Platform MaterialDigital (PMD) presentation

MATERIALDIGITAL

Innovations- Plattform MaterialDigital

Die Plattform für die Digitalisierung der Materialien

Ein Verbundprojekt von:

Fraunhofer IWM

KIT Karlsruher Institut für Technologie

MAX-PLANCK-INSTITUT FÜR EISENFORSCHUNG GmbH

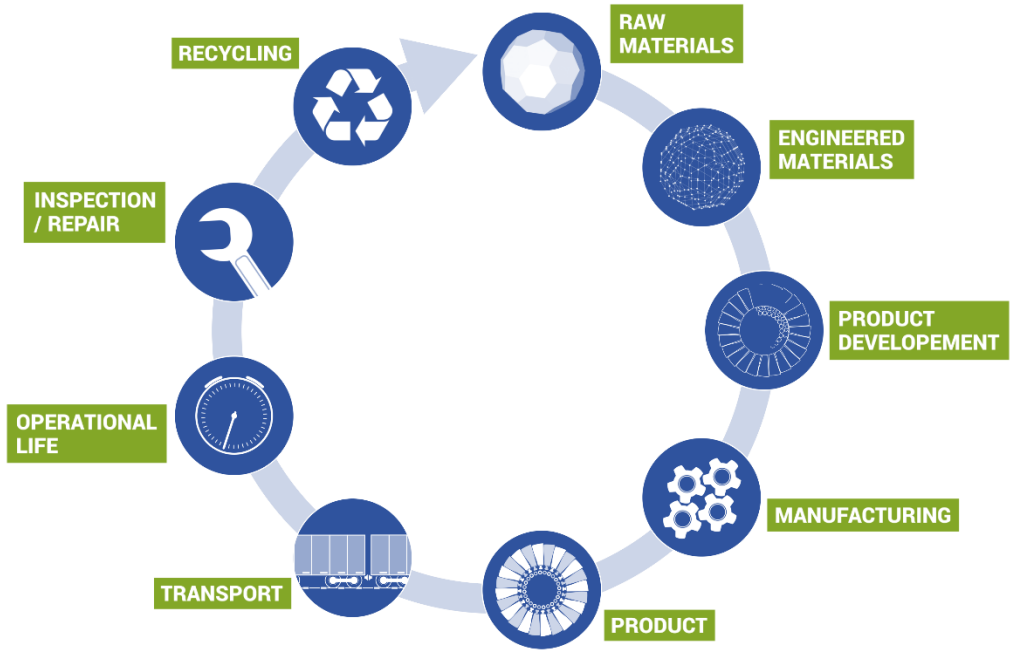
BAM Bundesanstalt für Materialforschung und -prüfung

IWT Leibniz-Institut für Werkstofforientierte Technologien

GEFÖRDERT VOM Bundesministerium für Bildung und Forschung

Why MaterialDigital

- Development of a uniform material data space to indicate a material through the various processes
- Drawing added value from the digitization of Industry 4.0
- Accessible and secure scientific exchange to e.g. develop materials or set up processes faster
- Value access and know-how to reuse expensive materials data
- Generation of reference data for comparison
- Validation of material models
- Building foundations for AI models
- Building a base for a sustainability and circular economy



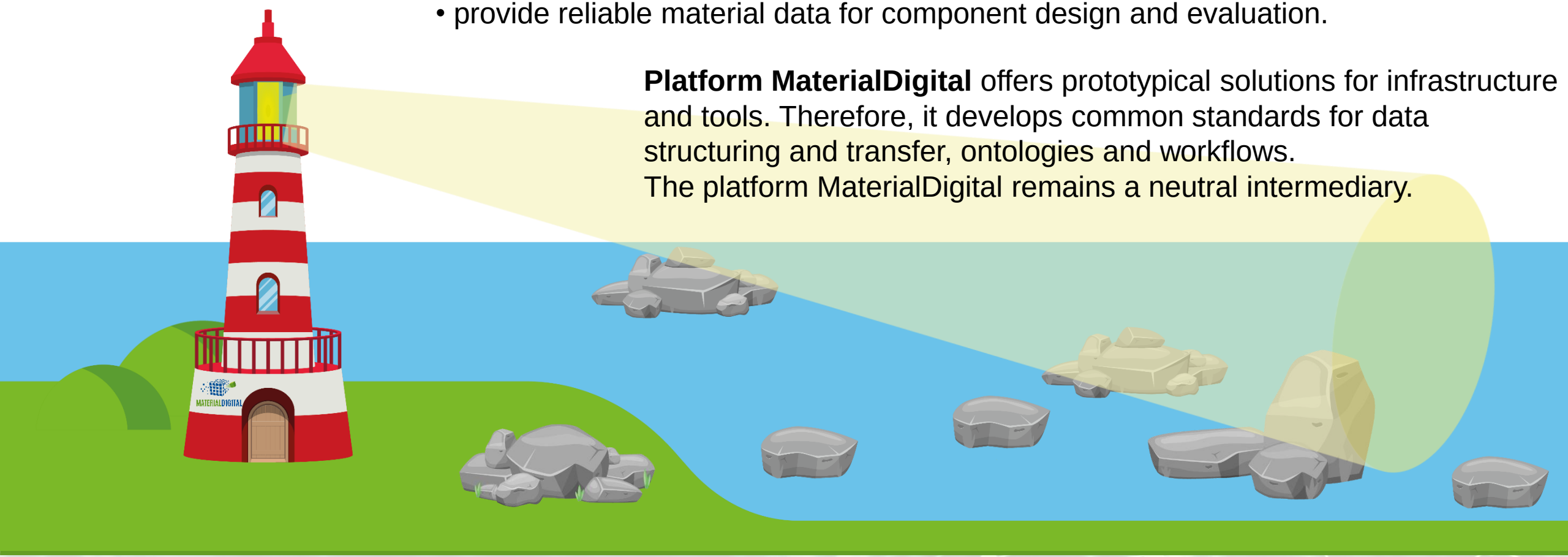
Graphic from PMD image film, YouTube

Vision of the light house project Platform MaterialDigital

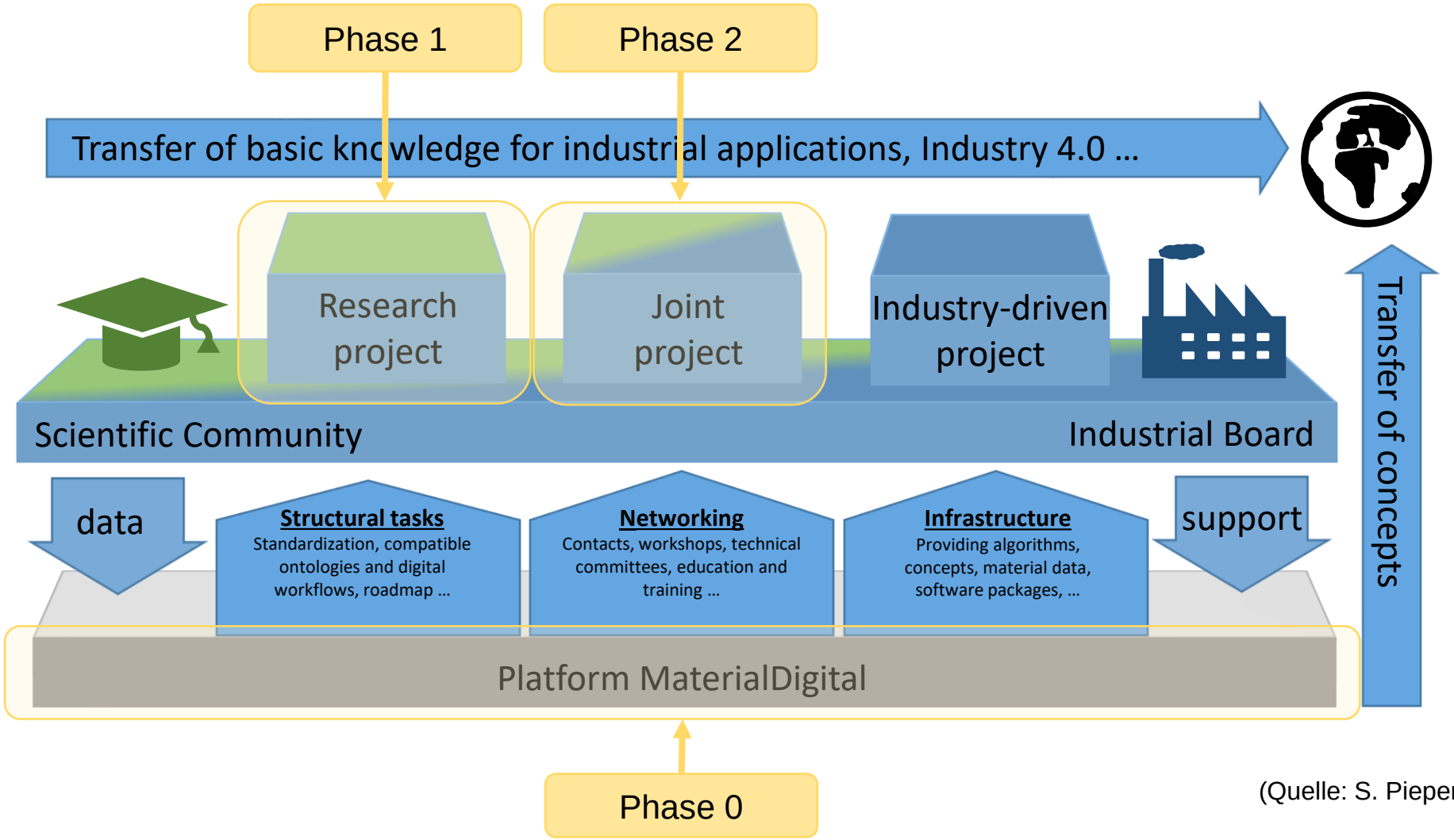
Long-term goals of the initiative MaterialDigital

- represent the digital material in its life cycle,
- map the digital material throughout the entire process chain,
- provide reliable material data for component design and evaluation.

Platform MaterialDigital offers prototypical solutions for infrastructure and tools. Therefore, it develops common standards for data structuring and transfer, ontologies and workflows.
The platform MaterialDigital remains a neutral intermediary.



Initiative MaterialDigital – three initial phases



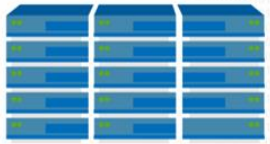
(Quelle: S. Pieper, VDI-TZ)

Why Platform MaterialDigital

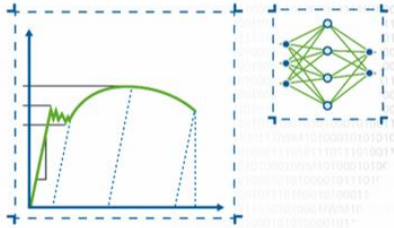
- Technological independence
- Safety and reliability of components that are produced
- Quality of data
- Preserving data ownership rights

Generation of material data

Storage of material data



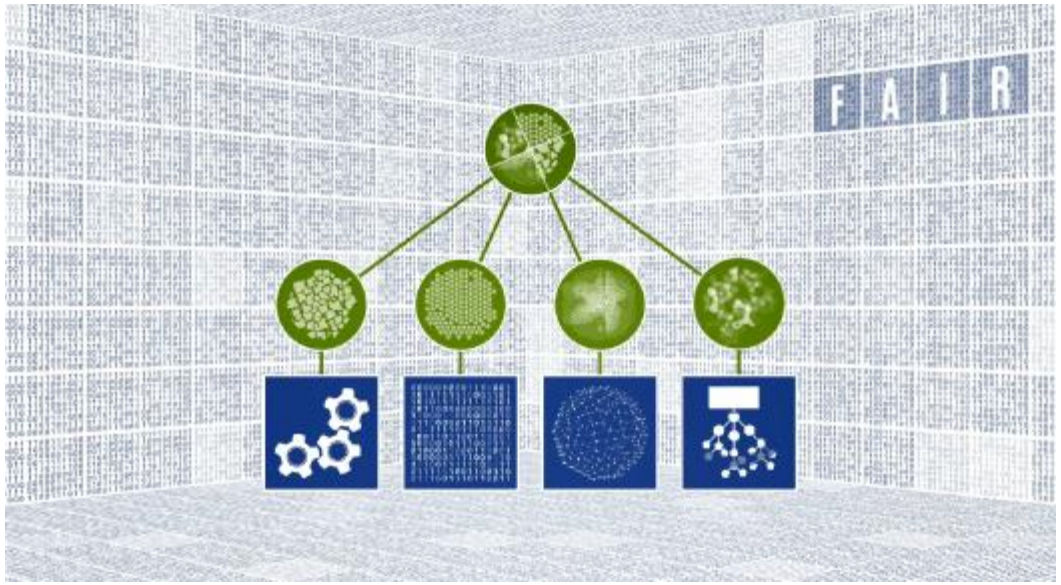
Data processing, model development



Data analysis, data evaluation

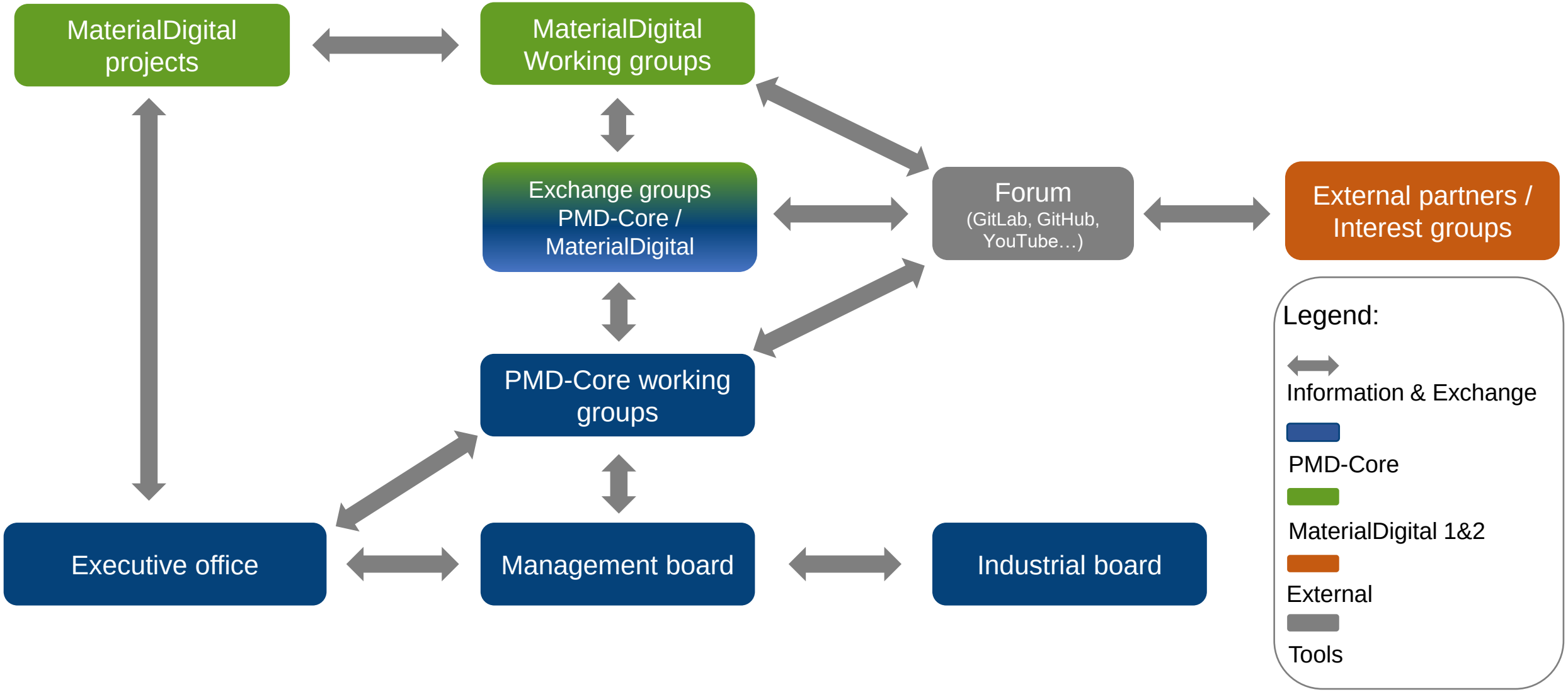
How do we implement it

- With semantic tools and a shared material ontology, we are able to use data and tools without barriers.
- Digital workflow tools enable project partners to work together across institute boundaries
- Through a secure network between the project partners, we allow a secure data transfer
- By networking the community, we achieve shared de facto standards that are broadly accepted in use

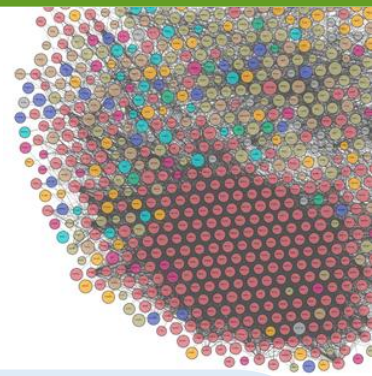


Graphic from PMD image film, YouTube

(Planned) organisational structure of MaterialDigital



Common understanding is the basis



Challenges

- Variety of heterogeneous data in different formats in data silos
- Contextual information about data is lost
- Data is simply shared, but not universally understood
- Non-transparent scripts and software solutions
- …

Usage of a common understanding and standards

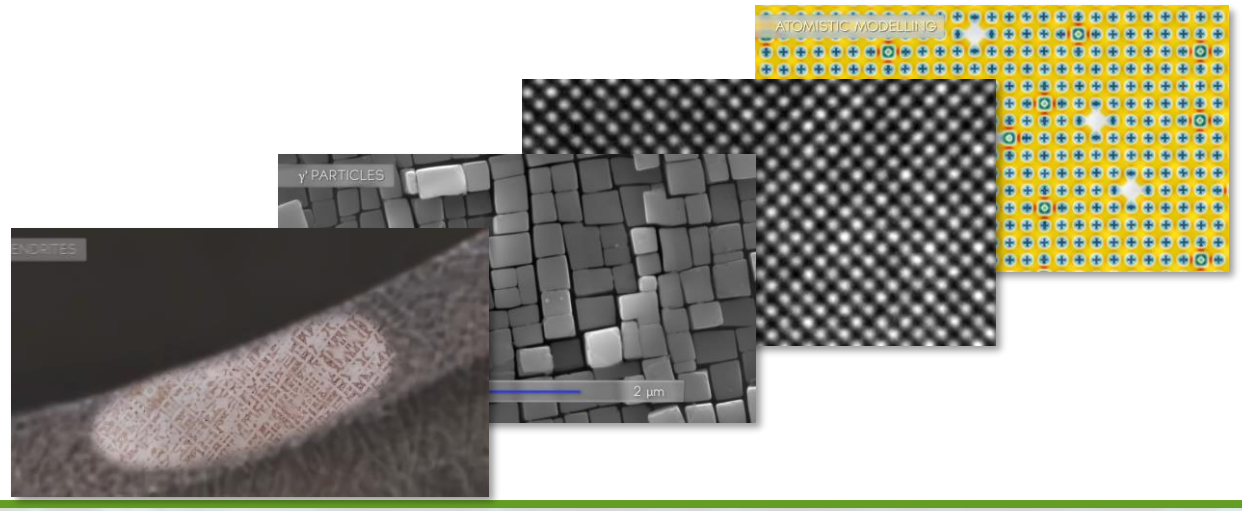
Aim

- Demolition of internal and external organizational silos
- Reproducibility and Re-usability keyword: FAIR

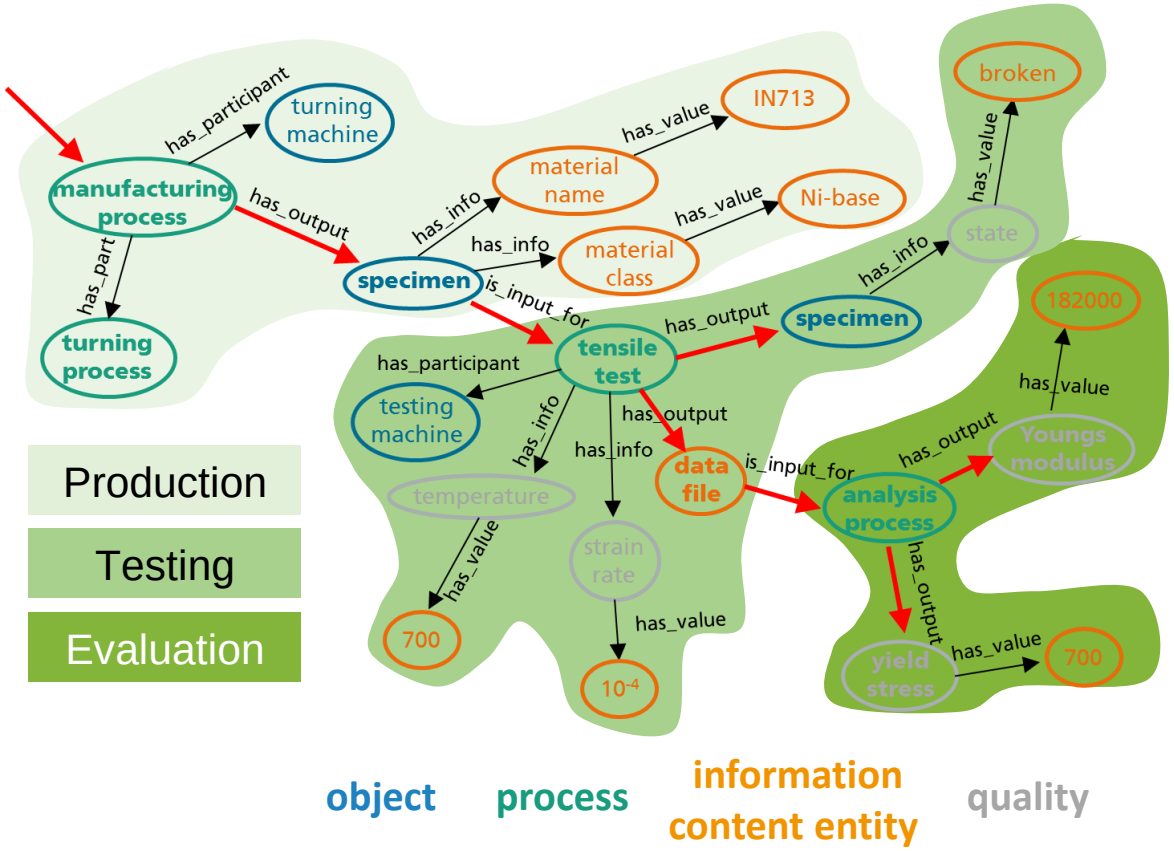
Findable
Accessible
Interoperable
Re-usable

Ontologies as a standardized description in the community

- Annotation of data and metadata using shared vocabulary
- Uniform metadata and ontologies make the context and thus the data itself understandable.
- Ontologies as a bottleneck: Implementation of the material data room is based on standardized descriptions and their willing use



Example: Knowledge Graph to describe the tensile test



C. Schweizer, H. Oesterlin, E. Augenstein, A. Hashibon, V. Friedmann

Current status Ontologies

PMD-Core

- Under-specified ontology to connect application ontologies of PMD projects
- Semantic anchor for the domain MSE
- Mapping to upper-level ontologies are possible

Where can I find that?

GitHub

Ontology Playground

- Community interaction (mainly) with PMD partner projects MSE & ontology experts
- Alignment of ontology usage
- Harmonization of ontology development

Where can I find that?

Conceptboard

GitLab (PMD partner projects only)

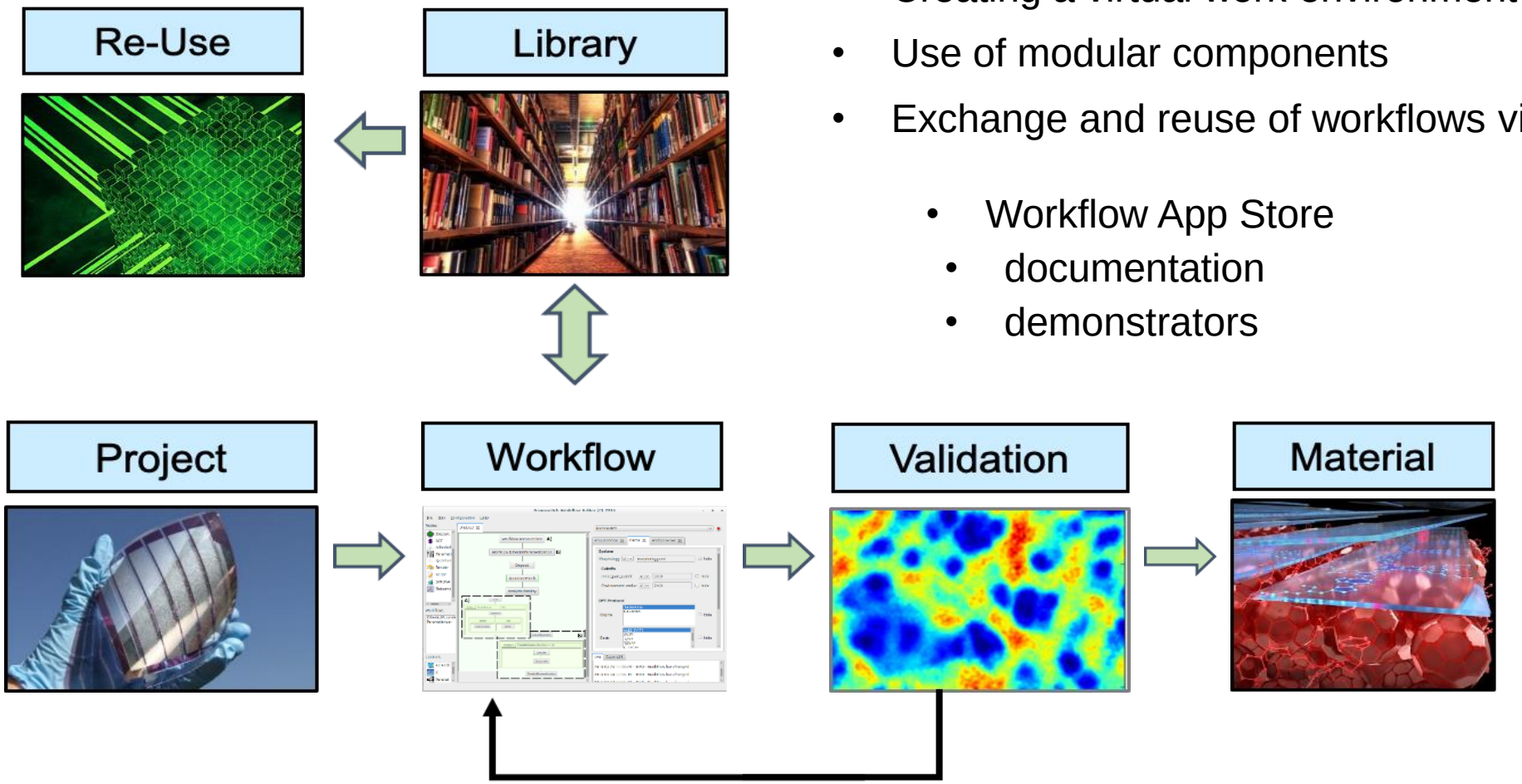
Digital Material Identifier

- DMI similar to DOI
- Dereferencing service for materials names providing info about materials
- Currently being addressed by the PMD

Where can I find that?

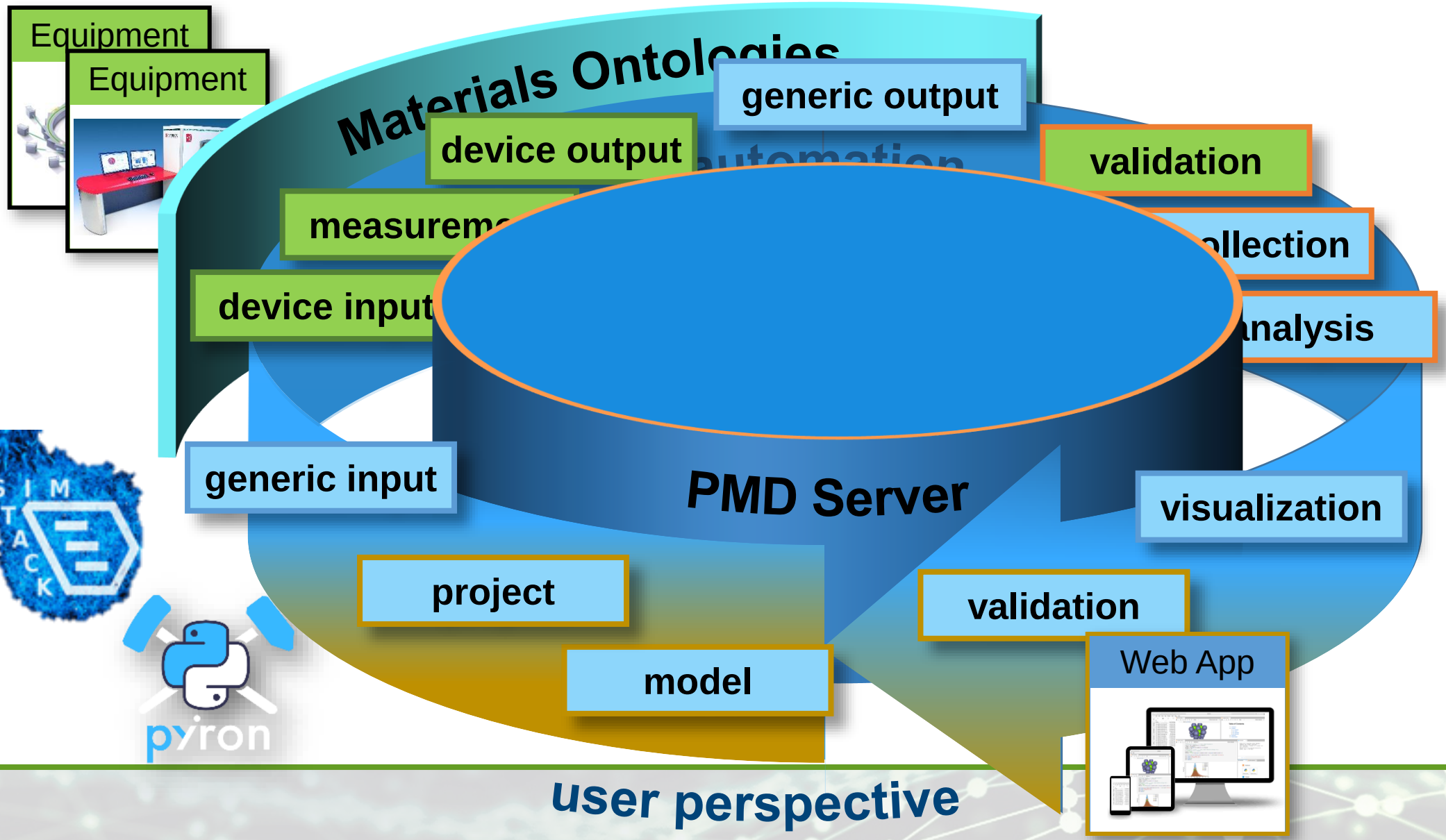
In progress

Workflows - Use of a digital library



- Creating a virtual work environment
- Use of modular components
- Exchange and reuse of workflows via
  - Workflow App Store
    - documentation
    - demonstrators

Generic structure of Workflows



Solution approaches:

- Automated, standardized workflows
- Reproducibility
- Extensibility
- Transferability
- Transparent web interface
- Linking of workflow and ontology
- Unified server structure

Current status Workflows

Workflow Environment

- Pyiron Server
  - 4 Docker containers
- SimStack Client
  - Windows & Linux
- Demonstrators
  - Atomistic & Continuum

Workflow Store

- 14 workflows/modules
- Template for workflow integration
- Metadata standards
- SSO connection
- Roadmap for feature implementation

Interplay within PMD

- Integration of software tools
  - Damask, FEniCS, OpenPhase
  - Precice
- Script job functionality
- Interface to ontology
  - incl. one demonstrator

https://github.com/materialdigital
https://github.com/kit-workflows
https://github.com/pyiron

Group Meeting

- Weekly exchange on relevant topics

(PMD partner projects only)

Forum

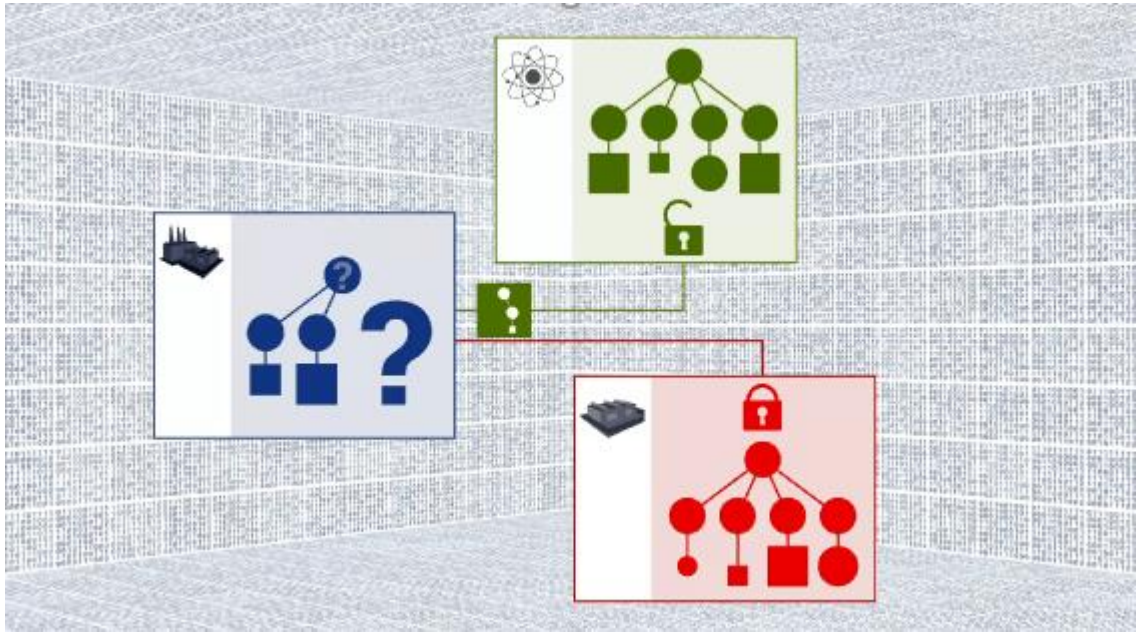
- User stories
- Discussion

YouTube

- Onboarding
- pyiron

How do servers interact within the PMD network

- The communication runs in a secure network, similar to a VPN.
- Depending on the application scenario, an own PMD server can be set up according to a unified structure, which can interact with the central PMD server.
- Within the prototypical platform there is a simple user management on service level.
- The goal is a decentralized storage of data within a connected data space. Data always remains in the hands of its owner, who decide whether and with whom it is shared.



Graphic from PMD image film, YouTube

Current status architecture and infrastructure

AAI & User Base

- Authentication and Authorization Infrastructure (AAI) is based on an SSO-service providing a centralized user base of approx. 1200 users, today.
- Enabling Ontology Playground and various other PMD Services
  - MaterialDigital Forum
  - Ontodocker App
  - Pyiron Apps

Containerized PMD-Server Applications

- OntoDocker App
- Pyiron App
- SimStack tutorial
- Workflow Store App

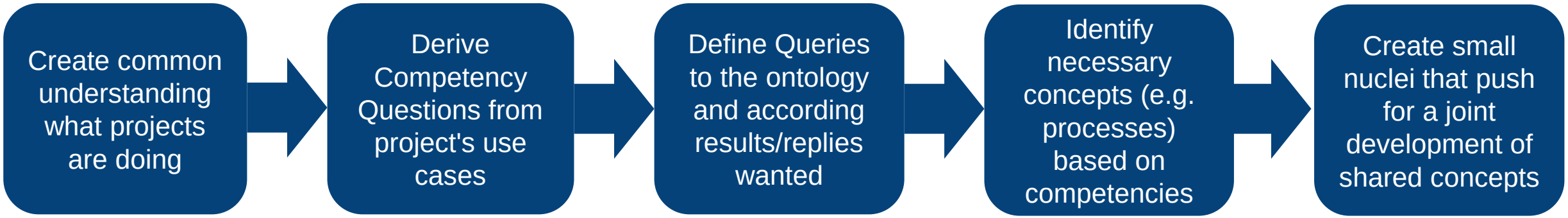
Guidance, Documentation, and Best Practices

- Public documentation on setup and configuration of core PMD services available
- Continuous updated to include new services as soon as they are fit for the community

Example for knowledge transfer and cooperation

"Ontology Playground" - a common working group between Platform MaterialDigital and academic projects

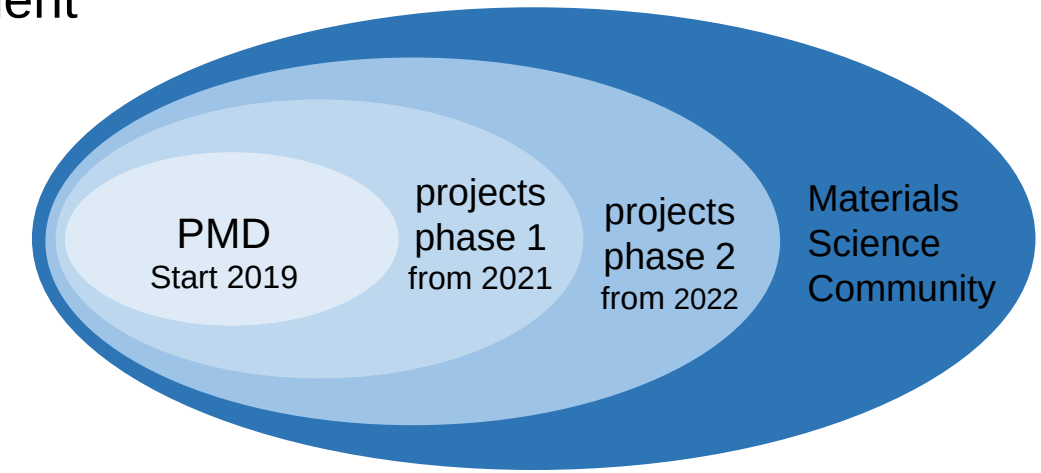
- Harmonization and guidance for ontology design
- Semantic inter-cooperability
- Joint development of an ontology based on the preliminary work of a project



Standardisation work in the PMD

- Deepening contacts with **DIN** to strengthen **digitization** aspects in standardization work, networking with stakeholders involved in standardization work
- **Linking** of the activities of different standardization areas **within DIN** (e.B. IT and mechanical test procedures), if necessary revision of existing standards in the sense of digitization (e.g. data structures, output files)

- Increased **acceptance** and **willingness** to implement within standardization bodies and stakeholders
- Establishment of **de-facto standards** in the community



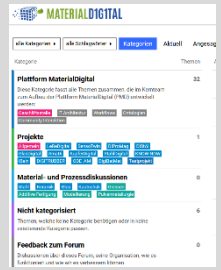
Current opportunities for collaboration

4 Implementation
- Participation in individual groups, e.g. Ontology Playground
- Work on user stories for workflows

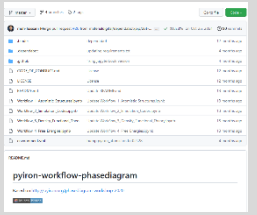
Conceptboard
Discourse
GitLab
GitHub

3 Participation
- Transparent active discussions with the community via our forum,
- check GitHub

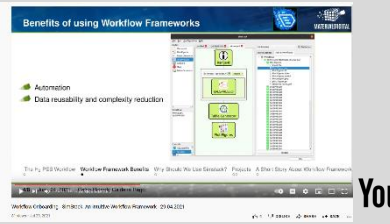
Discourse



GitHub



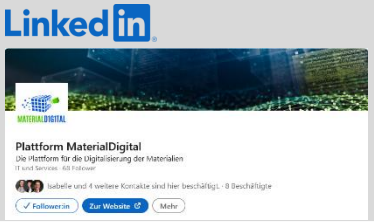
2 Adaptation
- Knowledge transfer via tutorials and information videos
- Rethink your own data structure and, if necessary, start preparation



YouTube

1 Information
- Follow the current status
- Share and pass on the concept

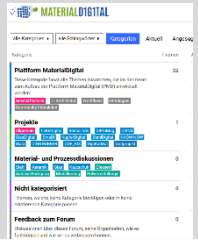
twitter



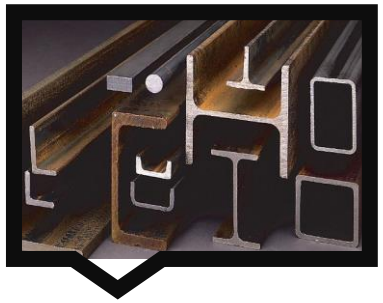
LinkedIn

MATERIALDIGITAL

Discourse



Example of an active participation in the community



Public exchange in the Forum

MATERIALD1G1TAL

alle Kategorien | alle Schlagwörter | Kategorien | Aktuell

Kategorie

Plattform MaterialDigital

Diese Kategorie fasst alle Themen zusammen, die im Kernteam zum Aufbau der Plattform MaterialDigital (PMD) entwickelt werden:

Geschäftsstelle | IT Architektur | Workflows | Ontologien | Community Interaktion

Projekte

Allgemein | LeBeDigital | SensoTwin | DiProMag | DiStAl | GlasDigital | SmaDi | KupferDigital | StahlDigital | KNOW-NOW | iBain | DIGITRUBBER | ODE_AM | DigiBatMat

Material- und Prozessdiskussionen

Stahl | Keramik | Glas | Kautschuk | Giessen | Additive Fertigung | Modellierung | Pulvermetallurgie

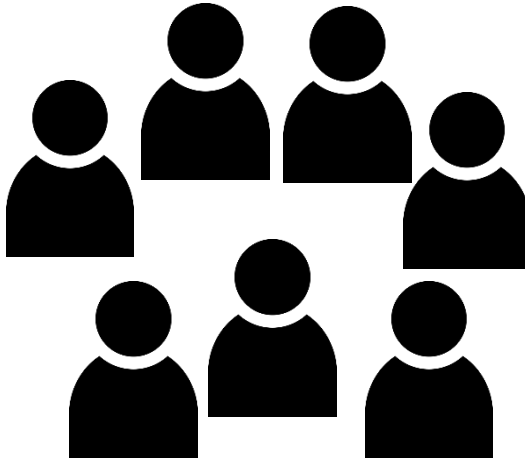
Nicht kategorisiert

Themen, welche keine Kategorie benötigen oder in keine existierende Kategorie passen.

Feedback zum Forum

Diskussionen über dieses Forum, seine Organisation, wie es funktioniert und wie wir es verbessern können.

Discussions in interest group



- Discussion and synergies about similar tasks and challenges / interests etc.
- Exchange via own part of the forum and let the community know about it
- Depending on your tasks and goals, a project in GitLab can be provided

Vielen Dank für Ihre Aufmerksamkeit!
Thank you for you attention!

BAM

Fraunhofer IWM

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FIZ Karlsruhe
Leibniz-Institut für Informationsinfrastruktur

Fraunhofer AISEC

Kontaktieren Sie uns und machen Sie mit!

forum.materialdigital.de

info@material-digital.de

GitLab

twitter

LinkedIn

YouTube

www.materialdigital.de