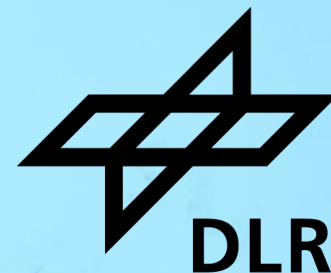


# FAIR FOR DIGITAL TWIN

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DLR, Institute of Data Science, Department for Data Management and Enrichment

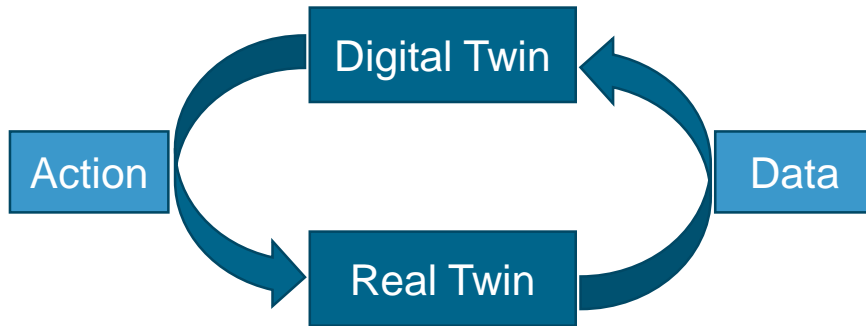
DLRK 2022



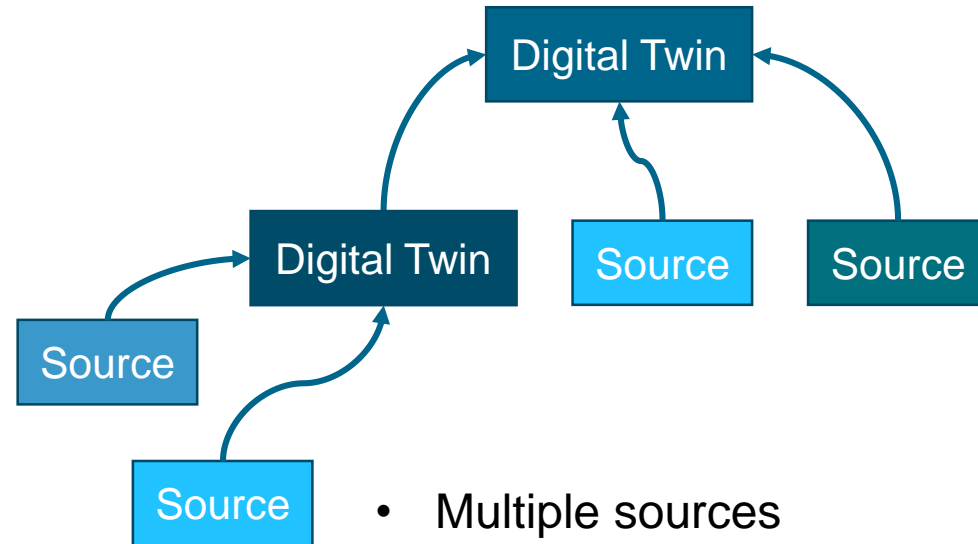
# INTRODUCTION

# What is the Problem?

Usual summary:



It's rather like this:



- Multiple sources
- Heterogenic
- Along e.g. a supply chain
- All talking about the same „thing“?
- Integration of data needed
  - Not created for that purpose!

# Approach in Science: FAIR Principles

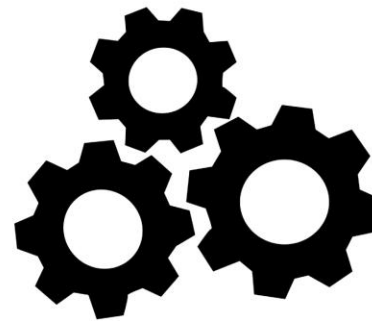


**F**indable

**A**ccessible

**I**nteroperable

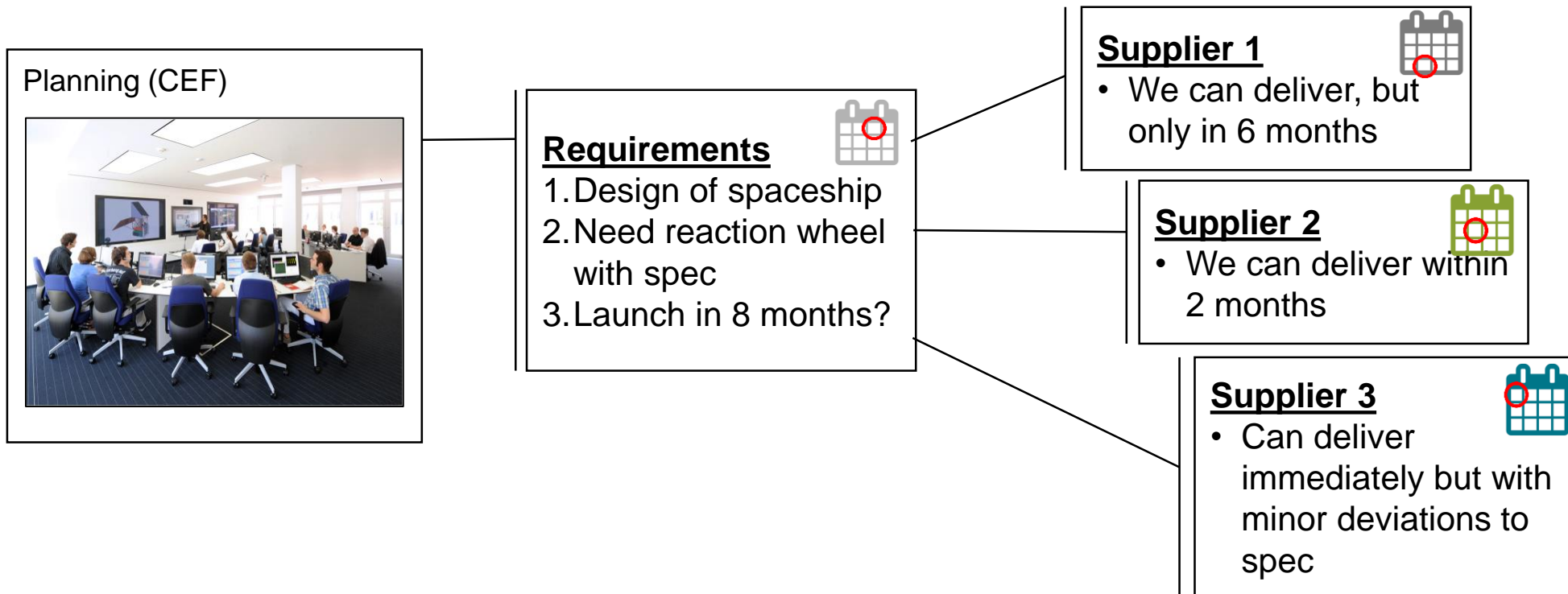
**R**eusable



By SangyaPundir - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=53414062>

# FAIR IN AN INDUSTRIAL CONTEXT

# Findability



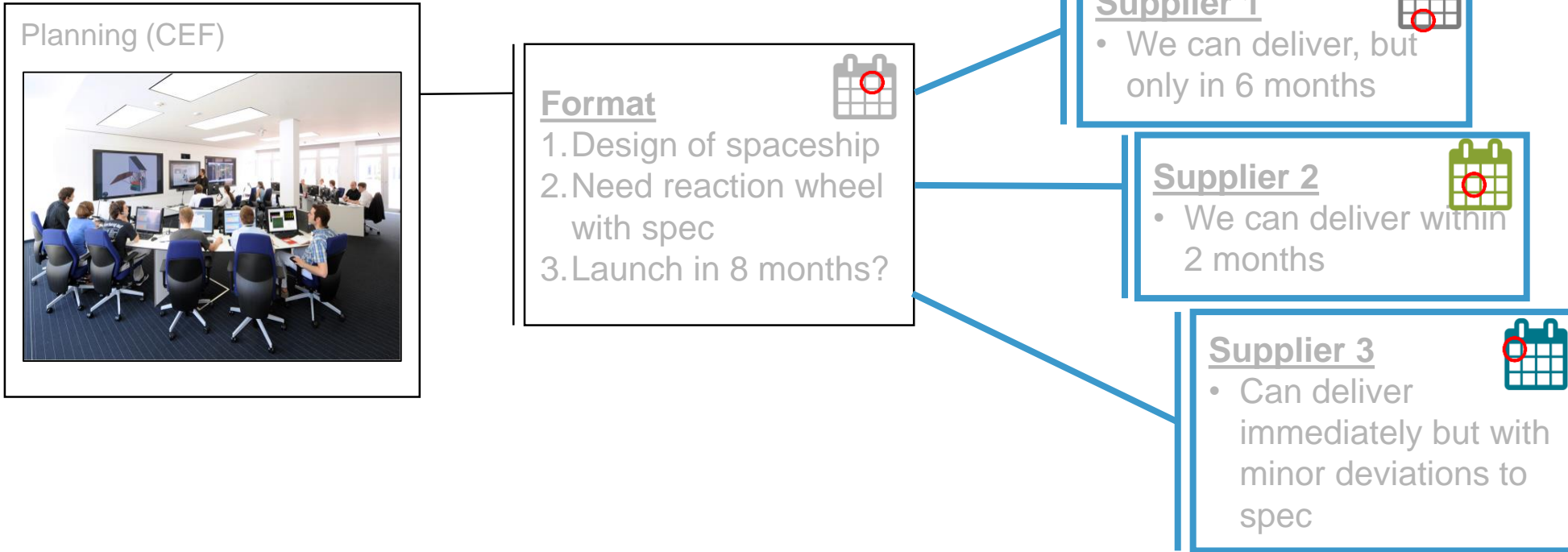
## What to find:

- Components
- Manufacturers
- Customer (needs)

## Quality of data:

- Most recent?
- From trustworthy party?
- For correct product?

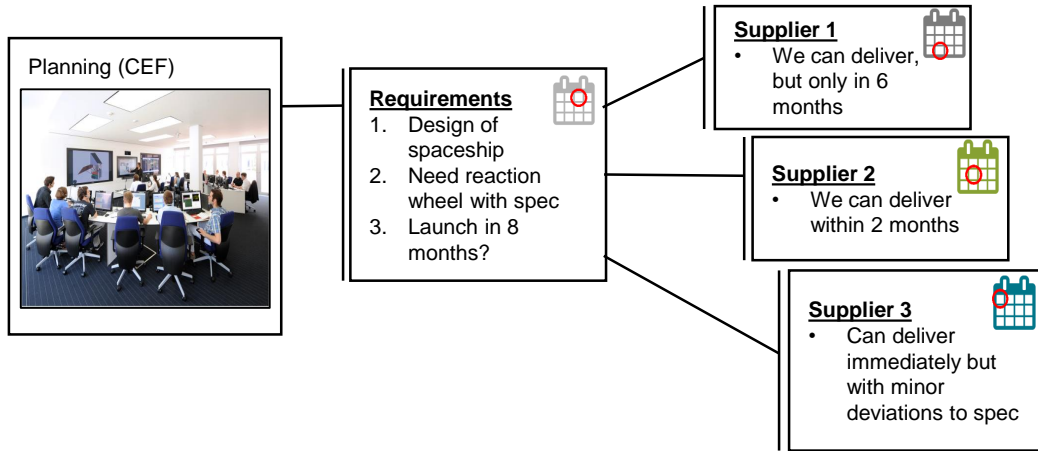
# Accessibility



## Aspects of Accessibility

- Machine-actionable (vs. human-actionable)
- Understandable format
- Authorization

# Interoperability

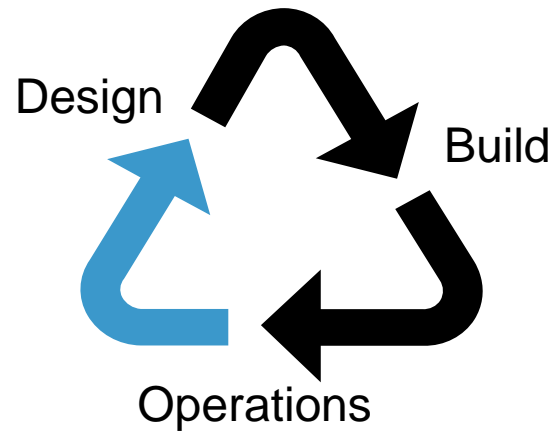


## Multiple levels:

- Data formats
- Product parameters comparable semantically
  - "weight" and "mass" – same physical property?
  - Always include or exclude: weight of insulation layer, or packaging, or anything else?
  - Unit (kilogram, gram, pounds, ounces, ...?)
  - Conversion of units
- MBSE tools and their underlying data models – usually not interoperable



# Re-Usability

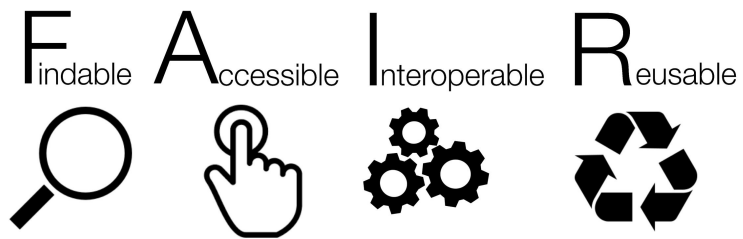


## Re-Use Model

- For next mission
- As blueprint / template
- Without big-effort migration!

## Lessons Learned

- Component failures
- Influence on components
- Usually: human understandable

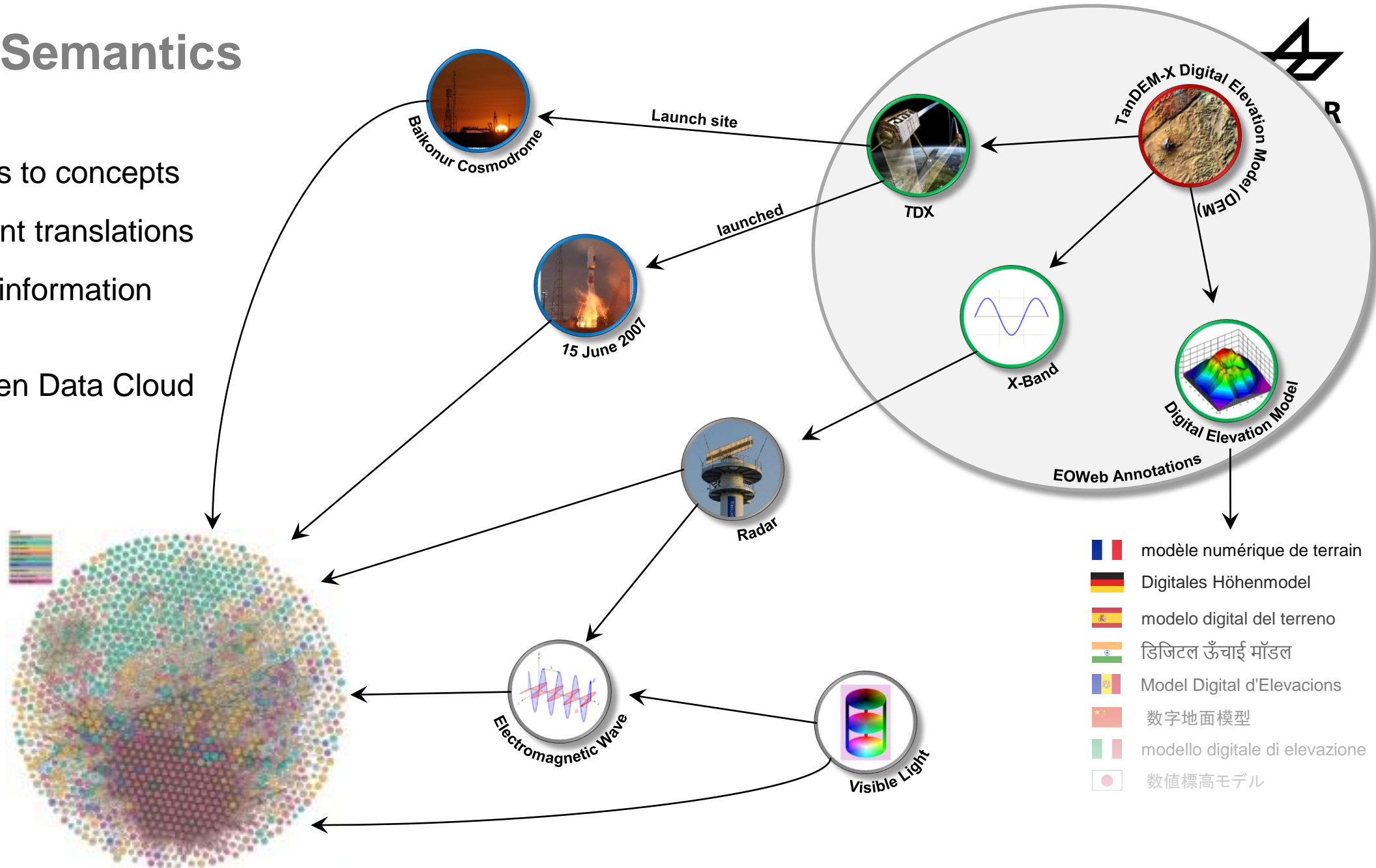


Depends on F, A, I !

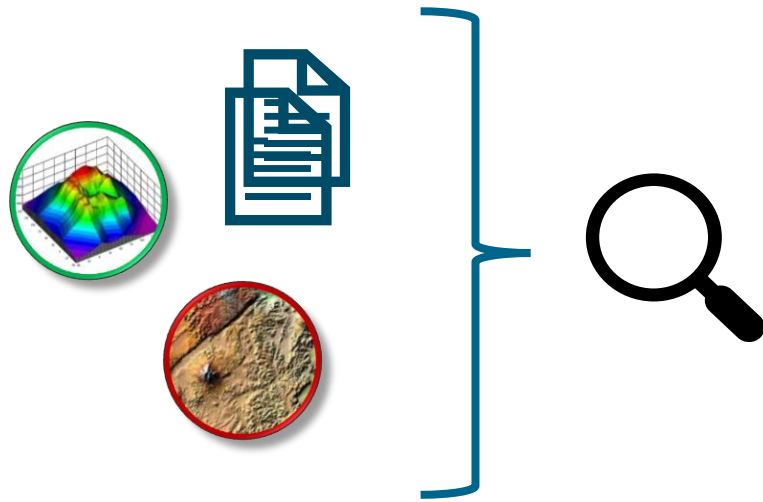
# A PATH FORWARD

# Shared Semantics

- From terms to concepts
- Independent translations
- Additional information
- Link to the Linked Open Data Cloud



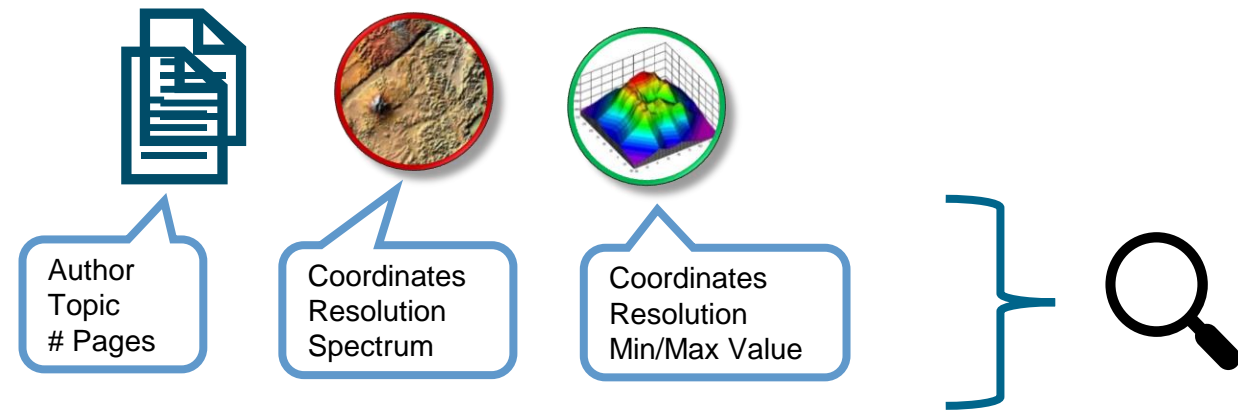
# Metadata



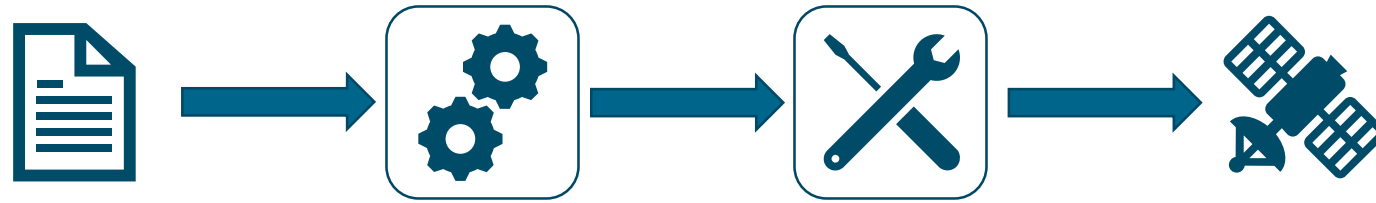
Primary data search is challenging. Especially:

- Data volume
- Information encoding (e.g., images)
- Proprietary formats
- Not machine-readable (e.g., scanned documents)

Therefore: provide semantic metadata!

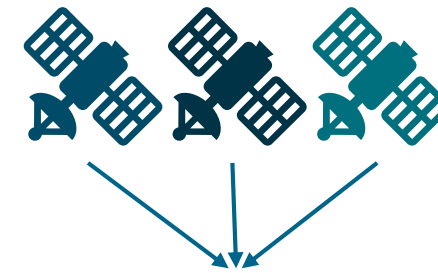


# Provenance



## Document Provenance!

- Environment conditions
- Accountability
  - Who provided/changed/deleted data?
  - When and why?
- Again: data from different parties -> must be FAIR!



Analysis across products, series, ...



# Open Formats



- Open format  $\neq$  open data!
- Open AND Machine-actionable
  
- E.g.: JSON-LD
  - Based on JSON
  - Backwards compatible
  - Human-readable

## A Simple Example

```
{  
  "@context": "https://json-ld.org/contexts/person.jsonld",  
  "@id": "http://dbpedia.org/resource/John_Lennon",  
  "name": "John Lennon",  
  "born": "1940-10-09",  
  "spouse": "http://dbpedia.org/resource/Cynthia_Lennon"  
}
```

<https://json-ld.org/>

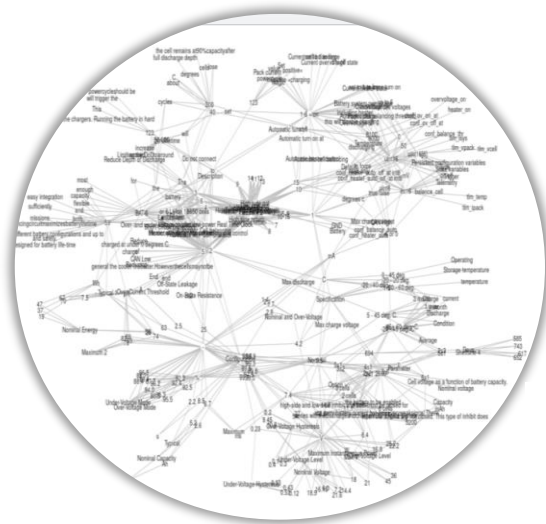
“From terms to concepts”

# Knowledge-Aware Systems

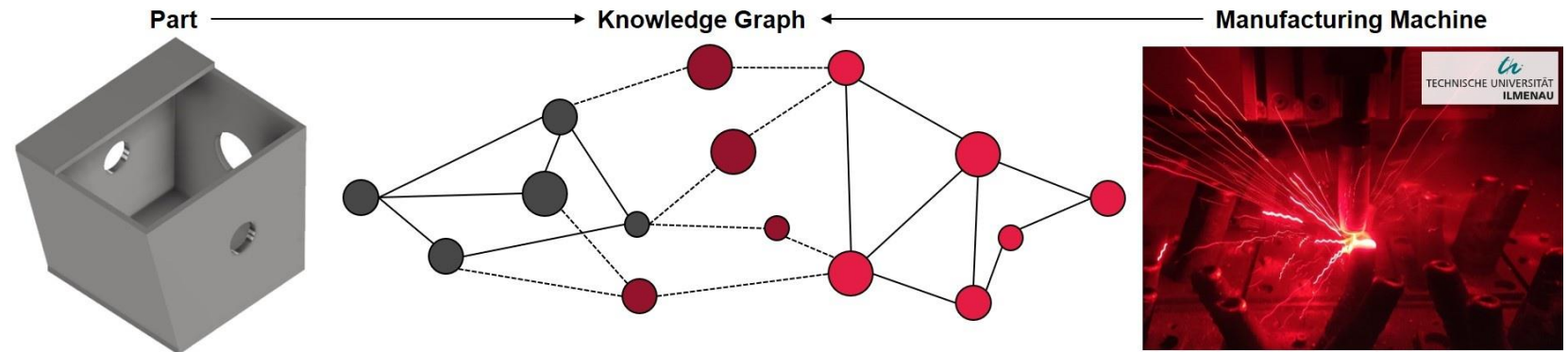


## Semantic Search

- Beyond full-text search & exact matches
- Language independent
- Include metadata, provenance, context



**Automated Matching** e.g. between requirements and machine capabilities





**THANK YOU!**



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Sources for “Shared Semantics” and “Metadata” slides:

Images:

- <https://eoweb.dlr.de/guestegp/productDetails/5eecd4c-de57-4624-99e9-60086b032aea>
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