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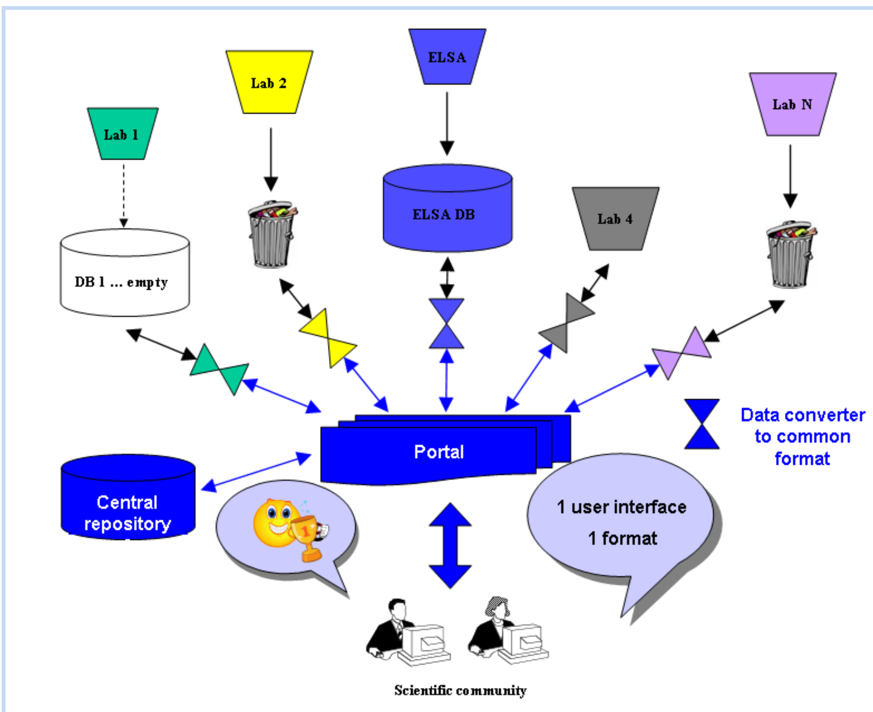
Anna Bosi and Pierre Pegon



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The ELSA database and what can be done regarding *SERIES networking activities*

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Content

1 Introduction

All countries dealing with seismic and dynamic experimental activities, not only Europe but also USA, Japan, Taiwan, etc., have been faced with the necessity of a data repository for storing and sharing earthquake engineering data.

The European Commission and almost all the governments of European seismic countries have made major investments in experimental research infrastructures in earthquake engineering but this large capacity and the associated human resources are not used efficiently, as they are extremely fragmented among different Member States or Associated Member States.

In Europe for example, there are more than 18 shaking tables, 6 reaction walls, 9 centrifuges and 1 in-situ test area. All these facilities are generating data, usually time series of physical quantities recorded at discrete locations rarely structurally stored. From a recent statistic, most of these laboratories do not have a database and a few of them have just recently started to implement one, each laboratory by choosing its own format and its own user interface, but no data is already uploaded. Only ELSA Laboratory operates a database, where all the experimental tests performed are automatically stored since several years.

The lack of data organization is now becoming a critical issue since the European scientific community, adapting to the constraint of the cost (that has recently led to a cut on the experimental activity) and urged from the incentive of the European Commission, is in last years becoming more and more collaborative. Researchers are thus faced with the need, within the same project, to exchange a huge amount of experimental results with the partners. However, the lack of organization of these data makes this exchange a difficult task, strictly dependent on the possibility to have access to the experiments performed on the laboratories. First, one has to trace the origin of the data (the laboratory where the experiment has been performed), then get in contact with the person who did the experiment and that is the effective “owner” of the data; wait for the reply (and the researchers are always very busy and thus poorly cooperative) and finally the user has to interpret what the busy researcher has sent to him and in which format (Figure 1).

This situation represents a limitation for the research, both in terms of organization and outcomes for model identification and thus an organization of all the data (both at the level of the test operators and the test users) appears now as a strong need.

The European community is now coping with this need within the FP7 collaborative project *SERIES* (*Seismic Engineering Research Infrastructures for European Synergies*).

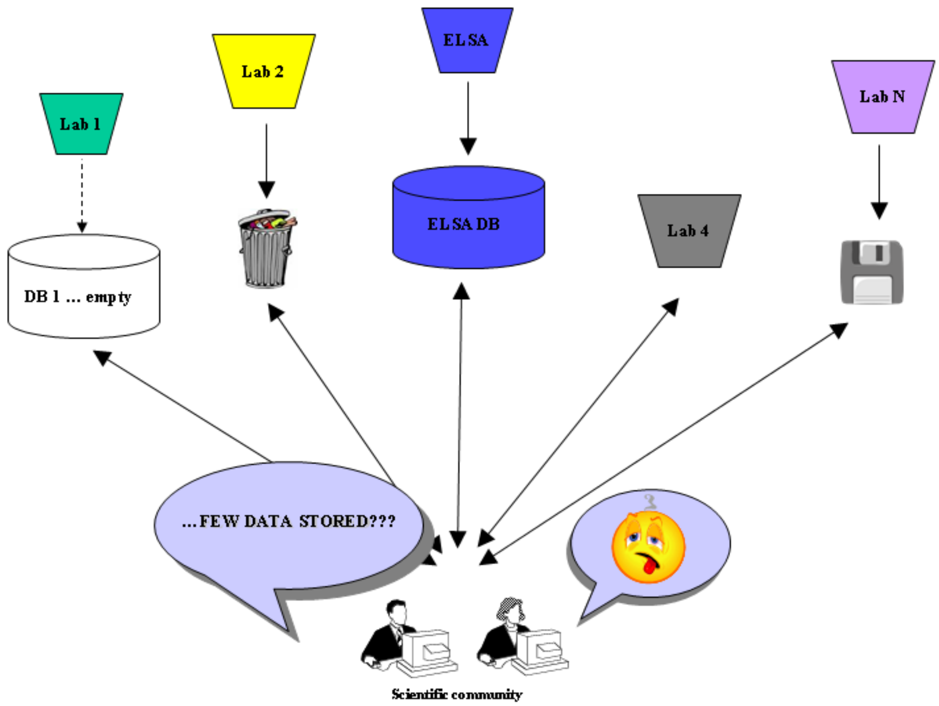

Figure 1. Data users face with N laboratories, few databases, only one of them regularly operated.

The main objective of this project is to unlock the huge potential of Europe's RTD community in earthquake engineering by contributing on bridging the two gaps of RTD in experimental earthquake engineering and structural dynamics: the one between Europe and the US or Japan, and that between European countries with high seismicity but less advanced RTD infrastructures on one hand and Member States more technologically advanced but with low seismicity on the other. First step in this direction is the integration of the entire European RTD community in earthquake engineering via a concerted program of networking activities, fostering a sustainable culture of co-operation among all research infrastructures and teams active in European earthquake engineering.

A key role on the networking activities is the implementation of an European distributed database of experimental information that requires first the identification of the formats and structures in use in the European experimental facilities by reviewing what is currently available in the consortium and then to the formulation of a common data model leading to an exchange protocol.

The US Earthquake Engineering community faced the same problem some years ago: the NEES (Network for Earthquake Engineering Simulation) platform has been created.

However, the approaches followed by the US community and the European one are different: US community has created a centralized database, while the European community had always focused on a distributed approach [4]:

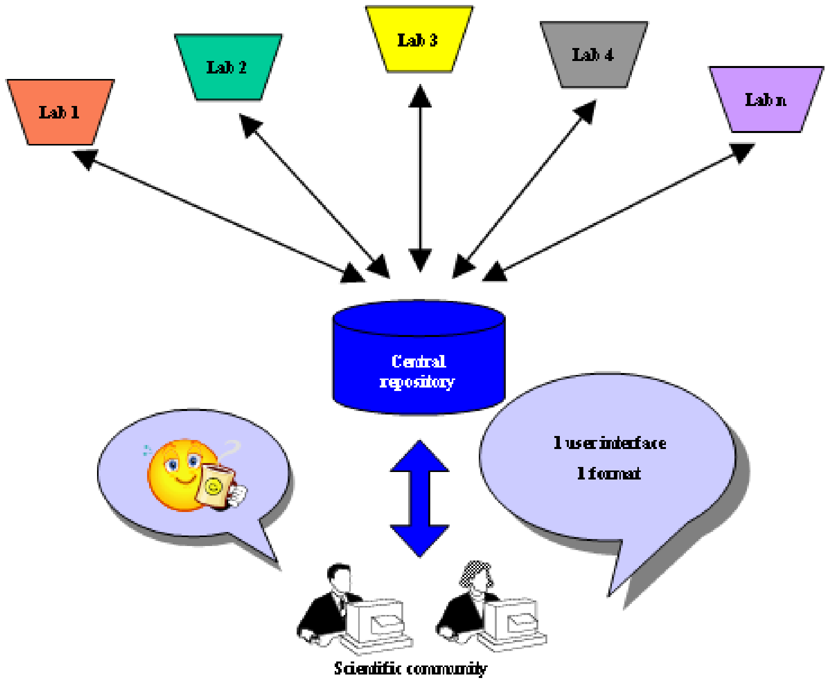

Figure 2. Centralized approach.

- In a *commonly defined uniform database*, the data are stored in a unique centralized database and the uniformity comes from a unique storage format. In a unique centralized database, all the data are stored in the same "repository" and the access is uniform.
- In a *commonly defined communication format* (or protocol) the laboratories remain the owners of the data which is stored locally; they implement the database locally (but by following a standard format universally approved) and then only by means of a common portal the exchange occurs by the adoption of a communication format.

  What is changing is that the dispersion becomes distribution. What has to be done is to be able to deliver, on request, a time series and its context in a standard form, instead of a locally defined form. Based on this communication format, a second action is thus needed: develop a virtual central database, a community of local databases that can be accessed through a unique central portal, the common communication format ensuring the uniformity of the downloaded data (Figure 3).

Even if it is not immediate, the second approach seems to be more appropriate to the heterogonous European community. In fact it is also a process in the sense that being part of the virtual database network does not preclude to host locally other types of data or to perform new specific developments. In other words, it is not a limitation to individual creativity. Moreover, the promising idea can be further shared at the level of the common format, enlarging the variety of data available at the level of the common portal.

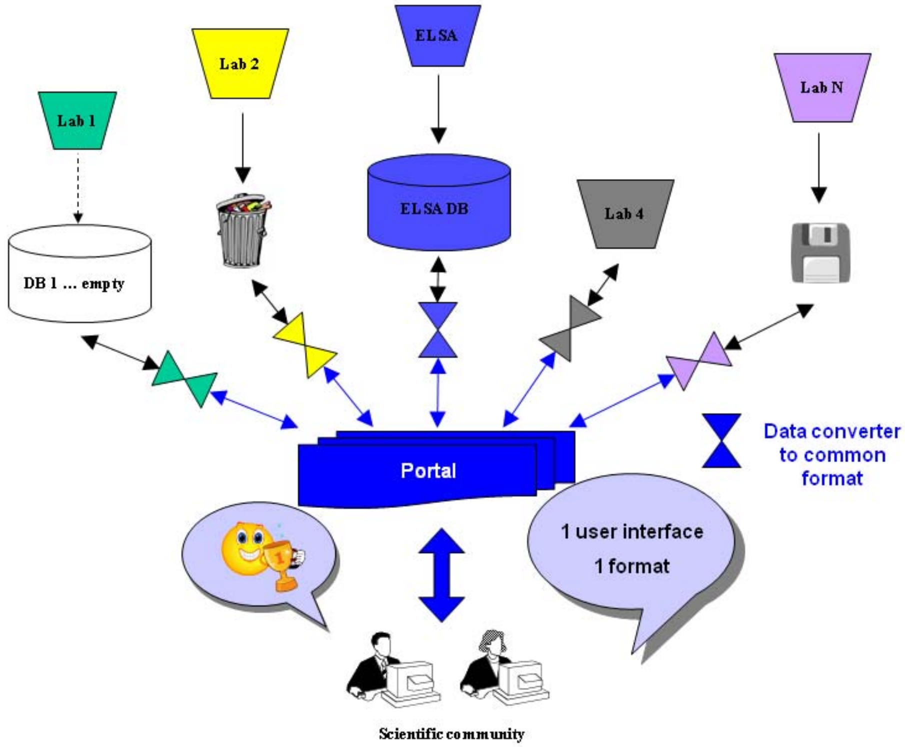

Figure 3. Distributed database with centralized access.

The aim of this report is twofold: first to analyse the ELSA data model. Being the only consolidate laboratory database currently in use, it will be the starting model for the definition of the standard format to be distributed among the European scientific community. Some useful hints and suggestions for an improvement of the current data model are also achieved by a critical investigation of NEEScentral data format and of the whole NEES experience. The general information collected by this scrutiny represents an essential support for the creation of a distributed seismic database among Europe.

Some hints about possible changes in the access to the ELSA database in view of the common web portal for the distributed database are finally mentioned in the conclusions.

2 ELSA data model

The European Laboratory for Structural Assessment has always taken care of the preservation of tests data. Since the early '90, every data were preserved in an apposite folder; even if stored all together, they were traceable by means of a special codification on the way to save them. Unfortunately, the uploading and the treatment were not automatic and, moreover, the data were accessible and comprehensible only for the restricted group of people that directly did the test. On the years that followed, the storage became more structured with the introduction of separate folders for each project; finally on the 2000, an effective new database started to be operative allowing web access from the whole world [2]. Even if some small changes have been introduced on the time, the main structure is still the one in use.

In what follows, ELSA *data model* is presented in a critical way, by showing also two examples of projects currently available. Strengths and weaknesses of the *data model* are underlined.

2.1 A typical experiment on ELSA database

A *data model* represents classes of entities that are of interest to store information, the attributes of that information and relationships among those entities and attributes. ELSA *data model* is based on a hierarchical structure of the objects, consisting of types *Project*, *Structure*, *Experiment* and finally *Signal*. Data and detailed information related to the experiment are collected. In Figure 4 is a sketch of this hierarchical organization.

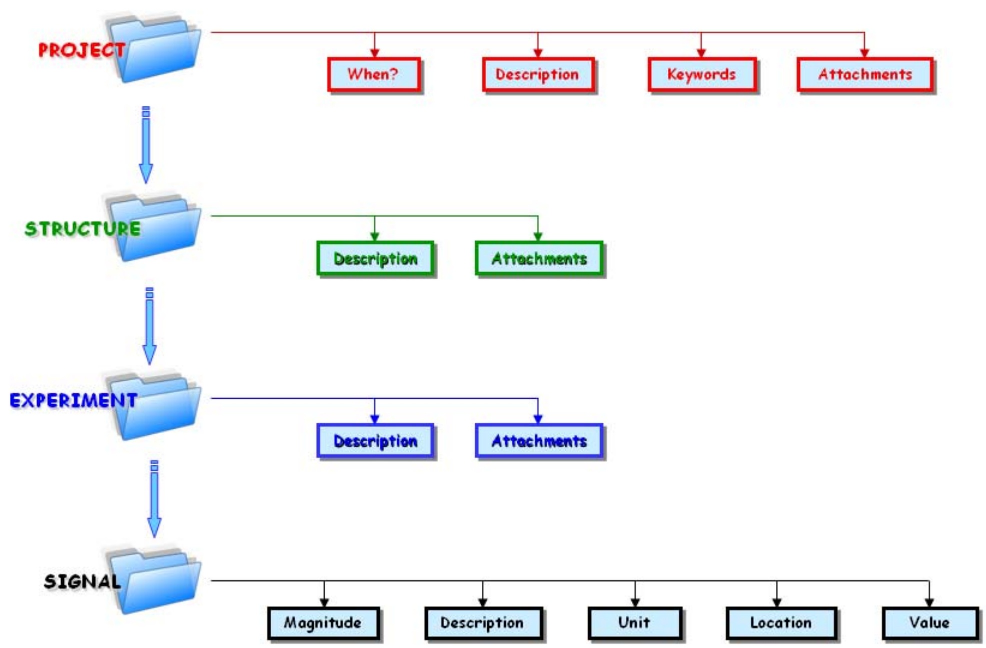

Figure 4. Hierarchical structure of ELSA data model.

For each *Project* some general information is given on the main interface (Figure 5), more detailed ones can be obtained by selecting a specific project (Figure 6).

Here, detailed information about the project and about the specimen are given as additional documentation appended on the bottom. Note that no standard fields are specified; the information given can thus vary and can be more or less detailed.

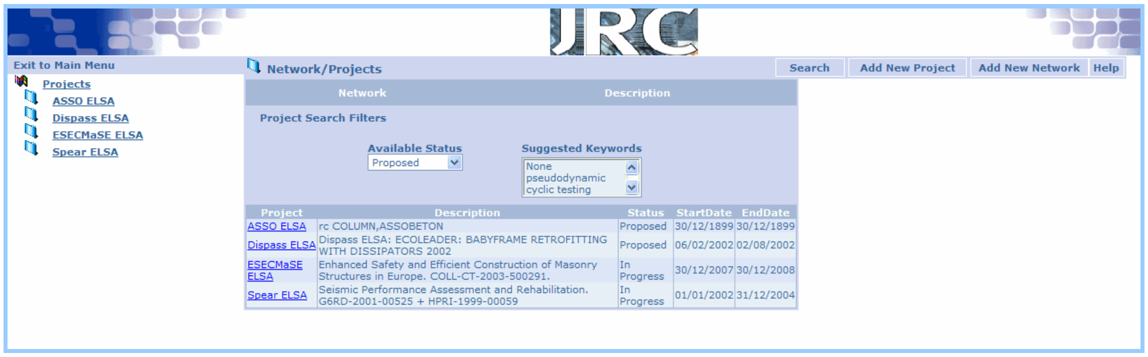

Figure 5. Web access to ELSA database. List of some *Projects* available (the complete list contains now more than 30 projects).

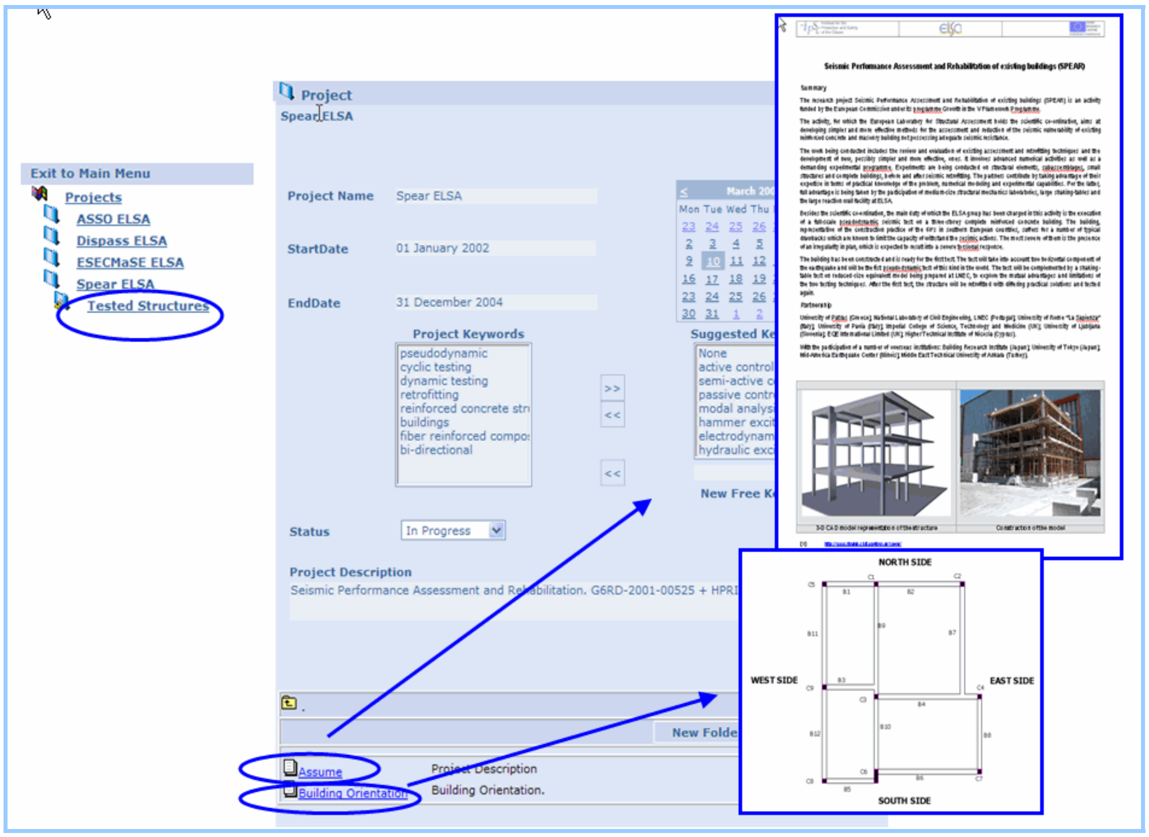

Figure 6. Details of the project *Spear (Seismic Performance Assessment and Rehabilitation)* [3].

For *Spear Project*, three *Structures* have been tested: the specimen on the original status and with two different types of retrofitting (Figure 7). For each configuration the related details on the instrumentations are given at this level.

On every *Structure* (the original specimen and the retrofitted ones), dynamic and pseudo-dynamic *Experiments* have been performed (see Figure 8): *dynamic random burst 5mm*, cyclic random burst 5mm, ... Frequently the very small preliminary experiments are just shortly described, and the characteristics of the performed tests result clear only to familiar users.

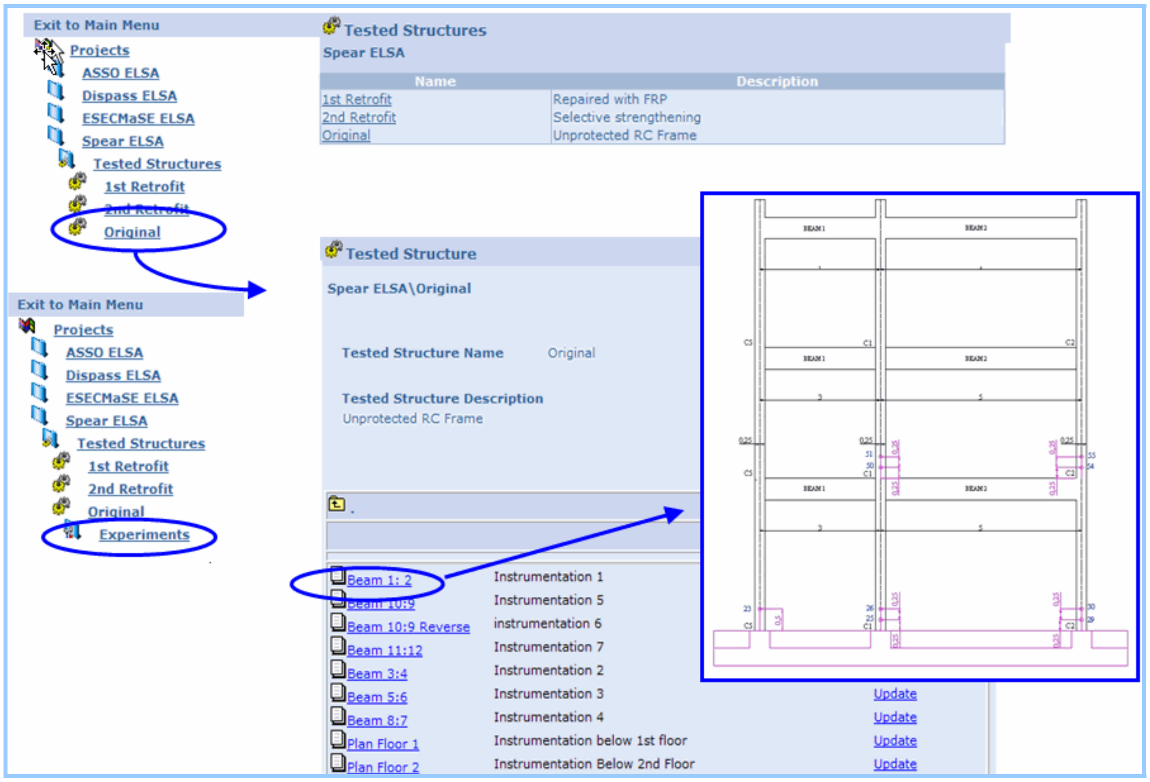

Figure 7. ***Structure*** **level.**

The results of each experiment are then collected and compared on the following sub-folders (in Figure 9 it is shown the content for the *s12* experiment, which is one of the main ones). The graphics uploaded result very useful for users that want to have direct access to the final plots of the signals without looking at each signal separately.

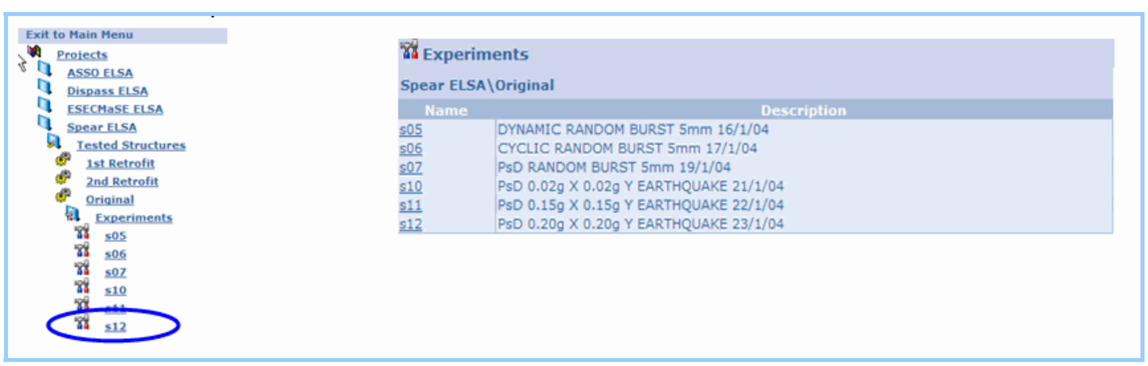

Figure 8. ***Experiment*** **level.**

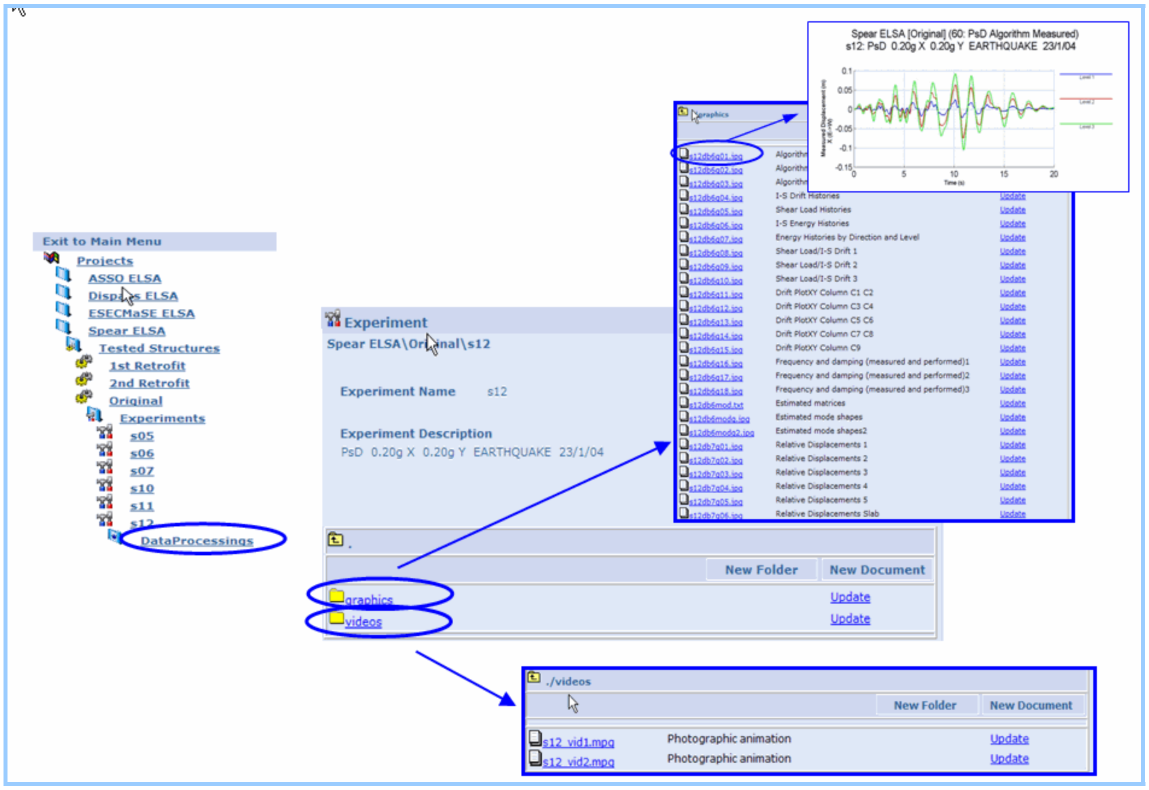

Figure 9. Experiment level: final graphics are available on the bottom.

Finally, for each *Experiment*, the *Data* are collected on six subfolders (Figure 10):

- *60 PsD Model Measured* where displacements and forces at the DoF's of the equation of motion measured during a pseudo dynamic test are collected;
- *62 PsD Model Derived* for pseudo dynamic data calculated from the previous ones, such as inter stories drift, etc;
- *63 PsD Model Identified* for data such frequency and damping identified from the previous ones, etc still in case of pseudo dynamic test;
- *70 Standard Measured* for local measurements from additional transducers not linked to the controllers such as (extensometers, inclinometers and additional load cells);
- *80 Controller Measured* for actuator load cell forces, Temposonics (internal) and Heidenhain (on the structure) displacements and, in general, transducers linked to the controllers;
- *82 Controller Derived* where derived measures from the previous group, such as mean displacement, shear forces, etc are listed.

The acronyms employed are standard through different projects, but not self explaining and some additional information could be given already with this description (or on request with the right button of the mouse).

DataProcessings

Spear ELSA\Original\s12

Name	Description
60	PsD Algorithm Measured
62	PsD Algorithm Generated
63	PsD Algorithm Identified
70	Standard Measured
80	Controller Measured

Figure 10. Data Processings for experiment *s12*.

These subfolders contain all signals: for example Figure 11 presents the signals regarding the pseudo-dynamic equation of motion. Each of them is fully characterized by specifying the magnitude, the unit employed, a parameter regarding the orientation and the floor level at which it has been measured. Orientation and level are given as additional parameters and other parameters can be added if necessary for a more complete characterization.

Signals | Deselect All Signals | Select All Signals | Download Binary Format | D

Spear ELSA\Original\s12\60

Name	Description	Magnitude	Unit	Param1	Param2	Param3	Param4	Param5
000		Time	s					
001	Measured	Displacement	m	X (E->W)	Level 1			
002	Measured	Displacement	m	Y (N->S)	Level 1			
003	Measured	Displacement	rad	Theta	Level 1			
004	Measured	Displacement	m	X (E->W)	Level 2			
005	Measured	Displacement	m	Y (N->S)	Level 2			
006	Measured	Displacement	rad	Theta	Level 2			
007	Measured	Displacement	m	X (E->W)	Level 3			
008	Measured	Displacement	m	Y (N->S)	Level 3			
009	Measured	Displacement	rad	Theta	Level 3			
010	Reference	Displacement	m	X (E->W)	Level 1			

Figure 11. Signals available.

Every signal can be displayed and downloaded (Figure 12).

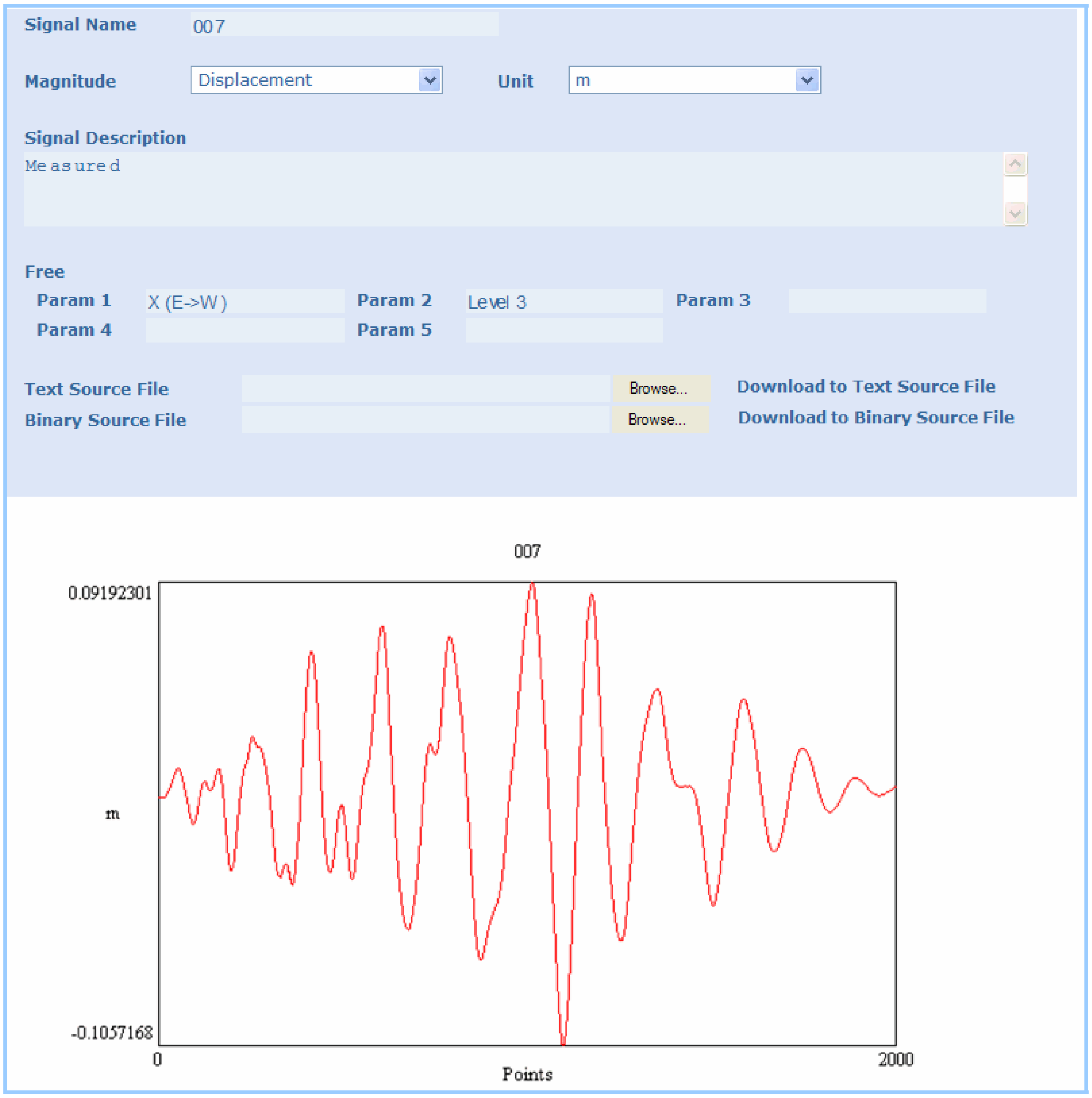

Figure 12. Displacement 007.

The overview on ELSA database allows noting that the *data model* results well organized. Nevertheless, it lacks for some fields:

- No specific folder is devoted to the information on the facility and on the specimen. They are given as additional documentations and nowhere is specified what data will be given.
- Raw data (the data directly acquired from the sensors) are not given. This has been added only in recent projects.
- Numerical computations are not considered.
- Some fields are comprehensible only to familiar users. Short descriptions are missed.

The strength of the model is the complete characterization given at signal level (Figure 11): magnitude, units and other useful information are given and it not necessary to look for this information elsewhere.

2.2 ESCMaSE experiment

Two main innovations are introduced in the *ESECMaSE (Enhanced Safety and Efficient Construction of Masonry Structures in Europe)* [1] experiment:

- The first one is the presence, at the *Structure* level, of some folders containing information about the instrumentation and the specimen (Figure 13). This information is given as pictures, graphics and documents.

  Unfortunately all these pieces information are given all together and in a non-structured way: no standard field is foreseen and thus their completeness depends on who uploaded the data.

- The second innovation is the presence at the *Experiment* level of the folder Config Master, Results Raw, Test Setup and Video (Figure 14). Config Master stores all the files required during the pseudo-dynamic test as input data, test files and libraries. They are not important for the external user but very interesting for the laboratory itself for long term know-how preservation.

  Results Raw are the data logged during the test in the binary format. For every acquisition a text file with information on the acquisition is added.

  All these pieces of information were missed on the *Spear* project. Unfortunately, a structured organization for this information is again missed here for some aspects: test set-up specifics are given at the same level as raw data and treated results, by generating a general disorder (Figure 14).

In conclusion, it is possible to state that the structure still lacks of systematic organization, but it presents the effort to give important information (above all for not familiar users) about the test that was completely missed before.

Numerical simulations are unfortunately not yet considered.

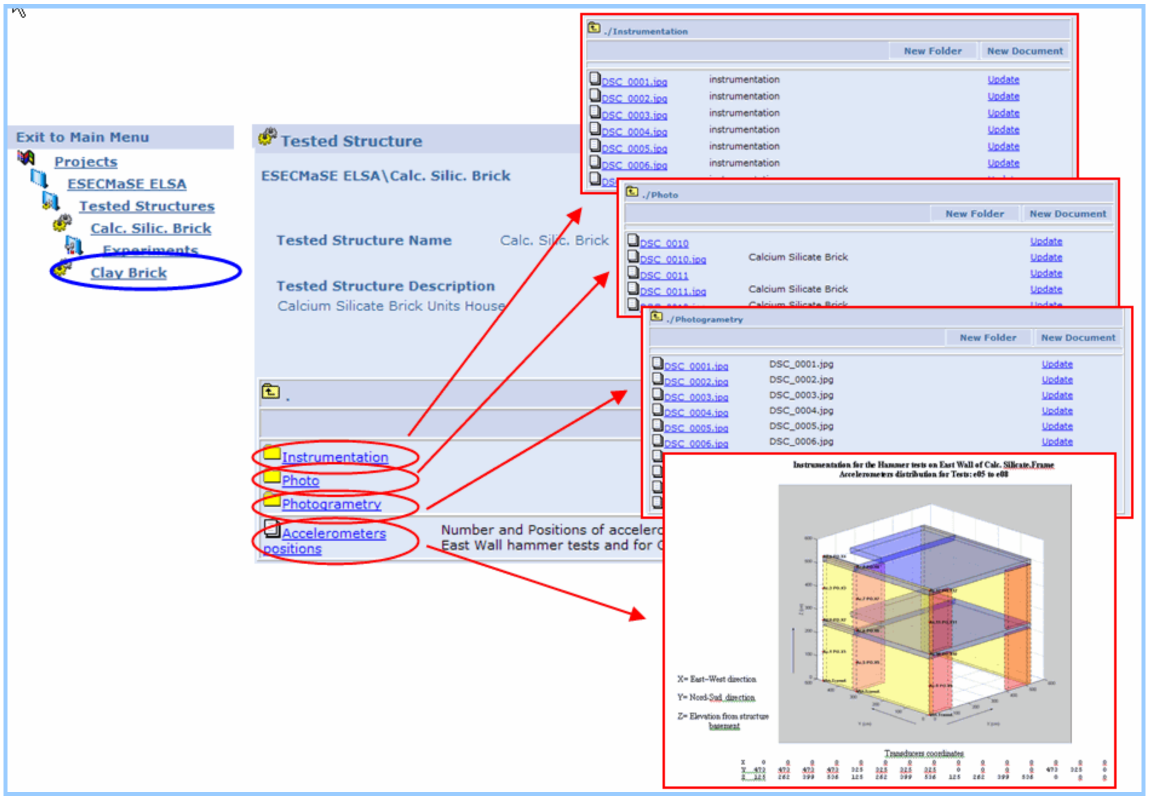

Figure 13. *Structure* level in ESECMaSE.

Figure 14. *Experiment* level in ESECMaSE.

3 Centralized database: NEES experience

The US-NEES initiative is an example of a centralized approach (Figure 15): it integrates 15 facilities by providing them not only a centralized data repository (NEEScentral) but also collaborative tools and earthquake simulation software, all linked together in order to provide access to different types of experimental and computational data and to promote and facilitate the collaborative and interactive process (Figure 16).

One of the main goals of NEES, when it was launched in 1999, was to develop a *data model* for earthquake engineering in close collaboration with the researchers in order to provide enough metadata about an experiment or simulation to effectively reproduce it and to foster the open exchange of knowledge among the community [5]. Then, independently of the success of the centralised approach, this data model is of interest for *SERIES* since it is already the result of an enquiry made over 15 facilities.

Another important issue was the dissemination of the results and the possibility for any people interested to have access to the NEES results. At that time it was thought that a centralized approach was the best way to solve the problem.

However, the presence of a central database does not prevent each laboratory (at least for a transition period) to maintain its own database (or their traditional way to storage data). The data thus need to be uploaded in the central database by the data owner and this represents a duplication of work and even a pain if the uploading has to be done manually.

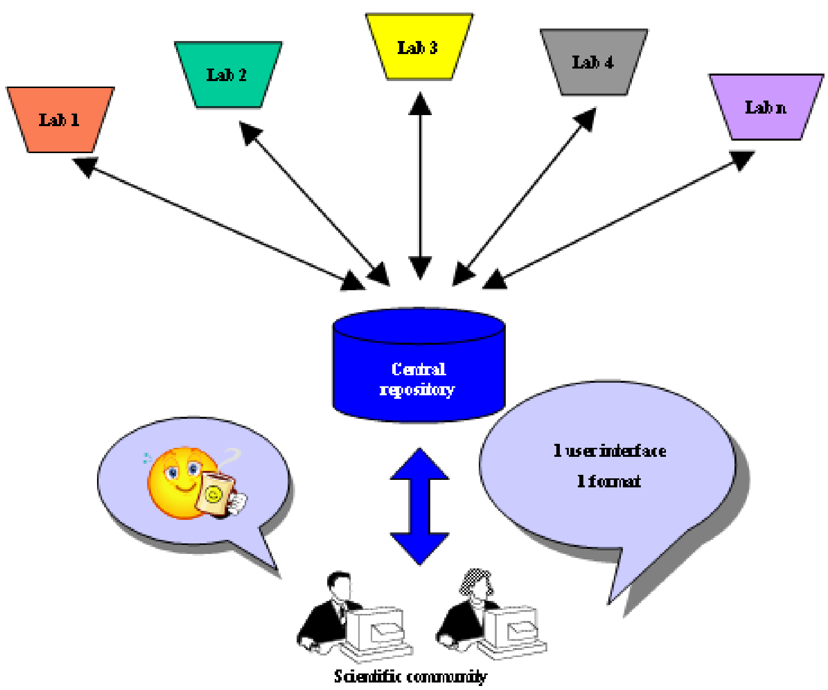

Figure 15. Centralized approach.

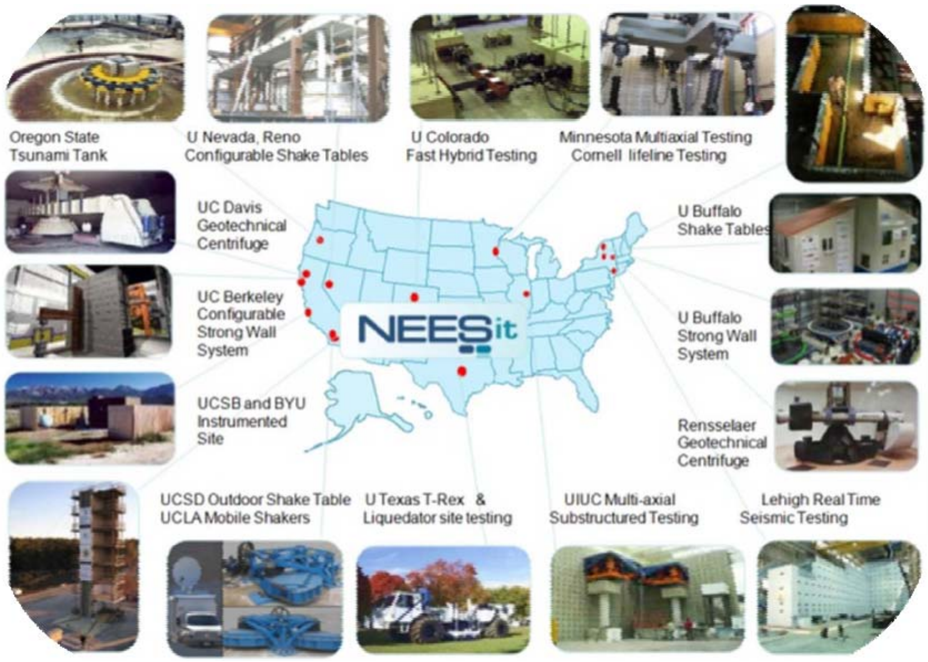

Figure 16. NEES equipment site.

3.1 IT challenges

Despite of the ambitious project and the huge effort put in this initiative, the NEEScentral repository has not been as successful as initially expected. Several are the (more or less) technical and psychological reasons:

- First of all, there was a lack of motivations on the scientific community; NEES repository represented more a duty than a necessity and the researchers were not enough motivated [6];
- Then, the lack of communication between the software developers and the final users (the researchers). It comes out, by just trying to consult NEES database, that the implemented software is in some case unnecessary complicated (as it will be shown in the following), it often leaves space to ambiguous interpretation and in any case it is not able to cope with the wide heterogeneity of seismic experimental data. This heterogeneity may even arise between two similar facilities (e.g. 2 centrifuges). The lack of automatic procedure to upload the data results in a great heterogeneity in nature, format and way of storing data, even if the container is unique. Only when standards folders are prescribed, the uploading is standard, otherwise the uploading is guided by a *personal* interpretation that commonly implies to upload the data in the less specific level completely bypassing the hierarchical structure.
- Reports about first years of NEES activity testify the difficulties previously presented: due to the complexity and redundancy of the implemented software, the use of NEEScentral resulted not immediate and researchers, that are always very busy, were not interested on learning new software. The reports highlight

also the fact that not enough effort has been put on finding effective way to train the researchers [6].

- Finally, and behind the appearances, there is also the psychological reluctance on losing the control on own data toward which the researchers seem to have always a great sense of ownership [4].

It is said that the basic problem was the lack of collaboration between who did the software and who had to use it: the complexity pursued by the former did not give immediate added values to the data owners.

In the next section, the NEES database is presented by describing the main characteristics of the implemented *data model*; a virtual tour on one of the available experiment is also given.

3.2 NEES data model

NEEScentral *data model* is based in a hierarchical structure, consisting of *Project*, *Experiment*, *Trial* and finally *Data*, where results and detailed information related to the experiment (or the simulation) are collected. Figure 17 gives a sketch of this hierarchical organization.

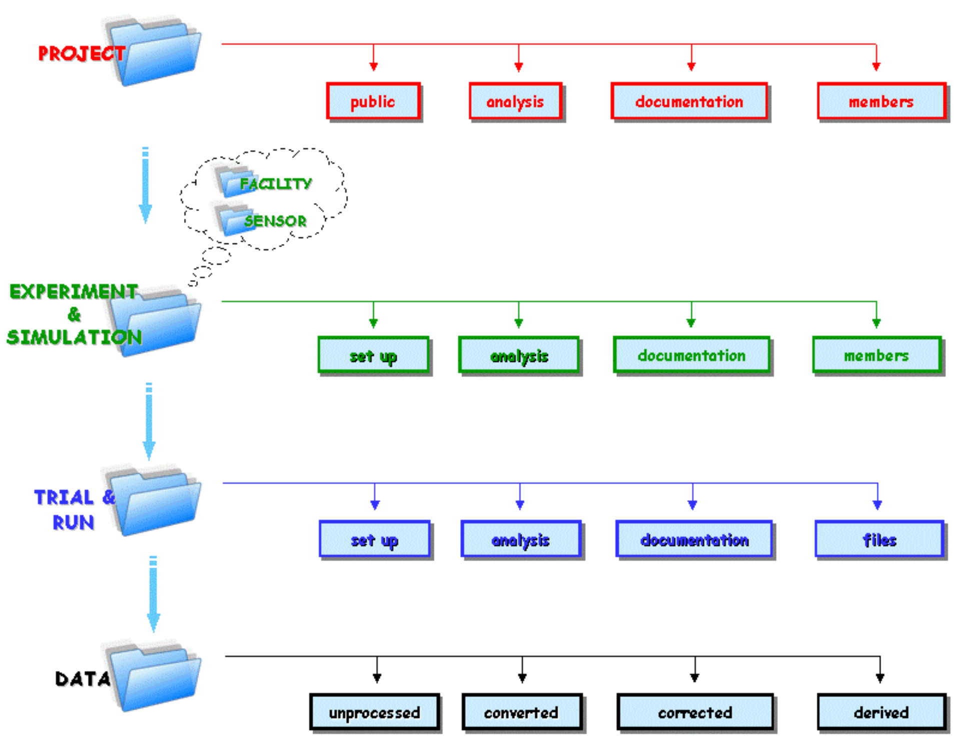

Figure 17. Hierarchical structure of NEES *data model*.

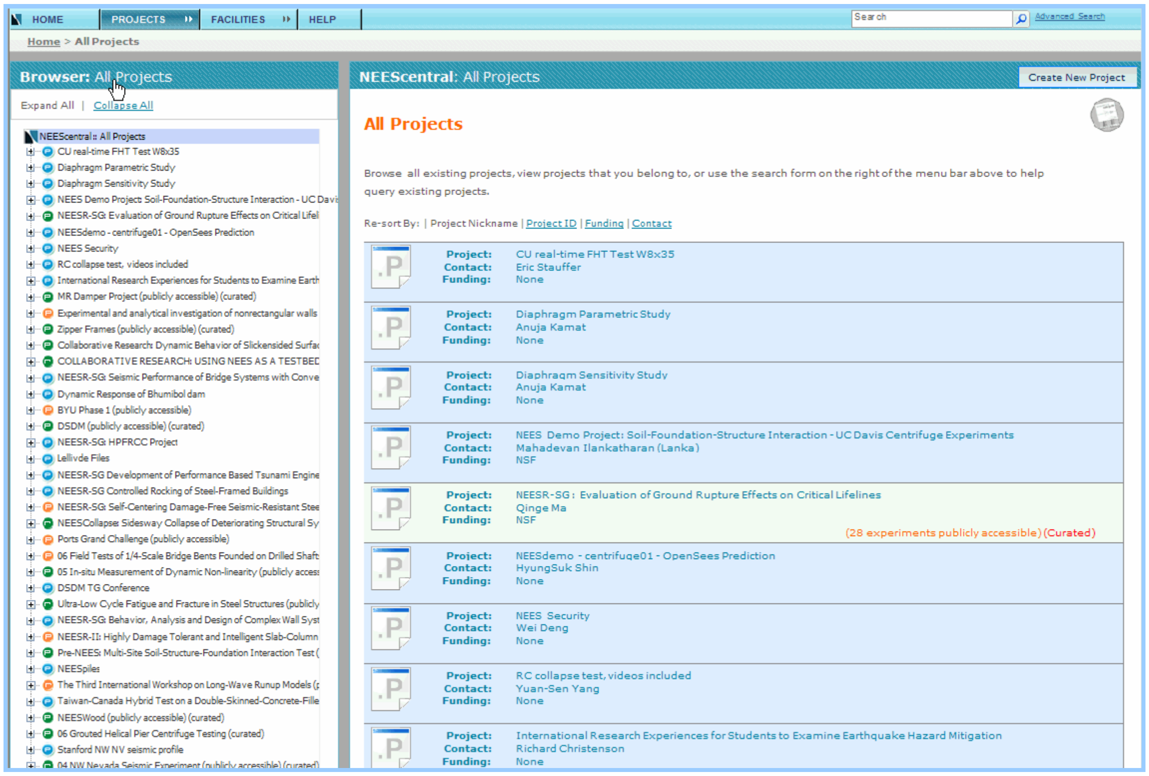

Figure 18. Example of *Project* folder in NEES

The main interface of NEEScentral is presented in Figure 18 where all the projects are listed. Looking inside those publicly accessible, one discovers that a large part of them does not contain any information and any data, almost simply the name. Only the projects funded by the National Science Foundation are always complete: in this case, researchers were urged to upload the data.

The presence of a large number of empty projects confirms that the existence of the central database does not avoid researchers to maintain the local database where in most of the case the upload comes automatically. Then, only if forced, they upload the data otherwise they do not feel the necessity neither the utility of doing it.

We selected one of the public projects that contain data, a study on soil–foundation–structure interaction. By respecting the hierarchy on Figure 17, at the top there is the directory *Project* where the formal name of the project, a description, the publishing status and other general aspects are collected (Figure 19).

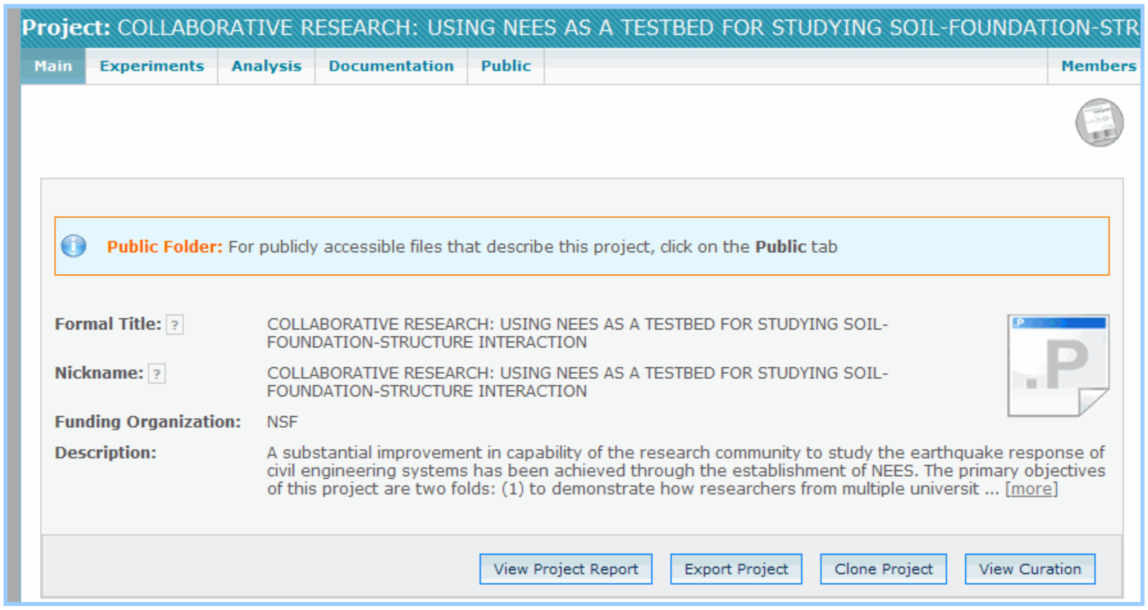

Figure 19. Example of *Project* folder in NEES.

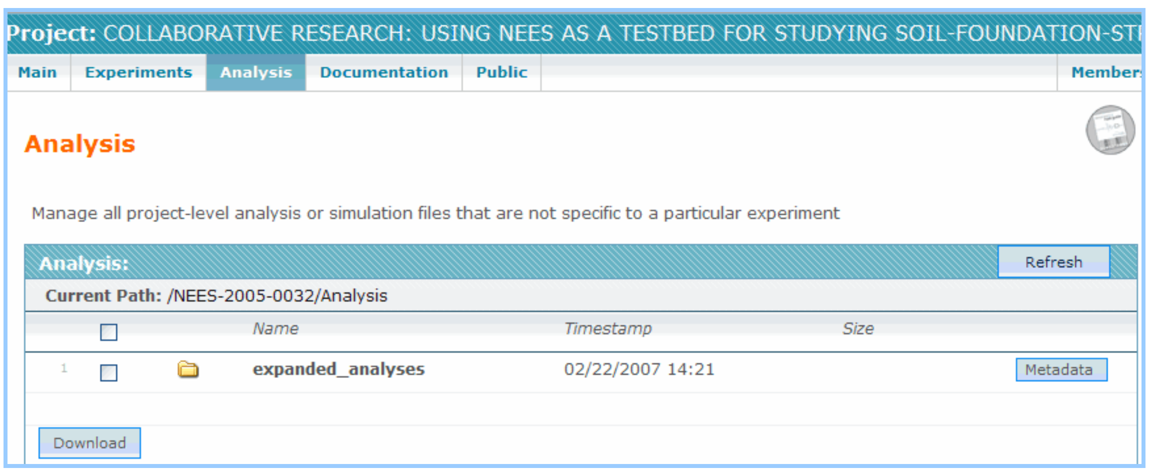

Figure 20. Subfolder *Analysis*.

Additional details can be given in the *Documentation* sub-folder. Here, all the files that can be explicative of the project can be uploaded as documents, pictures etc. *Public* sub-folder is dedicated for the documentation public accessible.

At the *Project* level, there are also the sub-folders *Analysis* and *Experiment*: in *Analysis* should be stored the simulations that are not specific to a particular experiment (Figure 20). In reality, looking inside, several simulations are included, some of them referred to specific trials and some that compare final results (Figure 21). Sap files are also present. This confirms the fact that, very often, the hierarchical structure is completely bypassed and the information is uploaded in a personal way, in particular when the researchers found difficult to understand what they should upload.

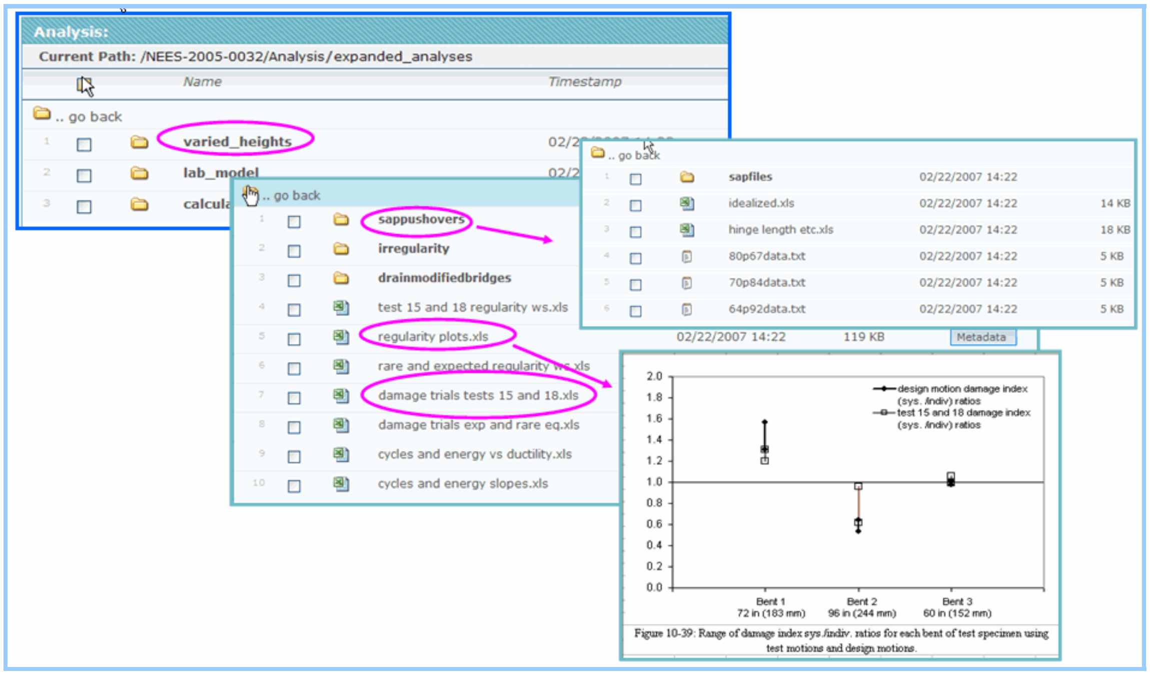

Figure 21. Contents of the subfolder *Analysis*.

On the bottom level there is the *Experiment/Simulation* directory that enters on the details on the facility and the specimen (physical test or computation simulation); three main subfolders are present (apart from those related to the documentation and the members): *set-up*, again *analysis* and the following sub directory *Trials* (or *Runs* in case of simulation) (Figure 22).

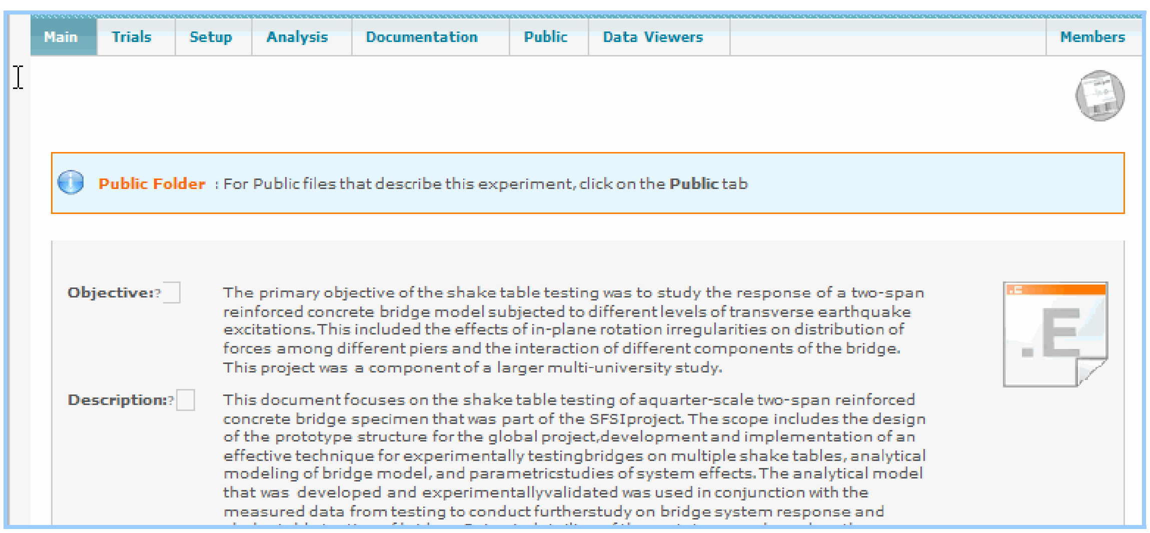

Figure 22. *Experiment/Simulation* directory.

In *set-up*, are specified the characteristics of the facility as the type of actuator or source, the sensors and their location (with reference to a specified coordinate system), the scale factor and the information about the specimen such as the geometry (also with drawings and photos), material properties, test set-up configuration, etc (Figure 23). This folder results to be well organized: in fact, the presence of a standardized set of fields (measurement units, material proprieties …) prevents to have incomplete or confused information about the test depending on who uploads the data on the database. In addition, since no specific format is required for this information, the user feels free to use the one that he considers more adequate. This flexibility is very useful also considering that in some case a format (for example a picture) can be more useful that an other (as a long document) or vice-versa depending on the characteristics of the tests.

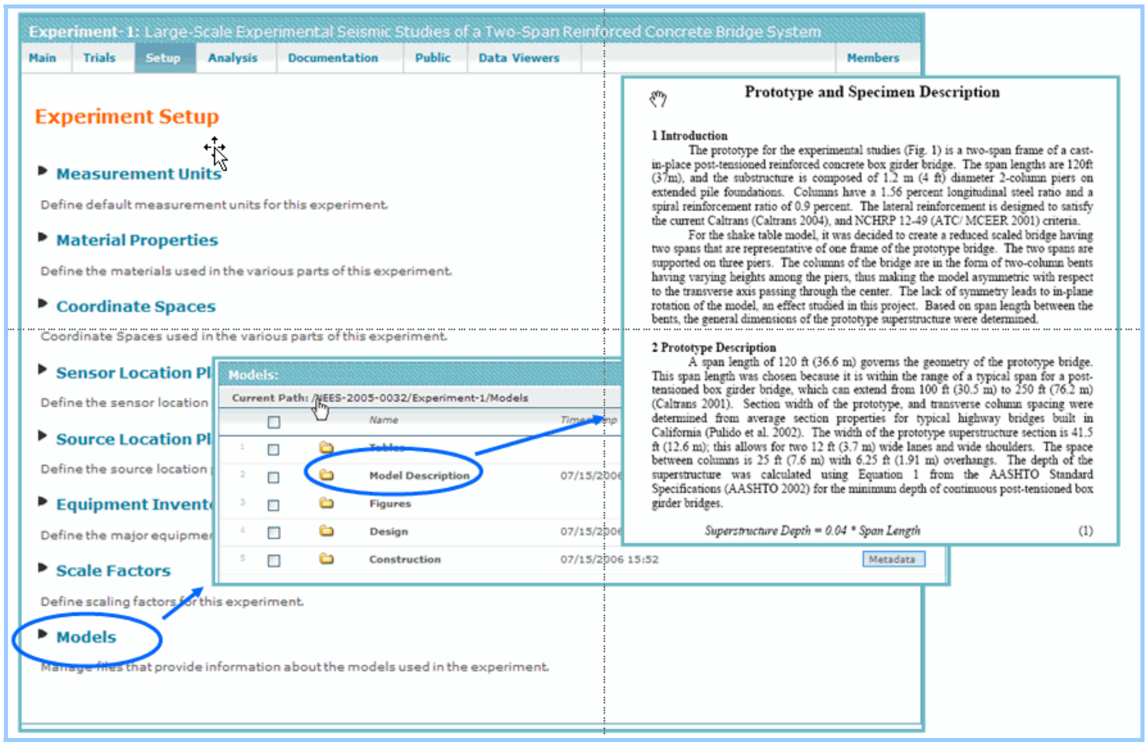

Figure 23. ***Experiment set-up*** **collects particulars about the facility and the specimen.**

In case of computation simulation (that often occurs also as support of the experimental campaign), the hardware and the operating system used, the software and its version number and the assumptions made on the model should be specified still on the *set-up* folder. Also in this case, the user can give this information in the format that he prefers.

Input files used for the simulation and results not specific of a particular run must be here uploaded on the *Analysis* sub-folder instead (Figure 24).

In reality, checking on all the experiments available online, the information related to computation simulations is often incomplete and not presented in a standardized format.

As result, it is a pain to understand what have been done (computationally), where to look for and also to understand what is available.

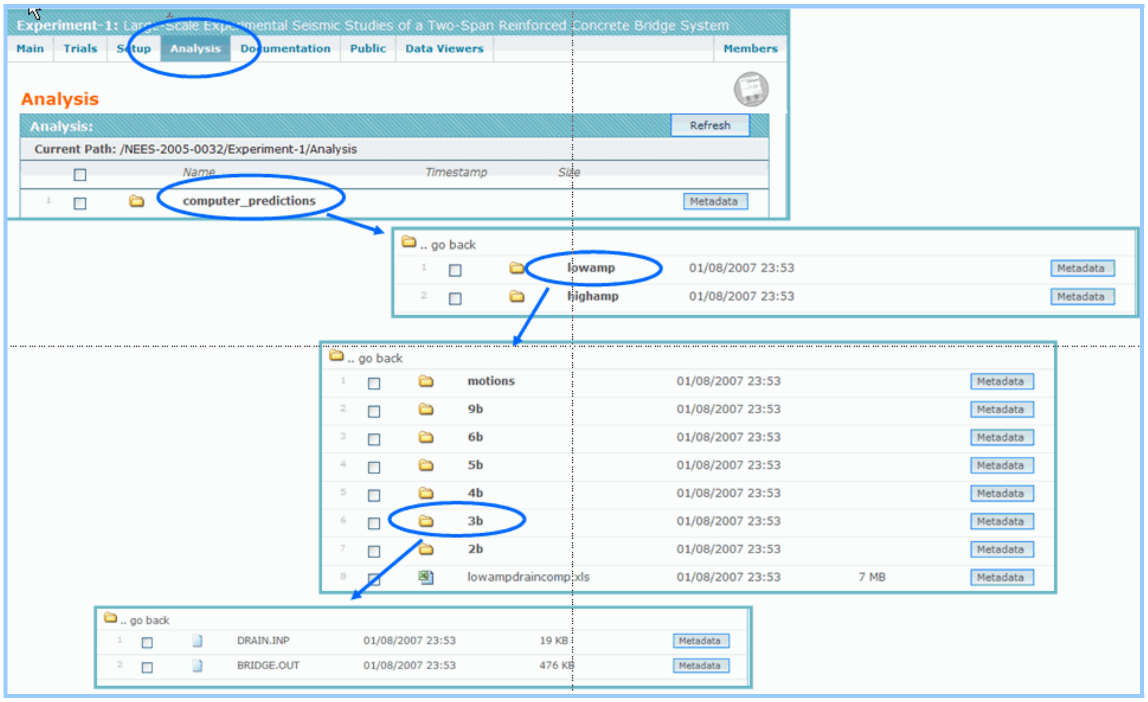

Figure 24. *Analysis* folder at experiment level.

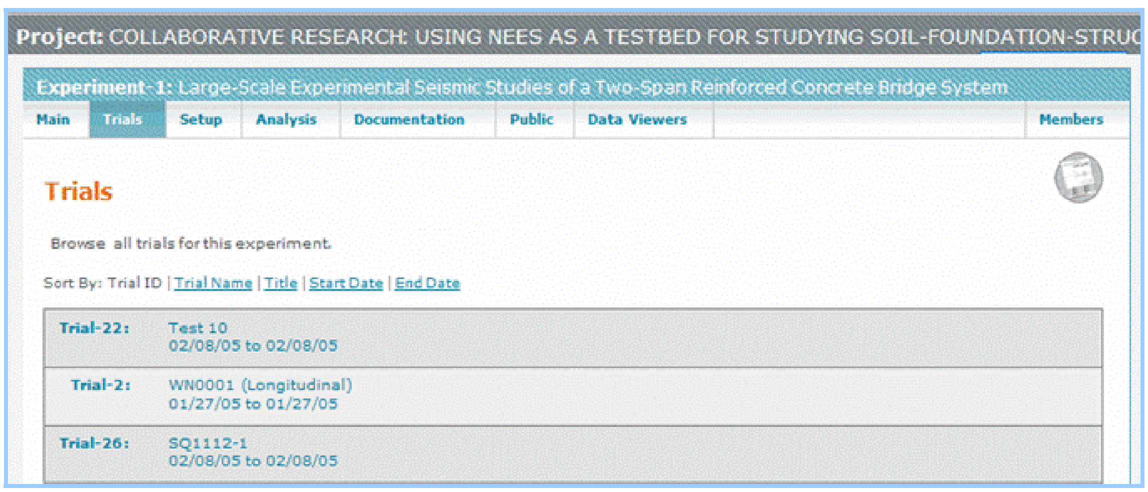

Figure 25. *Trials* directory.

A difficulty arises also because each *Experiment* can contain multiple *Trials* with only minor changes to the configuration parameters defined at the experiment level (Figure 25). Example of these minor changes may be, in case of physical test, the relocation of a subset of instruments; slightly different material properties that are specified on the subfolder *set-up*.

For each *Trial*, a complete description is available (Figure 26) and specifics are once again fully described on the *set-up* subfolder (Figure 27).

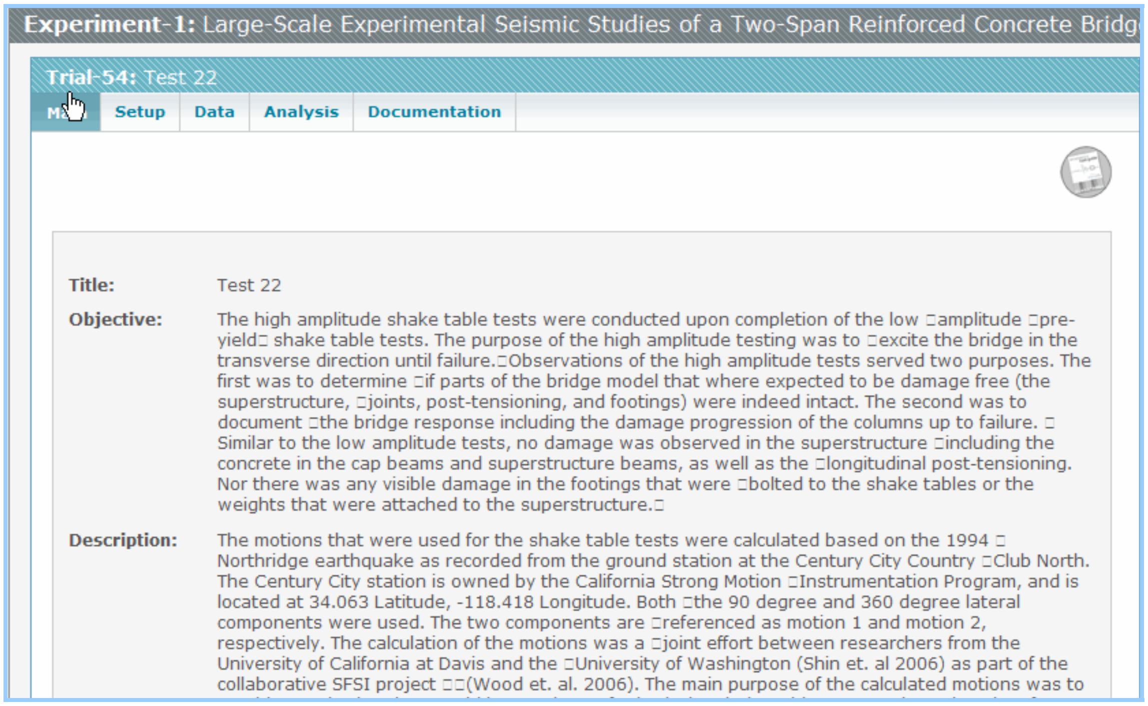

Figure 26. Description of the trial.

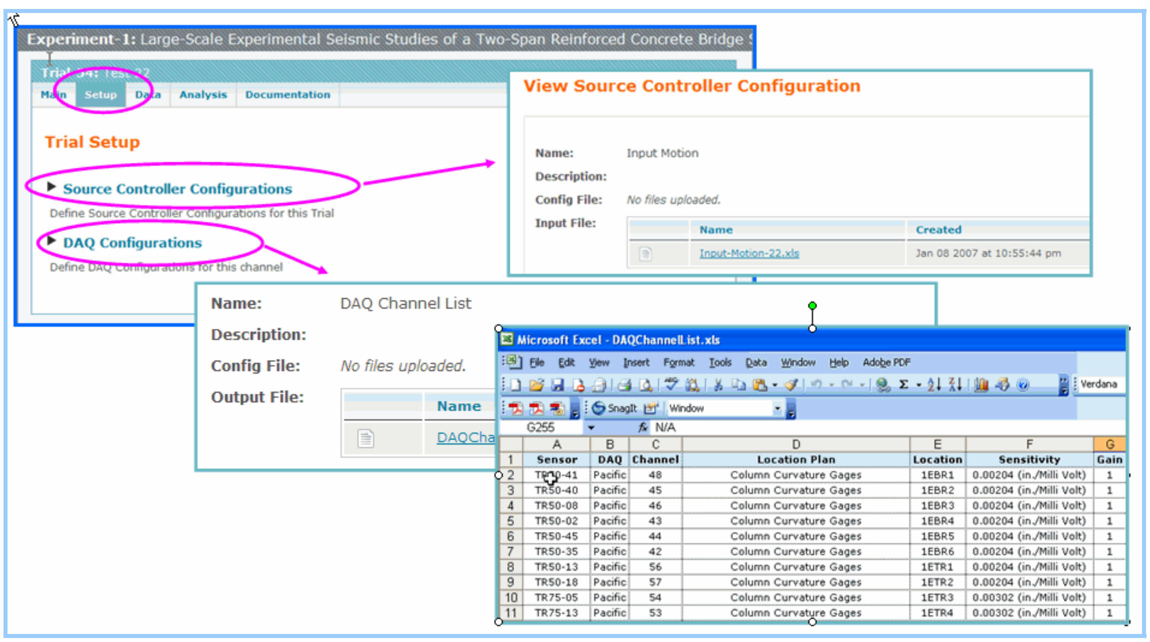

Figure 27. *Trail set-up* folder.

In case of numerical simulation, each *Run* (in behalf of *Trial*) can differ for the simulation type (dynamic, pushover, etc.), for the load type (nodal, distributed, etc.), for the element type (beam, shell, etc.). Particulars about the numerical simulation and the output files should be given in the *Analysis* subfolder at *Trials/Runs* level.

In most of the case, instead, the subfolder *Analysis* at the *Trials/Runs* level is empty and all the computational file are given at the level of *Experiment* and the differences between the runs are far from being obvious (Figure 28).

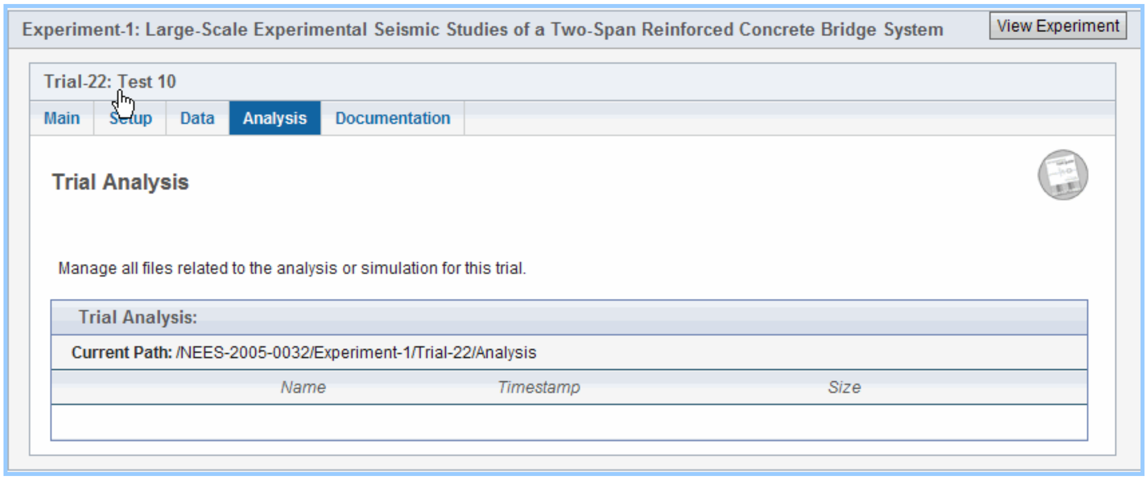

Figure 28. *Analysis* folder at *Trial/Run* level.

At the bottom of the whole hierarchy, is the *Data* folder (Figure 29) that gathers the Unprocessed, Converted, Corrected and Derived Data that are respectively the data as they come from the measurements (often in a format not immediately readable), the measurement data converted, the data corrected by removing noise or applying other corrector factor and finally the derived data as a displacement profile along an axis.

Sometimes, depending on the facility or on the experiment, not all these folders are used or at least filled; not always raw data are available.

The format in which the data are available is not standard, sometimes there are text files, sometimes excel files that collect all the data together.

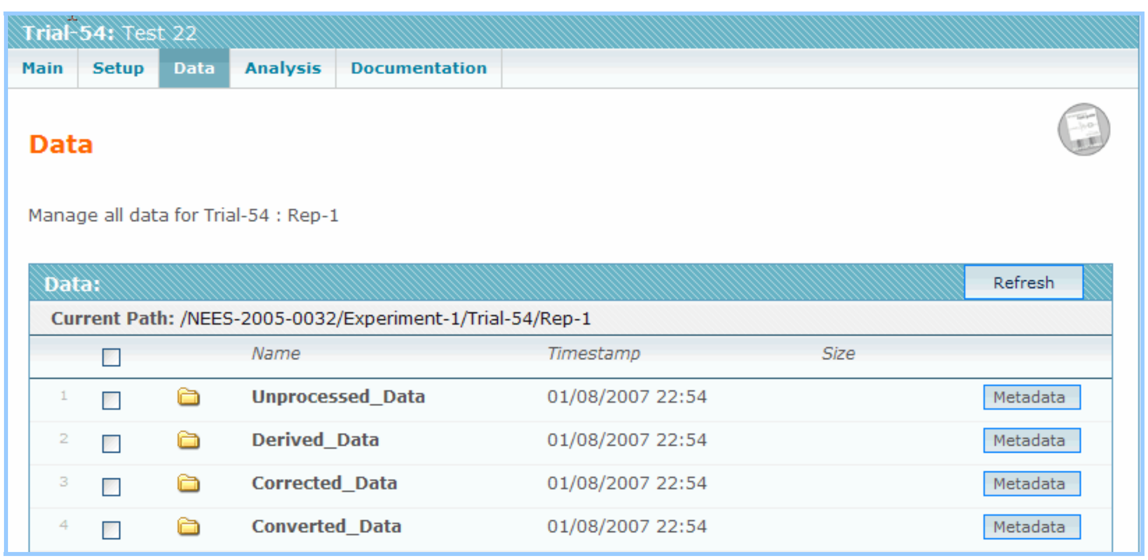

Figure 29. *Data* level.

The analysis of NEES repository has been useful to evaluate the main aspect of a central database, its strengths and weaknesses.

- First, despite the apparently long catalogue of experiment listed on the main page (see Figure 18), a large part of these experiments does not contain any data. This confirms that the presence of a central database does not prevent each laboratory to maintain their own the local database, and the uploading of data to the central database is seen as a duplication of work and is not always carried out.
- The structure sometimes results to be too sophisticated or leave space to some ambiguities that can't be resolved intuitively. The users, instead of trying to understand the correct use by consulting the documentation, put all data together at the less specific level (for example at the *Experiments* or *Project* level). This is particularly frequent for numerical simulations that rarely follow the hierarchy of the *data model*.
- Strength of NEEScentral data model is the request on the *set-up* folder of precise details about the facility and the specimen. In the *data model* are foreseen some fixed fields (in Figure 23) to be filled but without requiring a specific format; the user is therefore free to use documents, drawings, pictures as he prefers and all the information are given.

4 ELSA Database in the European Distributed Database: what can be done

The general overview of NEEScentral database and of two experiments on the ELSA database has been useful to define a more adequate *data model* to fit the needs of scientific community and users.

- NEES experience first of all suggests pursuing simplicity on the choice of the *data* model in order to avoid ambiguities. It gives also some important hints on data field useful to better define the experiment.
- *An example of an old project such as Spear* on ELSA database, even if well organized, lacks some important information.
- An example of a recent project such as ESECMaSE on ELSA database provides an additional amount of useful information about the tests but unfortunately not always in a structured way.

Figure 30 presents a scheme for a new *data model* that tries to account the requests of simplicity and completeness.

Project, *Specimen*, *Experiment & Computation* and *Signal* are the main hierarchical levels. At each level it is required to give the technical information in both native format (as *AutoCAD* files for drawings) and most readable format as .pdf files for non familiar users. The native format is useful for the internal users of the database, the .pdf one for the external users.

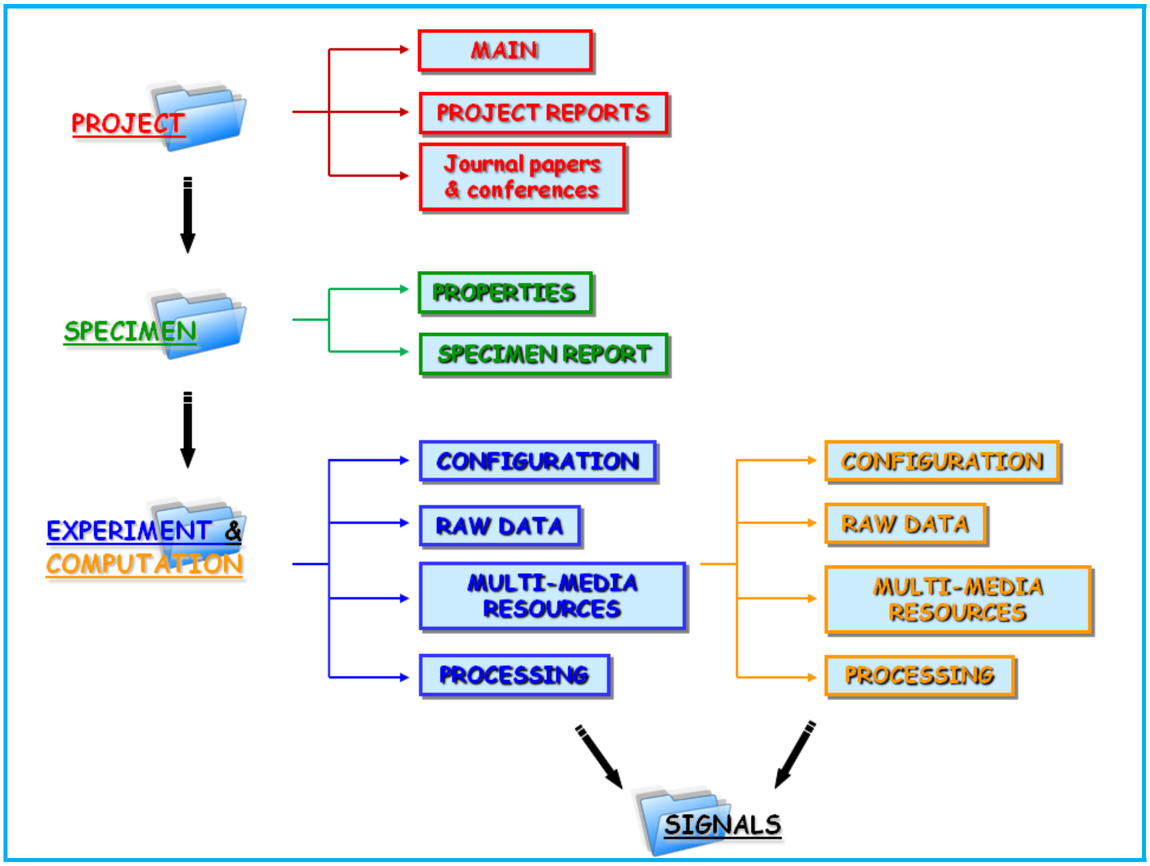

Figure 30. Proposal for the new ELSA *data model*.

4.1 Project

Project directory manages the general information related to the project, including the scientific publications produced with the results obtained (Figure 31). The *Main* folder is the first interface that appears opening the project; it contains a set of fixed fields that fully characterize the *project* as the partners, the objectives, etc... Extended reports are uploaded on the *Project reports* folder, whereas a separate folder is foreseen to host publications on journals papers, conferences and book chapters.

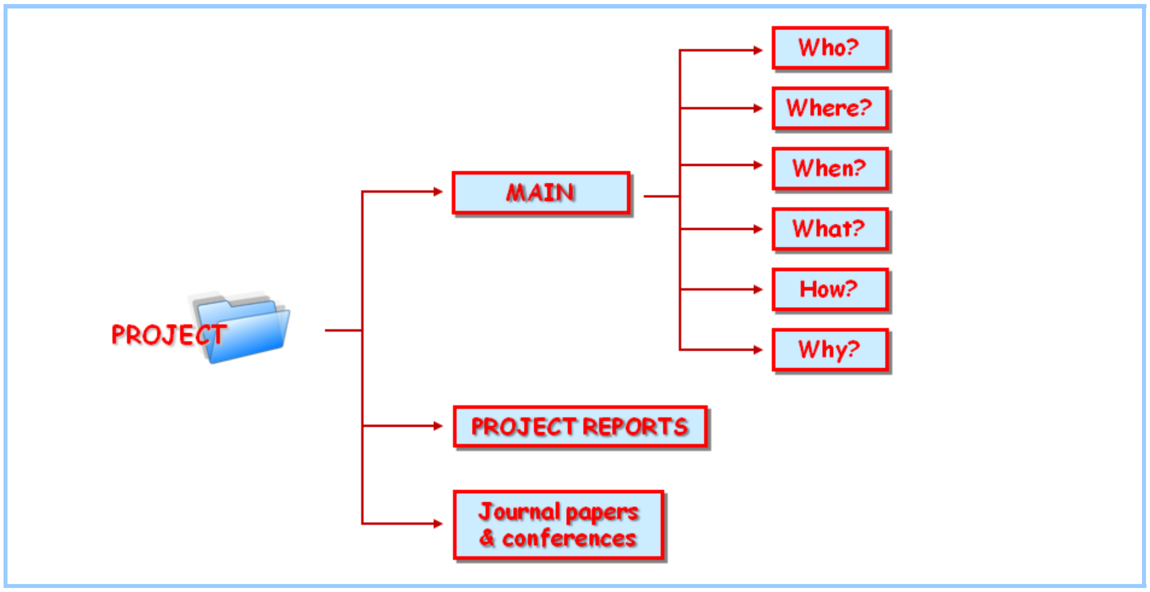

Figure 31. *Project* level for the new ELSA *data model*.

4.2 Specimen

For each *Project*, several *Specimens* are usually tested or analysed as for example the original and the retrofitted ones. Each of them has to be fully characterized by specifying the geometry, the materials and its history; two main folders are proposed: *Properties* and *Specimen report* (Figure 32).

<u>Properties</u>

NEES Set-up folder has been taken as model (Figure 23) for the *Properties* folder; here, there is a set of standard fields to be filled:

- *Coordinate reference system* where the user has to locate the structure tested on the laboratory, also by indicating the coordinate system of reference.
- *Scale factor*: a large part of experimental tests are performed on scaled structures. To scale geometrically a structure implies also to scale other derived quantities as the density, loads, time,... Adequate documentation should be given explaining the assumptions made.
- *Geometry* that reports the dimensions and the shape of the specimen tested. Here, both the *AutoCAD* files and the relative .pdf ones should be given and if necessary also other documentation that describes the structure.
- *Material properties*: the structural materials should be fully characterized by indicating their mechanical parameters (modulus of elasticity, yield stress, ultimate stress, Poisson’s ratio, density...).
- *Photos*.
- *Construction, transport and demolition*: the phase of construction of the structure should be adequately documented, by specifying for example if some technical

problems occurred. Also information on the demolition of the structure could result of public interest.

Specimen report

The results of all the experiments performed on a specimen are often collected in a specific (internal or not) report and for each specimen such report is produced. The folder *Specimen report* collects this type of report.

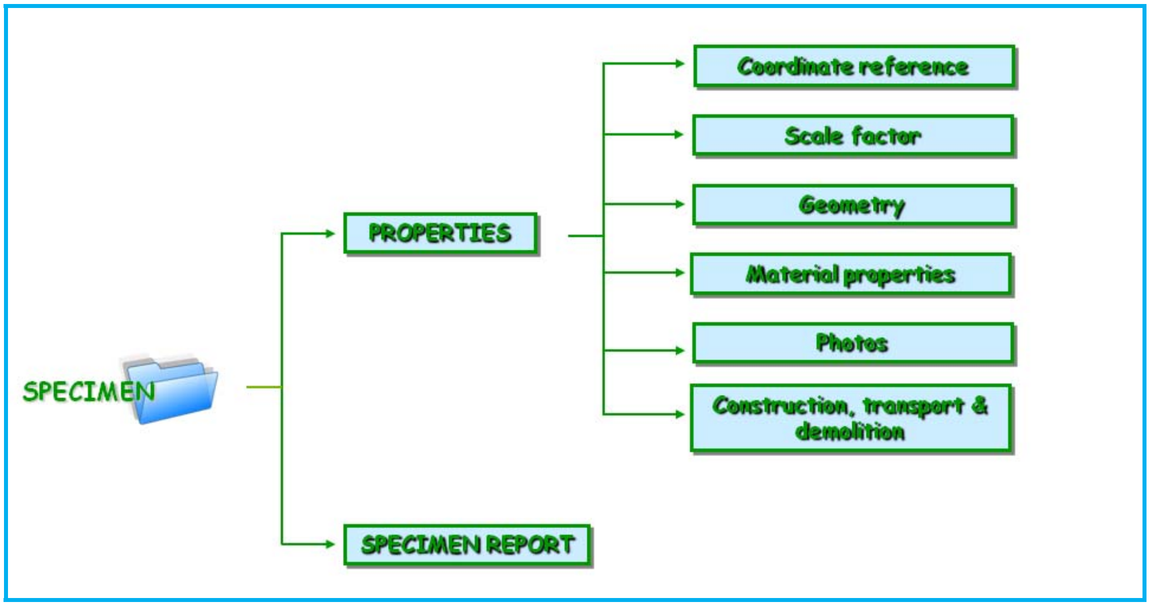

Figure 32. *Specimen* directory for the new ELSA *data model*.

4.3 Experiment

In case of physical test, the same specimen is usually subjected to several *experiments* that differ from the type (cyclic test, PsD test, fatigue test) and the location of the loading or of the transducers system. Each of these experiments will produce different results. Four main folders collect this information: *set-up*, *raw data*, *multi-media resources* and *post-processing*.

Configuration

Configuration folder manages all the information about the loading and the sensors, their characteristics, location and the parameters used on the tests.

- *Hardware* contains the equipment inventory, both devices (pistons, servo-valves, controllers,...) and sensors and their location with reference to the coordinate reference system previously defined. Standard template files will be created for the inventory in such a way to use always the same format for this kind of data.
- *Software* contains the controller input files used on the test. In these files, all the parameters of the experiment are specified and thus always retraceable and consultable. In case of the development of a new dll, the version of the algorithm used shall be also provided.

Raw data

Raw data are preserved in this folder.

Multi-media resources

This folder contains the multi-media resources that describe the results of the experiment campaign. It consists of three main resources:

- *Graphics* such as the final results of the tests performed on the same specimen already compared. These plots are very useful in particular for external users that want to have direct access to the final results without checking all the signals logged.
- *Photos* related to the specimen and the damage undergone during the tests for example.
- *Videos* of the tests.

Processing

The *post-processing* folder contains the signals produced on the *experiment* and the programs used to treat these signals (*Matlab*, *Cast3M* files,...); two sub-folder are foreseen, namely, *Treatment Program* and *Signals*.

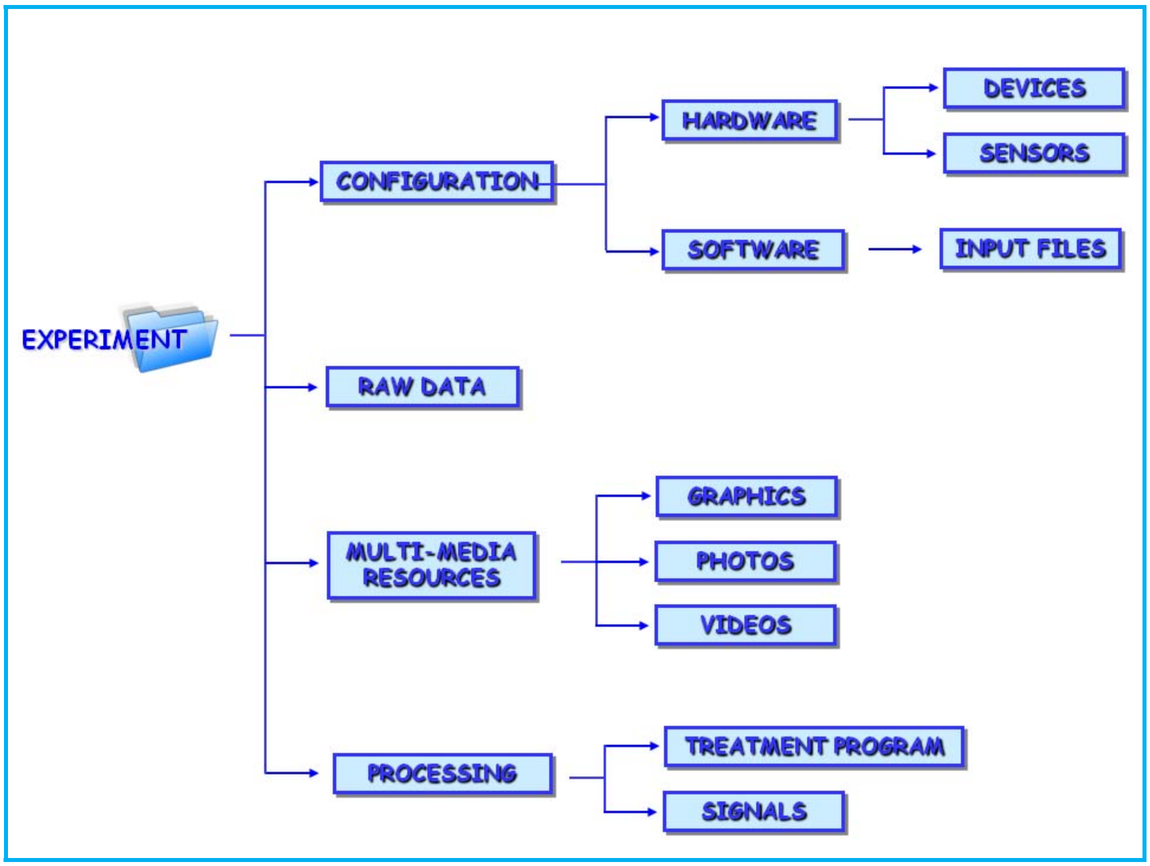

Figure 33. *Experiment* directory for the new ELSA *data model*.

4.4 Computation

Both the *Experiment* and *Computation* directories are considered. In fact, computer simulations often precede (or they should do) the experimental campaigns; then, it is considered of interest to report on the database also this preparatory phase, also for comparing physical results with expected ones. In case of hybrid tests, instead, the presence of both experimental and computational directories is obviously necessary.

The *Computation* folder follows the same scheme as the *Experimental* one, with four main sub-folders: *configuration*, *raw data*, *multi-media resources* and *processing*. Here, are reported the slight differences that characterize each computation performed (as the type of load, or other input parameters) and the final results obtained.

Configuration

This folder manages all the information about the input of the test; in particular:

- *Computer system* specify the system used for the computation, the software and the version number.
- *Mesh and model* reports the assumption made on the model as the elements modelled (beam, column, etc...), the type of simulation (dynamic, pushover, etc...), the type of load (nodal, uniform, excitation, etc...).
- *Input files*, the files used on the simulation.

Raw data

Original output files are preserved in this folder.

Multi-media resources

This folder contains the multi-media resources that describe the results of the experiment campaign. It consists of three main resources:

- *Graphics* such as the final results of the tests performed on the same specimen already compared. These plots are very useful in particular for external users that want to have direct access to the final results without checking all the signals logged.
- *Animations*.
- *3D plots* as stress maps,...

Processing

The *processing* folder contains the signals produced on the *computation* and the programs used to treat these signals (*Matlab*, *Cast3M* files, etc.); two sub-folders are foreseen, namely, *Treatment Program* and *Signals*.

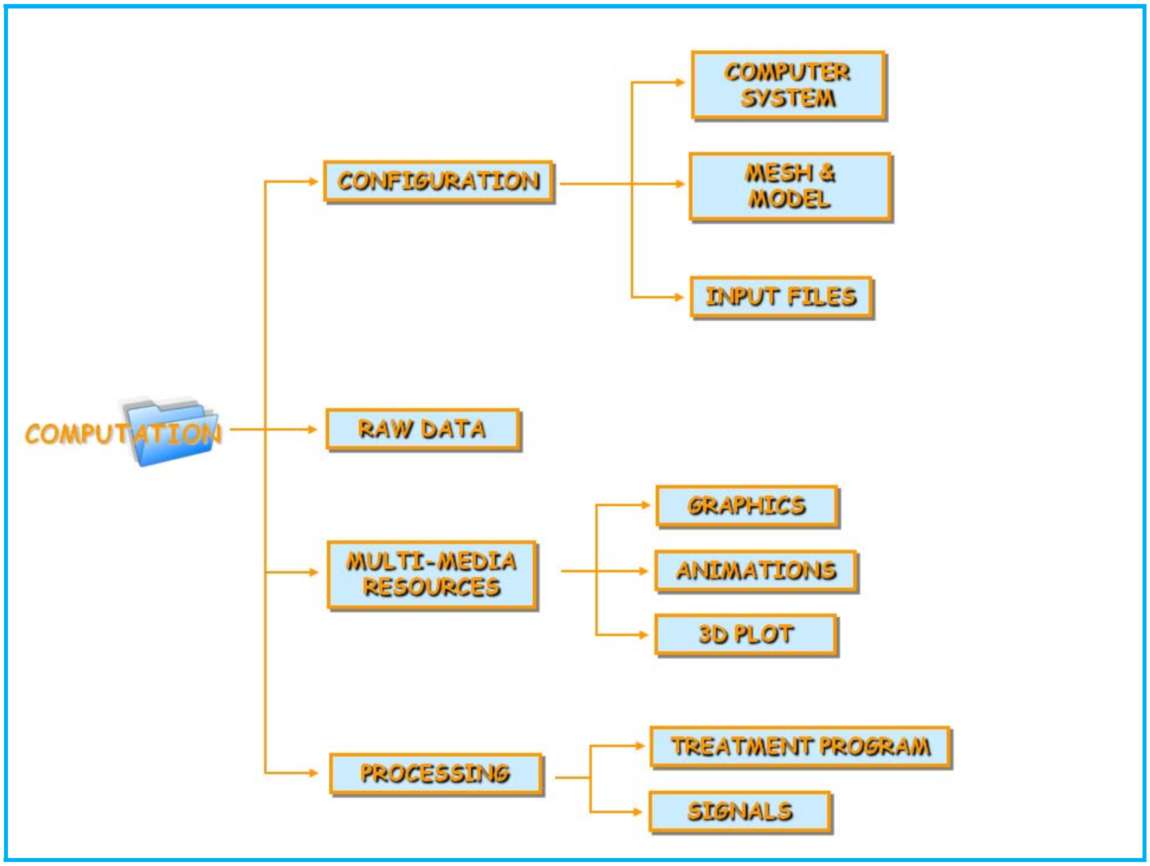

Figure 33. Computation directory for the new ELSA data model.

4.5 Signal

The organization of *signal* folder currently present on ELSA data base well satisfies the request of completeness and simplicity. It includes the whole set of signals measured and treated that, for example in case of pseudo-dynamic test, are stored in the main subfolders named by the acronyms *PsD Algorithm Measured, Generated and Identified*. An explanation of the acronym's meaning will be included for non familiar users. Each signal can then be downloaded both in binary or text format.

5 Conclusion and further work

This report provides a short analysis of the ELSA and NEEScentral databases together with a comparison of them. The main point to note is that the data structures are compatible. Most of the fields existing in one DB has its equivalent in the other. In some aspects, NEEScentral seems to be more structured than ELSA DB, and this leads to some recommendations on possible changes on the ELSA DB.

These changes are also important for the SERIES project. Since the network activities of SERIES have to setup a distributed database with a centralized portal able to query the DBs of the consortium and to download information in a standard form, the strengthening of the structure of the ELSA DB is important if it has to be accessed by a intermediate system (the common portal) and no longer directly by the end-user.

The current ELSA DB is accessed by means of a Web site which connects the server hosting the data (SQL database) by means of a DCOM object (AcqCtrlDB). Since most of the data hosted by the DB are produced using *Matlab* or *Cast3M*, both programs have been equipped with a DCOM interface allowing them to use AcqCtrlDB to upload and download data. This implementation allows interoperable machine-to-machine interaction over the network and to comply with the JRC policy regarding firewall. However, it is a non-standard solution.

Further work should include the implementation of the new data format. This can be done by expanding the current ELSA/SQL database, modifying the DCOM object and updating of the Web site. Another possibility is to proceed to a major standardization of the Web Site and access the ELSA/SQL DB using Web Services. The same Web Services could be accessed by the new ELSA Web site as well as the SERIES website. An even more ambitious development would also include a complete renewal of the ELSA database by making it evolved toward a more general and easy-to-modify-and-administrate data platform such as the one offered using SharePoint with the advantage that, by construction, the data in SharePoint are accessible by means of already existing SharePoint Web services.

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Abstract

This document critically presents the ELSA database for experimental results and compares its data structure with the one of the *NEEScentral* repository established in the US for storing the experimental results of 15 laboratories. This comparison leads to some proposed modifications of the ELSA data format that could be further used as a template for the *SERIES/NA1* network activities. Some implementation directions are also given.

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