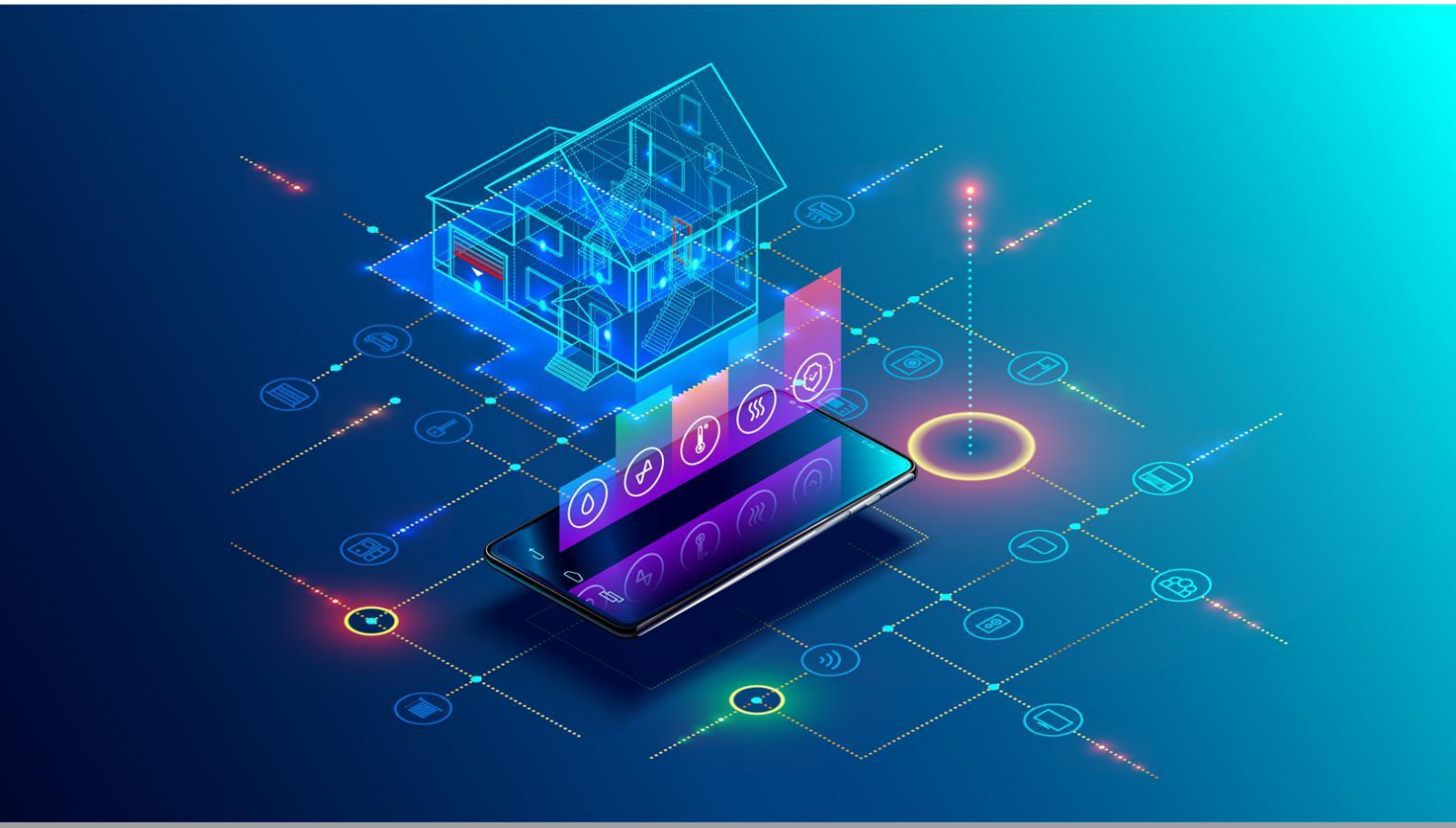
BIM SPEED

Evaluation and Recommendations of BIM data security, privacy, social and ethical aspects

Deliverable Report D6.4



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BIM-SPEED

Harmonised Building Information Speedway for Energy-Efficient Renovation

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Publishable executive summary

This document contains the Privacy Impact Assessment of BIM-SPEED together with embedded social and ethical considerations. The data collected, shared, and processed by BIM-SPEED is assessed in terms of privacy and the potential risks within this process. Even though this report briefly mentions and discusses some deliverables of the project, its focus is on the impact the developed tools have on stakeholders.

For more information on how the data is managed in these deliverables, please refer to the Data Management Plan (deliverable 10.3). Throughout the BIM-SPEED project, data is collected via the use of technologies, tracking several data points within buildings to facilitate efficient renovation practices. In this privacy impact assessment, potential privacy risks are assessed on a per-tool basis, providing a short explanation of the tools as well as their associated risks. In order to minimize these risks, documentation of the mitigation of the risks is presented. Furthermore, social perspectives, especially those related to citizens as collateral data subjects are presented. This deliverable can be used by other projects and corporations making use of the BIM-SPEED tools or working in the sector who are looking to understand the potential privacy and socio-ethical implications of these.

List of acronyms and abbreviations

DoA: Description of Action

BIM: Building Information Model

Cap/OpEx: Capital / Operational Expenditure

EeB: Energy-efficient Building

EPBD: Energy Performance Buildings Directive

ESCO: Energy Services Company

GDPR: General Data Protection Regulation

GIS: Geospatial Information System

HVAC: Heating Ventilation Air Conditioning

IEQ: Indoor Environment Quality

IPR: Intellectual Property Right

KPI: Key Performance Indicator

LCA: Life Cycle Analysis

LCC: Life Cycle Costing

MEP: Mechanical Electrical Plumbing

nZEB: Nearly Zero-Energy Buildings

PnP: Plug and Play

R&D: Research and Development

RES: Renewable Energy Source

RoI: Return on Investment

SME: Small and Medium-size Enterprise

TCP: Technology Commercialisation Platform

TRL: Technology Readiness Level

VR/AR: Virtual / Augmented Reality

OS: Operational System

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1. Data, Processing, and Social Considerations

1.1 Introduction

The BIM-SPEED project developed an integrated BIM platform based on a pre-existing platform - KROQI - to facilitate the efficient renovation of the existing building stock. As the foundation of the project calls for the employment of technologies to track several data points (e.g., thermal, and acoustic data of residences), the impacts on stakeholders' privacy should be acknowledged and assessed as well as social issues stemming from these practices acknowledged. The BIM-SPEED project is guided by several principles of Privacy-by-design as is implemented throughout the development of the project. First, it is proactive instead of reactive in that it does not wait or expect for data breaches to happen to implement mitigation techniques (later explored in this report). Second, privacy preserving techniques are implemented from the design phase. In other words, from the design of the tools, privacy considerations have been made and measures taken to ensure the privacy-centric development. Third, full lifecycle privacy assurance is embedded into the project from development to decommission, data is protected, and mitigation techniques accounted for. Fourth, the transparency of steps taken to ensure privacy and data protection are guaranteed (as detailed in this document). Lastly, we implement privacy considerations from the user perspective rather than from the design perspective, thus ensuring a user-centric privacy-by-design solution. This document is structured with the basis of a Data Protection Impact Assessment (DPIA) made necessary with the introduction of the GDPR.

1.2 Data Collection, Sharing and Data Processing

The data collected by each deliverable and work can be found in the Data Management Plan (deliverable 10.3). For detailed information on how the project's data is collected, shared, and processed please refer to deliverable 10.30. Nonetheless, summarised information is presented below to offer context for the assessment of the developed tools' privacy impact.

Specification of personal data:

- Involved responsible parties: all parties involved in the BIM-SPEED consortium.
- Fasada (FAS) as the coordinator of the demonstration sites is responsible for ensuring the mitigating measures proposed in this document are implemented. Erasmus University Rotterdam (ERA) as Data Security Manager is responsible for ensuring the correct evaluation of the measures taken.
- Categories of data subject differ according to the tools used. For instance, while data collection may be focused on the thermal or acoustic permeability of a building, heat signatures or noise may be captured as a byproduct. Thus, residents ought to be considered in this impact assessment.
- Erasmus University Rotterdam (ERA), as Data Protection Officer & Privacy Manager of BIM-SPEED, is responsible for reporting and assessing potential data breaches to the Supervisory Authority – The supervisor authority is the Data Protection Authority of the country in which the breach took

place. In case of uncertainty regarding the place of the breach, the Dutch Data Protection Authority shall be the one ERA reports to – Authoriteit Persoonsgegevens (https://autoriteitpersoonsgegevens.nl)

1.3 Authorisation for data usage

The collection and use of the [personal] data are necessary for the legitimate interests and purpose of the consortium. It is necessary to collect the represented data for the consortium and its partners to perform tasks that may result in a more efficient renovation of the existing building stock, therefore reducing costs to operators whilst improving the living conditions of residents - and thus accomplish the objectives set out for the project.

1.4 Involvement of evaluation or scoring methods

If technologies are implemented with the purpose of scoring data subjects (e.g., monitoring performance), these need to be assessed in detail in a privacy impact assessment. However, the activities carried out by the BIM-SPEED consortium do not involve the evaluation or scoring of data subjects.

1.5 Involvement of automatic decision-making

There are no automatic decision-making activities (i.e., when technologies make decisions without human interference) with respect to data subjects taking place within BIM-SPEED. Therefore no authorisation for automatic decision-making is requested.

1.6 Systematic Monitoring of a Publicly Accessible Area

BIM-SPEED tracks the conditions (e.g., humidity, temperature, CO2 levels) inside the residents' homes as well as the building's facade. There is no active monitoring of publicly accessible areas.

1.7 Sensitive Data

Although BIM-SPEED does not track individuals directly, there is some data collected about the indoor condition of their homes that could be regarded as sensitive information. As an example, while gathering temperature using infrared technologies, individuals' body temperature may be inadvertently collected. Accordingly, residents' personal data, such as heat data, though may be collected as a byproduct, are not saved, nor subject to subsequent analysis. Furthermore, while monitoring a household's energy consumption may be possible to infer the habits from its residents (e.g., when they are home, the divisions of the house they are in). However, this data is disregarded and only purposeful data (i.e., data collected for the specific purpose of the tool such as building data) is used for analysis. Residents may feel uncomfortable with having these data collected. Nonetheless, with the anonymisation of the collected data and by not saving data connected to body heat it is possible to mitigate these potential risks. All these considerations are communicated to residents to ensure transparency between the project and residents.

The documents stored in the BIM-SPEED platform can be word, excel documents holding personal information (phone numbers, e-mails, budget). This information is kept secure by access logs, and authentication requirements. Additionally, IFC documents may hold the name of the architect, location of the building, amongst other sensitive data.

1.8 Socio-Ethical Aspects and Considerations

While data is collected for the purpose of digitalising building and construction processes, people are subject to having their data collected as a by-product. With these practices, residents become collateral data subjects. Assuring an ethical approach to this data collection, residents are willing and voluntary participants consenting to data being collected from their houses for the purposes of the project and being aware of their potential risks as data subjects. Their personal information is anonymised, and the partners who deal directly with them maintain these data confidential.

1.9 Data Deletion Policy

Some categories of data are deleted five years after the end of the project. Open access data, such as, for example, weather data, even though deleted may still be accessible through other sources. The Data Protection Officer (ERA) ensures this policy is carried out in coordination with TUB and DEMO. More detailed information on this, please refer to the Data Management Plan (deliverable 10.3).

1.10 Data processing on a large scale

In respect to the data processing from demonstration sites, BIM-SPEED is currently monitoring residential dwellings of which 5 flats on the Dutch Demonstration site use ComfortEye technology (as stated in the Data Management Plan). Collected data, as expressed above, pertains to the dwellings' humidity levels, temperature, and electric consumption. Some dwellings are collecting CO2 data to check for ventilation routines in those dwellings in which humidity problems were detected prior to the start of retrofitting.
The tools developed by partners in the consortium also process data on a large scale as detailed in the next chapter.

1.11 Vulnerable Individuals

In the context of the GDPR, the project does not collect data from vulnerable individuals. Although there may be vulnerable individuals living in the monitored dwellings, BIM-SPEED did not and will not receive any information about them.

1.12 Prevention of individuals from exercising a right, using a service, or fulfilling a contract

BIM-SPEED's data collected and processed does not prevent any individual from exercising their rights, using any services, or fulfilling any contract. The data collected, as mentioned, pertains to the geometric data of the demonstration site, as well as data from sensors placed throughout residences. Even though these sensors may collect sensitive information, as discussed in section 1.7, this will not prevent the residents from exercising their rights, using any services, or fulfilling a contract.

2. Tool explanations and associated risks

In this section the tools developed by the BIM-SPEED project are introduced and the potential privacy risks associated identified and evaluated. In the following section actions implemented by the project to mitigate these risks are discussed and an assessment of the risk likelihood and impact are presented.

2.1.1 3DASH tool (CARTIF)

The 3DASH tool automatically detects and creates BIM entities from 3D point clouds acquired by laser scanning or photogrammetry systems. The tool supports the creation of As-Built models using point clouds as data for the generation of BIM models using REVIT software. This specifically tailored plug-in for REVIT is programmed in C++ and supported by the Point Cloud Library (PLC) as a standalone, large-scale, open software project for image and point cloud processing. 3DASH can precisely display the detected features in a unique working project (RVT/RFA). The PCL has a wide range of statistical algorithmic to detect geometrical primitives such as planes, cylinders, spheres, or cones. The tool reduces time in both the generation of As-Built models and comparing them to previous existing models, or the generation of these models without previous documentation. Additionally, the tool gives a high accuracy through a mathematical process based on algorithms for the detection and generation of walls using point clouds.

Risks

- Through the usage of laser scans, data on the residences is acquired, which can give an overview of the layout of living spaces, such as where walls are positioned, of (future) residents

2.1.2 Acoustic soft sensor (UNIVPM)

The tool is an innovative soft-sensing system for buildings' acoustic comfort measurement that uses a simulation-based approach and/or measured data. It allows for assessing the acoustic comfort before building envelope renovation interventions and its improvement due to potential renovation scenarios.

Risks

This tool is related to the Comfort Eye, to which the same risks apply (see '3.1.14 Comfort Eye').

2.1.3 Application for crowdsourcing inhabitants' input (DEMO)

This app (available as a free downloadable mobile app) collects data on existing Buildings from inhabitants through a questionnaire that. The app makes it possible to collect building data that is personal or subjective, such as experienced comfort level, from building inhabitants. Furthermore, the crowdsourcing approach allows to collect building data about the building conditions without the effort of inspectors, and without having to enter private homes to do an inventory. This tool makes it possible to relate collected building data to spaces in a BIM model, which allows new kinds of analysis. The collection of subjective inhabitant perception data is greatly simplified. The data collection process can be parallelized and thereby reduces time and effort significantly. New kinds of analysis through BIM 3D mappings allow for computer automation, and thus, potentially better insights with less effort.

Risks

- Personal data is collected, which includes added risks in terms of data collection, retention and protection.
- Accessibility: as multiple people can access this information it is hard to keep control over who can and should not access the data collected through this app.

2.1.4 BACN2BIM (CARTIF)

The BACN2BIM tool allows users to collect information from sensors (dynamic data) installed in buildings and download this data from the BIM-Speed platform. The tool allows inserting information about the Building Automation Control network into BIM models through IFC. Users do not need to connect to other external IoT platforms to download the required data. Instead, they can download dynamic data from the building directly from the BIM-SPEED platform. All the information relative to dynamic data about the behaviour of the building is also available to be used by users in other tools such as Building Energy Performance Simulation. The tool provides the addition of relevant information about the monitoring system installed on the building in the .ifc file.

Risks

- Interoperability: different kinds of data need to integrate with each other, and everyone can add tools to this, the control over the data can be lost.
- Responsibility: who is responsible for the personal data once it is merged is unclear.
- Accessibility: as many users can access the BIMSPEED platform and download the dynamic data directly, control over who is allowed access and who is not can be lost. Although this may be offset by clearly defining user roles within the platform.

2.1.5 BEM Calibration procedure (UNIVPM)

This is a procedure/tool for the calibration of BEM to guarantee an adequate level of accuracy and then to achieve a reliable performance prediction in the renovation design. It includes a plug-in for REVIT which makes easier the generation of the building model using 3D point clouds. The main benefits for the users are the time reduction in BEM calibration, increasing accuracy of the BEM, increasing accuracy of saving calculation of different energy retrofit measures/scenarios, encouraging BEM calibration in the building energy performance simulation

Risks

- Data protection and accessibility: those who have access to the BIM-SPEED platform have access to acoustic, thermal and visual data collected from homes which could result in a complete picture of living situation, socioeconomic status, etc.
- Interoperability: some OS may not support the tool.

2.1.6 BEM Generator (MTB)

The Simple BEM generator is a tool to create a computable BEM without the input of an existing BIM. It is especially useful to conduct initial fast simulations and optimization procedures to create an overview for a project without BIM. As creating a detailed BIM is often a lengthy process, these initial results help to decide

whether a specific project is worth the effort or whether another project might have a greater potential for improvement.

This tool is not part of the standard BIM- to-BEM project process but it is a “bonus tool” that can be used at an early stage. The tool creates a simplified BEM that may be used for an initial analysis. The model is not calibrated according to consumption data. Instead, standardized assumptions of use schedules and consumption are applied. The tool offers a low-barrier entry into BIM and specifically simulation by usability for non-experts with minimal user effort involved. The user of the BEM Generator (simplified) are planners, architects, and building owners.

Risks

- Merged data flow: when different data flows are merged, this can create a more complete picture of what renovations in their early stages look like, thus potentially providing a residence layout and, thus, may represent a privacy risk.

2.1.7 BIM Execution Plan (MOW)

BEP is a plan defining the goals of implementing BIM technology in a project. It describes how the constructed model will be applied and explains the implementation processes and the ways of information exchange. It also contains information on the entire project infrastructure required for a successful BIM implementation. This tool offers clear communication, improved collaboration as well as data and project transparency.

Risks

Unintended confidential information included in deliverable. This is stored on BIM-SPEED’s Sharepoint.

2.1.8 BIM-based Life Cycle Cost and Asset Management (DEMO)

The purpose of life-cycle costing is to quantify the life-cycle cost (LCC) for input into a decision-making or evaluation process and it includes inputs from other evaluations (e.g., environmental assessment, design assessment, safety assessment, functionality assessment, and regulatory compliance assessment). The quantification should be to the level of detail that is required for key project stages. The scope of costs included/excluded from an LCC analysis should be defined and agreed upon with the client at the outset.

Risks

No risks are associated with this tool.

2.1.9 BIM Maturity Tool (PB40)

The BIM maturity tool is an online tool that scans the BIM maturity level of your company through a questionnaire and provides guidance on what should be improved to achieve specific goals in a renovation project, such as reducing energy consumption or increasing the comfort level. The tool is designed for anyone involved in renovation projects that are interested in implementing BIM-based methodologies.

Risks

- Interoperability: control can be lost when different kinds of data are all integrated and aggregated.
- Accessibility: with many people being able to access the data directly and in real-time, control over who has access and who does not can be lost.

2.1.10 BIM-SPEED Library (STRESS)

BIM-SPEED BIM library encompasses the BIM-SPEED database covering several materials and components useful for energy-efficient renovation of buildings. In the library, different building components can be viewed and selected for renovation design. The components can be downloaded in BIM formats. The library collects a set of parameters and files (BIM models, technical sheets, pdf, etc.). The parameters are divided into four packages: the “Info package”, the “Energy package”, the “LCA package” and the “LCC package”. The tool’s impacts are time reduction, carbon footprint reduction, and energy reduction.

Risks

- Authorisation: As this tool operates as a ‘library’, different data flows come together, and data is stored in the same place. Who is authorised to access these different data can be hard to define.
- Combined collected data could make it easier to develop insights about individuals. For example, heat and acoustic signals being used to understand living patterns.

2.1.11 BIM-SPEED Passport (ARC)

The BIM passport gives an opportunity for workflow integration by marking information requirements, checking models, and assessing models. IFC LOD Lifer will be used in connection to the BIM Object Library database if a model assessment is not approved. This tool will offer a view of what data is available in relation to their building. The quality of the data is another aspect that the BIM passport gives an insight on. This tool benefits the users in time reduction due to the way it will not go through all the documents one has to see the quality and quantity. Also, financial, because the owner will invest in data that will be relevant, and not redundant.

Risks

- The passport presents data readily accessible and bundled in one place, which could lead to more insight and potentially more personal data.

2.1.12 BIM-SPEED platform (CSTB)

The BIM-SPEED platform is a platform where all tools are visible, as well as the data collected through them. A company can purchase (some of) these tools and use them for their own projects. At its core, the platform offers collaboration services like users' accounts, tasks, and document management.

Risks

- The platform stores and manages user data and accounts involving information such as name, address, and phone number. These data need a secure management protocol, and the end-user must have control over these data (cf. GDPR). For expansion into jurisdictions outside the EU, compliance with ISO 27001 certification is observed.
- The collaboration platform manages projects' information and resources like documents, chats, comments, tasks, etc. These are personal information that needs to be under the total control of the end-user. It must be possible for him to completely delete any information that he has created or imported into the Cloud platform.
- The platform integrates external services that are accessing user files in the collaboration suite when the users are triggering them. This results in user data being potentially scattered over different partners' cloud infrastructures without the full understanding of the situation by the end user. A centralised feature to delete externally pulled resources in a simple way must be set up (cf. 3rd party Data management service)
- Interoperability: as all different kinds of data need to integrate with each other and everyone can add tools to this, the control over the data can be lost.
- Accessibility: due to the number of people able to access the platform as well as the ability for one account to have multiple users, control over who is and is not allowed access to the data can be lost.
- Function creep (using information for the purpose that it was not initially intended to): as companies can purchase the tools on the platform, this could cause them to have access to, for example, the number of hours employees worked on the platform.

2.1.13 BIMtoBEPS (CARTIF)

This tool addresses the interoperability between BIM models contained in IFC4 files and building energy modelling using TRNSYS 18 as a simulation engine. Specifically, the building energy model is generated according to the data input file (*.b18) structure associated with the TRNSYS Type 56 that can be manually generated using the TRNBuild user interface in a process that tends to be time-consuming and error-prone.
This tool allows the automatization of the BIM to BEM process reducing time in the generation of BEM models.

Risks

This tool is related to the BIM Execution Plan, which is formatted as PDF attachments. There are no foreseeable risks in relation to this tool.

2.1.14 Comfort Eye (UNIVPM)

The “Comfort Eye” is an innovative IEQ monitoring system for assessing building performance. IT communicates in real time and, it provides a measure of thermal comfort (according to ISO7730 and ISO7726), IAQ, visual comfort, and thermal images of the indoor environment. Thermal and acoustic comfort are important quantitative parameters that are linked to the wellness of inhabitants. The knowledge of those levels is important, especially for the inhabitants. Additionally, the identification of rooms with bad thermal comfort can be connected also to the lack of energy saving.

Risks

- Data protection and accessibility: those who have access to BIM-SPEED have access to acoustic, thermal and visual data collected from homes which could result in a complete picture of living situation, socioeconomic status, etc.
- Reinforcing inequality: depending on where the Comfort Eye is implemented, it could make already wealthy homes wealthier, whilst reinforcing thermal inequality.
- Uninformed residents: when the Comfort Eye is already implemented in a house and residents are not aware of it, this could result in an indirect absence of consent in terms of monitoring the house.

2.1.15 CYPETHERM E-plus (CYPE)

CYPETHERM Eplus tool is designed to provide thermal simulations and analysis using a BIM model. It is based on the Energy Plus calculation engine and generates detailed reports on a building's energy performance throughout the year based on the climatic data of its location. Modelling and energy simulation of buildings with EnergyPlus™ is integrated with the Open BIM workflow via IFC. EnergyPlus ™ is a calculation engine developed by the Department of Energy of the United States of America (DOE), is one of the most used, powerful, and recognized energy simulation engines of today. Thanks to its integration in CYPETHERM EPlus the application becomes a powerful tool for the energy simulation of buildings, allowing to know the energy demand, as well as the energy performance of AC systems, energy consumption by system, and energy vector used.

Risks

- General energy levels and energy consumption measured could give insights into living habits and when residents are home or not.

2.1.16 CYPETHERM Improvements (CYPE)

CYPETHERM Improvements is a tool for energy audits and analysis of improvement measures in buildings. This application acts as a complement to CYPETHERM energy simulation programs that use the EnergyPlus™ analysis motor. The initial situation of the building and improvement measures can be imported from files in XML format that are generated by CYPETHERM energy simulation.

Risks

This tool is related to the CYPETHERM E-plus, to which the same risks apply (see 'CYPETHERM E-plus').

- General energy levels and energy consumption measured could give insights into living habits and when residents are home or not.

2.1.17 Dynamo scripts for correctitude of modelling (ARC)

Two Dynamo scripts can be used to examine that all the required equipments are modelled and that all valves are placed in the correct position. By using this tool BIM modelers will save time by not having to conduct manual inspections or use other software to make sure the equipments were modelled in the correct room, and if all the valves have been placed or if they are missing.

Risks

No foreseeable risks with this tool.

2.1.18 ECOtool (CARTIF)

The ECOtool automatizes the calculation of economic indicators related to the occupation and maintenance phases of the building renovation process. The tool is prepared to automatically calculate a set of indicators such as Operational Energy Costs, Investment, Life cycle cost, Return of Investment, Payback Period, and Operational Primary Energy Demand. It uses static data (IFC, energy bills), and dynamic data (energy consumption, energy costs) of the building. It counts on processes and ETLs to automatically obtain the required inputs from heterogeneous data sources. OpenAPIs are used to obtain information from the BIM-SPEED Platform and ThingsBoard IoT Platform within it.

Risks

- The variety of different data streams can create a more complete picture than originally intended.
- Assessing the energy levels of the buildings might lead to more insight or information about residents' income.

2.1.19 GIS Data Provider (TUB/CSTB)

This service supports the collection of surrounding geospatial and environmental data within a specific radius around the demonstration site. It retrieves surrounding data based on the location of the building extracted from the BIM (IFC) of the building. It offers a better understanding of the limitations and opportunities in the construction site prior to the analysis. This tool reduces time and costs. Through this tool users can

extract relevant datasets only by selecting the demonstration site and downloading the relevant datasets. The conventional approach includes searching the required datasets for different stages of the building renovation, going through all available GIS data sources from public and private organizations to retrieve the relevant datasets, and pre-processing the huge datasets of cities to extract data for a specific buffer around the building. Additionally, knowing in advance about the limitations in the construction site helps to design the process with less cost for instance for data collection method selection.

Risks

- The collected information about the building and surrounding area/neighbourhood can result in knowing where the building is located, as well as being able to assess the socioeconomic status of its residents and assess whether it is a 'safe' or 'unsafe' neighbourhood. Nonetheless, only the end-user can manipulate this data which are already taken from public repositories, thus minimising any potential risks.

2.1.20 IFC4Acoustic parser service (CARTIF)

A specific ETL (Extract, Transform and Load), to connect the Acoustic tool to the BIM- SPEED platform. This ETL performs an automatic parse between the BIM model and the Acoustic tool, using an IFC file as input (IFC4: ADD2-TC1 schema version) and generating an output in JSON that will be used by the Acoustic tool and will connect through an API. This tool reduces time and improves the accuracy of the results compared to traditional methods because no user iteration is required to obtain the necessary data.

Risks

No risks are associated with this tool.

2.1.21 KPI Dashboard (MTB)

This tool collects (1.) evaluation preferences considering environmental, social, and economic aspects, (2). Different renovation scenarios (3.) KPI results from preceding tools regarding energy simulation, lighting simulation, acoustic simulation. The user gets a comparative overview of his renovation scenarios according to KPIs results and ranking considering preferences. In the KPI dashboard information and results from the preceding simulation and calculation tools and from the Multicriteria decision-making tool are collected. It will allow the display of different renovation scenarios and by that enable a holistic performance assessment.

Risks

- Interoperability: As the dashboard is operated by different people and different data streams integrate with each other, the control over the data can be lost.
- Accessibility: Due to the number of people having access to the dashboard, control over who is allowed to access which data can be lost or become fuzzy.
- The evaluation preferences in this tool consider environmental, social and economic aspects which could contain sensitive data.

2.1.22 Lighting and visual comfort analysis (UNSTUDIO)

Climate Studio, Revit, Rhino+ Grasshopper: Industry-based energy and comfort tool with LEED, BREAM, WELL certification compatibility, and verification. The added value of Climate studio is the in strong

visuals, user customization, accreditation measurements, extensive artificial light library, speed of simulations, expansion with Grasshopper, and Melanopic readings.

Risks

This tool is related to the Comfort Eye, to which the same risks apply (see 'Comfort Eye').

- General energy levels and energy consumption measured could give insights into living habits and when residents are home or not.

2.1.23 Material service (CSTB)

This service can be applied to an IFC file from the platform. It processes the file, investigates the materials that are named in the IFC file, and adds materials' details required for thermal simulation (thermal conductivity, Mass density, emissivity, etc.) in an augmented IFC file (initial IFC + material details information) generated as output to be used by simulation tools. The Material Service makes simulation condition setups easier.

Risks

No risks are associated with this tool.

2.1.24 MEREEN weather service (CSTB)

This tool facilitates the collection of surrounding built and natural environmental data and the collection of historical actual weather data. The data is retrieved from the closest weather stations to the demonstration sites, or from the IFC file of the building. The ready-to-use information provided is essential for building energy simulations. The collected data can be used for example, for calibration purposes.

Risks

This tool is related to the GIS data provider, to which the same risks apply (see 'GIS data provider').

2.1.25 Multicriteria decision-making tool (TUB)

The multicriteria decision-making methodology and tool assist the selection of a suitable renovation alternative considering the inputs of all involved in the decision-making process. In the tool, you can establish the assessment criteria for all proposed alternatives, collect the preferences from all involved in the decision process regarding all criteria proposed. The result is a ranking showing the alternatives according to their performance in relation to the preferences collected.

It is a structured approach to engage different stakeholders and conduct the decision-making process, to capture the preferences of different stakeholders' groups, and to transparently identify which renovation alternatives are more suitable according to the objectives and preferences of the different stakeholders. Additionally, it is a sustainable approach considering environmental, social, and economic aspects as well as an intuitive and accessible tool based on an excel file that is easy to understand and to work with.

Risks

- Interoperability: As the dashboard is operated by different people and different data streams integrate with each other, the control over the data can be lost.
- Accessibility: Due to the number of people having access to the dashboard, control over who is allowed to access which data can be lost.

- The evaluation preferences in this tool consider environmental, social and economic aspects, which raise ethical concerns to be mitigated.

2.1.26 Naming convention tool (CSTB)

This tool facilitates the implementation of file naming conventions in the project. The tool allows the creation of the rule for a file naming convention for each project. It also checks and warns if the file name does not match the file naming convention rule. It is very simple to use and convenient to synchronize files and manage different versions. The naming convention service makes it possible to assign a naming convention created by end-users to specific folders of their projects. Anytime a file is synchronized with a folder that has a naming convention assigned, the system checks that the synchronized file is properly named. It raises a visual alert sign if the document is insufficiently named. The user can then use the user interface to rename the file according to be applied naming convention. However, this tool does not allow to force a naming convention for synchronized files.

Risks

No risks are associated with this tool.

2.1.27 Open BIM Analytical Model (CYPE)

Open BIM analytical Model is a tool for automatically creating high-precision energy models (BEM) which are calculated in other specific thermal and acoustic analysis and simulation applications. The tool can be used by Architects, Engineers, and Energy experts who need to perform precise energy analysis and simulations taking into consideration information that is not considered in a BIM model, such as thermal bridges. This tool automates the generation of the advanced analytical model saves considerable time and improves the accuracy of the calculation results and the quality of the whole process. The time reduction will depend on the complexity of the project and the accuracy of the results can easily be justified by comparing two calculation results.

Risks

No risks are associated with this tool.

2.1.28 Open BIM Construction Systems (CYPE)

The Open BIM Construction System is a tool for determining building systems in BIM models to prepare the model for energy simulation and analysis. This tool provides addition and homogenization of relevant information for the energy simulation. A flexible system adapted to different use cases automatically update information based on an Open BIM interconnected workflow.

Risks

No risks are associated with this tool.

2.1.29 Thermal Texturing of BIM (ASP)

Volumetrization Techniques, Thermal Texturing of BIM tool (VT1 tool) is a technique of producing 3D thermal models from the 2D thermal scans and the CAD model of the building. This technique does not require knowledge in 3D modelling as even the basics are easy to navigate. This tool provides visualization of the thermal situation, which is of higher usability than the 2D scans.

Risks

No risks are associated with this tool.

2.1.30 Thermal photogrammetry (ASP)

Volumetrization Technique, the Thermal Photogrammetry tool (VT2 tool) is a method of volumetrization of the 2D thermal scans. The process takes advantage of photogrammetry but requires some adjustments and special requirements of the 2D thermal scans. The workflow begins with 2D scans, adjusting them, passing through photogrammetry, and finally receiving a 3D thermal model. This tool provides visualization of the thermal situation, which is of higher usability than 2D scans.

Risks

No risks are associated with this tool.

2.1.31 VR tools for presentation for owners and clients (ASP)

Virtual Reality applications (for Android devices and iPhones) in VR boxes for presentations of solutions for renovation, addressed to owners and clients.

Risks

- Accessibility: As the VR tools are accessed by many people, control over who is allowed to access which data can be lost.
- The VR tool can give a full picture of the layout of the (future) residential area.

2.1.32 VR, AR/MR (ASP)

XRT1 EXTENDED REALITY TECHNOLOGIES SET, PART 1 AUGMENTED REALITY – MICROSOFT HOLOLENS 2

XRT1 tool is a methodology for creating holograms from BIM and photogrammetric models by the game engine Unity. It allows users to visualize by Microsoft HoloLens 2 for different renovation scenarios, comparing the existing building with the variants of design solutions. The tool is supported by a primary file with all the needed settings for importing BIM and photogrammetric models.

XRT2 EXTENDED REALITY TECHNOLOGIES SET, PART 2 VIRTUAL REALITY – OCULUS QUEST

XRT2 tool is a methodology for creating VR models from BIM and photogrammetric models by the game engine Unity. It allows users to visualize by Oculus Quest 2 different renovation scenarios, comparing the existing building with the variants of design solutions. The tool is supported by a primary file with all the needed settings for importing BIM and photogrammetric models.

XRT3 EXTENDED REALITY TECHNOLOGIES SET, PART 3 VIRTUAL REALITY – VR BOX AND ANDROID / IOS

XRT3 tool is a methodology for creating VR models from BIM and photogrammetric models by the game engine Unity. It allows users to visualize by VR Box and Android device or iPhone different renovation scenarios, comparing the existing building with the variants of design solutions. The tool is supported by a primary file with all the needed settings for importing BIM and photogrammetric models.

XRT4 EXTENDED REALITY TECHNOLOGIES SET, PART 4 AUGMENTED REALITY – 3D ANAGLYPH GLASSES

XRT4 tool is a methodology for creating desktop AR models from BIM and photogrammetric models by Unity, using Holo SDK. It allows users to visualize by 3D anaglyph glasses at front of the desktop different renovation scenarios, comparing the existing building with the variants of design solutions. The tool is supported by a primary file with all the needed settings for importing BIM and photogrammetric models.

XRT5 EXTENDED REALITY TECHNOLOGIES SET, PART 5 AUGMENTED REALITY – MOBILE

XRT5 tool is a methodology for creating mobile AR models from BIM and photogrammetric models by the game engine Unity. It allows users to visualize by an Android device or iPhone different renovation scenarios, comparing the existing building with the variants of design solutions.

Risks

This tool is related to the VR tools for presentation for owners and clients, to which the same risks apply (see ‘VR tools for presentation for owners and clients ').

3. List of mitigations

Mitigation	Explanation
Central deletion plan	A central deletion plan is implemented to counter any data breaches or other related issues (example: a data shredder)
Data encryption	Data translated from plain text into cypher text, avoiding the possibility of outsiders accessing data.
Data minimisation	Minimising the details and specifics of data collected, for example through recording averages rather than real-time data. Collecting only data that is necessary for the purpose.
Data standardisation	Using only standardised data within the tool, to avoid issues related to real-time or other types of data collected.
Human factors	Considering human factors within these tools avoid the risks of missing potential areas needing to be renovated.
Identification of accessibility	By identifying the accessibility of data early on, potential unauthorised usage of the collected data will not be possible.
Minimising tracking worker performance	Not tracking worker performance for privacy/data protection and risks surrounding workplace surveillance.
Proper management of risks	When all risks mentioned in the PIA are properly managed and addressed, the tools will help those houses who need them most.
Pseudonymization of data	This is done to prevent the data from pinpointing a specific data subject, meaning the likelihood of data being traced back to individuals gets minimised.
Randomising collected data	To avoid data points being linked to specific residences, data should be randomis ed, not allowing it to be traced back to the original residence.
Retention of data	The amount of time the data is used should have a clear retention period, after which it should be deleted. In the case of this project, it is 5 years.
Transparency principle	Residents, users, and others should always be aware of which data is collected/measured through either an app or interface to see how it benefits them.
Two-factor authentication	To increase the security of the data, two-factor authentication should be implemented on user platforms.
User access policies	Policies are implemented to regulate who has access to the data, such as role-based access or setting permission and privileges to enable or deny access to specific users.

3.1 Overview of risks and mitigations

After discussing in detail, the risks and mitigations of the tools developed by the BIM-SPEED project, the following table provides an overview of the mitigations associated with each tool. The matrix to assess the risk and impact are as follows:

Likelihood (of data being leaked/disseminated without consent): 1 - unlikely; 2 - likely; 3 - very likely

Impact (if data is leaked how serious would be the impact for the data subjects): 1 - low; 2 - moderate; 3- high

Therefore, the risk level is then calculated by multiplying the likelihood of the data being leaked/disseminated without consent by its impact should it happen. This an often-used technique to

assess the impact that risks may have to certain tools and whether mitigations have a significant effect in diminishing their likelihood. The risks are as discussed in Chapter 2. In those that no values are represented (i.e., with an 'x') are of difficult assessment and thus, even when mitigation strategies are implemented, the likelihood of a data breach and its impact are hard to assess.

The results and risks are assessed from 1 (acceptable risk) to 9 (critical - action needs to be taken):

1 to 3 - **Low Risk - Acceptable**

4 to 5 - **Medium Risk - Acceptable**

6 to 8 - **High Risk - Unacceptable (needs and constant monitoring)**

9 - **Critical Risk - Unacceptable (action is needed)**

Tools	Partners Responsible	Mitigations	Likelihood 1 unlikely 2 likely 3 very likely	Impact 1 low 2 moderate 3 high	Risk (likelihood x impact)
3DASH tool	CARTIF	Data encryption, user access policies	2	2	4
Acoustic soft sensor	UNIVPM	Data minimization, identification of accessibility	2	2	4
Application for crowdsourcing inhabitants' input	DEMO	Randomizing collected data, user access policies, retention of data	2	3	6
BACN2BIM	CARTIF	Data encryption, user access policies	2	1	2
BEM Calibration procedure	UNIVPM	Data encryption, user access policies	2	2	4
BEM Generator	MTB	Data standardization	3	1	3
BIM-based Life Cycle Cost and Asset Management	DEMO	x			
BIM Execution plan	MOW	Omision in deliverable	1	1	1
BIM Maturity tool	PB40	x			
BIM-SPEED Library	STRESS	Data encryption, user access policies	3	1	3
BIM-SPEED Passport	ARC	Data encryption, user access policies	2	2	4
BIM-SPEED platform	CSTB	Data encryption, user access policies, two factor authentication	1	3	3
BIMtoBEPS	CARTIF	Data encryption, user access policies	2	2	4

Comfort Eye	UNIVPM	Data minimization, identification of accessibility, proper management of risks, transparency principle	2	2	4
CYPETHERM E-plus	CYPE	Data minimization, human factors, randomizing collected data	1	2	2
CYPETERM Improvements	CYPE	Data minimization, human factors, randomizing collected data	1	2	2
Dynamo scripts for correctitude of modelling	ARC	Data encryption, user access policy	1	3	3
ECOtool	CARTIF	Data encryption, user access policies, pseudonymization of data, randomizing collected data	2	2	4
GIS data provider	TUB/CSTB	Data pseudonymization	2	3	6
IFC4Acoustic parser service	CARTIF	x			
KPI Dashboard	MTB	Data encryption, user access policies, central deletion plan	2	2	4
Lighting and visual comfort analysis	UNSTUDIO	Data minimization, identification of accessibility, proper management of risks, transparency principle	2	2	4
Material service	CSTB	x			
MEREEN weather service	CSTB	Data pseudonymization	2	1	2
Multicriteria decision making tool	TUB	Data encryption, user access policies, central deletion plan	2	2	4
Naming convention tool	CSTB	x	x	x	x
Open BIM Analytical Model	CYPE	x			
Open BIM Construction Systems	CYPE	x			
Thermal photogrammetry	ASP	x			

Thermal Texturing of BIM	ASP	x			
VR/AR	ASP	User access policies, randomizing collected data	2	2	4
VR tools for presentation for owners and clients	ASP	User access policies, randomizing collected data	2	2	4
BIM-SPEED platform	CSTB	Profile interface from the platform makes it possible to delete personal data / personal accounts. Alternatively, according to GDPR, it is possible to send a message to dpo@cstb.fr. or a letter to the KROQI platform managers to request the deletion of personal data. see https://www.cstb.fr/fr/protection-donnees.	1	2	2
BIM-SPEED platform	CSTB	The administrative interface allows the deletion of entire projects or accounts resulting in the destruction of personal resources on servers. A mail can be sent to platform administration services to request account deletion.	1	2	2

4. Conclusion

Human factors ought to be considered when making renovation decisions. Humans (workers, residents, construction industry professionals) interact with these technologies and are impacted by them. Accordingly, ensuring that the privacy of all stakeholders is protected is crucial. The project took a privacy-by-design approach in that privacy considerations were central to the development of the tools and platform. In this report potential risks were systematically considered and evaluated. For instance, the use of thermal and acoustic sensors to understand the building's performance may give indications about the socioeconomic status of the inhabitants and habits. Accordingly, this Privacy Impact Assessment presents the different tools developed by the BIM-SPEED project and assess the impact to stakeholders' privacy. First an introduction to how the data is collected and processed, more generally, including sensitive information is presented. Second, a list of the tools developed and potential risks to stakeholders' privacy is discussed. The risks here presented are merely a hypothesis and not a representation of what will happen. Considering the potential risks, we propose several mitigation actions to ensure the stakeholders are protected. Lastly, with input from all partners, a matrix assessment of risk is proposed for the different tools.