

LAYFORM

Efficient Material Hybridization by Unconventional Lay-up and Forming of Metals and Composites for Fabrication of Multifunctional Structures



DELIVERABLE

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Acronyms List

Acronym	Definition
AWS	Amazon Web Services
DMP	Data Management Plan
ORD	Open Research Data
PC	Project Coordinator

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Executive summary

This deliverable provides the first version of the Data Management Plan for project LAY2FORM. This deliverable presents a preliminary description of how research data collected and generated within the scope of the project will be handled during and after the end of LAY2FORM activities, namely concerning the standards and sharing approaches. The Data Management will be continuously reviewed and updated in months 24 and 48 as planned in LAY2FORM deliverables list. This document follows the template provided by the European Commission¹.

¹ http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf#page=10

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1 Introduction

LAY2FORM project participates in the Open Research Data Pilot (ORD pilot) according to Articles 29.2 and 29.3 of the GAM. This participation entails the sharing and reuse of research data generated by H2020 programme funded projects to improve and maximize their impact. Notwithstanding this, the ORD Pilot addresses the balance required between openness and protection of scientific knowledge for the sake of commercialization, privacy and security purposes, following the principle “as open as possible, as closed as necessary”.

The main purpose of this DMP is to describe the data management policies to be followed by LAY2FORM consortium. More specifically, this document presents an overview of the types of datasets to be generated and collected during the project, the data standards and how data will be shared and preserved for later reuse.

This DMP reflects the Consortium Agreement established by the partners and currently in force. This DMP is also consistent with exploitation and IPR requirements of the project.

Within the scope of the project, any research data linked or potentially linked to results that can be exploited by any consortium partner will not be considered into the open domain to protect commercialization interests. Any other research data not linked to exploitable results will be deposited in an open access repository.

This DMP is a document to be continuously reviewed during the course of the project. The first version of the DMP presented in this document will be updated in M24 (September-2019) and M48 (September-2021) of the project as formal deliverables, with more detail on the procedures for data management.

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2 Summary of data types

With the framework of the project LAY2FORM research data, including datasets with data, metrics and procedures, will be open for benchmarking purposes, as well as technical data needed to validate the results presented in the deposited scientific publications.

A summary of the data types, their formats and standards to be generated and collected during the project are provided in Table 1 . During the project and in the planned future issues of the Data Management Plan, this list may be updated if necessary.

Table 1 - Summary of data types, formats and standards

Types of Data	Data formats and standards
Experimental/ observation-derived data.	Microsoft Office (docx, xlsx, pptx,...) and Adobe Acrobat (pdf) will be the reference file formats. LaTeX may be used for the production of scientific and technical documentation.
Models and representations (Product, system and process)	
Project and WP management documents (reports, presentations,...).	
Scientific and technical publications	
FEM structural simulation studies (Product, system and tooling)	FEM simulation results will be stored in the ERF format (based on the HDF5 file format)
FEM process simulation studies (hot-forming)	ISO-STEP - according to ISO 10303 and ISO 14649 10-17 - will be the standard for CAx data; non-applicable “ab-origine” data is stored in original SW tool used and exported in ISO-STEP.
Software and algorithms (CAx, Decision Support System)	
Measurements raw data obtained during system/process/part characterization	Some data linked to DSS will be stored under an ASCII file format Data will be filed in original format - sensor/application specific - then exported to ASCII file using TXT and CSV format.
Images	JPEG compressed format or equivalent. TIFF uncompressed for shearography and thermography.
Videos (short movies, animations, ...)	MPEG codec / AVI format.

The manufacturing process pilot to be developed within the scope of LAY2FORM has been mapped and its several sub-processes were identified. In addition to this, several parameters, both for the process control and process defect have been analysed. This is

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perceived as a critical stage in terms of data management, in the way that a preliminary overview of several parameters have been defined for each sub-process. Table 2 presents shows some of these input parameters and quality criteria evaluated.

Most of the data collected will be used for controlling the manufacturing process through the Self-adaptive system and the Decision Support System.

The datasets collected will serve as a basis to the creation of a historical dataset.

Table 2 - Summary of main manufacturing steps with some associated control / defect parameters.

Manufacturing stage	Process control data	Process defect data*
Texturing	-	Surface roughness
Tape feeding	Feeding velocity, tape alignment	-
Tape cutting	Laser frequency, displacement speed.	Heat affected zone (laser cutting), metal bent, fibre dragging
US spot bonding	US frequency, US holding time, US pressure, number of welded spots	Local resin degradation, welding quality.
Stacked layup	-	Size of lap and gaps, local fibre damage, tape misalignment
Stack heating	Consolidation temperature	Blank under or over heated. Material degradation.
Stack compaction	Loading rate (press ramp speed), consolidation pressure/vacuum, holding time	Intimate contact, thermoplastic overflow, fibre drag, fibre misalignment, non-homogeneous fibre volume fraction
Cooling	Cooling rate	Warpage
Consolidated blank	-	Intimate contact, void distribution, void size, void content, thermoplastic overflow, fibre drag, fibre misalignment, non homogeneous fibre volume fraction.
Holding consolidated blank	Blank holder gripping force	-
Heating	Blank temperature	Blank under or over heated, matrix degradation.
In-place tension control	Blank in-plane stress	Material slip / fibre breakage
Transfer to press position	Transfer time, transfer speed, trajectory: speed and position	Transfer time out of process window

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Molten matrix consolidated blank (shearography)	-	Shear wrinkling, sagging, non-uniform temperature, matrix degradation, adhesive degradation, temperature loss, transfer-time mismatch, void content, position placement
Forming	Mould temperature, loading rate, press trajectory: speed, position and time, moulding pressurization: time, force and speed, moulding de-pressurization: time and speed, die temperature	Parallelism, Wrinkles, fibre misalignment, insert misalignment, fibre breakage.
Force control (blank holder)	Clamp force, blank in-plane stress	Material slip
Consolidation	Consolidation time	-
Molten formed sub product	-	Intra-ply shear, fibre wrinkling, fibre buckling, fibre waviness, air entrapment, fibre damage.
Cooling	Cooling rate, clamp force	Premature solidification, non-uniform surface temperature, transverse cracking, metal/composite adhesion
Demoulding	Cooling rate	-
Formed sub product	-	Residual stress/warpage/spring-in, transverse cracking, adhesion metal/composite, crystallization
Edge trimming	Laser type, laser power, trajectory	-
Final product	-	Geometry, delamination, mechanical properties, matrix degradation

* The process defect data mentioned in the table will only be generated provided that the defect detection technology contemplated within the framework of the Lay2Form project are relevant for each type of defect. This will be assessed during the course of the project.

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3 FAIR data

3.1 Data findability

Appropriate provisions will be implemented within the scope of LAY2FORM to make data generated in the project findable in repositories. Sets of metadata attributes will be created through a machine-readable index in a searchable resource to facilitate the findability of the data.

At the current state, the metadata requirements for the different data sets to be generated are under development. Notwithstanding this, and with respect to scientific publications to be deposited in repositories, the project will comply with minimum metadata format requirements, namely: 1) the terms ['European Union (EU)' and 'Horizon 2020'] ['Euratom' and 'Euratom research and training programme 2014-2018']; 2) the name of the action, acronym and grant number; 3) the publication date and length of embargo period (if applicable); 4) a persistent identifier (such as a Digital Object Identifier or DOI).

3.2 Data accessibility

There are three access levels for the data generated by LAY2FORM:

- **Public:** access and download are permitted only to registered users in the project website (<http://lay2form-project.eu/>), against password to login to the system. The list of files open to the public for dissemination will be maintained available and accessible by download via the website. Interested users need to request a login and a password to the official project e-mail. The purpose is to track data use and build a contact database for the project.
- **Confidential:** accessible only to the subscriber of the Grant Agreement, namely their beneficiaries and linked third parties. Confidential data exchanged between consortium partners is made accessible through a repository in an internal secured server hosted by the PC. Data is available to partners through a webFTP site from which access is granted via a login and password provided by the PC.
- **Open access:** peer review scientific publications and experimental data needed to validate results will be deposited in a repository using the “gold model” as preferential way, meaning that such data will be available for both subscribers and the wider public, with permitted reuse. Furthermore, the LAY2FORM consortium will seek for opportunities to provide open access to non-peer reviewed scientific publications, such as monographs or conference proceedings.

Some of the data generated during the manufacturing process, or by the self-adaptive system, or coming from the process simulation, will most likely be stored on a cloud

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service hosted by AWS. The storage conditions are currently under study and have not yet been implemented in the project. These data will also be available to the project partners.

In order to promote exchange and raise awareness on the project results with other researchers, stimulating concurrent research to accelerate the uptake and further development of breakthrough LAY2FORM technology concepts, research data will be deposited in a public research data repository, namely Zenodo.

Both public and confidential data will be maintained accessible to authorized users for at least 5 years after the end of the project.

3.3 Data interoperability

Data interoperability, or the ability for data to be processed by different systems, will be ensured through standardised terms or controlled vocabularies with qualified references to other metadata, so that can be machine readable, following the FAIR principles

At the present moment, metadata requirements are under study by the consortium. Metadata templates and generators such as may be used to support this task. The Dublin Core Schema, developed by the Dublin Core Metadata Initiative is a set of vocabulary terms for describing digital and physical resources, and may be used for this purpose.

3.4 Data re-use (through clarifying licences)

Data re-use, or the ability for data to be understood by humans and machines through sets of precise and relevant metadata attributes, will be ensured by a clarifying data usage licence. In the scope of project LAY2FORM, a set of rights will be retained by the copyrights holders, and a Creative Commons will be used for this purpose.

By observing the different rights granted by the six licences available from Creative Commons, a licence **CC BY-NC-ND 4.0** will be used for the data generated in the project. The following attributes of this licence should be noted:

- **BY:** stands for attributions. A user of the data must give appropriate credit, a link to the licence, and indicate if changes were made.
- **NC:** stands for non-commercial. A licence with an NC modifier cannot be used for a commercial purpose, such as being sold or used in an advertisement. You may not use the material for commercial purposes. A commercial use is one primarily intended for commercial advantage or monetary compensation.

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- **ND:** stands for no derivatives. This limits the creation of derivative works based upon the original, such as rewriting or translations. A user of the data must not distribute modified, remixed, transformed or built upon material.

4 Allocation of resources

Data management will be assumed by the project coordinator – INEGI - taking the responsibility for the communication activities under the frame of WP1, and the associated costs eligible for this purpose.

The costs related to open access publications were already considered in the estimated budget of the project.

5 Data security

Multiple levels of security to access, transfer, store and back-up data files (encryption methods: Secure Sockets Layer (SSL) will be implemented to the PC server, the project website and on the cloud infrastructure Amazon Web Services (AWS), which is currently under study.

Regarding AWS, the data will be stored on S3 and Glacier services and used by any AWS service (SageMaker, Redshift, ...) located in the European region (Ireland, Frankfurt, London or Paris). To prevent disaster recovery, all data available on AWS will be replicated within an AWS Region across multiple Availability Zones

AWS provides specific features and services which customers can leverage as they seek to comply with the GDPR (https://aws.amazon.com/compliance/gdpr-center/?nc1=h_ls).

6 Ethical aspects

The ethical framework of the data management within project LAY2FORM is currently being assessed. In this regard, the General Data Protection Regulation (GDPR), which entered into force on the 25th of May 2018, is under study in order to ensure compliance with the newest legislation.