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*Research Article*

# Accelerating the Transition to Green Building Neighbourhoods: A New Decision Support Platform

**Henri Sohier[1], Carl Schultz[2*], Yazan Zayed[2], Aliakbar Kamari[2], Luc Jonveaux[3], Kostas Zavitsas[4], Georgia Pantelide[5], Joaquin Trinanes[6], Asier Alejandre[7], Jessica Mberi[8], Cristian Maxim[1]**

[1] IRT SystemX, France
[2*] DIGIT, Aarhus University, Denmark
[3] Mott MacDonald, France
[4] VLTN, Belgium
[5] eBOS Technologies, Cyprus
[6] Universidad de Santiago de Compostela, Spain
[7] ITA INNOVA, Spain
[8] Akkodis, France

* Correspondence: cschultz@ece.au.dk



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## Abstract

Green Building Neighbourhoods (GBNs) foster sustainable, accessible, low-carbon living through shared energy, green mobility, and social cohesion. Steering a neighbourhood towards GBN status faces hurdles in governance, financing, citizen engagement, technological innovation, and accessible tools. Current rapidly evolving digital technologies, such as BIM and Digital Twins, accelerate this transition by offering real-time tracking and visibility, fostering better coordination among stakeholders and facilitating early issue detection. The emerging advanced decision intelligence and digital decisioning platforms incorporate artificial intelligence (AI), analytics, and large datasets. This integration enables automation, optimisation, and the consistent delivery of data-driven decisions across various ecosystems. We report on the development of a novel Decision Support Platform (DSP) within the EU H2020 PROBONO project. The PROBONO DSP is iteratively tested in six "Living Labs" in Madrid, Dublin, Brussels, Aarhus, Porto, and Prague, each at different life-cycle stages and seeking to address themes such as energy, emissions, mobility, and health. Key functionality includes digitalizing social values in BIM, large-scale scenario sampling, thermal-comfort simulation and monitoring, mobility benchmarking, anomaly detection, and energy-investment comparison. Deployment in the Living Labs has enhanced information sharing, ideation, and stakeholder discussion through concise overviews and tailored recommendations. Modular integration has enabled emergent features.

**Keywords:** Decision support system (DSS); Decision support platform (DSP); Sustainable decision-making support; Green building neighbourhood (GBN).

## Highlights

- Web-based system architecture is presented that divides internal DSP system "modules" into three layers, separating functionality into: activity planning, technical data overviews, and data computation.
- Discovery of novel functionality, and barriers to technology have been lowered, through free association and information sharing about Living Labs needs between module developers, and an aim of innovation replication between Living Labs

# 1 Introduction

In alignment with the European Green Deal, Green Building Neighbourhoods (GBNs) refer to a scale that encompasses a set of buildings, smaller than district level, and that fosters and promotes localised sustainable, environmentally friendly patterns and behaviours in a mutually beneficial way across, and between, those buildings, e.g. barrier-free accessibility, green mobility, shared energy infrastructure, socially cohesive communities etc. Although GBNs are the essential "building blocks" of Positive Energy Districts, it is a major challenge to trigger and drive the development of a neighbourhood towards GBN status. Factors include governance, policies and regulations, citizen engagement, financing, and the adoption, installation and operation of appropriate technological innovations, and the need for easily accessible tools that support stakeholders in making effective decisions related to Architecture, Engineering, Construction, and Operation (AECO) of buildings.

Our research focuses on this last factor of supporting effective decision making. Two major research questions that we address are:

- RQ1. How can effective decision support tools be developed to accommodate the diversity of stakeholders, specifically: (1) citizens eager to understand local initiatives and voice opinions; (2) neighbourhood orchestrators (including project managers, urbanists, public servants and building managers); (3) engineers and technicians charged with specialized analyses.
- RQ2. What development process should be undertaken, and what form should such decision support tools take, from a systems architecture perspective, to accommodate a diversity of tool developers, and to ensure flexibility, ease of access, and rapid application to different contexts?

In response to RQ1 and RQ2 we report on a novel GBN Decision Support Platform (DSP) developed within the large EU H2020 research project, PROBONO,[1] that aims to support a wide range of stakeholders with bespoke needs, roles, agendas, and backgrounds in making positive, informed decisions that kickstart and accelerate the transition to GBNs. Key contributions are:

- C1: Exploring the evolution of DSPs within the AECO sector over the last two decades, aiming to identify the principal drivers, major technological advancements, and the corresponding impacts and benefits as the backbone for the development of a novel DSP aligned with the objectives outlined in the present article.
- C2: Establishing an overall framework for the development of large, bespoke DSPs with interdisciplinary, geographically distributed development teams and stakeholders, with a report on four key "lessons learnt" (findings) so far.

To the best of our knowledge, this is Europe's first, and largest, decision support platform for Green Building Neighbourhoods. It is unique in the size, scale, and heterogeneity of the Living Labs through which it is being simultaneously developed and evaluated (ensuring tight alignment with societal and industry needs), and in the extremely interdisciplinary consortium: highly diverse experts and actual stakeholders are being brought together in the development of our DSP. The resulting findings with respect to "lessons learnt" on tackling requirements (as captured in RQ1, RQ2 above) and the outcomes of system architecture approaches are therefore highly novel.

# 2 Advancements in Decision Support Platforms (DSPs) in AECO

Over the past two decades, the utilisation of advanced decision support systems (DSSs) (Shim et al. 2002) and performance-based simulation and assessment systems has significantly contributed to the advancements in buildings and neighbourhoods. Decision-making concepts (Kamari, 2023) such as sustainability (including countless aspects associated with its three classic bottom lines of

[1] https://www.probonoh2020.eu/

environment, economy, and society), energy-efficient, high-performance, and low-carbon design and construction are increasingly employed to denote the intent to incorporate contemporary simulation and analytical tools (Lam 2020), alongside decision-support frameworks, within the AEC industry.

With the emergence of novel rapidly-evolving digital technologies such as BIM and Digital Twins (Jahangir et al., 2024) as well as a focus on extending the potential functionality of the DSSs into the next phase when a building is in use/operation, new decision support frameworks are intended to improve building projects further by offering real-time tracking and visibility, fostering better coordination among stakeholders, and facilitating early issue detection (AEC Associates, 2025). Likewise, the new technology is advanced to reduce material waste and costs, enhance worker safety, ensure alignment with BIM standards and concepts, such as IFC, IDS, BCF, bSDD, UCF, etc. (buildingSMART, 2025), and overall, by acting as a live virtual replica of the physical construction, this technology enables continuous monitoring and immediate, data-driven decisions to keep the project on schedule (Attaran & Celik, 2023).

The AECO industry faces growing complexity in decision-making due to the addition of various lifecycle stages (design, construction, operation, renovation, and demolition) and the diverse needs of stakeholders (architects, engineers, contractors, owners, etc.). New decision-making platforms (DSPs) now offer advanced computing techniques and digital solutions to address these challenges (Marcher et al., 2020). Novel multi-stakeholder decision platforms (MSDPs) (United Nations Development Programme, 2012) for buildings are developed as collaborative frameworks that unite developers, architects, engineers, community members, and government officials to make joint decisions on building projects. By facilitating dialogue and fostering understanding, these platforms address complex issues and enable consensus-building among diverse interests (Hovardas, 2021), resulting in more inclusive and effective decisions for sustainable building design, retrofitting (D'Agostino et al., 2025), and urban development.

The development of new DSPs has been accelerated with the emergence of the set of Construction 4.0 technologies (Statsenko, 2023), including the internet and mobile technologies, resulting in web-based, collaborative, and executive systems. Currently, these platforms have advanced into Decision Intelligence Platforms and Digital Decisioning Platforms (Huang, 2025), which incorporate artificial intelligence (AI), analytics, and large datasets. This integration enables automation, optimisation, and the consistent delivery of data-driven decisions across various ecosystems.

DSPs in the AECO industry are emerging to handle the industry's increasing complexity, data volume, and the need for sustainability. These platforms leverage digital tools, AI, and simulations to support stakeholders in evaluating alternatives based on criteria such as cost, energy efficiency, and environmental impact, moving beyond traditional reliance on experience towards more informed, transparent, and integrated decision-making processes. In summary, the primary catalysts for the emergence of DSPs include four major key driving forces (according to Marcher et al., 2020; Hu et al., 2024; Too et al., 2025; USP Marketing Consultancy, 2023): (1) Increased Project Complexity, which necessitates more sophisticated analytical frameworks; (2) Digital Transformation, which facilitates the implementation of innovative technologies; (3) Sustainability Demands, reflecting the industry's urgent need to address environmental concerns; and (4) a Shift in Stakeholder Influence, whereby diverse participants in the decision-making landscape assert their perspectives and priorities. These factors collectively underscore the imperative for DSPs in the AECO sector to evolve and adapt to contemporary challenges. Meanwhile, moving from building to neighbourhood, neighbourhood-scale digital twin concepts (Hemetsberger, 2020) and systems (Alpay, 2025; Michielsen, 2024) are growing as an interactive online model of a local area that uses real-world data to simulate community operations and infrastructure. The new technologies are developed to aid urban planning, resident engagement, low-carbon energy transition (Pye et al., 2019), and sustainability efforts through tools like virtual town halls and planning feedback systems.

The development and application of DSPs have various benefits and impacts. DSPs can significantly enhance decision quality by delivering structured analysis and comprehensive information, enabling decision-makers to make more accurate and informed choices (Sivasubramanian & Lee, 2022). Furthermore, these platforms promote enhanced transparency and collaboration among various project stakeholders through shared data and integrated analyses, which improves communication and understanding during the decision-making process (Stanitsa et al., 2022). Additionally, the automation of systematic evaluation processes contributes to increased efficiency, allowing for quicker and more effective decision-making throughout the project lifecycle (Marcher et al., 2021). Finally, these platforms encourage the adoption of sustainable practices by facilitating the identification and selection of sustainable products and processes, as they provide clearer visibility into lifecycle costs and environmental impacts (Too et al., 2025).

# 3 Methodology

Through the PROBONO project we are collaborating with a large, highly interdisciplinary consortium (47 partners, 14 countries) that gathers non-digital solution providers (e.g., for solar panels, redox flow batteries, green construction processes, biogenic building products, collaborative social engagement tools, etc.) together with digital solution providers. Our DSP is one of the many outputs of PROBONO, which is being iteratively developed and evaluated in an agile way, directly in-situ through six active pilot neighbourhoods referred to as “Living Labs” (LL) located in Madrid, Dublin, Brussels, Aarhus, Porto and Prague (Table 1). The six LLs contain infrastructure of differing nature and in diverse lifecycle phases, e.g. a district with important demolitions in Madrid, an operating school in Brussels, a university campus under renovation in Aarhus, and an industrial site shared by several organizations in Porto. Furthermore, the LLs are interested in different matters, from energy to emissions, mobility to health. These matters have been formalized in standards such as ISO 37101.

*Table 1: Living Labs in the PROBONO project and the corresponding actions to be facilitated by the DSP.*

| Living Lab and Vision | Actions requiring digital tooling |
|---|---|
| **Dublin (Dún Laoghaire):** Transforming a cluster of key municipal buildings into a sustainable, zero-carbon GBN. | Digitalise social intentions of preserving a “sense of heritage” while enhancing “thermal comfort” using BIM standard objects. Displaying results of geodesign modelling exercise in GIS and 3D format and integration of open data procedures. |
| **Madrid:** Developing four distinct areas (Chamartin Station, Chamartin Business District, Malmea-San Roque-Tres Olivos, and Las Tablas Oeste) into interconnected GBNs. | Identify hotspots, implement mitigation strategies; anticipate particle propagation due to construction work; time series derived from climate projections; logistical plan of material supplier sourcing for District Cooling Heating System. |
| **Porto (Sonae Campus):** Establishing a sustainable campus that exceeds its energy consumption through renewable sources. | Overview energy production and consumption; overview CO2 emissions. |
| **Brussels (Auderghem Commune):** Renovating the De l’Autre Côté de l’Ecole (ACE) school building to create a sustainable, energy-positive, zero-emission facility. | Improve mobility directly around the school where traffic can be dangerous; identify anomalies in energy consumption; explore renovation design options for the building roof. |
| **Aarhus (University Campus):** Supporting the university's Campus 2.0 renovation program to minimize environmental impact and promote social qualities. | Improve the thermal comfort and air quality of a building under renovation; compare the carbon footprints of very different renovation scenarios; Digitalise social intentions using BIM standard objects. |
| **Prague (University Campus):** Enhancing the Czech Technical University campus to achieve at least nearly Zero Energy Building (nZEB) standards, with the potential for energy-positive performance. | Evaluate thermal comfort considering factors such as solar panels and green roofs. |

The fragmented demand from the LLs, combined with the multi-partner structure of the project, led to the development of different modules within the DSP. The DSP development process, in close collaboration with LLs, is illustrated in Figure 1. Each module is developed by a dedicated "module leader", who is responsible for its specification, architecture, and testing in collaboration with a "partnered" LL who acts as a client stakeholder. Specification and solution development involves input from all relevant stakeholders with continual validation in tight feedback loops. Progress and lessons learned are presented internally within the DSP development team during regular bi-weekly meetings which triggers ideation and the discovery, exploration, and trialling of new DSP services for various LLs.

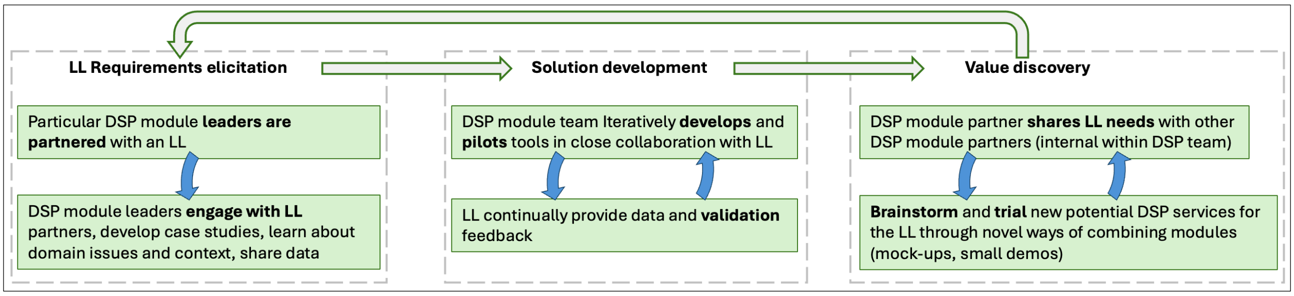



*Figure 1:System engineering process applied for DSP development in tight collaboration with Living Lab (LL) stakeholders.*

## 4 The PROBONO Decision Support Platform (DSP) System

Our DSP is being developed as a modular, cloud-based system as part of a larger GBN Digital Twin platform (GBN-DT). A web-based human-machine interface serves as an entry point. Figure 2 illustrates the high-level architecture of the DSP in relation to other systems. Tooling is organized on three layers: (i) a decision-workflow manager with smart recommendations, (ii) visualization dashboards for technical data and (iii) a solution catalogue that hosts simulation and artificial-intelligence services.

The Common Data Space is a central hub for data management and analysis within the GBN-DT platform. It deploys storage solutions: a data lake, InfluxDB for time-series data and Hadoop Distributed File System (HDFS) for file storage with semantic enrichment capabilities via ontologies in a Dynamic District Infrastructure Management (DDIM) server; and security mechanisms, including end-to-end encryption and token-based authentication using Keycloak. It utilises Intelligent Monitoring Control (IMC) connectors developed to support custom solutions for APIs, secure file transfers, and BIM models; and an orchestration engine that manages data workflows and automates ingestion processes of complex data streams with robustness features to ensuring reliable operation.

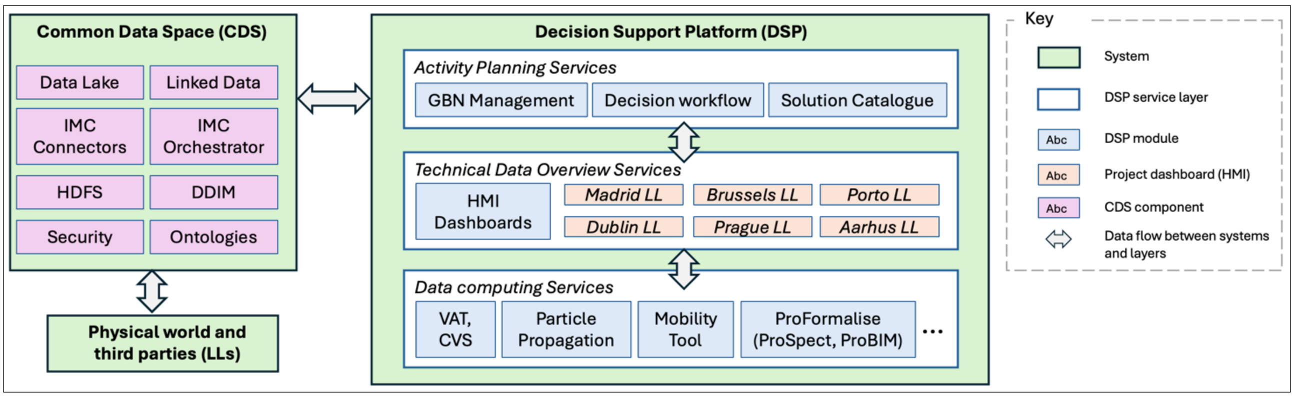


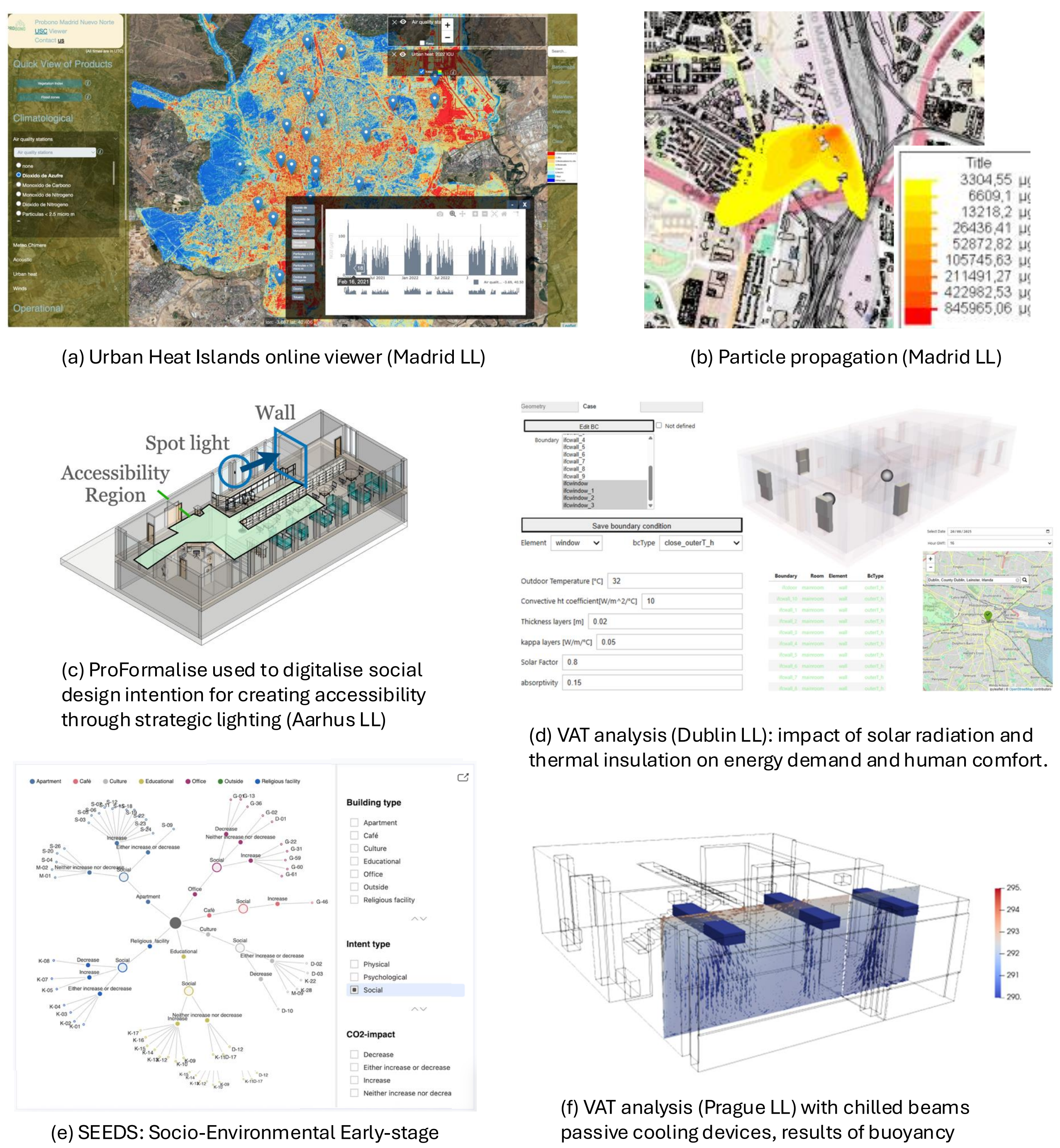

*Figure 2: High-level system architecture of the Decision Support Platform, with three services layers, and the interaction with the common data space and physical buildings, sensor data, and third parties (including Living Labs).*

## 4.1 Module and Development

Due to the diverse needs of the Living Labs and the contributions from multiple independent partners, the DSP is not a single, monolithic application, it does not rely on a single code repository, and modules are implemented in a variety of different languages (C++, Python, Prolog, Javascript, etc.). Although many modules are web-based, the DSP is not *purely* web-based; functionality is also provided in the form of command-line applications and plugins for desktop applications. Figure 3 presents screenshots of a selection of modules, and Table 2 describes the current set of 13 modules in the DSP.

*Table 2: List of developed modules in the DSP.*

| Module | Functionality |
|---|---|
| Human-Machine Interface (HMI) | Serves as the primary interface for users to interact with and make informed decisions based on the GBN system's complex datasets and tools. Includes real-time data visualisation (sensor measurements, environmental indicators, building performance metrics) and a *solution catalogue* of tools related to energy efficiency, sustainability, and occupant comfort. |
| ProFormalise (Zayed et al., 2025) | Tool suite for eliciting and modelling human-centred social design intentions in a building (e.g. privacy, accessibility, wayfinding) and integrating them natively into BIM models ("ProBIM") for querying, visualisation and verification. |
| SEEDS (Kristoffersen et al., 2025) | Socio-Environmental Early-stage Decision Support; a tool designed to help building design stakeholders identify and evaluate the environmental impact of socially oriented design intents. |
| NovaDM (Schultz & Kamari, 2025) | Establishes a formal Renovation Domain Model with renovation design space exploration utilities, enabling designers to define their renovation scenario options and then explore the vast design space of renovation scenarios. |
| Decision workflow | Allows users to define a strategic vision, challenges, and offers tailored solutions with smart recommendations based on LLM technology (Jonveaux, 2025) about suitable stakeholders, tools and resources that best align with the user's needs, supporting a workflow-driven approach to addressing project challenges and optimizing decision-making. |
| Ventilation Assessment Tool (VAT) | Computation Fluid Dynamics (CFD)-based simulation tool for predicting ventilation, air quality, and comfort trajectories within buildings. Helps to ensure adequate comfort while minimizing energy consumption. Automatically generates meshes and numerical setups from user-defined CAD files and boundary conditions; generates reports with 3D results and a summary of key results: temperatures, velocities, air quality indices. |
| Comfort Virtual Sensor (CVS) | Visualization of 3D real-time thermal comfort predictions on buildings under operation by using reduced order model techniques and a limited number of physical sensors. |
| Mobility data visualization and analysis | High-level assessment and visualisations of neighbourhood transport system performance (traffic, safety, emissions) based on cluster analysis of neighbourhood data. Uses standardised city data framework (in ISO37101) to identify parameters beyond transport infrastructure that might have an indirect effect on transport performance. |
| Construction material resourcing optimization | Optimises supplier sourcing for implementing construction projects (location, cost, emissions), used at the procurement phase. Input includes LCA data, national standardised sourcing options (emissions for producing and transporting material units), user defined supplier sources that reflect real-word options. |
| Anomaly detection | Machine learning-based analysis and monitoring of energy performance parameters (power consumption, power factor, current balance across phases, individual phase data), automatically detects anomalies such as phase unbalances and drops in efficiency. |
| Prediction of particle propagation | Simulates dispersion of contaminants from demolitions and incorporates it into a visual decision-making tool, enabling demolition technicians to plan operations in urban areas more effectively, minimizing environmental and health risks by considering real-time weather conditions and population density. |
| Energy Class Simulation | Machine learning-based classifier that predicts the energy class of a building based on input parameters such as dwelling area, window area, year of construction, and so on. |
| Urban Heat Islands | Analyses and visualises surface temperatures of urban environments. High-resolution maps (10m) show the spatial variability of temperatures, allowing users to track temperature variability over time at different temporal intervals, identify temperature patterns, and identify hotspots that guide material selection for construction and urban design. |




(a) Urban Heat Islands online viewer (Madrid LL)

(b) Particle propagation (Madrid LL)

(c) ProFormalise used to digitalise social design intention for creating accessibility through strategic lighting (Aarhus LL)

(d) VAT analysis (Dublin LL): impact of solar radiation and thermal insulation on energy demand and human comfort.

(e) SEEDS: Socio-Environmental Early-stage Decision Support (Aarhus LL)

(f) VAT analysis (Prague LL) with chilled beams passive cooling devices, results of buoyancy driven air paths and temperature

*Figure 3: Screenshots of visualisations from various modules in the DSP.*

## 4.2 Module and Development

The modules of the DSP are grouped into three types of services, represented as layers. All layers are dependent on directly communicating to the Common Data Space (CDS) to retrieve data while the "Data Computing" layer can also receive module execution requests from the other two layers and update the information available in the CDS.

- **"Data Computing" Layer:** includes modules that run simulations and models. These computational modules are at the core of the DSP and focus on specific problems (e.g. thermal comfort, particle propagation, human-centred social design intentions) in specific areas, such as aspects of a Living

Lab. These modules typically require specific representations of buildings or neighbourhoods, have specific in-depth data requirements, and require expert users. Their aim is not to deal with high-level decisions, nor to consolidate information, but rather to quantify specific metrics. Such simulations and models are designed in a robust way to enable applicability to baseline and GBN-level scenarios. Their output is stored in the Common Data Space, for further use.

- **"Technical Data Overview" Layer:** provides users with an overview of technical data in a Living Lab, including measurements (e.g. electricity consumption and production) and simulation results (e.g. predicted temperatures, costs). It may also include post-processed data, such as KPIs or threshold checks. While this layer is less problem-specific, it generally still requires customized development for each Living Lab, as the data varies greatly between them. This layer also accommodates the requirements that arise for the DSP Human Machine Interface, which acts as a dashboard that addresses specific interface needs the LLs have requested. Such needs might range from generic requests such as the visualisation of measurements to more specialised ones that emerge after the application of a series of the "Data Computing" layer models.
- **"Activity Planning" Layer:** supports users in problem scoping, defining needs, exploring new Living Lab activities, and identifying effective technical modules and tools. Functionality is adjustable to the user type: (a) to provide non-technical users with a high-level overview that enables assessment and visualisation of performance, and identification of pathways towards GBN status, and (b) to enable technical users to easily understand and access the capabilities of the "Data Computing" layer. The methodological approach and data structure of the ISO37101 is adopted and complemented by high-level Machine Learning based data analytic modules in the Decision Workflow (Jonveaux, 2024).

# 5 Key Findings

Application of our DSP in the six Living Labs has, thus far, demonstrated improved information sharing, ideation and discussion by offering concise overviews and smart recommendations. In some important cases, the flexible integration of modules and data led to the emergence of new functionalities.

***Finding 1*. Web-based architecture and distributed development partners:** The DSP's modular, web-based architecture has significantly eased co-development by partners distributed across Europe. The careful management of access to functionality and data (for both human users and "plug-in" system modules) has been essential: (1) certain services can be accessed by anyone (e.g., for large scale citizen engagement), others are only for registered stakeholders with certain roles (e.g., launching new activities in a neighbourhood, or starting computationally expensive simulations); (2) all modules have access to the Common Data Space that manages data storage and authentication. The development of a standardised Open Knowledge Graph was found to be critical for managing the complexity of linking huge datasets, and unifying concepts, within and between Living Labs, structured following ISO 37101.

***Finding 2*. Value discovery through partner engagement and tool integration:** Many important unforeseen use cases have been discovered during development that emerged from interactions amongst development partners and LL stakeholders. The key triggers for value discovery have been the combination of (a) free association between DSP partners via numerous remote meetings over many months, (b) where each DSP partner is involved in different LLs thereby creating information pathways from LL needs and opportunities into the DSP team, and (c) a project-level agenda of actively pursuing replication of DSP services between LLs. This has stimulated discussions about opportunities for collaboration and an openness from LL stakeholders to explore new experimental use cases.

For example, the Aarhus LL building "Kitchen 2.0" is being renovated from a former hospital into a startup innovation hub, including a former boiler room and sanitation area into a mixed-use conference and work area with an adjoining kitchenette and offices. ProFormalise was used to capture social requirements of thermal comfort, air quality (e.g. restricting kitchen aromas from entering the conference area), and sound comfort. The Decision Workflow tool automatically reads the social requirements from the ProBIM model and identifies simulation tools to assess different renovation scenarios, which included the VAT.

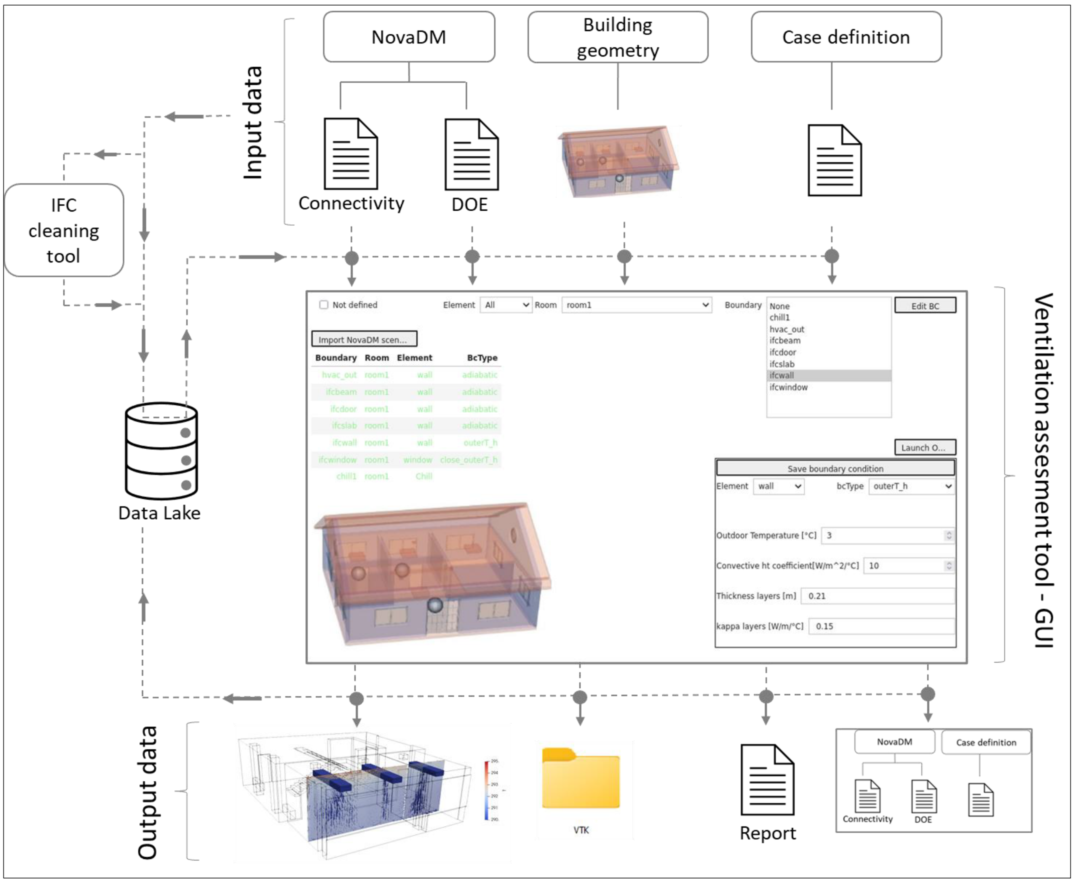



*Figure 4: System diagram showing new integration of VAT and NovaDM based on Decision Workflow scoping.*

NovaDM was used to “program” different candidate HVAC configurations, and used VAT to evaluate alternative renovation scenarios. Other examples include: the Brussel’s LL where a school requires roof renovation which led to the application of NovaDM for "programming” the renovation choices and rapidly exploring the renovation design space (consisting of ~17k candidate scenarios), COWI’s LCA analysis calculations for assessing different renovation scenarios; and the Dublin LL where a heritage status Harbour Master’s Lodge requires renovation to improve thermal comfort and energy efficiency following strict heritage regulations. This led to the integration of ProFormalise for capturing the social requirements of maintaining a sense of heritage and thermal comfort, and VAT for predicting the air quality and ambient temperature through air flow simulations.

***Finding 3.* Lowering governance barriers through replication:** Construction and renovation projects are complex, and stakeholders (e.g. building owners, renovation programme directors) are understandably cautious about committing to implementing unfamiliar innovations and sharing data in a large international network. Demonstrating value in one LL has been a way forward for adoption in other LLs, and the design and implementation process in one LL provides a roadmap as a starting point for adoption in other LLs. For example, Akkodis’s Energy Class Simulator was trialled and demonstrated on case studies in France and together with a DSP partner based in the Aarhus LL, the Akkodis team was able to access required training data for their simulator and is now being integrated with NovaDM tools to enable energy classes to be included as Key Performance Indicators when designing for renovation.

***Finding 4.* Challenges in identifying the right stakeholders and values:** While users are important contributors, identifying them early in the process can be challenging, in particular, in an innovative context where the pool of user is yet to be fully realised. The DSP has such a wide scope that users can also significantly vary. Furthermore, users alone cannot solely be expected to provide a complete specification for innovative software. Users may even resist change due to familiarity with existing workflows. These challenges highlight the importance of involving a broader range of stakeholders to complement user input.

# 6 Conclusions

We have presented the current state of development of a large Decision Support Platform (DSP) within the PROBONO project that addresses diverse needs in six Living Labs across Europe. A major challenge is in effectively managing such a geographically distributed and multi-disciplinary development team and set of stakeholders. The current methodology and web-based system architecture is presented, with internal DSP system "modules" divided into three layers separating functionality into: activity planning, technical data overviews, and data computation. The DSP currently consists of 12 such modules, with each module being developed by a "leader" partner and each module being assigned to a selection of target Living Lab stakeholders who work together closely to ensure alignment of requirements and tools. Owing to information exchange and regular free association between DSP module developers and Living Lab stakeholders, numerous novel functionalities have been identified resulting in the unforeseen integration of various modules. We report on this finding, along with three other findings pertaining to web-based architectures for managing distributed development teams, lowering technology adoption barriers through replication, and requirements engineering challenges.

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**Ethical Approval Declaration**
The study was conducted in accordance with established standards for research integrity and ethics.

**Data Availability Statement**
Data can be made available upon reasonable request to the corresponding author.

**Conflicts of Interest**
The authors declare no conflict of interest. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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