

D3.2 - Development of wind engineering data model

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Authors	S. Bousias (UPAT) M. Burlando (UNIGE) A. Costache (WU) S. Gillmeier (TUE) M.P. Repetto (UNIGE) P. Delpech (CSTB)	Deliverable type	Report
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OVERVIEW

As part of the TA activities of the user groups, a significant volume of experimental data will be produced and made available following the experimental activities. The data and associated metadata will be made publicly available through a scheme of a dedicated portal which will store searchable metadata and provide links to public repositories where the actual data are stored.

To facilitate data/metadata querying a data model must be used. Such data model was developed and employed, in the earthquake engineering domain, within the SERIES project and enhanced further (considering the Common European Research Information Format, CERIF, as a comprehensive information model for the domain of scientific research).

Within ERIES, the approach is extended further to cover experimental data produced in the domain of wind engineering. To that end, the EDF/CERIF data models are used as the basis for such enhancement.

1 OVERVIEW ON EDF / CERIF INFORMATION MODELS

The Exchange Data Format (EDF) represents a uniform way of structuring experimental data (value and context) in the domain of structural testing under. It was developed under the SERIES project [1] to provide a general naming scheme that is common ground to structural experimentation - it builds around the hierarchy presented in Figure 1, comprising four levels of entities: Project, Specimen, Experiment & Computation and Signal:

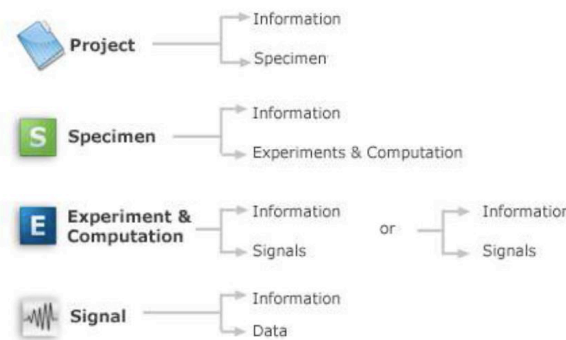
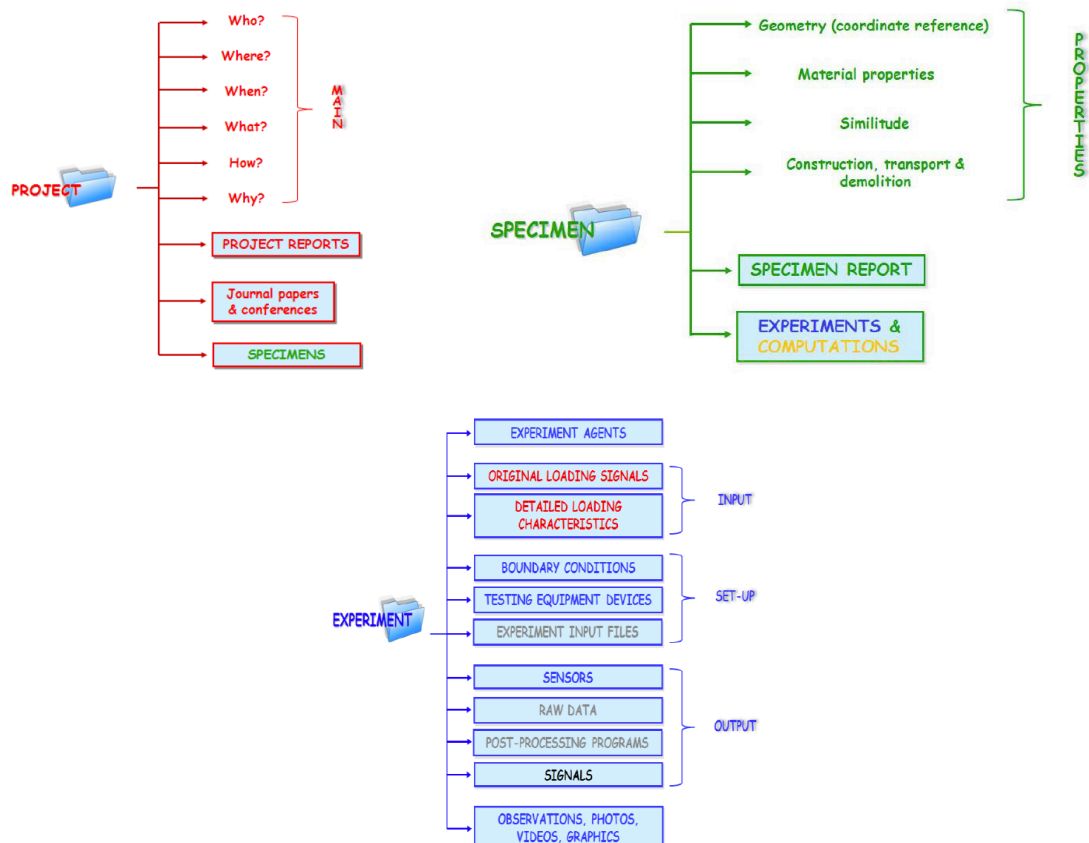


Figure 1 EDF data hierarchy overview

Each level of the hierarchy dissolves into fields with data that contain information pertinent to each level (Figure 2).



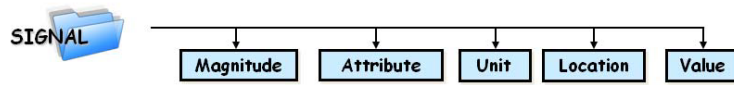


Figure 2 EDF levels of entities

The EDF format was later further modified within the SERA project to comply with EPOS infrastructure [2] which was based on the Common European Research Information Format – CERIF, (<https://www.eurocris.org>) metadata reference model. CERIF targets at describing entities in the Research domain, such as person, organisation, project, publication, patent, data, facility, equipment, service, funding, measurement, indicators, identifiers and their relationships. The image below presents an overall view over the Research domain and its related entities.

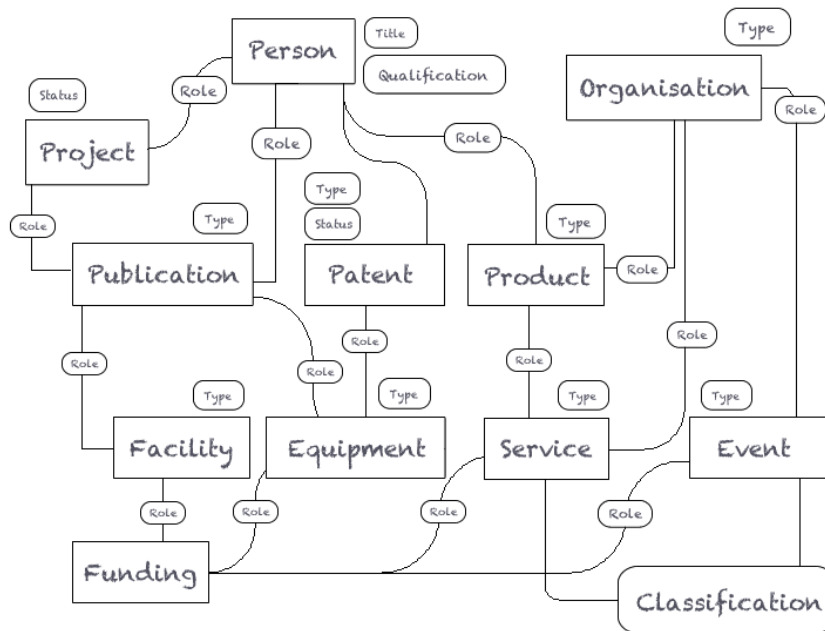


Figure 3 CERIF reference model

2 EXTENSION TO WIND ENGINEERING DATA

To satisfy the needs in ERIES, where experimental data from another domain, i.e. wind engineering, need to be incorporated, a thorough discussion on the issue commenced among partners in WP3. As literature review revealed, no data model dedicated to wind-engineering data model was available - a taxonomy and meta data model developed on the Data Catalog Vocabulary (DCAT) for wind energy applications [3, 4], was considered not appropriate for the type of data provided within ERIES.

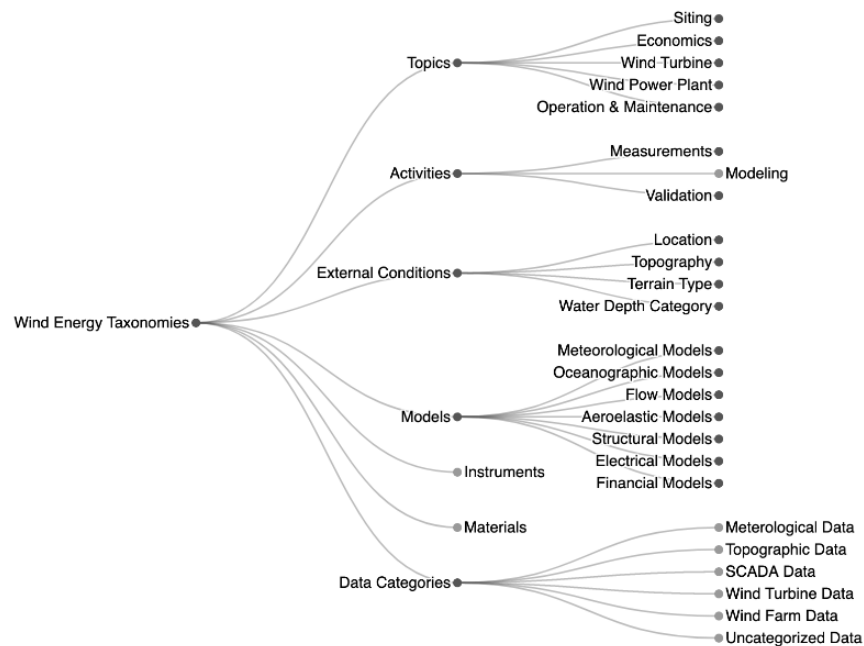


Figure 4 Taxonomy for Wind Energy data (<http://data.windenergy.dtu.dk/taxonomy/>)

Upon studying the structure and content of experimental data produced in for wind engineering applications it was realized that, with minor deviations, the pair EDF/CERIF data models may cover the needs for providing a "unified" way of metadata presentation in ERIES data portal - deviations regarded mostly differences in the terminology employed and could easily be accounted for. The extension proposed will also form the underlying guide for appropriately presenting the experimental datasets, which wind engineering facilities will make available to public repositories for open access.

2.1 Modifications to EDF

The following modifications are introduced to the EDF/CERIF metadata model to describe data resulting from the experimental activities of wind engineering laboratories. *It is noted that the data/metadata model proposed is general - nonetheless, only some of the attributes (with their name shown "boxed") are required when a new project is added to the portal (to provide searchable content for users), with the rest being used (where appropriate) for providing users with the maximum possible information for effectively using the data. The latter are to be included in the accompanying documents, e.g. the Data Paper or those uploaded to the public repository (data files and metadata).*

[Project]-->

"What": the subject of the test (the main focus research area of the project) may be described by one (or more) of the following keywords:

- Structural
- Cladding
- Aeroelastic
- Aerodynamics (ship, vehicle, etc.)
- Wind energy
- Pedestrian wind study
- Urban model
- Approach flow conditions
- Velocity distribution / Flow field
- Other - (user-compiled field)

"How" --> values:

- Pressure study
- Force balance study
- Topographic study
- Flow visualization
- Computational
- Other - (user-compiled field)

"Why" --> 300word-field

[SPECIMEN] is renamed to [SPECIMEN/MODEL] with the following attributes and values:

"Type":

- building
- bridge
- vehicle
- ship
- sail/canopy
- wind tower
- solar panel
- other - specify (user-compiled field)

"Material(s)", with values:

- concrete
- steel
- aluminum
- wood
- acrylic/composite
- foam
- PVC
- 3D-print
- other - Specify (user-compiled field)

"Specimen geometric scale" (substitutes "Scale" - any other scaling introduced maybe be provided in documents supplied to describe the metadata accompanying the data, e.g. in a DOI-indexed Data Paper).

Numeric value of model-to-prototype ratio (user provided value):

1 :

"Construction/transport/demolition" : may be obsolete

[EXPERIMENT] :

"Type", values:

- Wind tunnel
- Lidar scanning
- Other.....

"Boundary conditions": information describing, e.g. approach flow conditions or simulation of pollutant sources etc.

"Original input signals": may include the description of the forcing function employed (e.g. the wind tunnel "reference" can be identified as "input signal").

"Configuration" : (if necessary) describes the type of equipment used to "excite" the model. A PDF file providing more setup details, especially if not possible to capture under the "boundary conditions" section, may be used.

"Sensors": describes the sensors employed in measuring data, their location as well as other metadata about them - this information is to be included (e.g. in a Data Paper or as descriptive files - drawings, text document - uploaded to the public repository where data is stored) as information provided to users for understanding the data). The data per sensor maybe provided as individual files or (preferably) as a data matrix, according to the **ERIES Data Management Plan**.

3 SUMMARY

A data model, result of the collaborative effort of the main earthquake engineering facilities in Europe and the funding provided by SERIES (FP7) and SERA (Horizon 2020) projects, has been developed and made available. The transnational access activity in ERIES develops along the same lines, with the addition of (open access) data resulting from facilities of a different scientific domain, that of wind engineering. Thus, a need emerges for a data model capable of describing in a general, concise and transparent way the new data type and providing all the associated metadata which render the data understandable by third-parties seeking in re-using the data, as described in ERIES Data Management Plan (ERIES Deliverable D3.1).

This report describes the data model developed to describe wind engineering data. It is shown that, with targeted modifications resulting from interactions within ERIES-WP3, the existing data model built to describe test results offered by earthquake engineering facilities, may be used. The updated model complies to what is foreseen in ERIES Data Management Plan and forms a basis of common understanding both, for the facilities uploading the basic metadata about a project (as required by, and stored at, the central data access portal) to facilitate querying by interested users, as well as for structuring the data and the metadata which facilities will provide through Data Papers and actual data uploading to public repositories.

4 REFERENCES

SERIES project - Deliverable NA1.1: DB prototype and Data Format, 2009

SERA project - Deliverable D6.4: Review of current SERIES and EPOS databases, 2018

IRPWIND project - Deliverable D2.3: Taxonomy and meta data for wind energy R&D, 2017

DTU Wind Energy metadata and terminology, 2020, doi: 10.5281/zenodo.4033073

ERIES, Deliverable D3.1: ERIES Data Management Plan, 2023