NATIONAL RESEARCH
DATA INFRASTRUCTURE FOR
ENGINEERING SCIENCES

NFDI4ing

Keynote NFDI4Ing Conference 2022

Unifying the Understanding of RDM in Engineering Science

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Chair of Metrology and Quality Management &
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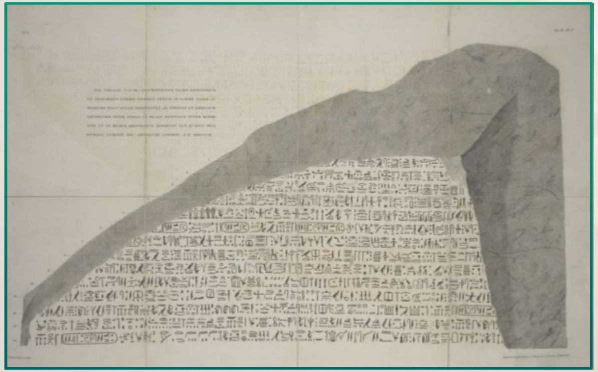
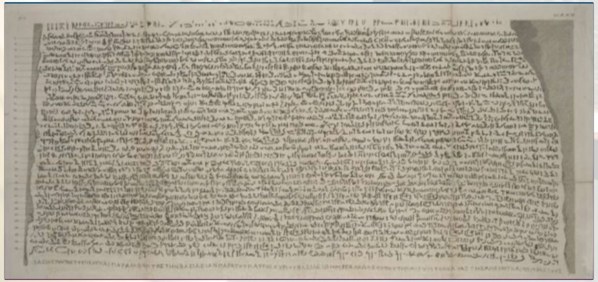
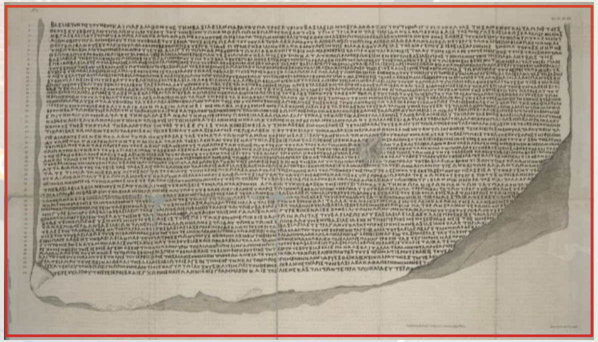
image: pexels.com/



Egyptian hieroglyphs



Egyptian Demotic



Ancient Greek

background: pexels.com
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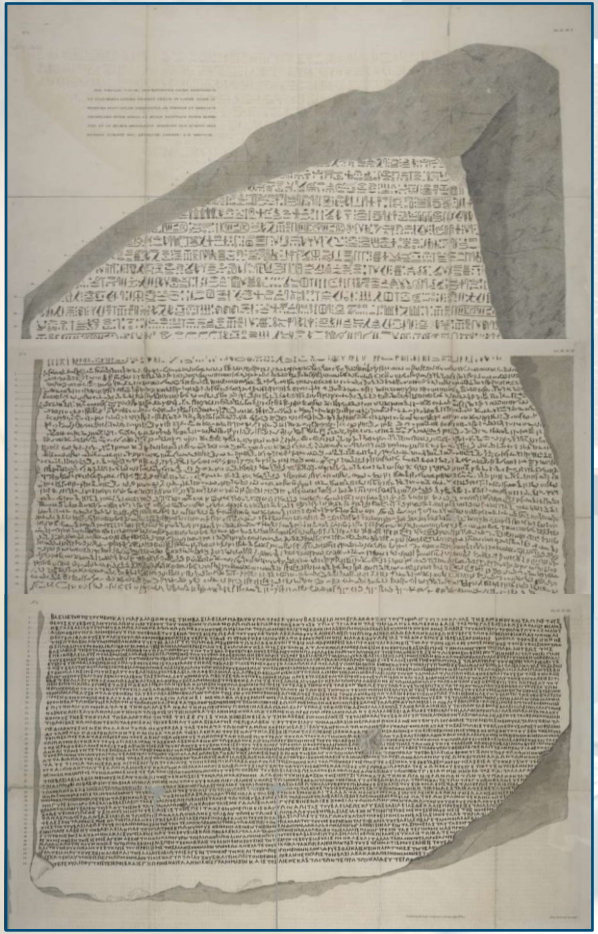

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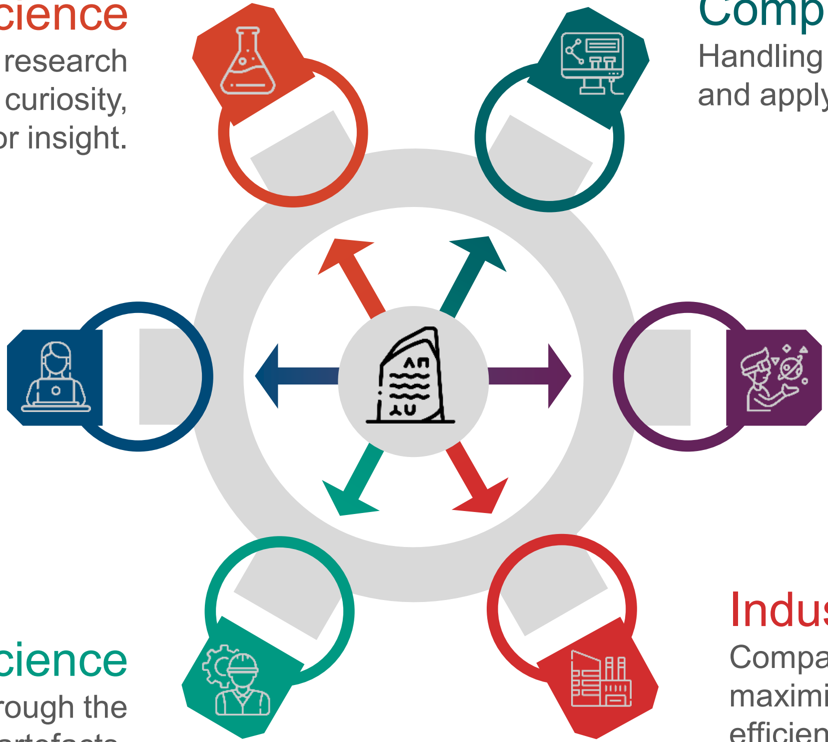
Rosetta Stone

image: *The Rosetta Stone*, 196 B.C.E., Ptolemaic Period, 112.3 x 75.7 x 28.4 cm, Egypt (British Museum, London) (photo: Steven Zucker, CC BY-NC-SA 2.0) icons: Flaticon.com

Science
Universities and research institutes driven by curiosity, looking for insight.

Computer Science
Handling abstract pieces of information and applying them to various domains.



Present
Adapting to available technology in the current environment.

Future
Anticipate the advancement of new technologies.

Engineering Science
Solving problems through the creation of artefacts.

Industry
Companies driven by profit maximization, seeking for efficiency and waste reduction.

RDM requires the amalgamation of Engineering and Computer Science

Goals

Methods

Mentalities

Engineering Science

Computer Science

Knowledge

Domains

Tools

images: pexels.com

Use Case: Ultrashort Pulse Manufacturing

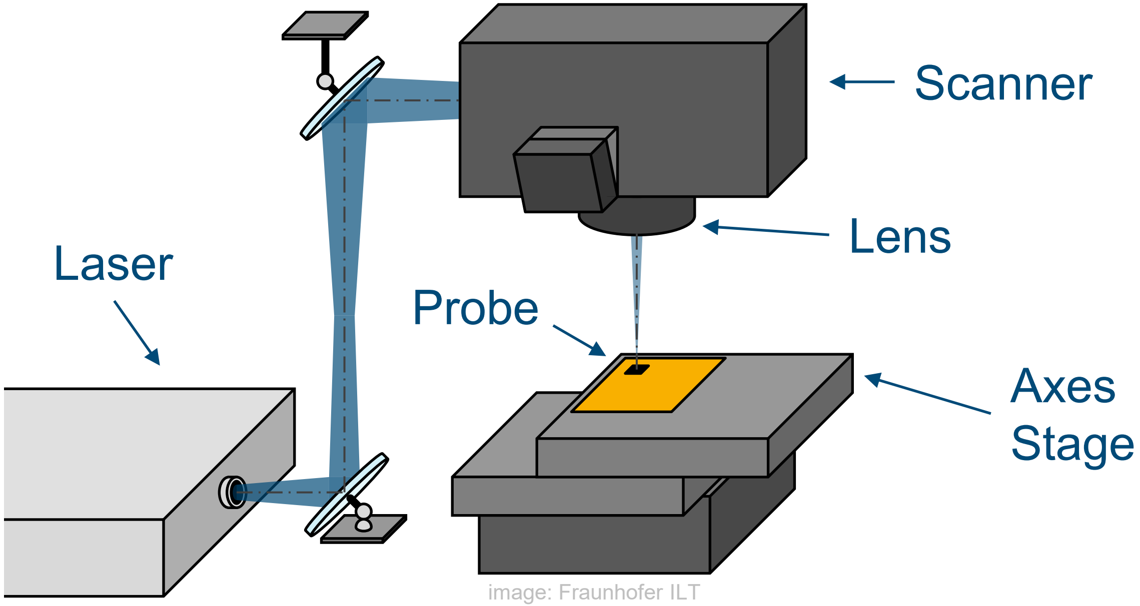
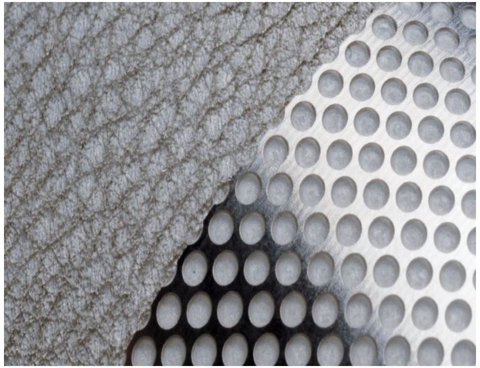
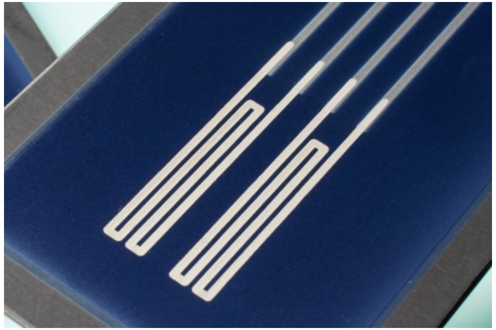


image: Fraunhofer ILT





images:
Fraunhofer ILT

The decentralized and adaptive Ultrashort Pulse Manufacturing architecture puts RDM in the spotlight

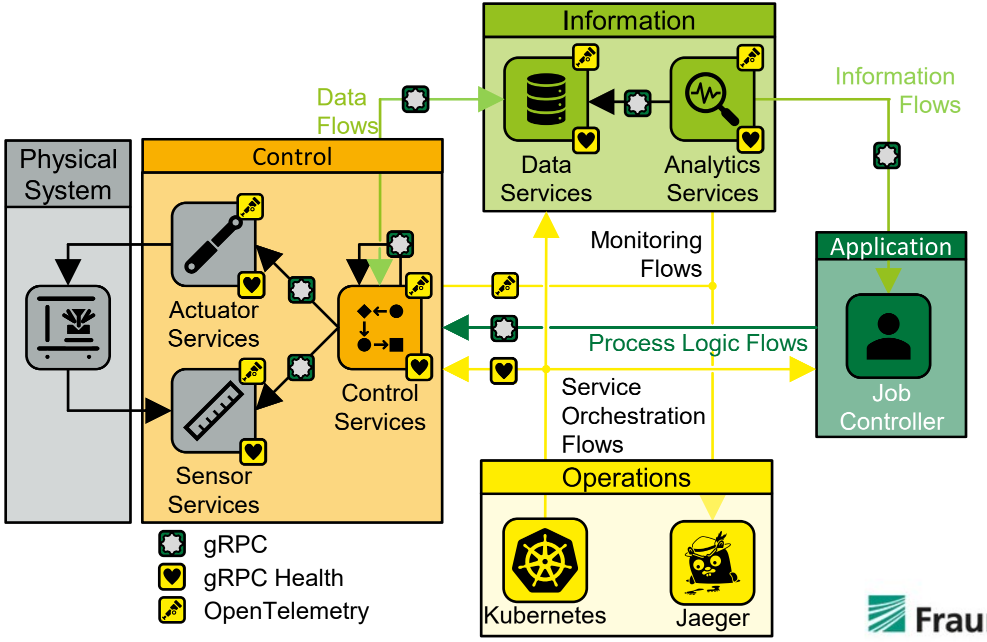


image: Fraunhofer ILT

Complexity

Control and data acquisition is organized in interconnected microservices running on an on-premises *Kubernetes* cluster.

Configurability

Dynamic service deployments enable flexible system reconfigurations.

Observability

Compared to conventional setups, this architecture makes the underlying manufacturing process extremely transparent. However data management becomes challenging.

RDM requires the anticipation of future uses

Requirements

Technologies

Solutions

Present

Future

Change

Adaption

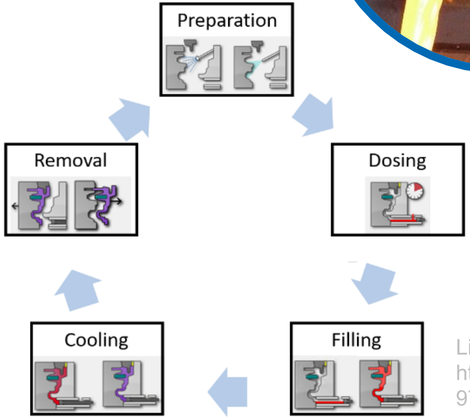
Integration

images: pexels.com

Use Case: High-Pressure Die Casting

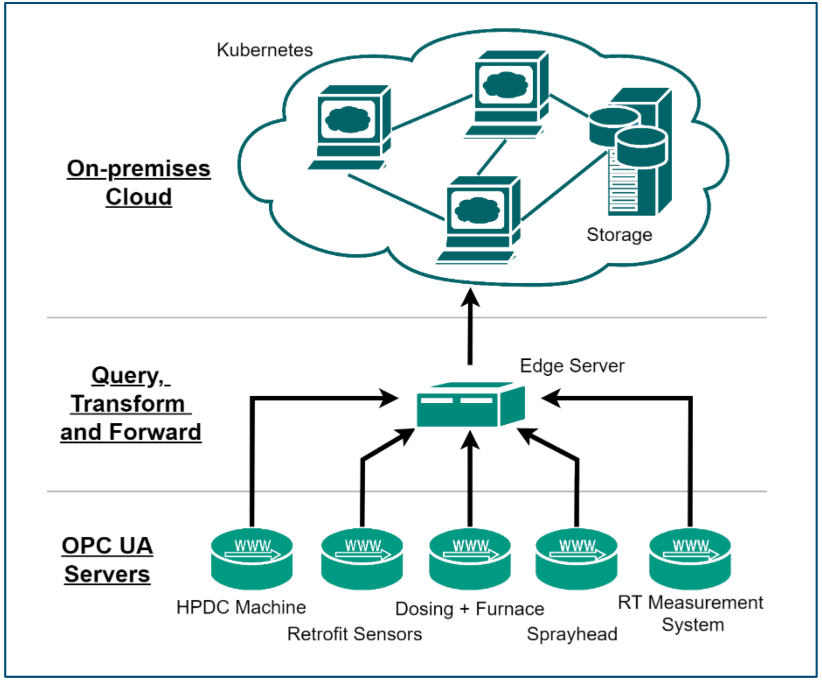
image: https://pixabay.com/photos/crucible-foundry-molten-bronze-2109202/

image: Foundry Institute – RWTH Aachen University



Lipp et al. (2021), https://doi.org/10.1007/978-3-030-75418-1_3

Creating transparency in High-Pressure Die Casting through digitization



Cloud

Data is collected, stored, made accessible and shared through a *MinIO* object storage running on a *Kubernetes* on-premises cloud infrastructure.

Transport

Node-red and *Apache Kafka* provides easily configurable data streaming, transformation and data model integration. Data flows from machines into the cloud.

Machine

The HPDC unit is digitized through *Internet Protocol*-based *OPC UA* servers using their semantic machine models.

image: Theissen-Lipp et al. (2022). Integrating an XPath-Enhanced OPC UA Data Collection Into Industrial Communication. In *27th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA)* (pre-print). IEEE.

Foundry Institute | INTERNET OF PRODUCTION | RWTHAACHEN UNIVERSITY

Synergies between academic and industrial research still need to be exploited

Motivation

Education

Research

Science

Industry

Sharing

Cooperation

Confidentiality

images: pexels.com

Use Case: NFDI4Ing Community-based Training

Education

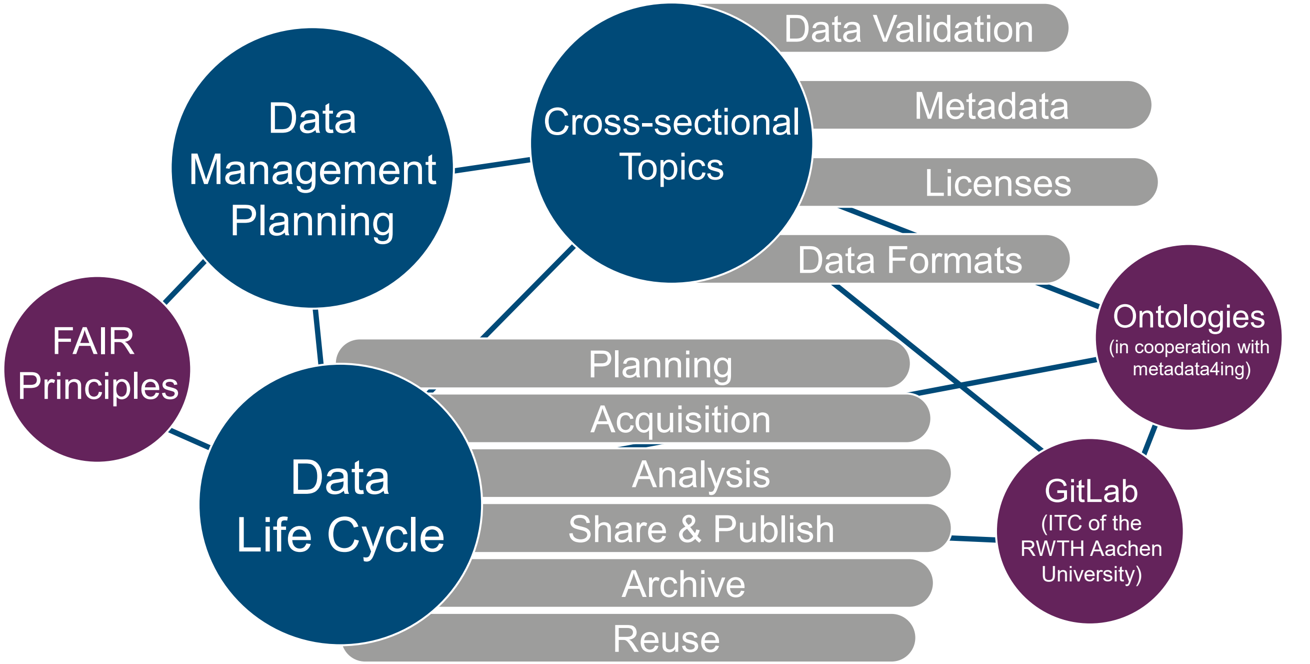
One central common goal of science as well as industry is enabling their people to work with data.

Data Literacy

Being able to read, understand, create and communicate data as information.

Trainings

Creating and sharing trainings as one way to drive the community forward.



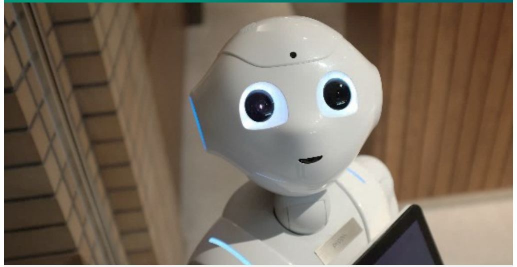
Example: Research Methods in Engineering Science

Methods A common goal of academic and industrial research is the development and establishment of new data management methods for various domains.

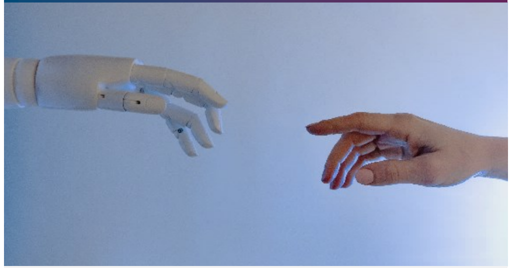
Science		Industry
One-of-a-kind experiments	Unique Experiments	R&D department
Research software development, e.g. AR for manufacturing	Software Development	Industrial software products
Data publishing and unique identifier, e.g. DOI & ORCID	Data Lineage and Provenance	Product tracking and traceability

Computer vision, archiving solutions	High-performance Computing	Recommendations systems and machine learning services
Multi-scale material simulations	Simulation	Car crash simulations, NVH simulation and CFD
Many heterogeneous data sources, Shibboleth and single-sign-on	Data Access Management	Data sharing and access for reporting and product development
Digital twins and digital shadows	Quality Assurance & Control	Product / Process Quality, ISO 9000

Unifying the Understanding of Research Data Management



Successful research data management requires methods of both disciplines, engineering science and computer science to be combined.

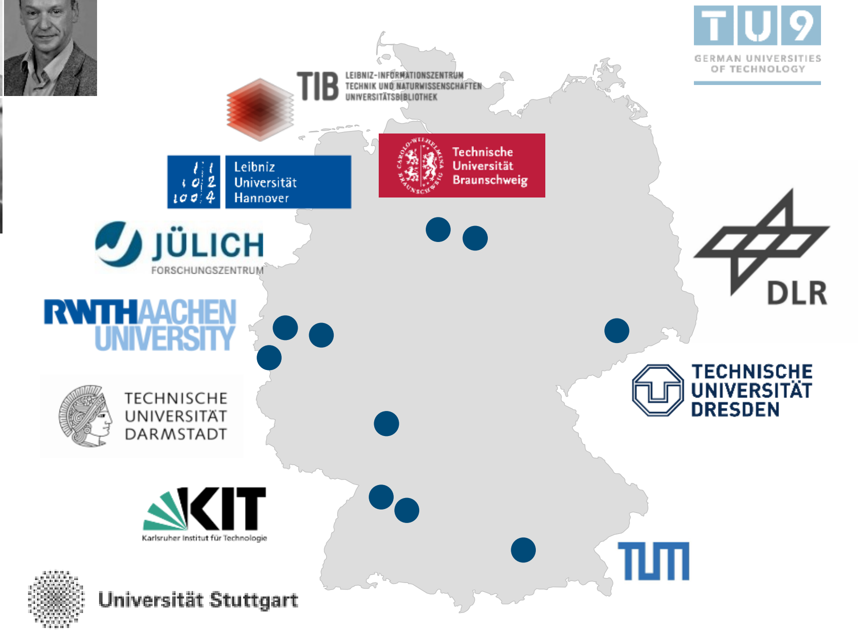


Research data management does not only need represent the current state of the art, but must also reflect, envision and help to shape future technologies and domains of application.

Research is not only conducted at universities. Finding and exploiting areas of cooperation and synergy is essential to reach an integrated vision of research data management.

images: pexels.com

NFDI4Ing: A strongly integrated and coherent team



7 Archetypes

7 Base Services

5 Community Clusters

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4 + 1 Sections

Thank you for listening!

Image: The Rosetta Stone, 196 B.C.E., Ptolemaic Period, 112.3 x 75.7 x 28.4 cm, Egypt (British Museum, London) (photo: Steven Zucker, CC BY-NC-SA 2.0)

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