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Unifying Physical Test and Simulation Data: ASAM ODS Pipelines for AI-Driven Occupant Injury Prediction

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Agenda

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- CAE Data Challenge
- CAE Data Needs
- ASAM ODS Pipelines
  for AI-Driven Occupant Injury Prediction
- Summary

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CAE Data Challenge

"Meta-Models do not fail because of algorithms;
they fail because of data fragmentation, lack of context, and missing traceability."

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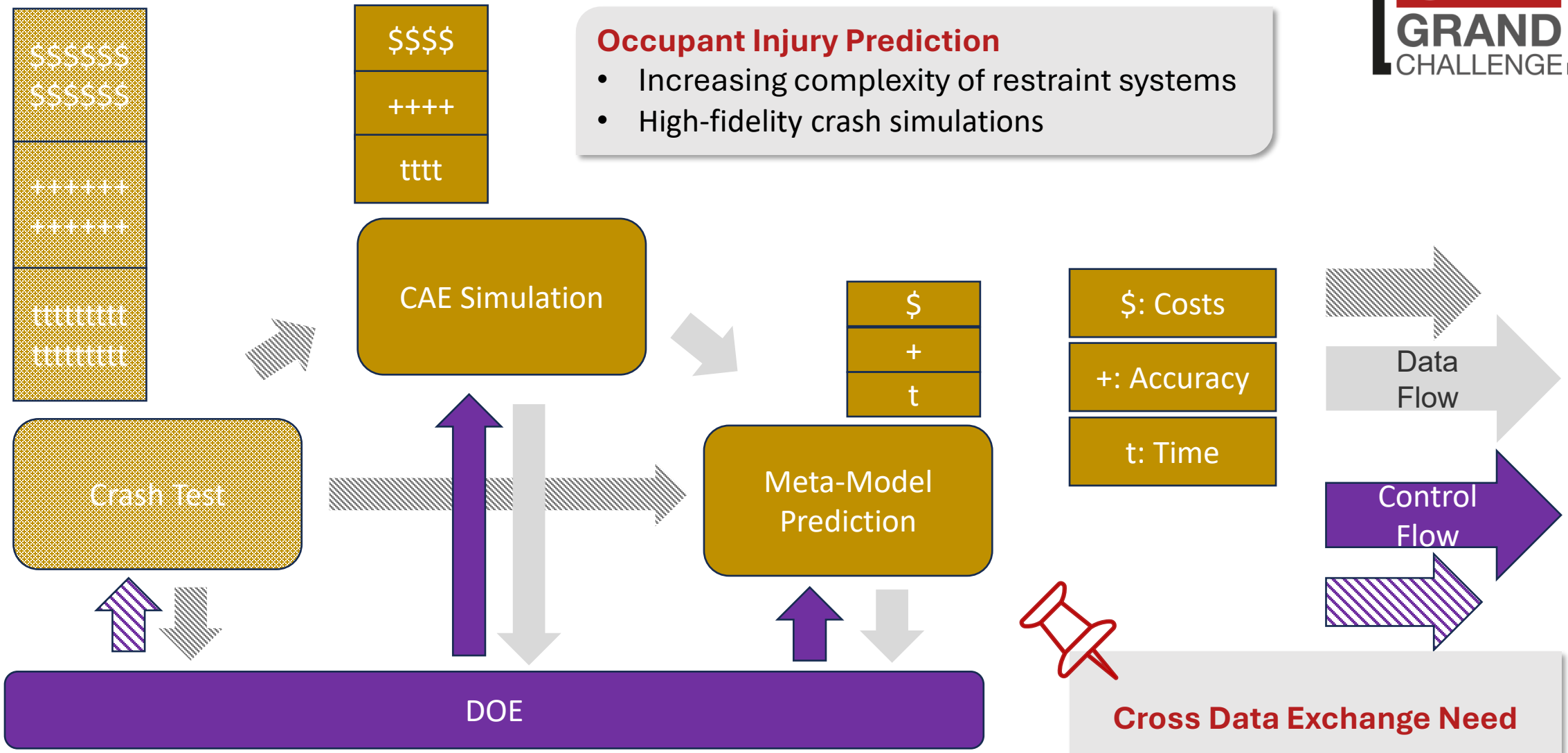
CAE System Overview

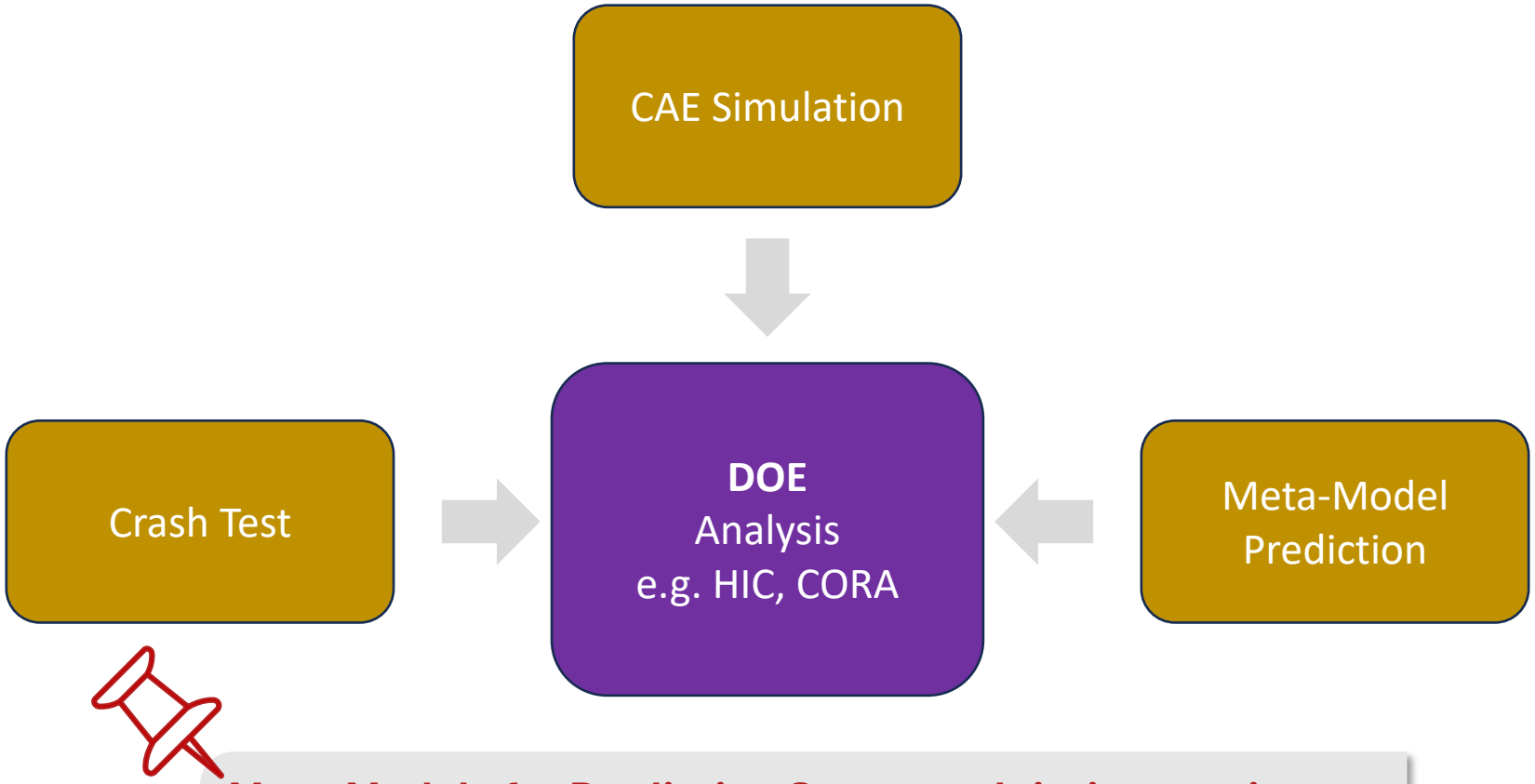


Occupant Injury Prediction

- Increasing complexity of restraint systems
- High-fidelity crash simulations

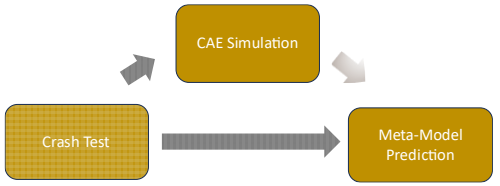
Cross Data Exchange Need

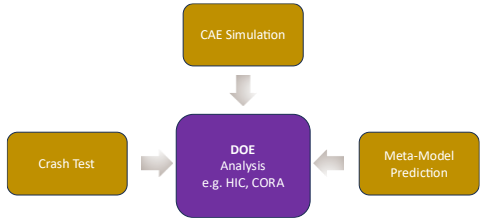
CAE & Meta-Model Data Analysis (DOE)



Meta-Models for Predicting Occupant Injuries require continuous validation against real test (and simulation) data

CAE Data Challenge





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- Crash Test Result Data Formats
  - ISO-MME
  - TDMS
  - DTS
  - CSV/ASCII

Data Format Diversity Problem
(Variety, Velocity, Volume)

- Data comes in dozens of different formats (tools)
- Structured, Semi-structured, Unstructured

- CAE Simulation Result Data Formats
  - LS-DYNA (. binout, .rcforc, …)
  - Abaqus (.pcbin, .thp)
  - Pam-Crash (.odb)
  - ANSYS (.rst)

Data Quality Problem
(Veracity)

- Inconsistently formatted
- Missing Meta Data

- CAE Simulation Input Data Formats
  - LS-DYNA (.k, .key)
  - Abaqus (.inp)
  - Pam-Crash (.pc, .xml)
  - ANSYS (.dat, .cdb)

Challenging to utilize systematically!

- Meta-Model & Analysis Input Data Formats
  - CSV
  - HDF5
  - NumPy/Pandas
  - Parquet

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CAE Data Needs

Requirements for solving the CAE Data Challenge

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Meta-Model & DOE-Pipeline Data Needs

Meta-Model & DOE-Pipeline Data Needs

- Automated data ingestion
- Data lineage – information about
  - Raw data origin
  - CAE runs (incl. parametrization / CAE model version)
  - Other data context (e.g. hardware/software test setup)
- Parameter abstraction / Content unification
  - Data Model for consistent meta data definitions
  - Data Catalogs for consistent contents (e.g. ISO-MME channels)
- Compare Test and Simulation Results directly
- API-based data access (HTTP, Python, MCP)

Meta-Model & DOE-Pipeline Data Needs

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Your CAE data is here…

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**Analysis,
Meta-Model definition
and
Machine Learning
Pipelines
connect here …**

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ASAM ODS Pipelines for AI-Driven Occupant Injury Prediction

Solution proposal for solving the CAE Data Challenge

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ASAM ODS Data Pipeline

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Your CAE data is here…

Plugins — Automated Data Ingestion

ODSServer — Consistent Meta Data and Content

ODSBox — Standardized Python API

AIConnect — Agentic AI Workflows (MCP)

Analysis,
Meta-Model definition
and
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Pipelines
connect here …

ASAM ODS Data Pipeline Components

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ASAM ODS Data Pipeline Components

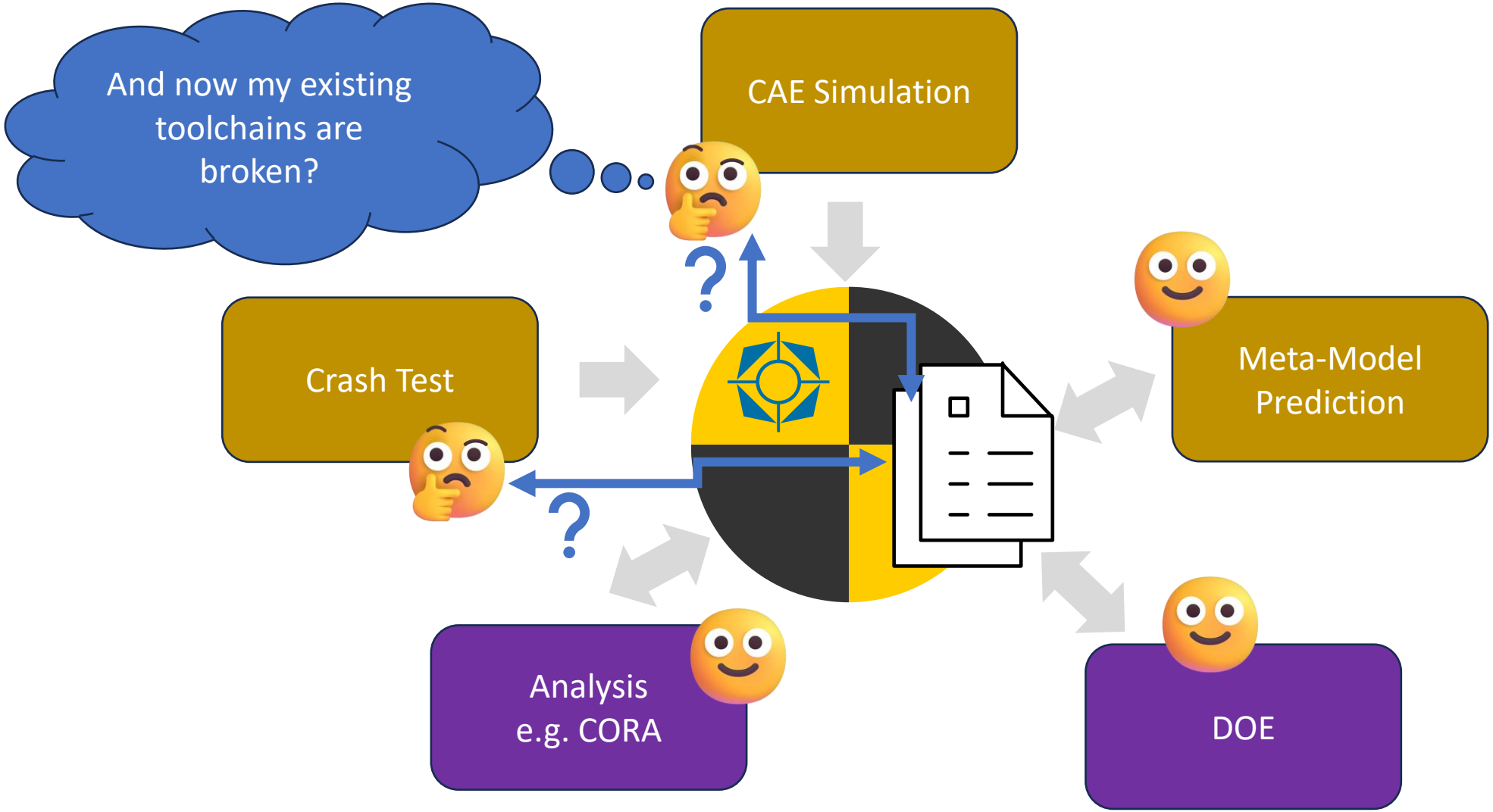
ASAM ODS ExD Plugins
Lightweight gRPC-microservice to extract meta and channel data from files

ASAM ODS Server
Standardized long-term data storage with customizable data model

ASAM ODSBox
Open-Source library with intuitive query language and Pandas DataFrames

ASAM ODSAIConnect
Open-source MCP server connecting ODS data to agentic AI workflows

ASAM ODS “CrashDataHub”



Avoiding Toolchain Disruption

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Avoid Toolchain Disruption

- ExD Plugins allow files to stay in original location
- No data duplication because of “channel data link”
- Sharing of “file pointer” to external tools possible
- Alternatively (additionally) file download possible
- File format conversion on download possible
  - Combine selective data from different files into result file
  - Convert to tool-specific result file format

Rich File handling capabilities

No Toolchain Disruption

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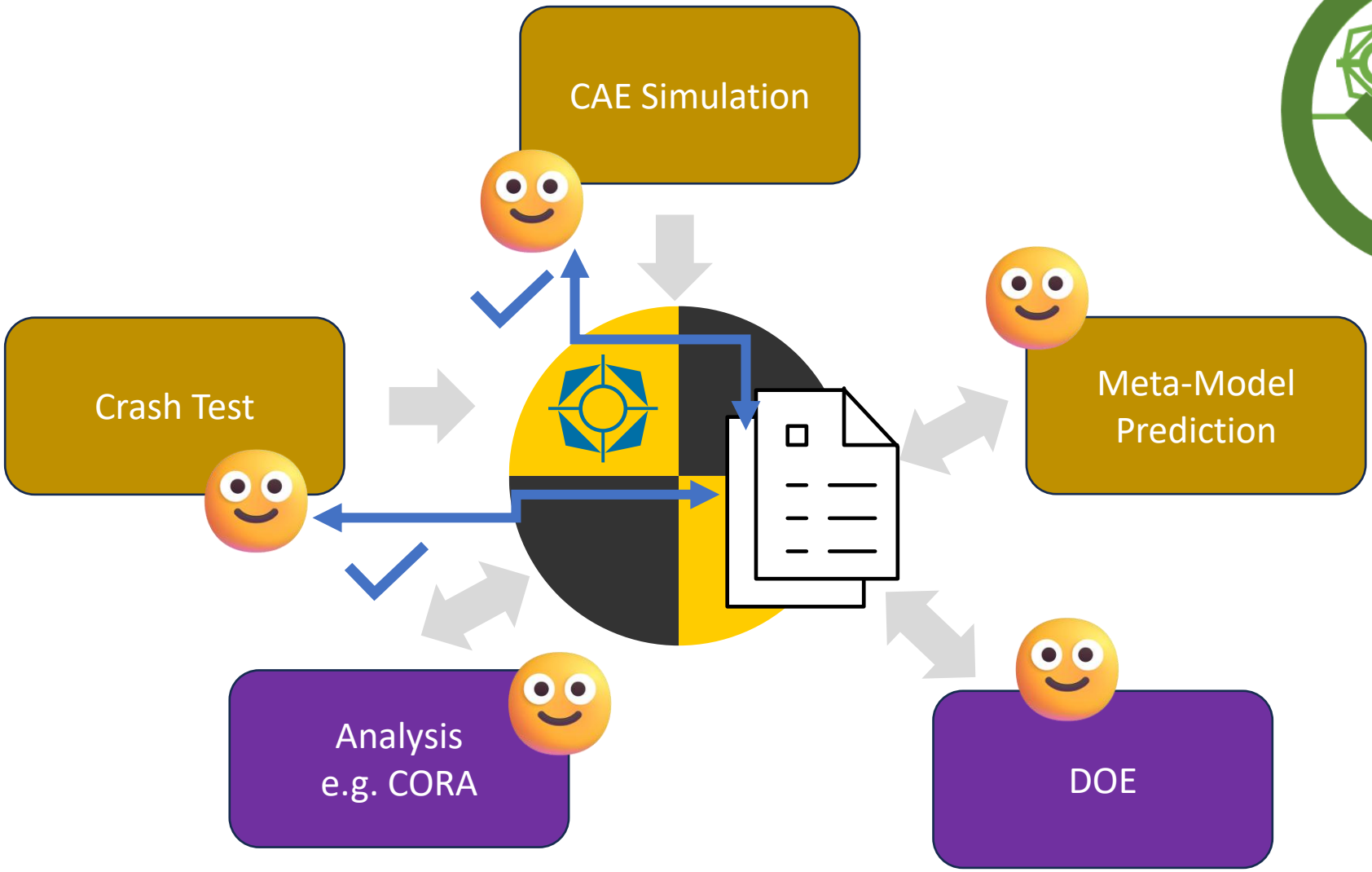
ASAM ODS “CrashDataHub”



Summary

Summary – Challenge and Approach

Challenge and Approach

CAE Data Challenge for Meta-Models

"Meta-Models do not fail because of algorithms;
they fail because of data fragmentation, lack of context, and missing traceability."

The Problem

- Crash CAE and physical tests generate **high-value data**
- Data exists in **isolated formats** (ISO-MME, solver outputs)
- Limited reuse, **poor AI readiness**, weak traceability

The Approach

- Integrate physical test and simulation data into a **structured ASAM ODS data model**
- Expose data via: ODS **HTTP** APIs, **Python** wrappers, **MCP** services
- Create a single, **AI-ready data backbone** for CAE and Meta-Models

Summary – ASAM ODS Enables Scalable CAE & Meta-Models

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ASAM ODS as Enabler

ASAM ODS-Based Data Management Platform Capabilities

- Unified semantic data model for **physical test + simulation data**
- Preservation of **engineering context** (Test conditions, Model versions, Boundary conditions,…)
- **Machine-readable, reproducible access** for AI pipelines (via HTTP, Python, MCP)

ASAM ODS Standard Advantages

- Create a **common data space**
- Foster **cross-team collaboration**
- Support **data governance**
- Enable **end-to-end traceability**
- Suitable for **long-term data storage**
- **Avoid vendor lock-in**

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Thank you!

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Further Reading & Getting Started

Learn More about ASAM ODS

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- Official ASAM Homepage: ASAM ODS Wiki
- Open-source Tutorial (Git): Data Management Learning Path

Recommended For

- CAE engineers
- Test engineers
- Data & AI teams
- Meta-model developers

Standards-based foundation for future occupant safety engineering