



3DxVERSE

Work Package 2

D2.2: Data Management Plan

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List of abbreviations and acronyms

| Abbreviation | Meaning |
|----------------|---|
| AR | Augmented Reality |
| CEN | European Committee for Standardization |
| DMP | Data Management Plan |
| DPA | Data Protection Authority |
| DPIA | Data Protection Impact Assessment |
| DPO | Data Protection Officer |
| DPP | Data Protection Policy |
| DT | Digital Twin |
| EB | Ethics Board |
| ECHR | European Court of Human Rights |
| EDIC | European Digital Infrastructure Consortia |
| EEA | European Economic Area |
| EM | Ethical Manager |
| ETSI | European Telecommunications Standards Institute |
| ETR 100 | European digital cellular telecommunication system report on abbreviations and acronyms |
| GDPR | General Data Protection Regulation (EU) 2016/679 |
| ICO | Information Commissioner's Office |
| ID | Identification |
| IF | Incidental Findings |
| ISO | International Organization for Standardization |
| IT | Information Technologies |
| ITS | Intelligent Transport System |
| KPI | Key Performance Indicator |
| LaaS | Logistics as a Service |
| MaaS | Mobility as a Service |
| MIM | Minimal Interoperability Mechanisms |
| OASC | Open & Agile Smart Cities |
| OEM | Original equipment manufacturer |
| ORDP | Open access to Research Data Pilot |
| POPD | Protection Of Personal Data |
| PSA | Privacy&Security Assessment |
| QM | Quality Manager |
| SES | Socio Economic Status |
| SME | Small and Medium-sized Enterprise |
| SSL | Secure Sockets Layer |
| TC | Traffic Control |
| UC | Use Cases |
| UN | United Nations |
| WP | Work package including the task description of ethical requirements |
| VR/XR | Virtual / eXtended Reality |

EXECUTIVE SUMMARY

The Open access to Research Data Pilot (ORDP) aims to improve access to and re-use of research data generated by the DIGITAL Program projects. 3DxVERSE is fully committed to ORDP. As such, the development of a Data Management Plan (DMP) is required and is embodied in this deliverable.

The 3DxVERSE DMP focuses on the governance of data generated and collected during the project, considering the ethics rules and GDPR. It details what data the project will generate and what datasets will be made publicly accessible for research purposes. According to the project's description of work, the DMP will be issued in two versions. This deliverable corresponds to the first version.

First, this document gives an overview of the 3DxVERSE data by providing a description of the four data categories considered in the project:

- Technical data: data handled during the technical development of the Pilot Sites and operations of the use cases.
- Evaluation data: data selected and collected during the trials for evaluation purposes.
- Open research data: data agreed to be published under the frame of ORDP.
- Internal administrative data: data related to the internal management of the project.

Then it introduces how the FAIR approach is implemented in 3DxVERSE. It also addresses the allocation of resources to data management. Additionally, it offers insight on the data management per work packages. Finally, it addresses the ethical and privacy aspects while providing recommendations regarding data security.

1 INTRODUCTION

1.1 Project introduction

The 3DxVERSE project [1] aims to harness the potential of Digital Twins to foster sustainable travel and living communities. The initiative focuses on key use cases at various levels, from airports to living communities, encompassing sustainability, economic growth, societal development, safety, security, resilience, and corporate sustainability responsibility in a holistic approach. By establishing interoperable Digital Twins and leveraging cutting-edge technologies like AI, XR/VR and Data Spaces, this project aligns with the New European Bauhaus initiative and the G20 Framework for Systems of Digital Public Infrastructure. Through potential collaboration with organisations like the International Data Spaces Association, Open & Agile Smart Cities (OASC) working on the OASC Minimal Interoperability Mechanisms (MIMs), and European Digital Infrastructure Consortia (EDIC's), we seek to create a transformative impact on digital inclusion, innovation, and sustainability, contributing to the achievement of the 2030 Agenda for Sustainable Development. By creating an open, interoperable, secure, trustworthy, fair and inclusive reference implementation blueprint digital twin for EU citizens, businesses and public administrations, this project strives to build a resilient, inclusive, and environmentally conscious digital economy and society. The focus on societal impact, economic growth, and sustainability reflects our commitment to achieving the Sustainable Development Goals and shaping Europe's digital future. The project involves collaboration with global partners, including Amsterdam, Rotterdam, Almelo, Enschede, Aruba, Hamburg and can scale to global collaboration with partner countries, including Africa, India, Singapore, Japan, UK, and Canada.

1.2 Purpose of the deliverable

The present deliverable describes the data management lifecycle of the data to be generated, collected and processed during the project. It outlines the approach to make 3DxVERSE data FAIR by indicating what data will be generated, collected and processed, what standards will be applied, how the research data will be preserved and what parts of the datasets will be shared for the evaluation needs and to comply with the ORDP requirements. This document will address also the ethical and privacy aspects as well as some data security principles. This deliverable is a living document and will be updated according to the evolution of the project:

- The deliverable D2.2 (M03, i.e. March 2025) outlines the data management plan according to the current development of the project. It identifies a first set of data categories that will be involved in the project and proposes the data management process that will be followed in the next developments.

This deliverable serves as an entry point to grasp the project-wide data management approach in 3DxVERSE. As such it provides a big picture of the data management at the project level while dealing with more focus on research data management as required by ORDP. As an entry point, it provides links towards and between more specialised deliverables, namely the D3.1 – Digital Twin interoperability testbed, reference architecture: First Version, D3.2 – Digital Twin interoperability testbed, reference architecture: Final version, D4.1 – Digital Commons Framework for Digital Twin & DPI :first report, D4.2 – Digital Commons Framework for Digital Twin & DPI :final report, D5.1 – Security and Privacy of Digital Twins: first report, D5.2 – Cyber Security and compliance: final report, D6.1 – Digital Twin for sustainable living Communities-Use Case Design, D6.2 – Digital Twin for Airport: use case design, D6.3 – Design digital twin simulation models: First iteration, D6.4 – Design digital twin simulation models: second iteration, D7.1 – Digital Twin for sustainable living Communities-Integration interoperable digital twin testbed : Version 1, D7.2 – Digital Twin for sustainable living Communities-Integration interoperable digital twin testbed: Version 2, D7.3 – Digital Twin for Airport -Integration interoperable digital twin testbed: Version 1, D7.4 – Digital Twin for Airport -Integration interoperable

digital twin testbed: Version 2, D8.5 Interoperability and Data Governance: first report and D8.6 Interoperability and Data Governance: final report. On top of all these deliverables, there are the ethics deliverables as follows : D2.3 Ethics Report 1, D2.4 Ethics Report 2 and D2.5 Ethics Report 3. This relationship is illustrated on Figure 1. It is important to note that these deliverables will be available in the later stage of the project.

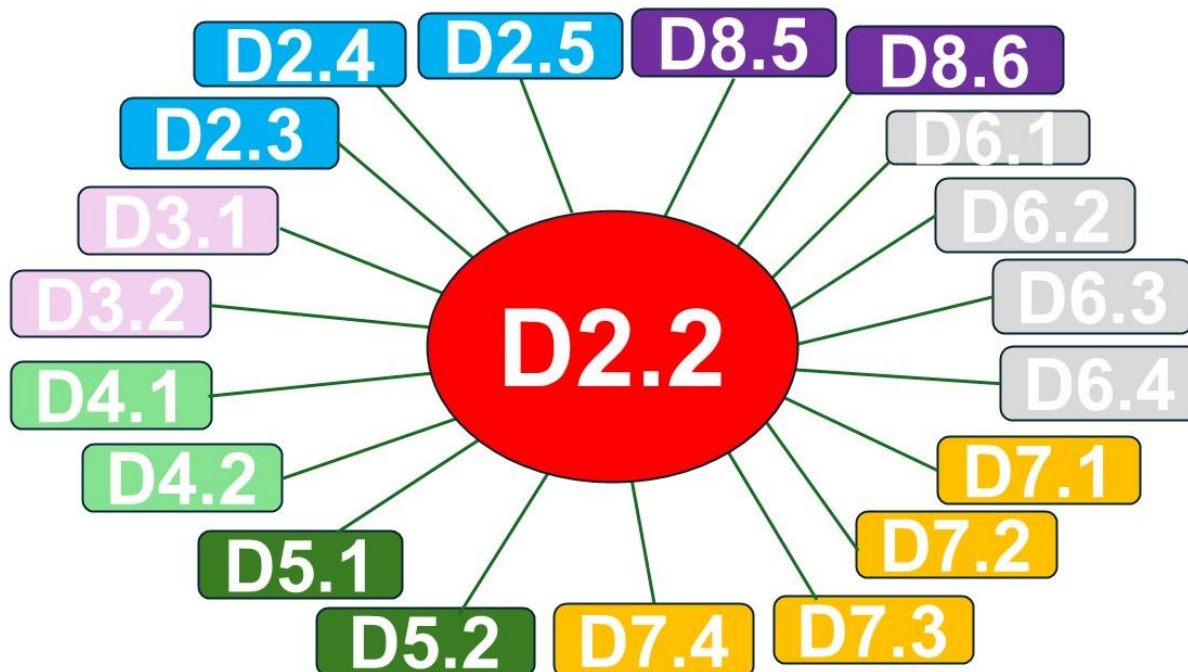


Figure 1: Relationship between D2.2 and data-related deliverables

1.3 Intended audience

The dissemination level of D2.2 is ‘public’ (PU) and it is available to the members of the consortium, the European Commission (EC) services and those external to the project.

This document is primarily intended to serve as an internal guideline and reference for all 3DxVERSE beneficiaries, especially the governance bodies such as the General Assembly, the Steering Committee, the Technical Management Team, and the Advisory Board.

This deliverable provides data management information to Pilot sites coordinators and other technical profiles participating in WP3, WP4, WP5, WP6, WP 7 and WP8.

2 3DXVERSE DATA

2.1 Introduction

3DxVERSE will handle different types of data which can be organised in four categories: *technical data*, *evaluation data*, *open research data* and *internal administrative data*. This chapter will describe these data categories while providing information on their management and sharing.

2.2 Data categories

This section introduces the categories of data that are handled in the project which are: the technical data, the evaluation data, the open research data and the internal administrative data. A short description of these categories is given in Table 1 while more details on the corresponding data management are provided in the upcoming subsections.

| | Short description |
|-------------------------------------|--|
| Technical data | This category includes the data related to the technical development and operation of the use cases. The technical data is generated and handled by the Pilot Site components including sensors and existing platforms. This category is discussed in more detail in 2.2.1 |
| Evaluation data | The evaluation data concerns the data used to compute the KPIs described in WP6 for the evaluation of the project. They are collected during the trials. This category is discussed in more detail in 2.2.2 |
| Open research data | This category contains the data and results that will be published by the project to comply with ORDP requirements. It is discussed in more details in 2.2.3. |
| Internal administrative data | This category refers to the data generated/shared internally for administrative and management purposes. It is addressed in 2.2.4. |

Table 1: Description of 3DxVERSE data categories

The data handling in 3DxVERSE can be linked to three phases in the project as illustrated on **Figure 2**. The technical development phase corresponds to the set up and execution of the use cases at the Pilot sites. The data handled in this phase, which falls in the technical data category, corresponds to the data generated by the Pilot Sites data sources that are involved in the technical implementation and the use case operations. The evaluation phase corresponds to the evaluation of the use cases following a specific methodology (see deliverables D6.1 and D6.2 in M9, D6.3 in M12 and D6.4 in M15). It requires the collection of a subset of the data generated during the technical development phase (technical data) on which the evaluation is performed (evaluation data). Finally, the publication phase consists in the selection and the publication of a subset of the evaluation data as research data at the end of the project following the ORDP requirements. Only part of the evaluation data on which the partners agree to make

openly available will be published and will constitute the open research data. To sum up, the open research data is a subset of the evaluation data which is itself a subset of the technical data.

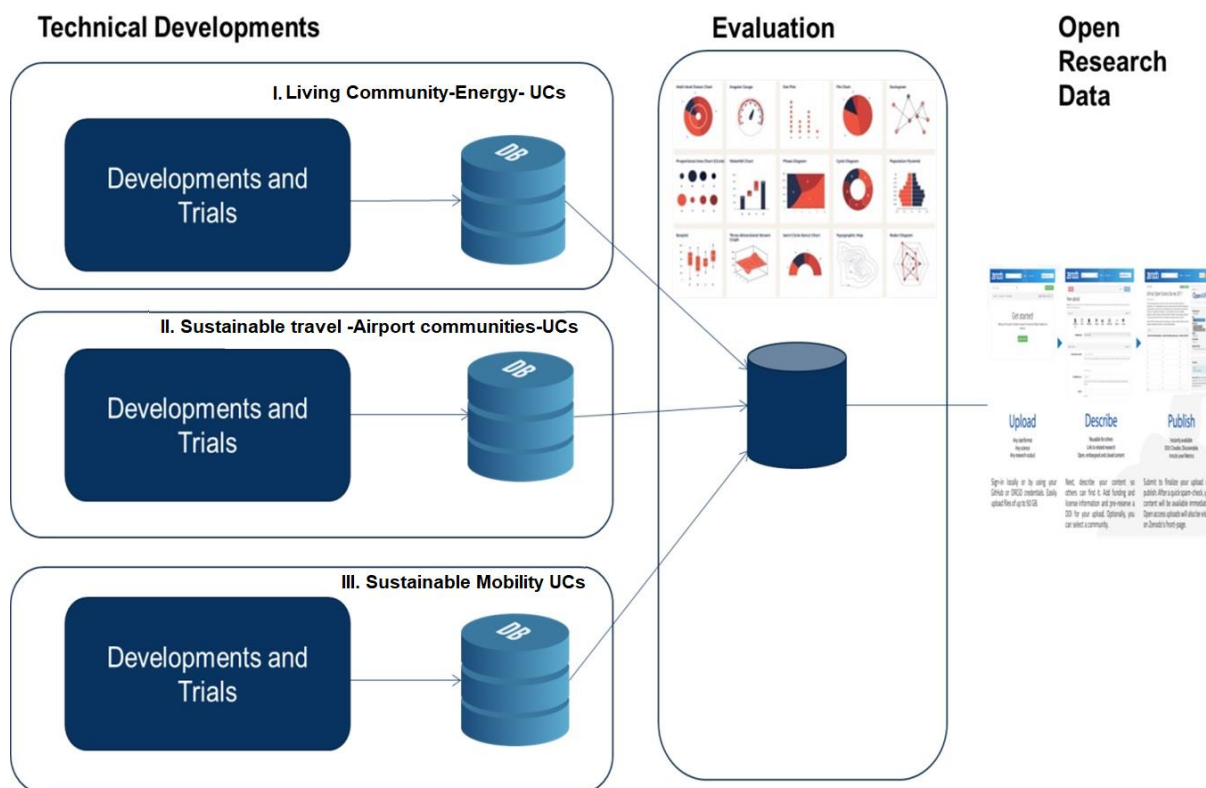


Figure 2: Data management in 3DxVERSE

2.2.1 Technical data

The technical data category includes the data related to the technical developments (see Figure 2). The technical data are generated at the Pilot Site level with the data sources including the sensors, the existing platforms, the network components but also the Pilot Sites stakeholders. The technical data may contain personal data. In this case, the GDPR rules apply (see 6.1). Regarding the sharing of the technical data, it is up to the Pilot Sites stakeholders to decide what data they accept to be shared with the evaluation team and later published under ORDP.

An early survey of the LLs data management architecture allowed the identification of the initial subcategories of technical data described in Table 2. It will be updated over the course of the project, with a final list of subcategories provided in D8.5 Interoperability and Data Governance: first report[M12] and D8.6 Interoperability and Data Governance: final report [M30].

| Categories | Sub-categories | Description |
|--|--|---|
| <ul style="list-style-type: none"> Driver | <ul style="list-style-type: none"> Background | <ul style="list-style-type: none"> Refers to a set of personal data collected throughout questionnaires or other means which might contain demographic, physical, cognitive, driver experiences and driving style data. |
| | <ul style="list-style-type: none"> Attitude | <ul style="list-style-type: none"> Includes data related to the driver's attitude towards driving and the 3DxVERSE projects. This category can also contain other types of data collected by questionnaires. |
| <ul style="list-style-type: none"> Vehicle | <ul style="list-style-type: none"> Identification | <ul style="list-style-type: none"> These data are related to vehicle identification such as the VIN (road vehicle, plain, taxi, public transport vehicle, etc). |
| | <ul style="list-style-type: none"> Sensors | <ul style="list-style-type: none"> 3DxVERSE vehicles embed many sensors to collect different types of data such as the position (GPS), temperature, Battery level, Fuel level and consumption, Oil level, Tire pressure, etc. |
| | <ul style="list-style-type: none"> Communication Units | <ul style="list-style-type: none"> These are the data related to characteristics of the OBUs such as the 5G, Wifi, ITS-G5, etc. |
| <ul style="list-style-type: none"> DT Technologies and their application | <ul style="list-style-type: none"> Beyond5G, Network Slicing | <ul style="list-style-type: none"> This sub-category contains data related to the Network Slicing related to its allocation, latencies, bandwidth, jitter, reliability and privacy. Other types of data are related to the tenant, the Network Slice Provider and the Network Slice Agent. |
| | <ul style="list-style-type: none"> MEC | <ul style="list-style-type: none"> This sub-category contains data related to the performances of the MEC in terms of end-to-end latency and the efficiency of the network operation. |
| | <ul style="list-style-type: none"> NFV-MANO | <ul style="list-style-type: none"> These data are related to the performance of the NFV-MANO measured in the Pilot Sites about the on-demand and automatic deployment, high-availability, resilience of operation of demanding DT services and IoT-5G. |
| | <ul style="list-style-type: none"> Precise Positioning | <ul style="list-style-type: none"> These data are related to the accuracy of the Precise Positioning which is particularly important in the logistics domain. The accuracy and the characteristics of the GNSS and additional component such as the Ultra-Wide Band might also be logged. |
| | <ul style="list-style-type: none"> Traffic Management Application | <ul style="list-style-type: none"> These are data related to traffic management such as the traffic volume (number of vehicles per time) and traffic density (number of vehicles per road segment). The positions at which the |

| | | |
|--|---|--|
| | | <ul style="list-style-type: none"> • volume and the density are measured are also logged. |
| | <ul style="list-style-type: none"> • Augmented Reality (AR) and Virtual Reality (VR) | <ul style="list-style-type: none"> • Offers immersive experiences and is being used for training, product design, and marketing. |
| | <ul style="list-style-type: none"> • Internet of Things (IoT) | <ul style="list-style-type: none"> • Connects devices and sensors to the internet to gather and exchange data, offering real-time insights and improving operational efficiency. |
| <ul style="list-style-type: none"> • Cloud Infrastructure and Services | <ul style="list-style-type: none"> • Edge | <ul style="list-style-type: none"> • A dedicated cloud infrastructure will be deployed. Data related to this infrastructure can be collected such as the server specifications, the latencies, the bandwidth, etc. • Moves computation closer to the data source, reducing latency and bandwidth usage, which is critical for real-time processing, especially in IoT applications. |
| <ul style="list-style-type: none"> • Airports | <ul style="list-style-type: none"> • Environmental | <ul style="list-style-type: none"> • For evaluation purposes, data related to the environmental impact of 3DxVERSE will be collected using sensors deployed in the airports. |
| <ul style="list-style-type: none"> • Sustainable Living Communities | <ul style="list-style-type: none"> • Environmental | <ul style="list-style-type: none"> • For evaluation purposes, data related to sustainable energy sources and scenarios for positive energy district, including per building and per local energy common energy consumption and production such as Wind, Solar and Hydrogen. Also, societal impact such as noise of Wind Turbines. |
| <ul style="list-style-type: none"> • 3D Geo Data | <ul style="list-style-type: none"> • 3D mapping | <ul style="list-style-type: none"> • 3D mapping of building, Geo Area and with Geo Spatial Data Sources like Satellites, Lidar / Photogrammetry Models from Drones / Planes and 3D mapping of streets and in buildings. • Geo Data from public and commercial data providers including Weather/Climate, Building Information, Statistics information of local economic, demographic, infrastructure providers. |

Table 2: Illustration of Technical data

The technical data are produced/collected/shared during the use case operations allowing the execution of the trials. Thus, it is of high importance for the evaluation phase of the project. In fact, the evaluation team relies on a subset of the technical data to conduct the evaluation processes. Some of the technical data are confidential to the Pilot Sites while others will be provided to the evaluation team and will be later publicly available following the ORDP scheme.

The requirements regarding the handling of technical data and the cybersecurity aspects are discussed in detail in D5.1 Security and Privacy of Digital Twins: first report[M6] and D5.2 Security and Privacy of Digital Twins: final report [M30].

2.2.2 Evaluation data

The evaluation data category includes the technical data that will be collected during the trials. The data is selected following the evaluation methodology, the main purpose being the calculation of KPIs. The evaluation data collection and storage rely on the data collection tools described in T7.5: Technology readiness evaluation for pilots.

The project’s evaluation methodology is depicted in the Figure 3: **3DxVERSE Evaluation Methodology**.

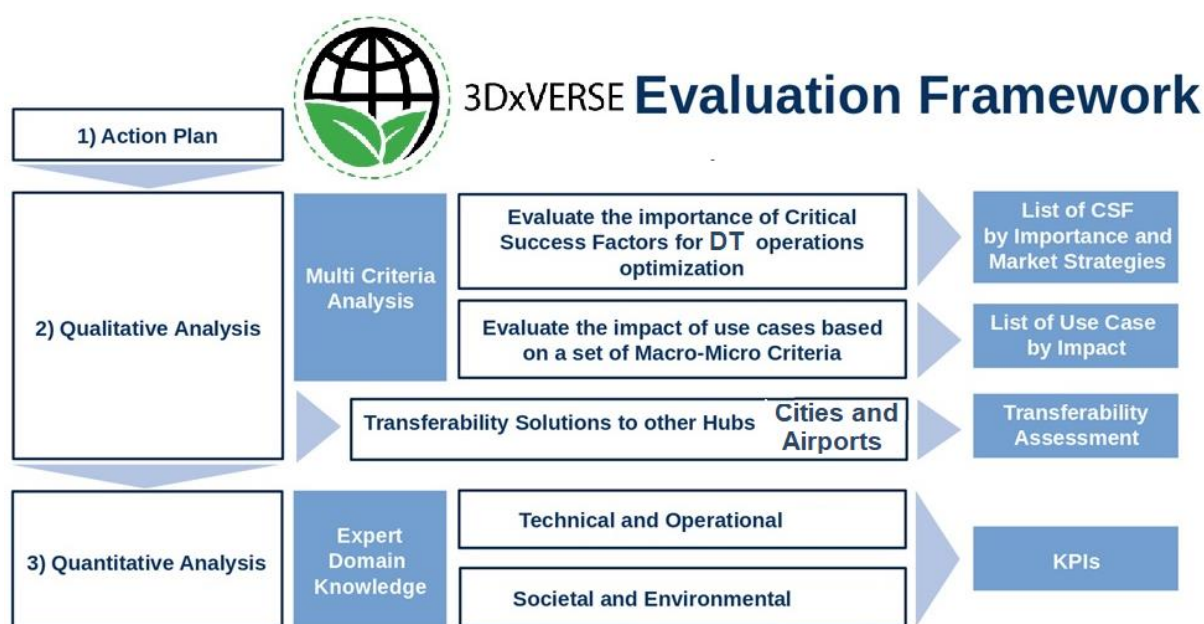


Figure 3: 3DxVERSE Evaluation Methodology

This evaluation methodology uses a Multicriteria Analysis method based on two main components: i) the Key Performance Indicators (KPIs) and Macro/Micro Criteria and ii) the Critical Success Factor (CSF). The KPIs are collected at each Pilot Site and used to assess the impact of 3DxVERSE Platform and of the Use Cases in the Pilot Site. The Macro/Micro Criteria is a business strategic approach that break down the goals of the project (i.e. Macro Criteria) into measurable objectives (i.e. Micro Criteria) that can be then evaluated using selected metrics (KPIs), while the latter extracts knowledge from port managers, employees and other stakeholders to understand whether the technologies introduced by the 3DxVERSE project improved the previous operations.

Table 3 describes some of the KPIs example that will be used for the evaluation. The detailed sets of data collected for each KPI per Pilot Site will be provided in T7.5: Technology readiness evaluation for pilots.

| Macro-criteria | Micro-Criteria | KPI | Description |
|----------------------------------|--|--|---|
| Technical and Operational | Provide accurate communications and recommendations for operations | Urban Mobility Efficiency | The total traffic throughput served per geographic area: Traffic Flow Optimization, Public Transport Utilization/Taxis, Carbon Footprint Reduction |
| | | Area traffic capacity | |
| | | Energy Consumption and Efficiency | Energy Usage in Buildings: Monitoring and reducing energy consumption in residential and commercial buildings. Renewable Energy Adoption: Percentage of total energy consumption from renewable sources (solar, wind, etc.). |
| | | Operational Efficiency for airports | Passenger Throughput: Reduction in wait times at security, check-in, and baggage claim. Flight On-Time Performance: Increase in the percentage of flights departing and arriving on time. Airport Space Utilization: Optimized use of terminal space and other airport facilities (gates, lounges, etc.). |
| | | Airport resource Optimisation | Staff Allocation Efficiency: Better management of airport staff based on real-time passenger flow data. Aircraft Turnaround Time: Reduction in the time needed to prepare aircraft for the next flight. Energy Usage per Terminal: Reduction in energy consumption in terminals and other buildings. |
| Passenger Experience | | Customer Satisfaction Score: Improved ratings from passengers on aspects like check-in, security, and overall experience. Baggage Handling Efficiency: Reduction in lost or delayed baggage incidents. Passenger Journey Time: Reduced total time spent from check-in to boarding. | |
| Noise Exposure Contours | | Total Area within Noise Exposure Contours (dB Levels): This KPI tracks the total land area within specific noise thresholds (e.g., 55 dB, 65 dB, 75 dB) from aircraft movements. Population Impacted by Noise: Measures the number of people living or working in areas affected by noise above a certain threshold (e.g., 65 dB). Noise Impact Zones for Specific Aircraft Movements: Analyses how specific types of aircraft or particular flight routes impact noise levels in surrounding areas. | |

| | |
|---|---|
| Urban Development Compliance | <p>Percentage of Development Projects in Restricted Areas: Measures how many new developments or construction projects are being planned within areas where specific rules should apply (e.g., no new houses or noise-sensitive buildings). A lower percentage indicates better adherence to development restrictions.</p> <p>Number of Non-compliant Developments: Tracks the number of developments that do not comply with urban development rules in restricted zones (e.g., illegal housing construction or buildings sensitive to noise near the airport).</p> <p>Enforcement Actions: Number of legal or administrative actions taken against non-compliant developments, such as fines or building permits being revoked.</p> |
| Coverage area probability in a city/airport | <p>The area under consideration in which a service is provided by the mobile radio network to the end user in a quality (i.e., data rate, latency, packet loss rate) that is sufficient for the intended application.</p> |
| Reliability | <p>The amount of sent packets successfully delivered to a given system node within the time constraint required by the targeted service, divided by the total number of sent network layer packets or percentage of packets properly received within the given maximum E2E latency.</p> |
| Increase number of ITC services | <p>Availability</p> <p>The amount of time a system is in condition to deliver services divided by the amount of time it is expected to deliver services in a specific area. The availability in percent is defined as the number of places (related to a predefined area unit or pixel size) where the Quality of Experience (QoE) level requested by the end-user is achieved divided by the total coverage area of a single radio cell or multi-cell area (equal to the total number of pixels) times 100.</p> |
| Bandwidth | <p>The maximal aggregated total system bandwidth</p> |
| Coverage | <p>The amount of Maximum Coupling Loss (MCL) in uplink (UL) and downlink (DL) between a UE and a TRxP (antenna connectors for a data rate of x bps). The coverage target should be >160 dB.</p> |

| | | | |
|----------------------|--|---|---|
| | Degree of centralization of data and information sources | of OSM-VNF/Private and 5G network components onboarding and configuration | The amount of time required to complete the operation should be less than 15 min. |
| | Decrease traffic and incidents | Reduced density of vehicles in the yard | The density of vehicles in the case study area |
| Environmental | Decrease health risks for workers | Air quality | The amount of pollutants found types (e.g. NOx, HC, PM, etc.) |
| Societal | Improve quality of working environment | Improved yard vehicle operator safety | The amount of injuries |

Table 3: A subset of 3DxVERSE KPIs -as example

2.2.3 Open research data

2.2.3.1 Open research data category

3DxVERSE has agreed to participate in the Digital Cloud AI 2023 Research Data Pilot and follows the guidelines associated with ‘open’ access to ensure that the results of the project are openly available.

The open research data category includes the data that will be made openly available at the end of the project. It corresponds to a subset of the evaluation data on which the partners agree to publish. Hence, the open research datasets can be of one the subcategories of technical data described in 2.2.1 or include processed data like the KPI calculated during the evaluation.

Since the evaluation phase has not yet begun, it is not yet known what datasets will be publicly shared. This section will be enriched with such information in the second release of the DMP.

2.2.3.2 ORDP participation

3DxVERSE will ensure the open access to all peer-reviewed scientific publications relating to its results and will provide access to the research data needed to validate the results presented in deposited scientific publications. The following lists the minimum fields of metadata that should come with a 3DxVERSE project-generated scientific publication in a repository:

- The terms: “European Union (EU)”, “Horizon Europe”, “Digital Cloud AI”
- Name of the action: DIGITAL-2023-CLOUD-AI-04
- Acronym and grant number: 3DxVERSE, 101168258
- Publication date
- Length of embargo period if applicable
- Persistent identifier

When referencing open access data, 3DxVERSE will include at a minimum the following statement demonstrating EU support (with relevant information included into the repository metadata): “*This project has received funding from the European Union’s Digital Europe programme under grant agreement No. 101168258*”.

More information on the ORD Pilot can be found in Annex 1 of this document.

2.2.4 Internal administrative data

This category refers to the data produced by the project management activities such as meeting minutes, recordings, internal reports, for historical purposes and follow-up. The data is collected by the management team including the project manager, the WP leaders and task leaders. The data is stored using a project management tool that requires the authentication of the users. The internal administrative data is confidential, only for the members of the Consortium.

2.3 Datasets description

2.3.1 General data description

This section provides guidelines on how to describe the different types of datasets to be collected and shared by 3DxVERSE after the end of the project with respect to ORDP which aims to improve and maximise access to and re-use of research data generated by DIGITAL-2023-CLOUD-AI projects.

As the nature and extent of these datasets can evolve during the project, updates of the description will be provided in the next version of the DMP.

The description of the different datasets should provide information on their reference, file format, standards, methodologies, metadata and repository to be used. More detail is given below.

2.3.2 Template used for 3DxVERSE dataset description

Table 4: Template for dataset reference provides the template to be used to describe 3DxVERSE datasets.

| | |
|-------------------------------|---|
| Dataset Reference | Each dataset will have a reference that will be generated by the combination of the name of the project, the trial site, the use case in which it is generated and the datatype: “3DxVERSE_Pilot_Site_UC_Datatype”. |
| Dataset Name | Name of the dataset. |
| Dataset Description | Each dataset will have a full data description explaining the data provenance, origin and usefulness. Reference may be made to existing data that could be reused. |
| Standards and metadata | The metadata attributes list to be used to find the dataset. Metadata can be split into 4 categories: <ul style="list-style-type: none"> • Design and execution documentation, which corresponds to a high-level description of a data collection. • Descriptive metadata, which describes each component of the dataset (including origin and quality). • Structural metadata, which describes how the data is being organised. • Administrative metadata, which set the conditions on how the data can be accessed and how this is being implemented. |
| File Format | Any format that defines data. |
| Data Sharing | Explanation of the sharing policies related to the dataset between the next options: <ul style="list-style-type: none"> • Open: Open for public disposal. |

- Embargo: It will become public when the embargo period applied by the publisher is over. In case it is categorised as embargo, the end date of the embargo period must be written in DD/MM/YYYY format.
- Restricted: Only for project internal use

Each dataset must:

- Have its distribution license
- Provide information about personal data
- Mention if the data is anonymised or not
- Tell if the dataset entails personal data and how this issue is considered.

Archiving and Preservation

The preservation guarantee and the data storage during and after the project (for example databases, institutional repositories, public repositories, etc.).

Table 4: Template for dataset reference

2.4 Conclusion

This chapter proposes a summary of the data handled in 3DxVERSE by providing a description of the corresponding data categories as well as information on the management of the data with regards to data collection and sharing. It also provides a guideline to describe the shared datasets.

3 ON MAKING 3DXVERSE DATA FAIR

3DxVERSE will use the FAIR (Findable, Accessible, Interoperable and Reusable) approach for the data generated during the project. The FAIR principles aim to improve the practices for data management and data curation. These principles can be applied to a wide range of data management purposes, whether it is data collection or data management of larger research projects regardless of scientific disciplines. The FAIR principles are described in the guidelines for H2020 data management (European Commission Directorate-General for Research & Innovation, 2016) and they serve as a template for data lifecycle management. They also ensure that the most important components for lifecycle are covered. 3DxVERSE will commit to the following actions to implement the FAIR principles.

Making data Findable, including provisions of metadata in 3DxVERSE datasets:

- The datasets will have rich metadata to facilitate the findability. Open data formats (csv, xml) will be used.
- All the datasets will have Digital Object Identifiers provided by a public repository
- The reference used for the dataset will follow a format like, for example: “3DxVERSE_Pilot_Site_UC_Datatype_XX” (XX: identifier to be added for similar datasets).
- The standards for metadata will be defined for each dataset as described in section 2.3.2 (standards and metadata).

Making data openly Accessible:

- The datasets for evaluation will be described using the recommendations of metadata description from the ‘Standards and Metadata’ entry in the Table 4 Template for dataset reference.
- The data and their associated metadata will be made available either in a public repository or in an institutional repository. The Registry of Research Data Repositories¹ provides a useful listing of

¹ <https://www.re3data.org/>

repositories that you can search to find a place of deposit. For example, ZENODO² has already been chosen for some EU HE and H2020 projects and could be used in the case of the 3DxVERSE project

- The datasets are retrievable by their identifier using a standardised, open, free and universally implementable communications protocol.
- The protocol allows for an authentication and authorization procedure, where necessary. **Table 4: Template for dataset reference** will be used to provide information on the methods or software used to access the data.

Making data Interoperable:

- The metadata vocabularies, standards and methodologies will depend on the public repository and use the recommendations of metadata description from the Standards and Metadata entry in the **Table 4: Template for dataset reference**.
- The definition of the data formats will be made in the WP3 (Digital Twin Interoperability Testbed & Reference Architecture), WP6 (Use Case Design) and WP7 (Integrate interoperable digital twin testbed). The goal is to have the same format across Pilot Sites which will enable the development of common data quality check tools and enable partners responsible of the evaluation dealing with the same format across all pilot sites.

Making data re-usable (through clarifying licenses):

- All data producers will license their data to allow the widest reuse possible. Examples of licenses are available at <https://opendefinition.org/licenses/>.
- By default, the data will be made available for reuse. If any constraints exist, an embargo period will be mentioned in the Data Sharing row of **Table 4** to keep the data from reuse for a limited period of time.
- The data producers will make their data available for third parties within public repositories. The data will be reused for the scientific publication's validation purpose.

4 ALLOCATION OF RESOURCES TO DATA MANAGEMENT

The cost to make the data FAIR in 3DxVERSE shall be handled by each partner who will have to generate its data according to the requirements expressed in the Data Management Plan.

In the project, Harm Jan Arendshorst (ILABS) as Data Manager and Lampros Stergioulas (HHS) as Deputy Data Manager, will liaise with the TMT (Technical Management Team) about the data management issues. The Data Manager leads data management plan tasks and participates in the project coordination in terms of the evaluation data collection, storage and handling, as well as data publication as part of the ORDP.

All research data collected as part of this project is owned by the data producers or partners involved in the Pilot Sites. The partners in 3DxVERSE will take the responsibility for the collection, management, and sharing of the research data. Quality assessment will be the responsibility of the data manager of each Pilot Site.

² <https://zenodo.org/>

5 DATA MANAGEMENT PER WORK PACKAGE

5.1 Introduction

This chapter addresses the data management approach taken in each work package. It provides insight on what kind of data is handled by the work packages. It is important to note that the data addressed in this chapter belongs to the categories defined earlier but are managed in an aggregated way (mostly as deliverables). This chapter is inspired from the deliverable D6.4 of 5G-LOGINNOV[2].

For each work package, the collected datasets are described using a table containing:

- Data set reference and name: Pointer to the deliverable containing the data
- Data set description: Description of the data that will be generated or collected
- Data collection procedures: Description of how the data was collected or produced
- Data privacy: Description of how data is kept confidential, if applicable
- Data sharing/confidentiality: Description of how data will be shared, e.g. publicly available or consortium internal only

5.2 WP1 Ethics requirements

Deliverables D1.1, D2,3, D2,4 and D2.5 are dedicated to the ethical aspects of the 3DxVERSE project.

5.3 WP2 Project management and coordination

| WP2 | Project management and coordination |
|-------------------------------------|---|
| Data set reference and name | Project management plan coordination |
| Data set description | Report on governance procedures and bodies, related meetings, management tools as well as the internal rules of procedures. |
| Data collection procedures | Produced by the management team. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D2.2. |
| Data set reference and name | Innovation management plan |
| Data set description | Innovation plan and results. |
| Data collection procedures | Use of the CEN TS-16555 series of innovation management standards. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D2.1 and D2.2. |
| Data set reference and name | Data management plan |
| Data set description | List of 3DxVERSE data sets including those that will be published for research purposes. |

| | |
|-------------------------------------|--|
| | Set of guidelines for data management, description of the tools to manage research data. |
| Data collection procedures | Produced by the data management team. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D2.2. |
| Data set reference and name | Quality and risk management plan |
| Data set description | Set of guidelines and rules to efficiently manage risks and develop high quality reports and deliverables. |
| Data collection procedures | Produced by the management team. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D2.2. |

5.4 WP3 Digital Twin Interoperability Testbed & Reference Architecture

| WP3 | Digital Twin Interoperability Testbed & Reference Architecture |
|-------------------------------------|--|
| Data set reference and name | Digital Twin Interoperability Testbed & Reference Architecture |
| Data set description | Process for the reference architecture and DT interoperability testbed. |
| Data collection procedures | The data related to the DT reference architecture per pilot site. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverables D3.1 (intermediate version) and D3.2 (final version). |
| Data set reference and name | Data collection and evaluation procedures |
| Data set description | Information on the tools used for collecting and managing test data. |
| Data collection procedures | Not applicable. |
| Data privacy | The software source code will be open. |
| Data sharing/confidentiality | Textual description is publicly available as deliverable D3.2. |

5.5 WP4 Digital Commons Framework for Digital Twin & DPI

| WP4 Digital Commons Framework for Digital Twin & DPI | |
|--|---|
| Data set reference and name | Digital Commons Framework for DT & DPI |
| Data set description | Digital Commons Framework for DT & DPI |
| Data collection procedures | The data related to Digital Commons Framework for DT & DPI. |
| Data privacy | GDPR must apply if any questionnaire answer or interviews transcription will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverable D4.1. |
| Data set reference and name | Digital Commons Framework for DT & DPI |
| Data set description | Report on the process and results of the Digital Commons Framework for DT & DPI |
| Data collection procedures | The data related to Digital Commons Framework for DT & DPI. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D4.2. |
| Data set reference and name | Achievements with new actors and opportunities |
| Data set description | New business models for DT and living communities |
| Data collection procedures | The data related to Digital Commons Framework for DT & DPI. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D4.2. |
| Data set reference and name | Lesson learned and recommendations for stakeholders |
| Data set description | Recommendations to key stakeholders, to support the emergence of a European offer for new DT technologies enhancing next generation AI, AR, VR, IoT in Europe and beyond. |
| Data collection procedures | Recommendations based on WP4 results with consideration of roadmaps for sustainable logistics. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D4.2. |

5.6 WP5 Security & Privacy of Digital Twin

| WP5 | Security & Privacy of Digital Twins |
|-------------------------------------|---|
| Data set reference and name | Security & Privacy of Digital Twins |
| Data set description | Security & Privacy of Digital Twins |
| Data collection procedures | The data related to Security & Privacy of Digital Twins. |
| Data privacy | GDPR must apply if any questionnaire answer or interviews transcription will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverable D5.1. |
| Data set reference and name | Security & Privacy of Digital Twins |
| Data set description | Report on the process and results of the Security & Privacy of Digital Twins |
| Data collection procedures | The data related to Security & Privacy of Digital Twins. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D5.2. |
| Data set reference and name | The data related to Security & Privacy of Digital Twins. |
| Data set description | Security & Privacy of Digital Twins data related to living communities and airports |
| Data collection procedures | The data related to Security & Privacy of Digital Twins. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D5.2. |
| Data set reference and name | Lesson learned and recommendations for stakeholders |
| Data set description | Recommendations to key stakeholders, to support the emergence of a European offer for DT technologies enhancing next generation AI, IoT, AR, VR in Europe and beyond. |
| Data collection procedures | Recommendations based on WP5 results with consideration of roadmaps for sustainable logistics. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D5.2. |

5.7 WP6 Use Case Design

| WP6 | Use Case Design |
|-------------------------------------|---|
| Data set reference and name | Use cases |
| Data set description | Use cases description. |
| Data collection procedures | The data related to use cases per pilot site. |
| Data privacy | GDPR must apply if any questionnaire answer or interviews transcription will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverable D6.1 Digital Twin for sustainable living Communities-Use Case Design, Digital Twin for Airport: use case design |
| Data set reference and name | The data related to use cases per pilot site |
| Data set description | Report on the process and results of the Use case design |
| Data collection procedures | The data related to use cases per pilot site |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D6.2. |
| Data set reference and name | Achievements with new actors and opportunities |
| Data set description | New use cases. |
| Data collection procedures | The data related to use cases per pilot site |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D6.3: Design digital twin simulation models |
| Data set reference and name | Lesson learned and recommendations for stakeholders |
| Data set description | Recommendations to key stakeholders, to support digital twin simulation models. |
| Data collection procedures | The data related to digital twin simulation models per pilot site. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D6.4(final). |

5.8 WP7 Integrate interoperable digital twin testbed

| WP7 Integrate interoperable digital twin testbed | |
|--|---|
| Data set reference and name | Trial methodology, planning and coordination |
| Data set description | Overall trial methodology including templates for testbed scenarios, test cases, questionnaires and description of the data collection process. |
| Data collection procedures | The trial methodology is collectively specified by the involved partners. The data collection process relies on D7.1 input and D7.2 for Digital Twin for sustainable living Communities-Integration interoperable digital twin testbed. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D7.1&D7.2. |
| Data set reference and name | Pilot Sites trials preparation report |
| Data set description | Trial scenarios and test cases specifications per Pilot Site. |
| Data collection procedures | The trial scenarios and the test cases are specified by each Pilot Site using the methodology defined in D7.1 and D7.2. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D7.2. |
| Data set reference and name | Digital Twin for Airport -Integration interoperable digital twin testbed |
| Data set description | Evaluation and assessment of pilot sites data and trial results for operation optimization according to the tests scenarios defined in D7.2 and D7.4. |
| Data collection procedures | The results of evaluation are produced collectively by the involved partners. |
| Data privacy | GDPR must apply if any questionnaire answer will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverable D7.3. |
| Data set reference and name | Evaluation of social, economic and environmental impacts |
| Data set description | Evaluation and assessment of pilot sites data and trial results regarding the social, economic and environmental impacts. |
| Data collection procedures | The results of evaluation are produced collectively by the involved partners. |

| | |
|-------------------------------------|--|
| Data privacy | GDPR must apply if any questionnaire answer or interviews transcription will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverable D7.4. |

5.9 WP8 Pilots and Citizen Engagement

| WP8 | Pilots and Citizen Engagement |
|-------------------------------------|--|
| Data set reference and name | Plan to involve pilots and citizen |
| Data set description | Plan of activities to boost market and involve new actors. |
| Data collection procedures | State of the art, use of questionnaires, market analysis. |
| Data privacy | GDPR must apply if any questionnaire answer or interviews transcription will be available in the data set. |
| Data sharing/confidentiality | Publicly available as deliverables D8.1 and D8.2. |
| Data set reference and name | Digital twin for sustainable living communities and energy transition |
| Data set description | Report Digital twin for sustainable living communities and energy transition. |
| Data collection procedures | Citizen engagement. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D8.3 and D8.4. |
| Data set reference and name | Digital Twin for sustainable airport and living environment |
| Data set description | Digital Twin for sustainable airport and living environment |
| Data collection procedures | |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D8.5 and D8.6 |
| Data set reference and name | Interoperability and Data Governance |
| Data set description | Interoperability and Data Governance |
| Data collection procedures | Recommendations based on WP4 results with consideration of roadmaps for sustainable logistics. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D8.6. |

5.10 WP9 Dissemination, Communication and exploitation

| WP9 | Dissemination Communication and Exploitation |
|-------------------------------------|---|
| Data set reference and name | Communication and dissemination plan |
| Data set description | Communication and dissemination plans and materials (slides, flyers ...). |
| Data collection procedures | Not applicable. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | The plans are publicly available as deliverable D9.1, D9.2 (initial version) and D9.3 (final version). |
| Data set reference and name | Impact analysis report |
| Data set description | Framework for the commercialization of 3DxVERSE solutions. |
| Data collection procedures | Usage of Key Exploitable Results (KER), identification of the involved stakeholders, risk and transferability analysis. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D9.4 |
| Data set reference and name | Advisory board and Community Empowerment |
| Data set description | Advisory board & community |
| Data collection procedures | Not applicable. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D9.5 |
| Data set reference and name | Exploitation plan and report |
| Data set description | Framework for the commercialization of 3DxVERSE solutions. |
| Data collection procedures | Usage of Key Exploitable Results (KER), identification of the involved stakeholders, risk and transferability analysis. |
| Data privacy | Not applicable. |
| Data sharing/confidentiality | Publicly available as deliverable D9.6 (intermediate version) and D9.7 (final version). |

5.11 Conclusion

This chapter describes the data that contributes to each of the work packages objectives and their management. The data belongs to the categories identified in the previous chapter even if it is presented in an aggregated way (mostly as deliverables).

6 ETHICAL AND PRIVACY ASPECTS

6.1 Ethics deliverables

Ethics requirements are the subject of the Work Package 1: Ethics requirements and WP2: Project management and coordination be thoroughly described in the following deliverables:

D1.1 OEI - Requirement No. 1[M1]

An independent Ethics Advisor must be appointed to monitor the ethics issues involved in this project and how they are handled. The Advisor must be consulted at least on the real-time video surveillance by means of body-worn cameras, portable cameras and drone surveillance. A report by the Ethics Advisor must be submitted as a deliverable at the end of each reporting period.

D2.3 Ethics Report 1[M3]

H-Requirement No.1) addresses ethical compliance issues relating to the use of human participants in the Project's test activities. This document describes the procedures that the Project beneficiaries will adopt to make certain that recruitment and involvement of test subjects is voluntary and based on informed consent. This document will present the procedures and criteria that will be used to identify/recruit research participants. The informed consent procedures that will be implemented for the participation of humans must be submitted as a deliverable. Templates of the informed consent/assent forms and information sheets (in language and terms intelligible to the participants) must be submitted as a deliverable.

D2.4 : POPD - Requirement No. 2 [M15]

This deliverables focuses on the protection of personal data of 3DXVERSE, aiming at providing a single point of reference for the quality management processes implemented during the project. As Digital - Cloud-AI project, 3DXVERSE is bound by a set of Ethics requirements that touch on various aspects of its work plan, specifically the use of human participants in trials, personal data processing and the proper use of technology in the project.

D2.5 GEN – Requirement No. 3[M30]

This document is the deliverable D2.5 – General requirements- on the misuse of technology, aiming at describing the measures that 3DXVERSE will take to prevent the unethical use of the Projects materials, methods and technologies and of the knowledge generated. As a Digital-Cloud-AI project, 3DXVERSE is bound by a set of Ethics requirements that touch on various aspects of its work plan, specifically the misuse of technologies such as Artificial Intelligence (AI), machine learning (ML), Virtual Reality (VR), Augmented Reality (AR), and Extended Reality (XR) in trials and during the project.

The dissemination level of the Deliverables from WP1 and WP2 is confidential, only for members of the consortium including the Commission Services.

6.2 An approach to comply with GDPR in 3DxVERSE

This section refers to the terminologies in the General Data Protection Regulation (GDPR: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016) and provides an initial application of those terminologies to 3DxVERSE project. The approach proposed to handle the GDPR in the 3DxVERSE project consists in identifying all the concerned parties and identifies the actions they need to take in order to comply with the regulation. More specifically, this approach consists of six steps:

1. The first step consists in appointing a Data Protection Officer (DPO) and defining his mission in 3DxVERSE.
2. During this step, a complete cartography of the personal data processing will be made.
3. Based on the results of the previous step, priorities need to be set about the personal data processing which may be riskier.
4. This step consists in conducting a Data Privacy Impact Assessment to evaluate the risks of the processing identified during the previous step.
5. During this step, the procedures are implemented for 3DxVERSE in order to provide the protection of the personal data according to the GDPR.
6. This final step concerns the provision of a clear documentation of the whole data protection procedure that has been implemented.

Thus, this approach will enforce that personal data collected in 3DxVERSE shall be (Article 5):

- processed lawfully, fairly and in a transparent manner in relation to individuals,
- collected for specified, explicit and legitimate purposes and further processed for scientific purposes,
- adequate, relevant and limited to what is necessary for the purposes for which they are processed,
- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the personal data are processed,
- processed in a manner that ensures appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage.

Further refinement of the above-mentioned approach will be provided in next versions of this deliverable including for example a template to be filled by each data processor.

Since the project declares that the research involves personal data collection and/or processing, each data processor under the control of the data controller and the Data Protection Officer will declare how GDPR rules are fulfilled in a separate document.

7 DATA SECURITY

This chapter presents the overall security requirements to be fulfilled by the project and each Pilot Site. Two specific deliverables D5.1 – Security and Privacy of Digital Twins: first report[M6] and D5.2 – Cyber Security and compliance: final report[M30] will describe the Security and Privacy of Digital Twins to ensure compliancy with GDPR and cyber protection for safe port operations. D5.2 is SENSITIVE, only for members of the consortium, including the Commission Services.

The data produced during the execution of 3DxVERSE shall be stored per Pilot Site in local servers if deemed necessary and in a central server for the whole project. Those data are made compliant with the GDPR as described in the Deliverables D5.1 and D5.2. This chapter describes some security principles that are implemented in order to protect against any type of modification. Also, a more thorough management of the servers could be made using the ISO 27001 standards, the BSI-Standards or the ENISA Good practices. The security principles are listed below.

Authentication: All the users wanting to get access to the 3DxVERSE servers shall be authenticated. Also, proper means are used to authenticate the servers when necessary.

Authorization: The access to 3DxVERSE data servers is only available to the authenticated and authorised users. These categories and the rights of those users are defined and enforced. The appropriate access control policies and mechanisms (including physical access control) shall be identified for each trial site and project wide to provide the authorization.

Accounting: In 3DxVERSE any access and modification to a resource by any user is securely logged in order to prevent users from denying that data files were accessed, altered or deleted, when auditing.

Confidentiality: The data stored in 3DxVERSE servers shall be encrypted during transmission and storage.

Communication Security: Access to 3DxVERSE servers shall be done through encrypted communication channels such as HTTPS and IPsec.

Data Integrity: The data collected during 3DxVERSE shall be protected from malicious and accidental modifications by any users during their transmission or their storage. Cryptographic mechanisms such as hash functions and digital signatures shall be used.

Availability: This security principle assures that the 3DxVERSE servers shall be available for 3DxVERSE users during the defined interval of service. Also, regular backups of the data should be made.

8 CONCLUSION

This deliverable provides an overview of the data handled in 3DxVERSE. It describes the project's data categories and gives information on their management. It addresses the implementation of the FAIR principles in the project as well as the data management per work packages.

Since 3DxVERSE participates in the DIGITAL-2023-CLOUD-AI Open Research Data Pilot, guidelines associated with 'open' access are described to ensure that the results of the project are openly available to the research community. With this document, the project commits to ensure the open access to all peer-reviewed scientific publications relating to its results and will provide access to the research data needed to validate the results presented in deposited scientific publications.

This document constitutes the first release of the Data Management Plan. In the final release, more details will be provided comparatively, specifically regarding the description of the shared datasets, the standards and methodologies, the sharing and storage methods.

It is important to note that the Data Management Plan is a living document and will be constantly updated until the end of the 3DxVERSE project.

9 REFERENCES

[1] GRANT AGREEMENT Project 101168258 — 3DxVERSE

[2] Deliverable D6.4 of 5G-LOGINNOV: <https://5g-loginnov.eu/deliverables/deliverable-d6-4-data-management-plan-2>

ANNEX 1: OPEN RESEARCH DATA PILOT (ORDP)

Open access refers to the online provision of scientific information that is free of charge to the end-user and reusable. This scientific information handles the peer-reviewed scientific research articles/publications and the research data underlying publications.

Under the DIGITAL-2023-CLOUD-AI programme, the project must also aim to deposit the research data needed to validate the results presented in the deposited scientific publications, known as “underlying data”. In order to effectively supply this data, projects need to consider at an early stage how they are going to manage and share the data they create or generate under DIGITAL-2023-CLOUD-AI0 guidelines on data management and with respect of 3DxVERSE grant agreement.

The Commission is running a flexible pilot under DIGITAL-2023-CLOUD-AI called the Open Research Data Pilot (ORD pilot). The ORD pilot aims to improve and maximize access to and re-use of research data generated by DIGITAL-2023-CLOUD-AI projects and takes into account the need to balance openness and protection of scientific information, commercialization and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions.

By extending the pilot, open access becomes the default setting for research data generated in DIGITAL-2023-CLOUD-AI. (European Commission, s.d.)

However, not all data can be open. Projects can therefore opt out at any stage (either before or after signing the grant) and so free themselves retroactively from the obligations associated with the conditions – if:

- Participation is incompatible with the obligation to protect results that can reasonably be expected to be commercially or industrially exploited
- Participation is incompatible with the need for confidentiality in connection with security issues
- Participation is incompatible with rules on protecting personal data
- Participation would mean that the project's main aim might not be achieved
- The project will not generate / collect any research data or
- There are other legitimate reasons (you can enter these in a free-text box at the proposal stage).”

After depositing publications beneficiaries must ensure open access to those publications via the chosen repository.

“The two main routes to open access are:

- Self-archiving / 'green' open access – the author, or a representative, archives (deposits) the published article or the final peer-reviewed manuscript in an online repository before, at the same time as, or after publication. Some publishers request that open access be granted only after an embargo period has elapsed.
- Open access publishing / 'gold' open access - an article is immediately published in open access mode. In this model, the payment of publication costs is shifted away from subscribing readers. “

In the research context, examples of data include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. The focus is on research data that is available in digital format and stored in a public repository. Normally, users can

access, mine, exploit, reproduce, and disseminate openly accessible research data free of charge as explained in the following figure.

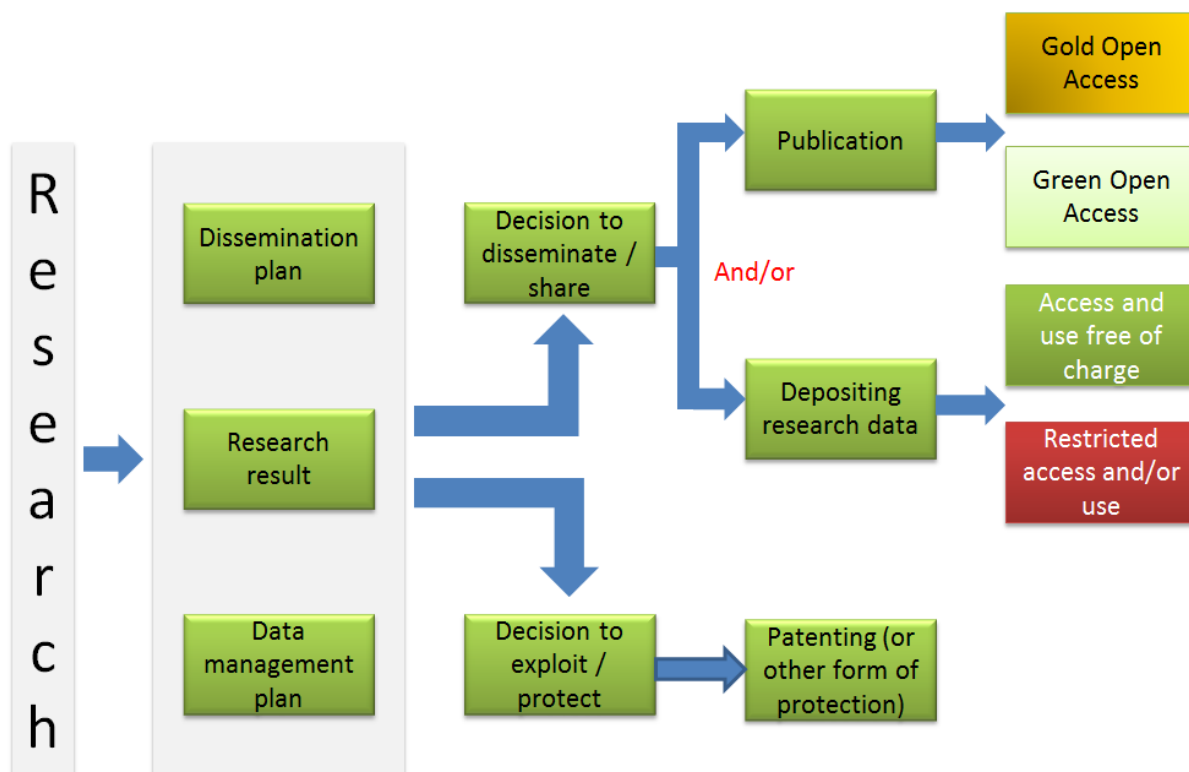


Figure 4: Principles of open access to research data