The Framework Programme for Research & Innovation
Innovation actions (IA)

Project Title:

Autonomous self powered miniaturized intelligent sensor for environmental sensing and asset tracking in smart IoT environments

AMANDA

Grant Agreement No: 825464

[H2020-ICT-2018-2020] Autonomous self powered miniaturized intelligent sensor for environmental sensing and asset tracking in smart IoT environments

Deliverable

D8.7 Data management plan & ethics v4

Deliverable No.		**D8.7**	
Workpackage No.	**WP8**	Workpackage Title and task type	**Project Management**
Task No.	**T8.3**	Task Title	**Data management, Ethics and Standardization**
Lead beneficiary		**CERTH**	
Dissemination level		**PU**	
Nature of Deliverable		**R**	
Delivery date		**30 September 2021**	
Status		**Final**	
File Name:		**AMANDA_D8.7_Data_management_plan_and_ethics_v4-v1.0**	
Project start date, duration		**02 January 2019, 45 Months**	

This project has received funding from the European Union's Horizon 2020 Research and innovation programme under Grant Agreement n°825464

Authors List

Leading Author (Editor)			
Surname	**Initials**	**Beneficiary Name**	**Contact email**
Kouzinopoulos	CS	CERTH	kouzinopoulos@iti.gr

Co-authors				
#	**Surname**	**Initials**	**Beneficiary Name**	**Contact email**
1	Bellanger	MB	Lightricity	mathieu.bellanger@lightricity.co.uk
2	Bembnowicz	PI	IMEC-NL	pawel.bembnowicz@imec.nl
3	Kanlis	AK	CERTH	alexkanlis@iti.gr
4	Karanassos	DK	CERTH	dkaranassos@iti.gr
5	Kauer	MK	Lightricity	matthias.kauer@lightricity.co.uk
6	Sideridis	PS	CERTH	sideridis@iti.gr
7	Van de Wiel	RW	IMEC-NL	rik.vandewiel@imec.nl
8	Van Hal	RH	IMEC-NL	roy.vanhal@imec-nl.nl

Reviewers List

List of Reviewers				
#	**Surname**	**Initials**	**Beneficiary Name**	**Contact email**
1	Brütsch	MB	ZHAW	manuel.bruetsch@zhaw.ch
2	Meli	MM	ZHAW	marcel.meli@zhaw.ch
3	Vujičić	OV	PENTA	oskar.vujicic@penta.hr

Document history			
Version	**Date**	**Status**	**Modifications made by**
V0.3	19/01/2020	Updates to Deliverable D8.3 with new developments on the Data Management Plan and the Data Management Portal	CERTH
V0.6	05/4/2020	Additional updates to the document, including more data files in Section 2.2	CERTH
V0.7	25/04/2020	Added documentation on datasets of the DMP	IMEC
V0.8	01/06/2020	Submitted for internal review	CERTH
V0.9	16/06/2020	Received feedback from reviewers	ZHAW, PENTA
V1.0	30/06/2020	Final version, ready for submission	CERTH
V1.2	05/11/2020	Included data from the evaluation of the second iteration of the unconstrained prototype	CERTH
V1.4	29/09/2021	Included data from the evaluation of the third iteration of the unconstrained prototype	CERTH
V1.6	18/10/2021	Included energy evaluation data and measurements from the CO_2 sensor	ZHAW, IMEC
V2.0	28/12/2021	Final version, ready for submission	CERTH
V2.1	07/02/2022	Added scientific papers to Zenodo	CERTH
V2.2	16/08/2022	Included additional datasets and scientific papers from the Consortium	CERTH
V2.8	15/09/2022	Incorporated comments from the reviewers	CERTH, ZHAW, PENTA
V3.0	30/09/2022	Final version, ready for submission	CERTH

List of definitions & abbreviations

Abbreviation	Definition
ASSC	Autonomous Smart Sensing Card
DG RTD	European Commission's Directorate-General for Research and Innovation
DMP	Data Management Plan
GDPR	General Data Protection Regulation
H2020	Horizon 2020
IIoT	Industrial Internet of Things
IPR	Intellectual Property Rights
LEPPI	Legal, Ethical, Privacy and Policy Issues
MCU	Microcontroller Unit
ORDP	Open Research Data Pilot
PMIC	Power Management Integrated Circuit
PV	Photo Voltaic
RF	Radio Frequency
RIA	Research and Innovation Action

Executive summary

This Deliverable provides a general description of the data management, ethics and standardisation of the AMANDA project. Moreover, it focuses on data collected from various activities up to the project's conclusion on M45. The document consists of the following Sections:

- Section 1 provides information about the project scope, the goals of this report and the Legal, Ethical, Privacy and Policy Issues (LEPPI) manager nomination
- Section 2 describes the needs, reasons and methods of AMANDA's data management, together with the implementation of the data management plan during M1-M45 of the project and can be used to track data collected during the project's lifetime
- Section 3 details ethical aspects of the project

This version includes updated information on data handling and ethics for the AMANDA project for the whole duration of the project. Further information is provided with reference to the implementation of the initial plan detailed in **Deliverable D8.3 - Data management plan and ethics v1**, **Deliverable D8.5 - Data management plan and ethics v2** and **Deliverable D8.6 - Data management plan and ethics v3**. Moreover, the Data Management Portal integration is presented, and its technical details analysed. The scientific output of the AMANDA project, uploaded to the data management platform, is also presented.

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1. Overall technical objectives

AMANDA is an ambitious project that developed a unique ASSC (Autonomous Smart Sensing Card) with the size, feel and look of a credit card. The ASSC is ideal for easy deployments in buildings (smart living environments), as a wearable, for infrastructure monitoring and to mitigate issues related to current and future epidemics or pandemics. The project covers the triangle of experimentation, development and standardisation to optimise the materials behaviour, connectivity, miniaturization, power consumption, security, intelligence, design and cost. AMANDA's partners have the expertise and combination of world-class manufacturing infrastructures and know-how. They are using micro- and nano-technology, new composites, innovative architectures and advanced software. AMANDA's vision is to overcome the existing technological challenges and achieve the development of a user-friendly wearable platform not only for indoor and outdoor environmental sensing, but also for asset- and people- tracking. A combination of developed and existing off-the-shelf technologies have been selected and are in the process of integration into the ASSC. Innovative PVs (Lightricity PV) and a PMIC (EPEAS), all packed in under a 3mm thickness. The project introduces technical breakthroughs that further boost miniaturisation, offers increased sensitivity, small footprint and ultra-low power consumption with a maintenance-free lifetime of more than 10 years.

The project execution requires tight cooperation between the partners. This leads to the generation of a significant amount of information, including datasheets, specifications, measurement and reporting data as well as scientific publications. The Data Management Plan (DMP) is in place to ensure that all information is categorised and stored in a safe way and can be accessed at any time by authorised users and, in case of public data, by the scientific community.

All work performed within the AMANDA project aims to incorporate the high standards set by the European Commission. To that end, the consortium put their efforts to make the research data created by the project FAIR [1]: Findable, Accessible, Interoperable and Reusable, in order to ensure that it is soundly managed and accessible.

The FAIR principles indicate different ways to handle data and their respective metadata. This serves as an important factor that leads to knowledge discovery and innovation, while enabling easier data and knowledge integration and reuse. As detailed in [1], the FAIR principles are:

- To be Findable
  - (meta)data is assigned a globally unique and persistent identifier
  - data is described with rich metadata
  - (meta)data clearly and explicitly includes the identifier of the data it describes
  - (meta)data is registered or indexed in a searchable resource
- To be Accessible
  - (meta)data is retrievable by their identifier using a standardized communications protocol
  - the protocol is open, free, and universally implementable
  - the protocol allows for an authentication and authorization procedure, where necessary
  - metadata is accessible, even when the data is no longer available
- To be Interoperable
  - (meta)data uses a formal, accessible, shared, and broadly applicable language for knowledge representation.
  - (meta)data uses vocabularies that follow FAIR principles
  - (meta)data includes qualified references to other (meta)data
- To be Reusable:

- (meta)data is richly described with a plurality of accurate and relevant attributes
- (meta)data is released with a clear and accessible data usage license
- (meta)data is associated with detailed provenance
- (meta)data meets domain-relevant community standards

This document is an updated version of **Deliverable D8.3 - Data management plan and ethics v1**, **Deliverable D8.5 - Data management plan and ethics v2** and **Deliverable D8.6 - Data management plan and ethics v3** submitted on M6, M18 and M36 respectively, which set the basis on which the consortium worked on handling the scientific data produced throughout the duration of the project. In this context, **Deliverable D8.7 - Data management plan and ethics v4** entails the relevant updates, implementations and tools developed by the consortium. The changes introduced in this document include:

- Updates to the outline of the document and modification of the respective Tables and Figures in order to provide the proper relevant information and details as they were explored during the period of M36 - M45
- The newer/relevant datasets that have been created during the period of M36 - M45 are detailed as they are shared via AMANDA's data management platform
- Further documentation, Figures and Tables were provided to argue the validity of the project's strategic data handling

An overview of the data management plan's timeline is provided in Figure 1. Between M36 and M45, the DMP was finalised based on the latest developments for the AMANDA ASSC and the result is reflected in this document. During the same period, additional datasets of the project were collected, as discussed in Section 2.3 and the Data Management Portal was updated, as detailed in Section 2.5.

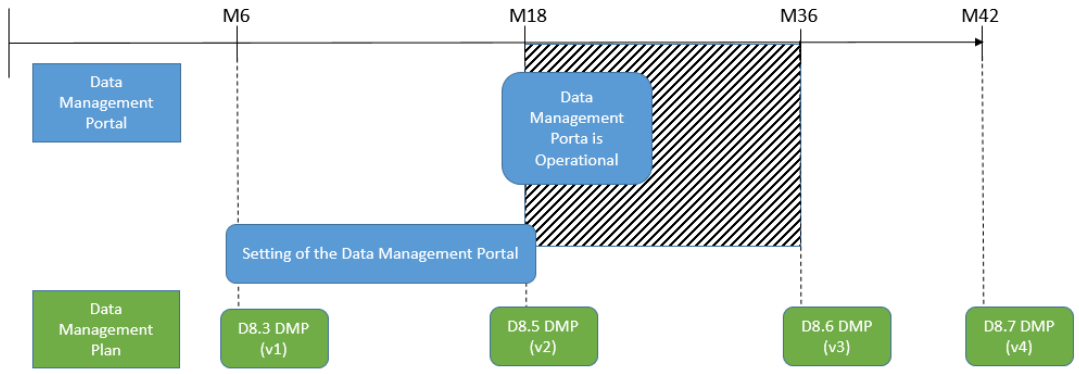


Figure 1 Data management timeline

1.2. Purpose, context and scope of this Deliverable

This document relates to data management and ethic plans within the AMANDA project. The DMP is a living document that evolved during the lifespan of the project. As the project progressed, it was updated as needed whenever significant changes arose, such as dataset updates or evaluation results. The data lifecycle of the AMANDA project followed a six-stage process, based on the methodology of [2], as presented in Figure 2 and detailed below:

- **Planning.** The strategizing on how data will be managed, the creation of a data management plan, and being aware of data policies that apply to the work

- **Collecting**. The data acquisition. It refers to two groups of techniques: documentation and data organization. Documentation can include metadata, and protocols, as well as documentation files and data dictionaries. Organization strategies for data management include file organization, file naming, how to document conventions, and the use of databases
- **Analysing**. Involves data analysis. It includes understanding the difference between managing raw and analysed data, as well as performing data quality management
- **Publishing**. The data-sharing stage of data's lifecycle
- **Preserving**. Data preservation examines the data to retain and how long to retain it, how to prepare data for the long term, and outsourcing data preservation to data repositories
- **Reusing**. Data reuse is the last stage of data management and the one that completes the data cycle

The document describes the process applied by the Consortium to ensure a quality data management and high ethical standards. It enables clear tracking of data collected, not only during the project execution but also after its conclusion.

Figure 2 The data lifecycle [2]

1.3. Appointment of a LEPPI manager

There is a need to appoint a LEPPI manager. The LEPPI manager is responsible for the coordination of all activities related to legal, ethical, privacy and policy issues that may arise during the development and validation phases of the project. In case of issues related to law, ethics and privacy, the LEPPI manager will cooperate and advise the following decisions making bodies: Plenary Board, Quality Control Board and Ethics Helpdesk. Table 1 shows the assigned LEPPI manager, chosen by the project partners.

Partner short name - company	Name	Email
IMEC	Rik van de Wiel	Rik.vandeWiel@imec.nl

Table 1 LEPPI nomination

Rik van de Wiel is a senior employee at IMEC. He has been working as an R&D manager in the field of connected health solutions for eight years. Rik van de Wiel contributed to many data collection trials, including a number of trials in which medical devices were evaluated.

2. Data management plan

A DMP is a key element of proper data management in a RIA project. The plan describes the life cycle for the data generated, collected and processed. A DMP should include information on:

- The data to be collected, processed and/or generated
- The methodology and standards that will be applied
- The dissemination level of the data
- The way data will be curated and preserved, including after the end of the project's duration

The European Commission is running a flexible pilot under Horizon 2020 called the Open Research Data Pilot (ORDP). The ORDP aims to improve and maximize access to research data generated by Horizon 2020 projects. This data should also be reusable. The ORDP 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. The AMANDA project is part of the ORDP, and this Deliverable provides insights regarding the data management, ethics and standardization which are applied within the project and focuses on the data collected up to M18 of the project. The project involves the generation and collection of technical data in different phases, as part of the following Tasks:

- Under **Task T2.2 - Evaluation and Adaptation of off-the-shelf sensors**, off-the-shelf sensors have been evaluated for inclusion to the project. Data of sensor readings has been gathered as part of the evaluation
- Under **Task T2.4 - Data fusion optimization engine**, the output of the data fusion optimisation engine is collected and used in the design, as part of **WP3,** and validation phase, as part of **WP5**, of the project
- The entire energy profile of the AMANDA card, as it goes through different modes, was captured as part of **Task T2.5 - Prototypes finalisation and setting-up sets of multiple sensors & Evaluate sensor and multi-sensor energy requirements**
- Measurements on the interfacing of the power electronics with the system's MCU was performed under **Task T3.4 - Power electronics interfacing with the main system microcontroller**
- Under **Tasks T4.2 - Cybersecurity by design implementation, T4.3 - Edge intelligence and User Interfacing** and **T4.4 - Accurate localisation and tracking tool**, the output of the cybersecurity, edge intelligence and positioning algorithms respectively are captured to assist in the integration of the software components with the system's firmware and to enable their optimisation
- The output of **Task T5.1.5** on the testing of the basic firmware routines are stored to aid in the optional hardware and firmware redesign step under **Task T5.1.6**. The output of the main firmware routines of the system are recorded under **Task T5.1.7**
- The results of the validation activities of **Tasks T6.2 - Lab Environment Validation** and **T6.3 - Overall Evaluation, Lessons Learnt and Improvements** are stored for future reference and to assist in the extraction of a set of conclusions that support the exploitation process of the project and underline key improvements and additions that optimise the system and increase the targeted spectrum of applications

2.1. Procedures of data collection

This Section summarises the active efforts of the AMANDA consortium to ensure that technical data generated and collected during the lifetime of the project are findable, openly accessible, interoperable and reusable.

2.1.1. Data collection process

The data collection description characterises, in plain text and for each data collection, the types of research data that are and will be collected during the study. It also describes how information is and will be collected and why it is needed. This gives a general overview that can be used to fine tune the data management if required. The following research data types are possible (but not limited to):

- **Observational data.** Captured in real time, typically cannot be reproduced exactly. Examples of observational data include sensor readings, sensory (human) observations, survey results, images
- **Experimental data.** Generated from a lab environment and equipment, can often be reproduced but may be expensive to do so
- **Simulation data**. From models, can typically be reproduced if the input data is known. Examples: output of data fusion algorithms, training datasets of edge Intelligence algorithms
- **Derived or compiled data.** Theoretical search, data mining or statistical analysis, can be reproduced if the analysis is documented

The data collector can complete the matrix containing the detailed information of the data collection in the study based upon the following check list:

- **Responsible Partner**. Indicates the Partner of the AMANDA Consortium responsible for the data
- **Data type**. Describes the type of data, including text, arithmetic values, images, models, audio and video files, simulated data
- **Data collection**. Explains the methodology of the data collection: how the data is and will be collected and from which components
- **Data format**. The format in which the data is stored, including text and CSV files, compressed and uncompressed images as well as raw binary data
- **Estimated size**. An estimation of the size for each collected data file
- **Software**. Indicates the tool or software needed to create/process/visualize the generated data
- **Comments**. Does the data have a specific character in terms of reproducibility, confidentiality and others? What does this mean for the management of the data?

2.1.2. Data collection description

This Section describes the context and type of collected data. Table 2 describes:

- **Dataset name.** It indicates the type of data; dataset (DS) produced during the validation and evaluation stages of the project or scientific paper (SP) published in a scientific conference, journal publication or as a book chapter. It also incorporates the data collector, versioning per collector and details on the way the data was generated. For example, the name "DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor" reflects the fact that the dataset was created by CERTH, it was the first generated dataset by CERTH, it was produced using an LIS3DH accelerometer and the measurement was taken with the integration of a 10k resistor
- **Status.** It includes information regarding whether it's a new dataset or an updated version of an existing one, the month they are made available and if the dataset is public or confidential

In order to ensure the reproducibility of the results generated, the publicly available data files can be accessed via different software tools, including LibreOffice Calc, Microsoft Excel spreadsheet or MATLAB.

#	Dataset name	Status	Date

1	SP.AMANDA.01.An_Autonomous_Self-Powered_Miniaturized_Smart_Sensing_Embedded_System	Public	M13
2	SP.AMANDA.02.Powering Sigfox nodes with harvested energy	Public	M14
3	DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor	Public	M15
4	DS.CERTH.02.OPT3001_Light_sensor_10k_resistor	Public	M15
5	DS.CERTH.03.SPH_MIC_1k_resistor	Public	M15
6	DS.IMEC.01.CO_2	Confidential	M18
7	SP.AMANDA.03.Low_Power_LoRaWAN_Node_Based_on_FRAM_Microcontroller	Public	M24
8	SP.AMANDA.04.Low_Light_Energy_Autonomous_LoRaWAN_Node	Public	M24
9	SP.AMANDA.05.A_low-power_embedded_system_for_fire_monitoring_and_detection_using_a_multilayer_perceptron	Public	M33
10	DS.MICRODUL.01.MS1089_SupplyCurrents	Confidential	M34
11	DS.MICRODUL.02.MS1089_TemperatureData	Confidential	M34
12	DS.MICRODUL.03.MS8892_SupplyCurrents	Confidential	M34
13	DS.MICRODUL.04.MS8892_CapacitanceData	Confidential	M34
14	DS.CERTH.04.LIS3MDL_SupplyCurrents	Public	M34
15	DS.CERTH.05.OPT3001_Light_sensor_SupplyCurrents_under_different_illumination_levels	Public	M34
16	DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents	Public	M34
17	DS.CERTH.07.STM32L496_ST1PS02DQTR_SupllyCurrents	Public	M34
18	DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents	Public	M34
19	DS.ZHAW.01.Energy_measurements	Public	M34
20	DS.ZHAW.02.Energy_measurements_SiP	Public	M34
21	DS.IMEC.02.CO2	Confidential	M34
22	SP.AMANDA.06.An_Encryption_Scheme_using_Dynamic_Keys_and_Stream_Ciphers_for_Embedded_Devices	Public	M42

Table 2 Project output details

2.1.3. Specification of the required components data collection

Component data was collected as part of **WP1 - System Specifications, Requirements and Use Cases**. This includes data from components being developed as part of the AMANDA project:

- Temperature sensor
- Capacitive sensor
- Imaging sensor
- Solid-state battery
- Energy harvester
- PMIC

Data was also gathered from State-of-the-Art analysis, data from the evaluation of off-the-shelf electronic components such as RF chipsets and modules, additional sensors including accelerometer, Volatile Organic Compound, humidity, light as well as other peripherals like timers, displays and memory ICs. Each technological partner within the consortium has contributed to the required data based on its current expertise and on technology scouting e.g. literature survey of patents and datasheets. The collected data was compiled into CSV documents that comprised various tables of relevant technical specification parameters, especially the electrical and mechanical data, graphs about the power consumption profiles and electronic block diagrams. The purpose of such documents is to share the same level of information between all partners, regardless of the individual level of expertise, in order to mutually understand the current status of each respective technology and put these into perspective with the intermediate and final project specification targets. As such, it can be considered as an internal technical project roadmap. Finally, it is also a comprehensive comparison tool for assessing the various sensors, RF and loads that are integrated into the ASSC.

2.2. Data storage and back-up

It is the responsibility of the partners to ensure that the data is regularly backed-up and stored securely for the lifetime of the project and beyond. These services have been implemented both for confidential as well as for publicly available data. The following types are distinguished:

- Hosting service (GitHub) with a web-based graphical interface that provides access control and several collaboration features, such as a wiki and basic task management tools, to make public data easily accessed
- Hosting service (GitLab) with a web-based graphical interface that provides access control and several collaboration features, such as a wiki and basic task management tools, for internal co-operation
- A general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN integration (Zenodo)

The data in this scope are stored and backed up as described in Table 3.

Ref. nr.	Responsible Partner	Data type	Storage medium and location	Backup location and backup frequency
1	CERTH	Confidential datasets	GitLab	Automated service backup
2	CERTH	Public datasets	Zenodo	Automated service backup

Table 3 Data storage and data backup information

2.3. Data documentation

The data processed is documented and labelled for immediate usage and future reference. The labelling consists of two parts:

- File naming. Files have naming conventions for each data type. There are many conventions for file naming. The well documented practical guidance from Purdue University [3] is followed. Naming convention is very helpful in case of manual and automatic search
- Metadata. Files have metadata that describes the data stored in the file. It includes a description of what the data contains and what each value represents. The reason to use metadata is, that it can be found easily when looking for information

Wherever possible, existing community standards should be identified and reused. An example of commonly used generic metadata can be found at Dublin Core Metadata Initiative [4]. The data processed in the study have been documented according to the standards with the data type as described in Table 4 - Table 25.

SP.AMANDA.01.An_Autonomous_Self-Powered_Miniaturized_Smart_Sensing_Embedded_System	
Data identification	
Source	Conference paper on the AMANDA project
Description	This paper introduces an Autonomous Smart Sensing Card (ASSC), an embedded system that will be powered indoors and outdoors by harvested energy, have miniaturized dimensions and serve multi-sensorial IoT applications for smart living and working environments. It will consist of a combination of newly developed and optimized off-the-shelf or close-to-commercialization technologies such as PV harvesters, energy storage and power management units, MCUs and sensors, all packed with a form factor under 3mm in thickness. The system will introduce technical breakthroughs that will boost further miniaturization, a small footprint, ultra-low power consumption as well as short- and long-range communications
Partners activities and responsibilities	
Partner author of the publication	The AMANDA Consortium
WPs and tasks	The paper was published as part of WP8 activities
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - Electronic smart systems, Embedded systems, Sensors, Microelectronics, Miniaturization, Autonomous operation, Energy harvesting
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public

Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.1109/ICCE-Berlin47944.2019.8966223
ZENODO link	https://zenodo.org/record/5925884
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 4 "SP.AMANDA.01.An_Autonomous_Self-Powered_Miniaturized_Smart_Sensing_Embedded_System"

SP.AMANDA.02.Powering Sigfox nodes with harvested energy	
Data identification	
Source	Conference paper on the AMANDA project
Description	Sigfox is one of the popular LPWAN technologies used in the Internet of Things. As in the case of many other wireless protocols, Sigfox nodes are mainly powered with batteries, which leads to important maintenance costs and slows down its acceptance. Enabling such systems to work on harvested energy will facilitate their use and acceptance. We designed and tested a Sigfox node that can be powered by a 1 cm2 solar cell, opening the door to further optimization in size and costs. Preliminary tests made at the window of one of our office show that one can transmit tens of message per day with that node
Partners activities and responsibilities	
Partner author of the publication	ZHAW
WPs and tasks	The paper was published as part of WP4 activities
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - LPWAN, Sigfox, Energy Harvesting, Solar, Wireless, Low Power
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public

Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.21256/zhaw-20066
ZENODO link	https://zenodo.org/record/5926130
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 5 "SP.AMANDA.02.Powering Sigfox nodes with harvested energy"

DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor	
Data identification	
Source	LIS3DH accelerometer sensor
Description	This dataset was gathered in order to establish the baseline on acceleration metrics. It consists of the acceleration forces on three different axis (x,y,z) together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of Task T2.2
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is 16kB

Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the orientation and activity detection of the ASSC. Moreover, this dataset could be useful in the benchmarking of different implementations of any 3-axis MEMS accelerometer to ensure their optimal performance
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 6 "DS.CERTH.01.LIS3DH_Accelerometer_10k_resistor"

DS.CERTH.02.OPT3001_Light_sensor_10k_resistor	
Data identification	
Source	OPT3001 light sensor
Description	This dataset was gathered in order to establish the baseline on the brightness of the ambient light over time. It consists of the intensity of light as visible by the human eye, in lux, together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of T2.2
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include:

	• Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is 15kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the brightness of the ambient light over time of the ASSC. Moreover, this dataset could be useful in the benchmarking of different implementations of any ambient light sensor to ensure their optimal performance
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 7 "DS.CERTH.02.OPT3001_Light_sensor_10k_resistor"

DS.CERTH.03.SPH_MIC_1k_resistor	
Data identification	
Source	SPH0645LM4H microphone sensor
Description	This dataset was gathered in order to establish the baseline on the spectrum frequency over time. It consists of the soundwave amplitude together with the respective timestamps of each measurement. These measurements were collected during the evaluation of the sensor for Deliverable D2.2
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH

WPs and tasks	The data was be collected within the activities of WP2 and more specifically within the activities of T2.2
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is 15kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the spectrum frequency over time of the ASSC. Moreover, this dataset could be useful in the benchmarking of different implementations of any I^2S MEMS microphone to ensure their optimal performance
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 8 "DS.CERTH.03.SPH_MIC_1k_resistor"

DS.IMEC.01.CO2	
Data identification	
Source	The CO_2 transducer is prepared from commercially available ITO on glass electrodes, covered with an ionic liquid based electrolyte layer
Description	Using the IMEC gas setup, a series of CO_2 steps of ~2000 ppm were switched on and off in a 5 minute cycle. At the 1h07m mark, the diluting gas for the setup was changed from pure nitrogen to compressed dry air,

	while at ~2h this was switched back to nitrogen
Partners activities and responsibilities	
Partner owner of the device	The device is owned by IMEC, where the data collection was performed
Partner in charge of data collection	IMEC
Partner in charge of data analysis	IMEC
Partner in charge of data storage	IMEC/CERTH
WPs and tasks	The data were collected within the activities of WP2 and more specifically within the activities of T2.2
Standards	
Info about metadata (production and storage dates, place) and documentation?	In the file detail, a verbal description of the experiment is provided
Standards, format, estimated volume of data	The data format is xlsx, an MS Excel file. The estimated volume of data is approximately 140kB
Data sharing and exploitation	
Dissemination level	Confidential
Data access policy	The data is research measurement. It should remain confidential
Data sharing, re-use and distribution	The created dataset is shared through the Data Management Portal only for members of the Consortium and the European Commission
Data exploitation (purpose/use of the data analysis)	The results show a fast response of both the real (Re) and imaginary (Im) parts of the measured impedance (Z) to changes in the CO_2 concentration in the absence or presence of oxygen. Previous sensors based on Pt on Si showed (reversible) deactivation when exposed to oxygen
Embargo periods (if any)	End of the project
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	All information belongs to the AMANDA consortium. All data will respect the partner policies

Table 9 “DS.IMEC.01.CO2”

SP.AMANDA.03.Low_Power_LoRaWAN_Node_Based_on_FRAM_Microcontroller	
Data identification	
Source	Conference paper on the AMANDA project
Description	In the quest to improve the energy requirements of LPWAN nodes and make them

	more suitable for energy harvesting, a microcontroller with on-chip Ferroelectric Random Access Memory (FRAM) was used as a controller in a LoRaWAN node. Energy measurements showed that the performance of such a device is comparable or better than that of a similar FLASH-based microcontroller. Furthermore, the advantages resulting from the high endurance and low-power characteristics of FRAM memories can be used to improve the node
Partners activities and responsibilities	
Partner author of the publication	ZHAW, CERTH
WPs and tasks	The paper was published as part of WP4 activities
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - LPWAN, LoRaWAN, FRAM, Low power, Energy Harvesting, LoRa
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public
Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.1109/IDAACS-SWS50031.2020.9297075
ZENODO link	https://zenodo.org/record/5925941
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 10 "SP.AMANDA.03.Low_Power_LoRaWAN_Node_Based_on_FRAM_Microcontroller"

SP.AMANDA.04.Low_Light_Energy_Autonomous_LoRaWAN_Node	
Data identification	
Source	Conference paper on the AMANDA project
Description	A LoRaWAN node powered using an 8 cm2 solar cell was designed and its low light harvesting performance evaluated. The embedded system is used to sense some parameters and transmit the results every 10 minutes, using the spreading factor

	SF7BW125 and transmitting with + 8 dBm, which allows the coverage of a small building. The node can cold start with less than 30 lux. Once started, its operations can be sustained down to 20 lux. Operation at higher spreading factors or higher RF output power is also possible if the transmission interval is increased. Such a performance enables the use of energy autonomous LPWAN nodes in poorly lit environments. The small size of the solar cell makes it possible to build small nodes
Partners activities and responsibilities	
Partner author of the publication	ZHAW, CERTH
WPs and tasks	The paper was published as part of WP4 activities
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - energy harvesting, solar cells, LPWAN, LoRaWAN, power management
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public
Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.1109/IDAACS-SWS50031.2020.9297089
ZENODO link	https://zenodo.org/record/5926015
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 11 "SP.AMANDA.04.Low_Light_Energy_Autonomous_LoRaWAN_Node"

SP.AMANDA.05.A_low-power_embedded_system_for_fire_monitoring_and_detection_using_a_multilayer_perceptron	
Data identification	
Source	Conference paper on the AMANDA project
Description	Fire monitoring and detection systems can evaluate data from environmental or image sensors in order to predict occurrences of fire. It is a complex procedure that requires a significant amount of

	energy as input data is usually acquired from multiple sensors and the algorithms generally have an increased complexity. This paper introduces a low-power fire monitoring and detection system that utilizes data from two environmental sensors. As a predictive algorithm for fire occurrences, it uses a multilayer perceptron (MLP) with a combination of different optimizations, developing a model with low memory requirements and high - accuracy predictions. The accuracy of the proposed system was verified using a dataset created by the environmental sensors for fire incidents and its performance was compared to existing approaches. An evaluation of the proposed system's power consumption and memory requirements is also presented
Partners activities and responsibilities	
Partner author of the publication	CERTH
WPs and tasks	The paper was published as part of WP4 activities
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - Fire detection and monitoring, Embedded systems, Low-power, MLP
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public
Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.1109/SAS51076.2021.9530090
ZENODO link	https://zenodo.org/record/5927036
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 12 "SP.AMANDA.05.A_low-power_embedded_system_for_fire_monitoring_and_detection_using_a_multilayer_perceptron"

DS.MICRODUL.01.MS1089_SupplyCurrents	
Data identification	
Source	Microdul MS1089 solid-state temperature sensor

Description	Supply current measurement in prototype package, in a lab environment. The supply current of the temperature sensor is measured during the start-up phase, the idle phase and the measurement phase
Partners activities and responsibilities	
Partner owner of the device	The device is owned by Microdul, where the data collection was performed
Partner in charge of data collection	Microdul
Partner in charge of data analysis	Microdul
Partner in charge of data storage	Microdul
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of task T2.1
Standards	
Info about metadata (production and storage dates, place) and documentation?	The measurement setup and the conditions (voltage, timing, etc.) are described in the data file(s) itself
Standards, format, estimated volume of data	The data format is in CSV. The estimated data size is a few MB
Data sharing and exploitation	
Dissemination level	Confidential
Data access policy	The data is research measurement. It should remain Confidential
Data sharing, re-use and distribution	The created dataset is available only for members of the Consortium. The data can be used to derive simulation models for the energy simulation tool developed in Task T1.4
Data exploitation (purpose/use of the data analysis)	The data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be stored beyond the lifetime of the project

Table 13 “DS.MICRODUL.01.MS1089_SupplyCurrents”

DS.MICRODUL.02.MS1089_TemperatureData	
Data identification	
Source	Microdul MS1089 solid-state temperature sensor

Description	Temperature data obtained from the sensor in prototype package, in a lab environment. The temperature data of the sensor in a calibrated state is obtained over the full temperature range
Partners activities and responsibilities	
Partner owner of the device	The device is owned by Microdul, where the data collection was performed
Partner in charge of data collection	Microdul
Partner in charge of data analysis	Microdul
Partner in charge of data storage	Microdul
WPs and tasks	The data are going to be collected within the activities of WP2 and more specifically within the activities of Task T2.1
Standards	
Info about metadata (production and storage dates, place) and documentation?	The measurement setup and the conditions (voltage, temperature, etc.) are described in the data file(s) itself
Standards, format, estimated volume of data	The data format is in CSV. The estimated data size maximum a few MB
Data sharing and exploitation	
Dissemination level	Confidential
Data access policy	The data is research measurement. It should remain Confidential
Data sharing, re-use and distribution	The created dataset is available only for members of the Consortium
Data exploitation (purpose/use of the data analysis)	The data is used for evaluation, and for comparison with the specified accuracy figures
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be stored beyond the lifetime of the project

Table 14 “DS.MICRODUL.02.MS1089_TemperatureData”

DS.MICRODUL.03.MS8892_SupplyCurrents	
Data identification	
Source	Microdul MS8892 ultra-low power capacitive sensor and touch switch for human body detection and system wake-up with absolute & relative switching threshold
Description	Supply current measurement in final QFN16 package, in a lab environment. The supply current of the capacitive sensor is measured

	as average current consumption in the different operating modes and sampling rates and both with internal and external clock source. The dynamic current consumption during the measurement phase is also measured and reported.
Partners activities and responsibilities	
Partner owner of the device	The device is owned by Microdul, where the data collection was performed
Partner in charge of data collection	Microdul
Partner in charge of data analysis	Microdul
Partner in charge of data storage	Microdul
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of task T2.1
Standards	
Info about metadata (production and storage dates, place) and documentation?	The measurement setup and the conditions (voltage, timing, etc.) are described in the data file(s) itself
Standards, format, estimated volume of data	The data format is in CSV. The estimated data size is a few MB
Data sharing and exploitation	
Dissemination level	Confidential
Data access policy	The data is research measurement. It should remain Confidential
Data sharing, re-use and distribution	The created dataset is available only for members of the Consortium. The data can be used to derive simulation models for the energy simulation tool developed in Task T1.4
Data exploitation (purpose/use of the data analysis)	The data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be stored beyond the lifetime of the project

Table 15 “DS.MICRODUL.03.MS8892_SupplyCurrents”

DS.MICRODUL.04.MS8892_CapacitanceData	
Data identification	
Source	Microdul MS8892 ultra-low power capacitive sensor and touch switch for human

	body detection and system wake-up with absolute & relative switching threshold
Description	Capacitance measurement in the final QFN16 package, in a lab environment. The capacitance (by means of a variable charge) is simulated by a programmable voltage source. The linearity of the measurement over the capacitance range will be evaluated.
Partners activities and responsibilities	
Partner owner of the device	The device is owned by Microdul, where the data collection was performed
Partner in charge of data collection	Microdul
Partner in charge of data analysis	Microdul
Partner in charge of data storage	Microdul
WPs and tasks	The data were collected within the activities of WP2 and more specifically within the activities of Task T2.1
Standards	
Info about metadata (production and storage dates, place) and documentation?	The measurement setup and the conditions (voltage, temperature, etc.) are described in the data file(s) itself
Standards, format, estimated volume of data	The data format is in CSV. The estimated data size maximum a few MB
Data sharing and exploitation	
Dissemination level	Confidential
Data access policy	The data is research measurement. It should remain Confidential
Data sharing, re-use and distribution	The created dataset is available only for members of the Consortium
Data exploitation (purpose/use of the data analysis)	The data is used for evaluation, and for comparison with the specified accuracy figures
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be stored beyond the lifetime of the project

Table 16 “DS.MICRODUL.04.MS8892_CapacitanceData”

DS.CERTH. 04.LIS3MDL_SupplyCurrents	
Data identification	
Source	LIS3MDL magnetometer sensor

Description	This dataset was gathered in order to evaluate the current consumption of the magnetic sensor in different operational modes. It consists of the average supply current for the Data rates of 10,20,40 and 80Hz. These measurements were collected during the evaluation of the sensor for Deliverable D2.6
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is a few kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 17 "DS.CERTH. 04.LIS3MDL_SupplyCurrents"

DS.CERTH.05.OPT3001_light_sensor_SupplyCurrents	
Data identification	
Source	OPT3001 Light sensor
Description	This dataset was gathered in order to evaluate the current consumption of the Light sensor under different illumination levels. It consists of the average supply current for the lux range of 300-8000lux. These measurements were collected during the evaluation of the sensor for Deliverable D2.6
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is a few kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None

Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 18 "DS.CERTH.05.OPT3001_light_sensor_SupplyCurrents"

DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents	
Data identification	
Source	STM32L496 Microcontroller
Description	This dataset was gathered in order to evaluate the current consumption of the Microcontroller with TPS6220x, as an external switching power supply, in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz - 80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP2 and more specifically within the activities of Task T2.5
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is a few kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal

Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 19 "DS.CERTH.06.STM32L496_TPS6220x_SupplyCurrents"

DS.CERTH.07.STM32L496_ST1PS02DQTR _SupplyCurrents	
Data identification	
Source	STM32L496 Microcontroller
Description	This dataset was gathered in order to evaluate the current consumption of the Microcontroller with ST1PS02DQTR, as an external switching power supply, in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz - 80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP3 and more specifically within the activities of Task T3.4
Standards	
Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References

	• Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is a few kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 20 "DS.CERTH.07.STM32L496_ST1PS02DQTR _SupplyCurrents"

DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents	
Data identification	
Source	STM32L496 Microcontroller
Description	This dataset was gathered in order to evaluate the current consumption of the Microcontroller in different operational modes. It consists of the average supply current for the clock frequency range of 100KHz-80MHz. These measurements were collected during the evaluation of the microcontroller for Deliverable D3.6
Partners activities and responsibilities	
Partner owner of the device	The device is owned by CERTH, where the data collection was performed
Partner in charge of data collection	CERTH
Partner in charge of data analysis	CERTH
Partner in charge of data storage	CERTH
WPs and tasks	The data was collected within the activities of WP3 and more specifically within the activities of Task T3.4
Standards	

Info about metadata (production and storage dates, place) and documentation?	The dataset is accompanied with a detailed documentation of its contents. Indicative metadata include: • Upload type • A Digital Object Identifier • Publication date • Access rights • References • Contributors
Standards, format, estimated volume of data	CSV data format. This dataset's size is a few kB
Data sharing and exploitation	
Dissemination level	Public
Data access policy	The full dataset is openly available through the AMANDA Data Management Portal
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Data exploitation (purpose/use of the data analysis)	The collected data serves as the baseline for the energy requirements of the ASSC. Moreover, this data is used for evaluation and comparison with the specified power consumption figures, and for modelling the power consumption in the AMANDA ASSC
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 21 "DS.CERTH.08.STM32L496_NUCELO_SupplyCurrents"

ZHAW.01.Energy_measurements	
Data identification	
Data set description	Energy measurement with one LoRa transmission and BLE in advertising mode. Advertisement interval of 40ms. LoRa: SF12, 9 Bytes user payload
Source (e.g. which device?))	The dataset will be collected from the RSL10 development board with the Semtech SX1261 LoRa shield
Partners activities and responsibilities	
Partner owner of the device	ZHAW
Partner in charge of data collection	ZHAW
Partner in charge of data analysis	ZHAW
Partner in charge of data storage	ZHAW

WPs and tasks	The data was collected within the activities of WP4 and more specifically within the activities of Task T4.1
Standards	
Info about metadata (Production and storage dates, place) and documentation?	Indicative metadata which include measurement of energy
Standards, Format, Estimated volume of data	The data format has not been defined yet. This data will be measured with a Power Analyzer and analyzed with different tools.
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Measuring if the card will work with the planned battery. With this measurement the development team can change the transmission interval
Data access policy / Dissemination level (Confidential, only for members of the Consortium and the Commission Service / Public	Confidential, only for members of the Consortium and the Commission Service. The data set should only be used during the development phase of the project
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): where? For how long?	All information belongs to the AMANDA consortium. All data will respect the partner policies

Table 22 “DS.ZHAW.01.Energy_measurements”

ZHAW.02.Energy_measurements_SiP	
Data identification	
Data set description	Energy measurement with one LoRa transmission and BLE in advertising mode. Advertisement interval of 40ms. LoRa: SF12, 9 Bytes user payload
Source (e.g. which device?))	The dataset will be collected from the RSL10 System in Package (SiP) development board with the Semtech SX1261 LoRa shield
Partners activities and responsibilities	
Partner owner of the device	ZHAW
Partner in charge of data collection	ZHAW
Partner in charge of data analysis	ZHAW
Partner in charge of data storage	ZHAW
WPs and tasks	The data was collected within the activities of WP4 and more specifically within the activities of Task T4.1

Standards	
Info about metadata (Production and storage dates, place) and documentation?	Indicative metadata which include measurement of energy
Standards, Format, Estimated volume of data	The data format has not been defined yet. This data will be measured with a Power Analyzer and analyzed with different tools
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Measuring if the card will work with the planned battery. With this measurement the development team can change the transmission interval
Data access policy / Dissemination level (Confidential, only for members of the Consortium and the Commission Service / Public	Confidential, only for members of the Consortium and the Commission Service The data set should only be used during the development phase of the project
Data sharing, re-use and distribution (How?)	The full dataset is openly available through the AMANDA Data Management Portal
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): where? For how long?	All information belongs to the AMANDA consortium. All data will respect the partner policies

Table 23 “DS.ZHAW.02.Energy_measurements_SiP”

DS.IMEC.02.CO2	
Data identification	
Data set description	Data to test the workings of an ITO based CO_2 sensor
Source (e.g. which device?))	The dataset is collected with Bio-Logic SP-300 potentiostat measuring an IMEC-developed sensor
Partners activities and responsibilities	
Partner owner of the device	IMEC
Partner in charge of data collection	IMEC
Partner in charge of data analysis	IMEC
Partner in charge of data storage	IMEC
WPs and tasks	Collected in context of WP2 (Sensor development and multi-sensorial optimisation) Task 2.1 (Sensor development and evaluation); and WP6 (ASSC Validation in Laboratory Environment and Evaluation), Task 6.2 Lab Environment Validation
Standards	

Info about metadata (Production and storage dates, place) and documentation?	Data includes gas profiles that the sensor has been exposed to, including date of evaluation in the lab
Standards, Format, Estimated volume of data	176 data points for a measurement of approximately 45 minutes. Each data point consists of a timestamp (relative to start of test), absolute and imaginary impedance, absolute impedance and phase angle
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Benchmarking of sample performance: a standard CO2 exposure test and exposure to humidity variations
Data access policy / Dissemination level (Confidential, only for members of the Consortium and the Commission Service / Public	The data may become public, and will be used as dataset for publication about the sensor principle and possible applications
Data sharing, re-use and distribution (How?)	The full dataset is confidential until May 2022 and then will be available through the AMANDA Data Management Portal
Embargo periods (if any)	Data should not be public before it is accepted for publication in journal approximately May 2022. Until then data can be used for internal consortium needs
Archiving and preservation (including storage and backup)	
Data storage (including backup): where? For how long?	All information belongs to the AMANDA consortium. All data will respect the partner policies. Data will be stored at IMEC for 5 years

Table 24 “DS.IMEC.02.CO2”

SP.AMANDA.06.An_Encryption_Scheme_using_Dynamic_Keys_and_Stream_Ciphers_for_Embedded_Devices	
Data identification	
Source	Conference paper on the AMANDA project
Description	Security in embedded devices can be challenging, due to limited available resources, including processing power, memory and energy autonomy. Embedded security solutions should have a low computational complexity and minimum memory requirements, while at the same time these must not reflect in the mechanism’s efficiency. This paper describes a lightweight scheme for Data in Transit Encryption (DiTE) using dynamic keys, designed for embedded devices. The scheme is based on the RC4 and ChaCha ciphers and uses communication channel characteristics, and especially the RSSi, to generate the encryption keys. The proposed algorithm provides an

	enhanced security level, due to the non static encryption keys, in both physical and transport level
Partners activities and responsibilities	
Partner author of the publication	CERTH
WPs and tasks	The paper was published as part of **Task T4.2 - Cybersecurity by design implementation**
Standards	
Info about metadata (production and storage dates, place) and documentation?	Index Terms - cybersecurity, encryption, embedded, lightweight, dynamic key
Standards, format, estimated volume of data	PDF format
Data sharing and exploitation	
Dissemination level	Public
Access policy	The paper is openly available through the AMANDA Data Management Portal
DOI	https://doi.org/10.1109/MECO55406.2022.9797120
ZENODO link	https://zenodo.org/record/6997419
Embargo periods (if any)	None
Archiving and preservation (including storage and backup)	
Data storage (including backup): Where? For how long?	The data will be available through the AMANDA Data Management Portal for the duration of the project's lifetime

Table 25 "SP.AMANDA.06.An_Encryption_Scheme_using_Dynamic_Keys_and_Stream_Ciphers_for_Embedded_Devices"

2.4. Data retention and archiving

This Section describes how long the data will be stored, what data can be archived and what safeguards are setup for the data archiving. Examples of safeguards are limited access, anonymisation, scrambling and deleting parts of data.

The default retention period is set to the end of the AMANDA project activities. However, the retention time should be adjusted to significance of collected data. Table 26 shows the suggested retention time for different types of data. Nevertheless, the experiment designer should have decisive voice in determining the retention period. Moreover, the files can be archived or deleted directly after processing.

Nr.	Data type	Suggested retention period
1	Non-anonymised raw measurements	Delete subsequent to project end
2	Anonymised raw measurements	5 years or more
3	Project reports	5 years or more

Table 26 Suggested retention time with respect to type of data

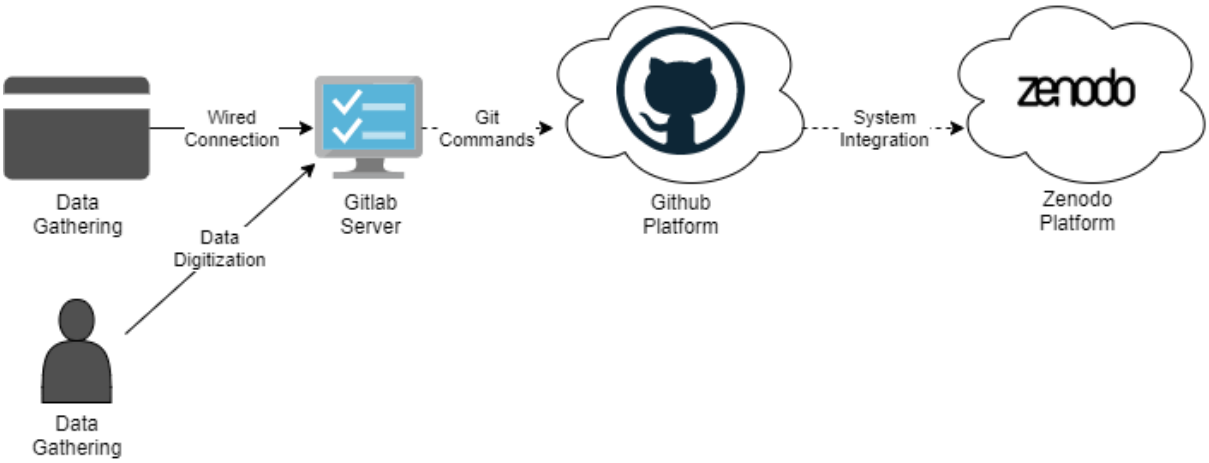
2.5. Data Management Portal

In the AMANDA project, the focus of the developed ASSC is on the operation monitoring of the environment, air quality and asset tracking. Different types of data are collected within the AMANDA project:

- Scientific/technology data, generated from the development activities
- Private information, gathered by the consortium, that derives from human participation
- Scientific publications

The project involves carrying out the data collection and a set of validation tests to assess the technology and effectiveness of the proposed framework in real-life conditions. The various models designed in the AMANDA project are anonymised and provided to the public as open models using the Open Model Initiative (OMI). They are already available to interested parties that could provide adaptations and contribute to the evolution of AMANDA models after the end of the project. Hence, it becomes apparent that the majority of research data generated by the project is and will continue to be open. In this context, a detailed data management plan was delivered in M6, as reported in **Deliverable D8.3 - Data management plan & ethics v1** and was subsequently updated in **Deliverable D8.2 - Project progress report** on M10, **Deliverable D8.5 - Data management plan & ethics v2** on M18 as well as **Deliverable D8.6 - Data management plan & ethics v3** on M36. The plan fully describes the procedures for ensuring that the data management process complies with national and EU legislation. The consortium's approach is in full compliance with the EU legislative and regulatory framework for data protection based on the uniform approach of the EC Directive 95/46/EC3, and the national legislative and regulatory framework for data protection of each project member country.

With respect to this, an automated method has been developed to make the relevant data publicly available. The first component is a dedicated "open access to research data" repository on a self-hosted Gitlab solution. As a next step, this repository is exclusively mirrored to an open-access depository on the Github platform (https://github.com/amanda-project/ORDP-repository). The last component of this automation is the Zenodo[1] platform. The aforementioned Github account is integrated with a Zenodo account that makes all the data publicly available and provides a DOI for each item in order for other interested parties to cite them easily. This mechanism is illustrated in Figure 3 below.



[1] Zenodo is a general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN. It allows researchers to deposit data sets, research software, reports, and any other research related digital artifacts. For each submission, a persistent digital object identifier (DOI) is minted, which makes the stored items easily citable.

Figure 3 Open access to research data automation

Specifically, there are certain actions that need to be followed in order to enable AMANDA's repository on GitHub to be citable and have a DOI assigned via the general-purpose open-access repository Zenodo. The first step in providing a DOI, to datasets and other submitted data which lacks one, is to select the repository of GitHub that will be integrated with Zenodo. An overview of AMANDA's current GitHub repository is given in Figure 4.

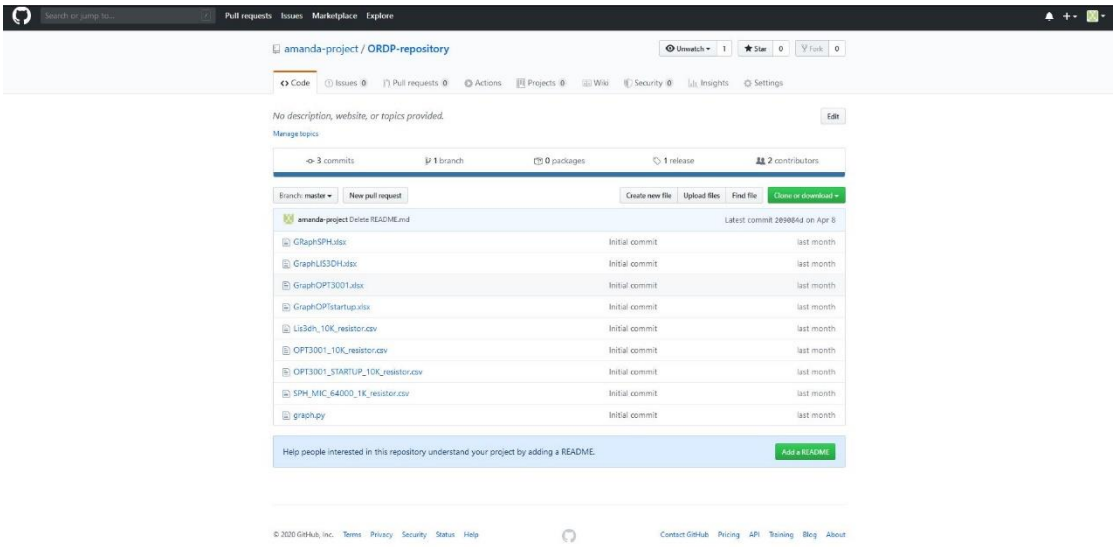


Figure 4 AMANDA GitHub repository

As the project progressed, the repository was updated and finalised. Moreover, the GitHub account needs to be linked to Zenodo.

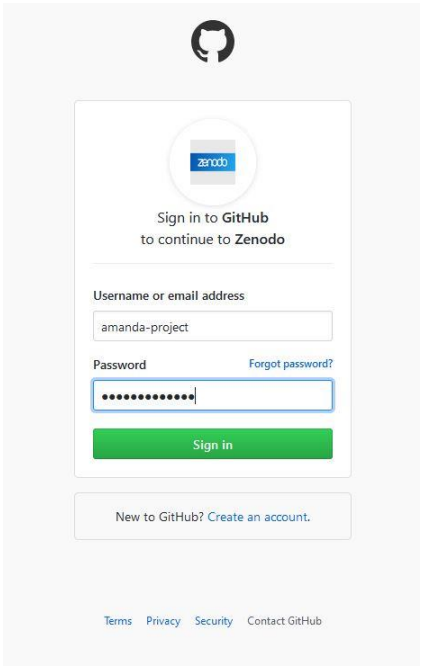


Figure 5 GitHub liked to Zenodo

Furthermore, a new release needs to be created within the GitHub project and Zenodo takes care of the automation that deposits the files and assigns a DOI to the relative data. As a result,

AMANDA project's data sets, research software, reports, and any other research related digital artifacts are and will be stored together with their persistent DOI which makes them easily citable. The Zenodo DOI of an example AMANDA dataset can be seen in Figure 6 below.

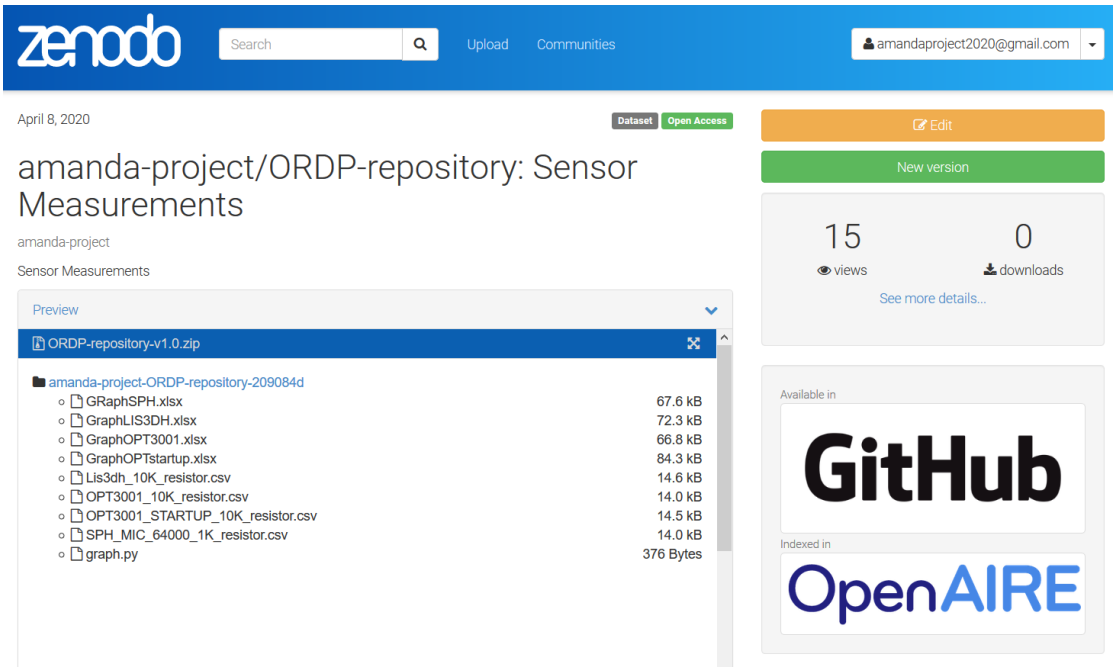


Figure 6 The DOI Zenodo of an example AMANDA dataset

The opportunity offered by this automation for AMANDA is to:

- Manage the datasets which are and will be collected within the project's actions
- Be flexible in terms of the parts of datasets that are made publicly available
- Facilitate the management of the data produced for the purposes of the AMANDA Project
- Provide a web-based implementation that enables its users to easily access and effectively manage the various data sets created throughout the development of the Project
- Provide a short description for each data set

The Zenodo platform offers the possibility to edit the metadata on the record. This feature enables edits for almost all metadata of a record. From the upload type fields, it becomes evident that several different type of files such as publications, datasets, images, software's source code and others can be uploaded. This is demonstrated in Figure 7 below.

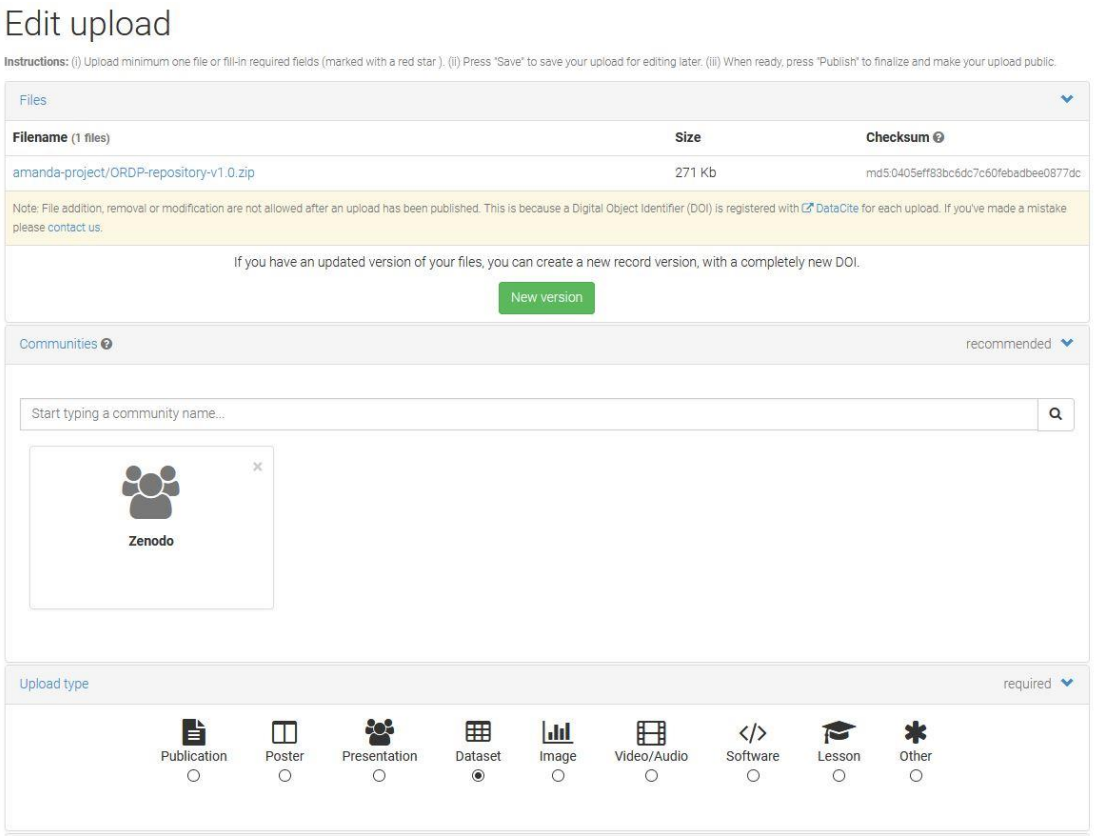


Figure 7 Edit field of Zenodo for metadata

A summary of the basic information that accompanies the file such as the digital object identifier, publication date, title, author, description, version, language, key words and additional notes are illustrated in Figure 8.

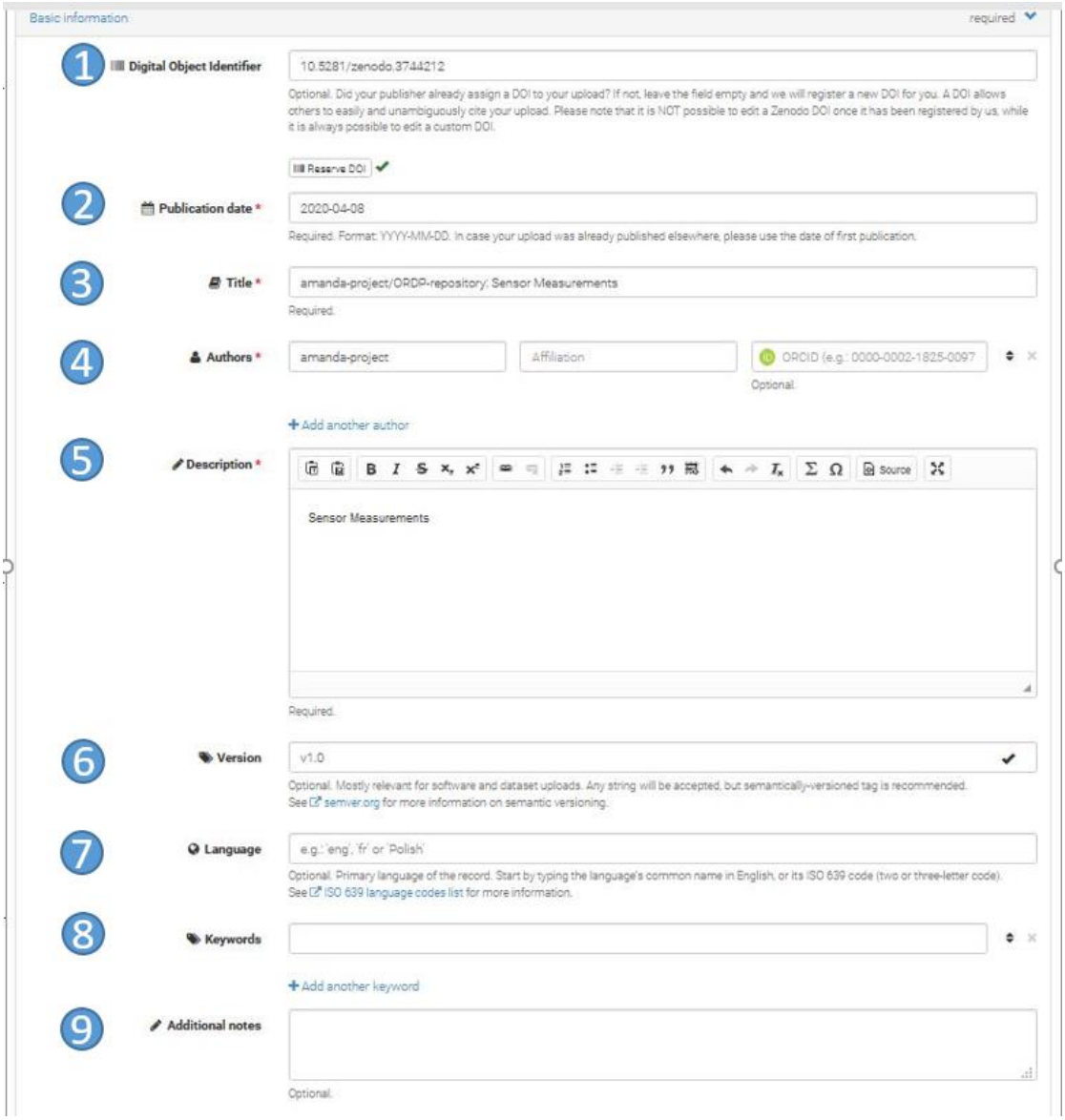


Figure 8 Basic information fields

Number	Field	Significance	Description
1	Digital object identifier	Optional	Identifier of the DOI
2	Publication date	Required	Date of first publication in case of upload file already published
3	Title	Required	Title of the upload file
4	Authors	Required	Author of the upload file
5	Description	Required	Description of the upload file
6	Version	Optional	Version of the upload file
7	Language	Optional	Primary language of the report
8	Keywords	Optional	Describe what the content about
9	Additional notes	Optional	Extra description for the upload file

Table 27 Basic information fields

The level of accessibility to the metadata can be chosen from the license tab. In addition, there is a field with regards to the grants that have funded the research, as shown in Figure 9.

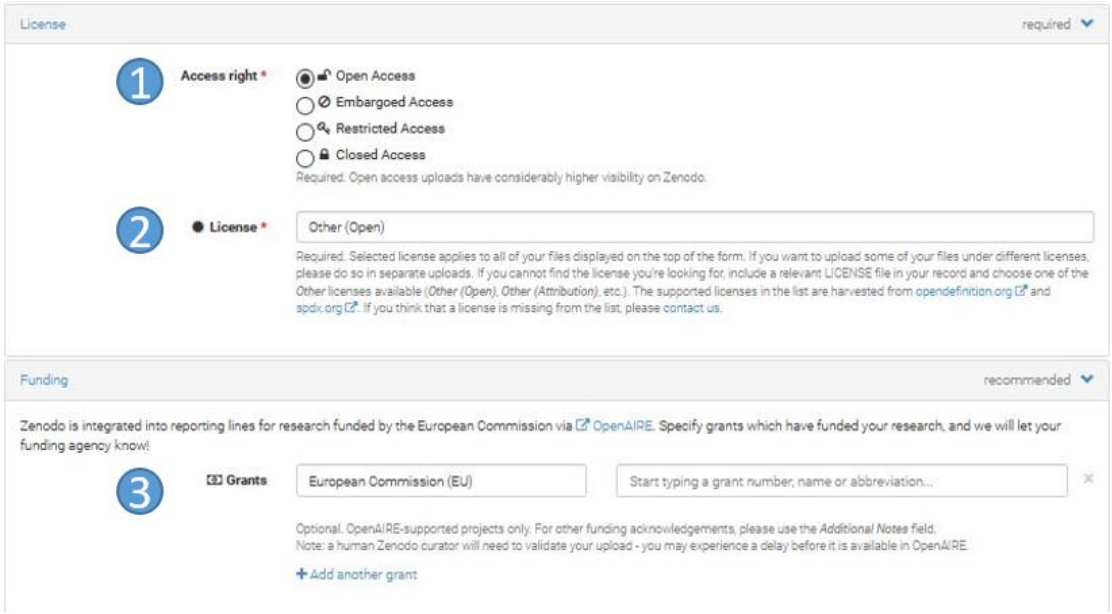


Figure 9 License and funding field

Number	Field	Significance	Description
1	Access right	Required	Accessibility of upload files
2	License	Required	License applies for the files
3	Grants	Optional	The grants that have funded the research

Table 28 License and funding field

Number	Field	Significance	Description
1	Related/alternate identifiers	Recommended	Specify identifiers of related publications and datasets
2	Contributors	Optional	Names of contributors that help to create the upload file
3	References	Optional	References for the upload file
4	Journal	Optional	If the upload file has been published in journal fill out the basic information of journal such as title, volume, issue, pages
5	Conference	Optional	If the upload file has been published in conference fill out the basic information of conference such as title, acronym, dates, place, website, session, part
6	Book/report/chapter	Optional	If the upload file has been published in book form, fill out the basic information

			of the book such as publisher, place, ISBM, book title, pages
7	Thesis	Optional	If the upload file has been published as thesis, fill out the basic information of thesis such as awarding university, supervisors
8	Subjects	Optional	Add subject from a taxonomy or controlled vocabulary with term and the identifier

Table 29 Other fields that can be specified on Zenodo

All metadata is stored internally in JSON-format according to a pre-defined JSON schema. They can be exported in several standard formats such as MARCXML, Dublin Core, and DataCite Metadata Schema (according to the OpenAIRE Guidelines).

3. Ethical concerns of the AMANDA project

The AMANDA consortium confirms that each partner checks with their national legislation/practice and their local ethics committee. That provides guidelines on data protection and privacy issues, in terms of both data protection and research procedures in relation to any of the proposed public engagement and potential volunteer research activities. Any procedures for electronic data protection and privacy conforms to Directive (EU) 2016/680 and Regulation (EU) 2016/679 on the protection of personal data and its enactments in the national legislations.

The process of adhering to the applicable regulations begins with a thorough investigation of the EU and national research projects' ethical guidelines as well as the examination of the directives regarding privacy and protection of personal data and free movement of data issues. The legislation with which the AMANDA consortium must conform includes:

- The Universal Declaration of Human Rights
- The Convention 108 for the Protection of Individuals with regard to Automatic Processing of Personal Data
- The Directive 95/46/EC & Directive 2002/58/EC of the European parliament regarding issues with privacy and protection of personal data and the free movement of such data
- Other European and national regulations related to privacy

The AMANDA project expects the development of a set of qualitative information collecting activities. In particular, interviews and questionnaires were planned, within Task 1.3. The double nature of consent appears again as both personal data and potentially sensitive information might be collected. Therefore, two issues become crucial from an ethical perspective: The confidentiality of the information and the anonymisation of personal data. The Code of Ethics of the International Sociological Association reminds researchers that "The security, anonymity and privacy of research subjects and informants should be respected rigorously" [5]. The sources of personal information obtained by researchers should be kept confidential, unless the informants have asked or agreed to be cited. Should informants be easily identifiable, researchers should remind them explicitly of the consequences that may follow from the publication of the research data and outcomes" [5]. From this article it is possible to extract some general rules that investigators must apply when designing and conducting their research:

- Information gathered from the participants should be kept confidential, unless specific consent to be cited is given by the participant.
- Information gathered should be anonymised and used only for the purpose for which it was collected.
- Participants must be informed when the investigator believes that some of the information shared may make them identifiable and the potential consequences.
- Participants must be given, in a clear and transparent manner, the opportunity to withdraw at any time and especially after being informed of their potential identification and potential consequences.

In case the collected data contains personal information, data protection principles and legal requirements extracted from Regulation 2016/679 should be taken into consideration. In particular the investigator needs to put in practice organizational and technical measures directed to "minimising the processing of personal data, pseudonymising personal data as soon as possible, transparency with regard to the functions and processing of personal data, enabling the data subject to monitor the data processing" [6].

In case the collected data contains personal information, the responsible partner of the AMANDA project should apply the following rules:

- Information collected from the participants should be anonymised. Responsible partners of the Consortium prepare a summary, of the conducted research's results. The

raw information is kept in local resources by the partners under their own responsibility and according to the data protection policies of their own organisations. Partners should pay special attention to the respect of the minimisation principle following article 89 (1) of Regulation 2016/679.

- Each task leader collects the summaries and send them to the Ethics Helpdesk. The Ethics Helpdesk reviews that no personal or sensitive information is contained in the summary, unless the participant has given specific consent. If needed, the Ethics Helpdesk can consult LEPPI during the process. The summary can be shared within the Consortium once this point is verified.
- The investigator must obtain specific consent from all the participants prior to their involvement in the different activities.
- The task leader of each of the activities proposes to the Ethics Helpdesk a text containing the specific information concerning the activity. The Ethics Helpdesk validates the specific Informed Consent Form before it is used with any participants. Informed consent must be obtained, in written form.
- Oral informed consent is highly discouraged. Although oral consent is legally valid, the data controller must be able to "demonstrate that the data subject has consented to processing of his or her personal data" (Regulation 2016/679, article 7.1). Therefore, investigators should only use this procedure when there is no other possibility and after having consulted with the Ethics Helpdesk. The Ethical Body evaluates the situation, bearing in mind the potential value of the information that could be obtained from the participant.

Duly signed Informed Consent forms, both written and electronic or proof of the oral consent, should be kept by the controller for a five years period to be available for auditing by the Ethics Helpdesk or any competent authority.

Miniaturizing the electronic system is going to be safe and non-intrusive. The project goals are technical. Most of the collected datasets are going to describe electronic system behaviour e.g. power consumption, voltage stability, radio connectivity performance and others. The measurements, which are not related to the technical evaluation of the system, are foreseen to be related to environmental conditions. An investigated subject is exposed to the measured conditions. There is no intention to directly gather measurement from bodies of living creatures. Thus, there is no interaction between the electronic system and the body of the subject. The project does not have the aim to perform human trials. However, experiments where the device is placed in the room where people are present are considered. The project is not in the scope of Utilisation of Genetic Resources the Access and Benefit Sharing (ABS).

4. Conclusions and future work

This deliverable details the completed data management and ethics of the project. Section 2 provides insight on the way the AMANDA Data Management Plan was created and implemented. This section can later be used to track all the generated data in the project. It therefore satisfies the need of reusability of the generated data required by directive 2013/37/EU. Furthermore, the data which is generated during the project is mostly related to the performance of the electronic hardware. Also, this Section includes the description and systematisation of the data originated from the project. The data management approach presented in this report mostly consists of labelling and describing the generated data. In this way the data can be tracked during and after the project's execution.

During this project, no human trials were planned. However, data collection in form of questionnaires was conducted. Personal or sensitive data was labelled as such. Then, it was stored, analysed and used anonymously. The individuals were informed comprehensively about the intended use of the information collected from them. Participants provided their permission for data collection for a scientific purpose, with their active approval in form of a written consent. There is a potential for field tests, if time permits and lab testing is successful. These tests include the deployment of prototypes at the location of end users for a preliminary evaluation of the ASSC. However, this decision will be made towards the end of the project.

For each data set, ethical issues are considered separately in Section 3. The ethical aspect of each dataset is evaluated in the data description.

Bibliography

[1] M. Wilkinson, M. Dumontier and I. Aalbersberg, "The FAIR Guiding Principles for scientific data management and stewardship," *Scientific data,* vol. 3, no. 1, pp. 1-9, 2016.

[2] K. Briney, "Data Management for Researchers: Organize, maintain and share your data for research success (Research Skills)," in *Data Management for Researchers*, 2015.

[3] S. Brandt, "Data Management for Undergraduate Researchers: File Naming Conventions," Purdue University Libraries, [Online]. Available: http://guides.lib.purdue.edu/c.php?g=353013&p=2378293. [Accessed 24 06 2019].

[4] D. Hillmann, "Dublin Core Metadata Initiative," 12 04 2001. [Online]. [Accessed 24 06 2019].

[5] U. C. Faculty of Political Sciences and Sociology, "Code of Ethics," ISA Forum of Sociology International Sociological Association, [Online]. Available: https://www.isa-sociology.org/en/about-isa/code-of-ethics.

[6] The European Parliament And The Council Of The European Union, “Regulation (Eu) 2016/679 Of The European Parliament And Of The Council,” *Official Journal of the European Union,* vol. L, no. 119, pp. 1-88, 2016.