JT, the 3D-lightweight format for visualization and beyond?

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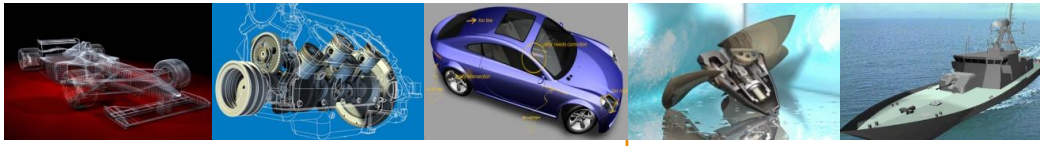

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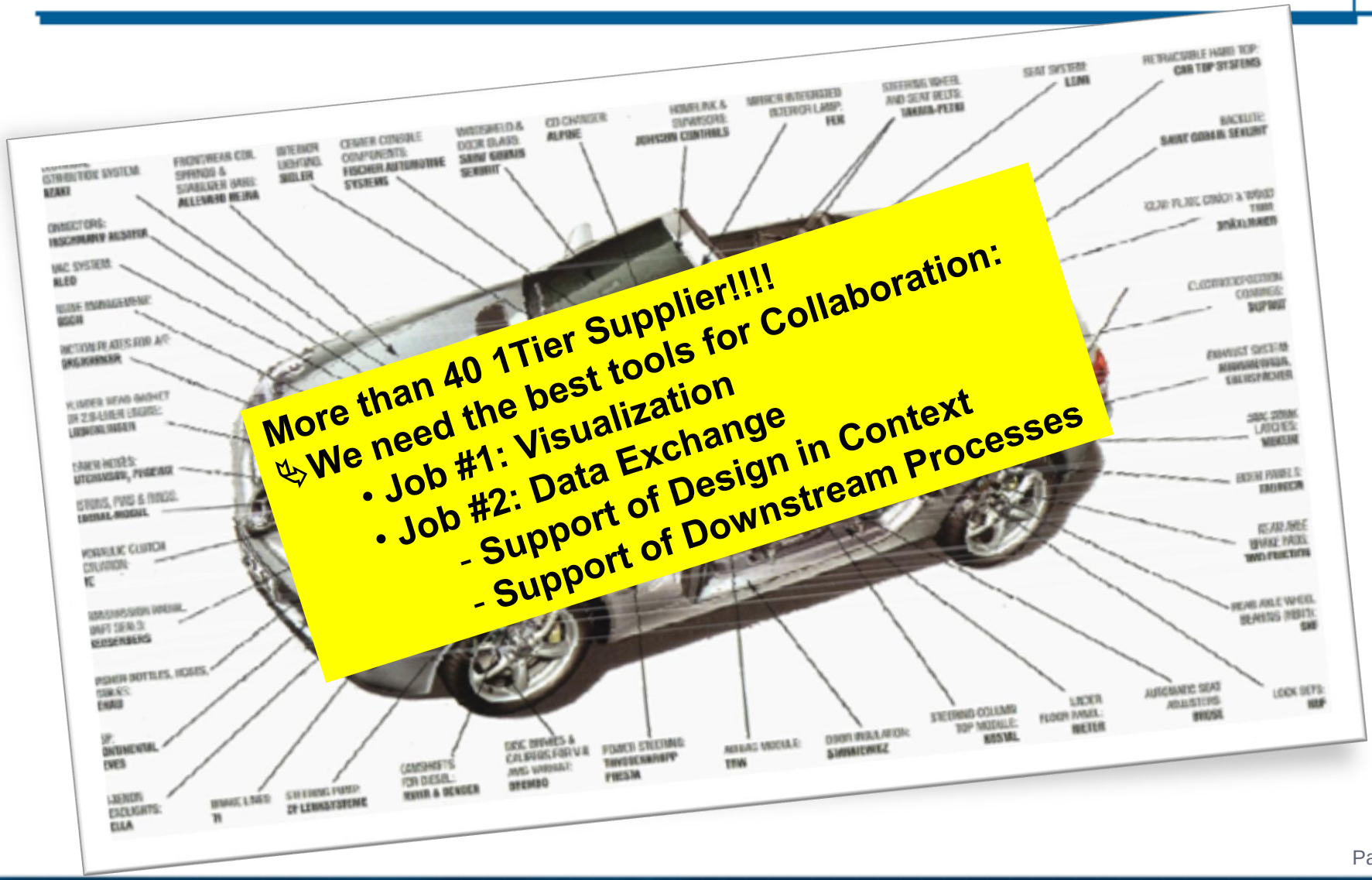
Agenda

- Introduction and motivation
- The bigger picture
- Key use cases in virtual product engineering
- Need for action
- Summary and outlook

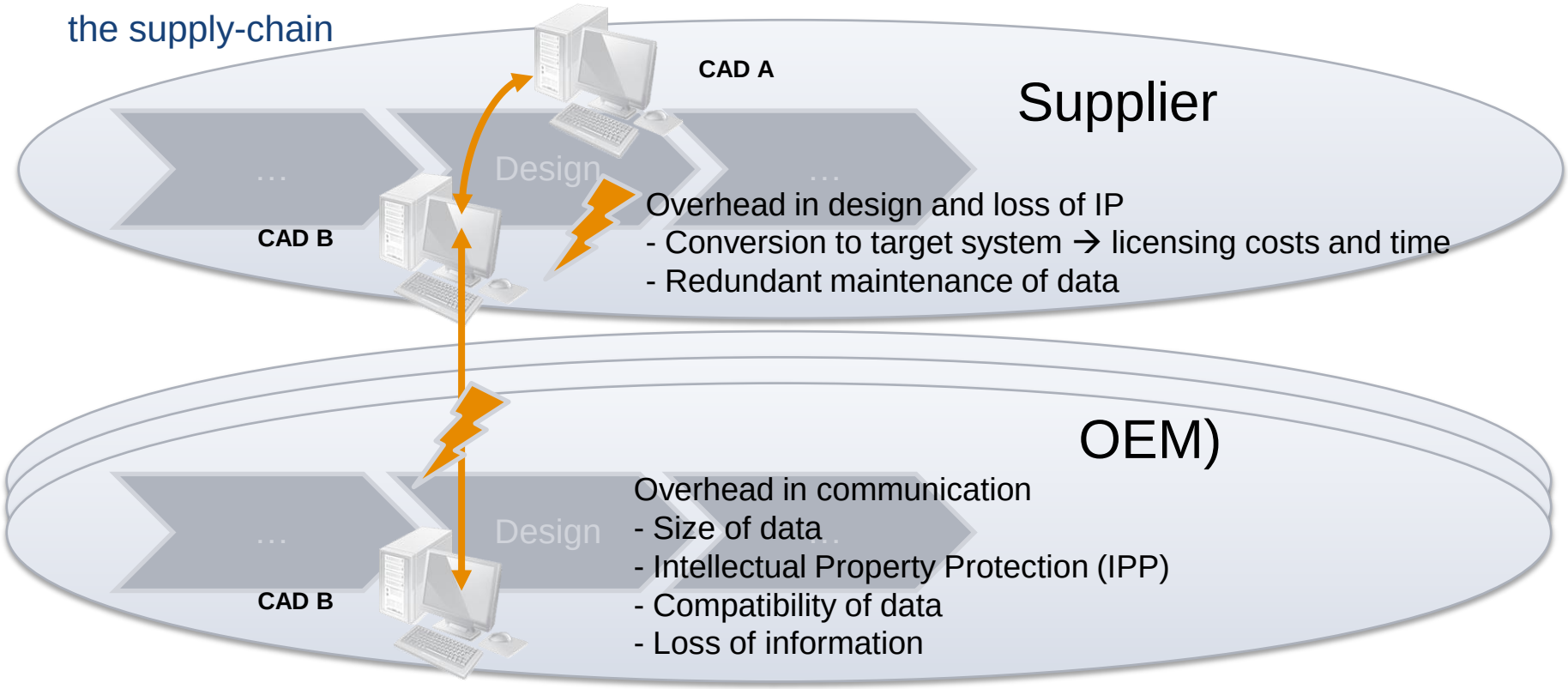
Complexity of the Supply Chain



We have reached a very good status in Visualization but…

Problems in supply chain

- Native CAD-files server as primary data carrier within the exchange of design throughout the supply-chain

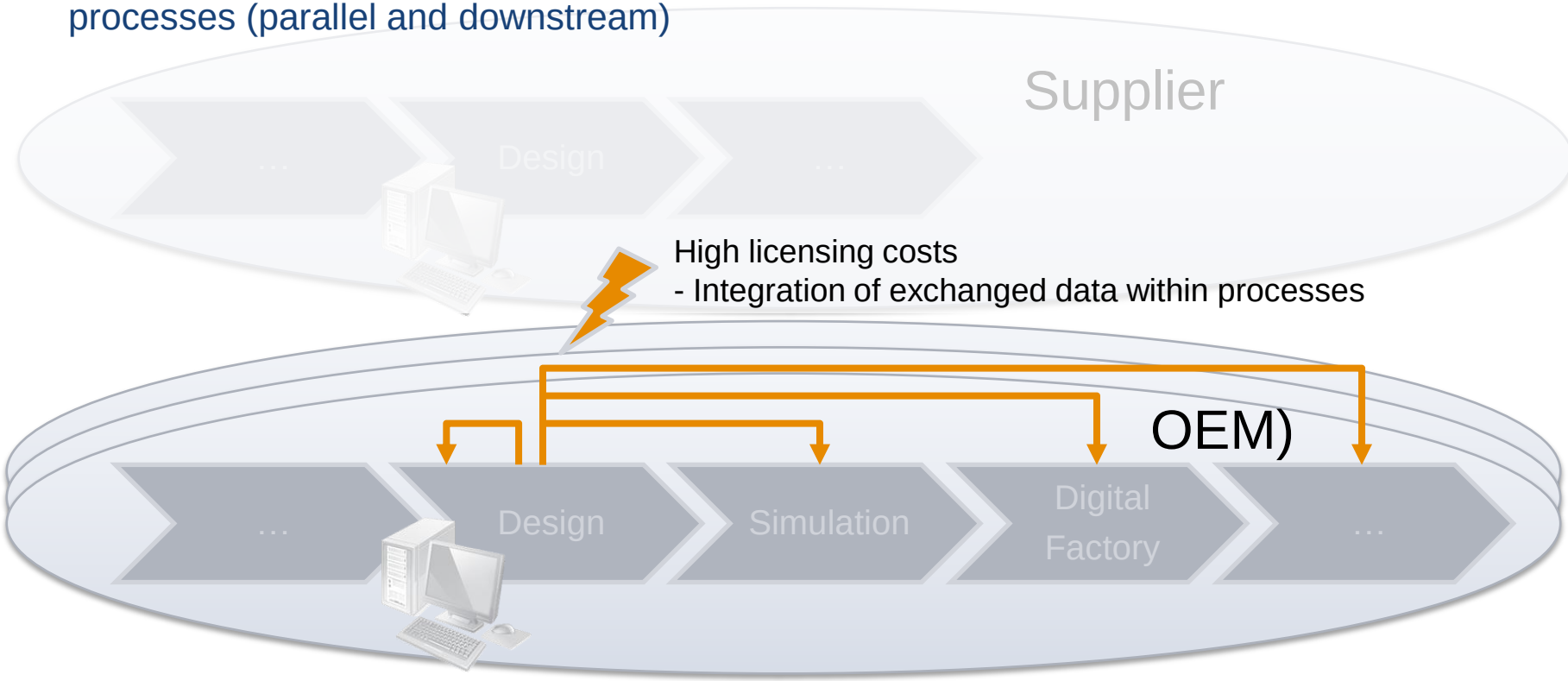


BOSCH Dr.-Ing. Jan Dietrich (Manager - Product Development Wiper Systems):
"Conversion to various CAD-solutions and –versions causes an overhead of 15%"

We have reached a very good status in Visualization but…

Problems in internal parallel and downstream processes

- Native CAD-files server as primary data carrier within internal virtual engineering processes (parallel and downstream)

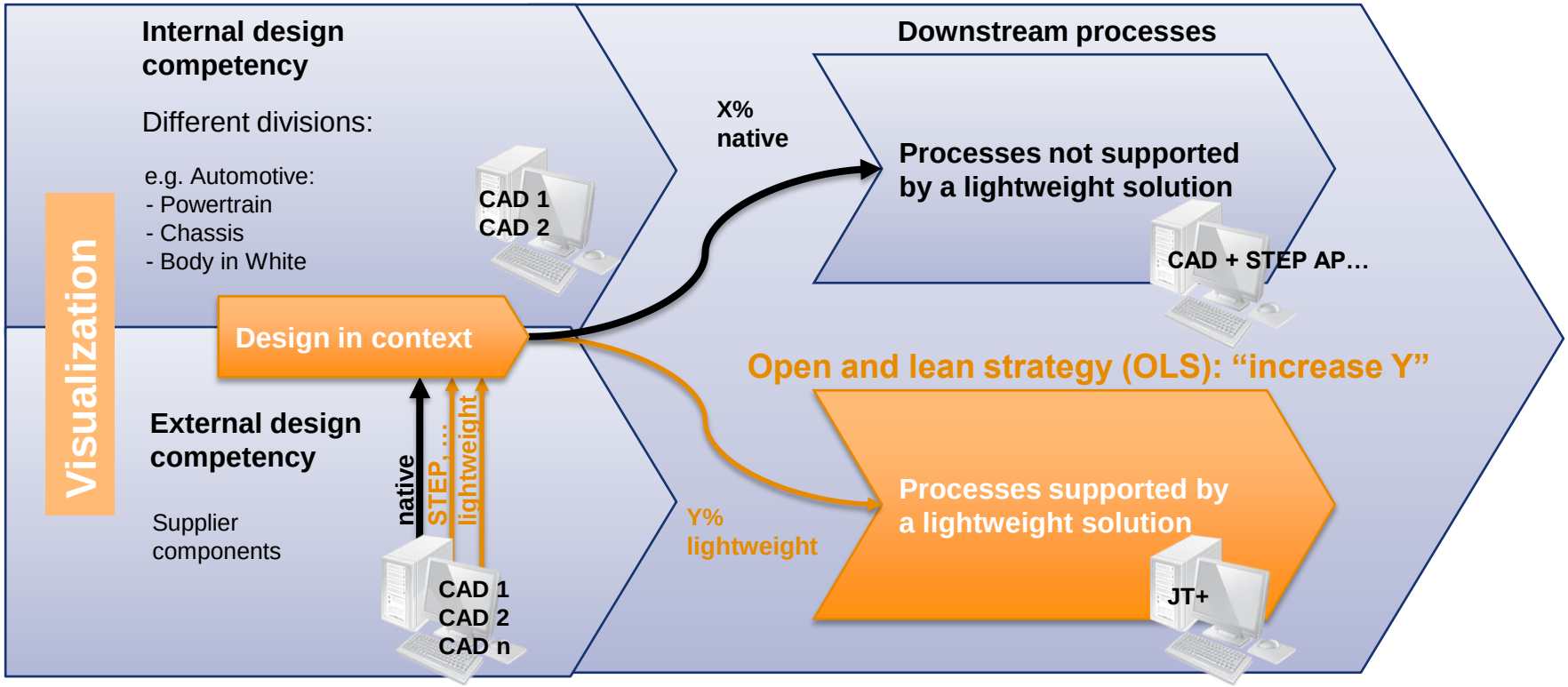


Question: Can a lightweight solution serve as an alternative to native CAD-files for supporting data exchange and downstream processes?

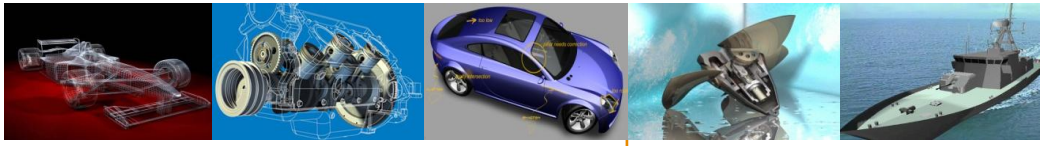
The Challenges beyond Visualization

Possibilities to optimize product engineering processes

- By integrating a lightweight solution into selective processes



Hypothesis: Y% processes can be rearranged to a lightweight solution. A remaining X% remains dependent of CAD or STEP AP´s. The ratio X/Y depends on data format capabilities and application / translator support.



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Vision and Required Work do be Done

Combination of neutral formats for processes that go beyond visualization

Open and lean data solution (neutral pipeline)

structure-oriented

- enhanced information (AP 242 XML, …)
- 3D-lightweight content (e.g. JT)

geometry-oriented

required content

Visualization is the basis

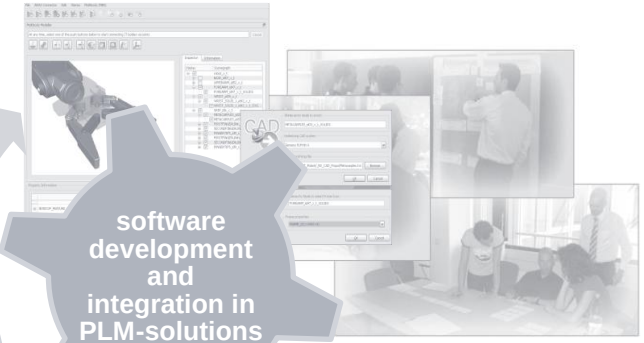
Neutral formats for design in context

Neutral formats for downstream processes
(Y% see Slide 7)

Neutral formats for intelligent supplier integration

Data exchange is the target

competencies and investigations in multiple industries
- automotive
- naval
- aircraft



software development and integration in PLM-solutions

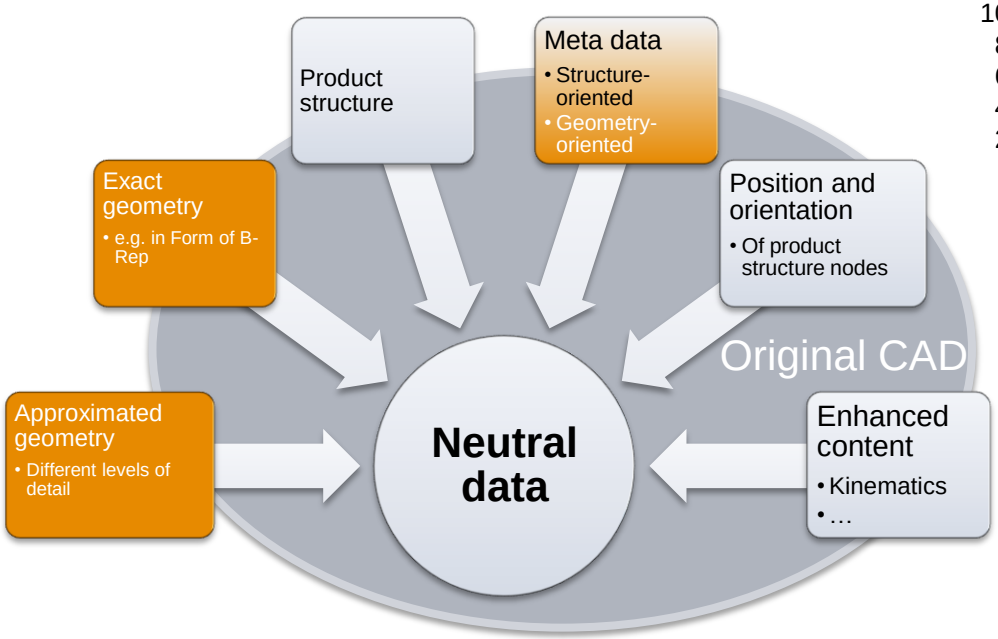
content harmonization
→ syntax
→ semantics
→ structure
…

process-oriented potential analysis
→ process analysis
→ use cases
→ requirements
…

Lightweight as Part of a Holistic Neutral Pipeline…

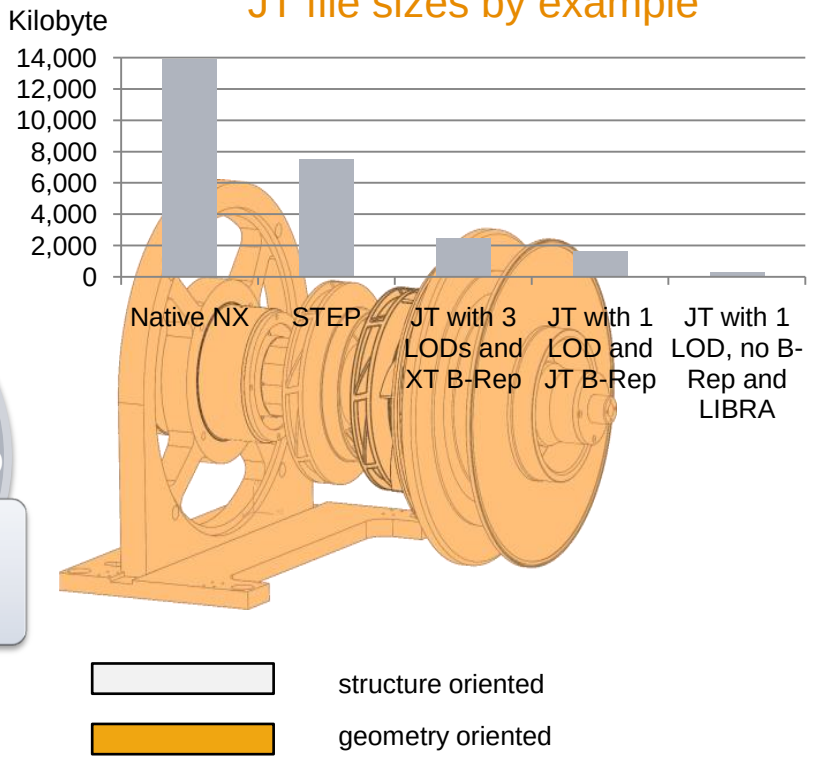
- 3D-lightweight primarily refers to compressed (down to 10%) visualization-oriented data, including geometry and geometry-oriented meta data.
- Neutral pipeline refers to CAD-derived contents

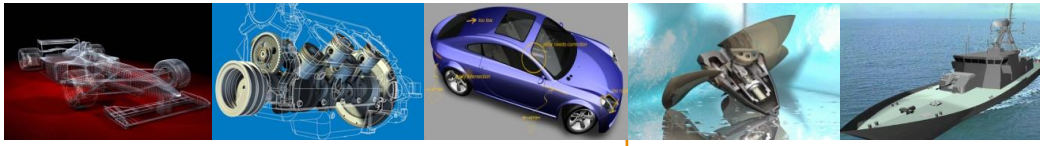
Negligence of design history and the sum of parametrical content



Neutral Pipeline Components

JT file sizes by example





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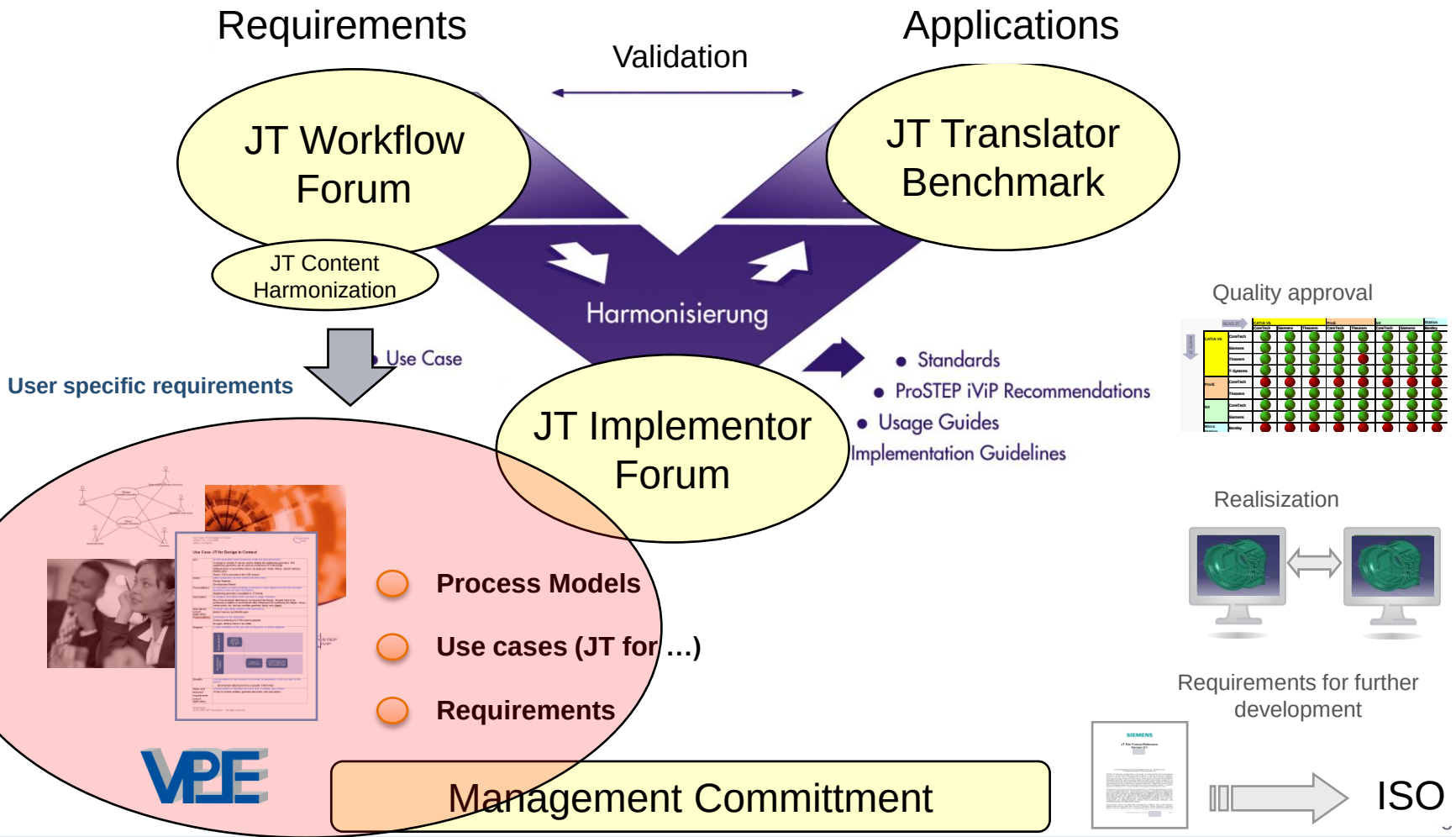
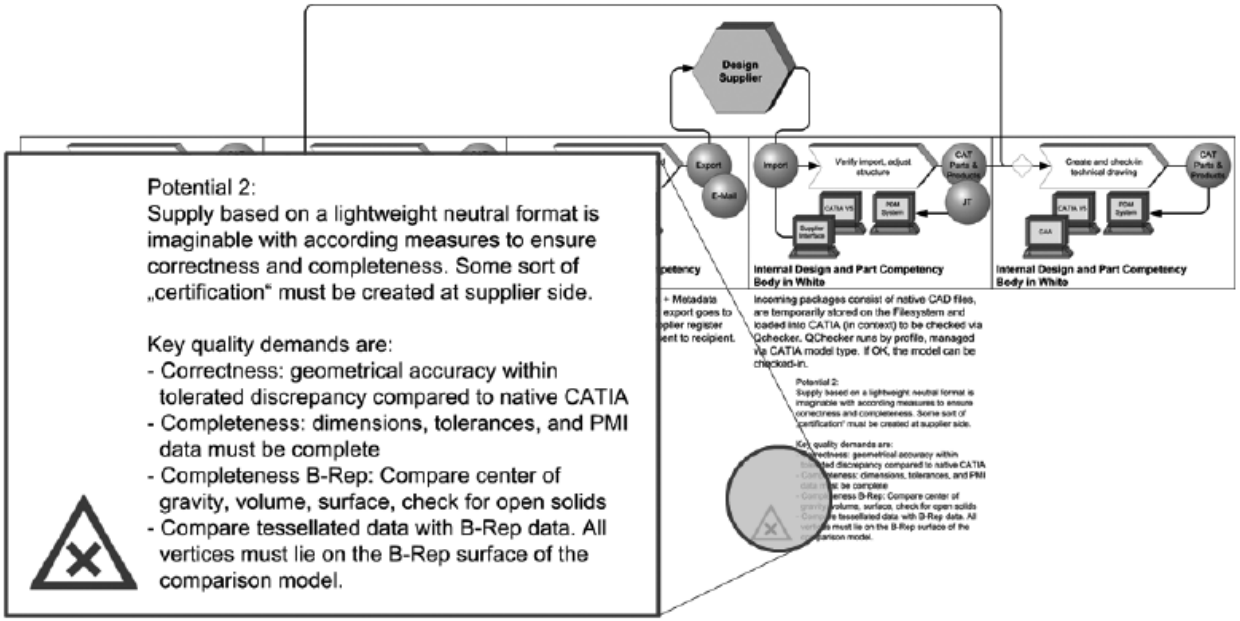
The ProSTEP iViP Association



Process Analysis of the Selected Use Cases

- Process analysis and identification of lightweight format application potentials
  - At four OEMs and one supplier



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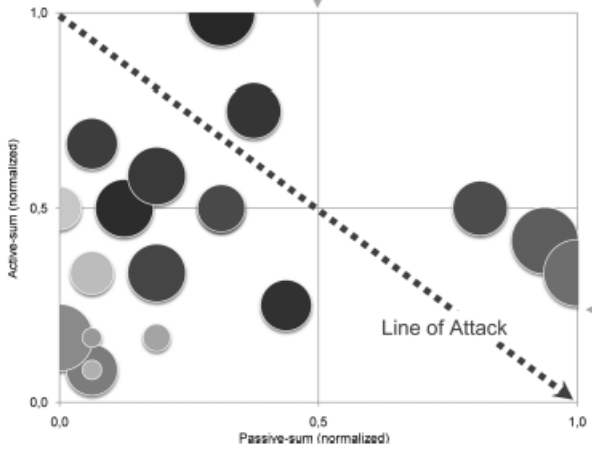
  - Pragmatic approach using a workshop character
  - Dynamic discussions of requirements relating to a lightweight format

Process models and initial requirements were documented.

Identification and Priorization of Use Cases

Summarized within a relevancy portfolio, given two criteria

- Active and passive sums to approximate inter-influences between use cases
- Use case significances (rel(UC))



Use Case	Simp. (S) [0,2]	Board Rel. (B) [0,3]	VPE Rel. (V) [0,3]	Significance weight (W) (S + B · 2 + V · 2) / 14	Normalized W vs. max
NF for (hybrid) Design in Context	0	3	3	0.86	1.00
NF for (non-hybrid) Design in Context	0	3	1	0.57	0.67
NF for Packaging	1	2	2	0.64	0.75
NF for Installation Feasibility	1	2	2	0.64	0.75
NF for high-end Visualization	1	2	1	0.50	0.58
NF for Multibody-Simulation (MBS)	1	2	2	0.64	0.75
NF for Finite Element Analysis (FEA)	1	2	1	0.50	0.58
NF for (Digital Factory) Layout Planning	0	3	0	0.43	0.50
NF for (Digital Factory) Bulk Material Handling	0	3	0	0.43	0.50
NF for (Digital Factory) Plant or Aggregate Development	0	3	1	0.57	0.67
NF for Supplier Integration (Supplier to OEM)	0	3	3	0.86	1.00
NF for Supplier Integration (OEM to Supplier)	0	3	3	0.86	1.00
NF for (Procurement) Bidding and Inquiry (Create Offering)	1	2	1	0.50	0.58
NF for Drawingless Manufacturing	0	3	3	0.86	1.00
NF for (Procurement) Bidding and Inquiry (Purchase)	1	0	0	0.07	0.08
NF for Marketing	2	0	0	0.14	0.17
NF for After Sales	1	0	0	0.07	0.08
NF for Product Documentation	1	0	2	0.36	0.42
NF for Engineering Change Management (ECM)	1	2	3	0.36	0.42

NF for (Digital Factory) Layout Planning	0	0	0	0	0	0	0		2	2	1	1	0	0	0	0	0	0	0	6	0.50	0	0	0	12	1.00
NF for (Digital Factory) Bulk Material Handling	0	0	0	0	0	0	0	2		2	1	1	0	0	0	0	0	0	0	6	0.50	0	0	0	9	0.75
NF for (Digital Factory) Plant or Aggregate Development	0	0	0	0	0	0	0	2	2		1	1	0	0	0	0	0	0	0	6	0.50	0	0	0	4	0.33
NF for Supplier Integration (Supplier to OEM)	1	1	0	0	0	0	0	0	0	1		1	0	0	1	0	0	0	0	5	0.42	0	0	0	6	0.50
NF for Supplier Integration (OEM to Supplier)	1	1	0	0	0	0	0	0	0	1	1		0	0	0	0	0	0	0	4	0.33	0	1	0	3	0.25
NF for (Procurement) Bidding and Inquiry (Create Offering)	0	0	0	0	0	0	0	0	0	0	0	1		0	0	0	0	0	0	1	0.08	0	0	0	7	0.58
NF for Drawingless Manufacturing	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	2	0.17	0	0	0	8	0.67
NF for (Procurement) Bidding and Inquiry (Purchase)	0	0	0	0	0	0	0	0	0	0	0	1	1	0		0	0	0	0	2	0.17					
NF for Marketing	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0		0	0	0	2	0.17					
NF for After Sales	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		0	0	1	0.08					
NF for Product Documetation	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	1		0	4	0.33					
NF for Engineering Change Management	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0		6	0.50					
Passive-sum	5	6	3	2	7	3	1	5	5	13	15	16	1	0	1	3	1	1	0							
Normalized Passive-sum (vs. max)	0.31	0.38	0.19	0.13	0.44	0.19	0.06	0.31	0.31	0.81	0.94	1.00	0.06	0.00	0.06	0.19	0.06	0.06	0.00							

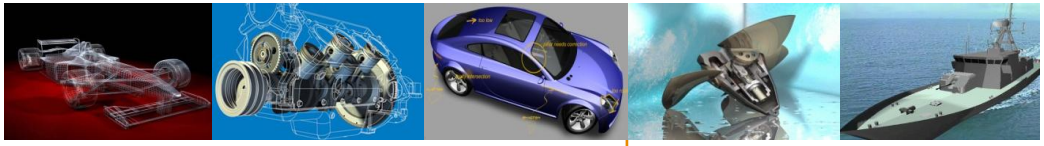
JTWF has identified 19 use cases and VPE prioritized 8 to be of key relevance for daily activities

The 8 Key Use Cases

- Key use cases for further consideration
  - Lightweight format for (hybrid) Design in Context
  - Lightweight format for (non-hybrid) Design in Context
  - Lightweight format for Packaging
  - Lightweight format for Installation Feasibility
  - Lightweight format for high-end Visualization
  - Lightweight format for Multibody Simulation (MBS)
  - Lightweight format for Finite Element Analysis (FEA)
  - Lightweight format for (Digital Factory) Plant or Aggregate Development

- Specification of use cases
  - Generation of a diagram with activities and responsibilities per use case
    - Application-neutral
  - Documentation of pre- and post-conditions
    - Borderlining use cases in terms of process analysis results

8 use cases that represent the core of the analyzed processes were documented. To each use case, there can be deviations and special conditions in industry.



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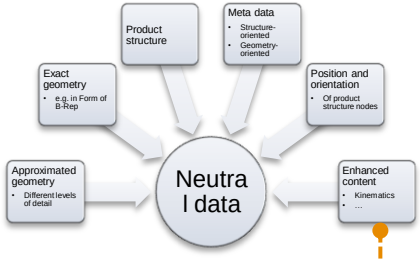
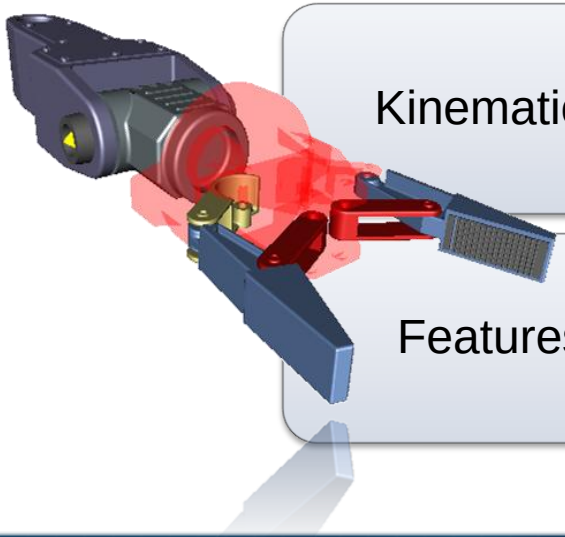
Need for action

At their core, many of the use cases are considered straight forward and supportable, such as…

- NF for (non-hybrid) Design in Context (DiC)
- NF for (hybrid) Design in Context (DiC)
- NF for Packaging
- NF for high-end Visualization



Others are considered complex and require further investigations, f.e.:



Kinematics

- NF for Installation Feasibility
- NF for Multibody Simulation (MBS)

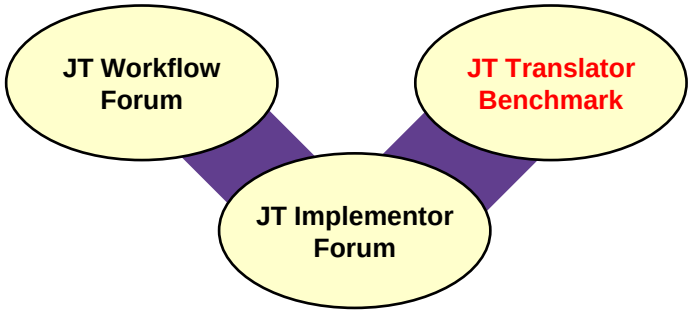
Correlation between structure-oriented kinematics (joints & fixes) and geometry-oriented content (e.g. attributes & reference geometry)

Features

- NF for CAM and Digital Factory

Need for features that go beyond PMI

ProSTEP iViP: JT Translator Benchmark (non hybrid DiC)



Goals of JT Translator Benchmark

- Neutral quality assurance of available JT translators
- Planned and controlled by JT Workflow Forum
- Technologically supported by JT Implementor Forum

READ JT / WRITE JT

		CATIA V5			ProE		NX		Micro Station
		CoreTech	Siemens	Theorem	CoreTech	Theorem	CoreTech	Siemens	Bentley
CATIA V5	CoreTech	●	●	●	●	●	●	●	●
	Siemens	●	●	●	●	●	●	●	●
	Theorem	●	●	●	●	○	●	●	●
	T-Systems	●	●	●	●	●	●	●	●
Pro/E	CoreTech	○	○	○	○	○	○	○	○
	Theorem	●	●	●	●	●	●	●	●
NX	CoreTech	●	●	●	●	●	●	●	●
	Siemens	●	●	●	●	●	●	●	●
Micro Station	Bentley	○	○	○	○	○	○	○	○

*: Projektpaten

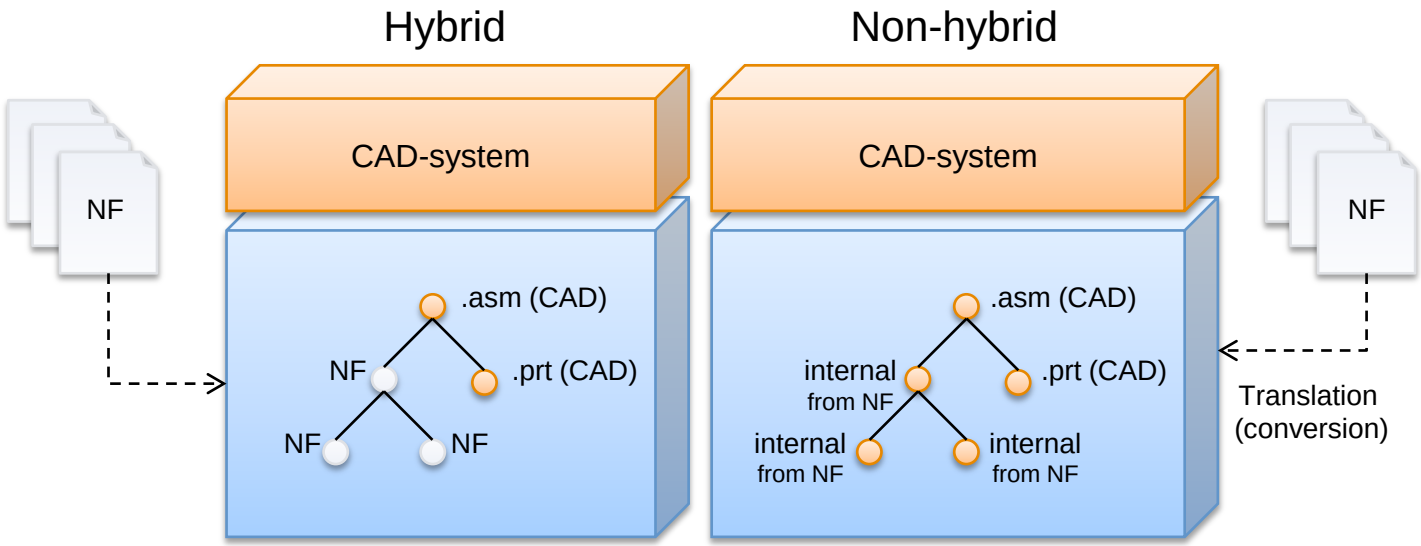
Use Case: NF for Hybrid Design in Context

Different CAD-systems

- E.g. in different design teams at different locations

Direct JT integration without conversion into CAD-internal representation

- Lightweight loading and visualization
- Measurements and other PMI on combined CAD and JT
- Until now only NX support

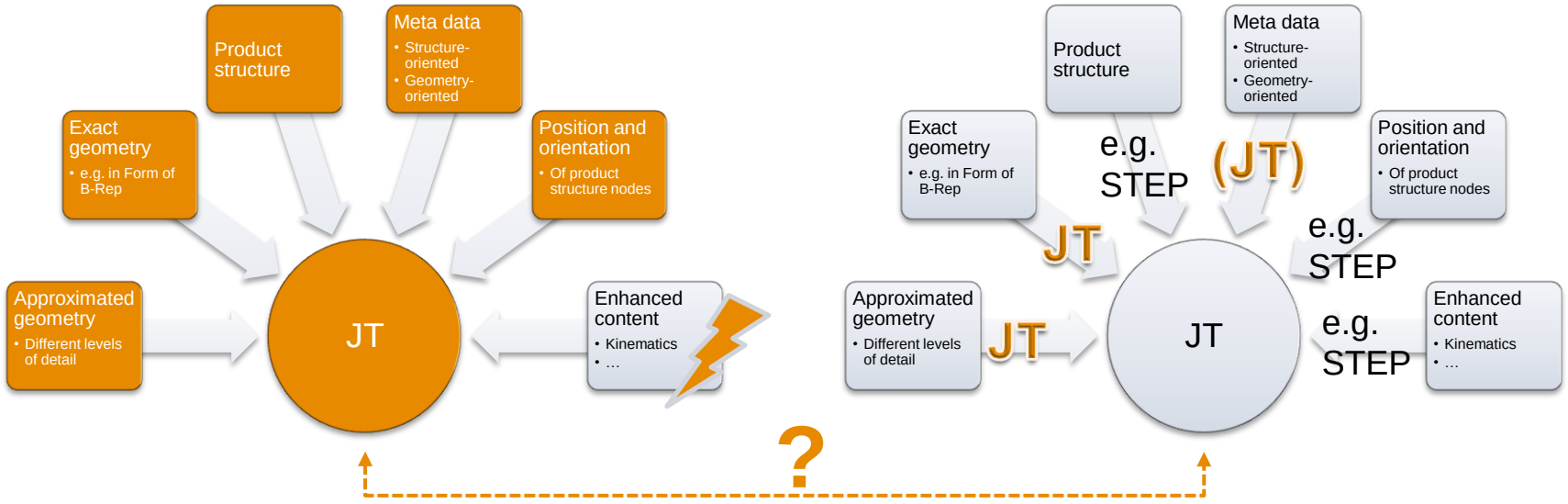


the .asm (assembly) and .prt (part) are exemplary extensions
internal could be new .prt or .asm, or another representation

Further thoughts on the neutral pipeline…

Today, JT is positioned somewhere in-between “visualization-oriented” and a holistic process-format.

- This is because JT features containers to store structure-oriented data as well
  - …but lacks containers for enhanced content
- This leads to confusion for users and application paradigms

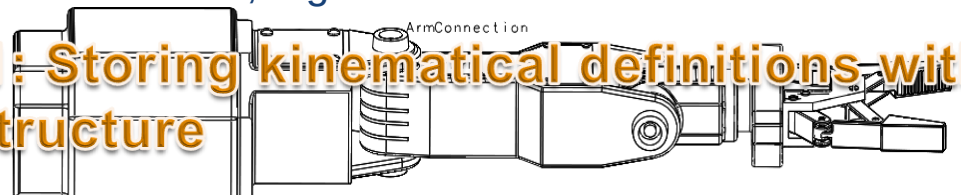


What is the right balance between geometry and structure oriented data?

Use Case: NF for Multibody Simulation

"…can we realize missing content given the containers that do exist…?"

- Concepts and prototypical solutions exist, e.g. for kinematics



Solution 1: Storing kinematical definitions within the product structure

- (ID 00:) ROBOT
  - (ID 02:) UPPER ARM
  - (ID 03:) LOWER ARM
  - (ID 05:) FINGERS
    - (ID 06:) META CARPAL
    - (ID 07:) FIST FINGER LEFT
  - (ID 13:) virt:kin
    - (ID 14:) virt:kin:constraints
      - (ID 15:) virt:kin:fixes
    - (ID 19:) virt:kin:joints
      - (ID 20:) virt:kin:joint:revolute_arm
        - (ID 21:) virt:kin:prim:revolute

Nodes with enhanced properties

Virtual sub-structure

ASSOCIATED NODE PROPERTIES	
	VALUE
FRAME_CG(00>03)	1.0 0.0 0.0 0.0 2.5 0.0 1.0 0.0 9.0 0.0 0.0 1.0 0.0 0.0 0.0 0.0 1.0
FRAME_1(00>03)	1.0 0.0 0.0 0.0 2.0 0.0 1.0 0.0 7.5 0.0 0.0 1.0 0.0 0.0 0.0 0.0 1.0
FRAME_2(00>03)	…
MASS	1.89
INERTIA(00>03)	18.12 0.25 0.0 0.25 36.71 0.0 0.0 0.0 25.1
UNITS	SI
…	…

Joint nodes with defining properties

ASSOCIATED NODE PROPERTIES	
KEY	VALUE
JOINT_AXIS	0.0 1.0 0.0
…	…

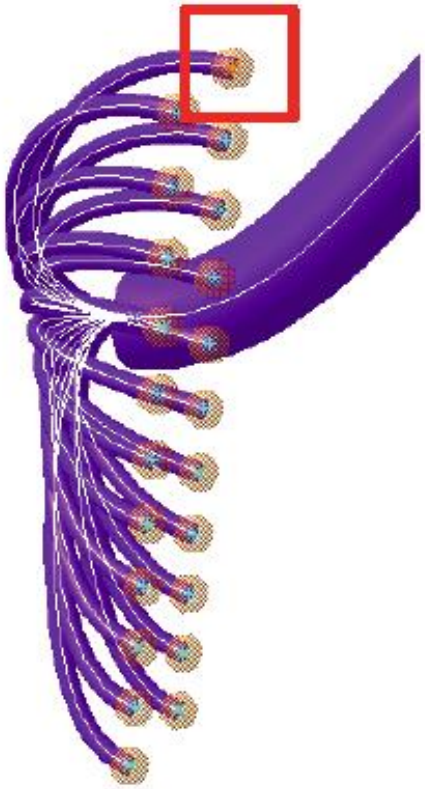
ASSOCIATED NODE PROPERTIES	
KEY	VALUE
JOINT_TYPE	revolute
JOINT_LINK_1	00>02_1
JOINT_LINK_2	00>03_1

Reference

Neutral formats for intelligent supplier integration

Example properties of supplier parts (excerpt)

- Often not or not completly parametric (depending on contracts)
- IP-protection is needed
- No inner product structure is of interest

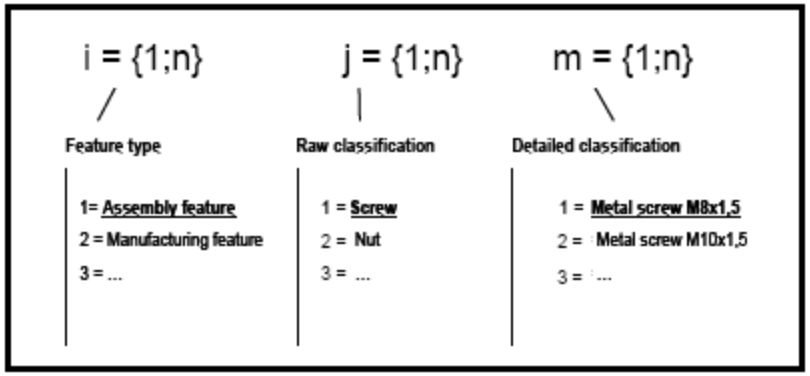


Need for (interface) feature information can be stated. In early product development phases these interface were changed and a change management has to established.

Example of Advanced Feature Structure

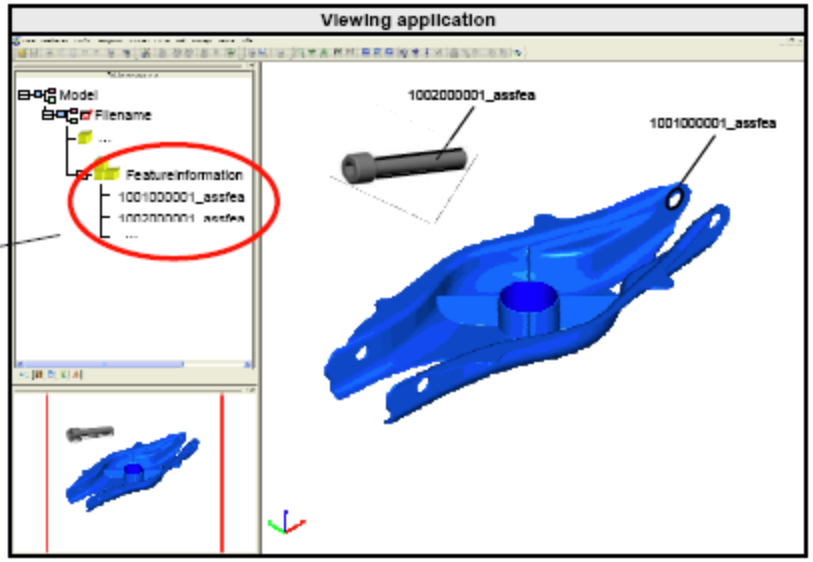
Proposal for unique feature ID nomenclature according to DIN 6763, [PAHL05, S.542]

We propose a general concept to name features and relevant geometry elements (such as connecting faces) used in collaboration projects.

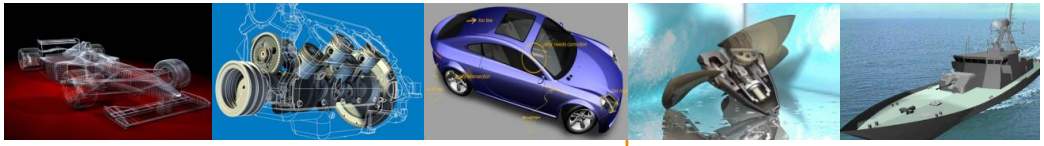


Proposal for a possible integration of the concept in a visualization tools:

- Unique feature IDs were granted (database or PDM-system)
- Entrypoint of feature information is stored in the structure of the vis.-data. Feature information itself lives in flexible XML-dataset
- Correlation between feature information (in data structure) and 3D-geometry is granted



Source: Sebastian Handschuh, Daimler



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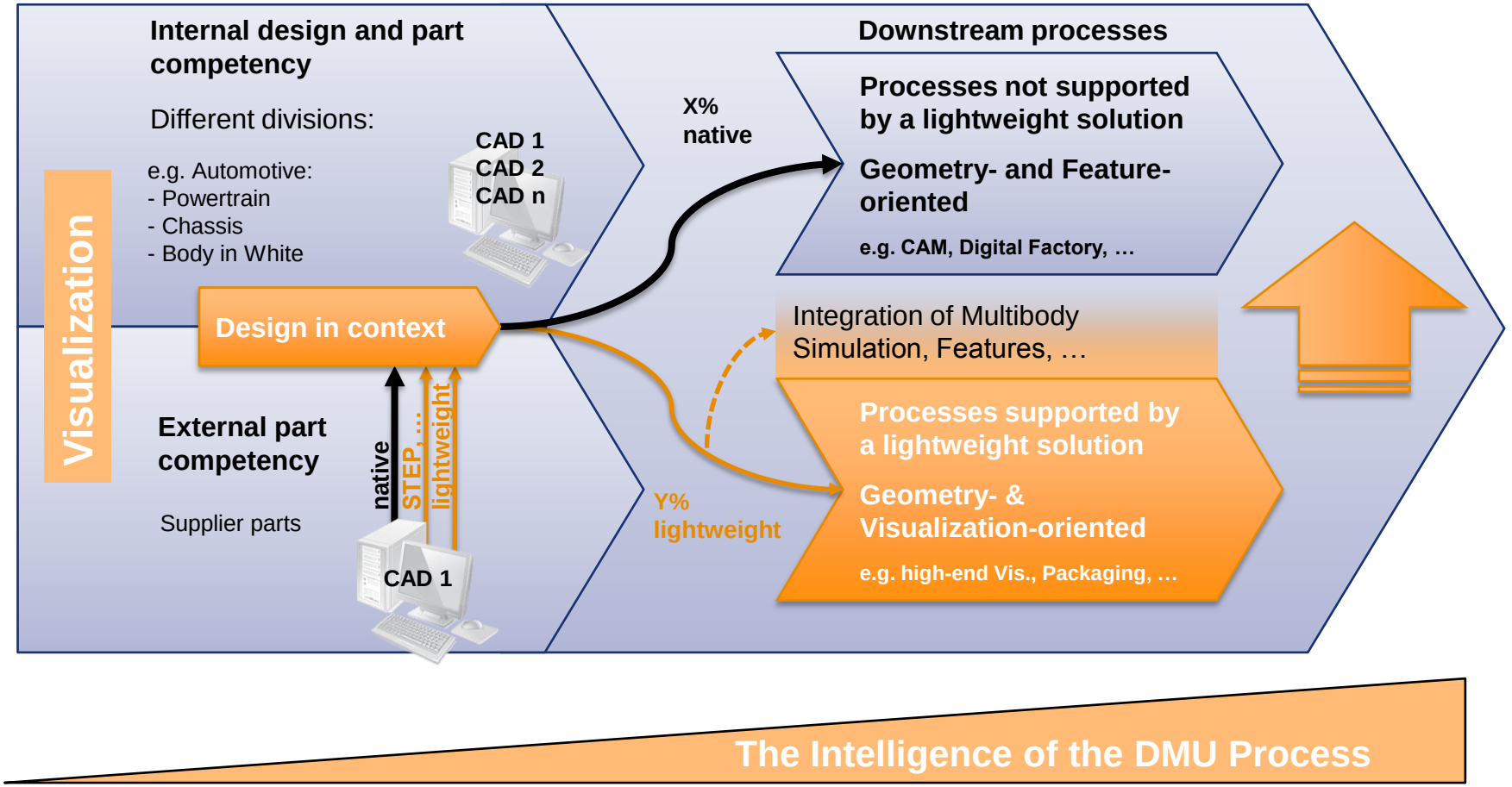
Summary 1

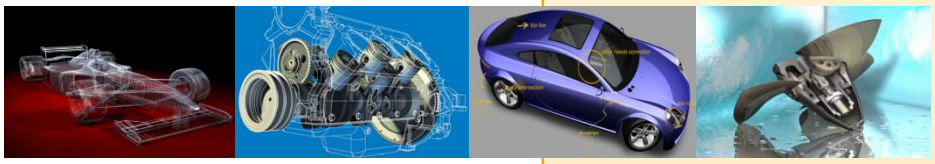
…the percentage of supportable processes can be further leveraged



Summary 2

- Other CAD Supplier have to support JT for Hybrid Design in Context
- CAE and DF Supplier have to Support JT for downstream processes
- Combine strengths of structure-oriented (e.g. STEP) and lightweight formats
- Decide how and where structure oriented information must be handled
- Missing functionalities must be provided by formats
- Translators must consistently provide required content
- Certification of translators must be provided by independent organization

Thanks for your kind attention



Questions?

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