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# Deliverable 6.1

## Data Management Plan

|                    |                                                                                                       |
|--------------------|-------------------------------------------------------------------------------------------------------|
| Project Acronym    | DISCO2030                                                                                             |
| Project Full Title | Combining DISsimilar materials into functional large-scale and light-weight COmponents and structures |
| Call Identifier    | HORIZON-CL4-2022-RESILIENCE-01                                                                        |
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|----------------------------|--------------------------------------------|
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| <b>Author(s)</b>           | Emre Osmanoglu, Nico Hempel, Anja Drescher |
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## Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgment of previously published material and of the work of others has been made through appropriate citation, quotation, or both.

## Table of contents

|                                      |   |
|--------------------------------------|---|
| Statement of originality.....        | 2 |
| Table of contents .....              | 3 |
| 1. Data Collection .....             | 4 |
| 1.1. Data description .....          | 4 |
| 1.2. Data generation .....           | 4 |
| 1.3. Method for data collection..... | 5 |
| 2. Data Processing .....             | 5 |
| 2.1. Data quality .....              | 5 |
| 2.2. Storage .....                   | 6 |
| 2.3. Access and security .....       | 7 |
| 3. Data Sharing .....                | 7 |
| 4. Management .....                  | 8 |
| 4.1. Legal obligations .....         | 8 |
| 4.2. Responsibilities.....           | 8 |

# 1. Data Collection

## 1.1. Data description

In the DISCO2030 project, two first-of-a-kind hybrid manufacturing methods for joining dissimilar metal-metal and metal-polymer materials will be developed in order to manufacture lightweight, complex-geometry multifunctional devices that are at the same time able to operate in harsh environments. During the development of the process, material and manufacturing data will be generated about the processes.

The main types of data currently envisaged to be collected in the project include: (1) Specifications of the use-cases by use-case partners (including potentially sensitive commercial information); (2) Data from the PBF and DED processes itself such as monitoring data or input parameters combined with resulting component/structure data; (3) Data from materials testing & metallographic characterization; (4) Simulation data (thermodynamic/kinetic materials simulation, thermomechanical finite element simulations); (5) Metadata such as a set of data that describes and gives information about other data like measurement techniques and used method.

TUM has a robust infrastructure in place for managing data, which will be utilized to support all DISCO2030 partners in managing non-commercially sensitive data. However, it is important to note that almost all of the deliverables of the project contain sensitive data. Thus, it is necessary to handle the data generated by the project with utmost care and consideration before publishing or making it available for public access. In addition, it is crucial to control access to the data, given the sensitive nature of the information. Specifically, some of the data generated may fall under the category of intellectual property or trade secrets, which requires an even higher level of security and confidentiality.

## 1.2. Data generation

The data on the manufacturing materials will be generated before the manufacturing test by conducting literature survey and computer simulations such thermodynamic and kinetic material simulations. Once the materials are fixed, experimental manufacturing will be conducted. In this step, simple geometries like a wall will be manufactured using directed energy deposition to mainly create samples for further examination.

The experimental parts generated by directed energy deposition will be cut and prepared for characterization tests. Partners will look into the local material characterization/composition level and define test procedures for dissimilar metal-metal materials, metal-polymer materials and graded materials. Various microscopic, macroscopic and spectroscopic techniques will be taken into account in this step. For the metal-metal and metal-polymer groups the key focus will lie on the interfaces/transition areas between two materials. Graded materials pose some additional challenges in regard to their characterization due to the lack of a monolithic material structure and lacking a clear interface between two materials. As a consequence, the partners will need to monitor that the actual local composition meets the targeted one (e.g. by energy dispersive X-ray spectroscopy, EDX) and determine both the local and overall mechanical behaviour (e.g. by tensile tests using digital image correlation for determining the local deformation).

Simulation data generated in the project falls under two categories, namely thermodynamic/kinetic materials simulation and thermomechanical finite element simulations. The first type of simulation is related to the behaviour of the materials, involving phase diagrams. The thermomechanical simulations involve modelling of the directed energy deposition process. To simulate the manufacturing process, Simufact Welding and Abaqus will be utilized. This type of simulation yields data related to the distortions and residual stress induced during the process.

### 1.3. Method for data collection

The data will be collected by conducting literature survey, computer simulations, experiments and testing. As the data is generated, it will be stored in the project cloud storage under the respective folders of the tasks. Each work package has its own folder in the storage area. The tasks of the work packages have their own subfolders in the storage. Project partners will upload their files to the respective task folder. The proposed naming convention is "DISCO2030" followed by underscore and task or deliverable code in the form of "Tx-x\_TEXT" followed by underscore and date in the form of year-month-day (e.g. DISCO2030\_D6-1\_DMP\_20230331).

To ensure that the data is properly handled, strict protocols for data processing and evaluation will be established, which is in compliance with TUM's Guidelines for Handling Research Data<sup>1</sup> and TUM Research Code of Conduct<sup>2</sup>. Additionally, access controls and security measures will be implemented to prevent unauthorized access to the data. These protocols will be regularly reviewed to ensure that they are up-to-date and effective. Through these measures, the confidentiality and reliability of the data will be ensured, while also enabling the project to achieve its objectives efficiently and effectively.

## 2. Data Processing

### 2.1. Data quality

The data that will be collected within the scope of DISCO2030 can be divided into five subcategories: (1) Specifications of the use-cases; (2) Data from the manufacturing processes; (3) Data from materials testing & metallographic characterization; (4) Simulation data; (5) Metadata.

Among these data types the first one, specification can contain potentially contain commercially sensitive data. The data from the manufacturing processes involves process parameters and contains sensitive data. Materials testing and metallographic characterization data includes test results, microscope images and thermodynamic simulation data. The simulation data involves finite element simulation results. Any other data like measurement techniques and used method falls under metadata category.

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<sup>1</sup><https://www.it.tum.de/en/it/projects/research-data-management/>

<sup>2</sup>[https://portal.mytum.de/archiv/kompodium\\_rechtsangelegenheiten/sonstiges/wiss\\_Fehlverh.pdf](https://portal.mytum.de/archiv/kompodium_rechtsangelegenheiten/sonstiges/wiss_Fehlverh.pdf)

## 2.2. Storage

A well-established infrastructure for data management is in place at TUM and will be used to support all project partners in managing non-commercially sensitive data. It consists of three main building blocks: the TUM Research Service Centre, the repository mediaTUM and the software TUM Workbench in combination with the Data Science Storage and.

The TUM Research Service Centre provides support for project partners on aspects related to data management, including infrastructure, individual data management questions, and publication. This includes ensuring that research data is stored, shared, and provided with metadata, as well as making it accessible to stakeholders outside of the consortium. To achieve this, the mediaTUM repository will be used to publish the respective data according to the FAIR principles. The FAIR principles ensure that research data is Findable, Accessible, Interoperable, and Reusable, making it easier for researchers to discover, access, and reuse data.

| <b>Principle</b>     | <b>Ensured by</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Findable</i>      | <ul style="list-style-type: none"> <li>• Issuing and supporting globally unique persistent identifiers.</li> <li>• Applying widely-use discovery metadata schema in human and machine-readable formats, including <i>Dublin Core</i>, <i>DDI</i>, <i>DataCite</i> and <i>Schema.org</i></li> <li>• Ensuring data and outputs are registered or indexed in a searchable resource, e.g., <i>DataCite</i>, <i>Schema.org</i>, <i>B2FIND</i>, and <i>VLO</i>.</li> </ul>                                                           |
| <i>Accessible</i>    | <ul style="list-style-type: none"> <li>• Items are retrievable by their identifier using a standardized communications protocol, e.g., <i>Hypertext Transfer Protocol</i>, <i>Rsync over Secure Shell</i>, <i>Representational State Transfer</i>, etc.</li> <li>• Supporting both session and API key-base authentication and authorisation protocols.</li> <li>• Facilitating appropriately robust deaccession procedures should changes need to be made to the items, or if items need to be removed completely.</li> </ul> |
| <i>Interoperable</i> | <ul style="list-style-type: none"> <li>• Using formal accessible, shared and broadly applicable language for knowledge representation via a Linked Data approach supported with JSOB-LD for Schema.org.</li> <li>• Ensuring the use of FAIR controlled vocabularies and data models.</li> <li>• Ensuring qualified references to other relevant data or research outputs via the DDI schema.</li> </ul>                                                                                                                        |
| <i>Reusable</i>      | <ul style="list-style-type: none"> <li>• Releasing items with a clear and accessible usage license, i.e., published under the default license CC0.</li> <li>• Ensuring items are associated with detailed provenance, including information about authors, providers, distributors, and other related data, and supported by W3C PROV.</li> <li>• Ensuring items meet domain relevant-community standards.</li> </ul>                                                                                                          |

mediaTUM is an innovative platform that supports the publication of digital documents, research data, and multimedia content. It is home to over 230,000 public records, documents, and images, and all content published on the platform is indexed by third-party services, including the German National Library and Google Scholar. As a result, mediaTUM provides researchers and

other external stakeholders with unparalleled access to TUM's Open Access publications, research data, and university bibliography.

Additionally, the TUM Workbench software will be used for easy data sharing according to acknowledged standards and enables collaborative activities (e.g., peer review, creation of digital lab journals, versioning). This mainly pertains to the project partners but can be extended to selected stakeholders outside of the consortium to stimulate external cooperation and the exploitation of the project results. While TUM Workbench is designed for medium amounts of data, the Data Science Storage – hosted by the Leibnitz Supercomputing Centre of the Bavarian Academy of Sciences and Humanities – can be used for data amounts greater than 20 TB with similar functionalities as the TUM Workbench. Both systems feature a rigorous user access system.

It is worth noting that both mediaTUM and the TUM Workbench software are based on open-source software, which is available via GitHub and is free of charge. This supports the open science principle of making research data and software openly available to others. By providing this support, project partners can ensure that their data is managed effectively, making it more discoverable, accessible, and reusable, and ultimately contributing to the advancement of knowledge in their field.

### **2.3. Access and security**

The access to the data storage is limited to project members, which is an important security measure to ensure that sensitive information is not accessible to unauthorized individuals. This is especially crucial in today's digital age where data breaches are becoming increasingly common. The project members, who are granted access to the data on the data storage platforms, have been carefully selected to ensure that they have the necessary expertise and experience to contribute effectively to the project. Additionally, the membership to the data storage platforms is strictly controlled and managed by TUM, which further enhances the security of the data. Any attempts to access the platform without a proper invitation and registration will be immediately detected and prevented. This rigorous process ensures that only authorized individuals are able to access the platform and the data stored within it, protecting the project's confidential information from potential threats.

The data generated in the project will be handled through the TUM Workbench. Workbench is a secure TUM platform, with all data being stored on servers maintained by the Leibniz Supercomputing Centre. Unlike cloud servers owned by third-party commercial providers, this ensures that the research data is protected against data loss and can be archived for the long term. Regular backups also mean that the data is always safe and secure, even in the event of an unexpected loss or damage to local files.

## **3. Data Sharing**

The open science strategy of DISCO2030 will be guided by the principle of making research results available free of charge as soon as possible in the process while ensuring the protection of sensitive financial data and intellectual property. The DISCO2030 open science strategy will be guided by TUM's Open Access Policy (adopted in 2014), which stipulates that “all research results

of scientists at TUM are to be made freely accessible throughout the world and thus be rendered as visible as possible”.

DISCO2030 will facilitate open access to all scientific publications released by partners which draw on project research results via the open research repository mediaTUM, hosted and managed by the coordinator TUM, and via the Open Research Europe platform.

Research outputs will be used to inform the publication of 5 academic papers and will be presented at 10 international academic conferences. Furthermore, since the data will be open access, other research groups will be able to use and implement the data generated by the project or data collection methodology in their respective works.

TUM is committed to sharing the research results of its scientists with the rest of the world. As an institution, TUM ensures that its members have access to the necessary financial and structural resources to achieve this objective. The university also provides support through its Research Service Centre, which assists project partners with various aspects of research data storage, sharing, and metadata provision. By doing so, TUM aims to make research data more accessible to research groups beyond the consortium.

Moreover, TUM recognizes the significance of research data management in ensuring data reproducibility and transparency. As such, the university is constantly exploring ways to improve its data management practices. One of the main ways that TUM is achieving this is by utilizing the mediaTUM repository to publish relevant research data. This approach facilitates both the access and sharing of research data, allowing the scientific community to benefit from the findings of TUM's scientists.

## **4. Management**

### **4.1. Legal obligations**

Some of the data generated in the project falls under sensitive category as mentioned in the project proposal. These data must be handled accordingly. The rules defined in the Grant Agreement and the Consortium Agreement, especially regarding confidentiality and approval of dissemination, will strictly be followed.

No personal data processing is envisaged as part of the research activities. Should it however be necessary to process personal data as part of the dissemination, exploitation and communication activities, compliance with GDPR and any other relevant national personal data protection legislation will be ensured.

### **4.2. Responsibilities**

The overall project coordinator (TUM), internal project leaders and IT support teams will be responsible for adequate handling of the research data during the project. The data creators will be responsible for data quality and regular updates during the project. After the project end, the coordinator (TUM) will be responsible for curating the data. The data handling will be overseen by the data management officer, Emre Osmanoglu from TUM.