Fraunhofer SCAI

Digital Twin Solutions for Manufacturing Engineering

Services and Software-Toolbox

What are digital twins good for?

Semantic Digital Twin systems are data ecosystems that comprise measurement data, simulation models, and analytics algorithms. They are

- searchable and extensible,
- interoperable and distributed,
- hybrid rule- and data-based, and
- human workflow driven.

For several reasons, innovative engineering teams will have digital twins as their natural development and analysis environments.

- Acceleration and cost-reduction: data- and AI-enhanced simulation chains and design loops
- Quality: explorative analysis improvement
- Trust: simplification of uncertainty assessment
- Markets: tradeable models as digital prototypes

Unique potentials, common challenges

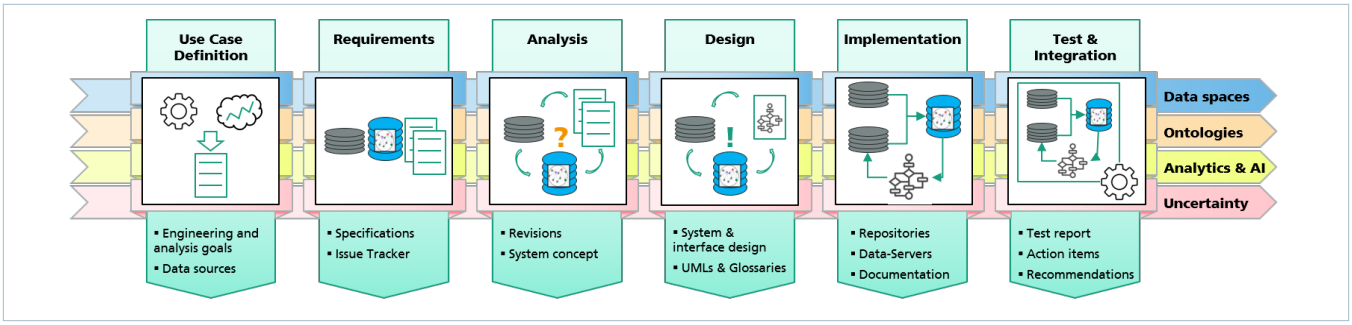
Engineers must overcome several hurdles to fully exploit digital twins, such as incompatible data formats and semantics, difficult traceability, and low data permeability into difficult-to-apply analytics. We support engineers in their development to build consistent twin ecosystems through toolbox-assisted services (Fig. 1).

Cooperative digitization process

Use-case and requirement engineering
Digital twins are purpose-driven and need concrete goals in mind. We capture each asset's role and dependencies for the overall functionality.

Analysis and design
We focus on the interplay of measurement, simulation, and analytics specific to your use case with experience from industrial research.

Implementation, test, and integration
We propose and realize framework-compatible solutions and aid in harmonizing your twin environment to reach your goals.



1) Twin Toolbox and Services support the Digital Twin software development process – driven by your design cycles

Key digital twin R&D pillars

- **Data Spaces** for seamless and secure data storage and access,
- **Ontologies** for a structure of the interplay of resources,
- **Analytics & AI** for gaining knowledge from information, models, and data, and
- **Uncertainty Quantification** for faster estimation and improvements of confidence in solutions.

We help build semantic digital twin systems

Our central service is building bridges between production engineering, CAE, and analytics in a single meta-system. We use our self-consistent twin toolbox, a modular Python-based framework (Fig. 2).

Established formats and standards
Consulting for seamless permeability of data through the twin:

- industry standard-compliant semantics for metadata,
- standard data formats, e.g., STEP, VMAP, DICONDE, and
- interface standards, e.g., FMI, OPC-UA.

Digital twin ontologies
Ontology engineering and guidelines

- project-specific ontologies extending a general framework,
- use of common mid-level domain ontologies derived from engineering industry standards,
- compatibility with established top-level ontologies,
- cross-project interoperability, and
- organization of knowledge domains, such as manufacturing, materials, CAE and virtual layout, analytics, and measurement.

Databases and metadata store
Appropriate data space architectures support

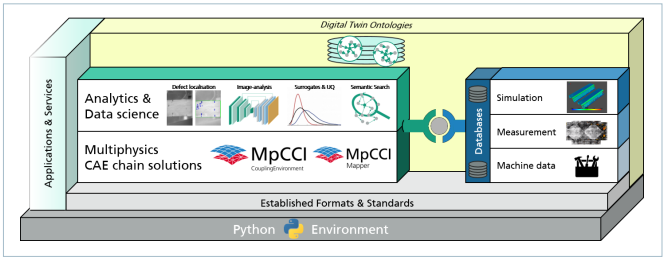
- metadata store to capture sources and results according to ontology,
- database connector extension for custom DMS, and
- quick tests of standard database and file-server APIs (MySQL, REST-APIs, SPARQL endpoints).

Multiphysics CAE chain solutions
We offer support in CAE chaining:

- parameterization, mapping, and coupling,
- embedding in the searchable architecture of data space, and
- measurement and machine data for model automation, validation, or calibration.

Analytics and data science
Exploration and implementation of data analytics include:

- machine and deep-learning models for localization, classification, and tracking of engineering features,
- computer vision and custom image data processing,
- surrogate modeling with a virtual design of experiments, optimization, and uncertainty quantification, and
- customization and abstraction of semantic search engines across the twin assets.



2) Toolbox concept for interoperability in CAE

Your benefits

Minimize twin exploration and maximize interoperability
Struggle to keep track of matching models and measurements?
We offer decentralized searchable twin assets (models and data) connected with standard semantics and interfaces.

Feel constrained by features of simulation management systems?
We offer step-wise extension into an industrial data space (IDS) for interoperable data flows.

Observe difficulties in combining your heterogeneous data in processing pipelines?
The seamless integration of custom data processing solutions reduces the overhead of exploring digital twin solutions.

Require a more precise and quicker estimation of uncertainties?
We integrate surrogates and optimization directly in your twin environment.

Contact

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Solutions for Digital Twins

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