SASIG Long Term Archiving & Retrieval of Digital Product Definition Data Quality Assurance Recommendation

FOREWORD

Many companies are migrating or have migrated their product definition and lifecycle management authoring processes from traditional hard-copy, paper based document management processes to processes that highly leverage computer aided/digital information creation techniques. As a consequence of this activity, new processes must also be defined to archive digital information and preserve access to it, in compliance with business and regulatory requirements.

Certain classes of product definition data specify multi-decade time periods. For this recommendation a time period is defined as the span of time over which classes of product information are to be managed by the long term archiving and retrieval system. Over these time periods, changes in both the editing and storage technologies impact an organization's ability to retrieve and use product information. All organizations which use digital product information will need strategies and processes that maintain the usability of the information over multiple generations of technology.

The SASIG Long Term Archiving & Retrieval Project is developing a set of recommendations to guide companies to effective and efficient archival and retrieval practices. The recommendations are partitioned into four topic areas: 1) Format, 2) LTAR Process, 3) Time Periods, and 4) Quality Assurance.

This document addresses the set of quality assurance recommendations. In particular, this document aims to provide a comprehensive explanation of the four checking and validation functions that define the LTAR QA strategy. The four functions are: Product Data Quality (PDQ) Check, Archival Rules Check, Fixity Check, and Equivalence Validation. Included is a detail description of what each function does, why it is needed, and when it should be performed.

ACKNOWLEDGEMENTS

Cape Cod Community College	Fredrick Bsharah
Daihatsu Motor Co., Ltd.	Masahiro Miyoshi
Digital Process Ltd.	Takamasa Tanaka
Fuji Heavy Industries Ltd.	Takaaki Koide
Fujitsu Kyushu Systems Limited	Katsuya Toyama
Fujitsu Kyushu Systems Limited	Taku Nagatomo
Hino Computer System Co.,Ltd.	Hiroshi Ohta
Honda Motor Co., Ltd.	Koichiro Kawakami
International TechneGroup Incorporated	Mike Lemon
Isuzu Motors Limited	Yoichi Ishida
Kawasaki Heavy Industries, Ltd.	Shinya Sato
Mitsubishi Fuso Truck and Bus Corporation	Kunihiko Yoshino
Mitsubishi Motors Corporation	Kenji Ando
Nissan Motor Co., Ltd.	Masaya Ozawa
PSA Peugeot Citroën	Frédéric Chambolle
Suzuki Motor Corporation	Tetsumi Kobayashi
Toyota Motor Corporation	Naohito Takeyama
Yamaha Motor Co., Ltd.	Takanori Toguchi

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1. INTRODUCTION: LONG TERM ARCHIVING & RETRIEVAL

In today's engineering and manufacturing organizations, paper based product design and analysis approaches have been or soon will be replaced by computer-based solutions that digitally store and manage the product definition information. New business processes, information architectures and models, and hardware/software infrastructures have been deployed within the OEM and supply communities to effectively leverage the initial usage of this newly created digital information.

However, the processes, models, and infrastructural designs for addressing the long term archival and retrieval (LTAR) of the digital information have not been widely deployed. Long term archival and retrieval has been a challenge because any solution requires alignment of storage media, data architecture, authoring/editing software, and hardware infrastructure. Such an alignment can be difficult to achieve because each of these components have their own unique lifecycle durations.

Until recently, the relative newness of digitally managed product definition and lifecycle information has afforded companies with the opportunity to ignore Long Term archival issues. However, many companies have now reached a level of maturity with digital product lifecycle information management so that issues pertaining to time period and reuse have become paramount with respect to their near-term business plans and economic viability.

The recommendations developed by this project have been designed to guide companies to effective and efficient archival and retrieval practices. Specific recommendations address Format, the LTAR Process, Time Period, and Quality Assurance. Figure 1 shows the relationship between the four recommendations with respect to the preparation, archival, and retrieval events. Figure 1 also depicts a planned project for developing a test bed capability for assessing an enterprise's LTAR capability.

The LTAR QA approach encompasses 4 functions, a Product Data Quality (PDQ) Check, an Archival Rules Check, a Fixity Check, and an Equivalence Validation. The Product Data Quality (PDQ) Check verifies that the original or target data being archived conforms to product data quality rules defined by the responsible organization. The Archival Rules Check validates that the Descriptive Information (DI) provided complies with the organization's policy. The DI is set of information, consisting primarily of information intended for supporting data access (finding, ordering, and retrieving of LTAR information). This term was originally defined by the Reference Model for an Open Archival Information System (ISO 14721 - OAIS). The Fixity Check substantiates that the archived data integrity has been maintained during the LTAR time period. The Equivalence Validation validates that after the translation process has completed that the translated data is still reliable with respect to the original data.

The section two of this recommendation elaborates on the meaning, usage, and dependencies of the four functions.

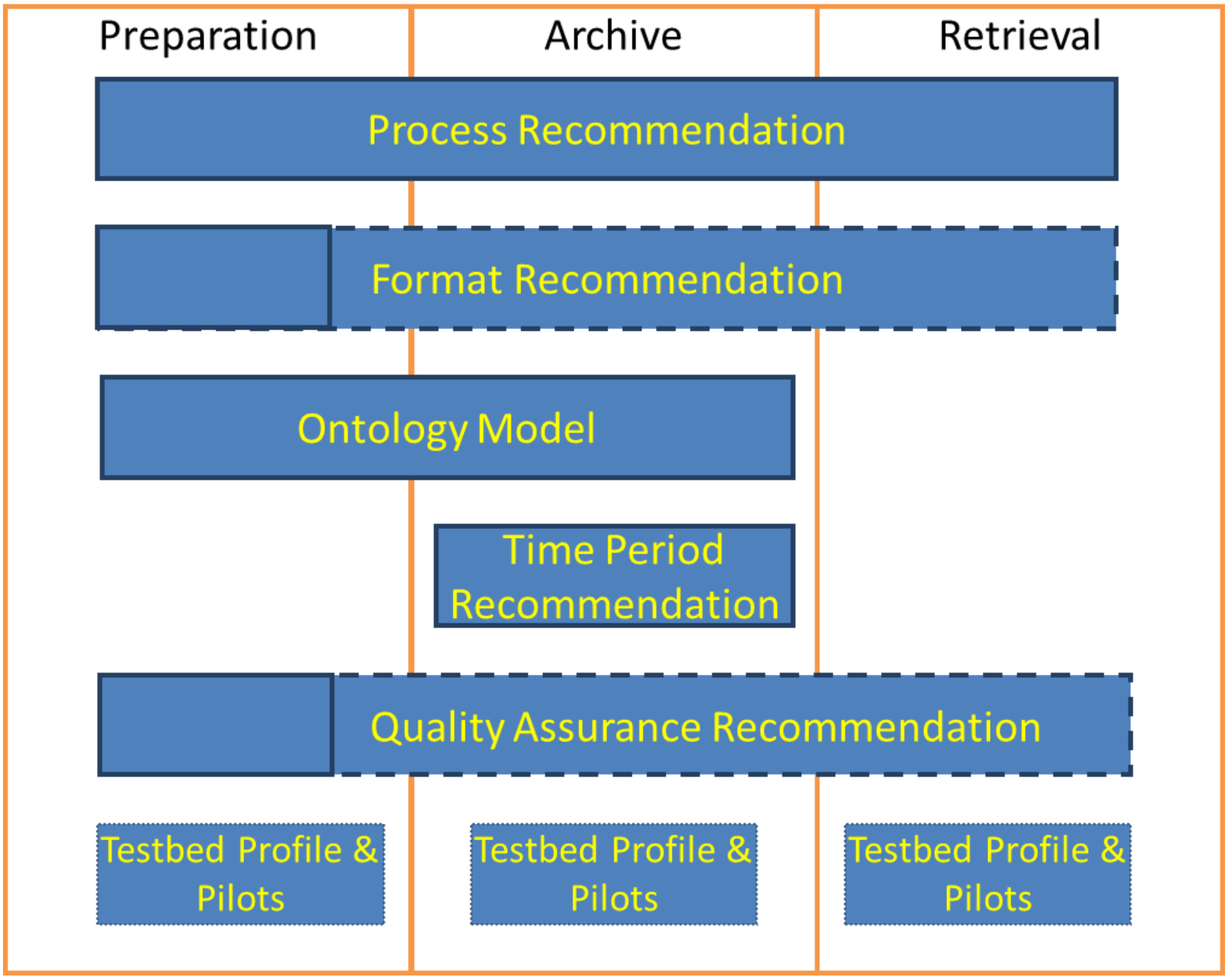


Figure 1 – Long Term Archiving Areas of Recommendation

2. LTAR QUALITY ASSURANCE RECOMMENDATION

2.1. Overview

From the most basic perspective the SASIG-LTAR Quality Assurance recommendation defines what verification and validation actions are required for an organization is to be successful in archiving and then retrieving one or more pieces of product data information. In this context ISO 9000: 2005 clause 3.8 definitions are used for verification and validation. Verification is confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. While validation means confirmation, through the provision of objective evidence that the specified requirements for a specific intended use or application have been fulfilled.

Therefore, the purpose of this recommendation document is to provide:

- Identify the four verification and validation functions that define the LTAR QA strategy.
- Describe in detail what each function does, why it is needed, and when it should be performed

2.2. LTAR QA strategy

To support a LTAR process, implementing a Quality Assurance strategy is necessary. SASIG-LTAR proposes to structure the QA approach with 4 main functions described below. The concerned QA functions are:

1. Product Data Quality (PDQ) Check: verify that the original or target data to be archived complies with Product Data Quality rules defined inside the company.
2. Archival Rules Check: validate that the Descriptive Information (DI) provided complies with the organization’s policy. The DI is set of information, consisting primarily of information intended for supporting data access (finding, ordering, and retrieving of LTAR information).
3. Fixity Check: confirm that the archived data integrity is maintained during the time period.
4. Equivalence Validation: validate that after the translation process the translated data is still reliable with respect to the original data.

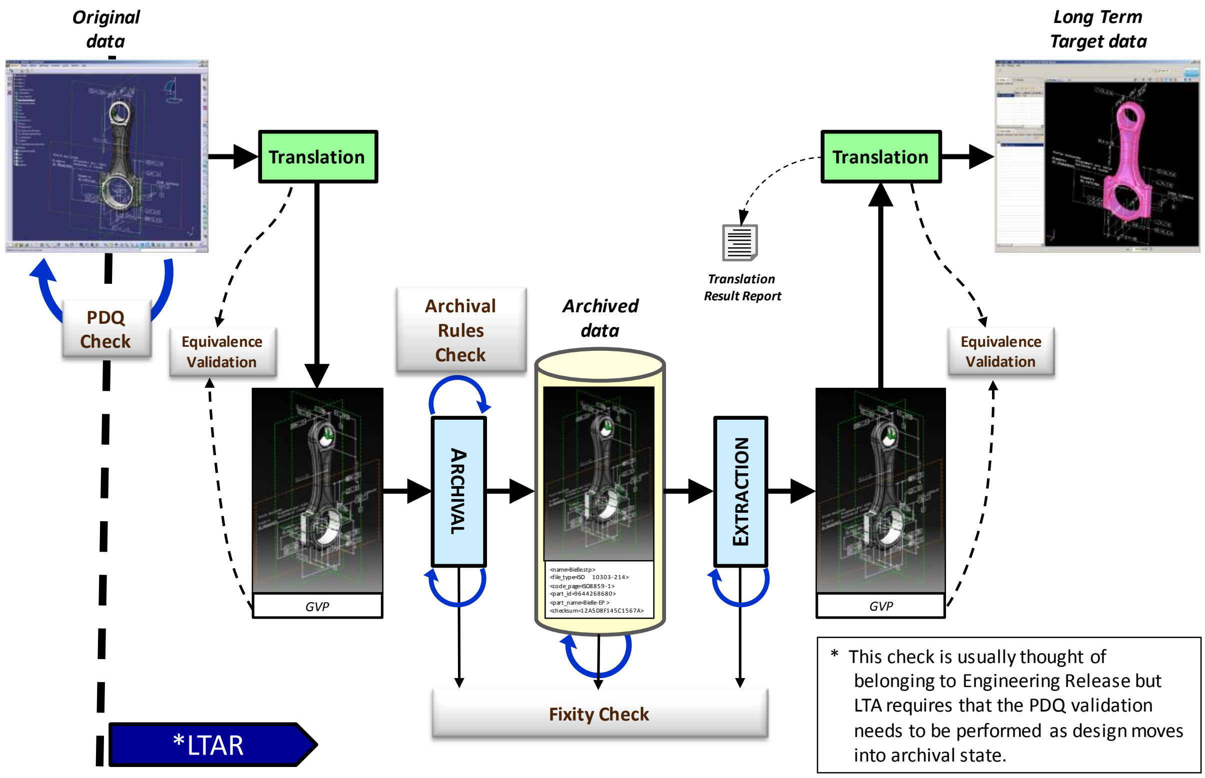


Figure 2 – Overview of Quality Assurance in the global LTAR process

In the figure above (see Figure 2) the four functions are depicted as the white shaded boxes. The PDQ check is shown occurring on the original data as the design moves into an archival state; hence the PDQ Check strategy considers LTAR requirements from the earliest phase. Equivalence Validation is associated with each translation. While the Archival Rules Check occurs during the archival step and the Fixity Check occurs periodically on the archived data to confirm that the data integrity is preserved. With respect to fixity checking frequency, the strategy is to allow each company/organization define its own specific policy.

2.3. Description of LTAR QA functions

In that section, we will present the 4 functions introduced in the last section.

2.3.1 PDQ Check

The need for high quality product data is easy to describe at a high level: poor data quality costs money, delays product development, and can result in poor quality products. Unfortunately, connecting PDQ costs to their causes is generally not so simple. During or after retrieval of a DIP the user can discover a PDQ problem that is usually difficult to solve because the original data may not be available.

To prevent such a case, SASIG recommends to run a PDQ check on the original data (see Figure 2). This PDQ check needs to select a set of criteria to be verified. SASIG PDQ recommendation [1] provides a wide range of criteria from which to select. Each organization will have to select its global PDQ strategy. Possible solutions could be:

- One PDQ profile for each domain activity
- One PDQ profile for several domains (e.g. product development, and LTAR)
- One PDQ profile for whole product lifecycle (product development, manufacturing, LTAR…)

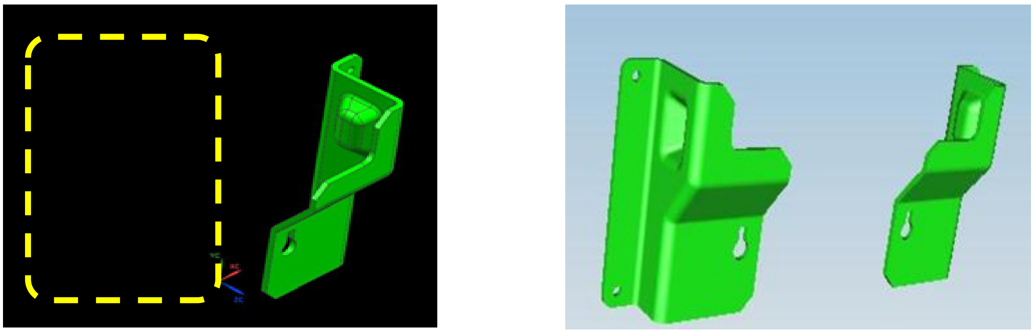
It is paramount that the PDQ check be performed prior to the start of the LTAR process.

A profile is characterized by a set of criteria each of which gets individually checked during the PDQ check. Specific criteria could be but are not limited to: construction history not updated, prohibited element used with the product model, and too narrow of surfaced used.

The criteria selection should be driven by LTAR requirements, such as completeness, unambiguous, independence (see Table 1).

Requirement	Description
Completeness	All information needed to perform the PDQ check is contained within the original data.
Unambiguous	All definition information needed to perform the PDQ check is contained within the original data and does not contain other duplicate or unrelated data.
Independency	No external definition or software functional dependency needed to perform the PDQ check.

Table 1 – PDQ requirements description



Display when archived (Construction reference data was set as hidden)

Display when retrieval (Construction reference data is displayed)

Figure 3 – Example of impact of software dependent contents on retrieval process

In the example shown on Figure 3, the independency requirement is illustrated. The archived data contains finished representation and hidden construction reference data used to create it. In this case the support of show/hide setting is expected in the reading software to display these construction reference data or not. If this setting is not properly supported, then both data will be displayed and may introduce ambiguity and the Archival to Retrieval Route will be invalid. This is an example of model dependency

2.3.2 Archival Rules Check

Archival Rules Check is needed to validate that the LTAR system complies with an organization's policies regarding archival and retrieval methods, rules and procedures. Therefore, it is imperative that the company policies are understood and put into practice when developing the LTAR system. The ISO 14721 - OAIS standard [2] was used as the template for the LTAR Archival Rules Check. The Archival Rules Check is applied to the Information Packages during Ingest and Retrieval phases. ISO 14721-OAIS specifies that an Information Package is a container consisting of two types of information objects, Content Information and Preservation Description Information (PDI) (see Figure 5). Depending on the archival life cycle stage, an Information Package may be a Submission Information Package (SIP) used by Ingest, an Archival Information Package (AIP) used by Archival, or a Dissemination Information Package (DIP) used by Retrieval (see Figure 4).

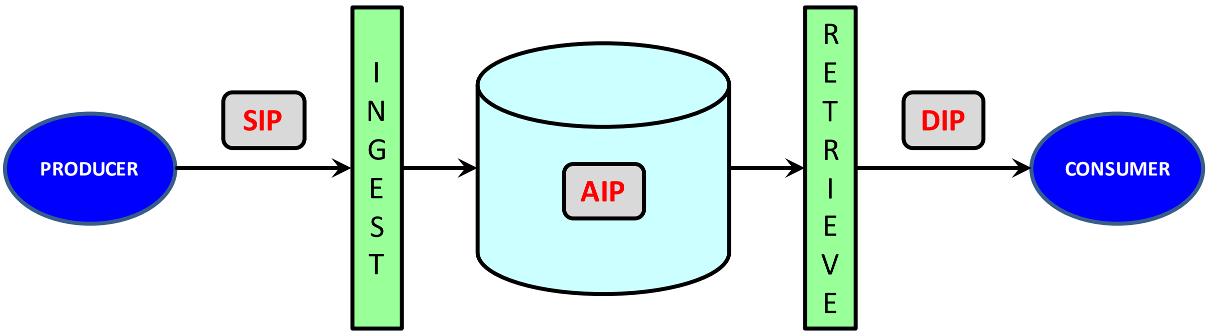


Figure 4 – Different kinds of Information Package used in the LTAR process

The Information Packages are used to structure and store the LTAR product data; to transport the required product data from the Producer [1] to the LTAR system, or to transport requested product data between the LTAR system and Consumers [2]. In this role, the Information Package is associated with two additional types of information objects: Packaging Information and Package Descriptions. Several types of Information Packages can also be used within the archival process. Figure 5 describes the relationships between each of those information objects. The following sections describe each information object in detail.

[1] Producer: The role played by those persons or client systems that provide the information to be preserved. This can include other information systems or persons. See SASIG Long Term Archiving & Retrieval of Digital Product Definition Data - Process Recommendation.
[2] Consumer: The role played by those persons or client systems, which interact with archival and retrieval services to find preserved information of interest and to access that information in detail. This can include other information systems or persons. See SASIG Long Term Archiving & Retrieval of Digital Product Definition Data - Process Recommendation

2.3.2.1 Content Information

In an Information Package, separating the Preservation Description Information from the Content Information is important. Content Information is the set of information that is the original target of preservation or that includes whole or subset of that information. The left side of Figure 5 shows the objects and associated relationships available in a Content Information.

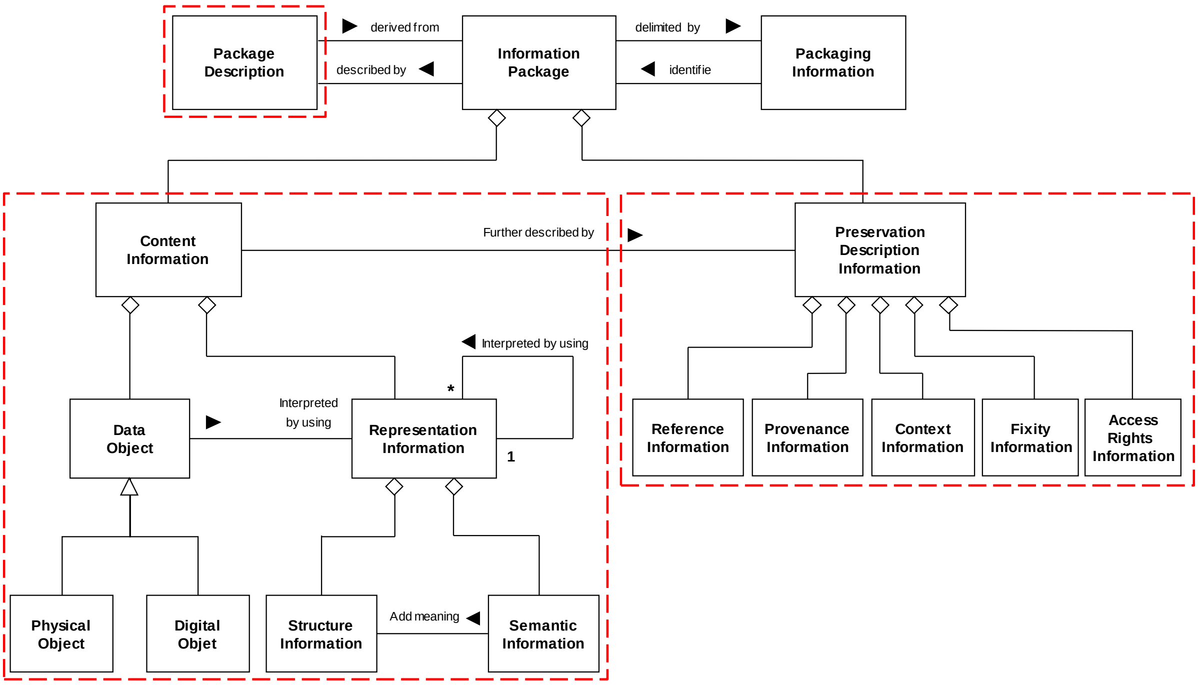


Figure 5 – Information Package model

The Content Information contains:

- **Data Object** to be archived in its archival format,
- **Representation Information** that consists in a set of explicit and exhaustive information that is necessary for a non-ambiguous understanding of the Data Object.

Representation Information is mandatory and required to ensure a correct reading of the archived data in the long term. This information may concern language, coding and meaning that could be evident at the moment when the data is archived, but will be forgotten or unknown many years later. Additionally, the referencing information in the Representation Information may necessitate the archival of data that is targeted through the Representation Information (e.g. an internal standard providing the meaning to the information). In this case, a dependency can be established between both archived objects (refer to Context Information in Preservation Description Information section).

Appendix A provides a proposal of Representation Information that could be used in an archival strategy.

2.3.2.2 Preservation Description Information

Preservation Description Information corresponds to the information which is necessary for adequate preservation of the Content Information. The information documents the relationships of the Content

Information to its environment, explains why the Content Information was created, and how it relates to other Content Information objects.

There are five components that make up Preservation Description Information (PDI) namely:

- **Reference Information** uniquely identifies the Content Information within the archival system, as well as to entities and systems external to the archival system.
- **Provenance Information** provides information about the Content Information history including its creation and potential modifications during the archival period.
- **Context Information** specifies relationships and dependencies of the Content Information to another Content Information. This includes why the Content Information was created, and how it relates to other Content Information objects existing elsewhere.
- **Fixity Information** aims to ensure that an archived data within an AIP has not been altered or corrupted. Fixity information should protect the Content Information from undocumented alteration and it allows for early identification of corrupted files so they may be replaced with an unaltered copy from the Producer or from Disaster Recovery.
- **Access Right Information** specifies the access restrictions applicable to the Content Information, covering the legal framework, licensing terms, and access control.

2.3.2.3 Package Description

Package Description metadata is used to access and retrieve archived data based on query criteria. Package Description primarily consists in a list of business and technical metadata that characterizes as best as possible the archived data.

A typical metadata list may include definitional information, taxonomic (subclass–superclass) hierarchy information, defining attributes and describing allowed values for these attributes as well as restrictions and/or rules could be applicable such as specific list of values. Usually, most of the metadata to be used in an archival system are derived from data management practices in companies. Data management practices can differ from one company to another due to cultural aspects. Nevertheless, they always relate to the same concepts, importance, and priority in terms of data description. Therefore, some metadata date may be considered as mandatory, whereas some others are optional.

Each Data Object can be characterized using a set of metadata. Some of them could be considered a common, but some others could be considered as specific, depending on the data type. These specific metadata should be driven by the ontology defined in the SASIG-LTAR Time Period recommendation.

Generally, the more archived information will have associated description metadata, the more its retrieval will be made easy.

Appendix B provides a proposal of Package Description metadata that could be used in an archival strategy.

2.3.2.4 Summary example

The drawing in Figure 6 archived. The selected archival format is TIFF, generated according a set of option parameters recommended within the automotive industry. The parameters specify that TIFF type format shall be TIFF 6.0, the resolution shall be 200x200 DPI, and the compression scheme shall be CCITT Group 4, in multiple pages’ mode.

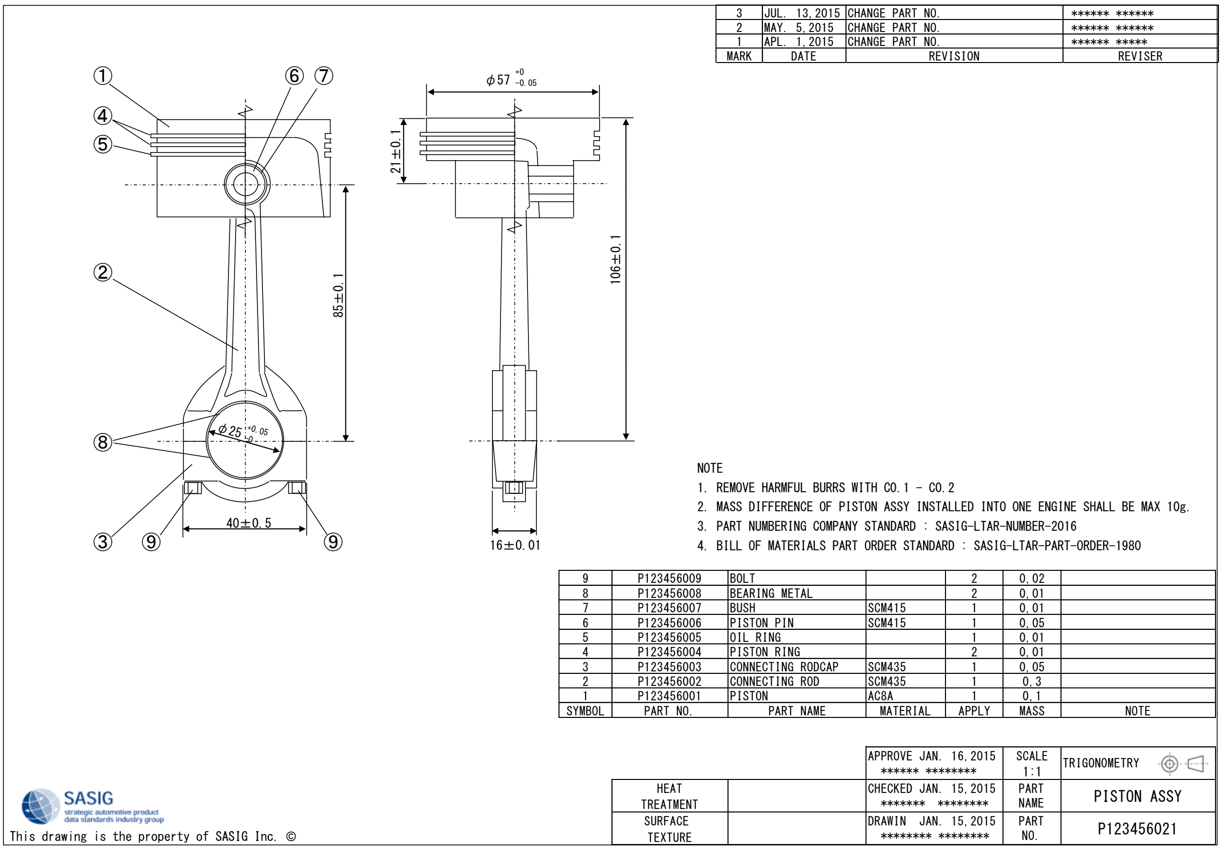


Figure 6 – Example of drawing to be archived

The drawing contains ISO views. Tolerances are of ISO type. Text inside the drawing is written in English. Part numbers used are driven by company specific standard (SASIG-LTAR-NUMBER-2016).

The drawing was designed using CATIA V5R19 SP4 in Windows 7 64bits environment, and converted into TIFF format using CATIA V5 interface, on 2015 January 16th. The part described by the drawing has the unique number P123456021, and its part name is PISTON ASSY. It was released on 2015 January 15th. This part is used by the project(s) xxxx, and classified the xxxx level of the internal car breakdown. The company SASIG Inc. owns the intellectual properties of the drawing contents. The checksum value is e4d909c290d0fb1ca068ffaddf22cbd0 computed with MD5 algorithm. The access to the drawing shall be restricted to the company member. The drawing contains information whose signification is specified in internal standards SASIG-LTAR-NUMBER-2016, SASIG-LTAR-PART-ORDER-1980 that were archived.

The associated Reference Information to retain in the AIP should then be:

- File format: TIFF 6.0
- Resolution unit: DPI
- Resolution: 200x200 DPI
- Data compression technique: lossless
- Compression scheme: CCITT Group 4
- Paging mode: multiple pages
- View type: ISO
- Tolerance type: ISO

- Scale: 1:1
- Text language: English
- Relevant standards: SASIG-LTAR-NUMBER-2016, SASIG-LTAR-PART-ORDER-1980

The associated Preservation Description Information to retain in the AIP should then be:

- Reference Information:
  - Unique part number: P123456021
- Provenance Information:
  - Original CAD system source: CATIA V5R19 SP4
  - Source Operating System: Windows 7 64bits
  - Interface used to generate the archival format: CATIA V5R19 SP4 TIFF interface
- Context Information:
  - Pointer to SASIG-LTAR-NUMBER-2016 standard archival record.
  - Pointer to SASIG-LTAR-PART-ORDER-1980 standard archival record.
- Fixity:
  - Checksum: e4d909c290d0fb1ca068ffaddf22cbd0
  - Checksum method: MD5
- Access Right Information:
  - Restricted access to the company member
  - Intellectual property is owned by company SASIG Inc.

The associated Package Description to retain in the AIP should then be:

- Part number: P123456021
- Part name: PISTON ASSY
- Release date: 2015 January 15th
- Intellectual property owner: SASIG Inc.
- Data type: Drawing
- Data format: TIFF

2.3.2.5 Packaging Information

Packaging Information is the information that is used to bind and identify the components of an Information Package. For example, it may be the volume and directory information used on a CD-ROM to provide the content of several files containing Content Information and Preservation Description Information.

OAIS ISO 14721 [2] states that the Content Information and PDI are viewed as being encapsulated and identifiable by the Packaging Information. The resulting conceptual container, the Information Package, is viewed as being discoverable by virtue of the Descriptive Information (see Figure 7).

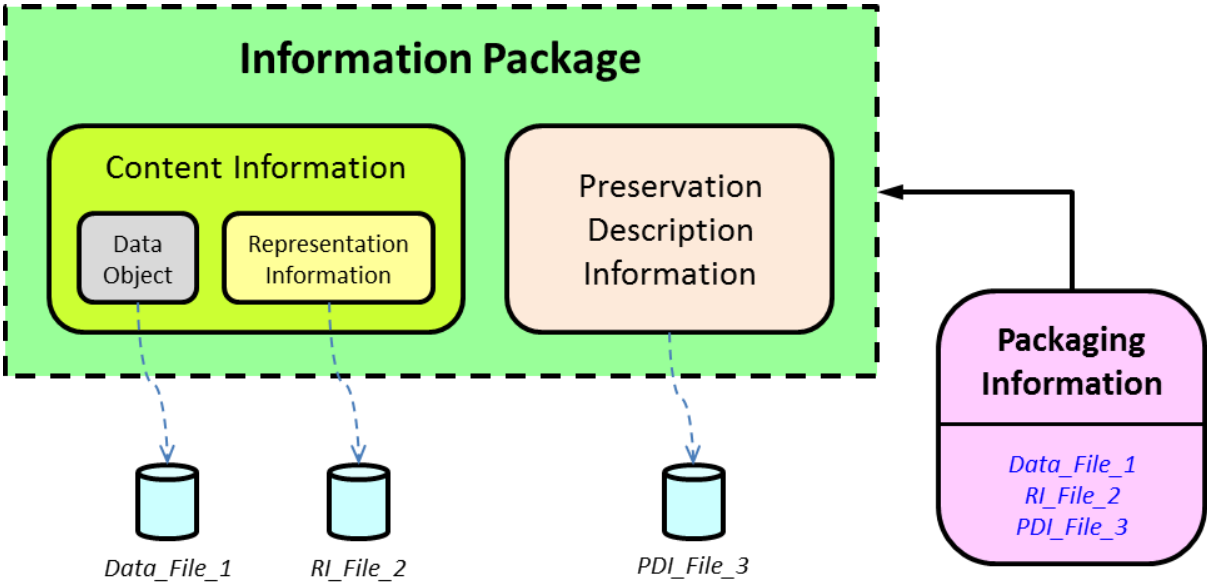


Figure 7 – Example of Packaging Information usage based on an Information Package

2.3.3 Fixity Check

Fixity aims to ensure that an archived data within an AIP has not been altered or corrupted during the LTAR time period. Fixity checking should protect the Content Information from undocumented alteration and it allows for early identification of corrupted files so they may be replaced with an unaltered copy from the Producer or from Disaster Recovery.

In practice, fixity could be obtained through a combination, or not, of different techniques such as checksum, CRC, etc.

A fixity value must be initially computed on the data translated into the archival format before the archival. The obtained result will be considered as the reference in the downstream LTAR process.

Once the data is archived, the fixity must be regularly computed and compared with the reference to confirm that the AIP integrity is preserved. The frequency of fixity checked needs to be defined in a company specific policy.

Finally, when a data is retrieved, fixity must be firstly computed and compared with the reference before the data is translated into the target format (see Figure 8).

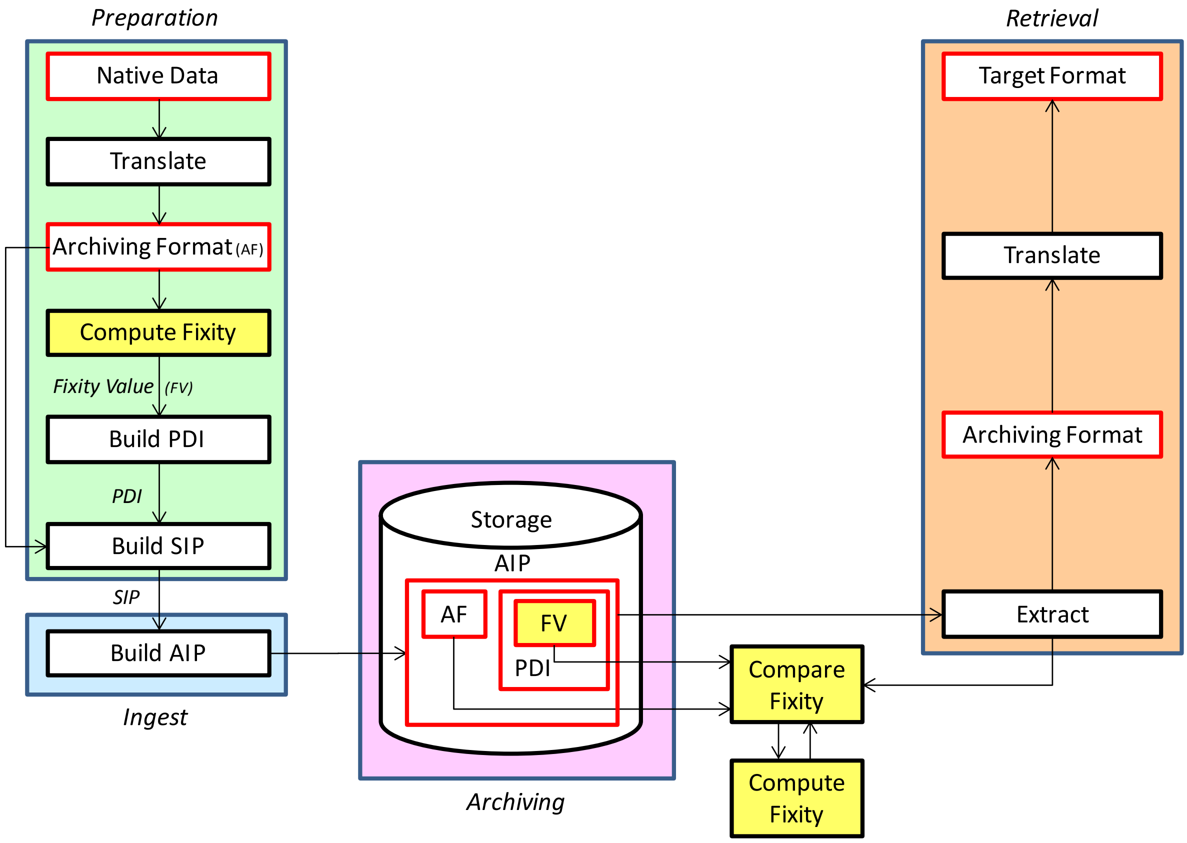


Figure 8 – Fixity computing and usage along the LTAR process

2.3.4 Equivalence Validation

Data archival requires translating original data into archival format. Related systems span a wide range of software like CAD, CAE, CAM, CAT, PLM and so on. We call this wide range of data translation as "CAx data conversion" (see Figure 9).

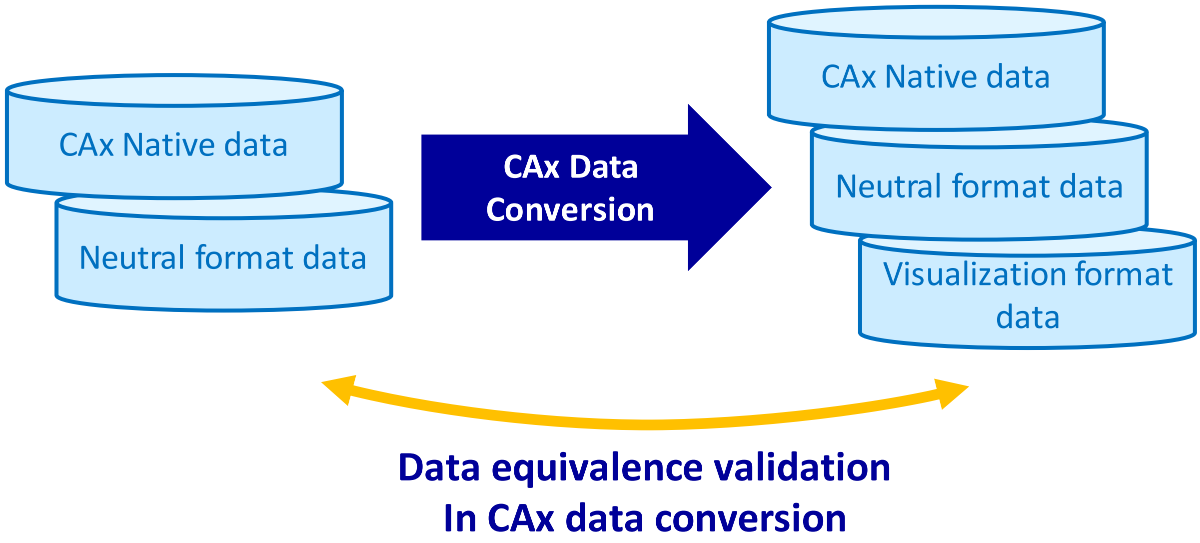


Figure 9 – Equivalence validation of CAx data

This guideline provides a list and a classification of criteria that are defined in a JAMA recommendation, Guidelines for Data Equivalence Validation in CAx Data Conversion [3], that will become a SASIG recommendation, and was submitted to ISO as input for a future standard. It is assumed that each company selects the applied criteria by referring to this list. Each company selects one or more validation class, but it is not necessary to check all the criteria in selected validation class.

This guideline aims to describe how to compare and validate that CAx data in archival format is equivalent to the original format, so that it can ensure CAx data reproducibility.

In addition, this guideline aims to standardize terminology related to equivalence validation and thus, to improve communication among involved persons.

CAx data equivalence is classified into three categories, visual equivalence, shape equivalence and semantic equivalence (see Figure 10).

This guideline provides a high level classification of equivalence validation criteria according to these categories, as defined in the original JAMA/JAPIA recommendation that remains the master document and could be enhanced during the next years. Thus, for detailed and updated definition of criteria, refer to this JAMA recommendation.

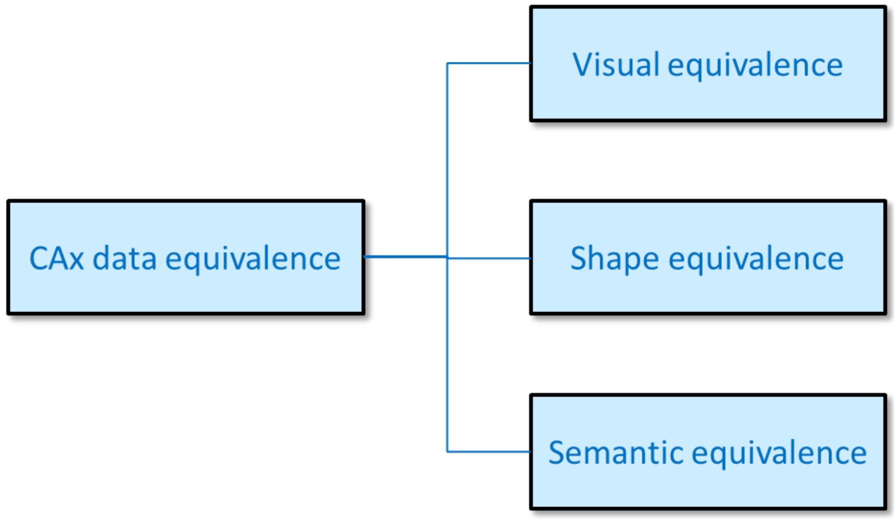


Figure 10 – Classification of CAx data equivalence

Visual equivalence means that data are displayed on computer screen identically.

Shape equivalence means that shape data are identical within given tolerance. This means various kinds of measurements such as location, distance, length, section, etc are identical within tolerance.

Semantic equivalence means that internal definition like entity relations and attribute properties are identical.

This classification will help in a clear understanding of which equivalence is required for a practical business.

2.3.4.1 Validation Classes

There are various usages of converted data, and level of equivalence validation is determined according to it. This section defines classification of equivalence validation levels.

Here, level of equivalence validation is called “validation class” that is classified into “validation class A”, “validation class B” and “validation class C” (see Table 2):

- **Validation class A** aims to guarantee reuse in CAx systems by satisfying all of visual equivalence, shape equivalence and semantic equivalence.
- **Validation class B** aims to guarantee reproducibility of part shape and part specification by satisfying shape equivalence and visual equivalence. Class B requires shape equivalence validation. It is subdivided into three classes according to rigor of shape equivalence validation:
  - **Validation class B1** addresses the case where only the whole shape is checked,
  - **Validation class B2** addresses the case where only edges are checked,
  - **Validation class B3** addresses the case where only the geometrical properties like center of gravity, volume and surface area are checked.
- **Validation class C** aims to guarantee visual reproducibility of drawings by satisfying visual equivalence.

<table>
<tr><th>Validation Class</th><th colspan="2">Target usage</th><th>Scope</th><th>Type of equivalence</th></tr>
<tr><td>A1</td><td colspan="2">Reuse throughout all of CAx systems</td><td>Whole of CAx data</td><td rowspan="3">Visual equivalence
Shape equivalence
Semantic equivalence</td></tr>
<tr><td>A2</td><td colspan="2">Reuse of 3D annotated model</td><td rowspan="2">3D annotated model</td></tr>
<tr><td>A3</td><td colspan="2">Reproduce of definition attributes in 3D annotated model</td></tr>
<tr><td>B1</td><td rowspan="3">Reproduce of parts shape

Reproduce of drawing visual display</td><td>Shape of face is reproduced</td><td rowspan="3">3D annotated model

3D model and simplified 2D drawing</td><td rowspan="3">Visual equivalence
Shape equivalence</td></tr>
<tr><td>B2</td><td>Shape of edge is reproduced</td></tr>
<tr><td>B3</td><td>Mass property is reproduced</td></tr>
<tr><td>C</td><td colspan="2">Reproduce of drawing visual display</td><td>2D drawing and 3D model 2D drawing</td><td>Visual equivalence</td></tr>
</table>

Table 2 - Validation class definition

2.3.4.2 Validation Criteria

Several validation criteria are proposed in this paragraph. They are grouped into functional families as defined in the original recommendation, JAMA/JAPIA Guidelines for Data Equivalence Validation in CAx Data Conversion. This guideline does not provide the full definition of each validation criteria that is already defined in the original recommendation previously mentioned. This initial list of validation criteria is provided as initial input, but may be extended in the future in the original recommendation or in a SASIG recommendation.

Items correspond to elements to be validated according to "Validation Class" as "Validation Criteria." List of Validation Criteria and their correspondence with Validation Class are shown in Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, and Table 9.

Geometry equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Center of gravity	Shape equivalence	×	×		×	×	×	
Surface centroid	Shape equivalence	×	×		×	×	×	
Curve centroid	Shape equivalence	×	×		×	×	×	
Volume	Shape equivalence	×	×		×	×	×	

Face area	Shape equivalence	×	×		×	×	×	
Moment of inertia	Shape equivalence	×	×		×	×	×	
Edge/Curve length	Shape equivalence	×	×		×	×		
Maximum distance between points	Shape equivalence	×	×		×	×		
Maximum distance between edges	Shape equivalence	×	×		×	×		
Maximum distance between faces	Shape equivalence	×	×		×			
Analytical surface definition	Shape equivalence	×	×		×			
Parametric definition	Semantic equivalence	×	×					
Geometric constraints definition	Semantic equivalence	×	×					
Form feature definition	Semantic equivalence	×	×	×				
History tree definition	Semantic equivalence	×	×					
2D wireframe display	Visual equivalence							×

Table 3 – Geometry equivalence validation criteria

Display attributes equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Visibility definition	Semantic equivalence	×	×	×				
Color/Transparency definition	Semantic equivalence	×	×	×				
Layer definition	Semantic equivalence	×	×	×				

Table 4 – Display attributes equivalence validation criteria

Assembly structure equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Assembly definition	Semantic equivalence	×	×	×				
Part Instances definition	Semantic equivalence	×	×	×				

Table 5 – Assembly structure equivalence validation criteria

Product characteristics equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
View definition	Semantic equivalence	×	×	×				
Drawing View layout definition	Semantic equivalence	×	×	×				
Drawing View layout display	Visual equivalence	×	×		×	×	×	×
Dimensional tolerance definition	Semantic equivalence	×	×	×				
Dimensional tolerance display	Visual equivalence	×	×		×	×	×	
Geometric tolerance definition	Semantic equivalence	×	×	×				
Geometric tolerance display	Visual equivalence	×	×		×	×	×	
Surface condition definition	Semantic equivalence	×	×	×				
Surface condition display	Visual equivalence	×	×		×	×	×	
Weld symbol definition	Semantic equivalence	×	×	×				
Weld symbol display	Visual equivalence	×	×		×	×	×	
Entity Note definition	Semantic equivalence	×	×	×				
Entity Note display	Visual equivalence	×	×		×	×	×	
Datum definition	Semantic equivalence	×	×	×				
Datum display	Visual equivalence	×	×		×	×	×	
Datum target definition	Semantic equivalence	×	×	×				
Datum target display	Visual equivalence	×	×		×	×	×	
Part Attribute definition	Semantic equivalence	×	×	×				
Drawing Note definition	Semantic equivalence	×	×	×				
Drawing Note display	Visual equivalence	×	×		×	×	×	×
PMI counts	Visual equivalence	×	×	×	×	×	×	
2D annotation display	Visual equivalence							×

Table 6 – Product characteristics equivalence validation criteria

Management data equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Part identification definition	Semantic equivalence	×	×	×				

Part version definition	Semantic equivalence	×	×	×				
Approval definition	Semantic equivalence	×	×	×				
Drawing Title display	Visual equivalence	×	×		×	×	×	×
Drawing Marker definition	Semantic equivalence	×	×	×				
Drawing Marker display	Visual equivalence	×	×		×	×	×	×
Intellectual property definition	Semantic equivalence	×	×	×				
Intellectual property display	Visual equivalence	×	×		×	×	×	×

Table 7 – Management data equivalence validation criteria

Manufacturing process information equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Process Plan definition	Semantic equivalence	×						
Process Operation definition	Semantic equivalence	×						
Machining Feature definition	Semantic equivalence	×						
Mating Relationship definition	Semantic equivalence	×						
Weld Feature definition	Semantic equivalence	×						
Measurement Feature definition	Semantic equivalence	×						

Table 8 – Manufacturing process information equivalence validation criteria

Analysis equivalence

Validation Criteria		Validation Class						
Title	Equivalence type	A1	A2	A3	B1	B2	B3	C
Kinematics definition	Semantic equivalence	×						

Table 9 – Analysis equivalence validation criteria

BIBLIOGRAPHY

[1] SASIG-PDQ, SASIG Product Data Quality Guidelines for the Global Automotive Industry - version 2.1, 2005.

[2] Consultative Committee for Space Data Systems, Reference Model for an Open Archival Information System (OAIS) - Recommended Practice CCSDS 650.0-M-2 - Magenta Book, June 2012.

[3] JAMA/JAPIA, Guidelines for Data Equivalence Validation in CAx Data Conversion, 2014.

APPENDIX A – Representation Information Classification Proposal

Table 10 provides a sample list of Representation Information to be used by any company as initial input to implement its LTAR system. This list aims to prevent users from starting their LTAR project with a "white page". Then, each user may be free to remove or to add representation information based on its company policy.

Name	Description	Sample Values
Language	Language used to write text in the data object	English/French/Japanese
Coding type	Type of byte encoding	ASCII, binary, …
Character coding system	Set of characters used	ISO 8859-1, …
File format	Type of file format used to generate the data object	ISO 10303-214, ISO 14306-1, IGES 5.6, PDF/A, …
Applicable standard	Company or national specific standard that specify how to interpret certain information in the data object (e.g. versioning system)	
Unit	Unit used by the data object	Meter, Millimeter, DPI, Pixel, …
Image Compression	In case of an image file, which algorithm is used to compress the image	Lossless, RLE, …
Paging mode	Whether the data object contains one or more pages	1 page, multi-pages,…
Scale	Scale used in the data object to represent information	1:1, 1:2, …
Tolerance type	Standard applied to represent tolerances	ISO, ASME, …
Drawing view type	Standard applied to get a view	ISO, ANSI, …

Table 10 – SASIG-LTAR sample list of Representation Information

APPENDIX B – Package Description Classification Proposal

Table 11 provides a sample list of metadata that could be used in a Package Description to be used by any company as initial input to implement its LTAR system. This list aims to prevent users from starting their LTAR project with a "white page". Then, each user may be free to remove or to add new metadata based on its company policy.

Name	Description	Sample Values
Object number	Unique number assigned to the object	A125-20145, 9628769780, …
Object name	Name/Title given to the object	PISTON ASSY, ….
Object version	Version value assigned to the object to track successive modifications	000, A, 1A, …
Description	Free text to provide additional explanation about the object	That part is used in variant number 5 of component A12564600.
Release date	Date when the object was officially frozen	2016/05/11, …
Creation date	Date when the object was created	2016/05/11, …
Checked date	Date when the object was checked	2016/05/11, …
Approval date	Date when the object design was approved	2016/05/11, …
Archival date	Date when the object was archived	2016/05/11, …
Related projects	Projects in which the object is used	X45, …
Breakdown level	Product breakdown level to which the object is associated	A12, 1A2R, …
Data quality check result	Value resulting from data quality check	80%, KO, …
Intellectual property owner	Name of the company that owns the intellectual property of the object	Nissan Motor, PSA Peugeot Citroën, Mitsubishi Motors, Digital Process
Data type	Category of the data archived	3D CAD, 2D Drawing, Analysis report, …
Domain	Application domain which the data is relevant to	Styling, Mechanical, Simulation, Electronic, …
Data format	File format of the object	ISO 10303-214, ISO 14306-1, IGES 5.6, PDF/A, TXT, …

Table 11 – SASIG-LTAR sample list of metadata Package Description

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