JAMA/JAPIA Task Force “Data Interoperability in Digital Engineering”

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

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Yuichi Sagawa

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Responsible for Elysium’s Interoperability technology
Project Manager of Elysium’s 3DxSUITE

Joined JAMA/JAPIA activities as an adviser from 2017

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Organization and participating companies

JAMA — Japan Automobile Manufacturers Association, Inc

Japan Auto Parts Industries Association — JAPIA

Task Force
"Data Interoperability in Digital Engineering"

25 companies, 60 people

Leader : Honda
Sub-leader: Toyota
Member : Isuzu, Suzuki, Daihatsu, Nissan, Hino, Matsuda, Mitsubishi, Yamaha, Subaru, Kawasaki

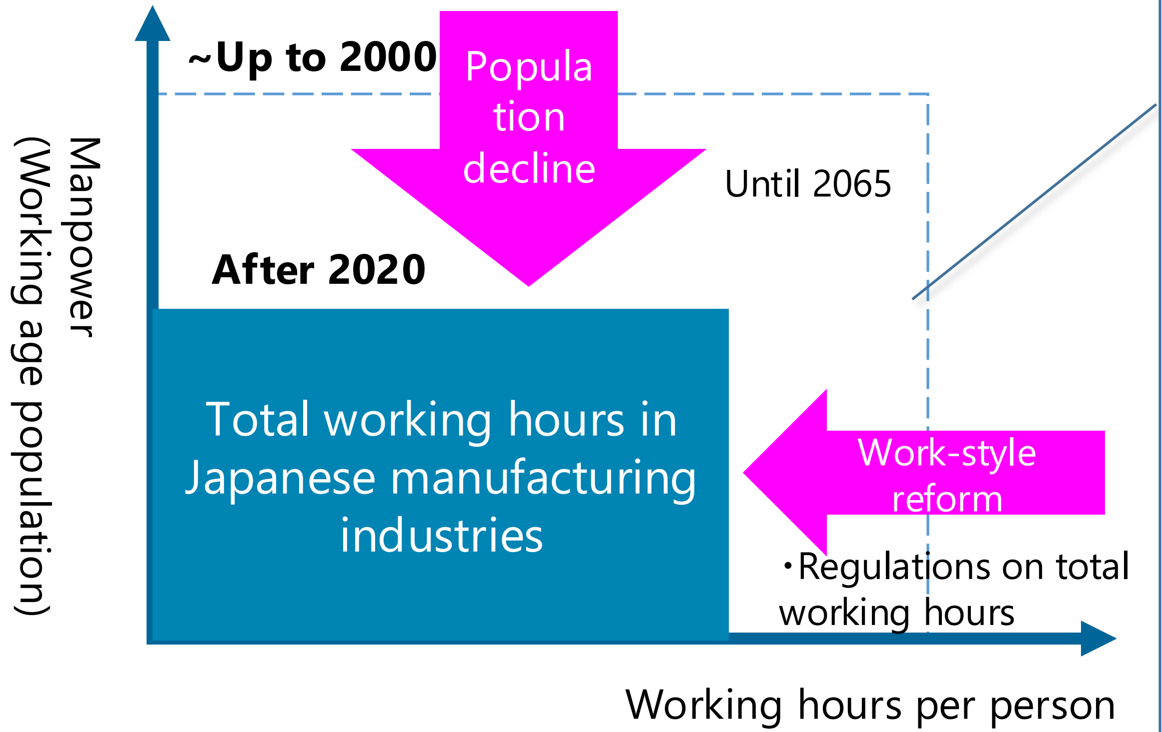
JAPIA Companies
Sub-leader: Denso
Sub-leader: Stanley Electric
Member : Aisin, Koito, TokaiRika, Toyo Denso, Toyoda Gosei, Bosch

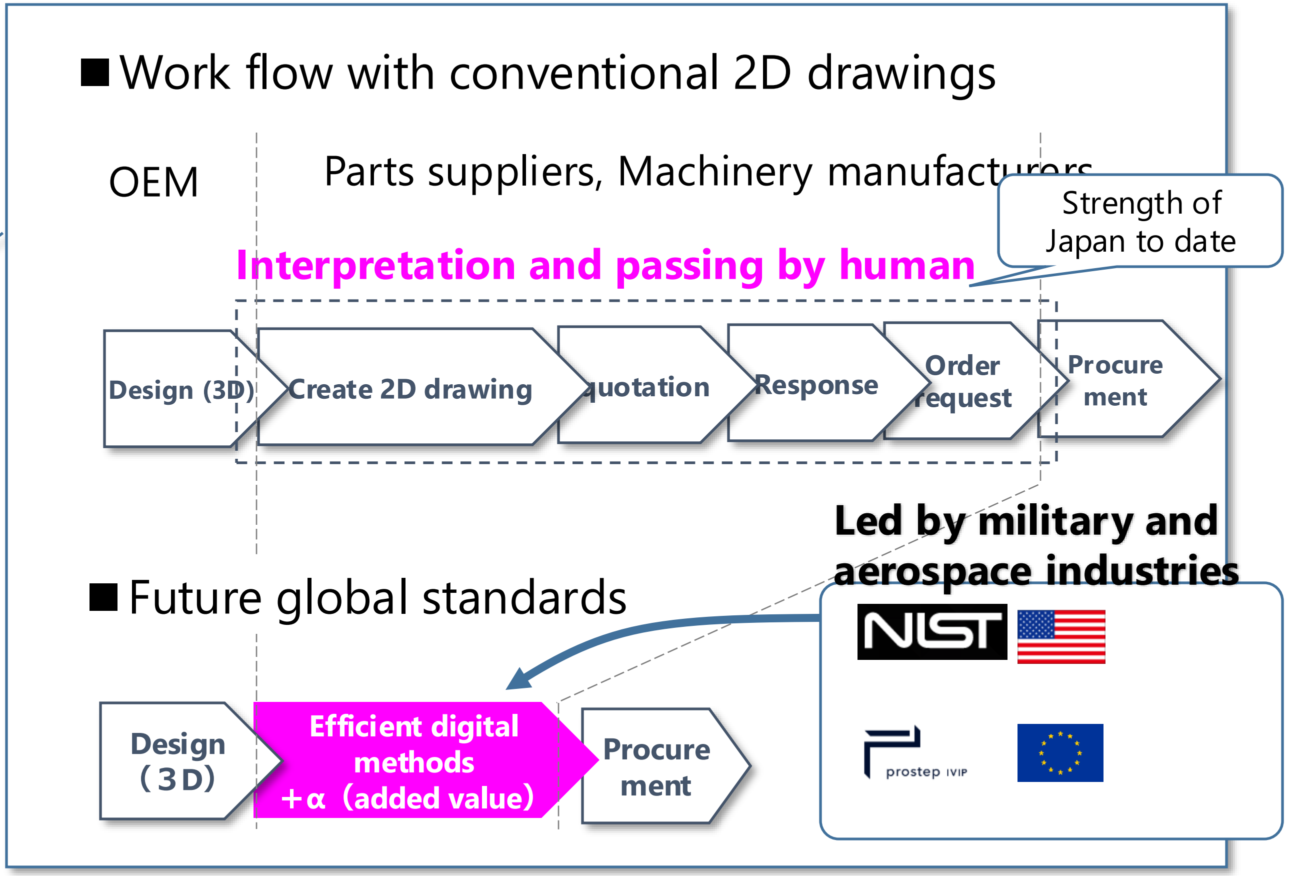
Observers
Siemens, PTC Japan, Dassault Systèmes, Elysium, SOLIZE, DI Square

Objective of the Task Force

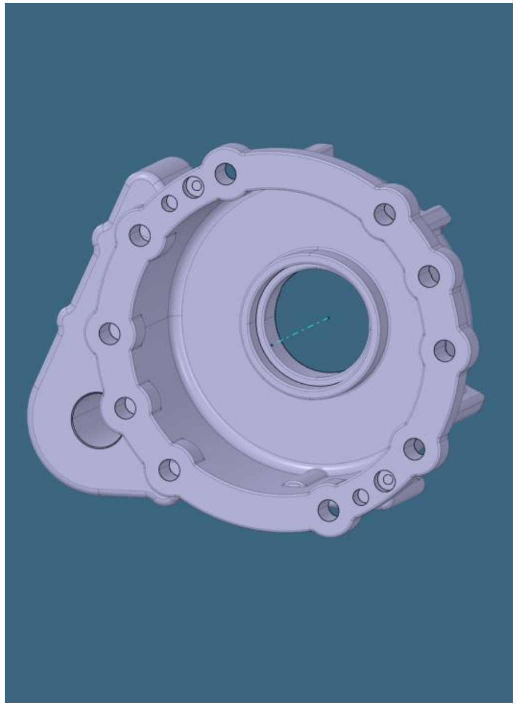
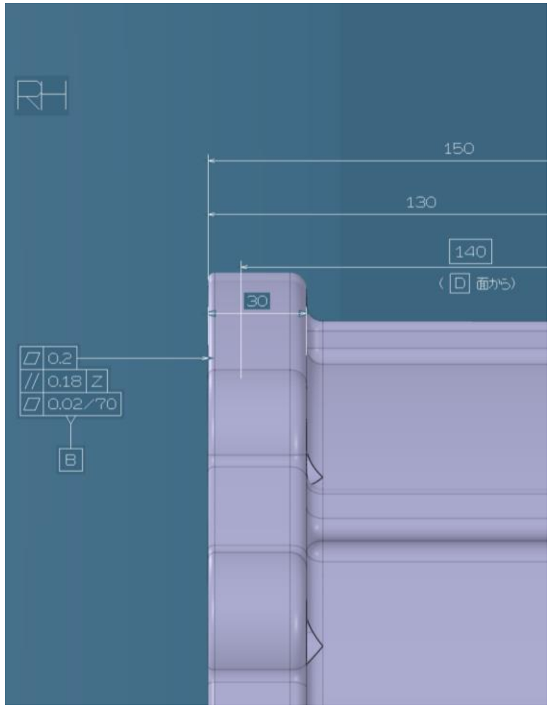
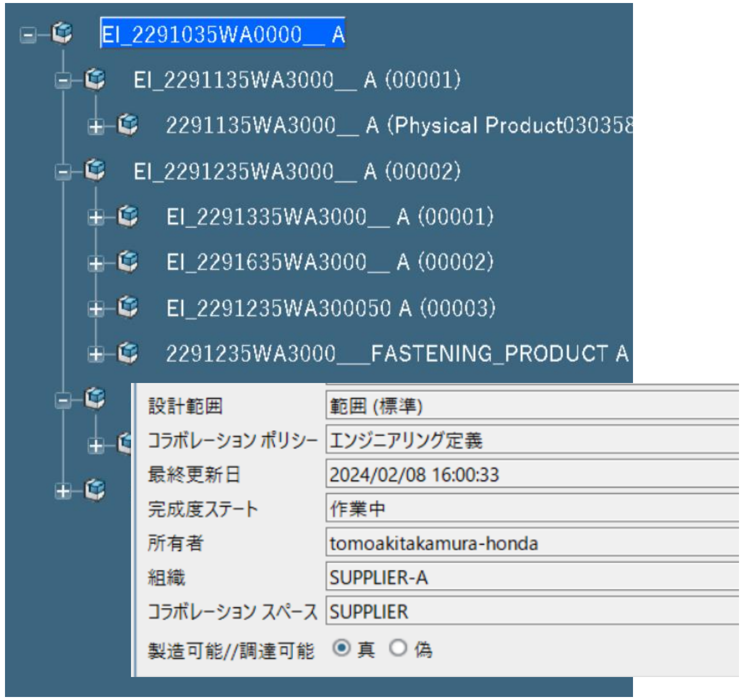
Time reduction is a critical mission in Japanese industries.

Transform the existing culture (2D drawing -> digital) and create new value.





What is DE (Digital Engineering) data?

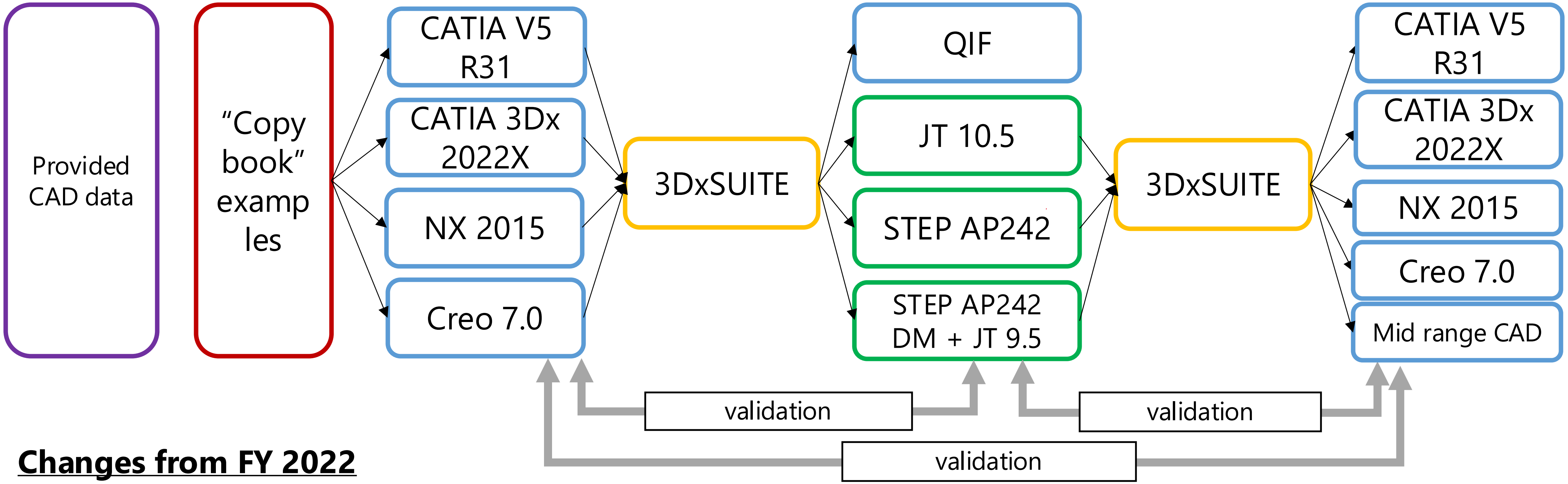
Data creation and management	3D model	PMI Product and Manufacturing Information	BOM Bill of Materials
			
CAD	○	○	○
PDM or BOM system, etc.			○

DE data distribution: Subjects and initiatives for practical use

Subjects		Initiatives in our task force
1. Data representation that aggregates PMI information into a 3D model Methodology to incorporate manufacturing information required by manufacturing and procurement departments into 3D models	⇨	Create a "copybook" of 3DA (MBD)
2. Improve CAD functionality for building 3D models Standardize functions that differ among CAD systems and improve the required functionality. Establish 3D-based design guidelines and reduce designing man-hours.	⇨	Enhance CAD functionalities Not covered in today's presentation
3. Fundamental technology for accurate and seamless distribution between digital tools Establish a guideline for using ISO standard formats. Improve interoperability of company-specific information (e.g., part numbers).	⇨	Verification of 3DA data distribution in a practical scenario (STEP3) Establish a foundation for the seamless distribution of attribute data

Contents

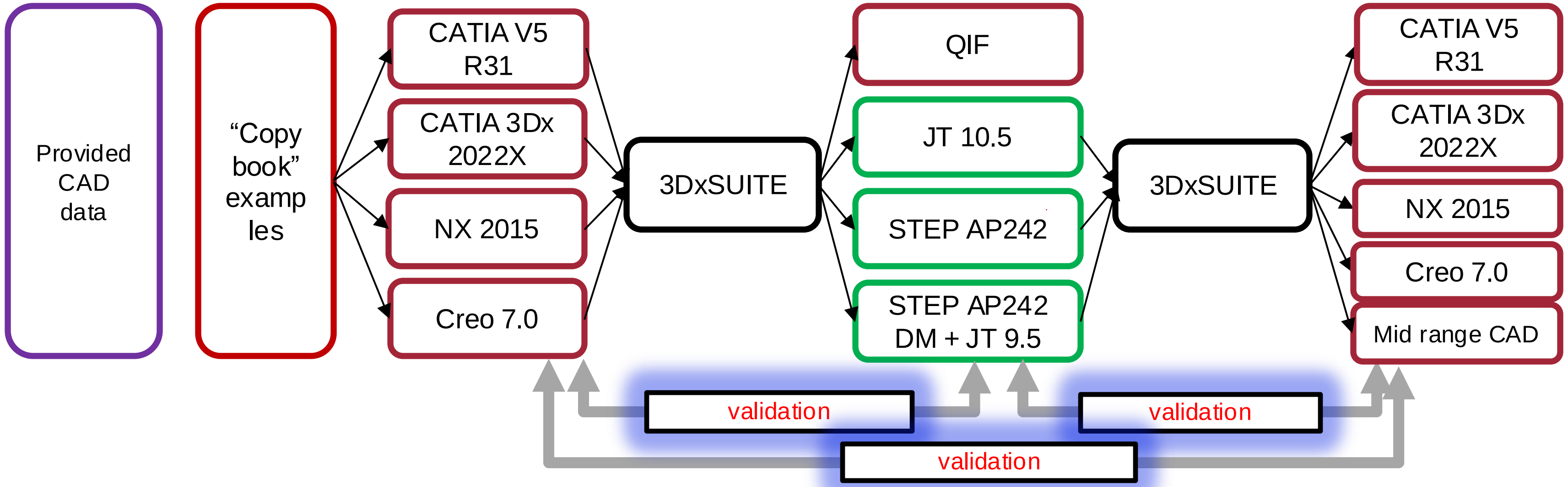
Overview of the data distribution scenario in FY 2023

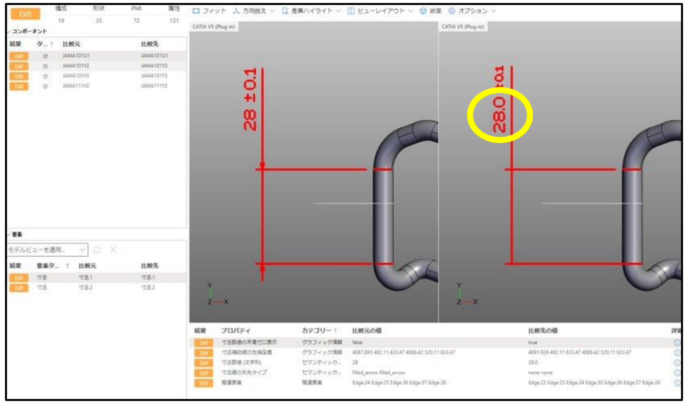


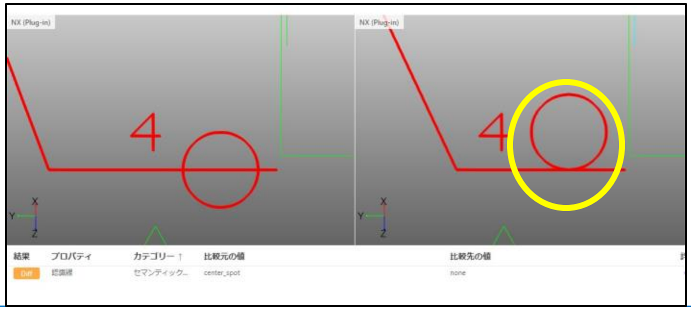
Changes from FY 2022

	FY 2022	FY 2023
CAD data	CAD data **as provided** by members	Can be used as a reference **"copybook"**
Publication	Only **within the task force**	**Public access and utilization**
CAD version	**The latest version.** Sometimes not referable.	CAD version **currently used by OEMs**
JT	**Ver. 9.5 and 10.5** (almost identical results)	**Ver. 10.5 only**

Insight towards Equivalence validation





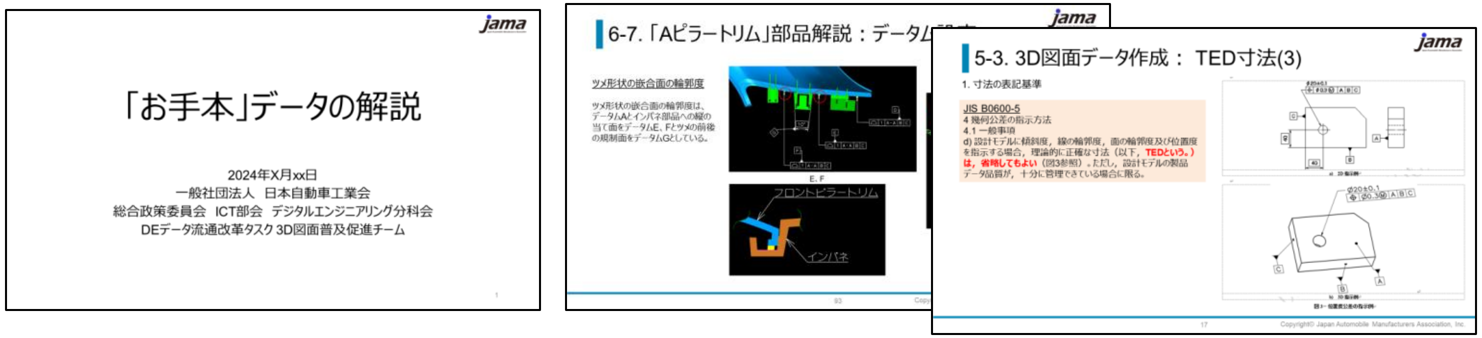


Equivalence validation of PMIs and attributes played a key role during investigation/confirmation of the data conversion result

- Equivalence validation between the original and converted data
- A commercial software was used on equivalence validation

The “copybook” policy

1. Comply with ISO (and JIS, ASME, JAMA) standards and guidelines.
2. Prepared not to violate each company’s confidentiality and copyright rules so that it can be widely used
    - 3D shapes are **not the ones of actual products**
    - **Absolute values** for size and geometric **tolerances are not actual**
    - **The presence or absence of dimensions and geometric tolerances and how they are defined can be used as a reference**
3. “Commentaries of the copybook” will be published together
    - Description of the "copybook" data and findings from the task force’s activities are included

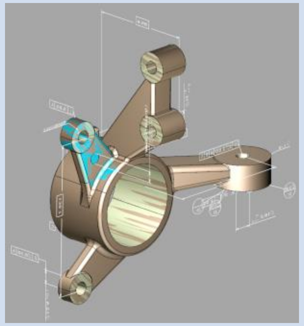
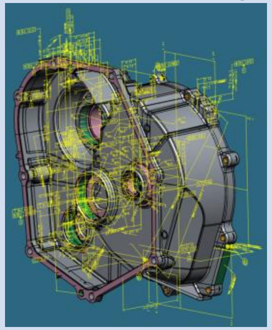
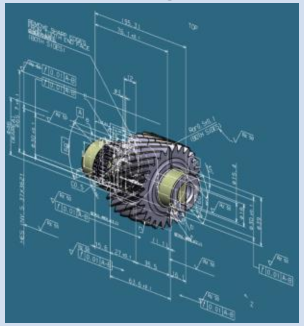
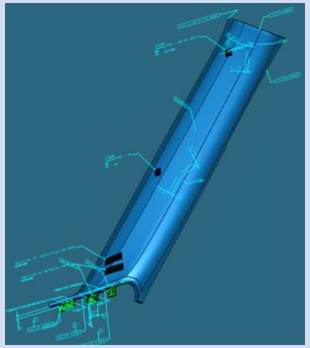
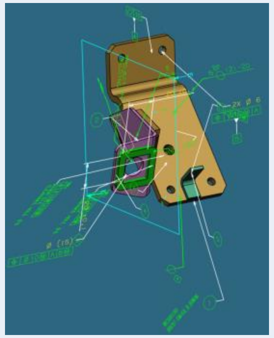
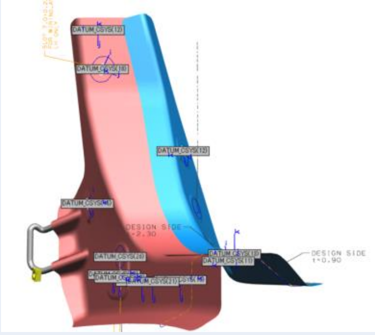
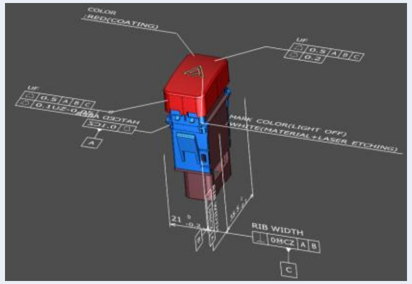


Consists of more than 100 slides

Commentaries of the cookbook

7 models in the “copybook”

The selected parts serve as a "copybook" for modeling 3DA data (MBD) in a wide range of fields

	Sheet metal	Casting	Plastic
Part		3. knuckle  4. housing  5. gear 	6. Trim 
Assembly	1. bracket  solid 2. C piller Reinf.  shell		7. Switch 

Verification of the “copybook” models

Design reviews were conducted by task force members for the seven models

お手本データ実施事項フォロー表

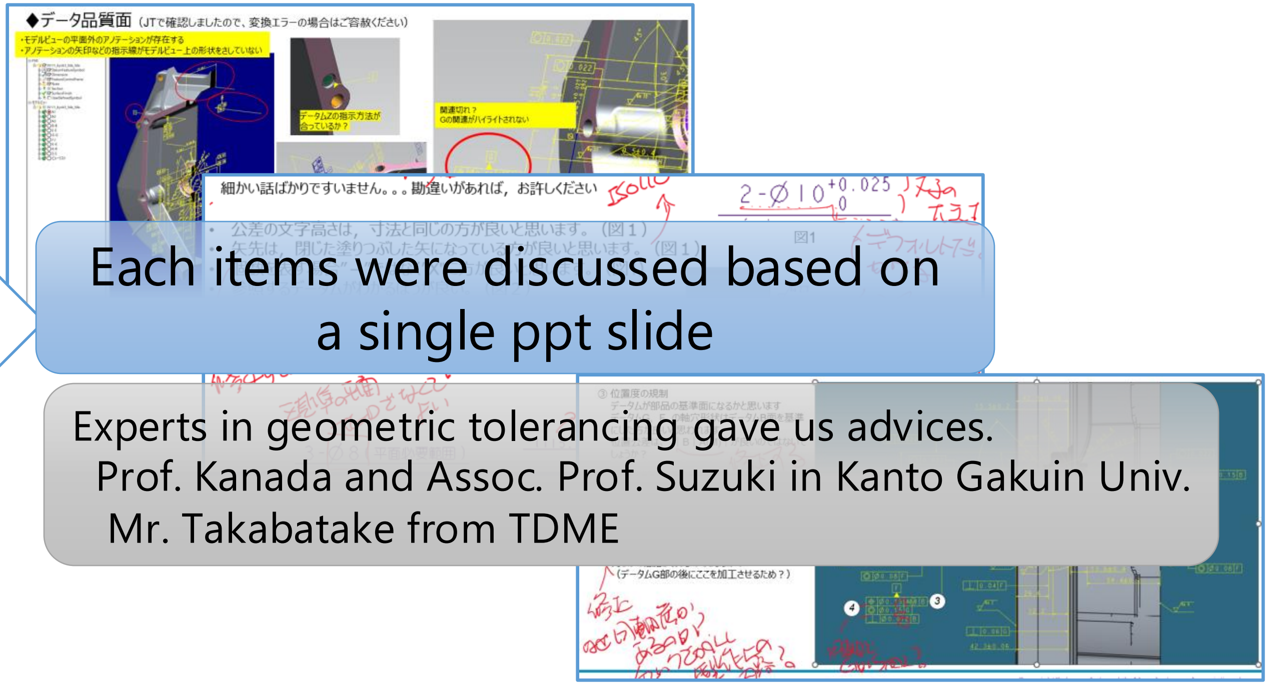
残指示 ①JAMA DR＃２後の修正
②有識者アドバイス後の修正

番号	摘出日時	モデル	指摘会社	PPT No	指摘事項	検討内容	検討記入	SOLIZE殿へのモデル依頼事項・結論	結論記入	モデル織込
93	9/15	いすゞ	トヨタ	2	③3D空間に浮いている品名などの注記は必要か？	このままとする。今後、ISO22081などを追加するニーズもあり。社名が記載されているが、社名は消す	9/15	社名は削除。それ以外はそのまま。	9/25	9/15SOLIZEにて対応済み。
94	9/15	いすゞ	トヨタ	3	溶接部のB BFは修正する必要はないか？	Bは強度指示、BFは検査指示だが、いすゞ社内ルールなので、JISに準拠した表記に改める	9/15	B、BFは削除。JISZ3021表5に合わせて、ナゲット径、打点の数、打点の間隔を記入する。	9/26	
95	9/15	いすゞ	トヨタ	5	幾何公差はM6指示なのか、Φ8に対しての指示なのか？	(M6)は消す	9/15	M6への指示なのでそのまま。修正不要。	9/25	(Close)
96	9/15	いすゞ	トヨタ	6		社内ルールとして、ピッチが…		JIS B0002-1の4.1によれば、ピッチは「も…		
97	9/15									
98	9/15									
99	9/15							変更する。		
100	9/15	いすゞ	ホンダ	4	バルーンが一つで、2つの部品の指示になっている。2つの部品にバルーン表示すべきではないか？	このまま	9/15	このまま	9/15	(Close)
101	9/15	いすゞ	マツダ	1	注記部分の対応	→No93	9/15	→No93	9/15	(別項目参照)
102	9/15	いすゞ	マツダ	2	①色の使い分け	→No86	9/15	→No86	9/15	(別項目参照)
103	9/15	いすゞ	マツダ	2	②引出線端末記号。塗潰丸の表記	JIS B0060-3に合わせる	9/15	JIS B0060-3 4.4.3に合わせて引き出し線の端末記号を修正する。		
104	9/15	いすゞ	マツダ	3	①アーク溶接と部品形状が乖離している	部品形状に合わせ、修正する	9/15	部品形状にR追加	9/25	9/15SOLIZE対応済み
105	9/15	いすゞ	マツダ	3	②プロジェクション溶接、スポット溶接が部品からズレている	部品形状に合わせ、修正する	9/15	溶接打点位置修正	9/25	9/19いすゞ対応済み
106	9/15	いすゞ	マツダ	3	③◇は何か	→No87	9/15	→No87	9/15	(別項目参照)
107	9/15	いすゞ	マツダ	4	Φ15のカッコの意味	→No92	9/15	→No92	9/15	(別項目参照)

Result of the design review

466 issues were pointed out.

Issues from the design review



Each items were discussed based on a single ppt slide

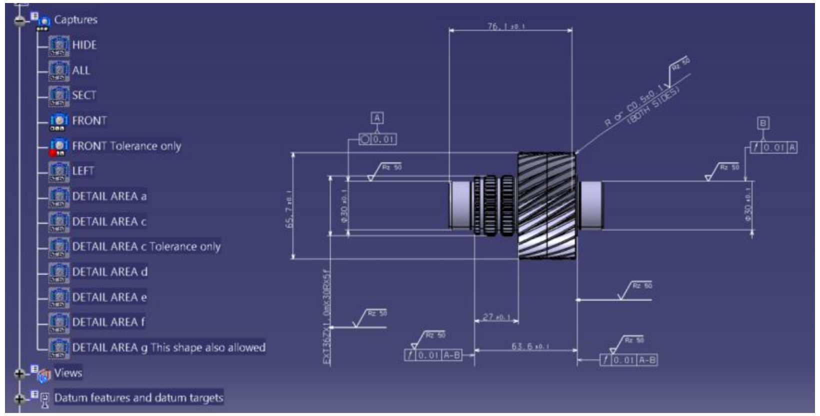
Experts in geometric tolerancing gave us advices.
Prof. Kanada and Assoc. Prof. Suzuki in Kanto Gakuin Univ.
Mr. Takabatake from TDME

Issue 1. Omission of dimensions

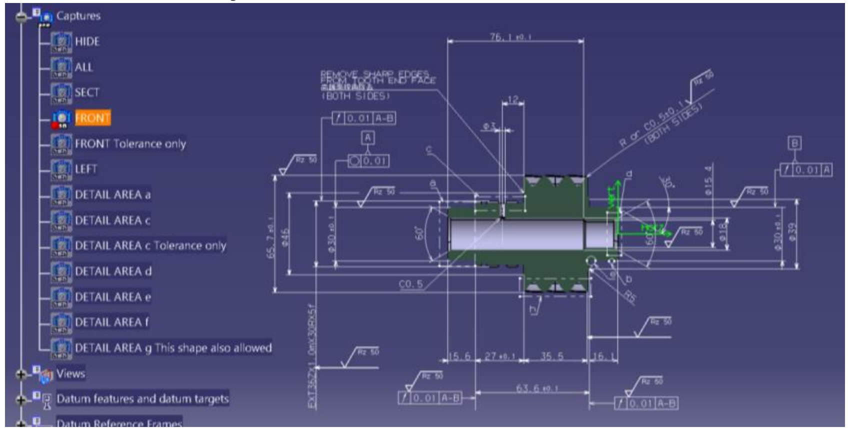
To reduce the man-hours required to create models, annotations should be as few as possible.

In principle, dimensions are limited to size tolerances only.

Reduced dimensions



Fully annotated dimensions



(Reference)　Dimension rules

From JIS B0060-1、-4、-5 (Japanese standards that correspond to ISO 16792)

JIS B0060-1

7 Graphical style of requirements to be displayed

7.2 Dimensions and dimensional tolerance limits

b) The method of indicating dimensions on the design model shall be as follows, in addition to JIS Z 8310.

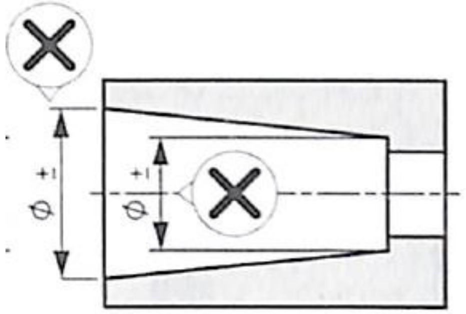
3) **Dimensions may be omitted** if the notes or other information state that "dimensions representing the size, shape, orientation, and position of the object are based on the design model". **However, dimensions shall not be omitted when tolerance limits for dimensions are required**

Issue 2. Dimensions associated with edges

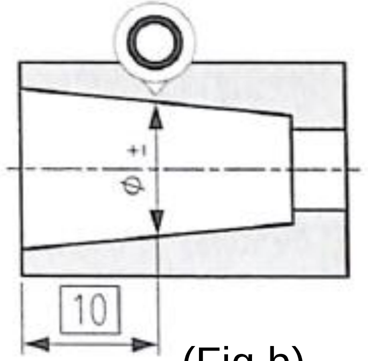
Modeling in accordance with ISO principles.

Size tolerance not specified between edges

e.g. The size tolerance should be indicated in the middle of the tapered hole, not at the edge, in consideration of measurement accuracy at the edge, as shown in Figure b.



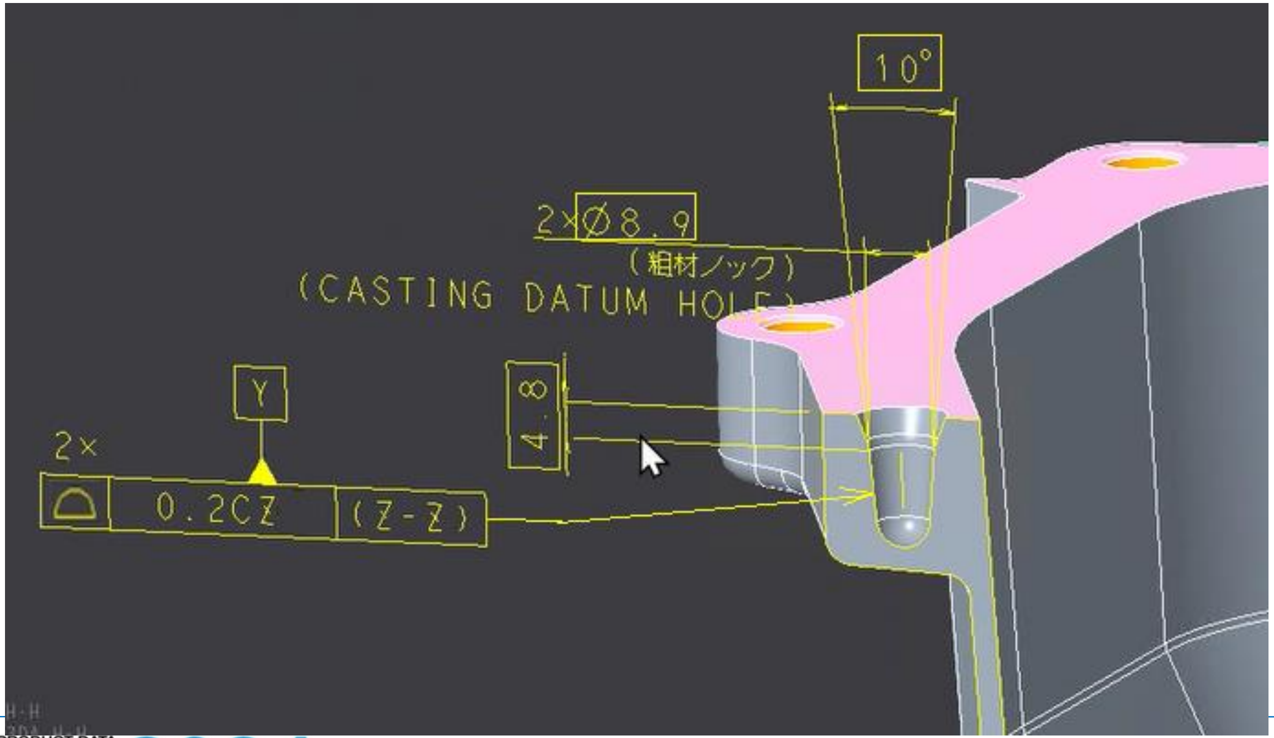
(Fig a)



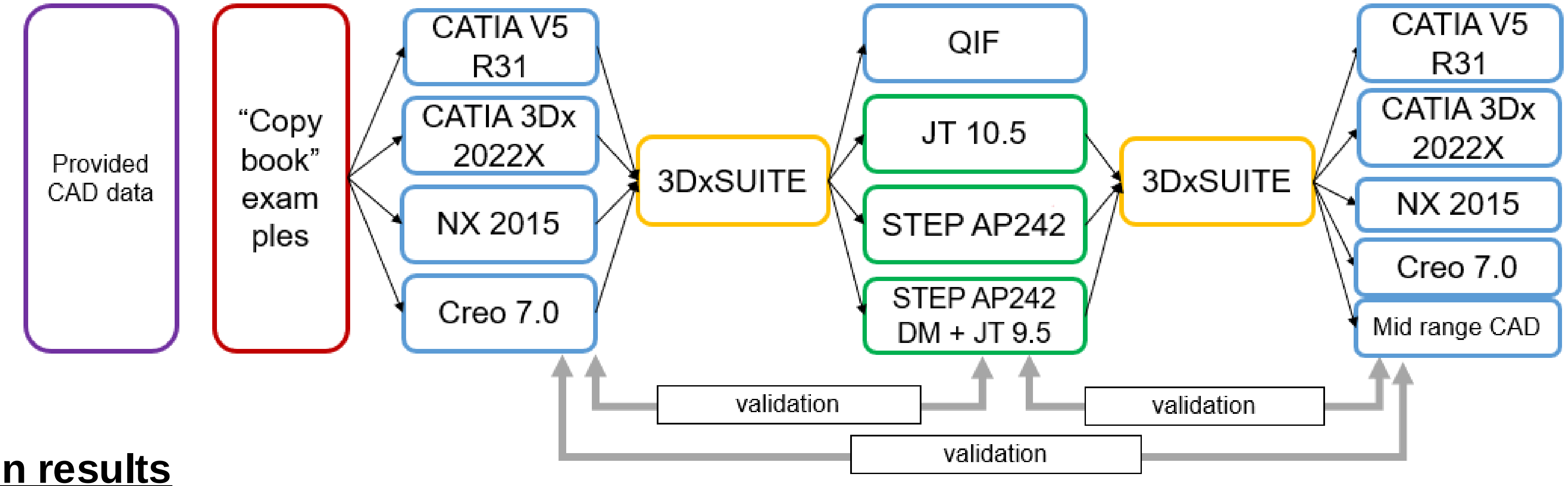
(Fig b)

From: 幾何公差公差解析実践ハンドブック
(Practical Handbook of Geometric Tolerance Analysis)

- The size and geometric tolerances of the tapered holes were set as follows, aiming for the simplest possible annotation.
- The taper is defined by the "surface profile." Consequently, the position of the axis is also determined.



Identified issues in the conversion of the “copybook” models



Verification results

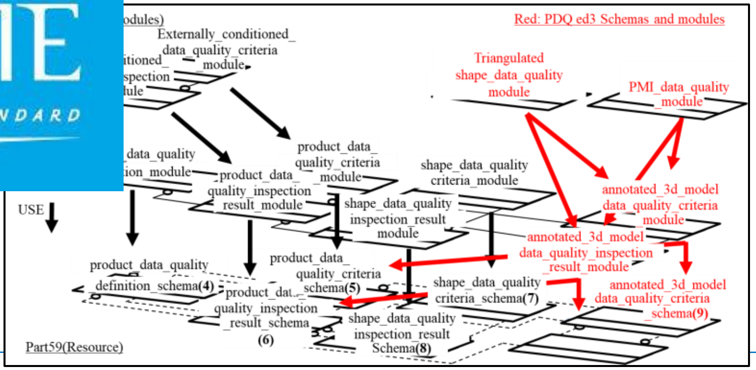
	Class.	Causes	Future actions by JAMA	#
1	Design	Design and modeling methods	Create and publish a "**modeling guideline**" for designers to improve design quality	6
2	CAD	Specifications and limitations of CADs	Update the “**CAD Functional Requirements Guidelines**” to encourage vendors to enhance functionalities	37
3	Conversion	Specifications and limitations of converters	Request improvements and enhancements to vendors	60
4	Standard	Specifications and limitations of standards	**Request enhancements to international organizations**	14

Insight towards PMI PDQ

	Class.	Causes	Future actions by JAMA	#
1	Design	Design and modeling methods	Create and publish a "**copybook**" for designers to improve design quality.	6
2	CAD	Specifications and limitations of CADs	Include in the "**CAD Functional Requirements Guidelines**" to encourage vendors to develop functionality	37
3	Conversion	Specifications and limitations of converters	Improvement requests to vendors and benchmark activities	60
4	Standard	Specifications and limitations of standards	**Revision requests to the international organization**	14

The capability to perform PMI PDQ checks is essential in identifying "Design" & "CAD" issues prior to data conversion/distribution

Important to apply checks compliant with ASME standards and PMI PDQ ed3 update in STEP AP242 ed4.

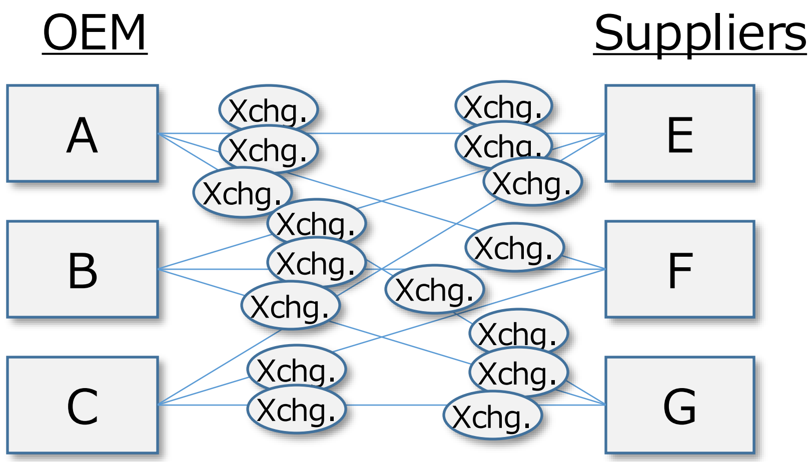


Contents

As-Is and To-Be of attribute data exchange

JAMA promotes the standardization of exchanges between company-specific definitions and standard formats

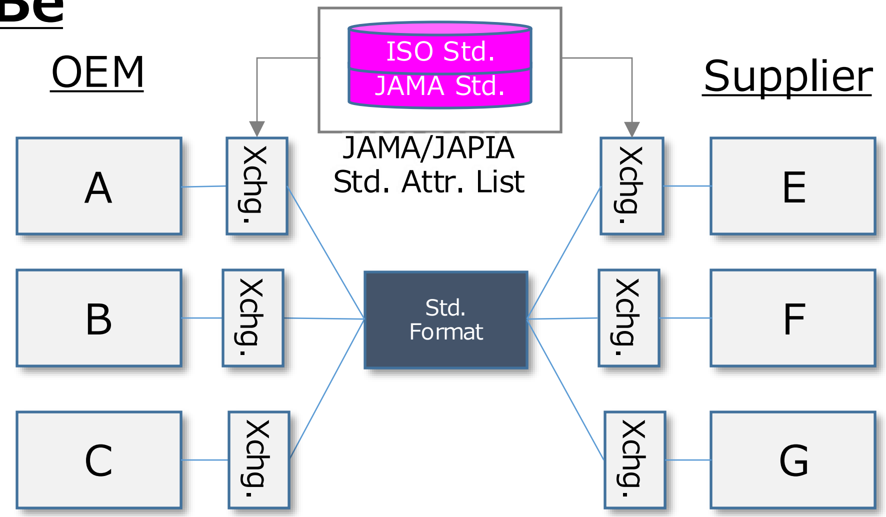
As-Is scenario



Individual cases are addressed
individually among each company

Issues
・Mnt. cost of conversion variations -> High
・Cost of xchg. and validation -> High

To-Be



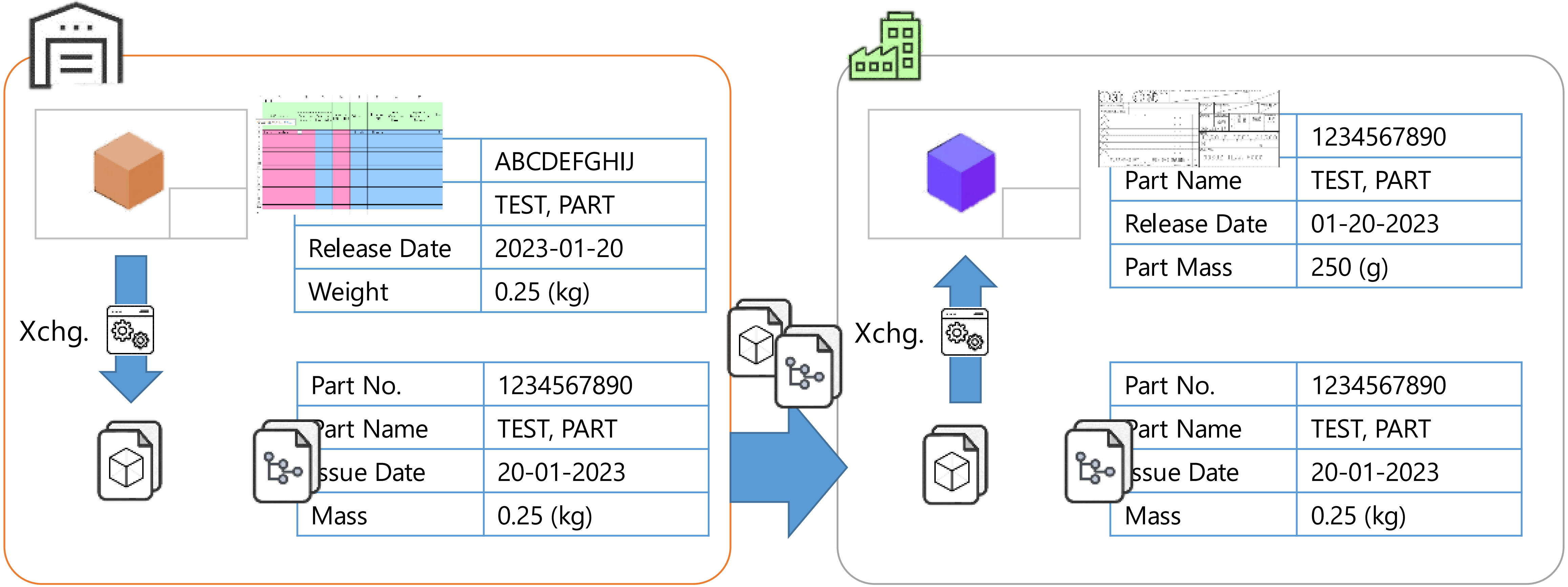
Each company can focus on the exchange between company-specific definitions and industry standard

Advantages
・Unified format and rules: reduced operating costs with stable quality
・Reduce barriers to new business/entry

Identify significant attributes in JAMA/JAPIA, and then organize how to use them in practice

Target use cases

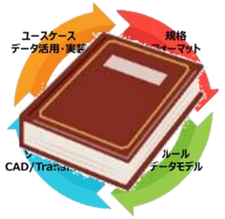
The target use case is **"data exchange between an OEM and supplier"** which is popular in any company



Steps taken toward standardization of product attribute data

Proof of principle

Organize the specification of product attribute data exchange to materials



- Study the Rec. Prac. from PDM-IF
- Extension from JAMA/JAPIA's perspective
- Consider operational methods

Step		Description	Utilize std. format	Incorporated into COTS	Implementation cost
PoC1 Basic	**Implement a simple tool to verify the principle**	Basic attribute exchange based on a mapping spreadsheet - Manual, using MS Office, etc. - No specific tools required	○	-	**Low**
PoC2 Advanced	**Incorporate into a commercial tool and verify the principle**	Incorporate the PoC1 functionalities into COTS. Automate manual tasks in PoC1.	○	○	**Mid**

PoP: JAMA/JAPIA Standard Attribute List

➢ Necessary information was compiled for the practical scenario

(1) JAMA/JAPIA Standard Attribute List

Contents
・Standard names and meanings of common attributes
Usage
・Referenced as standard when creating the mapping table.
Users
・People in charge
・People in charge

Defined 26 attributes necessary in a practical data exchange scenario

(2) Company Specific Attribute Definition List

Contents
・The representations of attributes in each individual company
Usage
・A mapping table from each company to the JAMA standard
Users
・People in charge of data exchange methods preparation

(3) A sample STEP AP 242 DM file

Contents
・A sample STEP AP 242 DM file that includes all items in the standard attribute list with commentaries.
Usage
・Understanding contents of XML files
・Verification and trouble shooting of result XML files
Users
・Implementers of tools, People in charge of data exchange methods preparation
・Support staff of data exchange

JAMA/JAPIA Standard Attribute List

Id. code	attribute name	Japanese attr. name
LA-0001	Standard Version	属性定義Ver.
AA-0001	Part Number	部品番号
AA-0002	Part Name	部品名称
AA-0003	Attached Chart	添付図表
AB-0001	Design Change No.	設変管理No.
AB-0002	Revision No.	改訂符号(部品)
AB-0003	Status	ステータス
AB-0004	Designer	設計者
AB-0005	Drawing Issued Date	図面発行日付
AB-0006	Approver	承認者
AB-0007	Event	イベント
CA-0001	Mass(Value)	質量(値)
CA-0002	Thickness	板厚（値）
CA-0003	Density	密度（値）
CA-0004	Volume	体積（値）
CA-0005	Centroid	重心
CB-0001	Mass(Unit)	質量(単位)
CB-0002	Thickness(Unit)	板厚(単位)
CB-0003	Density(Unit)	密度(単位)
CB-0004	Volume(Unit)	体積(単位)
CC-0001	Dimensional Tolerance Standard	寸法公差規格
CC-0002	Mass Tolerance Standard	質量公差規格
MA-0001	XML File auther	XMLファイル作成者
MA-0002	Company Domain Name	ドメイン名
MA-0003	Organization name	会社名・組織名
ZZ-0001	Material	材質

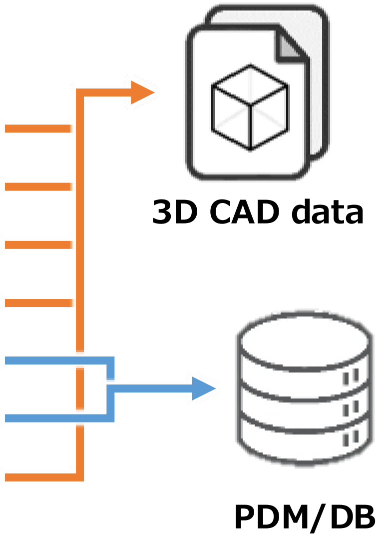
PoP: Company Specific Attribute Definition Sheet

Each company has different naming conventions, etc.
How data are managed also varies.

One’s company

<Attributes>

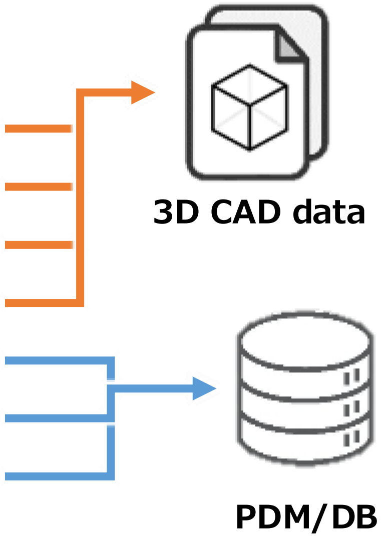
Attribute	Managed by
In-house part No	CAD
Partner part No	CAD
In-house part name	CAD
Partner part name	CAD
Release data	PDM
Approval status	PDM
Mass	CAD
…	



The partner company

<Attributes>

Attribute	Managed by
In-house part No	CAD
Partner part No	CAD
In-house part name	CAD
Partner part name	CAD
Release data	PDM
Approval status	PDM
Mass	PDM
…	



Basic verification scenario for PoC1 and 2

Bidirectional distribution of attribute data between two companies, in a model approval scenario.

Company A

Create sending data

1. A mapping table between attr. in A and JAMA standard attr.
2. Input attribute value
3. Create an AP 242 DM file

Attr. In A	Std. Attr.
AAA ↔	XXX
BBB ↔	YYY

Attr. In A	Std. Attr.
AAA	111
BBB	222

XML

Send

Verify received data

8. Import the received file and verify the contents

XML

Company B

Verify received data

4. A mapping table between attr. in B and JAMA standard attr.
5. Import the AP 242 DM file and verify the contents

Attr. In B	Std. Attr.
CCC ↔	XXX
DDD ↔	YYY

XML

Attr. In B	Value
CCC	111
DDD	222

Add approval information

6. Add attributes to the imported data
7. Create a new AP 242 DM file

Attr. In B	Std. Attr.
CCC	111
DDD	222
EEE	333

XML

Send

〇PoC1 checkpoints

☑ Are the materials prepared in the PoP sufficient for the workflow?

☑ Is there any information missing?

Remaining issues

Operation	Tool
• Transcription by humans **may cause errors.** • **The hurdle to implementing tools** at each company is **high**, and **the installation process is complex**. • Users are required to have **prior knowledge**. （The input style is influenced by the structure of STEP DM)	• Limitation in the number of non-standard attributes (up to 10) • **Assemblies are not supported.** • If there are multiple names for the same attribute, the tool cannot distinguish them.

〇PoC2 checkpoints

☑ Is there any information missing?

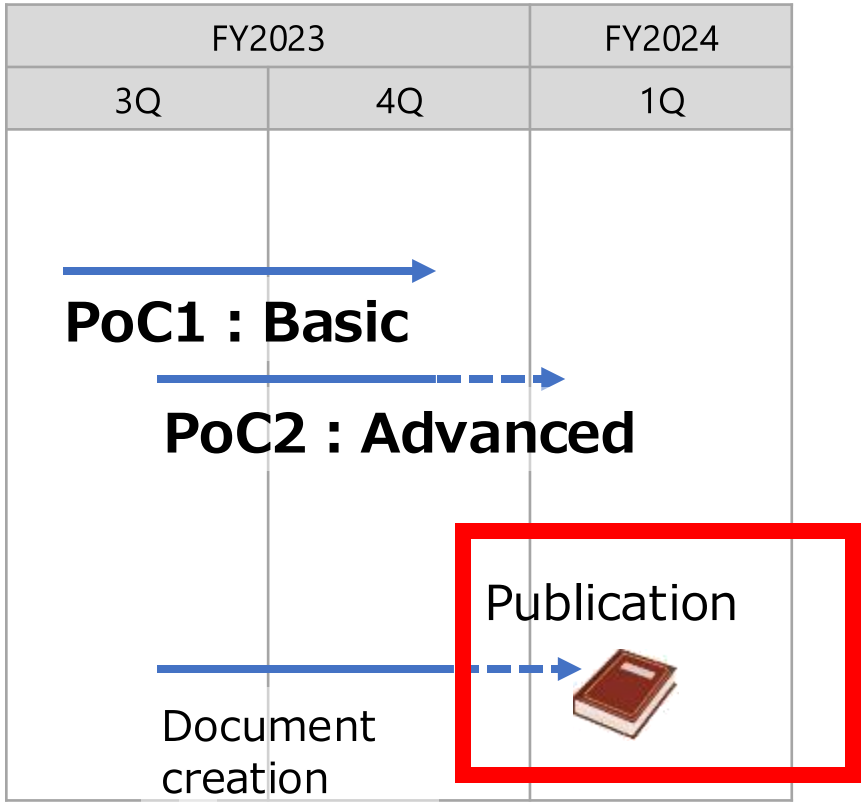
Summary

Operation notes	Tool issues
• A mutual agreement of attributes to include in the STEP XML is mandatory between sender and receiver • Attribute data managed in PDM needs to be organized so that it can be smoothly tied together with attribute data coming from the CAD system • Attribute data linked with multiple organizations need to be handled carefully so that they don't get mixed up	• Some attribute types change during data conversion • Some attribute data represented in specific units are not respected in unit conversion

Contents

Publication on the JAMA web page

- Published documents in April 2024



[デジタルエンジニアリングに関する標準化活動 | JAMA - 一般社団法人日本自動車工業会]

CAD function requirement guidelines
The copybook and commentaries

Attribute exchange guidelines

Future Activities

(white box)	FY 2023
(yellow box)	FY 2024 (Plan)

Subjects		Initiatives in our task force
1. Data representation that aggregates PMI information into a 3D model Methodology to incorporate manufacturing information required by manufacturing and procurement departments into 3D models	⇨	Create a "copybook" of 3DA (MBD) [FY 2023] Best practices for modeling efficiency (multi-part model, drawing check, etc.) [FY 2024 (Plan)]
2. Improve CAD functionality for building 3D models Standardize functions that differ among CAD systems and improve the required functionality. Establish 3D-based design guidelines and reduce designing man-hours.	⇨	Enhance CAD functionalities [FY 2024 (Plan)]
3. Fundamental technology for accurate and seamless distribution between digital tools Establish a guideline for using ISO standard formats. Improve interoperability of company-specific information (e.g., part numbers).	⇨	Verification of 3DA data distribution in a practical scenario (STEP3) [FY 2023] Establish a foundation for seamless distribution of attribute data [FY 2023] Apply to actual business scenarios and enhance the types of attributes supported [FY 2024 (Plan)]

Conclusions

- High interest from JAMA/JAPIA members has resulted in two years of active engagement.

- The following deliverables were created based on the latest business needs, and we recognize that they can be utilized by industry users for future business development.
  - The “copybook” of 3DA (MBD)
  - A foundation for seamless distribution of attribute data
  - CAD functionality requirement guidelines

- For practical use, we will continue to promote the development of an environment for companies that receive (refer to and use) data and to enhance the types of attributes supported.