DIGITAL THREADS FOR DIGITAL AGENTS & COLLABORATION: CONNECTING ALM, MECHANICS, E/E, SOFTWARE AND PRODUCTION

Markus Zimmermann

PLM Road Map™ & PDT EMEA 2026

AI in PLM: A Disruptive Opportunity and Challenge

Turning AI disruption into enterprise value:
Strategic insights for the PLM professional

4-5 November 2026

www.CIMdata.com

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A Rolls-Royce solution

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The Rolls-Royce Vision

Powering, protecting and connecting the modern world

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ROLLS-ROYCE GROUP

A world-class technology company, built on three strong and complementary business units.



Civil aviation

- **35** types of commercial aircraft powered by us
- **13,000** engines in service around the world
- **18,300** total employees
- **10.38 billion (€ 12.14 billion)** underlying revenue



Defence

- **160** customers in over 100 countries
- **16,000** engines in service around the world
- **12,000** total employees
- **4.77 billion (€ 5.58 billion)** underlying revenue



Power Systems

- **> 40,000** customers in 13 different industries
- **8,000** engines sold per year
- **11,000** total employees
- **4.89 billion (€ 5.72 billion)** underlying revenue

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We at Rolls-Royce provide world-class power solutions and complete life-cycle support under our product and solution brand ***mtu***.

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POWER SYSTEMS AT A GLANCE

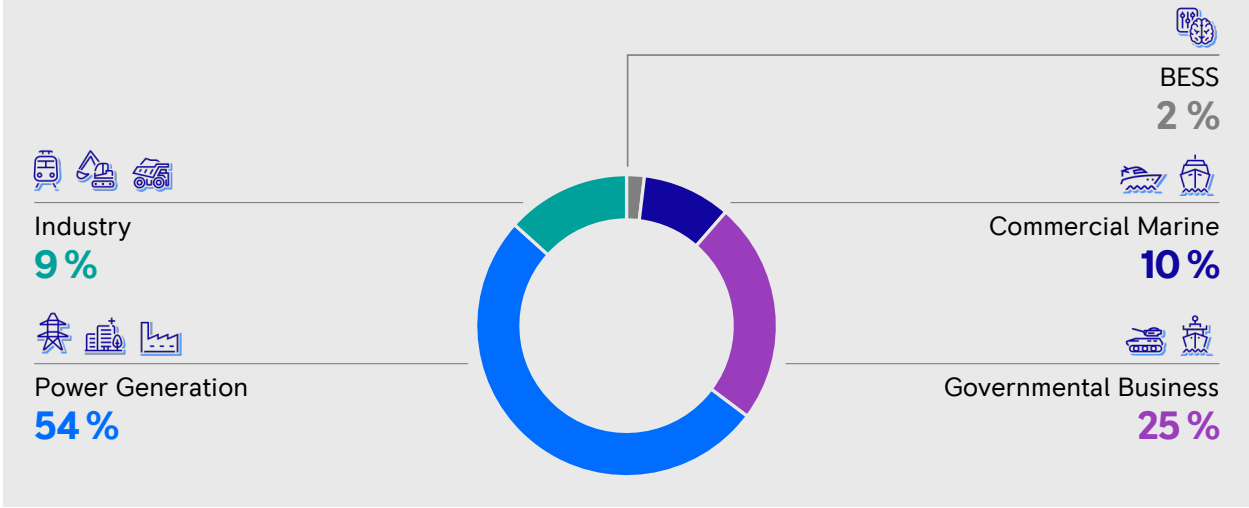
Turnover 2025

5.72 billion €*

(4.89 billion pounds)

Employees

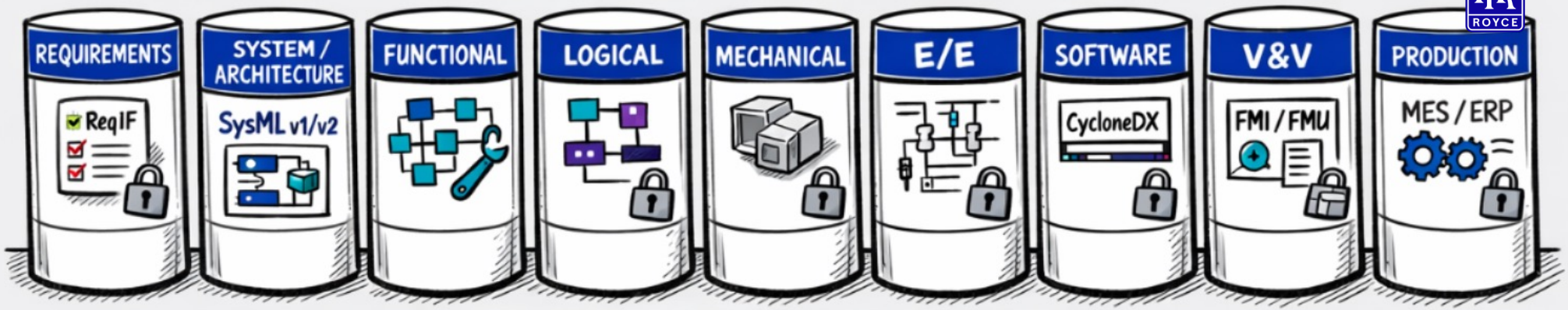
11,000



*The figures in British pounds are binding

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THE DATA EXISTS. THE MEANING GETS LOST.





Today, much of our data remains distributed across domain-specific silos.

Each expert understands the information within their own domain and tool.

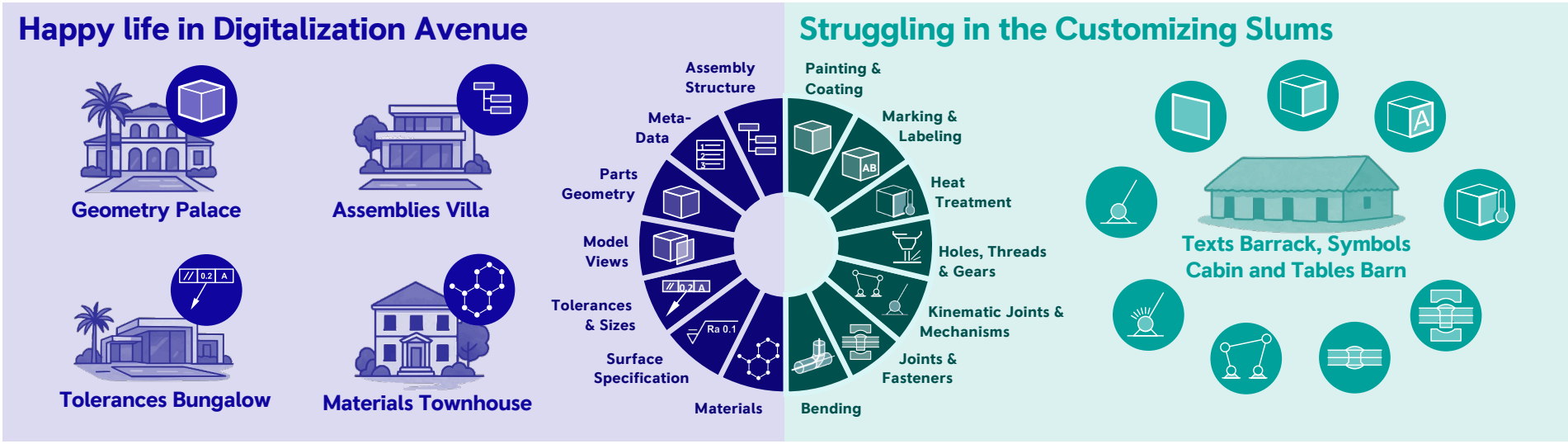
Yet connecting the dots still depends on aligning documents, exchanging reports, and interpreting knowledge from other domains.

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LIMITS OF CAD-CENTRIC MBD

In which houses does MBD (mechanical) information actually reside in the CAD model?



CAD systems are taking good care of some MBD information. But not all.

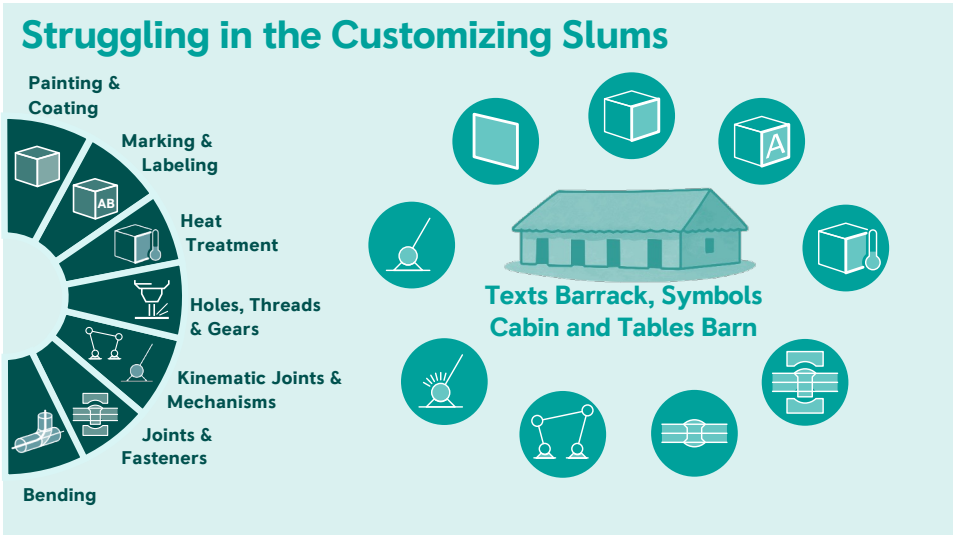
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LIMITATIONS OF CAD-CENTRIC MBD

Tough life in “Text Barrack”, “Symbols Cabin” & “Tables Barn”

- **Difficult to find a piece information** if you don’t know their address
- **No connection to Digital Thread** except CSV export
- **Customized symbols are like drugs**: they appear like solving the problem, but actually they don’t. Even worse: once customized, the information will **remain addicted to customization for its entire downstream life**.
- **Different customization “languages”** spoken in different organizations creating a **hell of confusion for shared suppliers**



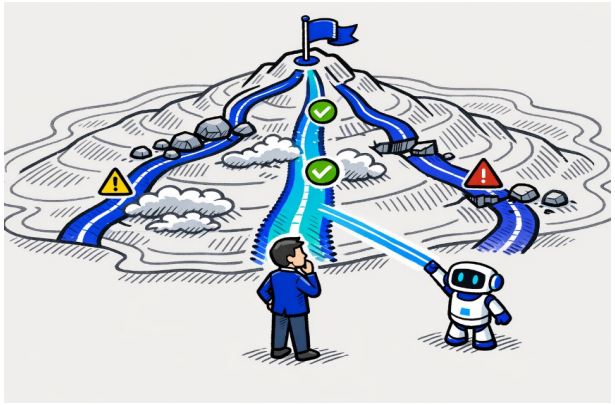
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WHAT WE EXPECT FROM DIGITAL AGENTS

ADVISE

- Finds and summarizes information
- Understands context
- Highlights impacts and risks
- Explains recommendations



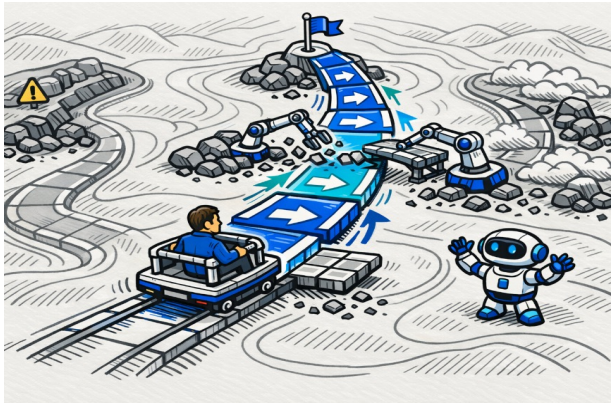
ASSIST

- Performs bounded tasks
- Works across systems
- Prepares actions
- Keeps a human in the loop



AUTOMATE

- Acts within defined rules
- Executes approved actions
- Propagates changes end-to-end
- Remains transparent and traceable



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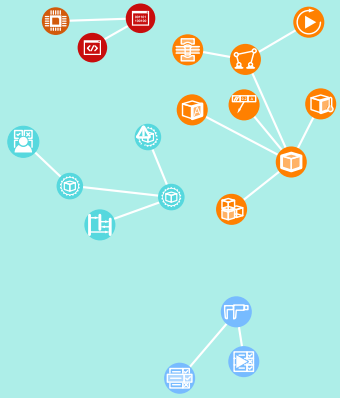
TRUSTED AGENTS NEED TRUSTED CONTEXT

Proprietary Data

CAD, PLM, RE, MBSE, CMM, FMEA, CAM, ERP

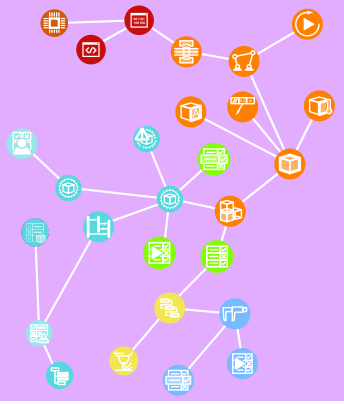
Domain Standards

ReqIF, SysML, Arcadia, FMI/FMU, STEP & JT, I++, QIF, KBL & VEC, AutomationML



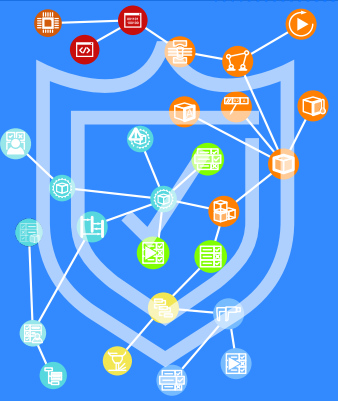
Shared Semantic Layer - E2E Ontology

Shared vocabulary, Consistent meaning across domains, Enables reasoning



Data Governance

Controlled data sharing, Access control (not semantics), Traceable AI usage, support EU AI Act & GDPR compliance

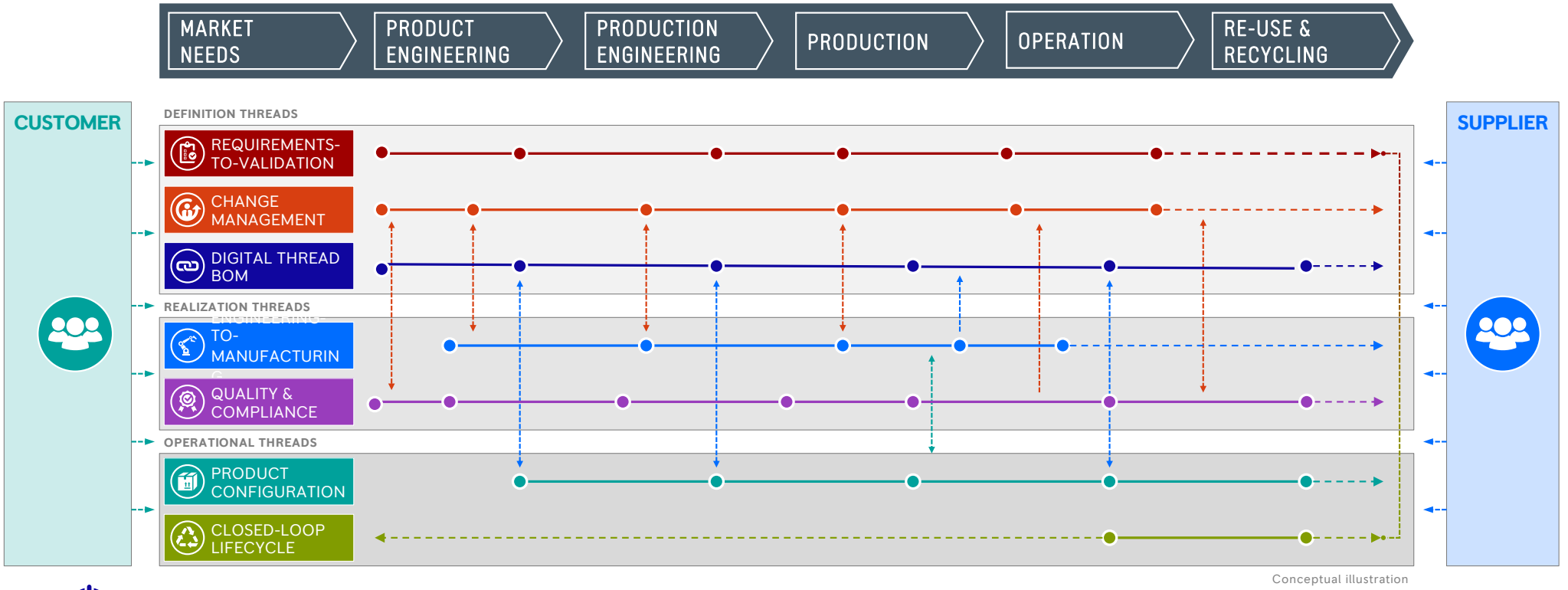


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OUR DIGITAL THREAD VISION

A SHARED INFORMATION AND DECISION SPACE



Conceptual illustration

CONNECTED DATA. FULL TRANSPARENCY. END-TO-END TRACEABILITY. FASTER AND BETTER-INFORMED DECISIONS.

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ONE ENGINEERING QUESTION

PURPOSE · DEPENDENCIES · IMPACT

What is this speed sensor for, and which functions depend on it?

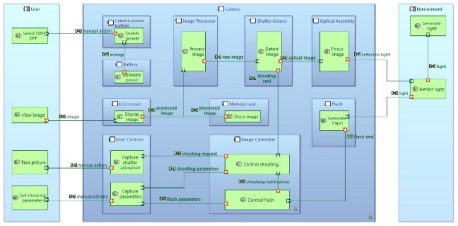
The answer lives across requirements, architecture, design and risk data.
Relevant data is distributed across six systems and maintained by five expert teams

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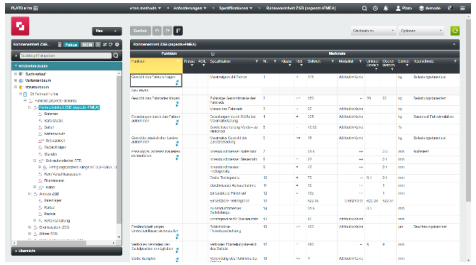
THE ANSWER REQUIRES INFORMATION FROM DIFFERENT SYSTEMS

Capella



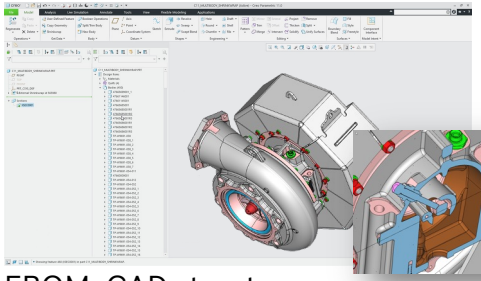
Functional Breakdown & Systems Architecture

PLATO SOLUTIONS BY SOFTWARE



FMEA

creo® windchill®



EBOM, CAD structure, geometry and tolerancing

MBOM planned

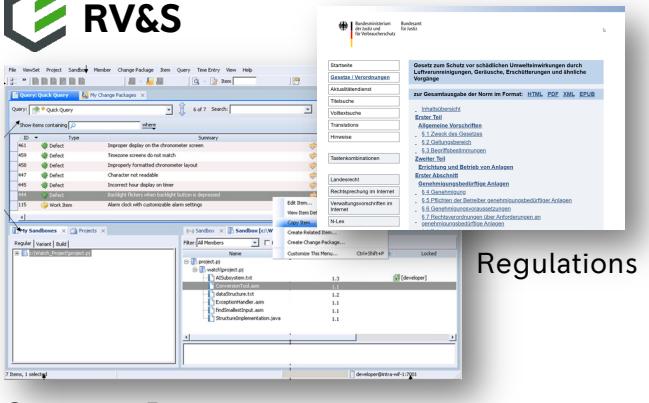
creo illustrate

Work instruction

SAP

MBOM, Process Plan

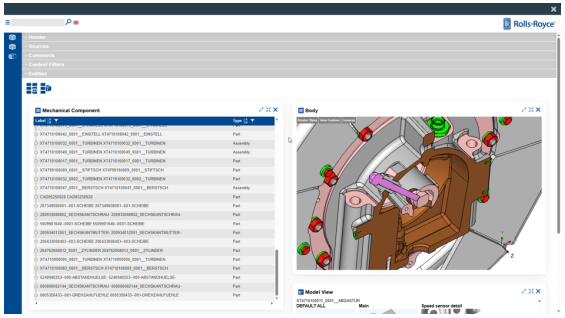
RV&S



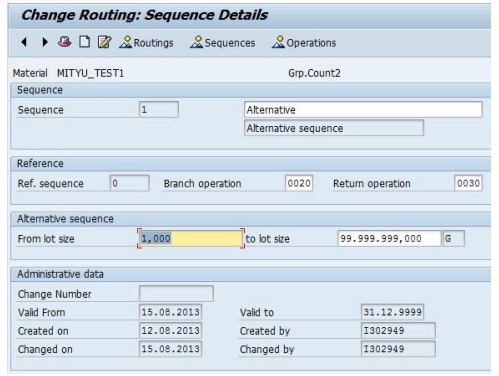
Regulations

Customer Requirements

Digital Data Package



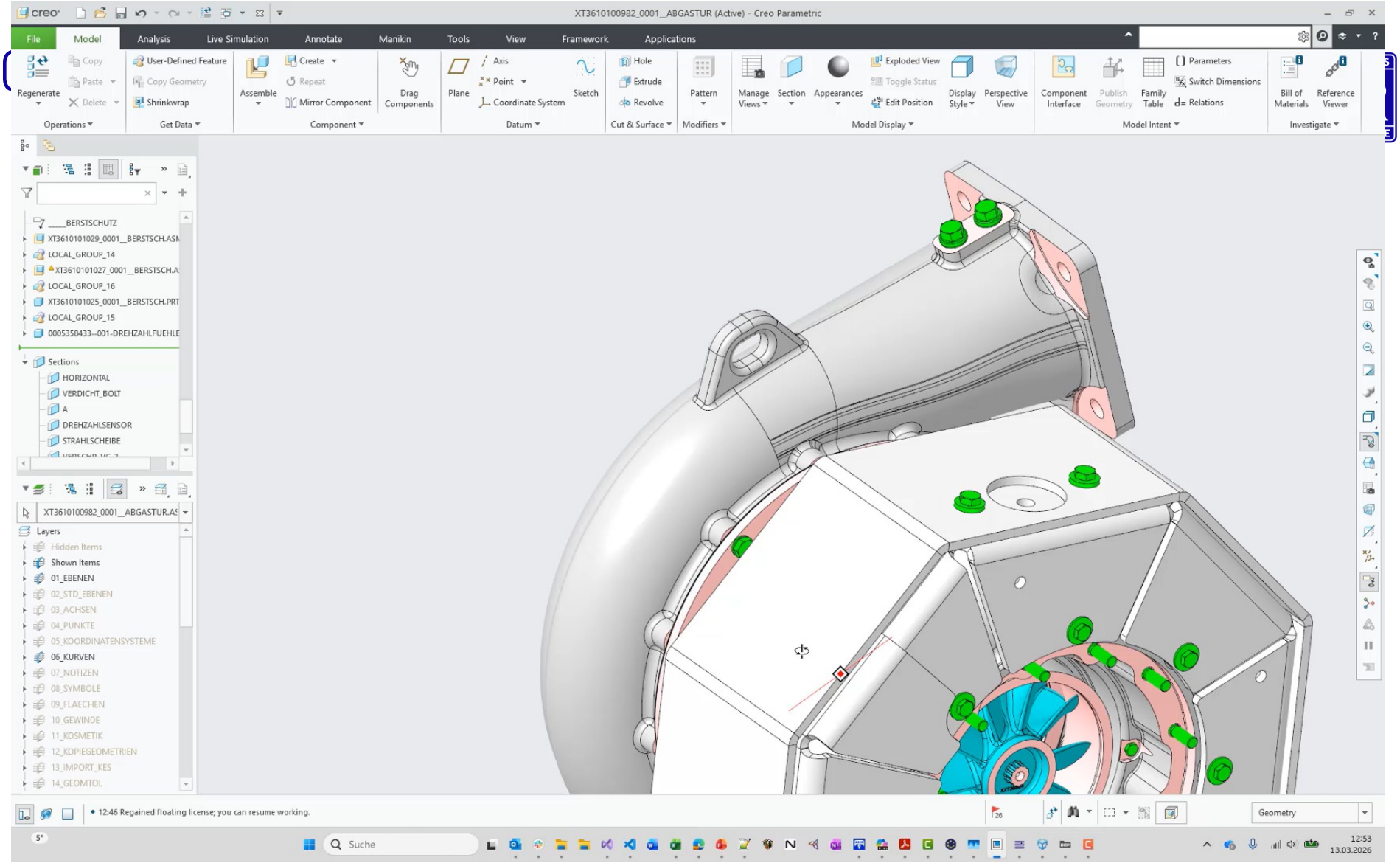
Digital Data Package Web Collaboration



Cryptshare

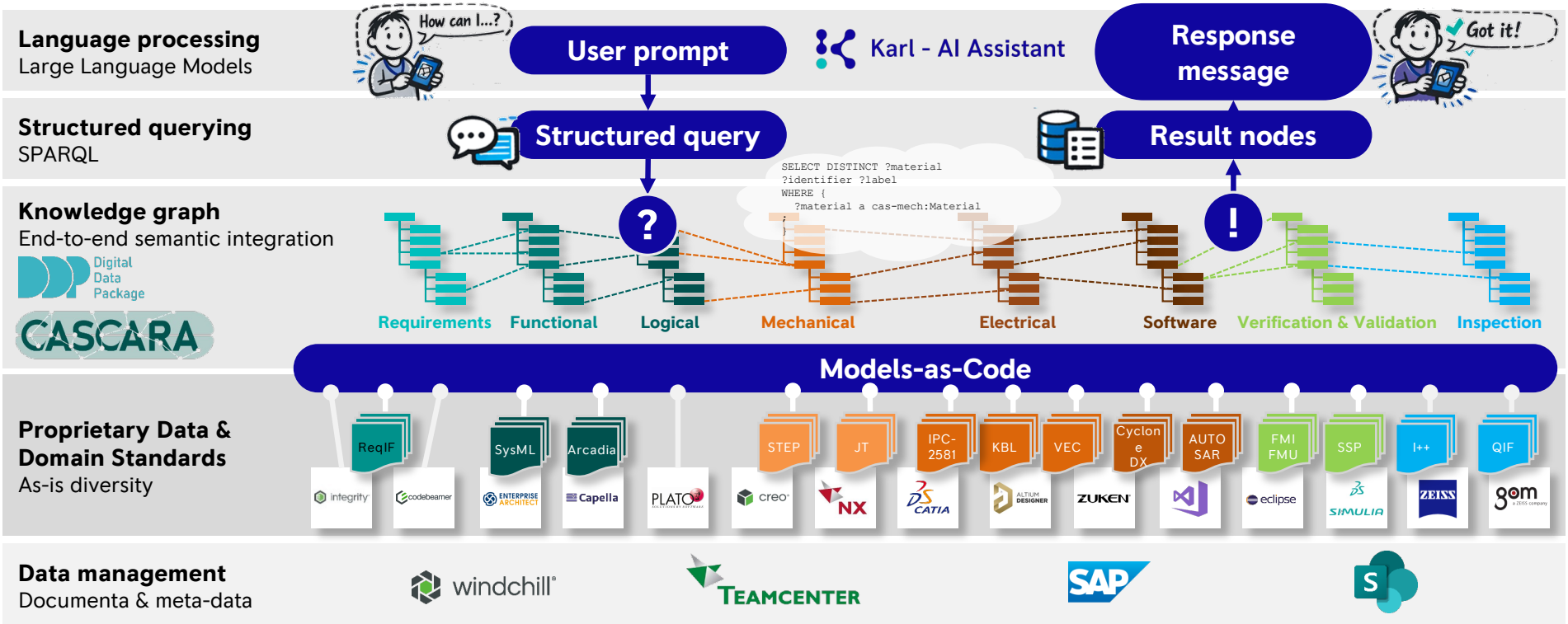
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XT3610100982_0001_ABGASTUR (Active) - Creo Parametric
File
Model
Analysis
Live Simulation
Annotate
Manikin
Tools
View
Framework
Applications
Regenerate
Copy
Paste
Delete
Operations
User-Defined Feature
Copy Geometry
Shrinkwrap
Get Data
Assemble
Create
Repeat
Mirror Component
Drag Components
Component
Plane
Axis
Point
Coordinate System
Sketch
Datum
Hole
Extrude
Revolve
Cut & Surface
Pattern
Modifiers
Manage Views
Section
Appearances
Exploded View
Toggle Status
Edit Position
Display Style
Perspective View
Model Display
Component Interface
Publish Geometry
Family Table
Parameters
Switch Dimensions
Relations
Model Intent
Bill of Materials
Reference Viewer
Investigate
____BERSTSCHUTZ
XT3610101029_0001__BERSTSCH.ASM
LOCAL_GROUP_14
XT3610101027_0001__BERSTSCH.A
LOCAL_GROUP_16
XT3610101025_0001__BERSTSCH.PRT
LOCAL_GROUP_15
0005358433--001-DREHZAHLFUEHLE
Sections
HORIZONTAL
VERDICHT_BOLT
A
DREHZAHLSENSOR
STRAHLSCHEIBE
XT3610100982_0001__ABGASTUR.AS
Layers
Hidden Items
Shown Items
01_EBENEN
02_STD_EBENEN
03_ACHSEN
04_PUNKTE
05_KOORDINATENSYSTEME
06_KURVEN
07_NOTIZEN
08_SYMBOLE
09_FLAECHEN
10_GEWINDE
11_KOSMETIK
12_KOPIEGEOMETRIEN
13_IMPORT_KES
14_GEOMTOL
12:46 Regained floating license; you can resume working.
Geometry
Suche
12:53
13.03.2026

LANGUAGE MODELS AND ONTOLOGIES: BEST OF BOTH WORLDS

Structured, cross-domain data in Ontologies leverage the power of Large Language Models



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DIGITAL THREADS FOR DIGITAL AGENTS



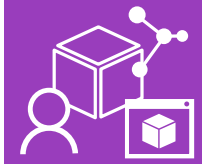
END-2-END DIGITAL ECOSYSTEM

- Involves **all domains** of product lifecycle
- Respects **de-facto diversity IT systems**
- Extends **across organizations** and involves multi-tier supply chain.



CROSS-DOMAIN SEMANTIC INTEGRATION

- Allows **relating to entities**, not models
- Provides **technical integration**
- Provides **semantic integration**



MODES OF USE

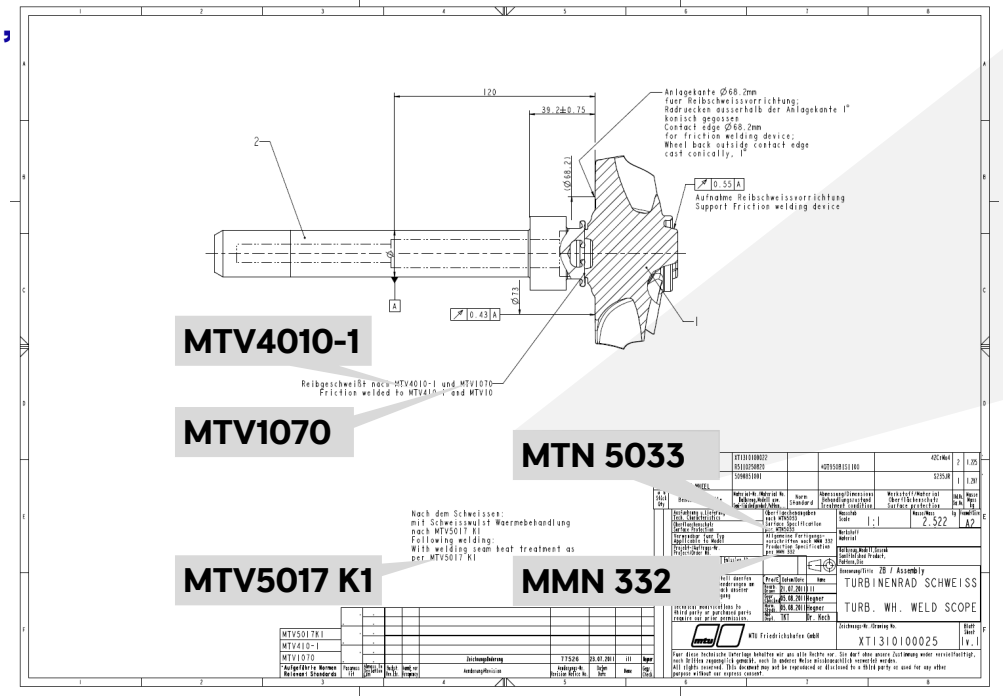
- Supports **human interaction** (viewing, annotating)
- Supports **agentic use** (API queries, …)
- Supports **file-centric use** (STEP, ReqIF)

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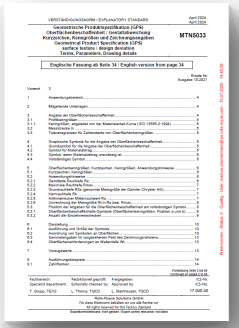
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STANDARDS TODAY

Does it really help understanding parts efficiently if we relate to a bunch of



View 2D drawing



MTN 5033
Read 66 pages

Further References:
- DIN EN ISO 3274:1998
- DIN EN ISO 4287:2010
- DIN EN ISO 4288:1998
- DIN EN ISO 16610-21
- DIN EN ISO 13565-1:1997
- DIN EN ISO 13565-2:1998
- ~~ISO 12085~~
- ~~ISO 13565-3~~
- […]



MTN 5033-1
Read 14 pages



MTN 5033-2
Read 8 pages



MTN 5033-3
Read 12 pages



MTN 5033-4
Read 36 pages

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SMART SEMANTIC STANDARDS



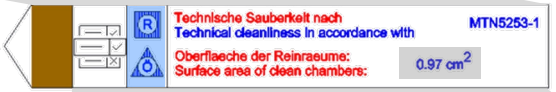
Extract from the standard

Technical cleanliness to MTN5253

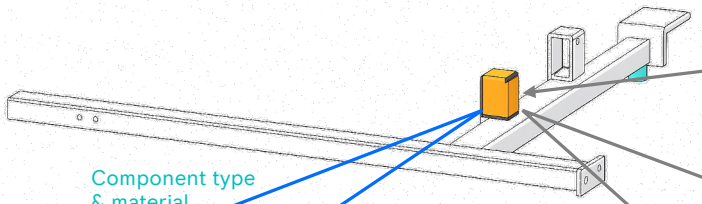
and, if required, identification of the throughflowing medium, for oil, for hydraulic oil, for intake air, for fuel (liquid), for fuel (gaseous), e.g.

Surface area of the clean areas: .....cm²

Graphical representation of the used part of the standard



Annotation associated to face(s)



Component type & material

Measured area of face(s)

Semantical information of used part of the standard

```
"TechnicalCleanliness": {
    "Reference": "MTN5253-1:2025-10",
    "Faces": [],
    "ThroughflowingMedium": "Oil",
    "SurfaceAreaCleanAreas": 0.0097,
    "MediaCode": "Ö",
    "Category": 2,
    "Maximum Particle Size": 600
    "Maximum Number Of Particles": 8
}
```

Extract from a table of the standard

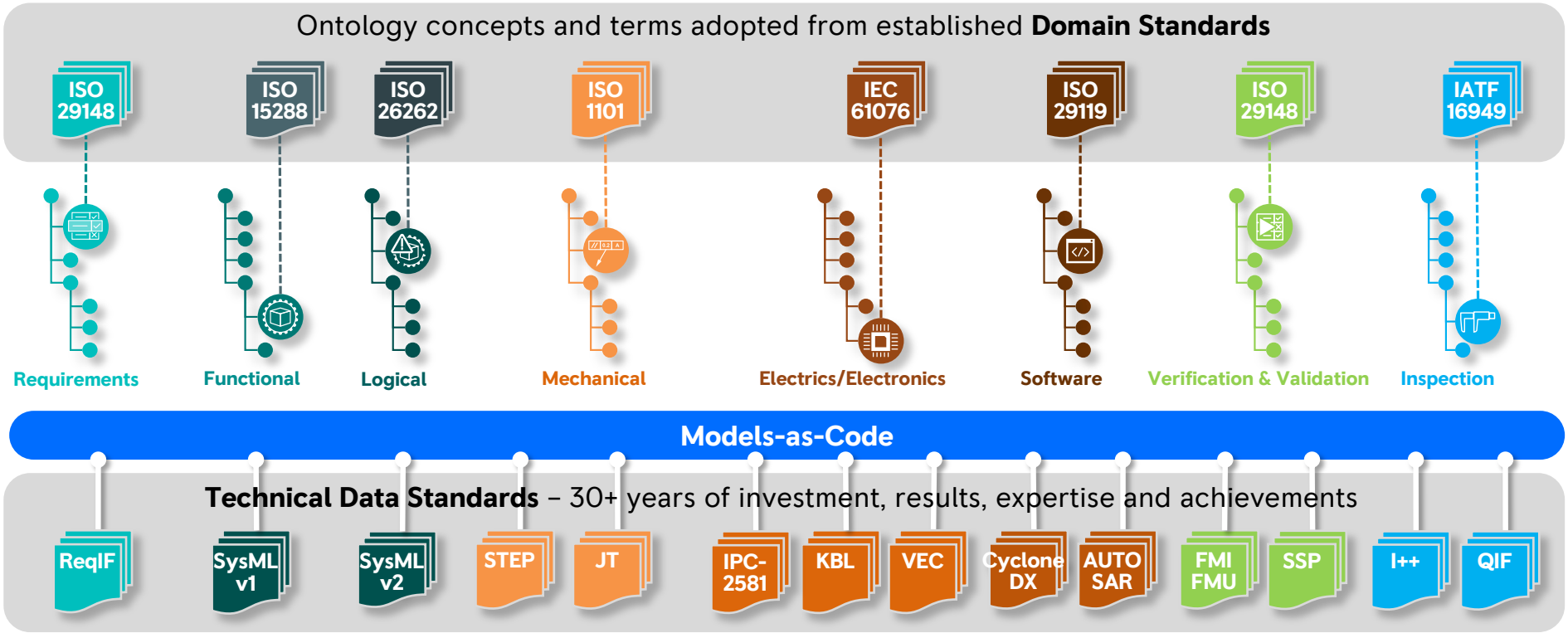
Medium	Components	Material	Max. particle size µm	Max. number of particles per 1000 cm² in the case of visual evaluation [1]					
				50 to 100 µm	100 to 200 µm	200 to 600 µm	400 to 600 µm	600 to 1000 µm	1000 to 1500 µm
	General	metallic mineral[3]	600				8		
ntake air and ex-haust gas recircu-ation (EGR)	Charge-air cooler EGR cooler[5]	metallic mineral[3]	600				8 [3]		
	Electrically operated flaps	metallic	1500				8	4	2
		mineral[3]	600				8	0	0
Fuel	General	metallic polymer	600	100[9]	25	5			
		mineral[3]	80						

Calculated number of particles per size

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FROM DOMAIN STANDARDS TO SHARED ENGINEERING MEANING

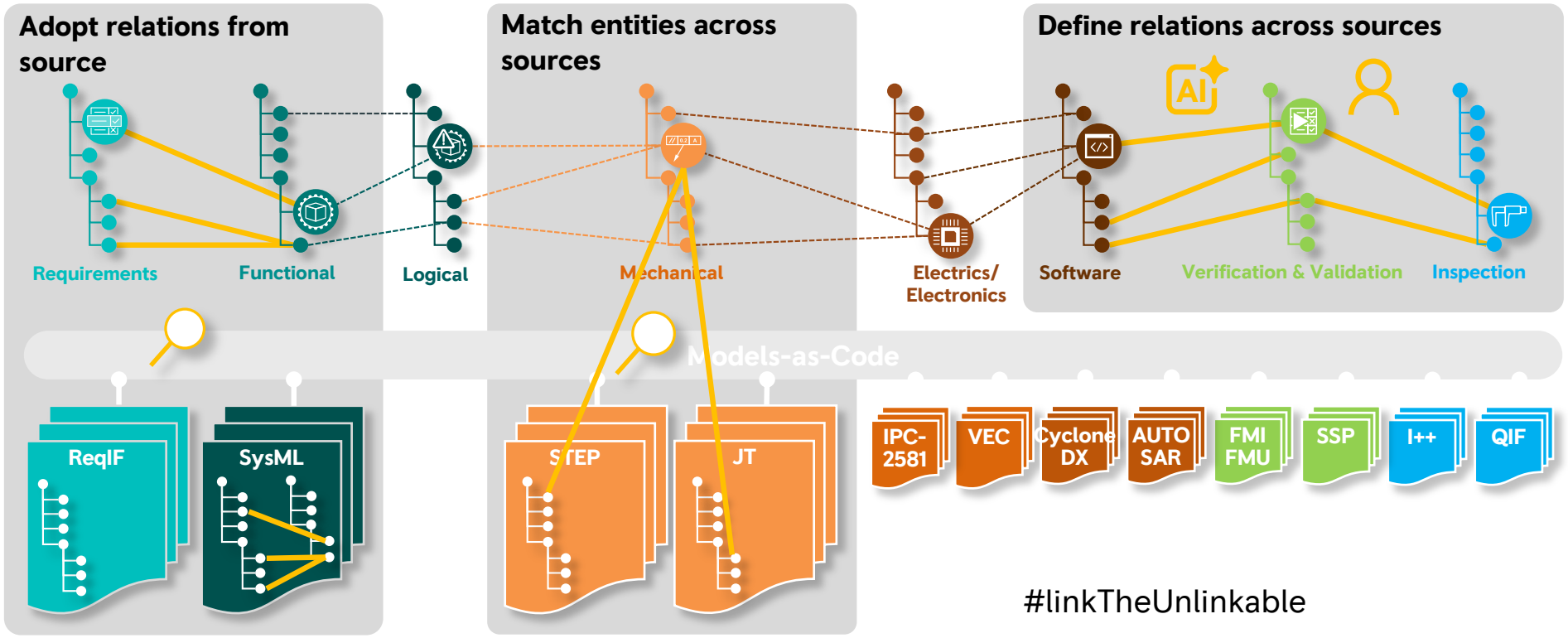
CASCaRA Connecting data entities from established sources to a knowledge graph people understand



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HOW CROSS-DOMAIN LINKS ARE ESTABLISHED

How we establish entity-level cross-model links in CASCaRA



#linkTheUnlinkable

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BUILDING BLOCKS FOR TRUSTED COLLABORATION

Trusted collaboration requires representation, sovereignty and engineering meaning.

Asset Administration Shells (AAS)

- AAS is a standardized digital representation of an asset.
- It contains structured information and functions.
- It enables asset identification, description, and interaction in a digital environment

Federated Data Spaces

- Federated data spaces aligned with GAIA-X principles.
- It provides a standard framework with interoperability rules, semantic models, and governance via use cases.
- It supports transparent and sovereign data exchange along the value chain.

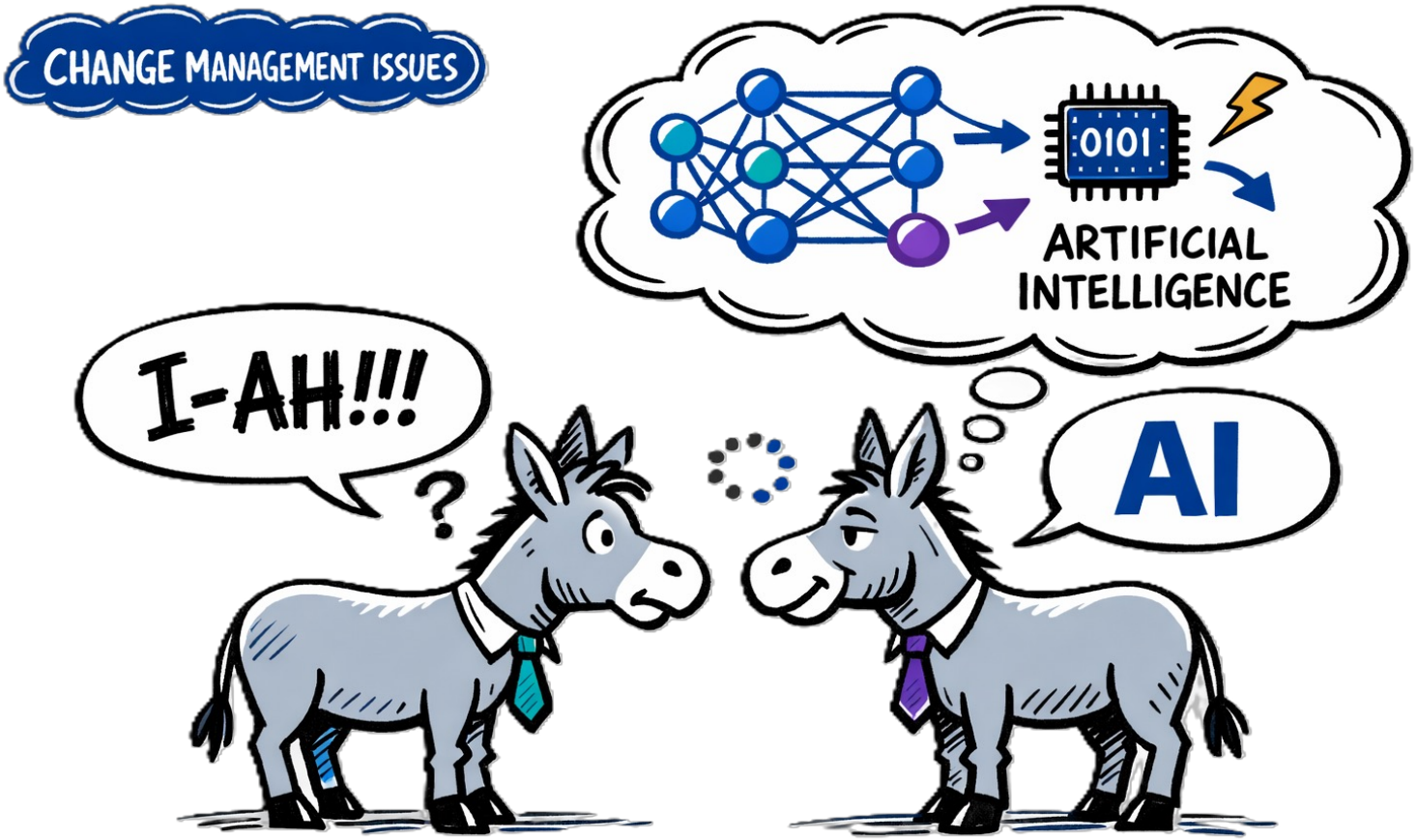
CASCaRA: Digital Data Package (DDP)

- Standardized data container for product-related engineering information
- Represents data as identifiable entities and semantically links using a shared ontology
- Enables traceable, cross-domain data exchange across the product lifecycle.

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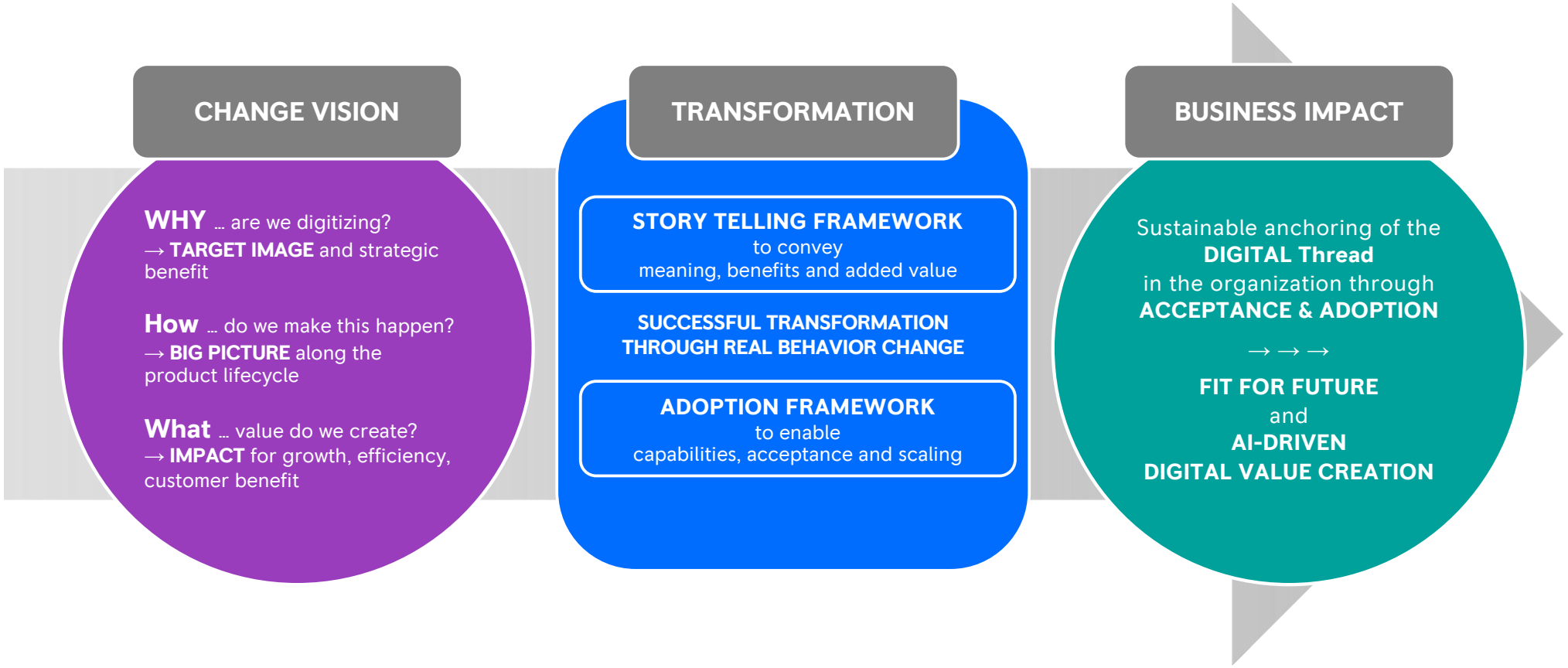
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SAME LANGUAGE – DIFFERENT UNDERSTANDING



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ARCHITECTURE ENABLES THE THREAD. ADOPTION ACTIVATES IT.



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THE SAME THREAD CREATES DIFFERENT VALUE FOR DIFFERENT ROLES

1. Story Anchor | **2. Stakeholder Analysis** | **3. Value Argumentation**

DESIGN ENGINEER

- Earlier manufacturability feedback
- Fewer late clarification loops
- Traceability & Transparency

BUYER

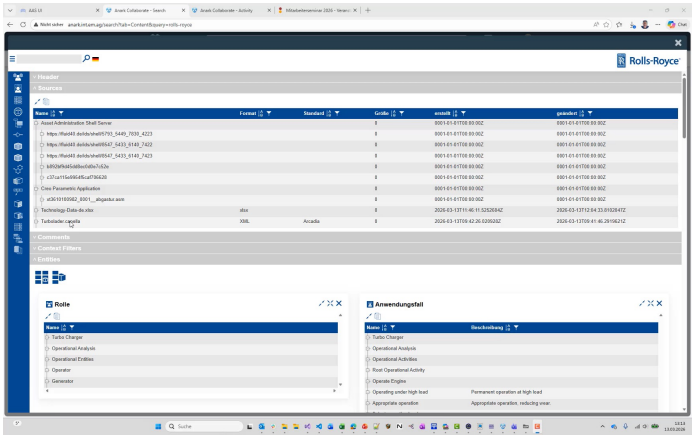
- More confident sourcing decisions
- Less manual coordination

SUPPLIER

- Earlier access to trusted definitions
- Less ambiguity and rework

4. Change Story Development → **5. Change Communication Plan**

MBD Supplier Collaboration Prototype



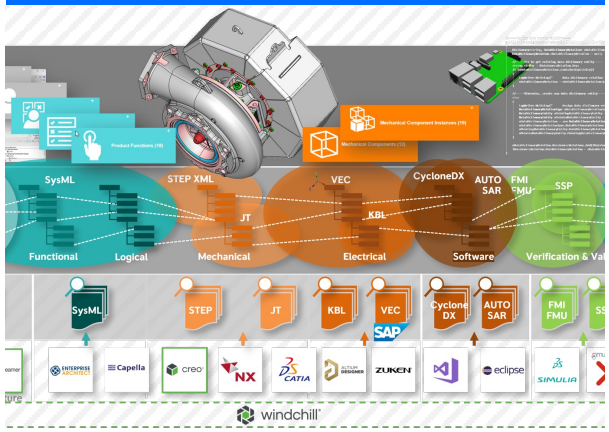
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CONNECT MEANING. ENABLE PEOPLE. EARN TRUST.

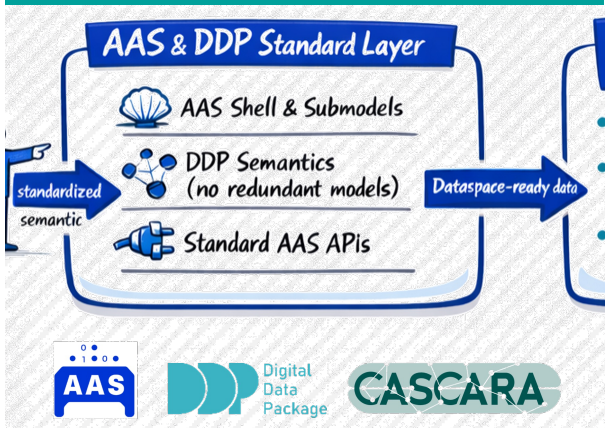
SEMANTICS

Connect engineering meaning



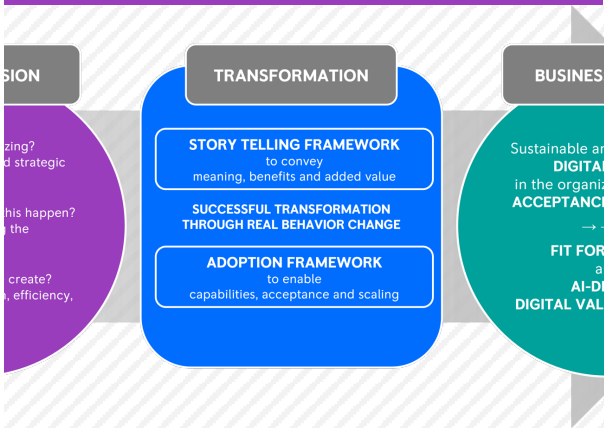
COLLABORATION

Share trusted context



ADOPTION

Turn information into behavior



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