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Publishing structural health monitoring data

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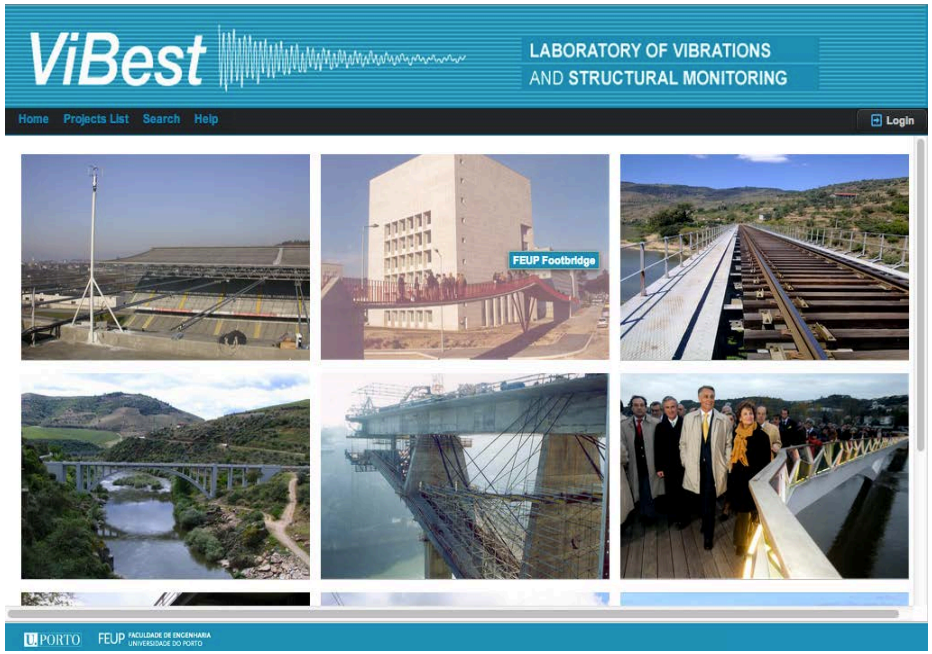
Context

- Research group in Civil Engineering
  - Structural Health Monitoring
  - Continuous data streams for several years
- External requirement
  - Publish research data
- Internal requirement
  - Manage data files
  - Organize, reuse, visualize
- Preserve the context
  - Both organizational and technical



Outline

- Project goals
- Metadata model for projects relying on monitoring data
- Prototype digital archive
- Conclusions

Publishing data

- Setting up scientific experiments and collecting data from them
  - Investment and effort justify publishing the data
- Cross check the results
- Enable further research
- Policy of several S&T funding agencies
  - data collected within funded projects must be publicly shared
- Monitoring natural phenomena
  - data sets become non-repeatable documents of actual facts

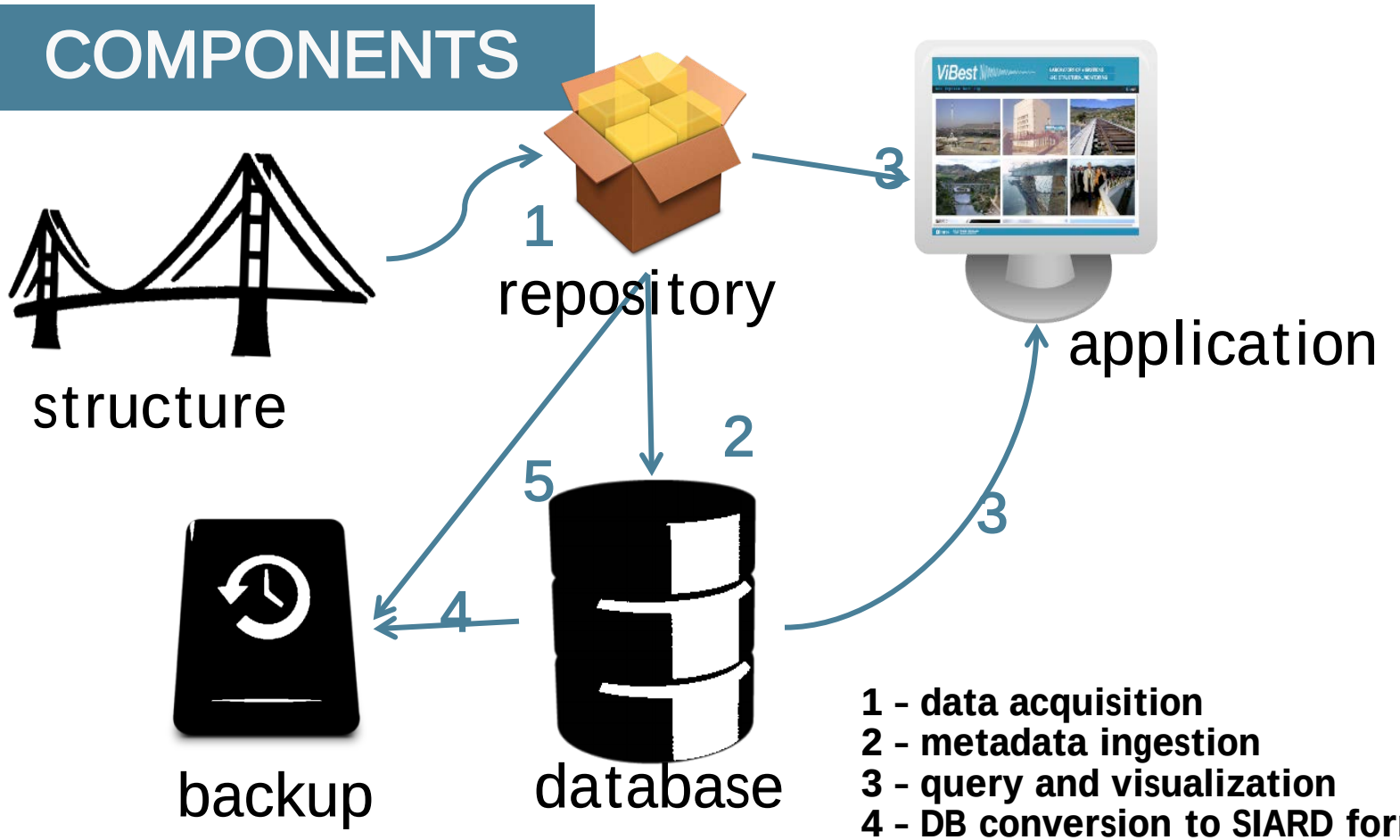
Trust

- Expertise and care
  - design, install and operate the experiment
  - to clean the raw data
- Resulting data sets + metadata
  - publishable authored documents
- Further reuse, especially in the long term
  - Depend on **trust** in the data sets
  - Metadata to assert meaning and authenticity

Main project goals

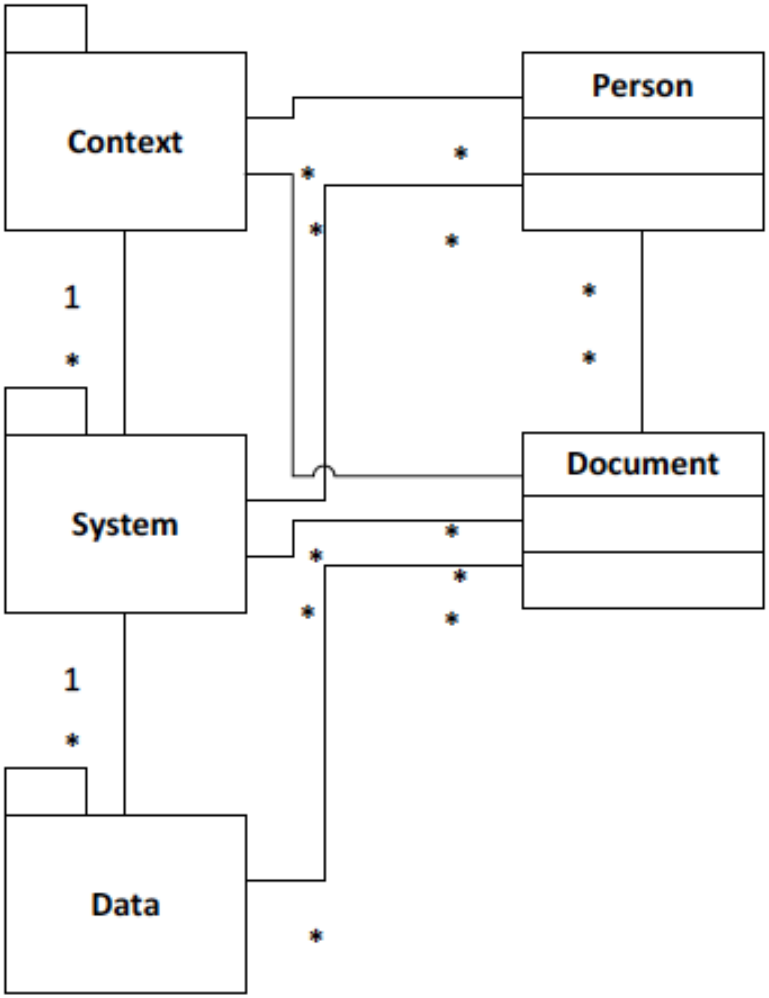
- Specify a metadata model for monitoring data
- Design and build a digital archive
  - Primary raw data and processed results of on-going projects
- Improve data reliability
  - integrated backup strategy
- Create a Web interface
  - browse and search metadata; visualize and download data
- Simple user management and access control
- Automate data files ingestion

Data life cycle

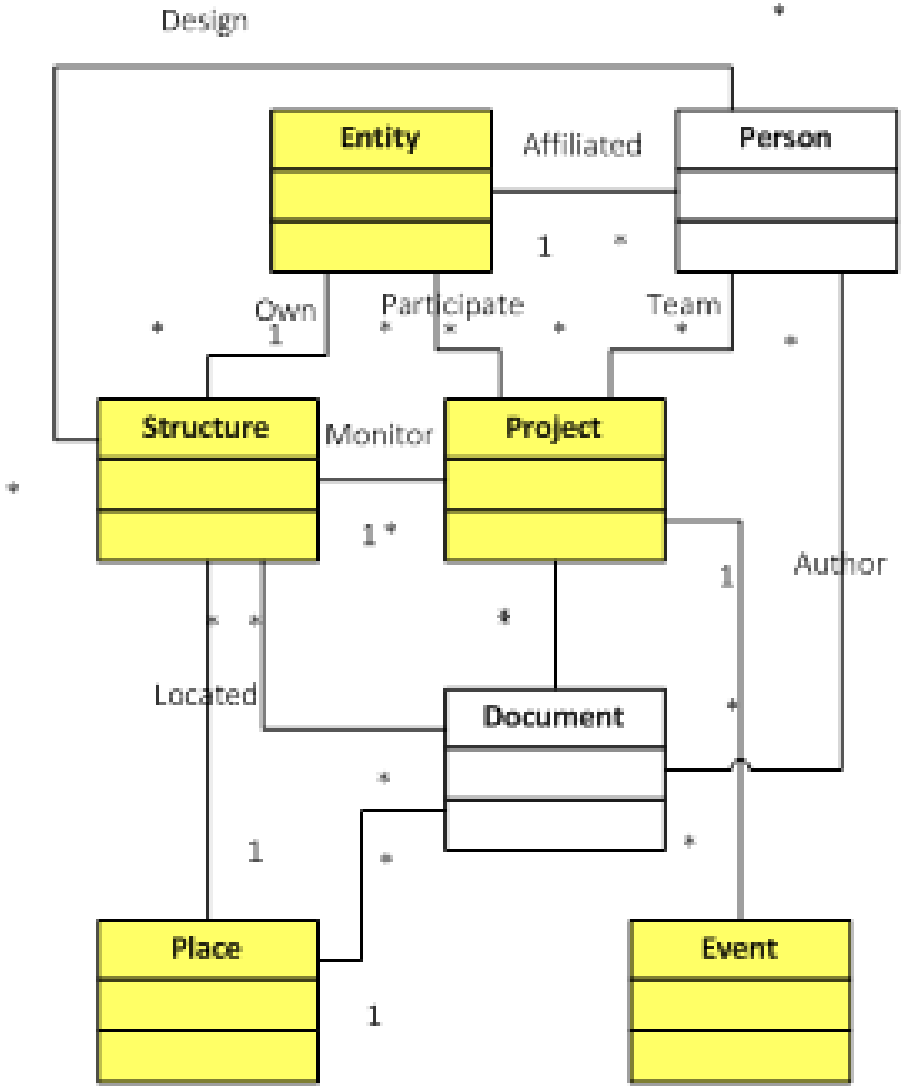


vibest.fe.up.pt/shm

Global metadata model



Context level



Project and structure info

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Project Monitoring Systems Datasets

Vib_SHM FEUP footbridge

Project Information

Vibration based Structural Health Monitoring of FEUP stress-ribbon footbridge
Goal: Vibration based Structural Health Monitoring of FEUP stress-ribbon footbridge.
Reference: FEUP

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FEUP Footbridge



Projects on this structure Documents Add Picture Add File
Name: FEUP Footbridge
Description: Footbridge on FEUP campus linking the forecourt of FEUP library to the gym and the canteen.
Type: Footbridge
Address: Via estruturante do Polo II, FEUP, Porto, Portugal
Built: 1999
Owner: Faculdade de Engenharia da Universidade do Porto
Designers:
João António Saraiva Pires da Fonseca

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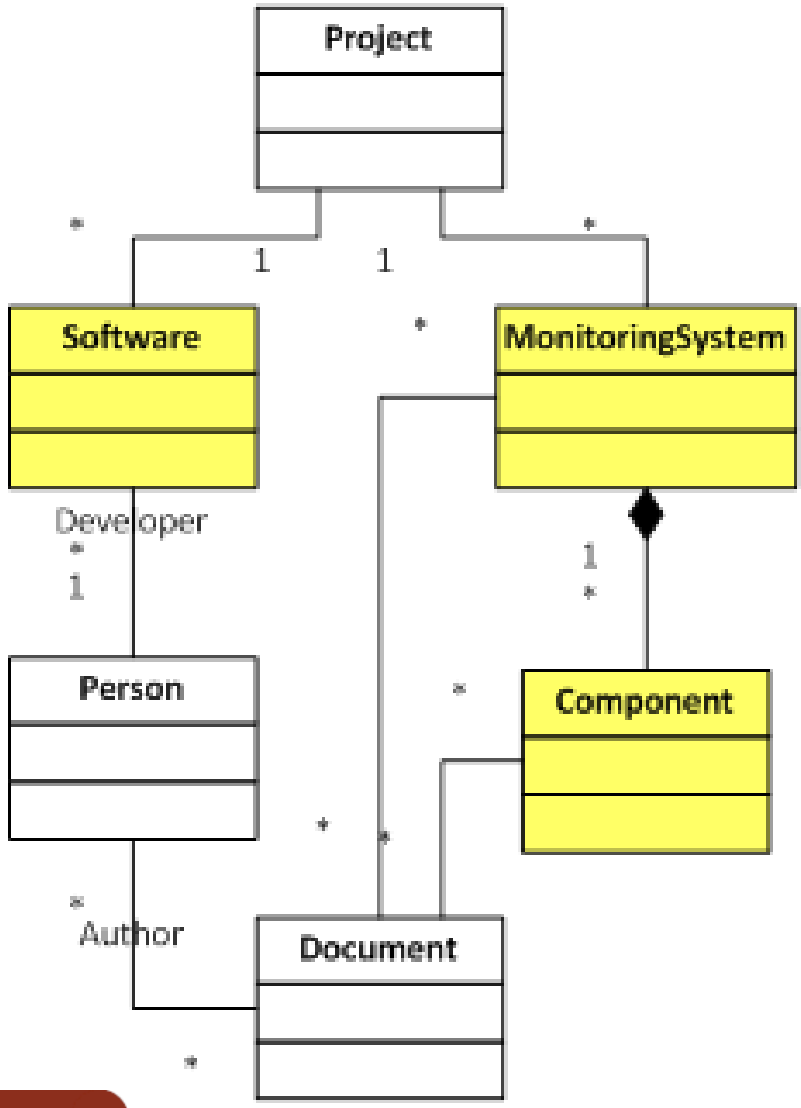
System level



Monitoring system

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FEUP-DAQ1

Project

Vib_SHM FEUP footbridge

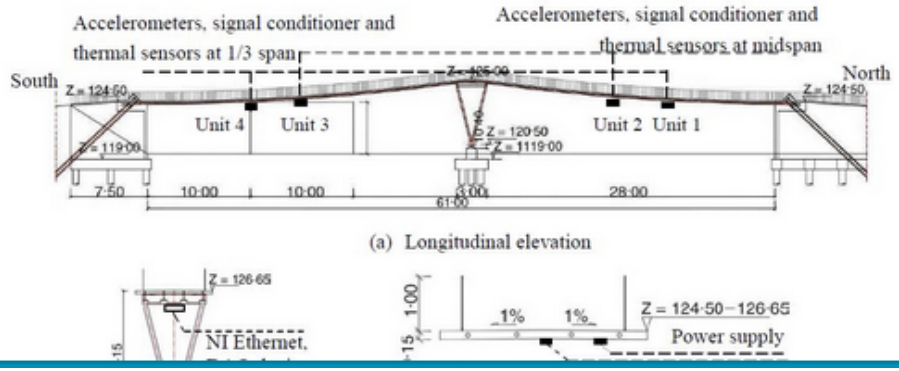
Monitoring System Information

Description: Measurement of accelerations and temperature in 4 sections of the deck for analysis of vibration levels and dynamic monitoring of the structure
Types: Vibration Based Structural Health Monitoring; Vibration Serviceability Assessment
Supplier: National Instruments Portugal
Manufacturer: National Instruments
Use Start: 2009/04/01

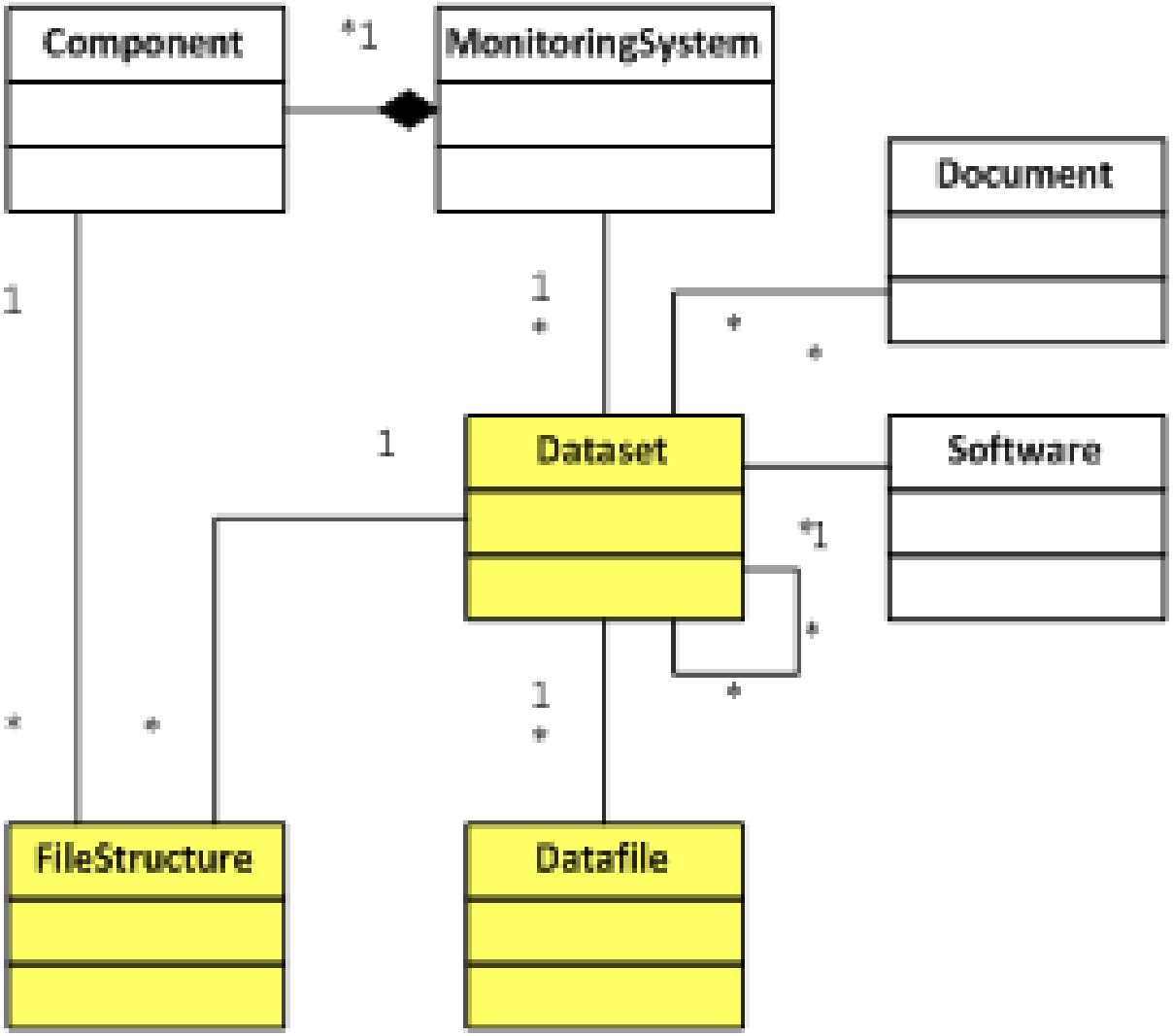
Documents Add File

Components:

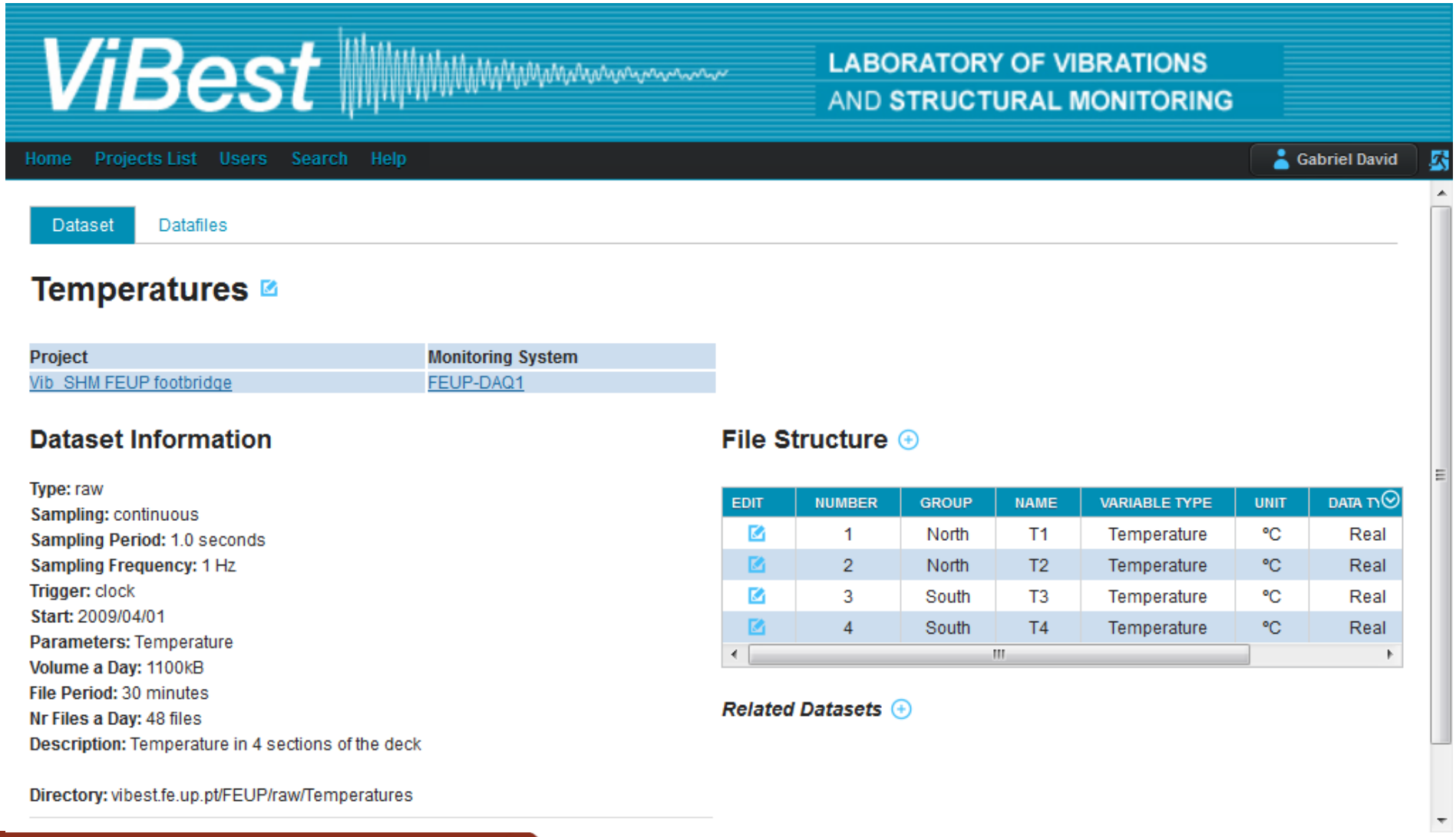
- 393C Accelerometer Add File Documents
- 393C Accelerometer Add File Documents
- 393C Accelerometer Add File Documents
- 393C Accelerometer Add File Documents
- 488A03 Signal conditioner Add File Documents
- 488A03 Signal conditioner Add File Documents
- 488A03 Signal conditioner Add File Documents
- 488A03 Signal conditioner Add File Documents



Data level


Component
*1
MonitoringSystem
Document
1
1
*
*
*
1
Dataset
Software
*1
*
*
1
*
*
*
FileStructure
Datafile

File structure



Digital archive

- Repository
  - Files coming every 30 min (67000 since 2009-04-01 on the example dataset)
  - Hierarchy of folders by year, month and day
- Conventional descriptive name for each file
  - **PROJSUByyyyMMdd_hhmmss[mili]_typ.ext**
- Technology
  - Postgres database management system
  - Vaadin framework for Java Web applications
  - Apache http server running on Ubuntu operating system
  - A few libraries for specific operations

Implemented services

- Simple user management system
  - Access control at project level and specific file level
- Automatic ingestion of new data files
- Web interface with compact design
- Data files
  - Search by interval; search by event
  - OAI-PMH for metadata (combined with authorization)
  - Download of set of files
    - Zipping facility for grouping
  - Visualization of set of files (graph and data)
    - 20000 points maximum displayed; interpolation if larger

Graph of accelerations

	S1-l	S1-vd	S1-vu	S2-l	S2-vd	S2-vu	S3-l	S3-vd	S3-vu	S4-l	S4-vd	S4-vu
Min.	396930.0	397688.0	-9086.0	347757.0	341848.0	-10585.0	686679.0	626120.0	596484.0	389788.0	125337.0	74133.0

Conclusions

- Filling in metadata is a bit demanding for researchers
  - Less than in the Core Scientific Metadata Model
  - Regarding data as an authored scientific outcome assigns responsibility and improves data quality
- Access control mechanism is a must
- Generality of the model for monitoring data
  - Relatively few concepts specific to Civil Engineering
- Open problem
  - How to visualize processed results? (may be MATLAB matrices)