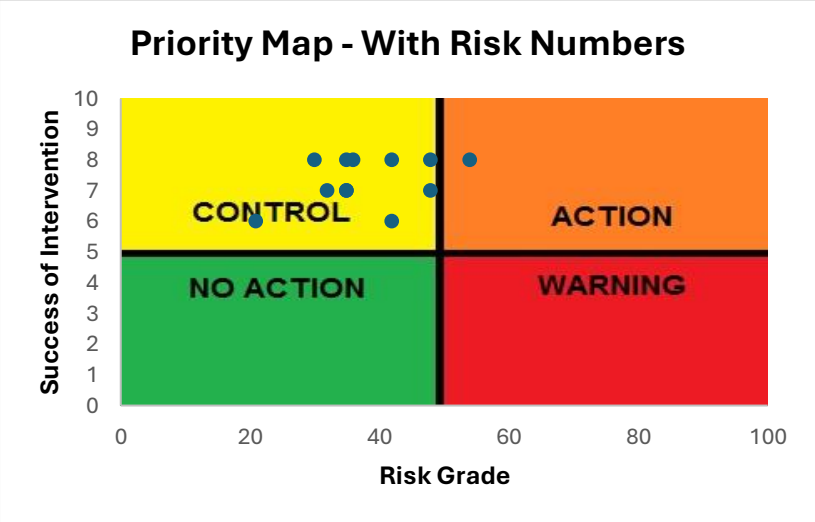
*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Difficulty in maintaining collaboration among diverse stakeholders	8	6	48	Regular communication, updates, and collaborative platforms.	8	Control
Lack of commitment from stakeholders	7	5	35	Establish clear roles and benefits for stakeholders	7	Control
Technological Risk Factors						
Integration challenges with existing urban systems	7	5	35	Adopting open standards and APIs for seamless integration	7	Control
Data accuracy and reliability issues	8	6	48	Implement robust data validation and verification processes	7	Control
Open databases that move to restrict access	7	3	21	Identify alternative open databases	6	Control
Market Risk Factors						
Limited adoption by urban planners and decision-makers	6	7	42	Demonstrate value through pilot projects and real-world case studies	8	Control
High competition from existing solutions	7	6	42	Highlight unique features and advantages of the tool	6	Control
IPR/Legal Risk Factors						
Risk of not securing IP rights for newly developed technologies	8	4	32	Promptly file for IP protection and maintain thorough documentation	7	Control
Changes in IP laws affecting the tool's usage and distribution	5	6	30	Regularly monitor and adapt to changes in IP laws	8	Control

Financial/Management Risk Factors						
Insufficient funding for ongoing maintenance and updates	9	6	54	Secure continuous funding and develop strategic partnerships	8	Action
Environmental/Regulation/Safety risks						
Changes in environmental regulations impacting urban heat mitigations strategies	7	5	35	Regularly update the tool to comply with current regulations	8	Control
Uncertainty in future climate scenarios affecting tool relevance	6	6	36	Periodical update tool based on latest climate data and research	8	Control

Table 23. KER6 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	11
Number of "Action" Risks	1
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0



5.6.5. IP rights

5.6.5.1. Background

Detection of overheating risk hotspots (Methodology/UPM): Use of overlapping methodologies of socio-economic and demographic indicators for the detection of the areas' most at risk of overheating in the city.

Use of non-conventional climate data (Know-how/UPM): Integration of Citizen Weather Stations (CWS) data for urban heat analysis.

Urban weather files creation (Methodology/UPM): Synthetic datasets created using artificial neural networks.

Social vulnerability (Methodology/MOB): Provision of fundamental technologies for analysing social vulnerability to heat within urban environments.

Data analysis/storage (Algorithms-storage/MOB): Analysis and storage of data for providing input to visualization tool

Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as BG codes BG11, BG12, BG13, BG14, BG15.

5.6.5.2. Foreground

Urban Heat Analysis Algorithms (Methodology/UPM): Newly developed algorithms for high-resolution urban heat analysis, based on unconventional urban climate data which allows for analysis standardisation.

Urban heat impacts on buildings' energy demand (Methodology/UPM): New impacts estimations based on innovative weather files adjusted for the urban heat under different climate change scenarios.

Decision Support Tool: Mitigation and adaptation solutions to urban heat based on the specific urban fabric and vulnerability factors.

Visualization Tools (Software/MOB): Innovative visualization tools and user interfaces created for the project are protected as new IP, ensuring exclusive rights to unique technological advancements. **Social Vulnerability (Methodology/MOB**): MOBICS has developed methodology for analysing social vulnerability to urban heat.

Please refer to Annex 2, for the specific foreground intellectual property associated with this KER, identified as FG codes FG.3.4.1, FG.3.4.2.

5.7. KER7: Urban flood analysis and resilience

5.7.1. Description

Urban flood analysis and resilience service will provide an innovative decision support service that calculates and visualises the expected flood damage to buildings and land use, and flood vulnerability hotspots with taking blue-green factors into account for the present and the future - according to different climate-driven scenarios in line with the standard accepted IPCCs. The service also provides relevant condition guidance for the design and implementation of building retrofits and blue-green infrastructure measures through a decision support tool.

5.7.2. Value Proposition Canvas

The key customer groups of KER7 are Urban Planners, Utility providers and Urban water managers, Municipalities and Regional Policy Makers, Insurances, City Residents and Building/House Owners, Companies in the Real Estate Sector, Research Groups and Academia.

KER7: Urban flood analysis and resilience			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	-visualisation tools for urban flood vulnerability -comparison tools for applying different measures and different climate change scenarios -tools for exporting reports -user-friendly, intuitive app -climate change data incorporation -measures for mitigating urban flood vulnerability to buildings and a city	- a tool for visualising the results of the analysis in different ways -Tools for informed decision-making on urban flood risk mitigation strategies -urban flood vulnerability hotspots identification -flood damage calculation to a building and comparison between them -blue-green infrastructure impacts for different measures and comparison between them -offering climate change scenarios -urban flood vulnerability visualisation in a coloured map	- give comparisons of different climate scenarios to decide on resilience strategies -give comparisons of different renovation scenarios to decide on resilience strategies and measures to apply to buildings -selected, simplified and updated methodologies and models for the impact of blue-green infrastructure covered by available data at European level -user-friendly web-based tool analysing flood damage -textual, graphs reports and GIS urban flood risk availbale data for download -give evidence about the most critical buildings and choose building stock to increase building resilience to flood damages based on available data
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	- to improve information on the availability of data for urban analysis -to promote blue-green infrastructure applying -to provide comparisons of different scenarios to promote the impact of implementing blue-green infrastructure -to improve urban planning and resilience against climate change -to map & register flood damage and urban flood vunerability hotspots to prioritize the implementation of mitigation and adaptation urban flood strategies in the city	- different types of visualisations -exportable reports -user-friendly app -climate-resilience and adaptation information & guidance about urban flood vulnerability -illustrative, easy-to-understand and illustrative visualisations that can be used to support a variety of reports and strategies -tool for informed decision-making including different climate change and measures implementation scenarios	- lack of available user-friendly tools providing analysis with useful and talkative reports and visualisations -difficulties in analysing flood damage without advanced computer skills -lack of incorporating climate change scenarios and blue-green infra. measures in existing urban flood vulnerability analysis -lack of simplified models for the impact of blue-green infrastructure -lack of comprehensive urban flood mitigation strategies for cities

Figure 9. KER7 Value Proposition Canvas

5.7.3. Exploitation Plan

5.7.3.1. Exploitation roadmap

Table 24. KER7 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	**Partnership building:** Creating strong partnerships with key urban stakeholders – policy makers, utilities and facility managers, urban planners, municipalities and other investors, and citizens, tenants and owners; Involving these stakeholders in pilot projects to demonstrate the value of the tool and gather their feedback. **Tool development and updates:** Focusing on the continuous development of the Urban Flood Vulnerability Analysis Tool, incorporating stakeholder feedback to ensure the most important functionalities, user-friendliness and effectiveness of the tool. **Training and support:** Implementing training programmes (workshops, manuals and user guides) to ensure that stakeholders know how to use the tool; Ensuring that technical support is available to quickly resolve any problems.
After 2 years	**Expansion and scaling-up:** Expanding the existing user base by targeting additional sites and attracting new users through dissemination activities of successful pilot projects and use cases; Adding new functionalities to increase the scope of the tool.

After 5 years	**Ongoing cooperation:** Maintaining and strengthening existing partnerships and exploring new opportunities for cooperation; Collaborating with research organisations to stay at the forefront of technology for urban flood vulnerability analysis.

5.7.3.2. Additional impacts

Economic growth:

- **Job creation:** Stimulating job creation through the development, maintenance, and enhancement of the tool; Attracting investment by demonstrating the tool's potential to improve urban resilience and planning; Investments in blue-green infrastructure offer long-term economic benefits, including cost savings on water management, increased property values, and job creation in green sectors. **Innovation and entrepreneurship:** Fostering innovation by providing high-quality data and analysis tools to entrepreneurs and businesses, enabling them to develop new products and services that address urban flood and climate resilience. **Green innovation:** Promoting the valorisation of green business innovation through the promotion of green entrepreneurship, co-operative innovation and environmental investment, and by supporting the principles of the circular economy.

Social benefits:

- **Quality of life:** Improving residents' health and quality of life in cities by providing tools to mitigate urban flood risks and enhance green urban spaces. **Public awareness:** Promoting the implementation of blue-green infrastructure; Increasing public awareness and engagement in climate resilience and urban planning through educational initiatives and community involvement; Empowering citizens with information and tools to take proactive measures against urban floods.

Environmental benefits:

- **Sustainable development:** Supporting sustainable urban development and climate adaptation strategies; Help cities reduce energy consumption through effective heat mitigation measures. **Climate resilience:** Supporting the goals of multiple policy areas, including enhancing ecosystem services in managing water resources and increasing resilience to climate risks by providing actionable data and analysis enabling resilient urban planning. **Ecosystem services:** Integrated urban innovations with blue-green infrastructure implementation for urban flood resilience can contribute to addressing global challenges by increasing water, energy, food security, and maintaining biodiversity.

5.7.4. Risk & Countermeasures

Table 25. KER7 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

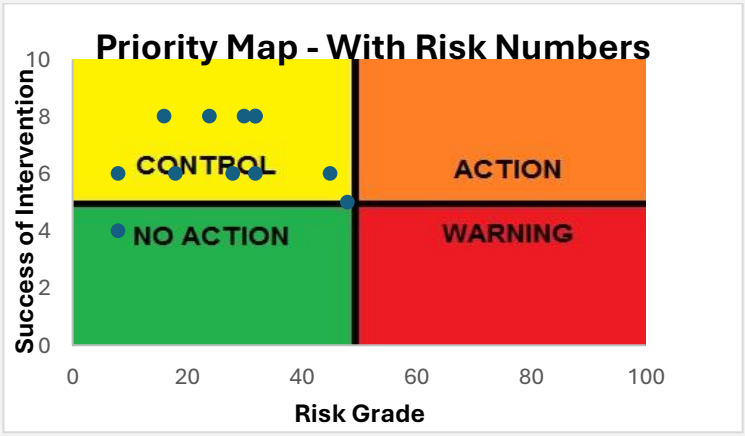
Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						

Partners break out and create competitive products	4	2	8	Signing of a clear and well-defined co-ownership agreement between IMZI and NAZKA Mapps to clarify the terms related the use of SE5 to establish clear terms and expectations for both partners, mitigating potential disputes by defining each partner's rights and responsibilities regarding the use of developed services. Additionally, the agreement provides a legal framework for resolving issues, further lowering the likelihood of significant operational disruptions. On the other hand, the probability of risk happening is reduced by the diversity in the partners' expertise.	6	Control.
Disagreement on ownership rules	7	4	28	Signing of a co-ownership agreement between IMZI and NAZKA Mapps to clarify the terms related the use of SE5	6	Control.
Technological Risk Factors						
Integration challenges with existing urban data systems	6	5	30	Adopting open standards and APIs for seamless integration	8	Control.
Open databases that move to restrict access	8	4	32	Identify alternative open databases	8	Control.
Connection and functional interaction with core platform of BUILDSPACE is too difficult/not feasible	4	8	32	Creation of open and standard data storage solutions, own-hosted, to be operational and performant. In any case, the service can function as an independent application without the core platform.	8	Control.
Market Risk Factors						
Exploitation disagreement: partners with divergent interests.	8	6	48	Strong communication with partner NAZKA Mapps on this topic	5	Between Control & No Action
Nobody buys the product. Too expensive.	9	5	45	Make the tool competitive for the market, in terms of price and functionalities, promote and demonstrate value through pilot	6	Control.

				projects and real-world case studies via social media and other communication channels		
Nobody buys the product. Nobody needs it.	9	2	18	Highlight unique features and advantages of the tool, promote and demonstrate value through pilot projects and real-world case studies via social media and other communication channels	6	Control.
IPR/Legal Risk Factors						
Know- how risks: IP rights for newly developed technologies cannot be proved	4	2	8	Apply for intellectual property protection and keep thorough records	4	No Action
Financial/Management Risk Factors						
No resources (human and financial) secured to make the next step toward exploitation	8	3	24	Look for new, additional resources	8	Control.
Multiple changes to original objectives.	4	4	16	Keep updates and flexibility	8	Control.
Environmental/Regulation/Safety risks						
Influence of laws and regulations.	8	4	32	Keep track of laws and regulations; and update if needed	6	Control.

Table 26. KER7 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	1
Number of "Control" Risks	10
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	1
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0



5.7.5. IP rights

5.7.5.1. Background

Cloud-based map platform technology (Nazka mapframe) (Software/NAZKA): Cloud-based map platform technology (Nazka mapframe) that provides functionalities, map interactivity and user interface components for comparisons, calculations and visualisations of geodata. Nazka's Mapframe technology: Nazka Mapps uses for the development of interactive maps its own system ("Mapframe") which is built from open-source web technologies (React, nodejs, MongoDB, Maplibre, Protomaps, Leaflet, …). The Mapframe is in constant evolution and subject to change at any time. Mapframe products are run in the cloud and shipped using Docker.

Cloud based map platforms UX & UI (Knowledge & Methodology/NAZKA): Methodologies on co-creation, wireframing, mockuping for UX and UI of geospatial services, digital maps and cloud-based mapping platforms.

Data analysis/storage (Knowledge & Architecture/NAZKA): Analysis and storage of data for providing input to visualization tool

Please refer to Annex 1, for the specific background intellectual property associated with this KER, identified as BG codes BG5, BG6, BG7.

5.7.5.2. Foreground

Blue-green Infrastructure Impact (Methodology/IMZI): Update of existing methodology to calculate an indirect index to assess the impact of blue-green infrastructure measures for building flood resilience

Urban flood resilience tool | visualization functionalities and design (Product /NAZKA): Create innovative visualization functionalities and tailored user interfaces (incl. Maps, dashboards, info panels, UX, UI)

Decision Support Tools (Knowledge/IMZI&NAZKA): Solutions, based on an assessment of flood damage vulnerability and Blue-green infrastructure impact, to mitigate and adapt to urban flooding

Please refer to Annex 2, for the specific foreground intellectual property associated with this KER, identified as FG codes FG.3.5.1, FG.3.5.2, FG.3.5.3, FG.3.5.4

5.8. KER8: Lessons learnt from BUILDSPACE demonstration in 4 real-world conditions

5.8.1. Description

The collection of best practices developed during Pilots activities should be a tangible, exploitable result that could be used for further research and implementation purposes. The outcome of KER 8 should have a practical format, such as a project handbook summarizing the best practices from both building and city-level Pilots, or a landing page with guidelines and videos presenting those best practices. By providing information on issues and problems on the one hand, and solutions and opportunities on the other, BUILDSPACE can provide tangible support to other research and implementation activities. The result could include specific examples from the pilots to illustrate the application and the impact of the services.

5.8.2. Value Proposition Canvas

The KER8 has three main customer segments: Urban stakeholders (real estate developers and managers, policy makers, construction companies, property managers), Citizens (residents and building owners) and ESCOs.

KER8: Lessons learnt from BUILDSPACE demonstration in 4 real-world conditions

Value Proposition

Products & Services	Gain Creators	Pain Relievers
Climate and Energy Tools • Tools to locate thermal losses and approximate repair costs. • Incorporate climate change data to support decision-making and comparative analysis. • Hotspot visualization tools for strategic urban planning. Social and Vulnerability Insights: • Visualization of areas requiring social or infrastructure intervention. • Workshops and training sessions to empower stakeholders. • BUILDSPACE ambassador providing actionable insights. Strategic Planning Tools: • Integration of satellite and public data to identify urban vulnerabilities. • Visualization tools supporting energy efficiency and resilience planning.	Customer-Centric Design • Intuitive tools for interaction with Digital Twin in VR, AR, and mobile platforms in mixed reality environments - VR glasses, tablets/smartphones[19] • Simplified visualization of construction phases with the use of 4D BIM model, and thermal performance [20] • Enables the verification of the quality of construction site works being performed Actionable Insights: • Tools displaying hidden elements, and thermal efficiency data, and also different scenarios, different visualization of the results, areas of social vulnerability to guide decision-making. • Maintenance schedules to streamline Facility Management Scalable and Adaptable Solutions: • Designed to work across various urban contexts with customizable features. • Built on trustable data integrating climate change scenarios and energy efficiency metrics. • Enhanced Stakeholder Experience: • Interactive visualizations for construction stages and social vulnerability mapping. • Climate scenario tools to aid strategic urban planning. Community and Collaboration: • Workshops, live events, and promotions to engage stakeholders and build energy communities. • User communities for feedback and shared experiences. • Created clear communication channels to facilitate timely decision-making and validation Reliability and Accessibility: • Established partnerships for up-to-date, accurate data. • Clear communication channels and multilingual support for diverse user groups, e.g. established user communicities for sharing experiences, feedback and tips. Outreach and Visibility: • High-impact promotional activities showcasing tangible benefits and use cases. • Partnerships with local entities to foster trust and adoption.	-S1.1: automatizing the process of creation of the Digital Twin - S1.2: facilitating verification of construction works progress. -S1.3: allowing information on the equipment in the building to be stored in one place - the Digital Twin -S1.3: facilitating the facility management of a building -S2.1: providing thermal representation of the envelope of the building -give comparisons of different climate scenarios to decide on resilience strategies -give evidence about the most critical buildings and choose building stock to increase building resilience to flood damages based on available data - provision of visualisation of areas of social vulnerability requiring intervention -Other relevant factors (weather, flood, etc.) influence considered. -Limited resources (incl. time, language, data) and expertise to replicate best practices. -The preparation of handbooks and guidelines that will enable the application of these solutions by stakeholders outside the Buildspace consortium and will not require specialized technical knowledge

Customer Segments

Customer Jobs	Gains	Pains
- S1.1: Automatic Digital Twin creation -S1.2: Displaying building phases in Digital Twin in AR device. -S1.3: Possibility to display of hidden objects together with the corresponding data in the Digital Twin -S2.1: Thermal representation of a building displayed in the Digital Twin -to improve information on the availability of data for urban analysis -to provide comparisons of different scenarios - identify areas of social vulnerability to prioritise interventions - get information on the condition of owned buildings regarding thermal losses -a tool for city designers, architects, NGOs to impact face of urban territory	-the aspect of having all information regarding building equipment inside the 3D building information representation (Digital Twin) -Streamlining and accelerating processes through innovative, automated solutions. -the possibility to visualise and interact with Digital Twin in mixed reality environments -the structure and the leading process strongly support development of the service and piloting -innovative solutions incorporating satellite data - use of technology to prioritise construction works in buildings of interest - use of climate data along with demographic data to classify areas based on social vulnerability - Communication with stakeholders and potential users is essential also for the future.	- inability to predict weather conditions when planning drone flyovers to deliver the thermal data of a building -lack of reliable high-resolution information about existing blue-green infrastructure -difficulties in promoting the project and stakeholders' engagement in the early phase of the project - lack of recent demographic information in building or block level - lack of digitalised information on building schematics -Not all digital twins has the same approach for getting data. That might make some difference in the results. -The updates of the information afterwards should be planned.

Figure 10. KER8 Value Proposition Canvas [17,18]

[17] this enables attractive representation of the building and better understanding of its space

[18] this enables attractive representation of the building phases and better understanding of their location in space and context of a building; digitalise the process of verifying the progress of construction works, making it more attractive and understandable

5.8.3. Exploitation Plan

5.8.3.1. Exploitation roadmap

Table 27. KER8 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	**Partnership Building:** Creating strong partnerships with key urban stakeholders – policy makers, utilities and facility managers, urban planners, municipalities and other investors, and citizens, tenants and owners; Involving these stakeholders in pilot projects to collect their actual needs and build trust. **Promotion:** Implementing promotion programmes (workshops, post by communication channels) to ensure that stakeholders are engaged to the project activities. **Lessons learnt**: Creating a collection of lessons learnt in a systemised, structured format which allows for successful, value-creating dissemination of the demonstration results. This with the goal of sharing the gained know-how outside of the BUILDSPACE consortium to promote the developed solutions.
After 2 years	**Expansion and Scaling-up:** Expanding the existing stakeholders base by targeting additional sites and attracting new users through dissemination activities of successful pilot projects and use cases. Exchange with other cities on the lessons learnt from the experiences from the services. Providing the document for potential city developments as the best practices. **Utilising the lessons learnt** in future construction project to create value for construction process participants. Especially promoting BUILDSPACE approach to enhance decision making, quality control and sustainability with the use of innovative, digital support tools.
After 5 years	**Ongoing cooperation:** Maintaining and strengthening existing partnerships and exploring new opportunities for cooperation.

5.8.3.2. Additional impacts

This KER being a structured and comprehensive resource documenting effective methodologies and strategies can inform policy decisions and strategic planning. By showcasing the effectiveness and potential of innovative technologies we can attract private sector investment but also increase the chances of securing grants and funding from international bodies, such as the European Union, for further development and research. The outcome of this KER could be a great representation of the main results of the project, which can serve for further research purposes. With a practical format, it has the potential to attract a wider group of stakeholders, providing an overview of the best practices from the project.

Economic Growth: Job Creation: Stimulating job creation through the development, maintenance, and enhancement of the solutions and tools; Attracting investment by demonstrating the tool's potential to improve urban resilience and planning; Investments in innovative measures offer long-term economic benefits, including cost savings, increased property values, and job creation in green, water and energy sectors. **Innovation and Entrepreneurship:** Fostering innovation by providing high-quality and satellite data, and analysis tools to entrepreneurs and businesses, enabling them to develop new products and services that address buildings climate resilience. **Green innovation:** Promoting business innovations by encouraging green entrepreneurship, cooperative innovation and environmental investment, and supporting circular economy principles.

Social Benefits: Public Awareness: Increasing public awareness and engagement in climate resilience and urban planning through promotion initiatives and community involvement; Empowering citizens with information and tools to take proactive measures against urban heat and floods.

Environmental Benefits: Sustainable Development: Supporting sustainable urban development and climate adaptation strategies; Help cities reduce energy consumption through effective heat mitigation measures. **Climate Resilience:** Increasing resilience to climate risks by providing actionable data and analysis enabling resilient urban planning.

5.8.4. Risk & Countermeasures

KER8 focuses on lessons learned from the demonstration sites, which are essential for validating BUILDSPACE solutions in real-world conditions. To ensure the risk analysis for this KER reflects practical insights, input was gathered from the representatives of the four pilot sites: **MOS** (Mostostal Warszawa, Warsaw/Poland), **MoP** (Municipality of Piraeus, Athens/Greece), **IMZI** (Blue-green Infrastructure Institute, Ljubljana/Slovenia) and **RPR** (Riga Planning Region, Riga/Latvia). Including this descriptive input ensures that the risks presented are grounded in real-world scenarios and aligned across all pilots, offering valuable context before presenting the KER8 risk assessment map (Table 28) and the risks summary (Table 29).**MOS:** Risks and limitations that could arise from this KER are related to partnership, IPR/ legal and quality of documentation. Firstly, maintaining collaboration among diverse stakeholders after the project closure could be challenging. Addressing this risk in the exploitation process could involve scheduling regular communication and updates to ensure collaboration among stakeholders. Together as a group we can create stronger impact than if we worked separately. This also means it is crucial to plan the exploitation activates during the project duration, so that we can smoothly transition into the next stage after the project ends. The risk of insufficient documentation regarding outcomes of pilot activities poses a significant threat to achieving results as defined in KER 8. Insufficient documentation could mean that clients would be lacking interest in the lessons learnt from BUILDSPACE as well as in using the tools showcased during the pilot activities. However, to counteract this, a handbook or separate handbooks on diverse services containing guidelines will be prepared. To assure scalability it is important to create thorough documentation of the demonstration results, which will clearly outline the value that BUILDSPACE innovations provide and enable the application of services by different stakeholders, extending the duration of individual services and providing the potential for implementing the solutions developed within Buildspace on an international scale. The results of the demonstrations will be incorporated into the handbook/ handbooks to provide examples of services usage, making them easier to understand and implement, thereby creating a greater impact. Monitoring and documenting all pilot activities is crucial especially regarding IPR and legal risk. There is always a risk of not securing IP rights for newly developed technologies by relevant partners. Maintaining thorough documentation and communication is essential to minimize this risk**.**

MoP: Risks and limitations for this KER would be whether there will be availability of the services after the end of the project to be demonstrated to other interested cities or regions. A successful pilot could be interesting to other cities, however ambiguous results would potentially make it difficult to engage with relevant stakeholders. Close monitoring and documenting each step towards service implementation is crucial to minimise the risks. Finally, a guide, videos or live tutorials of the services could be very helpful

for end users of the services. This will also ensure their ongoing engagement with and make them ambassadors of Buildspace services as good practices to be replicated in an international level.

IMZI: Main risks and limitations for collecting the lessons learnt from BUILDSPACE demonstration could be not evidenced actions, issues and solutions that were faced during the project. Detailed and systematic record-keeping with supporting material can minimalise these risks. Another risk is the lack of time at the end of the project to provide comprehensive material, which can be avoided by creating a concept and systematically collecting it on an ongoing basis. Another risk is also unavailability of the service after the end of the project, which can be prevented by ensuring partnership commitment. However, to avoid the risk of insufficient documentation of the presentation of the good practices and results of the pilot activities identified in KER 8, a guide will be prepared. By paying particular attention to an attractive appearance, user-friendly design, good visual material and sufficiently user-friendly descriptions that can be easily understood by all target users, the good practice examples from the pilots will reach a wide interested public.

RPR: Lack of updated data post-project could undermine usability. The overtake the best practise of the project might be hard due the limited recourses and knowledge about the creation the real-world models. The lack of updated data afterwards in the city level after the project might influence the use of the project results. To decrease the risk the involvement the municipality representatives are essential within the project. Active involvement of municipal representatives and other key players during the pilot phase to ensure the relevance and usability of results – it might add some extra value, e.g., energy community building perspectives in the municipality. Inform policy decision makers about service to effect urban planning strategies including to document the practical tools as BUILDSPACE. Strategically schedule disclosures to align with stakeholder decision-making cycles have to be planned. A pilot – a building or territory in municipality used the service for planning the development - in Pilot territory with real usage of the service might be used as Ambassador for others to enhance credibility.

The service might be a part of promotion material, as the basic tool to be promoted for renovation multiapartment residential houses and for public buildings. Delayed engagement or disclosure could undermine the outcomes' value. Translate technical results into accessible formats for diverse audiences: e.g. Easy language format in webpage will help to diverse the target group.

“Worthless result: ill-timed disclosure” also needs to be indicated due to a high importance of usefulness of the project’s results. If the pilots don’t provide direct engagement with key stakeholders, cannot get a timely response: confirmation or rejection of the relevance and usefulness of the results.

An accessible BUILDSPACE link featuring guidelines, case studies, and multimedia content (e.g., videos) to illustrate best practices might increase the interest of the service. By highlighting key challenges encountered during the solutions developing might emphasize potential applications and measurable impact of the methodologies. To illustrate the service, incorporate specific case studies to demonstrate the practical application of services and tools. Offer workshops and training sessions to stakeholders to bridge resource and knowledge gaps.

Table 28. KER8 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Clients do not like the platform/out of interest	9	4	36	Communication and marketing about platform's added value should be done widely	9	Control.
Worthless result: ill-timed disclosure.	8	4	32	Strong engagement of stakeholders and collection of their feed-backs	8	Control.
Difficulty in maintaining collaboration among diverse stakeholders	6	2	12	Regular communication and updates	8	Control.
Risk of lack of documentation regarding outcomes of Pilots activities	6	2	12	Monitoring and documenting progress of works	7	Control.
Availability of services	8	2	16	Ensure partnership's commitment	7	Control.
Technological Risk Factors						
Ambiguous Results	8	2	16	Monitoring and documenting pilot steps	8	Control
Risk of outdated data, if there is no renewal/update of data planned	8	8	64	Integration of information source databases	8	Action
Market Risk Factors						
No interest of society to implement the greener energy – no need for the services	6	5	30	Communication with public and stakeholders regularly	6	Control

Lack of interest and knowledge to start-up the greener energy investments lead to low interest of society	8	5	40	Guidelines of usage the service provided	6	Control
Lack of the mobilization of citizens and lack of business models	8	5	40	Service has to be promoted and communicated to wider audience as possible, inform stakeholders	5	Between control & No Action
Unsupportive legislation for green investments	8	4	32	Delivery of additional data for decision makers	5	Between control & No Action
Availability of other technical solutions	6	4	24	Development of high-quality service, which stands competitive services	6	Control
Small market - relatively small group of individuals who is interested in use of service	6	4	24	Service has to be developed for use in several markets	8	Control
Financial/Management Risk Factors						
Lack of time at the end of the project to provide comprehensive material	8	7	56	Create a concept and systematically collect material	6	Action!
Not available financial feasibility check	6	4	24	Collecting cost related information from involved partners	6	Control
IPR/Legal Risk Factors						
Risk of not securing IP rights for newly developed technologies	9	2	18	Maintaining thorough documentation	2	No Action'
Environmental/Regulation/Safety risks						
Historical building protection vs service provided	5	3	15	Agreement and collected data of historical/protected buildings to include in the project during the development process	5	Between Control & No Action

technology are not considered						

Table 29. KER8 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	1
Number of "Control" Risks	12
Number of "Action" Risks	2
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	3
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0

5.8.5. IP rights

5.8.5.1. Background

In the context of KER 8, there is no specific requirements regarding IP rights concerning Background.

5.8.5.2. Foreground

In the context of KER 8, there is no specific requirements regarding IP rights concerning Foreground.

5.9. KER9: Multi-level interaction and alignment with Copernicus/DestinE

5.9.1. Description

BUILDSPACE aims at interacting and aligning with Copernicus services and the Destination Earth programme with emphasis on Digital Twin technologies and Data Federation aspects. To achieve this goal, the project is interacting with the DestinE and Copernicus communities, following the landscape evolution and engaging in dedicated events and initiatives. Moreover, BUILDSPACE has the potential to provide high-impact use cases to DestinE and Copernicus and to increase the base of stakeholders.

5.9.2. Value Proposition Canvas

Concerning customer segments, KER9 addresses the Copernicus and DestinE communities, which are composed by a wide range of actors, which include public sector entities (policymakers, regulatory authorities, government agencies), scientific, education and research entities, private sector and industry stakeholders, NGOs and civil society organisations.

KER9: Multi-level interaction and alignment with Copernicus/DestinE			
Value Proposition	**Products & Services**	**Gain Creators**	**Pain Relievers**
	- High-impact use cases for DestinE -Community engagement model, e.g. for other projects	- DestinE and Copernicus communities engaged with interest in project results and methodologies -Provide relevant use cases for DestinE and Copernicus -Follow advances from the DestinE and Copernicus communities	- High-impact use cases -Engagement in the DestinE and Copernicus communities
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	- Need for high impact use cases for Copernicus and DestinE -Need from the Copernicus/DestinE side for feedback from stakeholders -Need to engage different communities	- Synchronization with new advances from the DestinE and Copernicus communities -High impact use cases for DestinE and Copernicus -Bidirectional engagement in the DestinE and Copernicus communities	- Lack of knowledge about the potential of Copernicus and DestinE -Difficulty in engaging stakeholders -Diverge from stakeholders needs -Outdated information about DestinE and Copernicus -Low impact use cases

Figure 11. KER9 Value Proposition Canvas

5.9.3. Exploitation Plan

5.9.3.1. Exploitation roadmap

Table 30. KER9 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Active participation in the Copernicus and Destination Earth communities, also providing two high-impact use cases.
After 2 years	Strengthen the ties between the BUILDSPACE stakeholders and Copernicus/DestinE communities.
After 5 years	Set a model for the interaction between new projects and the Copernicus/DestinE communities.

5.9.3.2. Additional impacts

Providing high-impact use cases, which leverage DestinE and Copernicus has the potential to provide benefits for the society in terms of exploitation of the DestinE and Copernicus facilities, and in turn in terms of adaptation and resilience to climate change scenarios, saving lives, avoiding physical damage to buildings and, finally, enhancing the built environment market.

Moreover, setting a model for the interaction between DestinE/Copernicus and EU funded projects can amplify the synergies among actors and stakeholders.

5.9.4. Risk & Countermeasures

Table 31. KER9 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						
Some partners (excluding ECMWF) may leave	4	4	16	Focus on the use cases driven by the active partners	7	Control
ECMWF partner may leave	7	2	14	Engage directly with the DestinE and Copernicus communities	6	Control
Technological Risk Factors						
A better DestinE/Copernicus vs EU funded projects interaction model is devised	7	5	35	Adapt and integrate the interaction model	7	Control
Technologies employed by DestinE and Copernicus are superseeded	3	3	9	Focus on the intrinsic value of the data	7	Control
Market Risk Factors						
Nobody is interested in the provided interaction model	8	6.25	50	Demonstrate the benefits and successes of the interaction model, investing in communication and dissemination	7	Between Control & Action
Nobody is interested in the provided use cases	8	1	8	Enhance communication with stakeholders and with the DestinE/Copernicus community	5	Between Control & No Action
Environmental/Regulation/Safety risks						

Provided use cases no longer relevant	8	2	16	Enhance communication with stakeholders and with the DestinE/Copernicus community	5	Between Control & No action

Table 32. KER9 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	4
Number of "Action" Risks	0
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	2
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	1

5.9.5. IP rights

5.9.5.1. Background

In the context of KER 9, there is no specific requirements regarding IP rights concerning Background.

5.9.5.2. Foreground

In the context of KER 9, there is no specific requirements regarding IP rights concerning Foreground.

5.10. KER10: Digital Educational Kit

5.10.1. Description

The Digital Educational kit was created in order to spread, in an innovative approach, the knowledge, expertise and 'know-how' developed in the framework of BUILDSPACE. It gathers the outcomes and results that were produced throughout the project, aiming to train higher education (university) students or anyone else interested in the topic of energy-efficiency and resilient cities planning. By using the kit, trainees will become fully familiar with the purpose of BUILDSPACE project, its services, the technical specifications and equipment applied, as well as the services applicability potential. In addition, trainees will have the opportunity to navigate themselves through a number of pilot story experiences in order to understand deeper the services' features and level of applicability.

The Digital Educational kit consists of 5 sections:

1) BUILDSPACE Co-creation and Stakeholder Engagement: This section describes in a nutshell the process that was followed by the project' s consortium to engage external key stakeholders in a co-creation journey for the initial development and design of the BUILDSPACE Services.
2) BUILDSPACE Services: This section offers a description of all BUILDSPACE Services in an experience builder format (ArcGIS), their technical specifications and equipment used, as well as their general applicability potential.
3) BUILDSPACE Pilots: In this section, trainees will have the opportunity to explore the results of BUILDSPACE Services. Four different stories of application will be described also in an experience builder format, including all 3 pilot phases (pre-pilot, full-pilot and large-scale), challenges, final findings for each service and final pilot results.
4) Supportive Material: A number of research articles, publications and/or journals related to BUILDSPACE and other EU relevant sister projects will be shared in this section, as supportive material.
5) Feedback Form: A dedicated form will gather feedback from trainees, thus, enabling the project team to improve the kit and the overall training process. Regarding its use, the Digital Educational kit is highly interactive and consists of presentations, pictures, videos, and interactive maps. This format assists the trainees to guide themselves easier through each section and explore the various aspects of the project, as well as best practices. In this interactive format and user-friendly environment, the user has the opportunity to understand in depth the processes of the BUILDSPACE services and their applications, through dynamic visualization and interaction with the results.
The kit has been developed in English and is open and available to the public on the project's website.

5.10.2. Value Proposition Canvas

KER 10 is open for use by the public and therefore, it does not target specific customer segments. However, an effort to address the broader public needs is being highlighted in the following value proposition canvas.

KER10: Digital Educational Kit

Value Proposition	Products & Services	Gain Creators	Pain Relievers
	-Comprehensive Guide for understanding DT generation and enrichment, integration/analysis of urban climate scenarios and estimation of energy demand building stock -An educational kit for the BUILDSPACE Services and pilot implementation (Description and Use) -Supportive documentation and scientific material for each BUILDSPACE Service	- Interactive exploration of services applications - Shareability and interconnectivity (PC, mobiles, IOS, Android etc.) -Provides supportive material (e.g articles, publications etc.) to trainees, to gain in-depth knowledge of the topics -Best practices of services and workflow in a user-friendly interface -Easily updatable kit -Easy to navigate	- A comprehensive and interactive presentation, easily updatable with no coding -ArcGIS experience builders for services/pilots: No need for domain acquisition and developer support -Interconnectivity with ArcGIS Survey and other Esri products
Customer Segments	**Customer Jobs**	**Gains**	**Pains**
	-Need for potential users to implement the BUILDSPACE Service workflows in their products and services -Need for thorough understanding of BUILDSPACE Services and their application	-Providing services and pilots with supportive documentation (articles, publications) -High-level, easy-to-grasp information -Elegant design of experience builders, easy and comfortable for presenting and for the readers to follow -Experience builders support service providers in presenting their work to third parties -Description of the Stakeholders' co-creation process followed during the project	- Esri (ArcGis company) product acquisition

Figure 12. KER10 Value Proposition Canvas

5.10.3. Exploitation Plan

5.10.3.1. Exploitation roadmap

Table 33. KER10 Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Provide interactive experience builders (presentations) for the BUILDSPACE services and pilot stories, including information on the project's co-creation process, and supportive material for higher education (university) students or anyone else interested in the topic of energy-efficiency and resilient cities planning.
After 2 years	Continue providing interactive experience, information and training material to university students and in the general public. Exploit services and pilot experience builders for BUILDSPACE presentations (conferences, info events etc.)
After 5 years	Continue providing interactive experience, information and training material to university students and in the general public. Exploit services and pilot experience builders for BUILDSPACE presentations (conferences, info events etc.)

5.10.3.2. Additional impacts

Digital Educational kit's main objective is to spread knowledge to the general public, and mostly to university students interested in topics related to energy efficiency and resilient cities. By providing know-how on innovative services and informed decision making towards energy-efficient buildings and climate resilient cities, the users of the kit will be able to delve into the project's details, understand the methodology behind the development of innovative services as well as navigate themselves through pilot applications.

The educational kit will be distributed to at least 10 universities around EU members and utilised by the partners who have teaching assignments at universities. In that way, more students (potential professionals) will get acquainted to a number of innovative solutions and applications related to the topics of energy-efficiency and resilient cities and therefore, add in their portfolio knowledge that could support them in their future professional and/or academic career.

5.10.4. Risk & Countermeasures

Table 34. KER10 Risk Assessment Map

*(The **Risk Grade** is calculated by multiplying the **Degree of Criticality** by the **Probability of Risk Happening** (both rated 1–10 based on preliminary estimations by partners). The **Estimated Success of Intervention** (rated 1–10 by partners) indicates the likelihood of successfully mitigating the risk. The conclusion is based on the comparison of these values to determine appropriate action)*

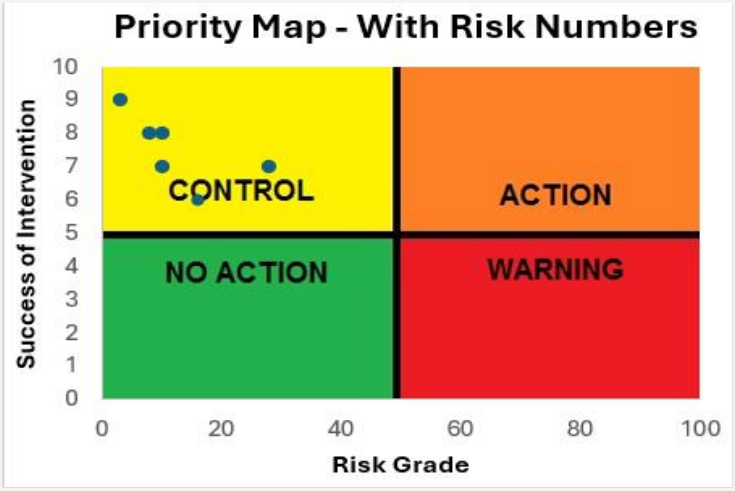
Description of Risks	Degree of criticality of the risk (1-10)	Probability of risk happening (1-10)	Risk Grade	Potential intervention	Estimated Feasibility Success of Intervention (1-10)	Conclusion
Partnership Risk Factors						

Partners using the Digital Educational kit to present only their service experience builder without giving credits to the full kit and its creators	1	3	3	Add creators' credentials in all sections of the kit	9	Control
Technological Risk Factors						
ArcGis software removes the experience builder feature from its software	5	2	10	Save the experience builders in .pdf, .ppt or other format in order to have backups	7	Control
Website's technical issues that would affect the kit	5	2	10	Maintain the website and check often for bugs and other security issues. Download all kit's relevant information and sections in .pdf	8	Control
ArcGIS experience builders not being shareable as a url	4	2	8	Explore options of domains	8	Control
IPR/Legal Risk Factors						
ArcGis software's license is revoked by the production company or expired	8	2	16	Check all alternative options and extract all information (experience builders) in .pdf format	6	Control
Financial/Management Risk Factors						
People responsible for developing Digital Educational toolkit have moved on	7	4	28	Knowledge transfer to another person	7	Control

Table 35. KER10 Summarizing Risks Table

Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	6
Number of "Action" Risks	0
Number of "Warning" Risks	0

Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0



5.10.5. IP rights

5.10.5.1. Background

In the context of KER 10, there is no specific requirements regarding IP rights concerning Background.

5.10.5.2. Foreground

NTUA is the creator of the Digital Educational kit, but there are no intellectual property rights arising. The development of the kit was based on pre-existing material provided by the service developers and pilots, and its main objective is to be displayed freely for training purposes.

6. Joint Exploitation Schemes of KERs

The rationale behind the development of joint exploitation schemes for KERs was to enhance the value and impact of individual KERs by creating integrated frameworks. These frameworks allow for a more comprehensive and scalable approach to addressing complex challenges in urban environments. By consolidating individual KERs into joint schemes, the project aimed to pool expertise, resources, and technological innovations from different partners, ensuring that the solutions offered were not only more effective but also adaptable to diverse urban contexts. The joint exploitation schemes were categorised into areas such as city-scale services, platform services, and building-scale services. Each category focused on delivering targeted solutions while maintaining flexibility for cross-sectoral integration, ultimately improving the project's ability to meet the evolving needs of stakeholders in urban planning, energy efficiency, and climate resilience.

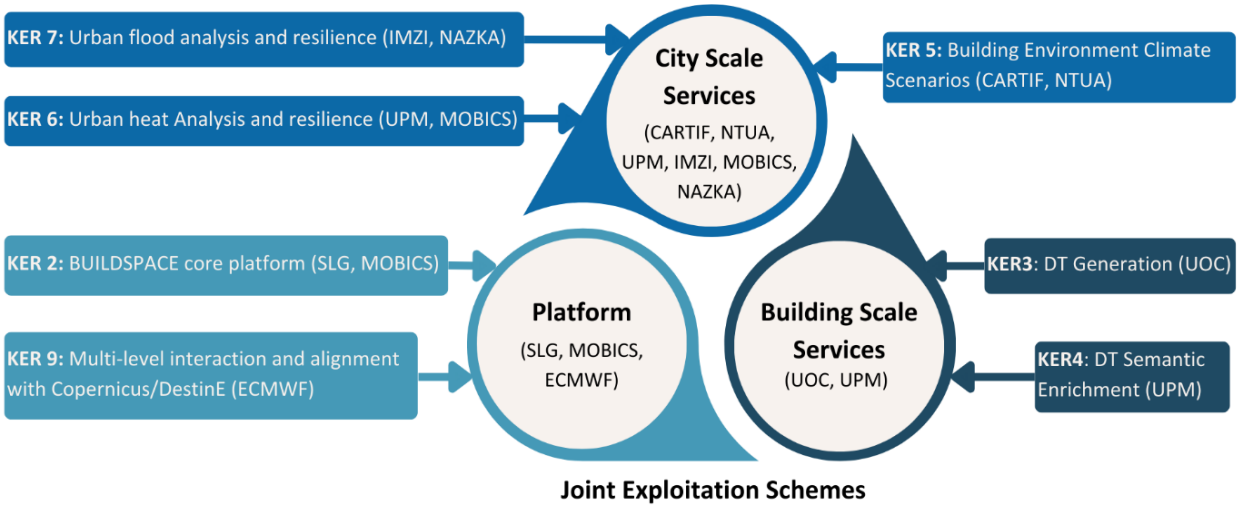


Figure 13. Joint Exploitation Schemes and Their Responsible Partners

Figure 13 visualises the categorisation of joint exploitation schemes into three main areas: City Scale Services, Platform, and Building Scale Services. It outlines the corresponding KERs under each category, along with the responsible partners, illustrating how these components work together to create a robust, integrated approach to urban resilience and energy efficiency. This structure emphasises the synergies between KERs and partners to maximise the project's overall impact.

6.1. City scale Services

6.1.1. Description

The Joint Exploitation Scheme for the city-scale services focuses on integrating three key services -built environment climate scenarios, urban heat analysis and urban flood analysis- into a unified offering for cities. These services are designed to address different aspects of climate resilience at the urban level, providing a comprehensive toolkit for municipal decision-makers.

The integration of these services creates a powerful synergy, allowing cities to assess and respond to the impacts of climate change more effectively. By leveraging the strengths of each KER (KER 5, KER 6 and KER 7 respectively for the services 3, 4 and 5), the joint scheme offers a holistic approach to urban resilience,

combining energy efficiency, heat vulnerability assessment and flood risk management in a single, cohesive platform.

Key features of the Joint Exploitation Scheme:

- **Comprehensive urban resilience tools**, combining tools for analysing the energy demand under different climate scenarios, assessing urban heat risks and evaluating flood vulnerabilities. This integration enables cities to make informed decisions on how to best protect their infrastructure (mainly buildings) and citizens from the adverse effects of climate change.
- **Data-driven insights**, combining high-resolution data, demographic information and urban analytics, the services provide actionable insights that are tailored to the specific needs of each city. This allows for more precise and effective climate adaptation strategies.
- **User-friendly interface** that makes it easy for urban planners, policymakers and other stakeholders to access and utilise the data and tools. This ensures that the services are not only powerful but also accessible to a broad audience.
- Scalability and replicability of the integrated services, designed to be scalable and adaptable to different city sizes, climates and urban forms. This flexibility ensures that the tools can be implemented across various European cities, making them widely applicable.

6.1.2. Lean Canvas

PROBLEMS

- Lack of knowledge about the city's building stock energy performance
- Difficulty in evaluating energy efficiency measures in buildings (also to encourage citizens of its benefits)
- Lack of information about the solar PV potential of the city's building stock rooftops
- Limitations on availability of conventional meteorological networks data
- Building energy simulations often do not incorporate the effect of urban heat in cities as climate context
- lack of available user-friendly tools providing analysis with useful and talkative reports and visualisations
- Difficulties in analysing flood damage without advanced computer skills
- Lack of incorporating climate change scenarios and blue-green infra. measures in existing urban flood vulnerability analysis
- Lack of comprehensive urban climate change mitigation strategies for cities.

EXISTING ALTERNATIVES

- Urban Weather Generator
- Meteoblue Urban Heat Map

SOLUTIONS

- Map & detailed information about the residential building stock energy demand
- Function to evaluate different scenarios with the application of different strategies for energy efficiency in a residential building
- Map & detailed information about the solar PV potential of the building stock rooftops
- Climate-resilience and adaptation information & guidance about urban flood vulnerability
- Tool for informed decision-making including different climate change and measures implementation scenarios

KEY METRICS

- Number of weather files downloaded
- Number of reports generated
- User satisfaction
- Registered users

UNIQUE VALUE PROPOSITIONS

- Very user-friendly tool with colours and simple buttons
- Additional explanations for a non-expert (but interested) user
- Maps! and intuitive colours
- Trustable models based on data
- Illustrative, easy-to-understand and illustrative visualisations that can be used to support a variety of reports and strategies
- Different types of visualisations, exportable reports, user-friendly app
- Enhanced assessments for both current and future climate scenarios
- Hotspots identification to prioritize areas of intervention

HIGH LEVEL CONCEPT

- Urban risk assessment at high resolution for the present and future climate scenarios.

UNFAIR ADVANTAGES

- Illustrative, easy-to-understand visualisations that can be used to support a variety of reports and strategies
- Accurate information on urban heat distribution and intensity in cities.
- Possibility of obtaining results for future climate scenarios

CHANNELS

- Social media
- Conferences
- Local authorities
- Third party events

CUSTOMER SEGMENTS

- Municipalities and regions policy- and decision- makers
- City residents
- Urban planners
- Urban infrastructure managers
- Academia
- Consultancy companies

EARLY ADOPTERS

- Academia
- Municipalities

EARLY MAJORITY

- Academia

COST STRUCTURE

- Costs for support and maintenance of the service
- Costs for development of new features
- Costs for the hosting of the services
- Costs for marketing and promotion

REVENUE STREAMS

- Freemium Model (subscriptions)

Figure 14. Lean Canvas: City scale Services

6.1.2.1. Customer segments

The city scale services mainly address municipalities and regional policy makers, as they are key players in urban climate resilience planning. These stakeholders require data-driven tools to analyse energy demand, urban heat impacts and flood risks, making informed decisions on buildings and policy. Urban planners and building managers are also critical users, leveraging these services to design and maintain climate-resilience cities. Consultancy firms play an important role by utilising the tools to provide expert advice to cities, while academia and research institutions use the data for studies that influence urban policy and innovation. City residents, while indirect beneficiaries, can also access these services at a basic user level. They can check the energy performance of their households, options for PV installation, as well as potential heat and flooding risks in their areas, and understand how climate resilience measures may impact their communities. This accessibility empowers residents to make informed decisions about their homes and participate more actively in local climate resilience efforts.

6.1.2.2. Problem

The city-scale services aim to address several critical problems that hinder effective urban climate resilience planning. Municipalities and urban planners often lack detailed knowledge about the energy performance of their building stock, making it difficult to evaluate and implement energy efficiency measures, and to encourage citizens to adopt them. Additionally, information on the solar PV potential of rooftops across the city is often insufficient, limiting the city's ability to harness renewable energy.

Moreover, conventional meteorological data networks are limited and building energy simulations frequently fail to account for the effects of urban heat, leading to incomplete assessments of energy needs and vulnerabilities. Urban flood risks assessments are also challenging due to the lack of user-friendly tools that provide comprehensive visualisations and reports. Without advanced skills, stakeholders struggle to analyse flood damage and incorporate climate change scenarios and blue-green infrastructures into their planning. Finally, cities often lack integrated strategies that combine these aspects into a coherent approach to mitigate and adapt to climate change. These challenges underscore the need for accessible, advanced tools that can provide detailed, actionable insights at the city scale.

6.1.2.3. Unique value proposition

The city-scale services offer a unique value proposition by providing highly accessible, user-friendly tools that simplify complex urban resilience planning for a wide range of users. These services are designed with intuitive interfaces, featuring colour-coded maps and easy-to-navigate buttons, making them approachable for both experts and non-experts alike. They also include additional explanations tailored for users who may not have technical expertise but are still interested in understanding and utilising the data. Moreover, the tools deliver reliable and actionable insights through trustable models based on robust data, ensuring that urban planners and decision-makers can confidently use the information to make informed decisions. The services offer diverse visualisations, including exportable reports and illustrative graphics, which can be easily integrated into strategic documents or presentations. Additionally, the ability to assess both current and future climate scenarios and identify hotspots for prioritising interventions makes these tools essential for creating comprehensive and forward-looking urban climate strategies. In essence, the city-scale services empower cities with the tools they need to navigate the challenges of climate change with clarity and confidence.

6.1.2.4. Solution

The city-scale services offer comprehensive solutions that address key challenges in urban climate resilience and energy planning. For residential building energy performance, the services provide detailed maps and data on current energy demand, allowing urban planners to visualise and assess the energy needs of the city's building stock. Additionally, users can evaluate different scenarios by applying various energy efficiency strategies, enabling informed decision-making to enhance energy performance at the city level. For solar energy, the services include detailed mapping of the solar PV potential of building rooftops, helping cities identify opportunities for renewable energy deployment. Furthermore, the urban flood vulnerability tool offers climate-resilience and adaptation guidance, incorporating various climate change scenarios and the impact of blue-green infrastructure measures. These tools equip municipalities, planners and other urban stakeholders with the necessary information to make informed decisions that enhance the city's resilience to climate change while optimising energy use and building planning.

6.1.2.5. Channels

The city-scale services will reach their target audiences primarily through social media, conferences and collaborations with local authorities. Social media platform will help raise awareness and engage a broad audience, while conferences and third-party events will showcase the services to industry professionals and municipalities. Additionally, partnerships with local authorities will ensure the tools are integrated into urban planning processes, making them accessible and relevant to end users. These combined channels will maximise the visibility and adoption of the services.

6.1.2.6. Revenue streams

The city-scale services will primarily generate revenue through a freemium model. Basic features of the services will be available to users at no cost, allowing broad accessibility and encouraging widespread use. For more advanced functionalities and in-depth analysis, users can opt for premium subscriptions, which will provide enhanced features and more comprehensive data insights. This approach ensures that the services cater to a wide range of users, from city residents and small municipalities to larger institutions and consulting firms, while generating revenue from those who require more specialised capabilities.

6.1.2.7. Cost Structure

The cost structure for the city-scale services includes several key components to ensure their effective operation and growth. Primary costs involve the ongoing support and maintenance of the services, ensuring they remain functional and up to date. Additionally, investment in the development of new features is essential to keep the tools relevant and responsive to user needs. Hosting costs are another significant factor, covering the infrastructure needed to run the services reliably. Lastly, marketing and promotion expenses are crucial for raising awareness and driving user adoption, ensuring that the services reach their target audiences effectively.

6.1.2.8. Key metrics

For the city-scale services, key metrics are crucial for assessing the effectiveness and impact of the tools. These include the number of weather files downloaded and reports generated, which indicate how extensively the tools are utilised for climate and energy analysis. User satisfaction is another critical metric, reflecting the overall experience and effectiveness of the services from the perspective of urban planners, municipalities and other stakeholders. additionally, tracking the number of registered users helps measure the growth and adoption rate of the services.

6.1.2.9. Unfair advantage

The city-scale services possess several key unfair advantages that set them apart from competitors. Their ability to provide highly illustrative and easy to understand visualisations stands-out, enabling users to generate clear, actionable reports and strategies with minimal technical expertise. Additionally, the services offer precise information on urban heat distribution and intensity, crucial for addressing heat-related challenges in cities. The tools also feature advanced capabilities for evaluating future climate scenarios, giving users valuable insights into long-term climate impacts and allowing for proactive planning and adaptation. These unique features collectively provide a significant edge by enhancing usability, accuracy, and foresight in urban climate resilience efforts.

6.1.3. Exploitation Roadmap

Table 36. Platform: Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Develop and test the city scale services implementing SE3, SE4 and SE5 functionalities in the respective pilots. Engage with key urban stakeholders through workshops and pilot programmes to demonstrate the tools' effectiveness. Ensure that each service is tested rigorously, refined based on stakeholder input and delivered through intuitive and user-friendly platforms.
After 2 years	Analyse the expansion of the deployment of the city scale services to additional cities and regions, leveraging successful pilot projects to build credibility and attract new users. Enhance the tools based on user feedback, study the possibility to incorporate additional features and functionalities, such as broader data integration and advanced analytics. Focus on generating and publicising case studies that highlight the benefits and effectiveness of the tools in various urban contexts. Strengthen partnerships with municipalities and consulting firms to support broader adoption and use of the services.
After 5 years	Evaluate the achievement of widespread adoption of the city scale services across Europe by capitalising on the established user base and expanding the tools' reach. Continue to innovate and update the services, integrating emerging technologies and addressing new urban challenges. Maintain and deepen relationships with key stakeholders, including local governments and academic institutions, to ensure the services remain relevant and cutting-edge. Pursue opportunities for collaboration with research organisations and other projects to further enhance the tools and solidify their position as leading solutions in urban climate resilience.

6.2. Platform

6.2.1. Description

The Platform serves as a central pillar in collaborative efforts to enhance urban resilience through advanced data-driven tools. It is specifically designed to integrate EO data, primarily from the European Copernicus program and EGNSS, to provide precise monitoring and actionable insights for urban planners, policymakers, and other stakeholders involved in climate resilience and sustainable urban development. The platform enables the synthesis of complex geospatial data into formats that are easily accessible and usable by non-experts, allowing for informed decision-making on energy efficiency, urban infrastructure, and climate adaptation strategies.

At its core, the platform consists of a three-layered architecture: an Identity Management Layer to ensure secure access control for various user groups, a Storage Layer that offers scalable and secure data storage for large and complex datasets, and an Integration Layer that enables seamless connections between internal services and external systems. These layers ensure that the platform operates with high scalability, resilience, and availability, leveraging cloud-native technologies. The platform is built on microservices within a Kubernetes cluster, ensuring that it can efficiently handle the increasing demands for real-time geospatial data processing and provide reliable services across different urban environments. The key value of the platform lies in its ability to support a wide range of applications, from geospatial analytics to urban planning, by utilizing high-resolution satellite data for precise climate and infrastructure assessments. The platform helps urban planners and policymakers develop more sustainable urban environments by enabling them to evaluate the energy performance of buildings, assess climate risks, and make data-driven decisions regarding infrastructure improvements and retrofitting strategies. Moreover, the platform fosters a collaborative approach by bringing together diverse stakeholders—municipal authorities, urban planners, consultants, academia, and private sector entities—into a unified ecosystem. This collaborative framework ensures that the tools developed are tailored to the specific needs of end-users, while also promoting the co-creation of innovative solutions that address local and regional climate challenges. The platform's open architecture and user-friendly design democratise access to complex data, encouraging broader participation in urban resilience initiatives and enabling a more inclusive approach to tackling urban climate vulnerabilities.

In summary, the BUILDSPACE platform is an essential component of the joint exploitation strategy, offering advanced tools and capabilities that transform how cities plan and manage climate resilience. By integrating cutting-edge satellite data, promoting stakeholder collaboration, and delivering actionable insights, the platform plays a crucial role in building sustainable, energy-efficient, and climate-resilient urban environment.

6.2.2. Lean Canvas

<table>
<tr>
<td rowspan="2">PROBLEMS
• Data Fragmentation dispersed in different platforms
• Lack of infrastructure for storage and processing at end users' side
• Inability to control the data ownership
• Additional integration work to consume Copernicus and DestinE data
• Complexity of keeping unified access to heterogeneous data (varying data formats and APIs)
• Low trust and motivation in data sharing
• Difficulties in sustaining and utilizing large amounts of data over time</td>
<td>SOLUTIONS
• 3-tier architecture (data collection, storage, discovery)
• Enable user authentication/authorization & flexible data sharing
• Client libraries to facilitate API integration
• Secure and scalable data storage</td>
<td rowspan="2">UNIQUE VALUE PROPOSITIONS
• Real-Time Resilience Profiling provides updates for emergency readiness.
• Custom Retrofitting delivers specific climate resilience.
• Unified access to heterogeneous data (Copernicus, EGNSS) through a common API
• Cloud native architecture/Open-source solution
• Enable added value services
• Risk Tool merges climate data with urban insights.</td>
<td rowspan="2">UNFAIR ADVANTAGES
• Exclusive Data Use integrates EGNSS and Copernicus for precise monitoring.
• Stakeholder Engagement involves unique co-creation with local governments
• Innovative Solutions use novel materials and digital twin technology.</td>
<td rowspan="2">CUSTOMER SEGMENTS
• Building stakeholders/ Data owners
• Local/Regional authorities
• Developers and SMEs
• Urban planners
• Researchers
• Citizens
• Civil protection

EARLY ADOPTERS
• Pilot users
• Project partners/service providers</td>
</tr>
<tr>
<td>KEY METRICS
• Support of Data Diversity
• User satisfaction
• Copernicus Data Diversity</td>
</tr>
<tr>
<td>EXISTING ALTERNATIVES
• Standard urban tools lack climate adaptation
• Generic climate approaches overlook specific building requirements.
• Traditional methods ignore advanced sustainability practices.</td>
<td>HIGH LEVEL CONCEPT
• A cloud-native open-source platform providing unified access to different Copernicus services and to EGNSS data, tailored to support climate resilience in urban scenarios</td>
<td>CHANNELS
• Stakeholder engagement activities
• Direct (free) sales to business and government agencies
• Promotional activities
• Partnerships with industry associations and academic institutions</td>
<td>EARLY MAJORITY
• Network of partners in R&D project
• Customer network in Greece (including public authorities and private sector)</td>
</tr>
<tr>
<td colspan="2">COST STRUCTURE
• Hosting and Maintenance
• Customisation
• Customer support and training
• Promotion</td>
<td colspan="3">REVENUE STREAMS
• Freemium
• On-demand model
• Platform as a Service/
• Data-driven business model</td>
</tr>
</table>

Figure 16. Lean Canvas: Platform

6.2.2.1. Customer segments

The BUILDSPACE platform targets a broad range of customer segments, all of whom play critical roles in urban development and resilience efforts. The primary users include building stakeholders and data owners, such as real estate developers and facility managers, who require precise data for improving the energy efficiency and sustainability of buildings. Local and regional authorities are key users as they need reliable data for climate resilience planning and emergency preparedness. The platform also serves developers and SMEs who are looking for innovative solutions to integrate into their products and services. Other important customer segments include urban planners, researchers working on sustainability and climate issues, citizens seeking information about their urban environment, and civil protection agencies responsible for emergency readiness.

6.2.2.2. Problem

The BUILDSPACE platform addresses several critical challenges in urban planning and climate resilience efforts. One of the major issues is data fragmentation, where essential geospatial and climate data are scattered across various platforms, making it difficult for users to access, integrate, and apply them efficiently. Furthermore, many end users, particularly municipal authorities, local governments, and SMEs, lack the necessary infrastructure for data storage and processing, which impedes their ability to manage the large volumes of data required for detailed analysis. Another significant challenge is the inability to control data ownership, which raises concerns about privacy, data security, and user trust, ultimately discouraging data sharing. Additionally, there is a high complexity in integrating data from sources like Copernicus and DestinE due to varying formats, APIs, and standards, requiring additional development work. Maintaining unified access to heterogeneous data is a resource-intensive task, which further complicates large-scale urban planning and sustainability initiatives. Lastly, low trust in data sharing and difficulties in sustaining large amounts of data over time present ongoing barriers to effective collaboration and long-term data utilization.

6.2.2.3. Unique value proposition

The BUILDSPACE platform distinguishes itself with several unique value propositions tailored to enhance urban climate resilience and sustainability. It offers Real-Time Resilience Profiling, providing real-time updates and insights that support emergency preparedness and response in urban settings. Additionally, the platform's Custom Retrofitting tools deliver highly specific and tailored recommendations for enhancing a city's climate resilience based on geospatial data. The platform’s strength lies in its ability to provide unified access to heterogeneous data sources, including Copernicus and EGNSS, through a common API, streamlining the process for urban planners and decision-makers. With its cloud-native, open-source architecture, the platform is flexible and scalable, capable of supporting a wide range of added-value services. Furthermore, the platform's Risk Tool combines climate data with urban insights, allowing planners to assess and mitigate potential risks, making it a crucial asset for long-term resilience planning.

6.2.2.4. Solution

The BUILDSPACE platform provides a comprehensive solution through its three-tier architecture, which includes data collection, storage, and discovery functionalities. The platform facilitates user authentication and authorization systems, allowing flexible and secure data-sharing mechanisms while ensuring data privacy and control. To reduce the complexity of API integration, the platform offers client libraries that simplify the process of integrating data from Copernicus, DestinE, and other sources.

Moreover, the platform delivers secure and scalable cloud-native data storage, ensuring that users can efficiently store, manage, and retrieve vast datasets without the need for significant upfront infrastructure investments. These solutions enable seamless collaboration among various stakeholders and promote a unified approach to urban resilience and climate adaptation.

6.2.2.5. Channels

The platform will reach its target audience through a combination of stakeholder engagement activities, including workshops, seminars, and collaboration with industry partners. Direct sales to business and government agencies, offered in a freemium model, will allow for broad adoption across different financial capacities. Promotional activities such as webinars, industry conferences, and targeted marketing campaigns will raise awareness about the platform's capabilities. Additionally, partnerships with academic institutions and industry associations will help embed the platform in both professional and educational contexts.

6.2.2.6. Revenue streams

The BUILDSPACE platform will adopt a freemium model, offering basic services for free while charging for premium features. An on-demand model will provide users with additional services, such as customized data reports or tailored insights. The platform will also generate revenue through a Platform as a Service (PaaS) model, enabling businesses and governments to integrate the platform's tools into their existing systems. Lastly, a data-driven business model will allow users to purchase specific datasets or analytics, creating a flexible revenue stream based on user needs.

6.2.2.7. Cost Structure

The BUILDSPACE platform's cost structure includes several key areas of investment. Hosting and maintenance of the platform are critical to ensuring its continued availability and performance, while customization services will cater to the specific needs of users across different regions and sectors. The platform will also provide customer support and training to ensure that users can maximize the value of the platform's tools and features. Promotional activities will form a significant part of the cost structure, ensuring that the platform reaches its intended market and gains widespread adoption.

6.2.2.8. Key metrics

The BUILDSPACE platform's success will be measured by several key performance indicators. Support of data diversity will be a primary metric, ensuring that the platform can handle various types of geospatial and climate data. User satisfaction is another critical measure, as the platform's value depends heavily on its ease of use and ability to meet the needs of its diverse user base. Additionally, Copernicus data diversity will be tracked to ensure that the platform integrates a wide range of EO data types, enhancing the quality of insights and decisions.

6.2.2.9. Unfair advantage

The platform's exclusive data use integrates EGNSS and Copernicus data, allowing for highly precise monitoring of urban environments, which provides unparalleled accuracy in urban planning and resilience-building efforts. Additionally, the platform fosters unique stakeholder engagement through co-creation processes with local governments and urban planners, ensuring that the platform is tailored to meet the specific needs of its users. Lastly, the platform incorporates innovative solutions, including the use of novel materials and digital twin technology, enabling cities to create highly accurate and interactive models for urban planning and sustainability projects.

6.2.3. Exploitation Roadmap

Table 37. Platform: Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Develop and pilot urban planning tools, establish partnerships, engage with stakeholders through workshops, and initiate marketing campaigns.
After 2 years	Expand tool deployment to additional cities, support case studies for marketing, enhance tool features based on user feedback, and increase market penetration.
After 5 years	Secure widespread adoption, continually innovate tools, and establish as a leader in urban sustainability.

6.3. Building Scale Services

6.3.1. Description

Both SE1 and SE2 focus on the digitalization transformation at the building scale. The Digital Twin generation (SE1) aims to reconstruct the geometry of the digital twins of buildings from locally sourced geometry data and will build the associated interfaces for human-information interaction between users and Digital Twins in mixed reality environments. The service will integrate methods to detect and classify building elements and convert it into a high-compatibility format digital model. The result of the digital twin will be exhibited in the XR (extended reality) support interface to enable the users to experience the building asset through the virtual environment. The Digital Twin Enrichment (SE2) has as its main objective to provide additional information to the platform at the scale of the building. This information will be based on RGB and thermal images using UAVs for the external envelope and SLAM-based point clouds for the internal envelope. The final objective of the provided information will be the identification and analysis of areas with thermal alterations in the building envelope (critical areas and envelope quality) and the supervision and detection of malfunctioning cells in rooftop solar installations; both processes will be carried out using artificial intelligence. This makes it possible to prioritise the areas of a building that need intervention, in addition to having greater knowledge about the quality of the envelopes in buildings to be rehabilitated. For newly constructed buildings, it allows to observe the differences with the proposed design and evaluate the errors made in the construction of the thermal envelope.

6.3.2. Lean Canvas

<table>
<tr>
<td rowspan="2"><u>PROBLEMS</u>
Lack of digital model of the existing assets
There is no accurate geometric information for the building asset
Lack of RGB, XYZ and thermal information integration solution
Lack of a thermal data collection protocol for drones in buildings
Lack of knowledge about the condition of the thermal envelope of buildings
Lack of knowledge when making decisions on prioritisation of areas/buildings for intervention
Lack of a 3D building thermal visualisation tool (models)
The data collected from the various resources cannot be integrated efficiently
<u>EXISTING ALTERNATIVES</u>
Manually input some of the data for digital twin generation
Manually measure the geometric information
collect the data again for the better data quality</td>
<td><u>SOLUTIONS</u>
The service provides the intelligent point cloud processing method for the semantic segmentation
The services provides the integration method to process the drone images and LiDAR point cloud
The service provides the method for the automatic digital twin generation with spatial relationship
Detection of areas to intervene or critical areas in the envelope
3D viewer with critical area detection (3D model)
Optimisation of the drone flight protocol</td>
<td><u>UNIQUE VALUE PROPOSITIONS</u>
User-friendly application/viewer with intuitive colours
Detailed information on critical areas to better understand them
Reliable thermal and RGB information of the building envelope status for personal and commercial use
Provide the accurate geometric information
Provide the automatic solution for the point cloud processing
Visualise the digital asset in the virtual reality environment</td>
<td><u>UNFAIR ADVANTAGES</u>
Methodology for the reconstruction of a 3D thermal and RGB model
Methodology for the ML-based PC processing method</td>
<td rowspan="2"><u>CUSTOMER SEGMENTS</u>
Municipalities and regions policy- and decision- makers
City residents
Building/houses owners
Companies in the rehabilitation sector
Research groups
Urban planners
<u>EARLY ADOPTERS</u>
Building asset owner
<u>EARLY MAJORITY</u>
End users of the building
City residence
Research groups</td>
</tr>
<tr>
<td><u>KEY METRICS</u>
User satisfaction
Comparison between the generated digital twin with the ground truth data
Accuracy of results
Speed of delivery of programme results</td>
<td><u>HIGH LEVEL CONCEPT</u>
AI support for the detection of critical building areas.
Machine learning based point cloud processing and 3D visualisation</td>
<td><u>CHANNELS</u>
Social media dissemination
Congresses / Conferences / Informative talks</td>
</tr>
<tr>
<td colspan="3"><u>COST STRUCTURE</u>
Hosting and Maintenance
Support and training
Promotion</td>
<td colspan="3"><u>REVENUE STREAMS</u>
Platform as a Service / Data-driven business model</td>
</tr>
</table>

Figure 17. Lean Canvas: Building Scale Services

6.3.2.1. Customer segments

Building-scale services are primarily aimed at municipal and regional policy makers, who play a key role in urban rehabilitation and energy efficiency in buildings. These stakeholders require data-driven tools to assess infrastructure conditions, implement sustainable regulations, and make informed decisions about rehabilitation projects. Building and house owners are also a crucial segment, as they seek to enhance the value of their properties through modernization and regulatory compliance solutions. Companies in the rehabilitation sector and consultancy firms utilize these services to optimize their projects and provide expert advice on urban rehabilitation matters. Research groups and urban planners rely on these services to integrate innovative and sustainable approaches into building design and planning. Finally, city residents, as indirect beneficiaries, can access these services to understand how rehabilitation measures impact their homes and communities, empowering them to make informed decisions and actively participate in local urban renewal efforts.

6.3.2.2. Problem

Building-scale services aim to tackle several key challenges that hinder effective decision-making and building rehabilitation efforts. The existing conditions of existing buildings are scanned through drones, airborne laser scanner or TLS equipment. The efficiency of point cloud data processing relies on the data collection method, data quality and the geometric characteristics of the buildings. In the BUILDSPACE project, there are four pilot projects are being tested. The various of the data collection method, and the different building architectural styles are the main challenges for the Digital Twin Generation – SE1. Another major issue is the lack of a thermal data collection protocol for drones, which makes it difficult to obtain consistent and accurate thermal readings of building envelopes. Furthermore, there is a lack of knowledge about the condition of the thermal envelope of buildings, which is crucial for understanding energy loss and efficiency. This gap in information makes it difficult for stakeholders to prioritize areas or buildings for intervention based on their thermal performance.

Additionally, there is no 3D building thermal visualization tool available, limiting the ability to create accurate models that integrate thermal data. For many buildings, there is a lack of a digital model of existing assets and accurate geometric information needed for effective rehabilitation planning. Finally, there is no integrated solution that combines RGB, XYZ, and thermal information, creating barriers to comprehensive building assessments. These problems highlight the need for advanced, integrated tools and protocols to improve building energy efficiency and facilitate informed decision-making.

6.3.2.3. Unique value proposition

Building-scale services provide a unique value proposition by offering user-friendly applications and viewers with intuitive colour schemes, making complex building assessments accessible to a wide range of users. These tools offer detailed information on critical areas of the building envelope, helping both personal and commercial users better understand potential issues. By delivering reliable thermal and RGB data on the condition of building envelopes, users gain actionable insights to enhance energy efficiency and maintenance planning.

Additionally, the services provide accurate geometric information, ensuring precise modelling of existing assets, which is crucial for rehabilitation and modernization projects. The automatic solution for point

cloud processing further simplifies the workflow, making it easier for users to process large datasets without extensive manual effort. These features make the services not only practical but also empowering, allowing customers to make informed, data-driven decisions about their buildings with ease and confidence.

6.3.2.4. Solution

The building-scale services offer comprehensive solutions that directly address key problems in building rehabilitation and assessment. The service provides an intelligent point cloud processing method for semantic segmentation, enabling precise categorization of building components. It also offers an integration method to process drone images and LiDAR point clouds, ensuring seamless data fusion from multiple sources for more accurate assessments. Additionally, the service facilitates the automatic generation of digital twins with spatial relationships, creating a detailed digital replica of the building for enhanced analysis and planning.

For thermal envelope assessments, the service allows for the detection of critical areas or areas that require intervention, ensuring that problem spots are easily identified. It includes a 3D viewer with critical area detection, giving users a visual, interactive tool to understand the thermal performance of the building. Finally, the service optimizes the drone flight protocol, ensuring that data collection is efficient and reliable. These solutions streamline the process of building assessment and rehabilitation, allowing users to make informed, data-driven decisions.

6.3.2.5. Channels

The building-scale services will reach their target customers primarily through social media dissemination and participation in congresses, conferences, and informative talks. Social media will be used to engage a broad audience, raising awareness about the services and their benefits to both personal and commercial users. Additionally, attending and presenting at industry conferences and congresses will showcase the services to key stakeholders, such as urban planners, building owners, and companies in the rehabilitation sector. These events provide a platform for networking and sharing the advantages of the services with decision-makers and professionals, ensuring their visibility and adoption.

6.3.2.6. Revenue streams

The algorithm for digital twin generation will be public as the open-sourced tool for the further development from the public developer. The platform for the digital twin visualisation could be generate revenue through a Platform as Service (PaaS) model, enabling business, government and building assets owner to further develop the service against with their specific requirements.

6.3.2.7. Cost Structure

The cost structure for the building-scale services includes several key elements necessary for effective operation and growth. Ongoing expenses include hosting and maintenance to ensure the platform remains functional and secure. Additionally, costs for support and training are essential to assist users and help them make the most of the services. Marketing and promotional expenses are also important, as they drive awareness and attract users through various channels. These combined costs ensure the services are reliable, well-supported, and effectively promoted to reach and engage the target audience.

6.3.2.8. Key metrics

For building-scale services, key metrics are essential for evaluating performance and success. Important indicators include user satisfaction, which reflects how well the services meet the needs and expectations

of users. Another critical metric is the comparison between the generated digital twin and the ground truth data, which assesses the accuracy and reliability of the digital models. Additionally, accuracy of results and speed of delivery of program outcomes are vital for ensuring that users receive precise and timely information. Monitoring these metrics helps gauge the effectiveness, efficiency, and user experience of the services, ensuring they meet their intended goals and drive continual improvement.

6.3.2.9. Unfair advantage

The building-scale services have several distinct advantages that provide a competitive edge. The methodology for reconstructing 3D thermal and RGB models offers a unique capability to create detailed and accurate visual representations of building envelopes. This advanced approach enables users to obtain a comprehensive understanding of thermal performance and structural conditions. Additionally, the machine learning-based point cloud processing method stands out by providing a sophisticated technique for handling and analysing complex data, enhancing the precision and efficiency of building assessments. These specialized methodologies offer significant advantages by delivering superior accuracy, detailed insights, and innovative solutions that set the services apart from competitors.

6.3.3. Exploitation Roadmap

Table 38. Building Scale: Exploitation Activities Plan

Exploitation Activities Plan	
During the project	Develop methods for geometric digital twin construction and anomaly detection using thermal and RGB images. Create a workflow to convert point cloud models into IFC-format digital twins and integrate VR/AR tools for visualization. Set up alert systems for detecting anomalies and establish baselines for normal conditions.
After 2 years	Launch a market-ready software product with advanced features, including real-time collaboration tools and improved interfaces. Enhance thermal and RGB imaging systems, integrate additional sensors, and develop predictive analytics using machine learning. Create advanced user interfaces, automate reporting, and begin marketing and sales efforts.
After 5 years	Integrate the software with industry tools like BIM and facility management systems and support advanced applications such as predictive maintenance and urban planning. Achieve full automation of the system, scale it to cover more areas, and use AI for continuous improvement. Promote widespread adoption, invest in R&D to stay ahead in technology, and expand the system's capabilities.

7. Conclusion

In this deliverable, a comprehensive update on the business and exploitation plans for the BUILDSPACE project has been provided, with a focus on KERs and the strategic pathways for their successful commercialisation and long-term sustainability. It has been outlined how BUILDSPACE's innovative services, which span both building and city scales, are designed to respond to the demands of an evolving market. The integration of Copernicus and EGNSS services has enhanced the precision, usability, and scalability of these solutions. These services are expected to provide significant value to a broad range of stakeholders, including urban planners, construction companies, real estate developers, local authorities, and facility managers. By combining satellite data, DT models, and climate scenarios, BUILDSPACE is contributing to a crucial advancement in urban management and sustainable development.

Individual KERs have been strategically developed with distinct value propositions and market approaches. Each KER is supported by an exploitation roadmap, which includes detailed plans for stakeholder engagement, technology validation, and market entry. These roadmaps are expected to ensure that BUILDSPACE results are both technically robust and aligned with market trends and regulatory frameworks, thereby increasing their potential for successful deployment beyond the project's duration.

Significant emphasis has been placed on the exploitation framework, outlining a phased approach towards market readiness. The planning, development, and validation phases are intended to systematically transition BUILDSPACE results from project outputs to fully marketable services. Potential risks, including technological, market, and partnership risks, have been thoroughly assessed in this deliverable. Mitigation strategies have been proposed to ensure smooth execution of the exploitation plans. Furthermore, IP management, particularly regarding the use of open-source technologies and proprietary developments, has been given careful consideration. This attention to risk management and IP protection is deemed essential in establishing a firm foundation for the BUILDSPACE outcomes to succeed in the competitive market landscape. Additionally, joint exploitation schemes have been introduced to facilitate collaborative efforts between project partners, ensuring that shared resources and expertise are effectively leveraged to maximise the project's impact.

In conclusion, it has been confirmed that BUILDSPACE is on a clear path to delivering high-impact, sustainable, and market-ready solutions. Through the detailed exploitation strategies and joint initiatives, BUILDSPACE is expected to contribute to meeting immediate market needs while positioning itself as a leader in the future of urban planning and management. The project's focus on stakeholder collaboration, robust technical development, and strategic market alignment ensures that its innovative solutions will offer lasting value, supporting the transformation of European cities into more energy-efficient and climate-resilient environments.

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9. Annexes

Annex 1. BUILDSPACE BG knowledge identification

(Abbreviations for the table: "ASSET TYPES= Knowledge: K; Tool: T ; Software: S ; Algorithm: A; Product: P "; "TYPE OF PROTECTION = Proprietary: P")

#	Relevant Background	Contributing Partner	BG number	Asset Type	Category	Short Description of BG	Type of Protection	Conditions to use within the project	Conditions to use outside the project	Interest in further exploitation through the project results
1	Methodology for building stock characterization	CARTIF	BG1	K	Script and model	Knowledge on the **characterisation of building stock** at city level, on city level modelling, and on geometrical analysis based on cadastral knowledge and the INSPIRE directive	Proprietary	The methodology is applied by CARTIF to deliver SE3	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
2	Methodology for map-based energy demand estimation	CARTIF	BG2	K	Script and model	Knowledge for **estimation of energy demand and representation** in a map with the characterised building stock	Proprietary	The methodology is applied by CARTIF to deliver SE3	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
3	Methodology for modelling future climate scenarios	CARTIF	BG3	K	Script and model	Knowledge for **modelling future climate change scenarios**, including Copernicus EO data analysis, and general processing and downscaling of climate models	Proprietary	The methodology is applied by CARTIF to deliver SE3	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
4	Digital map-based tool design and development	CARTIF	BG4	T(& design)	Tool	User-friendly **map-based web-tool development**, from general ICT knowledge and experience in the development of conceptual platform architectures, ICT services development and implementation	Proprietary	The tool design and development is applied by CARTIF to deliver SE3	The designs and source code of this specific component is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
5	Cloud based map platform technology (Nazka Mapframe)	NAZKA	BG5	S	Library	Software library developed by NAZKA that accelerates the **development of map based applications**	Proprietary	The library is used by NAZKA to deliver SE5	The source code of this specific component is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
6	Cloud based map platforms UX & UI	NAZKA	BG6	K	Methodology	UI/UX methodology for the **design of user friendly map-based applications**	Proprietary	The methodology is used by NAZKA to support BUILDSPACE service providers in	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes

								building user friendly applications		
7	Data analysis/storage	NAZKA	BG7	K	Architecture	Knowledge on the **deployment** of map-based applications.	Proprietary	The architecture is used by NAZKA for the hosting of SE5.	The designs and source code of this service is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
8	3D point cloud and mesh reconstruction	UPM	BG8	K	Methodology	Knowledge on **3D point cloud and mesh reconstruction**	Proprietary	The methodology is used by UPM for the development of SE2	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
9	Point Cloud Segmentation (SEG4D)	UPM	BG9	K	Methodology	Methodology for **Point Cloud Segmentation** gained through experience in the specific field.	Proprietary	The methodology is used by UPM for the development of SE2	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
10	Calibration mesh	UPM	BG10	P	Object	Product for the **calibration of mesh.**	Proprietary	The methodology is used by UPM for the development of SE2	The methodology is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
11	Meteorological time series morphing	UPM	BG11	K	Script	Script for the processing of the **meteorological time series**	CC BY-NC-ND 4.0	The script is used by UPM for the development of SE4	The script is open MIT licensed and it can be used freely by referencing the authors	Yes
12	Urban Heat hyperlocal mapping	UPM	BG12	K	Tool	Tool for the **mapping of urban heat** at spatial resolutions	CC BY-NC-ND 4.0	The tool is used by UPM for the development of SE4	The tool is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
13	Vulnerability spatial analyses	UPM	BG13	K	Tool	Tool for the analysis of **vulnerability to heat** at spatial resolutions	CC BY-NC-ND 4.0	The tool is used by UPM for the development of SE4	The tool is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
14	Identification of Urban Heat Risk areas	UPM	BG14	K	Tool	Tool that facilitate the identification of hotspots with **high urban heat risk**	CC BY-NC-ND 4.0	The tool is used by UPM for the development of SE4	The tool is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
15	Urban Weather Files	UPM	BG15	K	Tool	Knowledge on how to use urban weather files for the heat analysis	CC BY-NC-ND 4.0	The tool is used by UPM for the development of SE4	The tool is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes
16	Training image dataset	UOC and The University of Hong Kong	BG16	K	Training Dataset	Tool for the training of the algorithms with buildings images dataset	Open source license	The tool is used by UOC for the development of SE1	The dataset is open sourced can be used beyond the end of the project.	
17	Digital Twin generation	UOC	BG17	A	Methodology	Algorithms for the **generation of digital twin** of buildings	Proprietary	The algorithms are used by UOC for the development of SE1	The script is proprietary and its exploitation beyond the end of the project should be discussed among interested partners.	Yes

Annex 2. BUILDSPACE FG knowledge identification

(Abbreviations for the table: "ASSET TYPES= Knowledge: K ; Tool: T ; Software: S ; Algorithm: A; Product: P "; "TYPE OF PROTECTION= Proprietary: P")

WP	#	Project Result (PR) – Service (SE)	Specific Project Result	Main Partner(s)	Contributing Partner(s)	Related BG number	Short Description of FG	FG number	Asset Type	Category	Potential IP protection	Conditions to use within the project	Interest in further commercialisation	Conditions to use after the end of the project
3	3.1	PR1- SE 1	Methodology to support SE 1	UOC	-	BG16, BG17	**Point Cloud processing** for construction progress monitoring	FG.3.1.1	A	Methodology	P	Not granted	Yes	To be discussed among the partners
3	3.1	PR1- SE 1	Methodology to support SE 1	UOC	-	BG16, BG17	Generated IFC model	FG.3.1.2	Model	Model	P	Not granted	Yes	To be discussed among the partners
3	3.1	PR1- SE 1	Methodology to support SE 1	UOC	-	BG16, BG17	Integrated Digital Twin generation Algorithm	FG.3.1.3	A	Methodology	P	Not granted	Yes	To be discussed among the partners
3	3.1	PR1- SE 1	Methodology to support SE 1	UOC	-	-	SE1 documentations	FG.3.1.4	K	Document	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Methodology to support SE 1	UPM	-	BG8, BG10	**Calibration mesh**	FG.3.2.1	P	Object	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Model to support SE 2	UPM	-	BG9	**RGB model**	FG.3.2.2	P	Model	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Model to support SE 2	UPM	-	BG9	**Thermal model applied** for the enrichment of digital twin	FG.3.2.3	P	Model	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Model to support SE 2	UPM	-	BG9	**Detected model (critical areas)** applied for the enrichment of digital twin	FG.3.2.4	P	Model	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Documentation to support SE 2	UPM	-	-	**Manuals** to support data collection and related activities for SE 2	FG.3.2.5	P	Manuals	P	Manuals were made available to all partners to support pilot operations.	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Scripts to support SE 2	UPM	-	-	Script for **image matching** (3DTherm)	FG.3.2.6	S	Tool, script	P	Not granted	Yes	To be discussed among the partners
3	3.2	PR2- SE 2	Scripts to support SE 2	UPM	-	-	Script for **semi-automated detection** (INSPECTOR)	FG.3.2.7	S	Tool, script	P	Not granted	Yes	To be discussed among the partners
3	3.3	PR3- SE 3	Methodology to support SE 3	CARTIF	-	BG1	Refined algorithms and method for the **characterisation of the building stock** and the generation of buildings' **geometries**, as well as	FG.3.3.1	K	Script, model and tool	P	Not granted	Yes	To be discussed among the partners

							for estimating the **energy demand**							
3	3.3	PR3- SE 3	Methodology to support SE 3	CARTIF	-	BG2	Refined algorithms for modelling future climate scenarios	FG.3.3.2	K	Script, model and tool	P	Not granted	Yes	To be discussed among the partners
3	3.3	PR3- SE 3	Methodology to support SE 3	CARTIF	-	BG3	Gained knowledge on analysis for retrofitting strategies applicable to buildings, and relevant KPIs to assess the related gains	FG.3.3.3	K	Script, model and tool	P	Not granted	Yes	To be discussed among the partners
3	3.3	PR3- SE 3	Web tool that delivers SE 3	CARTIF	-	BG4	Development of web-tool map-based including diverse functionalities	FG.3.3.4	K	Tool	P	Not granted	Yes	To be discussed among the partners
3	3.4	PR4- SE 4	Methodology to support SE 4	UPM	-	BG11, BG12, BG13, BG14, BG15	Methodology for exposure spatial analyses	FG.3.4.1	K	Tool	CC BY-NC-ND 4.0	Licensed, Open, Non-Commercial Use	No	Licensed, Open, Non-Commercial Use
3	3.4	PR4- SE 4	Tool that delivers SE 4	UPM	-	-	Decision support tool including adaptation and mitigation strategies	FG.3.4.2	P	Tool	Open source Licence	Not granted	Yes	The software will be available as open source for non commerical use. For commercial use, special arrangements with partners should be made.
3	3.5	PR5- SE 5	Methodology to support SE 5	IMZI	-	-	Blue-green Infrastructure Impact assessment methodology	FG.3.5.1	K	Methodology	P	Granted, Royalty free in the context of the developments for Service 5	Yes	To be discussed among the partners
3	3.5	PR5- SE 5	Design of the tool for SE 5	NAZKA	-	BG5, BG6, BG7	Urban flood resilience tool (functionalities & design)	FG.3.5.2	Product: prototype	Tool & Design	P	Granted, Royalty free in the context of the developments for Service 5	Yes	To be discussed among the partners
3	3.5	PR5- SE 5	Algorithms to support SE 5	IMZI	-		Urban flood resilience algorithms	FG.3.5.3	A	Model	P	Granted, Royalty free in the context of the developments for Service 5	Yes	To be discussed among the partners

3	3.5	PR5- SE 5	Reports and models for SE 5	IMZI	NAZKA	BG5, BG6, BG7	Decision support tools (blue green and flood resilience)	FG.3.5.4	K	Documents, reports, models	P	Granted, Royalty free in the context of the developments for Service 5	Yes	To be discussed among the partners
3	3.6	PR6- SE 6	Software component of the core platform	SLG	-	-	Copernicus API integrating data to be consumed by BUILDSPACE services	FG.3.6.1	S	Software	Open source	Granted, Royalty free in the context of the developments of the core platform	Yes	Plan to be licensed under specific terms to be determined (e.g., MIT, Apache, etc.).
3	3.6	PR6- SE 6	Software component of the core platform	SLG	MOBICS	-	EGNSS Integration of Galileo HAS	FG.3.6.2	S	Software	Open source	Granted, Royalty free in the context of the developments of the core platform	Yes	Plan to be licensed under specific terms to be determined (e.g., MIT, Apache, etc.).
3	3.6	PR6- SE 6	Software component of the core platform	SLG	-	-	Client for the consumption of the Core Platform API	FG.3.6.3	S	Software	Open source	Granted, Royalty free in the context of the developments of the core platform	Yes	Plan to be licensed under specific terms to be determined (e.g., MIT, Apache, etc.).
3	3.6	PR6- SE 6	Software component of the core platform	SLG	-	-	CKAN integration (Backend)	FG.3.6.4	S	Software	Open source	Granted, Royalty free in the context of the developments of the core platform	Yes	Plan to be licensed under specific terms to be determined (e.g., MIT, Apache, etc.).
3	3.6	PR6- SE 6	Methodology for customization	SLG	-	-	Core platform customization, Frontend Developments	FG.3.6.5	K	Methods, Reports, Software	P	Not granted	Yes	To be discussed among the partners

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