DATA MANAGEMENT PLAN

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VERSION MANAGEMENT

Revision table

Version	Name	Date	Description
0.1	Ausra Andriukaitiene	20/02/2023	Document structure, the initial input
0.2	Iryna Osadcha	09/03/2023	Second iteration
0.3	Paulius Spudys	20/03/2023	Third iteration
0.4	Paraskevas Koukaras	27/03/2023	Document revision
1.0	KTU team	29/03/2023	Final update

LIST OF ACRONYMS AND ABBREVIATIONS

D	Deliverable
EC	European Commission
T	Task
WP	Working Package
DMP	Data management plan
DOI	Digital object identifier
DS	Dataset (a grouping of data)
FAIR	Findable, Accessible, Interoperable and Reusable
PID	Persistent Identifiers
URI	Uniform Resource Locator
PII	Publisher Item Identifier
ISSN	International Standard Serial Number
CC0	Creative Commons Zero license
CC BY	Creative Commons Attribution license

DATA MANAGEMENT PLAN

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1. INTRODUCTION

1.1. Objectives and structure of the deliverable

The purpose of this D6.1 Data management plan (DMP) is to provide a detailed plan on how SmartWins project Consortium will manage data generated by the project during its lifetime and beyond. This deliverable is the first version of the Data management plan and will be updated as the project evolves for the project's final review.

The DMP contains guidance on managing data in a comprehensive manner, covering aspects such as data standards, formats, sharing, and storage. By adhering to the DMP, the data will comply with the FAIR (Findable, Accessible, Interoperable and Reusable) principles, promoting its discoverability, accessibility, interoperability, and reusability.

The structure of the deliverable includes the general principles for the DMP, Data security and Ethics Management.

1.2. Relation to other WPs, Tasks and Deliverables

This deliverable is an outcome of Task T6.3 Risks, ethics, and quality management.

Since the scope of this deliverable covers all scientific and technical activities of the SmartWins project, it is related to all the WP's and their deliverables produced.

2. DATA SUMMARY

According to the SmartWins project objectives, the goal of WP1 T.1.1-T1.2 is to analyse the environmental life-cycle assessment and sustainability aspects of building energy assessments, as well as to evaluate indoor environmental quality assessment practices. This will be achieved by utilizing advanced tools and practices such as building and construction sustainability tools and technical standards, European standard EN 16798-1 (2019), and the main provisions of the Level(s) scheme.

WP1 T.1.3-T1.4 aims to develop the necessary monitoring and calculation procedures for an energy assessment of smart buildings based on IoT, BIM, and digital twins' frameworks. Additionally, the current practices for an operational energy assessment of buildings with the use of smart sensors and digital twins will be analysed, along with the utilization of the technical documentation derived from the EN52000 standards series and other building energy related standards.

SmartWins is expected to produce a variety of energy performance data, behaviour monitoring data, and other relevant information in multiple formats, including numerical data, texts, pictures, tables, etc. These data are anticipated to be collected from the project's demonstrator cases' contributors throughout the duration of the project.

According to project objectives and WPs:

- The objective of WP1 is to enhance KTU's research competence in the field of smart and carbon-neutral built environments using digital twins for sustainable building engineering projects. The result will be four scientific reports, D1.1, D1.2, D1.3, and D1.4, with fully open public access.
- WP2 aims to strengthen KTU's capacity to apply for competitive research funding and manage and administer funded projects. The outcome will be one review, D2.1, and three reports, D2.2, D2.3, and D2.4, with limited access under the conditions of the Grant Agreement (sensitive).
- WP3 is focused on creating linkages with businesses and providing access to the methodology to support open innovation. The result will be two reports, D3.2 and D3.3, with fully open public access, and reports D3.1 and D3.4 with limited access under the conditions of the Grant Agreement (sensitive).
- The objective of WP4 is to train and educate KTU researchers and students on the topic of next-generation digital twins, facilitating the transition to a smart, sustainable, resilient, and carbon-neutral built environment. The outcome will be reported D4.1 and D4.2 with limited access under the conditions of the Grant Agreement (sensitive).
- WP5 focuses on implementing the dissemination, exploitation, and communication actions of the project. The result will be reported D5.1 and reviews D5.2 and D5.3 with fully open public access.
- WP6 is responsible for coordinating the consortium, administering the project, reporting the results, monitoring tasks, milestones, and finances, and managing issues, deviations from expected quality, and risks. The result will be a current DMP, D6.1, and report D6.2 with fully open public access. Report D6.3 will have limited access under the conditions of the Grant Agreement (sensitive).

As the generation and collection of project data is underway, the precise size of data generated during the project's lifespan will be determined in the next iteration of the DMP.

The SmartWins project aims to actively involve the general public and non-professional academics in all aspects of its research. Specifically, T3.3 will prioritize citizens events

to share the project's findings and bridge the gap between the Lithuanian market and research. The project will also engage societal actors through the participation of citizens, experts, and local governments in dissemination activities, as well as through the drafting of a policy report.

Various dissemination methods and tools will be customized for each target audience and deliverable in the SmartWins project. These include:

- Developing a project website to serve as a communication tool and repository for all document-based deliverables, including training and learning materials, workshop content, and reports.
- Sharing open science deliverables such as publications, open data sets, and open-source algorithms through each partner's preferred repository.
- Producing reports for documentation purposes and disseminating them through the SmartWins website, open science repositories, or the European Commission Horizon Results platform.
- Organizing various events for different purposes, including a scientific conference on Digitalisation of the Environment in Lithuania (Task 2.2), two 2-day scientific workshops for the consortium (Task 2.3), two brokerage events to network investors, entrepreneurs, and researchers (Task 3.1), and two citizen events to interact with society and bridge the gap between citizens and research (Task 3.3). Conducting training sessions for researchers about scientific topics, research management, and entrepreneurship (Task 4.1), which will be filmed and shared openly online, live-streamed, and available on the SmartWins webpage. Three summer/winter schools will also be organized, open to PhD students or post-docs (Task 4.2). Participating in scientific conferences to share knowledge acquired in the SmartWins project with academic peers (Task 2.2) and organizing a scientific conference session in Lithuania (Task 2.2).
- Disseminating the policy report on the research status of SmartWins topics in Lithuania (Task 3.4) to Lithuanian policy makers.
- Conducting remote meetings with sister research projects to plan for cross-dissemination of results.

The training and learning materials created during the SmartWins project, as well as workshop content, will be made publicly available on the project's website. These resources are intended to be reused by third parties for their purposes.

2.1. Findable, Accessible, Interoperable and Reusable (FAIR) data

2.1.1. Making data findable, including provisions for metadata

The data will be assigned Persistent Identifiers (PIDs), such as Digital Object Identifiers (DOIs)[1], which are crucial for their explicit identification and citation facilitation. To ensure reliable data deposition and DOI allocation, reputable repositories like Zenodo[2] will be utilized. Additionally, the data will have extensive metadata to enhance their discoverability, citation, and reusability. Rich metadata provides valuable insights for data comprehension and simplifies automatic identification for systems. To maintain consistency and interoperability, standard metadata approaches like Dublin Core, CERIF, and DOI will be followed.

Metadata is essential for describing the data collected and generated by the SmartWins project. This information is required not only for facilitating open access to the data but also for searching or accessing data. However, since there are many different metadata standards for various types of data, it may not be feasible to find a single standard that fits all purposes. A practical approach would be to agree on a common and minimal catalogue metadata schema for datasets published in public catalogues and repositories. If necessary, data-type-specific schema extensions[3] could be used based on relevant subjects from a taxonomy or controlled vocabulary as described in the Zenodo API documentation or DataCite Metadata Schema Documentation for the Publication and Citation of Research Data and Other Research Outputs.

The Zenodo deposition metadata domain model, based on DataCite's metadata schema[4], will be used for open data generated by the project and deposited in a suitable repository. The model's minimum and recommended terms, which include mandatory fields such as Title of deposition, Abstract or description, Deposition files identifiers, Type of deposition, Date of publication, Creators/authors, Open license, Digital Object Identifier, Keywords, Persistent identifiers of related publications and Grants that funded the research.

This minimal metadata schema is compatible with the Dublin Core[5] metadata standard, and thus it can be interpreted by the OAI-PMH[6] catalogue and OpenAIRE Extensions[7]

[1] https://www.doi.org
[2] https://zenodo.org
[3] http://developers.Zenodo.org/#representation
[4] https://schema.datacite.org
[5] https://www.dublincore.org
[6] https://www.openarchives.org/pmh
[7] https://www.openaire.eu

to the default metadata schemas above, such as for spatial metadata or linked data, will be described in future versions of the DMP if necessary.

Upon depositing SmartWins results into a repository, accompanying search keywords and metadata shall be provided for optimizing possibilities for re-use.

If metadata files follow a different standard than the default catalogue metadata schema, they can still be included with the original dataset when published in the appropriate catalogue or repository. However, if data is collected or produced by the project but cannot be shared publicly due to restrictions outlined in the Grant Agreement, only metadata that adheres to the internal dataset metadata schema of the SmartWins data survey should be provided. This schema is utilized in accordance with the SmartWins data management policy.

2.1.2. Making data accessible

The data contributed will be stored in an Open Data repository, which can be accessed via the re3data[8] platform. This platform features a range of repositories, including Zenodo, DRYAD, Harvard Dataverse (for general data), and OpenEI (for energy data). These basics are in accordance with the guidelines on intellectual property rights of Horizon Europe.

Throughout the project, all partners will adhere to methods and procedures that ensure early and open sharing of project results. Research strategies will be preregistered, and reports will be recorded and uploaded to Open Access Repositories before the study's execution. Additionally, the project will utilize technologies such as pre-printing and crowd-sourcing, and will only consider repositories and journals that allow preprints. Some examples of general research topic repositories include Zenodo, Figshare, PeerJ, and OSF Preprints. Finally, participants will consult the publication's website and SHERPA/RoMEO[9] , a crowd-sourced database of journal preprint policies, to determine whether a journal accepts preprints.

Open SmartWins research results deposited in the Open Access repository will automatically be assigned a DOI. Additionally, these results will be identifiable by a persistent Uniform Resource Locator (URI) when deposited in institutional repositories, scientific publisher repositories, or other data and research repositories. If the institution is a DOI registrant with an agreement with a DOI registration agency, a DOI will also be assigned. Whether scientific publications receive a unique identifier like a DOI, Publisher Item Identifier (PII), International Standard Serial Number (ISSN), etc.

[8] https://www.re3data.org
[9] https://v2.sherpa.ac.uk/romeo

depends on the open access strategy (green or gold) selected by the editors, as well as the scientific publisher and the research repository used.

All data, except for personally identifiable information and confidential deliverables, will be openly accessible. Personal data processed in the project will be kept confidential and inaccessible to third parties. Management of sensitive data is described in more detail in Ethics and Data privacy sections in this document.

The research findings produced through SmartWins deployment will comply with EU Open Access and Open Science guidelines. This means that the project's papers will be submitted to Open Access Journals which will be verified through the SHERPA/RoMEO platform and DOAJ[10] , and recognized on platforms like ROAR, OpenDOAR, OpenAIRE, and OAD. In addition, all SmartWins publications, including reports, articles, and papers, will undergo open peer review and be published on the Open Research Europe platform[11].

These efforts will enhance the impact of SmartWins by providing the following advantages:

1. Open Access can increase paper citations.
2. Improve research visibility, utilization, and impact by making the project's outcomes accessible to professionals, practitioner, and business communities, as well as the general public.
3. Open Access can improve research speed, efficiency, efficacy, repeatability, and collaborations.

The researchers involved in SmartWins will use both Green Open Access (self-archiving in open repositories) and Gold Open Access (peer-reviewed publications in open access journals and/or repositories) techniques to achieve the highest level of impact while being cost-effective.

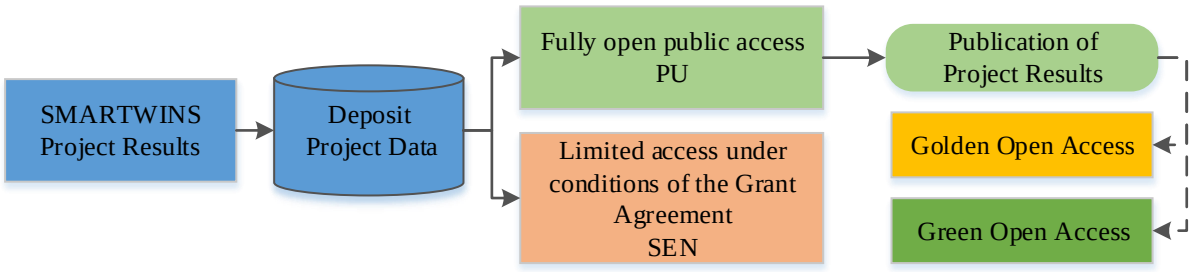

Figure 1. Data Management scheme for SmartWins project results

[10] https://doaj.org
[11] https://open-research-europe.ec.europa.eu/about

All SmartWins project data, with the exception of personally identifiable information, confidential deliverables, and data restricted by the Grant Agreement, will be openly and freely accessible through standardized access protocols.

If there is a need for restrictions on open access to research data, efforts will be made to provide access to the data under controlled conditions to other researchers. In cases where the data is restricted or embargoed and stored in the Zenodo repository, information regarding the restricted data will be disclosed in the repository. The metadata will include details on when the data will become available.

To authenticate the identity of any individual requesting access to SmartWins' default repository (Zenodo), the mechanism described in the preceding paragraph will be employed.

If there are any concerns regarding restricted access to research results, the SmartWins quality assurance and ethics board can serve as a data access committee and request clarification.

SmartWins plans to make the metadata available to the public by utilizing Creative Commons licenses, specifically the Attribution (CC BY) and Creative Commons Zero (CC0) licenses.

The data will be accessible and discoverable at least 3 years after the end of the project. A template for storing the data for long-term access is provided below. The metadata will contain information on how to remain accessible even after the data becomes unavailable.

Table 1. Template for long-term storage data

Title of data set	Storage location	Repository	Reasons for long-term storage	Time period

The publication of open data will conform to standard file formats, such as txt, pdf, csv, and others. Access to data will be facilitated through the use of standard tools, although the provision of specialized software is not considered mandatory. However, if deemed necessary, we will offer appropriate open-source software to access and analyze the data. The SmartWins website[12] will provide comprehensive documentation for accessing data through open-source software. In addition, the website will make available the corresponding source code and release repositories for public access.

[12] https://smartwins-project.eu

2.1.3. Making data interoperable

The default metadata schema for all types of open data will incorporate the following standard vocabularies: Open Definition, FundRef, OpenAIRE, and general ISO 19115 keywords for other data. Any additional vocabularies utilized will be disclosed in forthcoming versions of the DMP.

To ensure that the generated records can be easily integrated and interoperable with other applications, workflows, and information, they will follow commonly agreed-upon arrangements, standards, and community plans. This includes the use of keywords, well-ordered vocabularies, ontologies, or glossaries. The format of the data records will depend on the data type and will be uploaded to specific repositories in appropriate formats, such as:

- **Geospatial data**: DBF, SHP, NetCDF, GeoTIFF
- **Containers**: ZIP, GZIP, TAR
- **Statistical data**: SAS, OTA, ASCII, POR, SAV
- **Databases**: CSV, XML
- **Still images**: PDF, GIF, BMP, TIFF, PNG, JPEG 2000
- **Moving images**: MPEG, MXF, MOV, AVI
- **Web archive**: WARC
- **Tabular data**: CSV
- **Sounds**: MP3, WAVE, MXF, AIFF
- **Text**: HTML, PDF/A, XML, UTF-8, ASCII.
- **Microsoft Visio** (.vsd) and **Photoshop** (various formats, mostly .png) will be utilized for illustrations and graphic design. The files will be made available in formats such as .jpg, .psd, .tiff, and .ai.

As part of the project, we utilize the standard file formats mentioned earlier and ensure that each dataset includes standard Zenodo metadata.

At present, SmartWins has no intentions of introducing new project-specific ontologies or vocabularies. Instead, to promote the reuse, retrieval, and expansion of project outcomes, commonly used ontologies will be employed.

2.1.4. Increase data re-use

The produced data will be thoroughly validated and include explicit licensing and attribution information. To facilitate comprehension and analysis by others, a README

file will be provided as documentation. SmartWins intends to utilize Creative Commons licenses, such as the Attribution (CC BY) and Creative Commons Zero (CC0) licenses, to make the data available to the public.

SmartWins will place special emphasis on the three primary methodological approaches to research reproducibility: (i) reproduction, (ii) replication, and (iii) re-use, to ensure the results are reproducible. These three processes depend on having access to the original study's data and methods. To ensure that all project results, including data, reports, and papers, are accessible, we will be made available in Open Access repositories through pre-registrations or publications in open repositories or journals.

The outcomes generated by the project and stored in the respective repository can be utilized by third parties even after the project has ended. However, if certain research data required to validate a scientific publication cannot be made openly accessible due to confidentiality, security, personal data protection obligations or IPR concerns, such data may be stored in a restricted repository. Access to such data may be granted upon request, subject to the terms of a restricted license.

The quality assurance process for the project will be specified in the next iteration of the DMP, and this process will be implemented throughout the duration of the project.

3. OTHER RESEARCH OUTPUTS

Since data collection is still in progress, it is currently impossible to predict any additional research outputs, whether they are digital or physical. As the project continues and more information becomes available, a more detailed plan for managing these outputs, in line with the FAIR principles, will be provided in the next iteration of the DMP.

Each beneficiary will ensure that their other research outputs comply with the FAIR principles and are included in the next iteration of the DMP, as part of their management and sharing policies.

4. ALLOCATION OF RESOURCES

Each beneficiary responsible for leading Work Packages is accountable for preparing datasets to ensure that the data collected within their activities adhere to the FAIR principles. The Project Coordinator shares the responsibility for overall coordination and supervision. Additionally, consortium partners are accountable for ensuring that their activities comply with all relevant local, government, and international laws, regulations, and guidelines.

SmartWins is committed to making all generated research data findable, accessible, interoperable, and reusable (FAIR), in accordance with the H2020 Guidelines on FAIR Data Management. To achieve this, SmartWins will utilize the template outlined in Table 2 as a guide for implementing FAIR Data Management. This template will assist in providing a comprehensive description of the data sets, their purpose, relevance, and the methodology and procedures used for their collection.

Table 2. Template for data handling and management

Definition	Dataset information
Short description of data	TBD
Purpose and relevance of data collection and relation to objectives	TBD
Methodology	TBD
Data source, data ownership	TBD
Standards, data formats, vocabularies	TBD
Storage	TBD
Security & Privacy	TBD
Stakeholders, beneficiaries responsible for data management	TBD

The project website will host the curated public deliverables, while internal data sets will be backed up for potential future use and verification. The responsible data partner will determine the minimum number of years for archiving primary data.

5. DATA SECURITY

Throughout the project, the responsible partner will store the datasets on their storage system. Each partner is accountable for ensuring that the data is stored securely and in compliance with European Union data protection laws. Upon completion of the project, the repository holding the dataset will assume all responsibilities for data recovery and secure storage.

All data files will be managed, processed, stored and backed up in a secure environment - e.g., lockable computer systems with passwords, firewall system in place, power surge protection, virus/malicious intruder protection) and by controlling access to digital files with encryption and/or password protection.

To ensure secure transmission, all data files will be transferred using encrypted and password-protected connections. Partners can use the open source 7-zip tool, which provides full AES-256 encryption, or encryption options incorporated in MS Windows or MS Excel. Passwords will not be exchanged through email but shared in person-to-person communication between the partners.

Results submitted to the Zenodo repository are securely stored for long-term preservation.

6. ETHICS

The SmartWins consortium acknowledges that certain ethical, privacy, and data protection concerns may arise from the activities and events planned within the project's scope.

As part of the Research Work Package in SmartWins, certain activities may be conducted to gather stakeholder needs. In all cases, participants will be fully informed about the research and their voluntary participation in surveys or interviews. It is important that participants are aware of the nature of the research and the voluntary aspect of their involvement.

Towards the protection of the personal data the following issues will be considered:

- Data will be collected only having each participant’s explicit consent to obtain, store and use personal information for the project purposes.
- All data associated with a recognizable person will be held private;
- Any data or information about a person will be held private, regardless of how this data was acquired.
- All individual information will be anonymized (or coded) in full and at the earliest possible point in time during data processing;
- The acquired data will under no circumstances be used for commercial purposes.

For live interviews, a written consent documentation set will be provided to each recruited stakeholder at the beginning of the project. The documentation will consist of an information sheet and a consent form, both of which will be signed by the participant. The information sheet will outline the purpose of the research, the requirements for participation (including potential risks and benefits), the terms for withdrawal (participants have the right to withdraw at any time without prejudice or explanation), data usage during research, and procedures for maintaining confidentiality.

The consent form will be written in plain language, free of jargon, and will allow the participant to respond to each of these points clearly:

- The participant has read and understood the information about the project
- The participant has had the opportunity to ask questions
- The participant voluntarily agrees to participate in the project
- The participant understands that they can withdraw at any time without penalty or explanation
- Procedures regarding confidentiality are explained (use of names, pseudonyms, anonymization of data, etc.)
- Separate terms of consent for interviews, audio, video, or other forms of data collection
- Use of the data in research, publications, sharing, and archiving are explained
- Signatures and dates of signing for the participant and the researcher.

The consent documentation will be prepared and submitted at the start of the project to ensure that all stakeholders are aware of their rights and responsibilities. The use of plain language and clear explanations will help to ensure that all stakeholders can make informed decisions about their participation in the project.

The project partners will retain the signed original of the form, and a copy will be provided to the participant. To ensure robust data protection during interview research, the following measures will be implemented:

- Network file storage will be prioritized over cloud-based solutions.
- The use of USB memory keys will be prohibited.

For online surveys, participants will be required to click a button or type a response indicating that they have read and agreed to the consent/assent information before accessing the research survey questionnaire. The survey questions will not be visible until the participant indicates voluntary participation.

To inform participants of the risks associated with online data collection, the following statement will be included:

"There is a possibility of tampering from outside sources when collecting information through the internet. While the confidentiality of your responses will be protected once the data are downloaded, hacking or other security breaches could compromise your data's confidentiality. You are free to choose not to answer any question."

To ensure the confidentiality of downloaded data, the following steps will be taken:

- Only secure and reputable survey tools from third parties, such as Survey Monkey, EUSurvey or Zoomerang, will be used for online surveys.
- If the survey tool collects IP addresses, they will be removed from the downloaded data file.
- All responses from the online survey will be deleted. The resulting data file used for analysis should not contain any identifiable information, including IP addresses or other electronic identifiers.
- The data file will be saved on a password-protected computer. Backup data files will also be stored securely.

  The raw data will be retained only until the end of the project, and only the analysed results will be available afterward.

The aforementioned procedure will be presented to users prior to beginning the survey, giving them the option to participate or not. Similarly, these steps will be followed for gathering data through onsite monitoring (excluding sensitive data), as well as for the secondary usage of information. All primary and secondary data collected through onsite monitoring will be kept confidential and analysed solely within the project, with public disclosure limited to aggregated results. However, due to the distributed nature of the data platform's cloud hosting, with server locations spanning the globe, there is a possibility of data being transferred across EU borders.

Our data security policies will undergo a thorough review to ensure that storage and transfer practices align with the EU directives on ePrivacy and Data Protection. We will prioritize choosing storage locations within the EU whenever feasible. Additionally, we will ensure full and rigorous compliance with all relevant national privacy laws, including those that implement the pertinent European Directives (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 and Directive 2002/58/EC. We will continue to monitor upcoming changes in these directives, including the proposed repeal and review of Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002, to ensure continued compliance.

Our commitment to data security extends beyond compliance with legal requirements. We believe that protecting personal data is a fundamental ethical responsibility, and we are dedicated to maintaining the highest standards of security and privacy.

7. OTHER ISSUES

At present, the project solely relies on the data management procedures outlined in this policy and does not utilize any other methods for managing data.

Disclaimer

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