

Special aspects of experimental research in engineering sciences

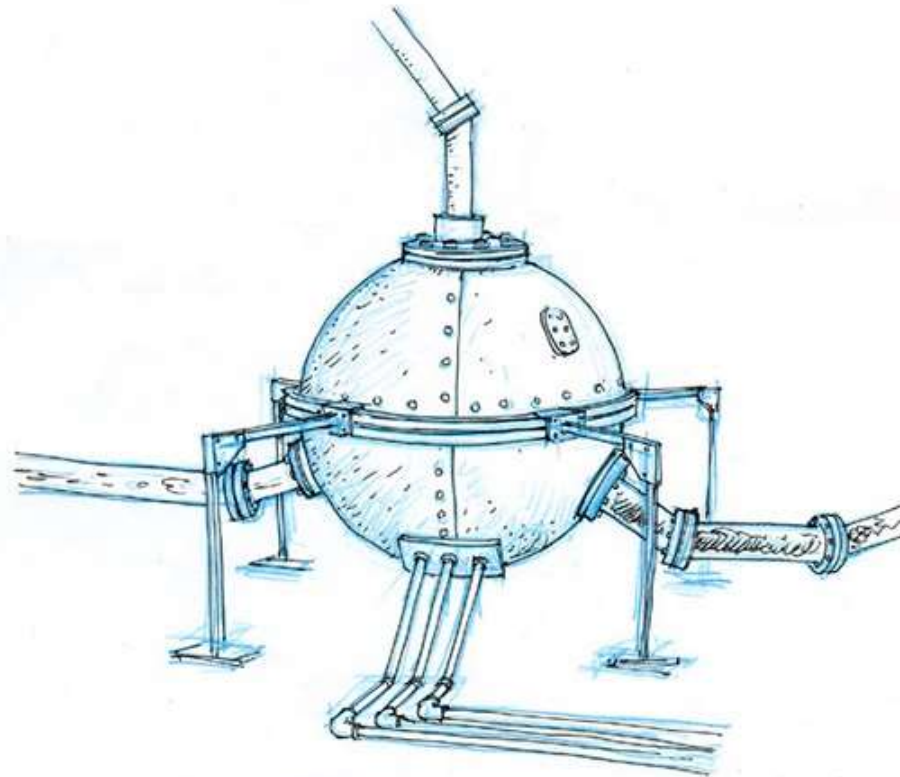
and consequential demands for research data management
Peter F. Pelz

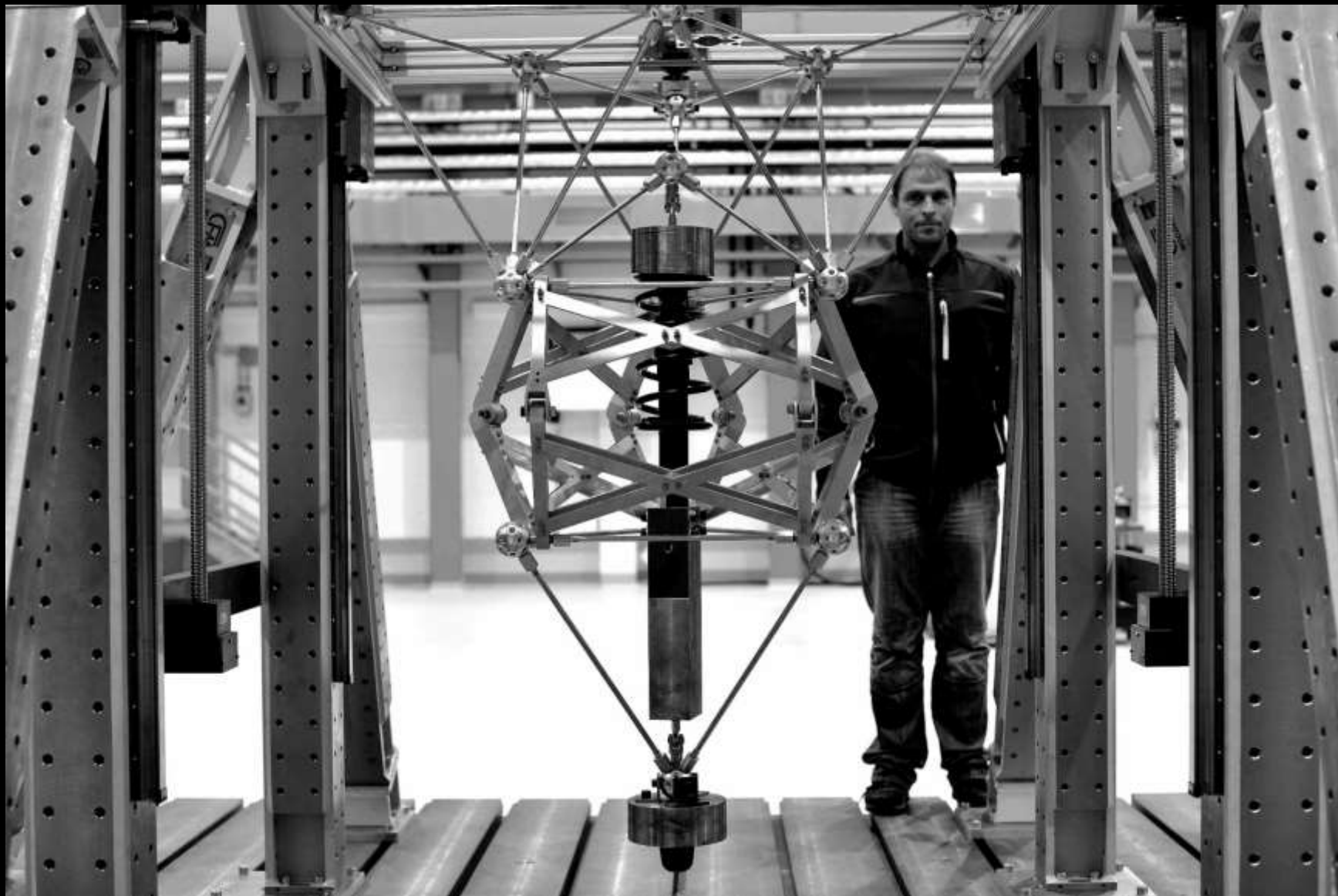


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DARMSTADT

SPB 805

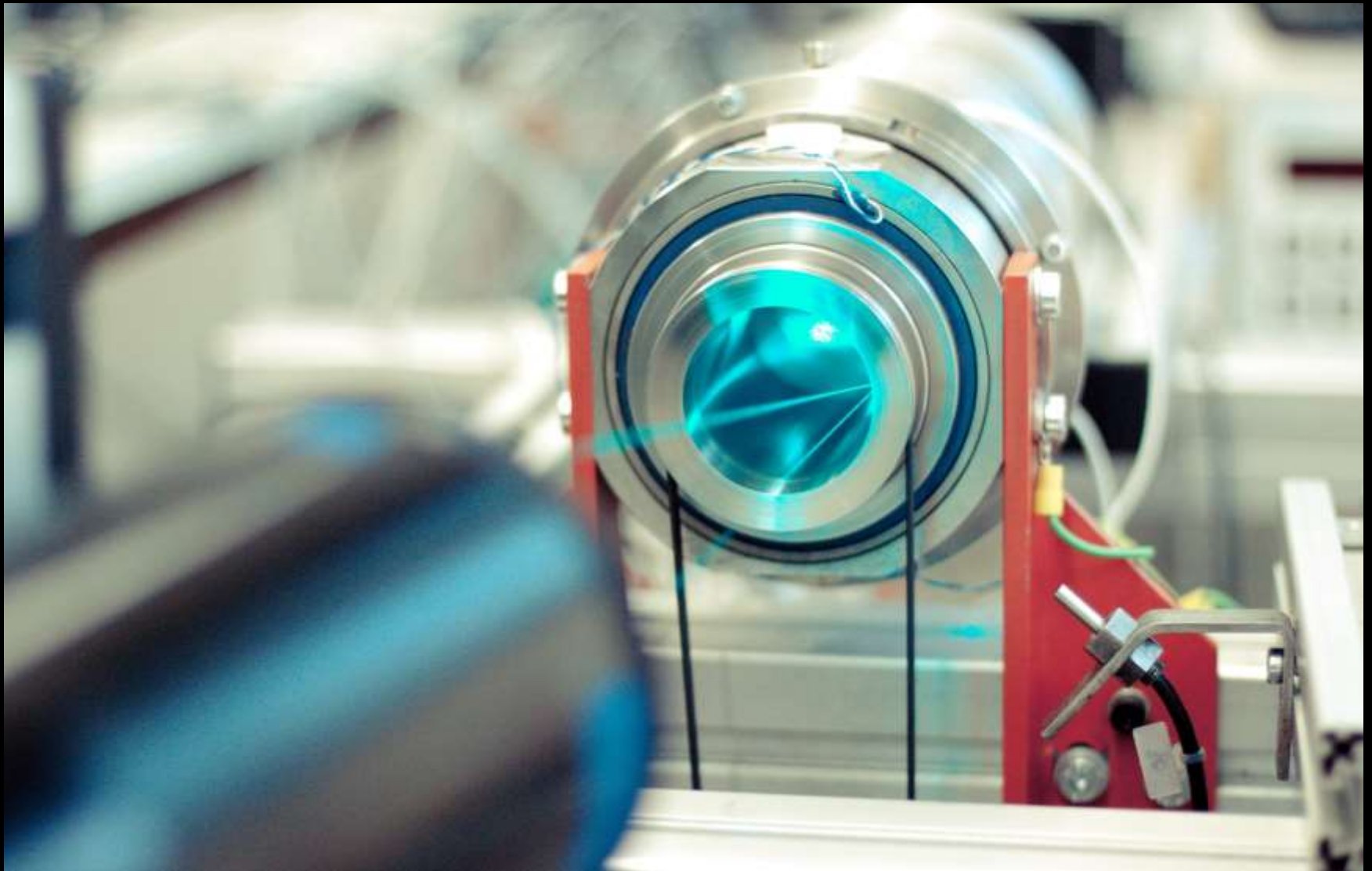
FLUID
SYSTEM
TECHNIK







Karstadt et. al.:
The influence of tip clearance on the acoustic and aerodynamic characteristic of fans;
ASME Turbo Expo
(2010)



Cloos, F. J.; Stapp, D.; Pelz, P. F.:
Swirl boundary layer and flow separation at the inlet of a rotating pipe;
Journal of Fluid Mechanics
(2017)

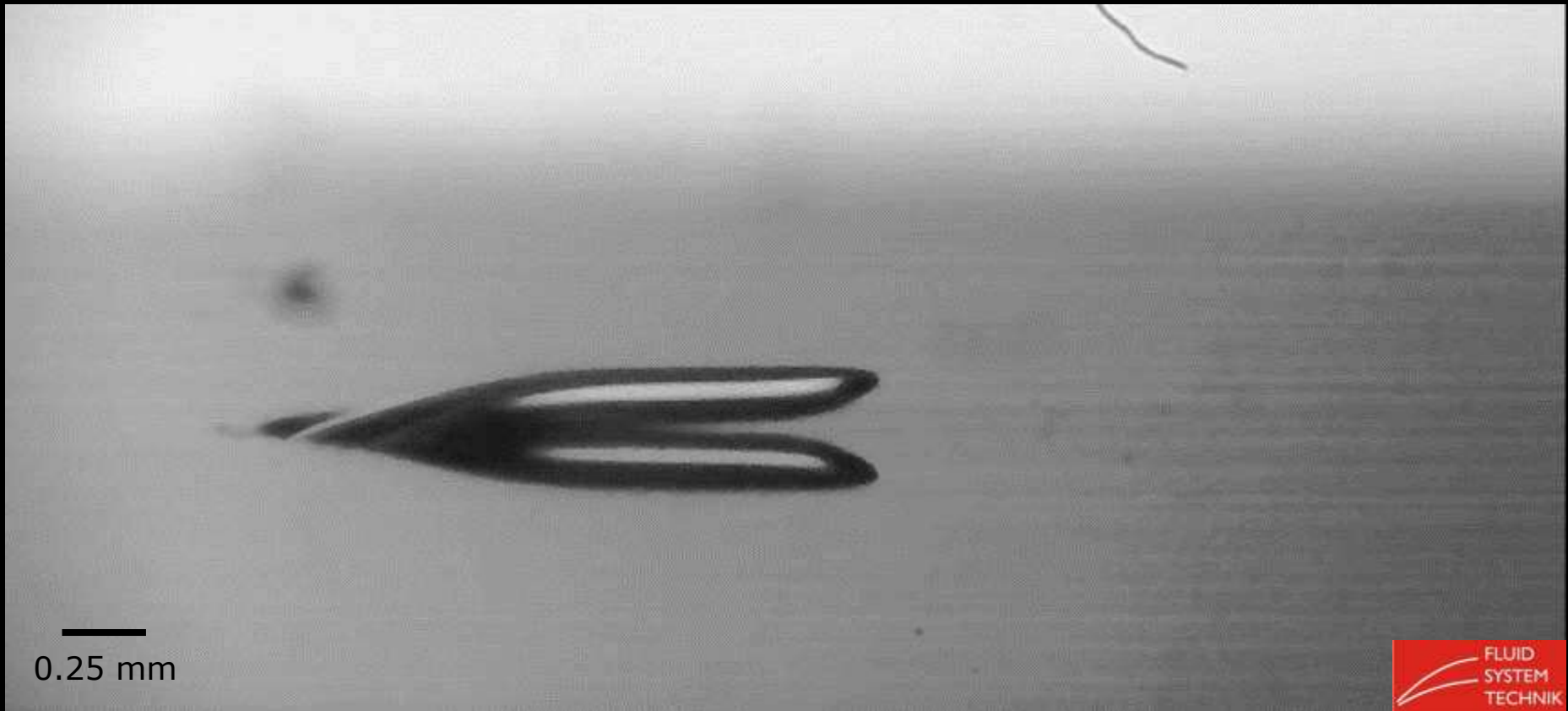






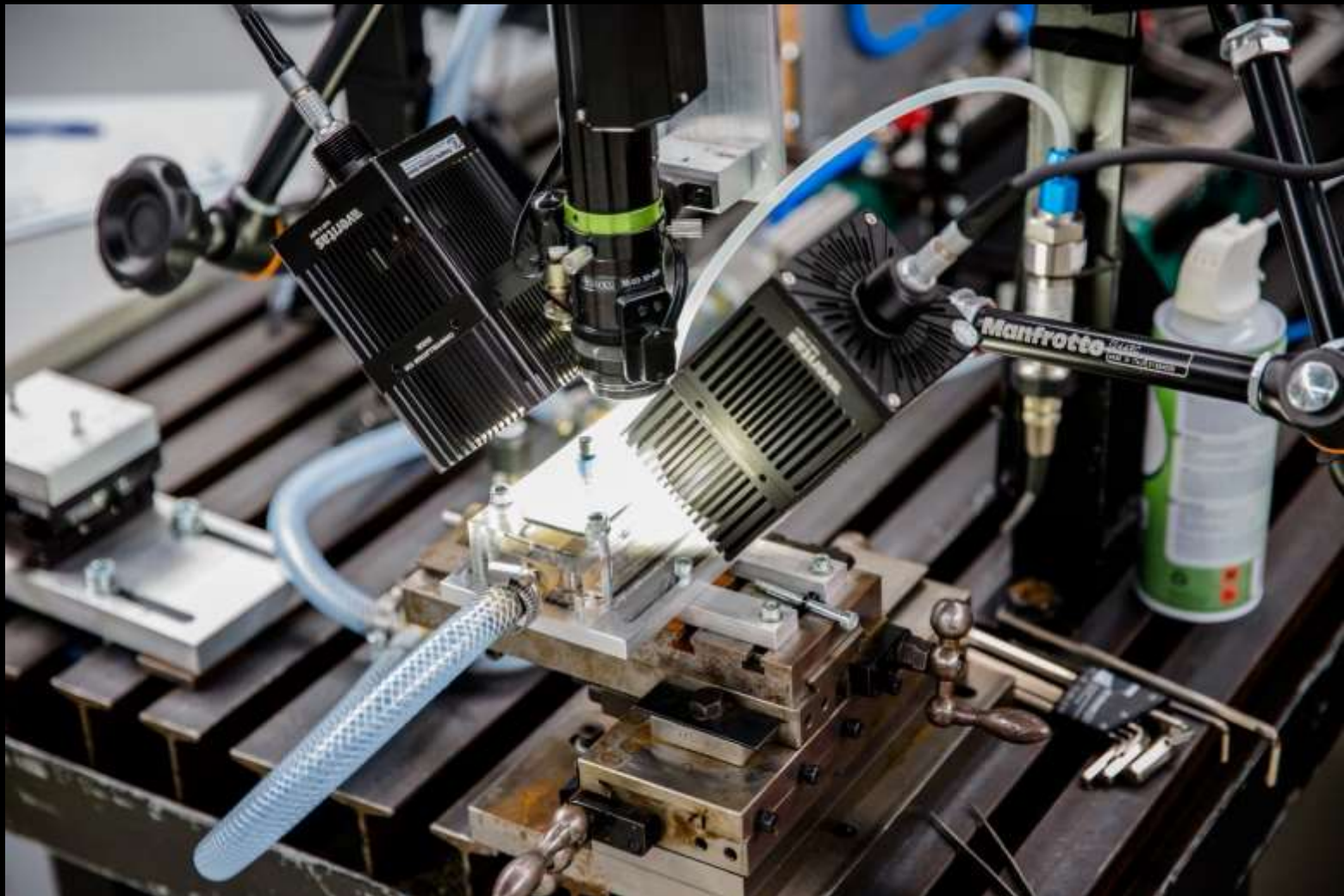
Recording 5000 fps
Video 30 fps

Pelz, P. F.; Keil, T.; Groß, T. F.:
The Transition from Sheet to Cloud Cavitation;
Journal of Fluid Mechanics
(2017)

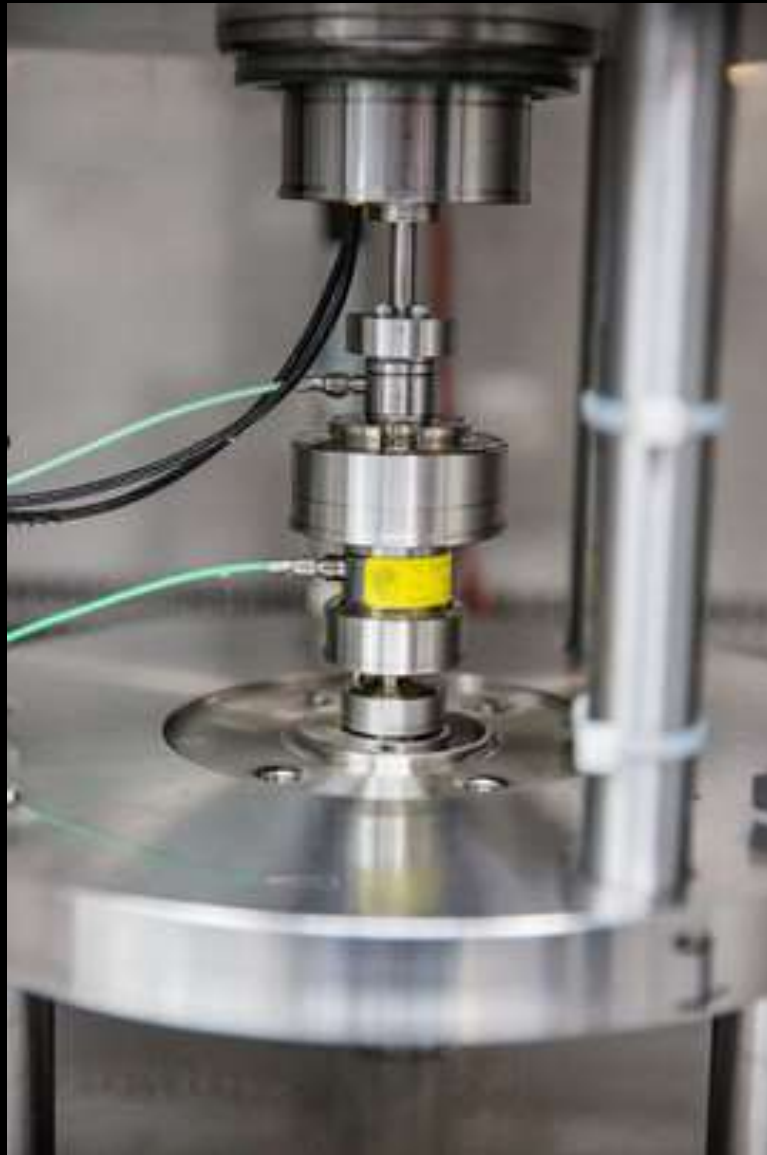


Recording 1000 fps
Video 15 fps

Groß, T. F.; Pelz, P. F.:
Diffusion-driven nucleation from surface nuclei in hydrodynamic cavitation;
Journal of Fluid Mechanics
(2017)



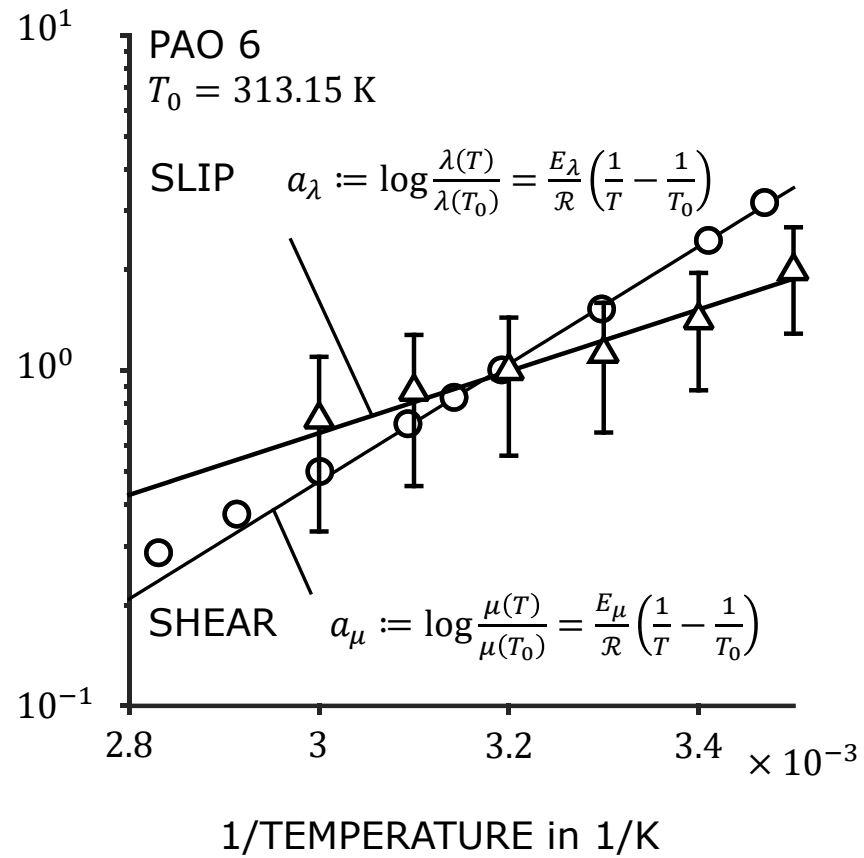
Groß, T. F. et. al.:
Bubble nucleation from micro crevices in a shear flow. Subtitle: Experimental determination of nucleation rates and surface nuclei growth;
Experiments in Fluids (2017)



Pelz, P. F.; Corneli, T.
The activation energy for wall slip;
Physical Review Letter
(under review 2017)



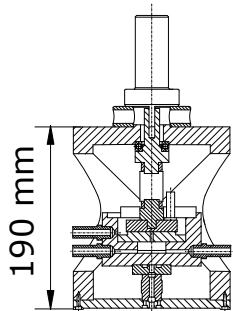
aggregated
data, plots



Experimental setups are living objects ...

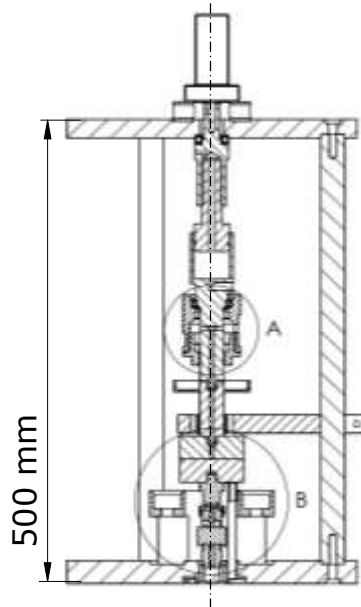


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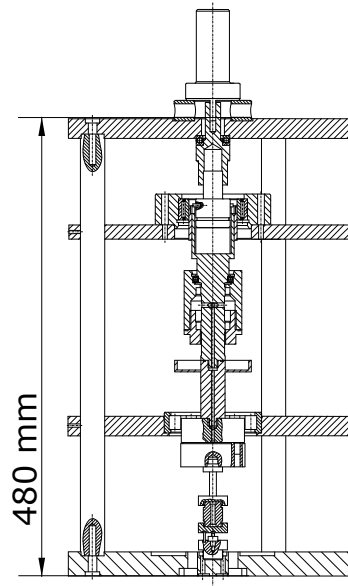
2013

*2 actuators
2 sensors*



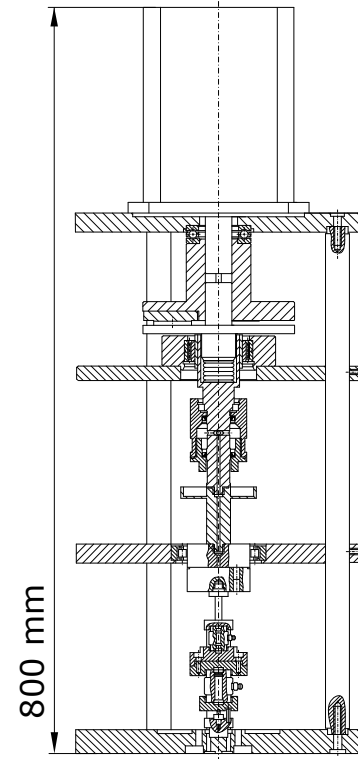
2014

*...
...*



2015

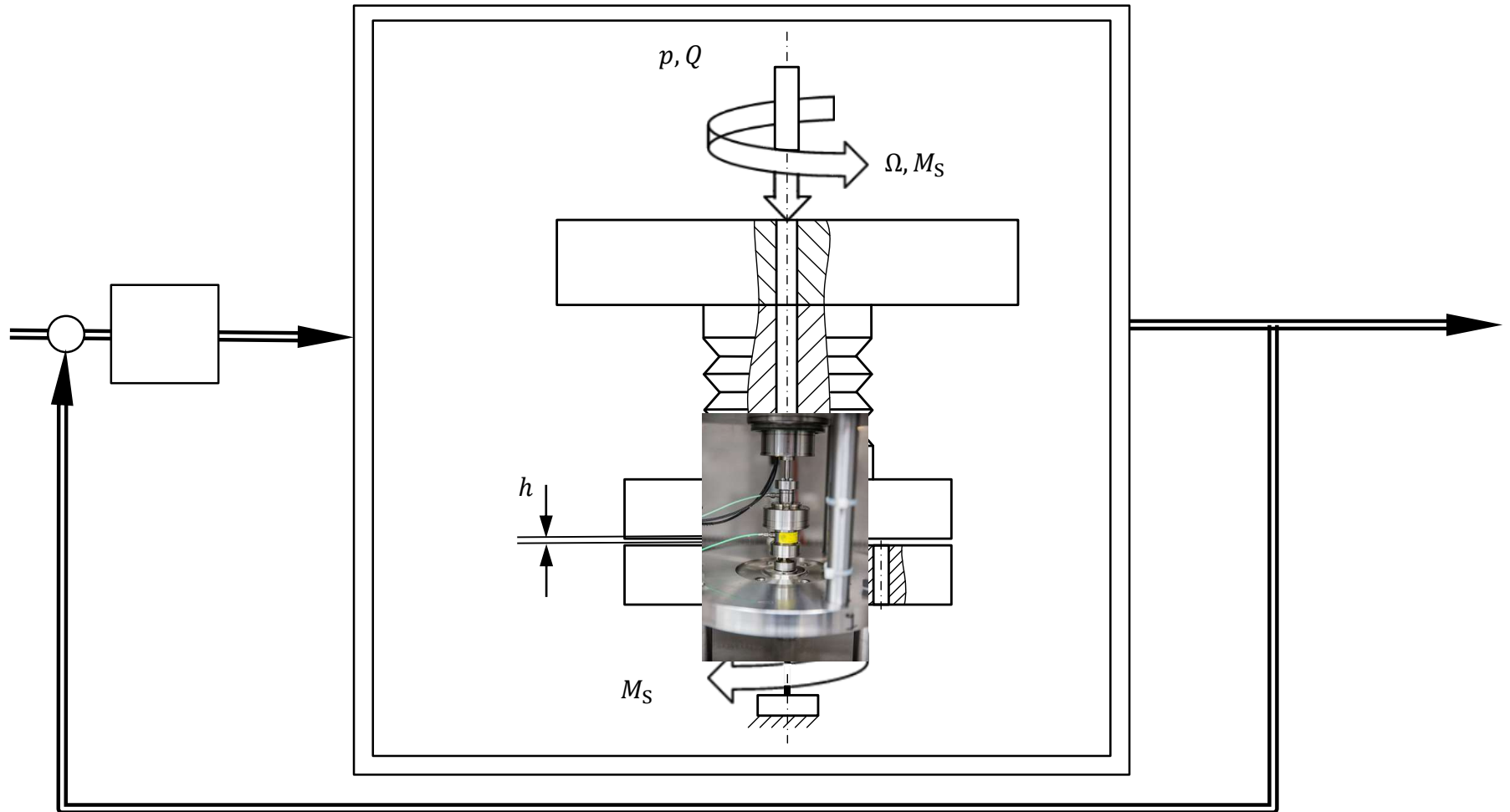
*...
...*



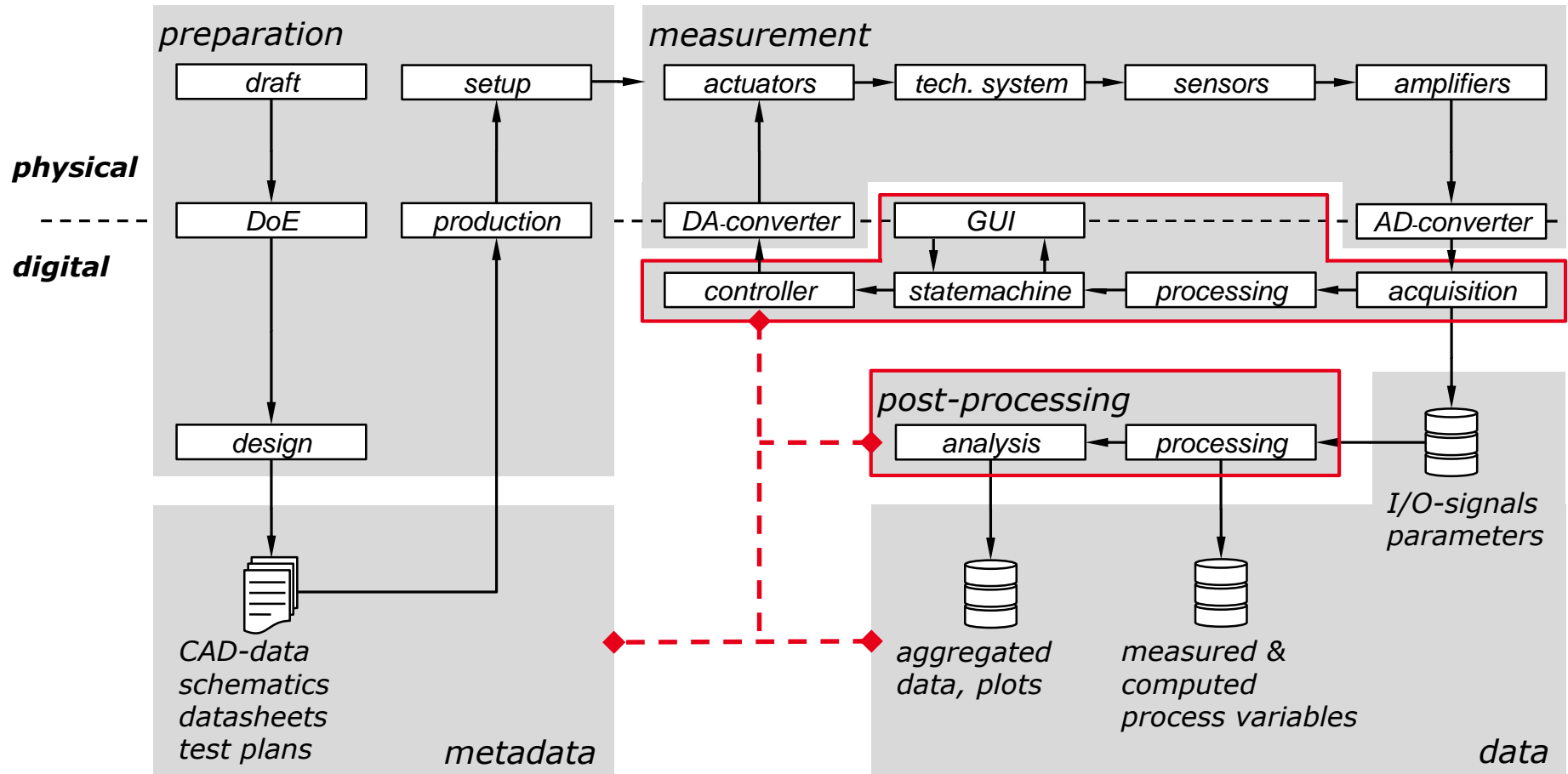
2016

*6 actuators
12 sensors*

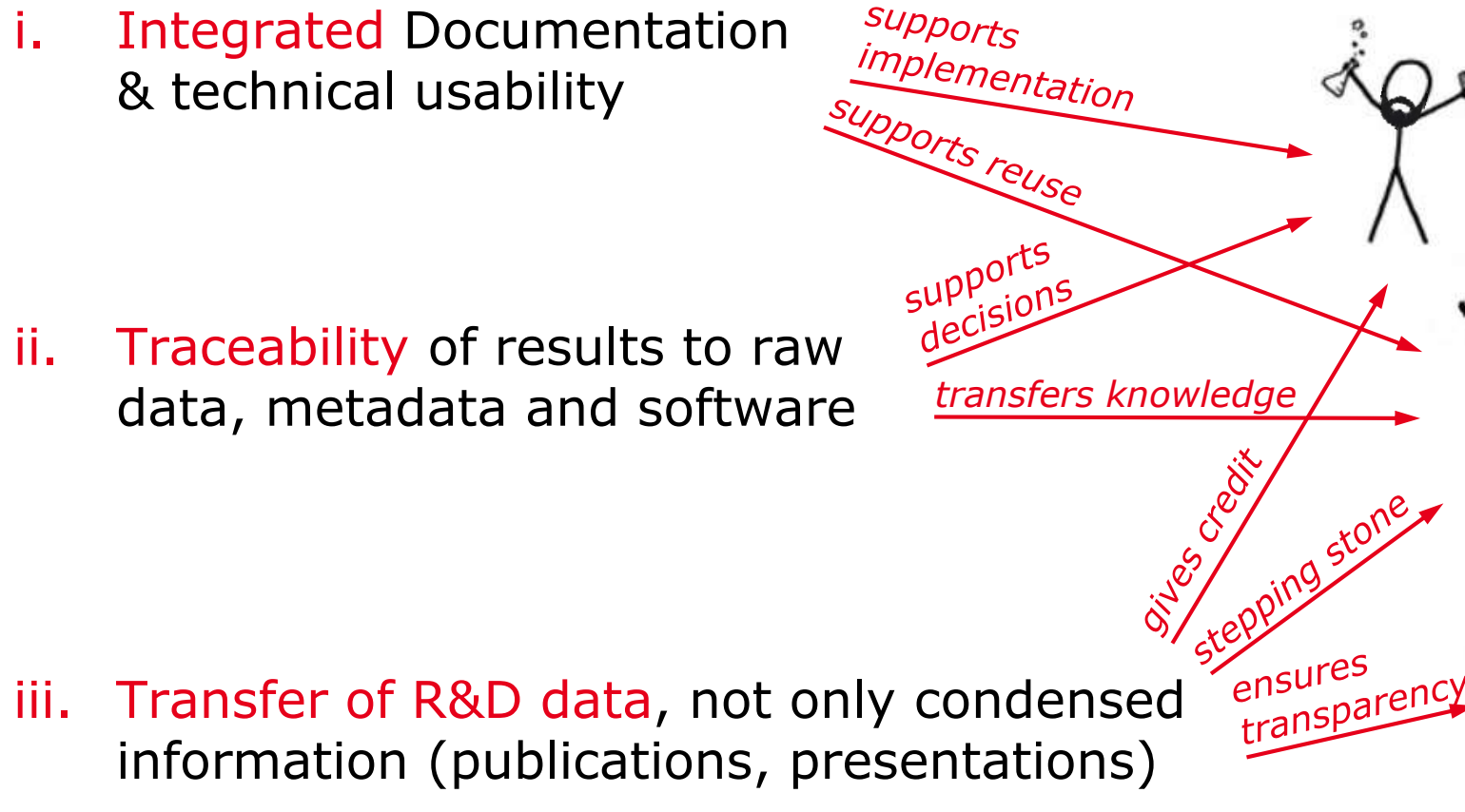
... subject to continuous improvements



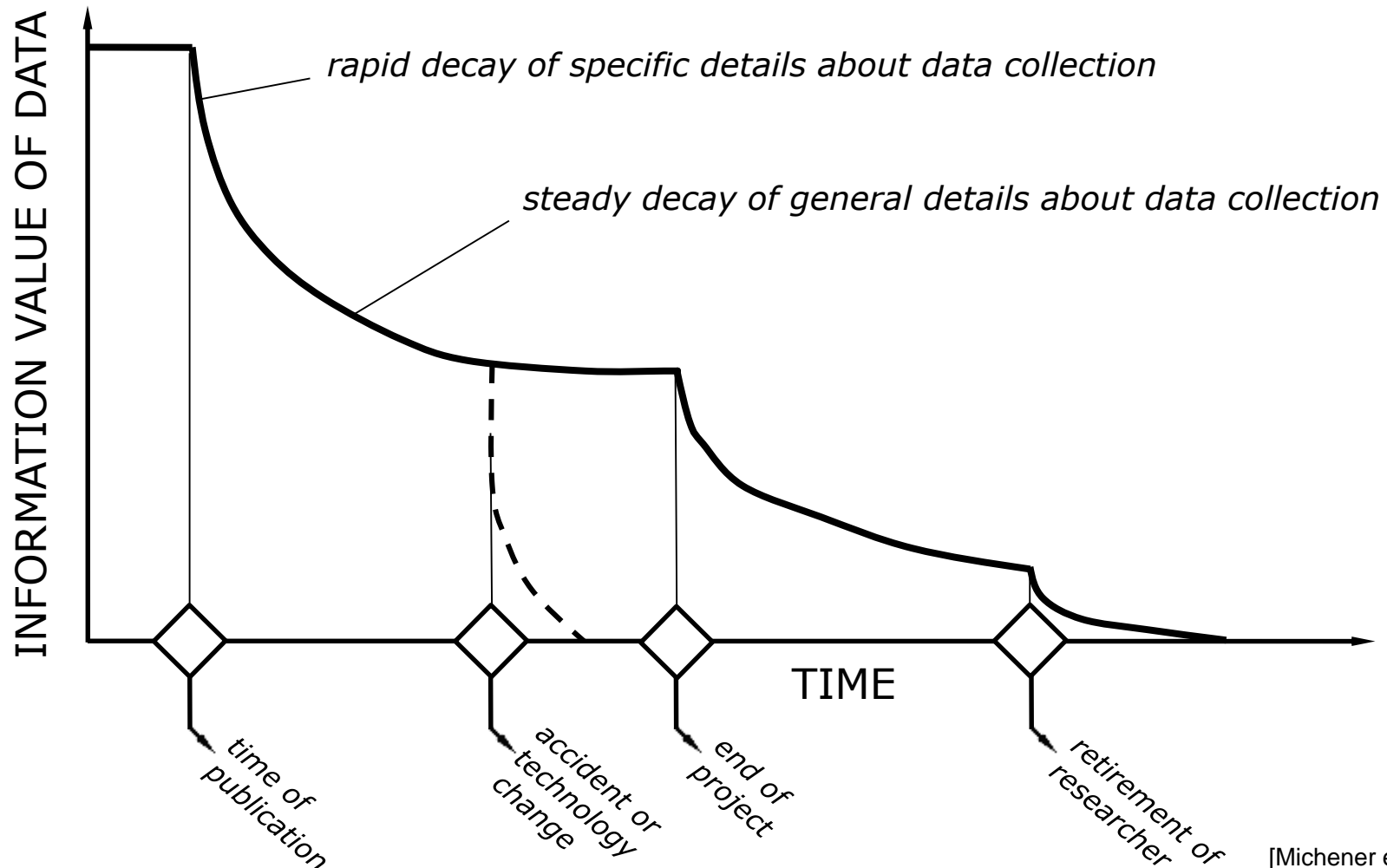
The general research environment in engineering sciences



Roadmap of sustainable research data management



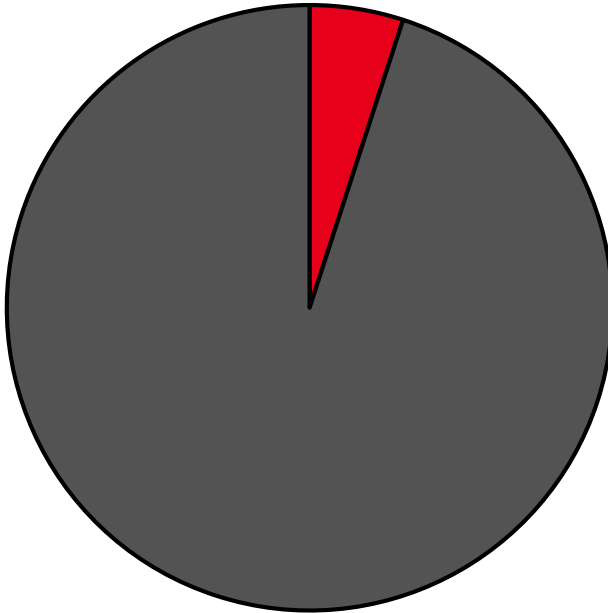
Data is not equal to information



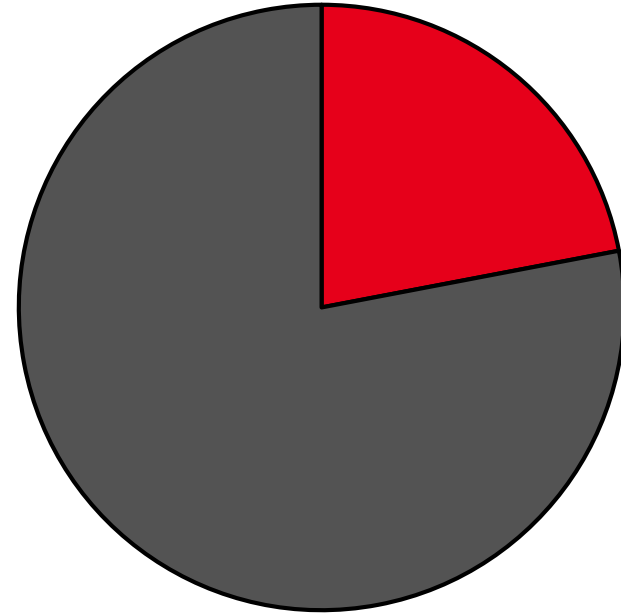
[Michener et al 1997]

Current state of information discovery

*only 5% of all data is
analyzed*



*only 22% of all data
contains sufficient
metadata*



[IDC 2014]



Current data access methods

(i) everyday life



(ii) scientific publications

ScienceDirect



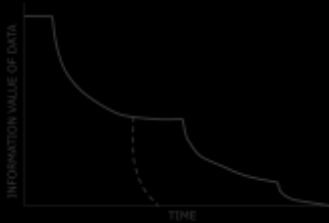
WEB OF SCIENCE™

(iii) scientific data, projects ...



PROBLEM

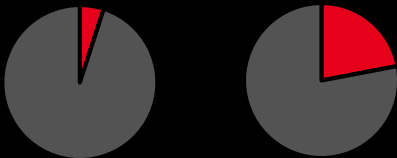
decay of information value



cumbersome data access



low data utilization



ANSWER

descriptive information
→ embedded metadata

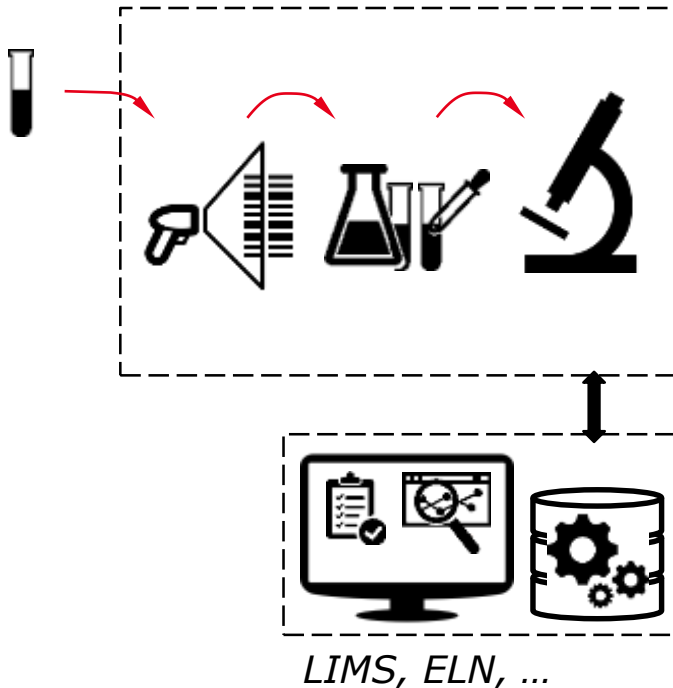
query language
→ graph database

automation
→ libraries & frameworks

Why existing software products are not applicable

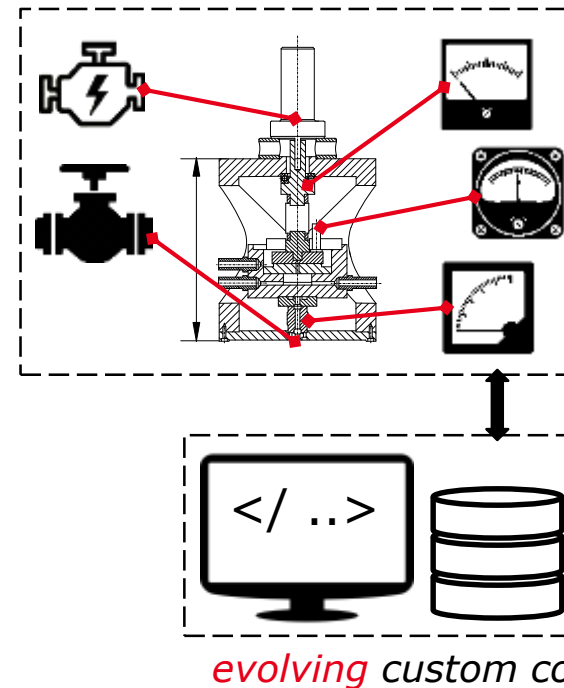
*bio, chemistry
experiments*

*highly **standardized**
instrumentation*



*engineering
experiments*

*continuously **evolving**,
one of a kind system*

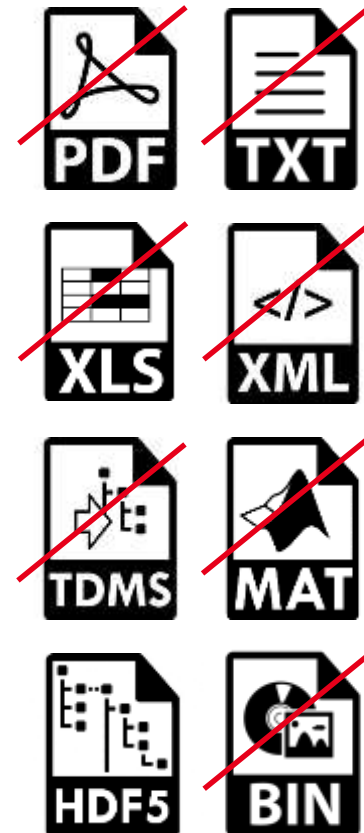
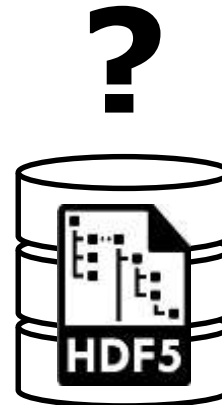


***objective**
is
changing*

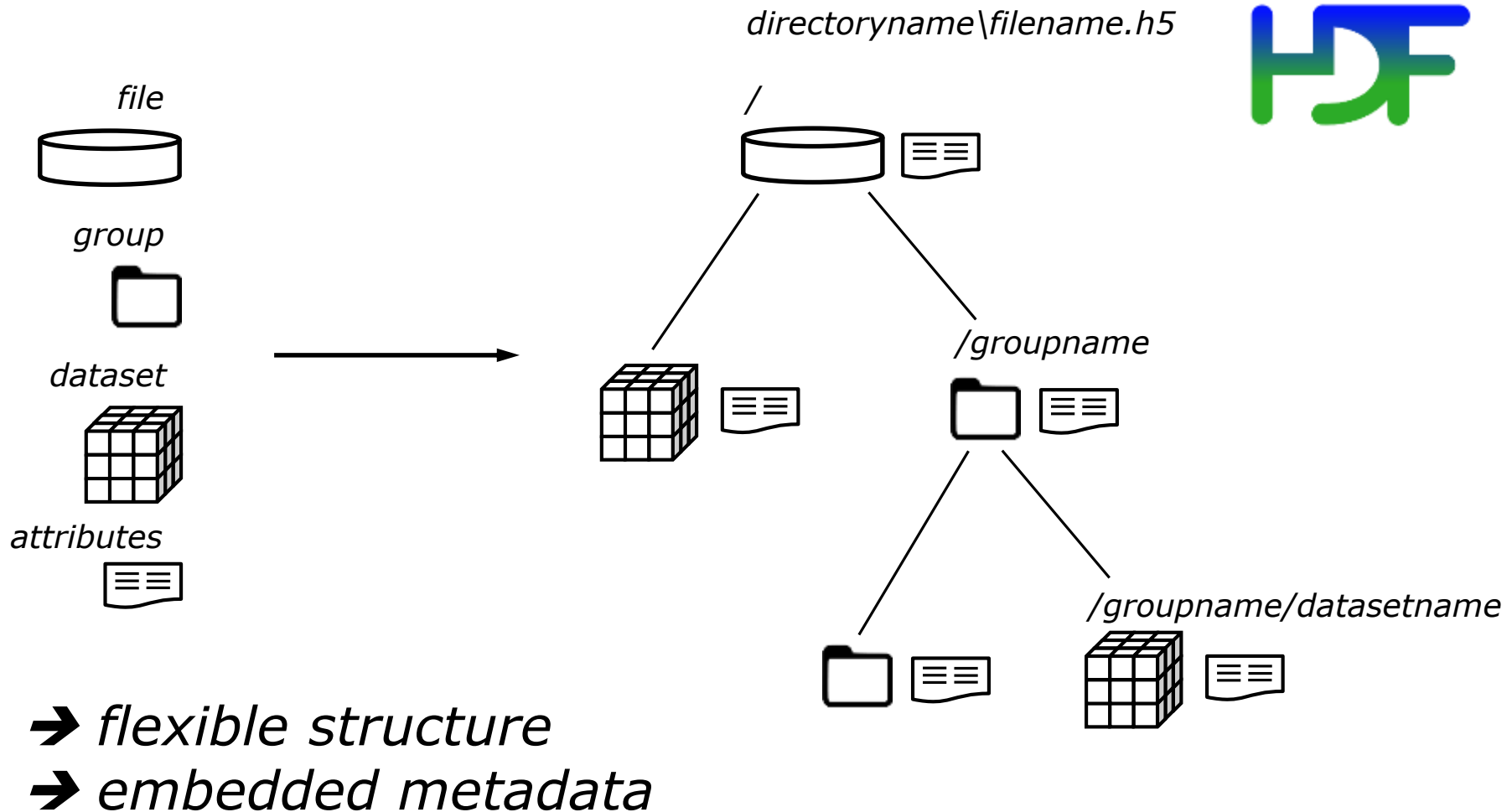
+
***unit under test**
is part of the
system*

A general purpose file format for heterogeneous & evolving data

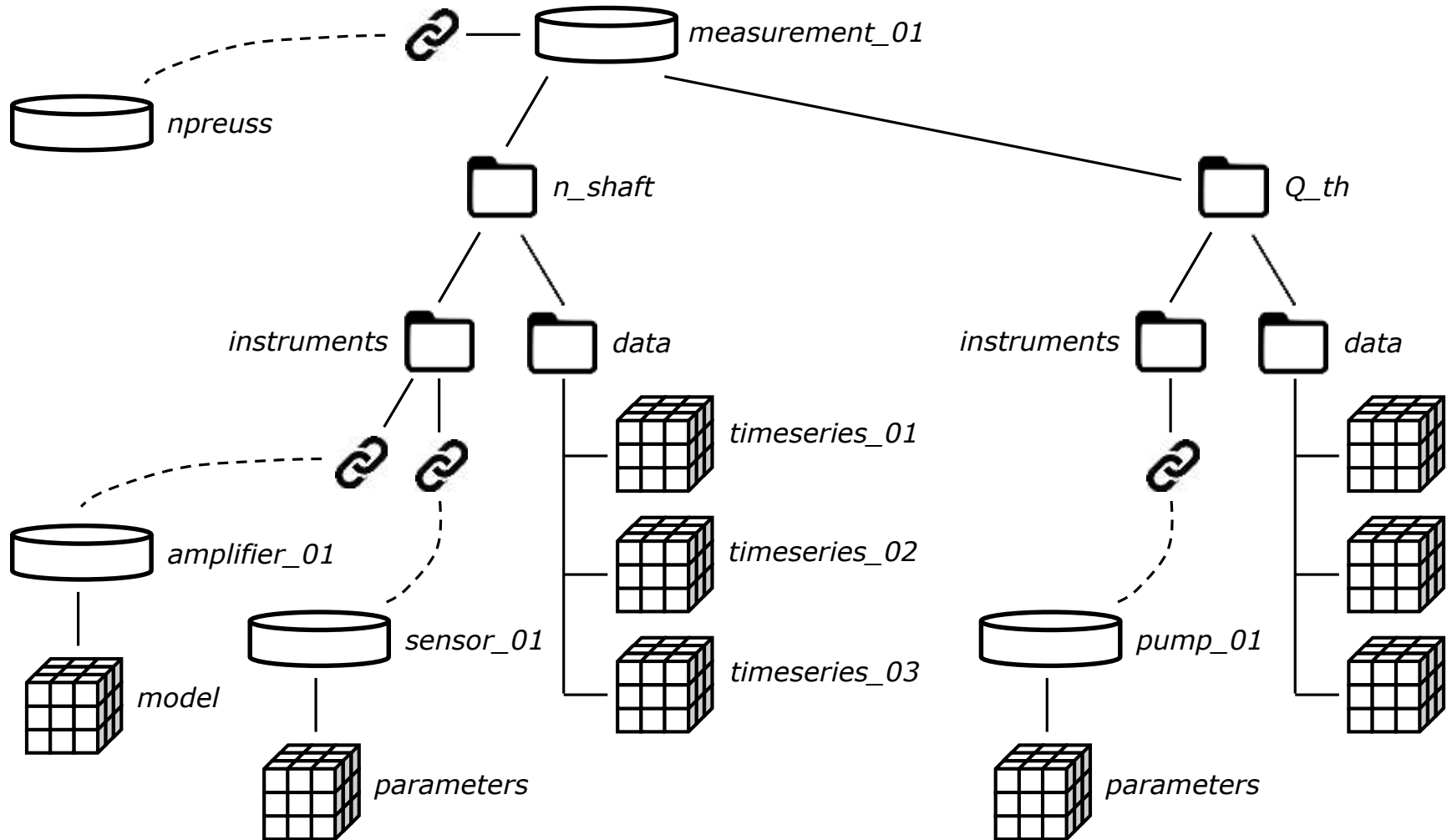
- i. flexible data structure
- ii. self descriptive
- iii. interoperability
- iv. independence
- v. simple interface



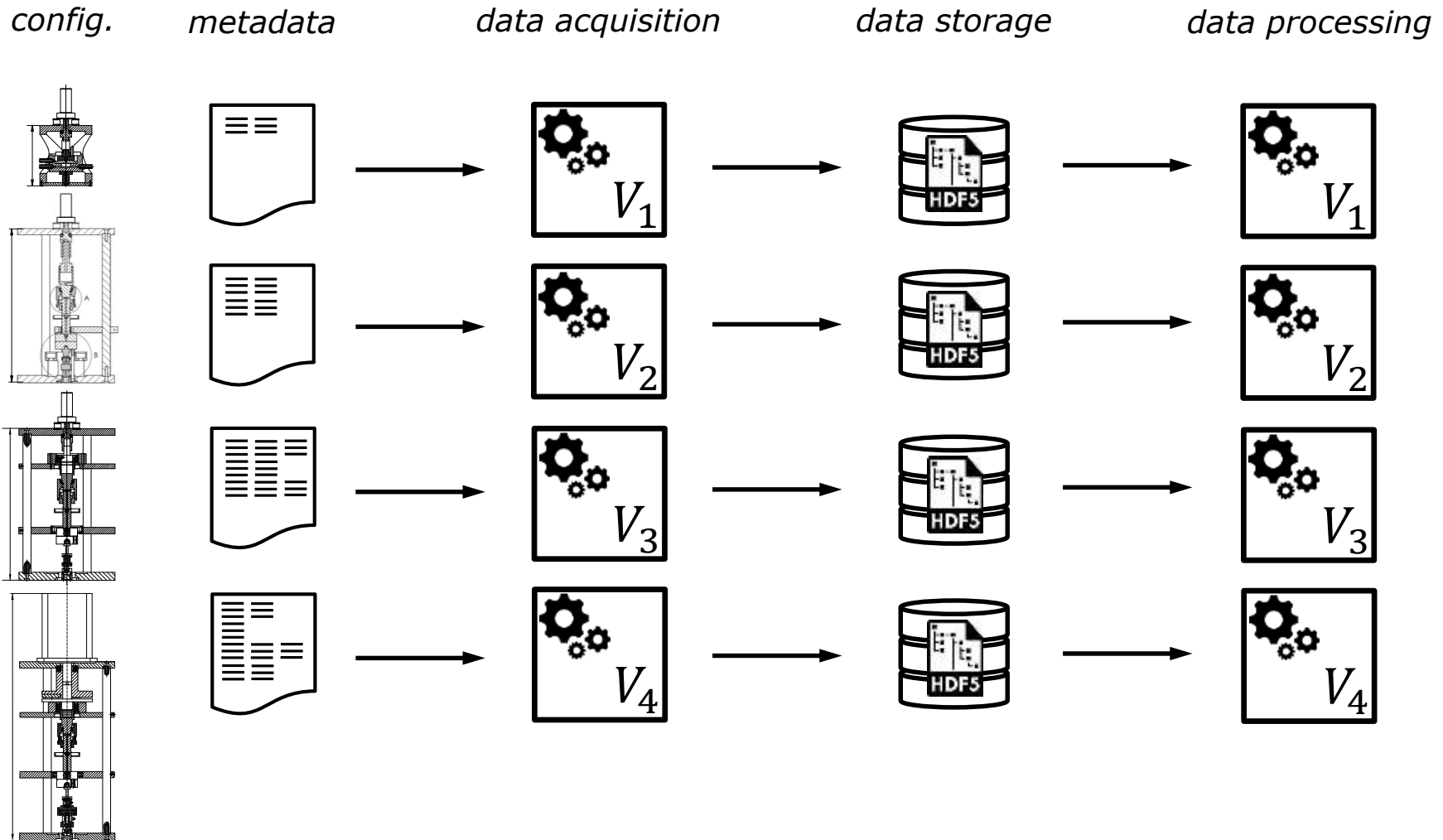
The HDF5 abstract data model



Exemplary concrete HDF5 data model



Hardcoded implementations need to evolve with the configuration



Modular & automatic embedding of descriptive information

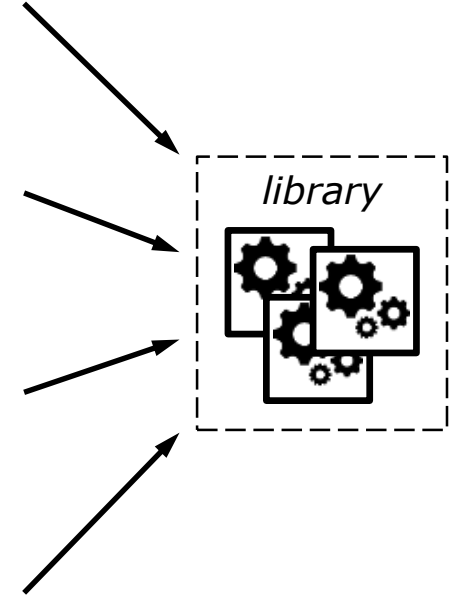
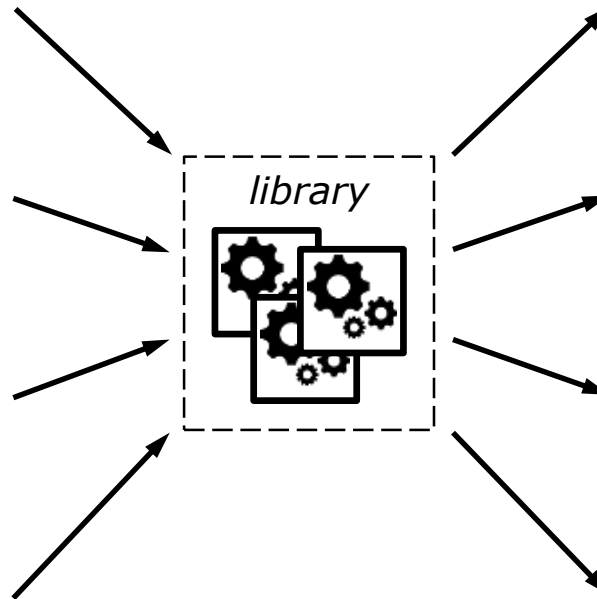
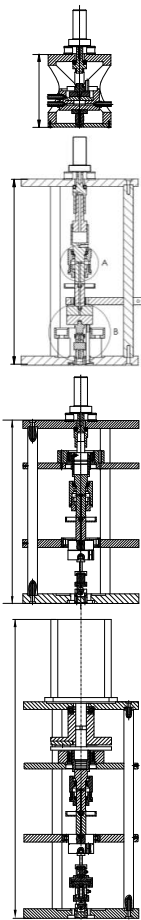
config.

metadata

data acquisition

data storage

data processing

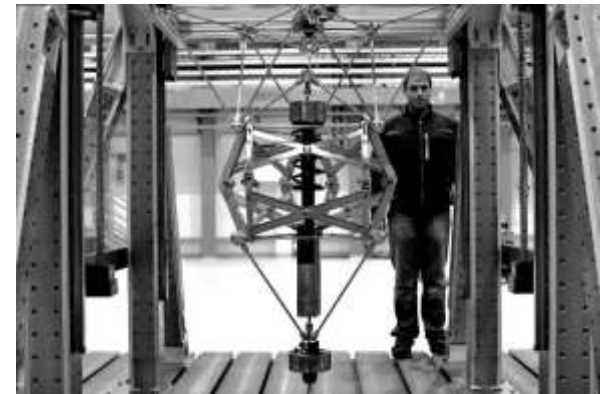


➔ *flexible*
➔ *scalable*

Concept validation at SFB805 and SFB1194 jointly with ULB

1. SFB 805

SFB demonstrator
all FST test rigs



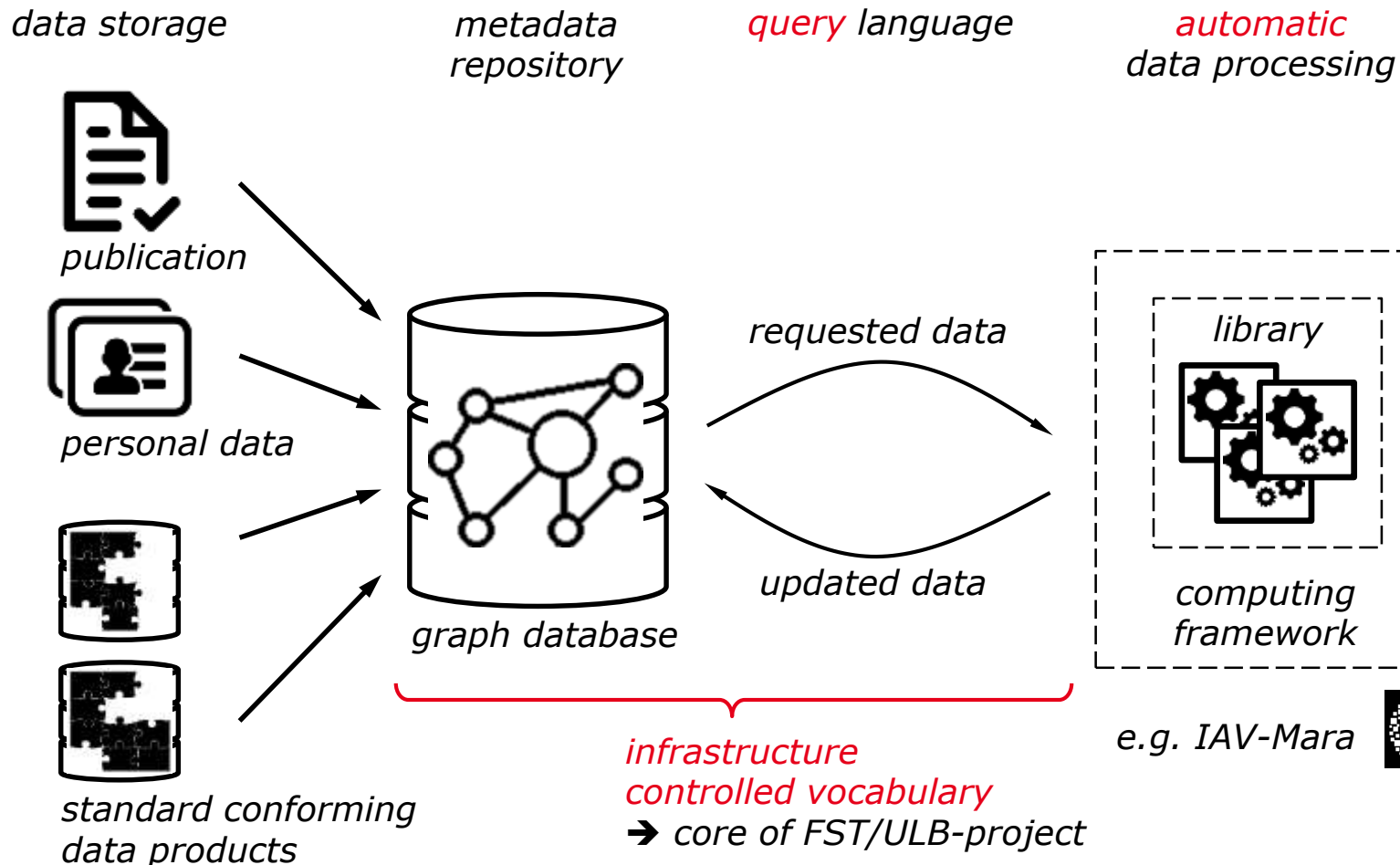
2. SFB 1194

IDD Prof. E. Dörsam



FST/ULB-project in preparation

data **querying** and analysis **automation**



Roadmap of sustainable research data management

