



3DEXPERIENCE®

Interoperability standards

Paris, 17th of May 2018

florian.porcher@3ds.com
R&D Interoperability

Agenda

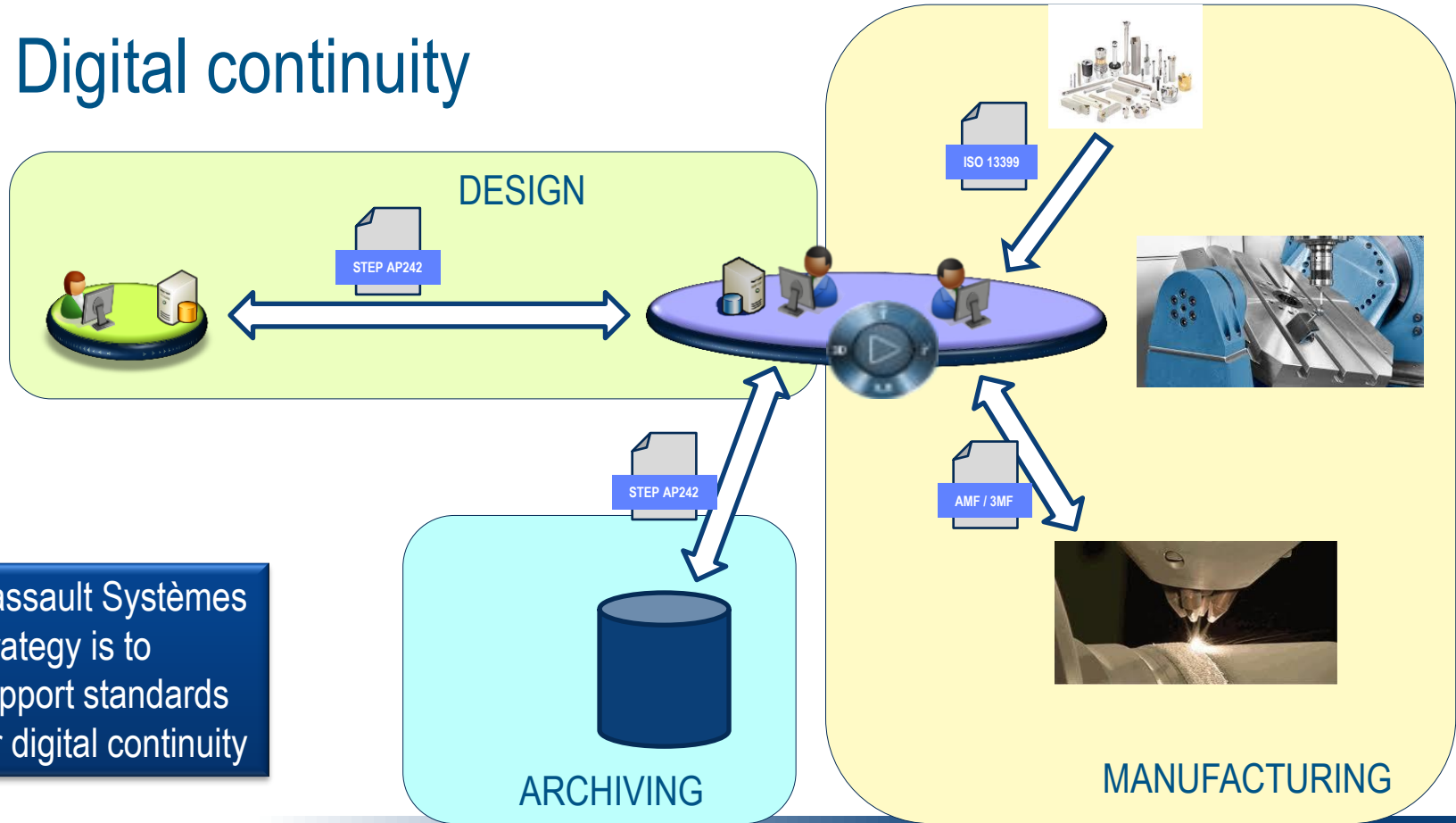
- ▶ Digital Collaboration for Aerospace&Defense and Automotive
 - ▷ STEP
 - ▷ ISO 15399
 - ▷ AMF/3MF
- ▶ Digital Collaboration for Architecture, Engineering and Construction (AEC)
 - ▷ IFC



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Digital Collaboration for Aerospace&Defense and Automotive

Digital continuity



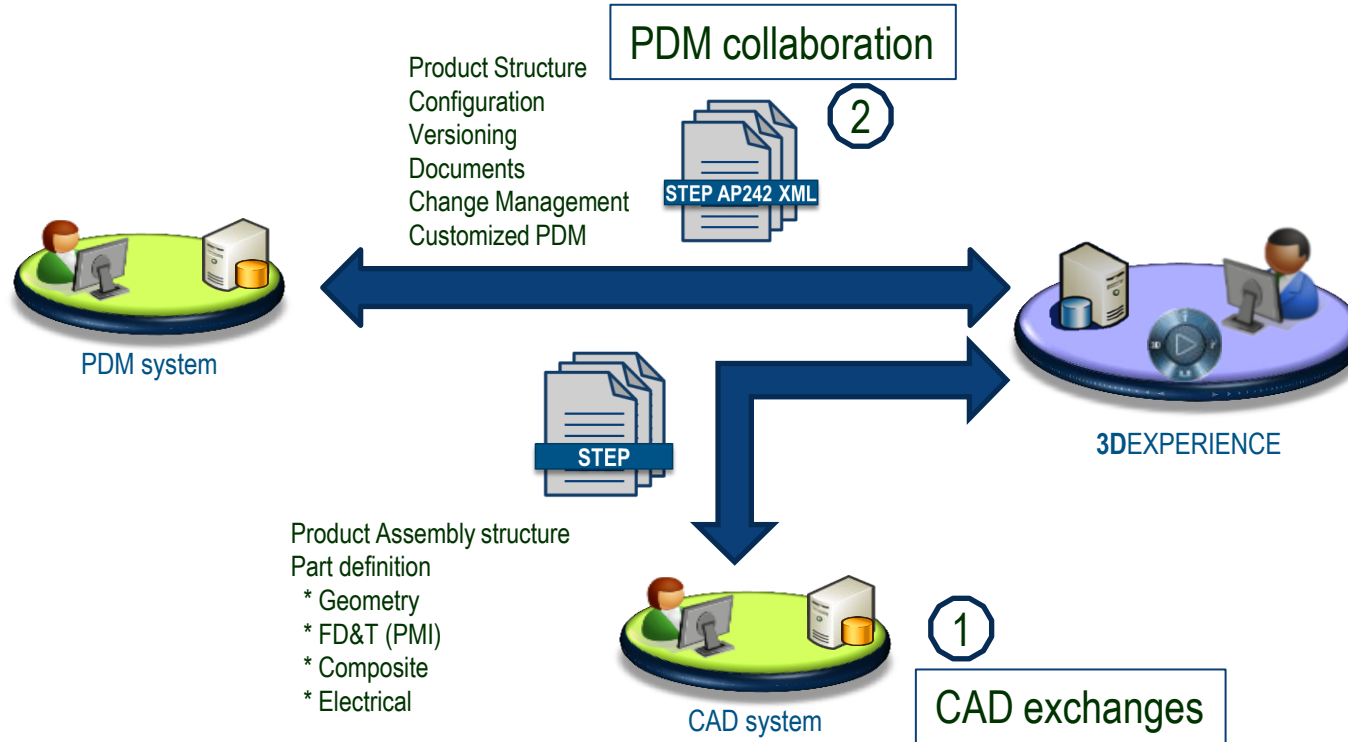
Dassault Systèmes
strategy is to
support standards
for digital continuity



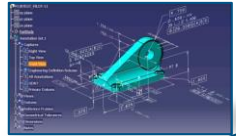
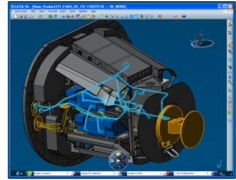
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STEP Data Exchange and Long Term Archiving

3DEXPERIENCE platform: STEP integration

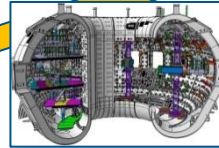
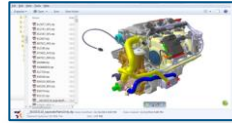


STEP AP242 : achievements and plans

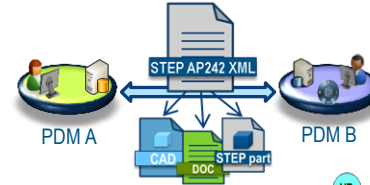


Product Structure Exact Geometry
Graphic PMI
Composites & Composites 3D
Tessellation & Tessellated PMI
AP242 XML
Compression

VP
VP
VP
VP
VP

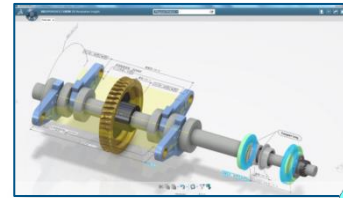


PDM collaboration



VP

Semantic PMI



VP

STEP AP242 Ed2

Electrical Harness
Advanced Composite
Advanced Semantic PMI
Persistent ID
Kinematic
Advanced Effectivities

In work

Supported Functionalities

In work

Futures extensions

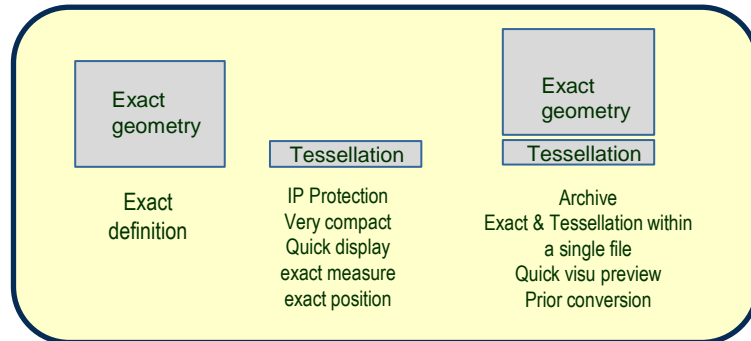
STEP AP242 CAD exchanges



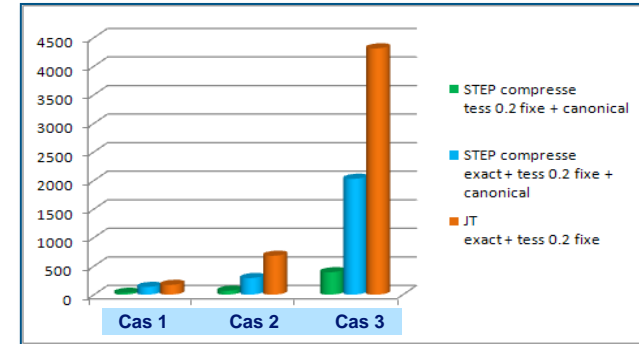
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STEP AP242 Tessellation

- ▶ **Compact** data size
- ▶ **Fast** for high speed **visualization**
- ▶ **Intelligent**: without need of Exact Brep geometry,
 - ▷ Exact measurement on or between canonical shapes (plane, cylinder, sphere, cone, ...)
 - ▷ Exact positioning using canonical shapes (plane, cylinder, sphere, cone, ...)
 - ▷ Brep-like Topology allowing direct association with 3D PMI presentation
- ▶ Customer can choose :



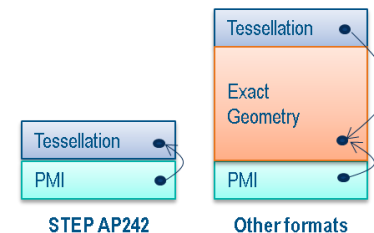
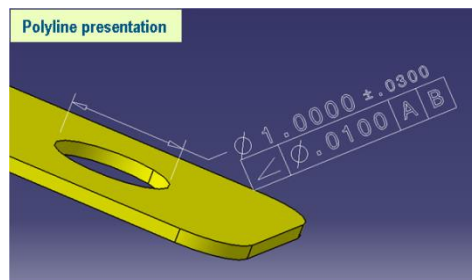
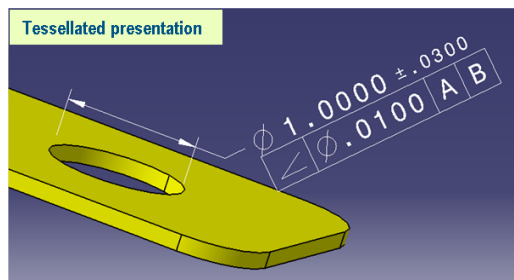
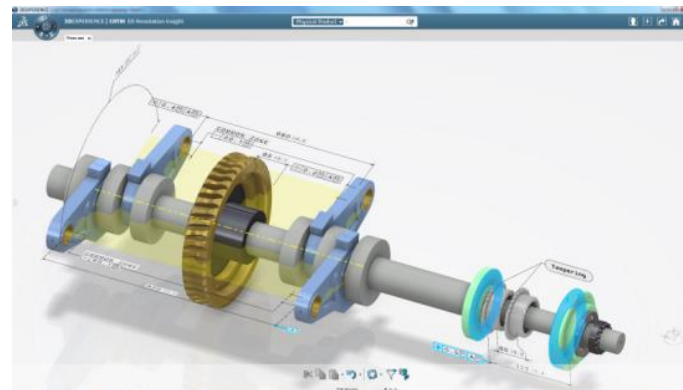
For review scenarios, STEP can be 10 times smaller than JT.



Results from customers benchmarks
(aerospace and automotive)

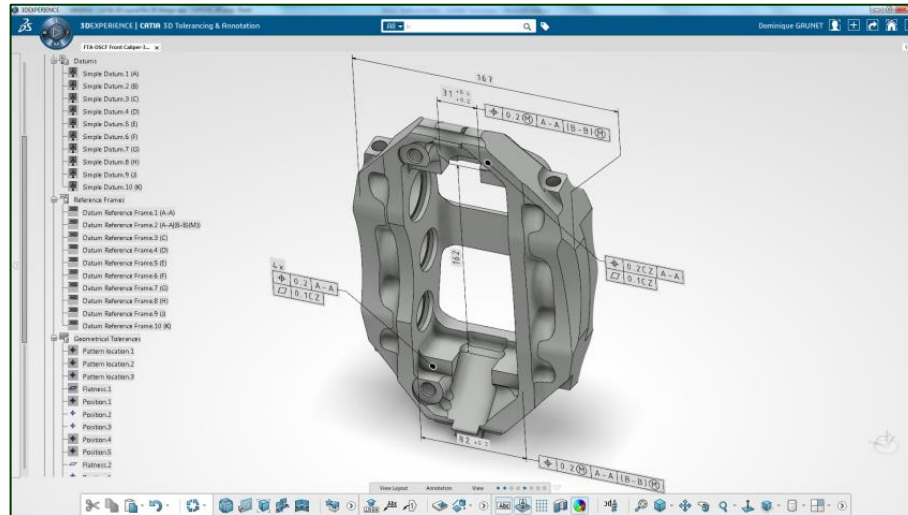
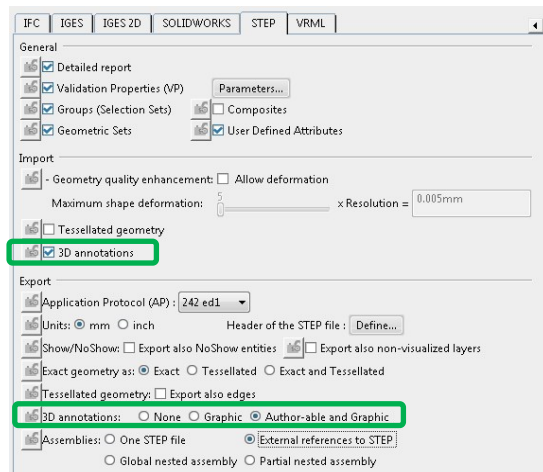
STEP PMI Representation (Graphic PMI)

- ▶ 3D PMI graphic conformance
- ▶ PMI associative with the geometry
- ▶ 3D Capture (PMI filtering per view)
- ▶ Validation properties
- ▶ Tessellation presentation with STEP AP242
 - ▷ Full WYSIWYG
 - ▷ Size of the PMI 2 times smaller in STEP files



STEP PMI Representation (Semantic PMI)

- Import / Export of native CATIA PMI as STEP **semantic PMI** and as **graphic PMI**.

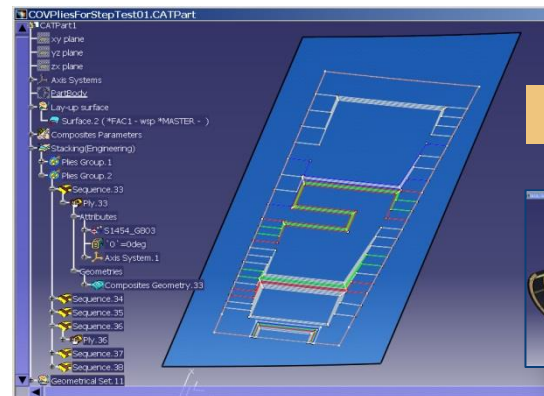


3DEXPERIENCE R2017x FD07 LA
3DEXPERIENCE R2018x GA
V5-6R2019 SP1 (to be confirmed)

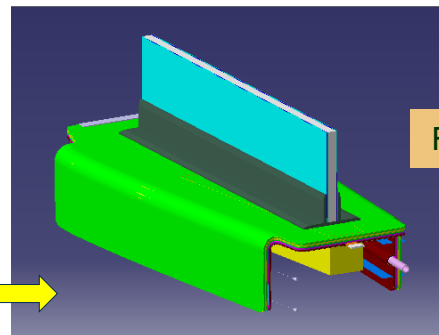
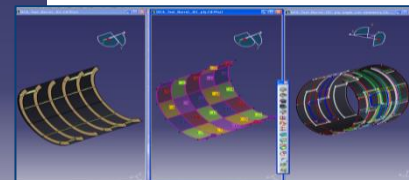
Characteristics	
STEP AP242 ed1 PMI	Dimension
	Datum feature
	Datum
	Datum target
	Datum system
	(Datum Reference Frame)
	Straightness
	Flatness
	Roundness
	(Circularity)
	Cylindricity
	Line profile
	(Profile of a line)
	Surface profile
	(Profile of a surface)
Non semantic	Parallelism
	Perpendicularity
	Angularity
	Position
	Concentricity
	Coaxiality (ISO only)
	Symmetry
	Circular run-out
	Total run-out
	Note
	Flag Note
	Surface texture symbol
	Welding symbol
	Other symbol

STEP Composites

- ▶ More & more composite parts in Aerospace
- ▶ 100% of CATIA Composites semantic stored in STEP
 - ▷ Ply
 - ▷ Sequence
 - ▷ Core
 - ▷ Cutpiece
 - ▷ Material
- ▶ Validation Properties
- ▶ Advanced ply orientation with AP242 Edition 2



Composites : 2.5D geometry



Full 3D geometry

AP242 tessellation allows to define the composites geometry in full 3D : one solid per ply.

- ▶ Kinematic Motion prototyping in 2016 (AP242 BO Model)
 - ▷ Sequence of discretized positions and orientations (motion result)
- ▶ Normalization activity to improve AP242 Edition 2
 - ▷ Modification of AP242 BO Model proposed by DS to experts

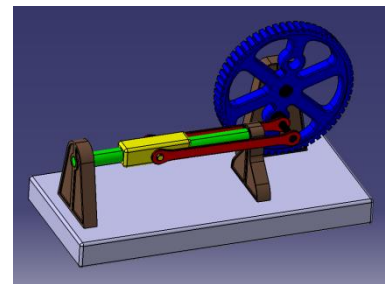
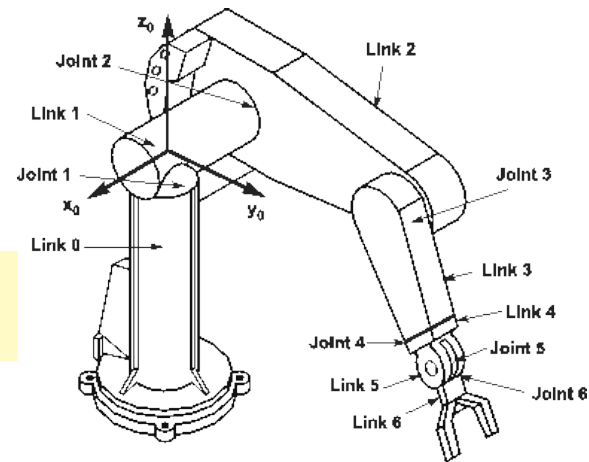
Data model now improved to solve the blocking issue (upcoming with AP242 E2)
Recommended Practices already updated to take into account the motion

- ▶ New Prototyping upcoming. CAX-IF testing.

- ▶ Kinematic Structure (Mechanism)

- ▷ Links, pairs, joints

Data model & draft Recommended Practices under study

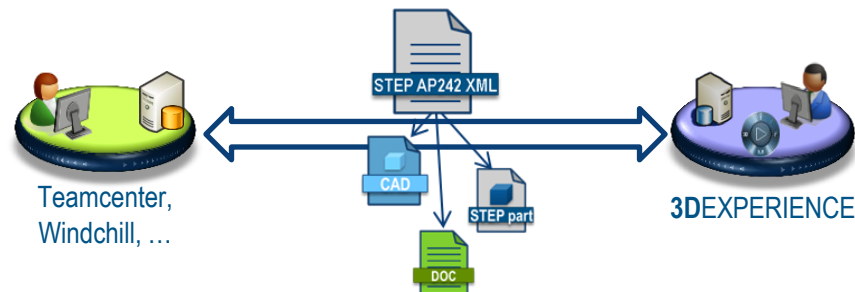




PDM collaboration with STEP

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STEP PDM Collaboration in 3DEXPERIENCE

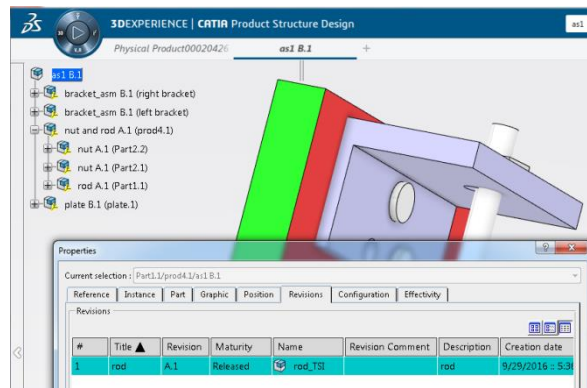
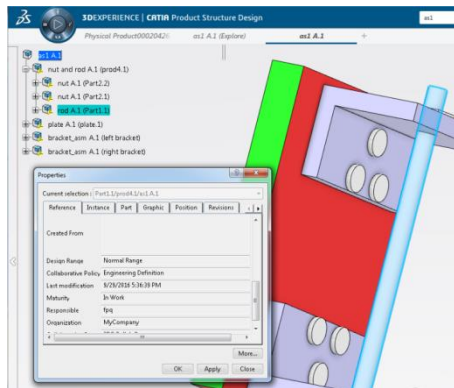


► Scenarios targeted with STEP AP242 XML.

- ▷ Exchange of assemblies referencing CAD files (STEP or native) and non-CAD documents (PDF, Office,...)
- ▷ STEP PDM Collaboration with **lifecycle** management (Versioning)
- ▷ STEP PDM Collaboration with **configuration** management (Effectivities)
- ▷ Exchange between **customized PDM system**

Product Lifecycle management

Design evolution: Iterative exchange with update and versioning.



- ▶ Version management
- ▶ Assembly modification (Add, Move, Remove)
- ▶ Lifecycle State status modification

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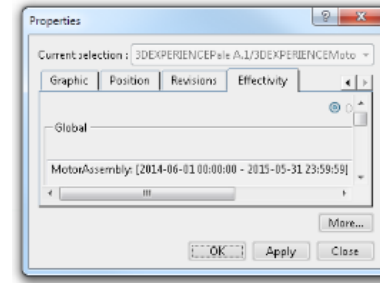
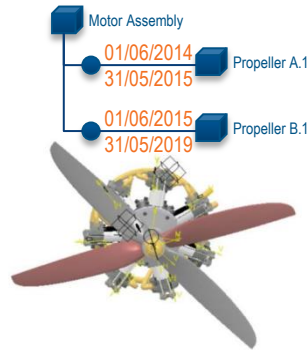


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3D DASSAULT SYSTEMES | The **3DEXPERIENCE®** Company

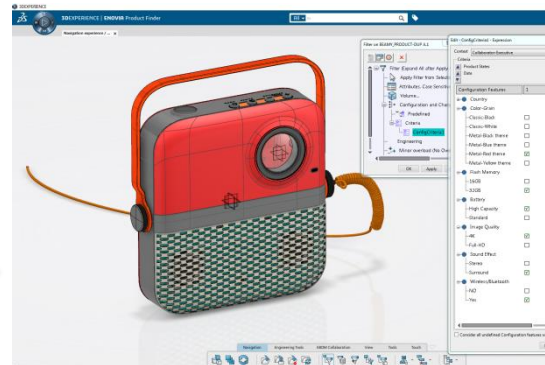
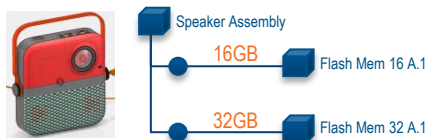
Configuration Management

Evolution effectivities (Date, Serial)



During Import, the assembly structure is created in 3DEXPERIENCE along with effectivities.

Variant effectivities (Variant, Option)



User can then apply filter to the assembly structure by selecting criteria (Date, Serial, Variant, Option ...)

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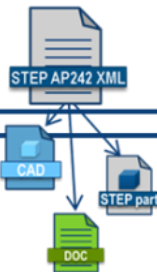
Customization management

Exchange between customized heterogeneous PDM system.

Customized



Teamcenter,
Windchill, ...



Customized



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PDMIFPart_TSI

- PDMIFlength_TSI
- PDMIFreal_TSI
- PDMIFmass_TSI
- ...

PDMIFPart_DS

- PDMIFlength_DS
- PDMIFreal_DS
- PDMIFmass_DS
- ...

Customized Type

Properties

Current selection : as1.A.1

Reference Revisions Preview Change

Type	PDMIFPart_DS (NLS is undefined)
Title	as1
Name	as1-TS111
Revision	A.1
Description	as1 desc
Revision Comment	
Creation date	5/17/2017 12:31:47 PM
Created From	
Design Range	Normal Range
Collaborative Policy	Engineering Definition
Last modification	5/17/2017 12:32:00 PM
Maturity	In Work
Responsible	fpq
Organization	MyCompany
Collaborative Space	3DS Collab Space
PDMIFlength_DS (NLS is undefined)	5.678mm
PDMIFreal_DS (NLS is undefined)	0
PDMIFmass_DS (NLS is undefined)	1234g
PDMIFbool_DS (NLS is undefined)	<input checked="" type="radio"/> True <input type="radio"/> False
PDMIFstring_DS (NLS is undefined)	PDMIF_TSI Part test string
PDMIFint_DS (NLS is undefined)	2

Customized Properties

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Dassault Systemes involvement in STEP normalization

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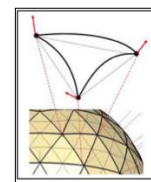
STEP AP242 Edition 2



► Dassault Systèmes participates in AP242 Edition 2 project

▷ Tessellation extensions (curved triangles, textures, scan data, ...)

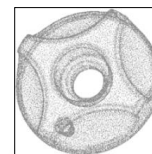
- Contribution to data model definition
- Participation to pilots



Curved triangles

▷ Electrical Wire Harness

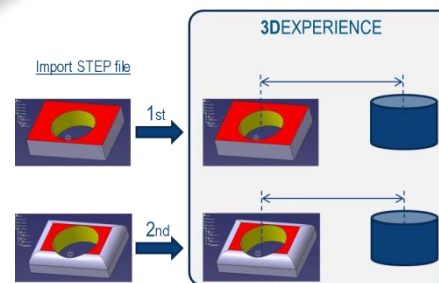
- Contribution to data model definition



3D scan data

▷ Persistent ID

- Allow relational design on STEP data by having persistent IDs on geometry elements.



Dassault Systèmes membership in STEP groups

► DS is member of AFNOR/IDMI, AFNeT, PDES inc and ProSTEP

- ▷ Strong collaboration with STEP experts and vendors to enhance interoperability and Long Term Archiving
- ▷ Contribution to and validation of STEP Recommended Practices
- ▷ Participation to Standardization Day, STEP AP242 Day



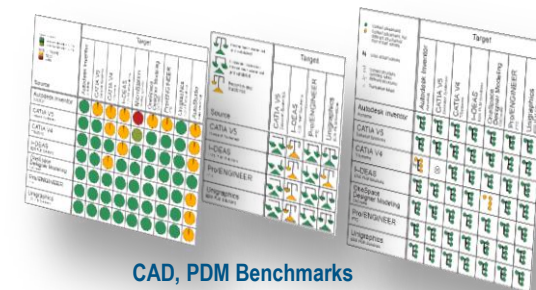
► Cooperation with LOTAR

- ▷ Data model definition (tessellation, PMI, ...)
- ▷ Participation to LOTAR pilots to validate data models



► DS participates in all CAX-IF Test rounds since TR2J (1999)

Vendor	System	Code	CAX-IF Test Round																		System Code	Rounds participated
			1J	2J	3J	4J	5J	6J	7J	8J	9J	10J	11J	12J	13J	14J	15J	16J	17J	18J		
Adobe	Acrobat 3D	a3																		a3	0	
Autodesk	AutoCAD / MDT	ac	x	x	x	x	x	x	x	x	x	x	x	x						ac	12	
Alibre	Alibre Design	ai				x	x													ai	4	
Autodesk	AliasStudio	al	x		x	x	x	x	x						x	x				al	9	
Dassault	CATIA V4/V5	c4/c5		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	c4/c5	18	
ISD	HiCad	hc							x	x	x									hc	3	
DataKit CrossCad	CATIA V5	d5																		d5	1	
DataKit CrossCad	Pro/Engineer	dp																		dp	1	
DataKit CrossCad	Unigraphics	u																		u	6	



CAD, PDM Benchmarks

► DS participates in PDM-IF

- ▷ Five test rounds achieved; 6th in progress

► DS participates to CAD and PDM Benchmarks

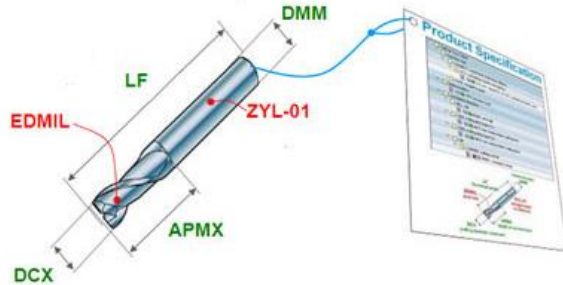


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ISO13399

ISO 13399

- ▶ ISO 13399 is a cutting tool data representation and exchange. Each tool is defined by a number of standardized ISO 13399 parameters



DMM - Shank diameter
LF - Functional length
EDMIL - End mill
ZYL-01 - Straight shank - no features
APMX - Depth of cut maximum
DCX - Cutting diameter maximum

▶ Actors :

- ▷ DS
- ▷ Kennametal
- ▷ Iscar
- ▷ Sandvik
- ▷ Siemens
- ▷ ...

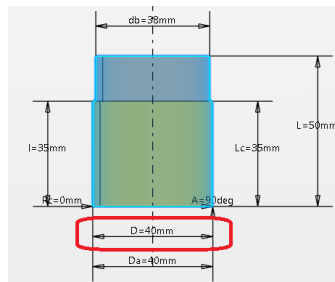


ISO13399

► ISO file contains :

▷ Attributes:

```
#144 = PLIB_PROPERTY_REFERENCE ('71D084653E57F', #73, '003');  
#145 = PROPERTY ((#7), $, '/IGNORE', #144, 'value', '003');  
#146 = NUMERICAL_VALUE ('cutting diameter', $, #7, '40.00');
```



▷ Link to dxf file

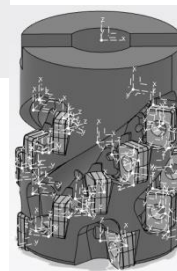
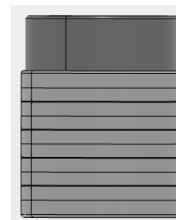
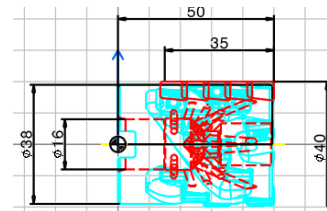
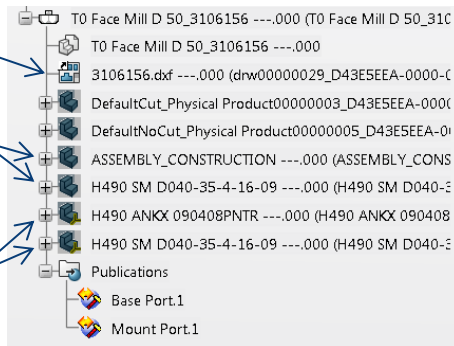
```
#44 = DOCUMENT_LOCATION_PROPERTY ('http://www.iscar.com/Ecat/IscarDXF/');  
#45 = EXTERNAL_FILE_ID_AND_LOCATION ('3106156.dxf', #44);
```

▷ Link to step file 3D rotary representation

```
#56 = DOCUMENT_LOCATION_PROPERTY ('http://www.iscar.com/Ecat/STPL/');  
#57 = EXTERNAL_FILE_ID_AND_LOCATION ('3106156.stp', #56);
```

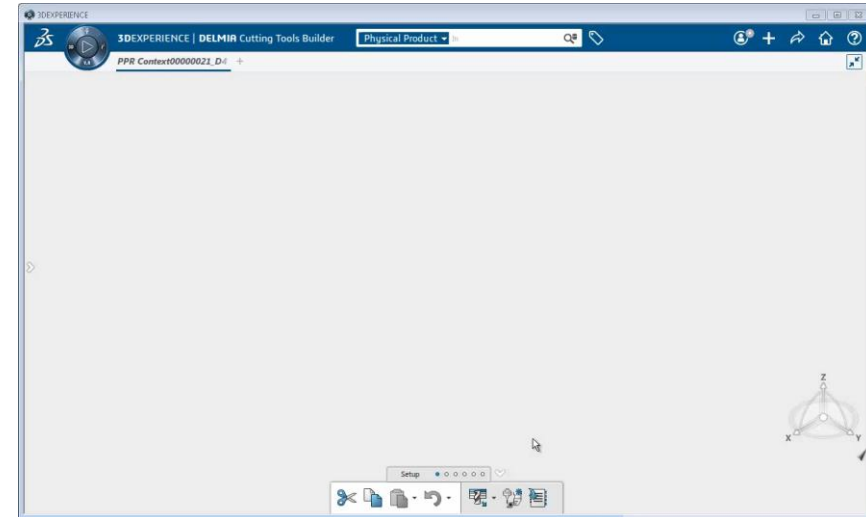
▷ Link to step file 3D static representation

```
#68 = DOCUMENT_LOCATION_PROPERTY ('http://www.iscar.com/Ecat/STP/');  
#69 = EXTERNAL_FILE_ID_AND_LOCATION ('3106156D.stp', #68);
```



ISO 13399 in DS products

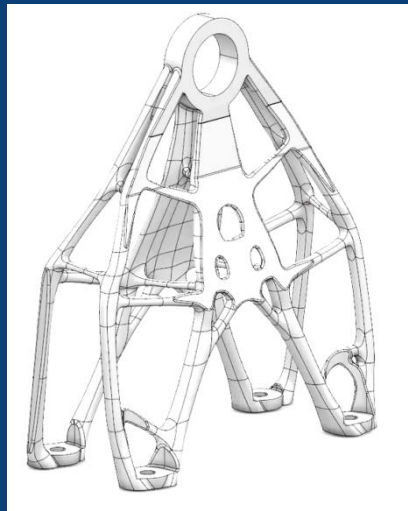
- ▶ Navigation in the tools catalogs from the 3DEXPERIENCE
- ▶ Selection of a tool
- ▶ Import of the tool definition and geometry using ISO13399
 - ▷ All attributes are retrieved in 3DEXPERIENCE and used by 3DEXPERIENCE Apps
 - ▷ STEP and DXF files are associated to the tool





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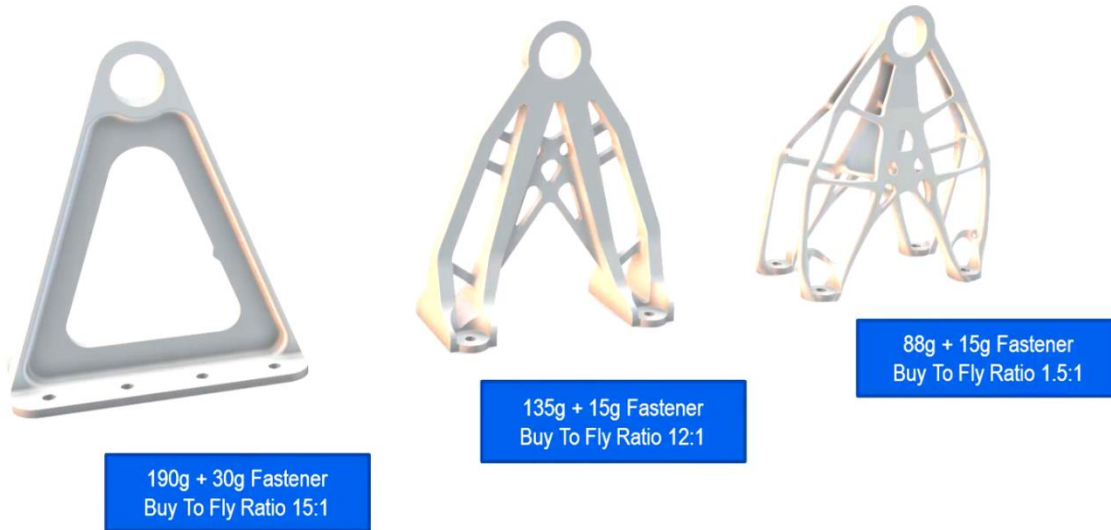
AMF / 3MF
for 3D Printing



3D Printing objectives

Reduce cost and weight

Produce parts impossible to build with subtractive manufacturing



Standards : 3 main formats for output to 3DPrinter

STL (Stereolithography format)

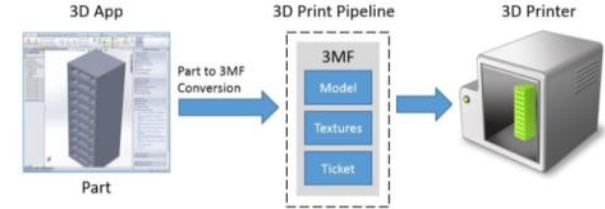


- ▶ De facto standard & most often used today
- ▶ Legacy format (1989), 3DSystem proprietary
- ▶ Geometrical information only
- ▶ Single object defined by a tessellation (list of triangles)
 - ▷ For each triangle is described its normal and vertices coordinates

AMF (Additive Manufacturing Format)

- ▶ ISO standard (ASTM F42 / ISO TC26)
- ▶ Emerging format (2013) extending capabilities vs STL:
 - ▷ XML-based format
 - ▷ One or multiple objects
 - ▷ Support for color, textures, graded materials
 - ▶ Material for each volume - Materials can be combined (graded materials)
 - ▶ Color for each volume, triangle or vertex
 - ▷ Constellations (Repeated instances)
 - ▷ Unit, formula

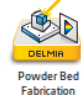
3MF (3D Manufacturing Format)



- ▶ initiated by Microsoft and specified by the 3MF consortium
- ▶ Emerging format (2015), Open and royalty-free specification from 3MFmembers
- ▶ Similar capabilities as AMF offer (except formula) + slicing description + beam lattices + new extensions being prepared
- ▶ Extensible, allow additional section to be added (new extensions being prepared)

Output for 3DPrinter: DS Drivers

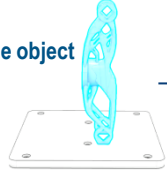
- ▶ DS favor standards and support AMF format
- ▶ DS is a founding member of the 3MF consortium
 - ▷ 3MF format emerging and evolving quickly
 - ▷ Enable output of new DS Additive manufacturing capabilities (support, slicing, ...)



Zoom on Additive Machine output

► Market standard: STL / 3MF CONSORTIUM / AMF (Additive Manufacturing Format)
ISO standard (ASTM F42 / ISO TC26)

Single object



Multi-objects

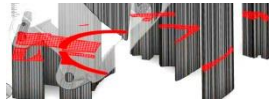


Specific description for support



Optimize file size

3MF < 1/3 STL bin < 1/12 AMF



Slices definition

EXPORT	STL		AMF		3MF	
Feature Geometry:	Standard	DS support	Standard	DS support	Standard	DS support
Single object 3Dshape	yes	yes	yes	yes	yes	yes
Multi-objects 3Dshape	n/a	n/a	yes	yes	yes	yes
Unit	n/a	n/a	yes	yes	yes	yes
Distinguish Support from Model	n/a	n/a	n/a	n/a	yes	yes
Optimise description of multi-instances	n/a	n/a	yes	planned Q1-2019	yes	yes
Curved triangles	n/a	n/a	yes	no	n/a	n/a
Beam Lattices	n/a	n/a	n/a	n/a	yes	plan to be confirmed
Feature Property:						
Color on object	n/a	n/a	yes	yes	yes	yes
Color on triangles	n/a	n/a	yes	yes	yes	yes
Color on vertex	n/a	n/a	yes	no	yes	no
Texture 2D	n/a	n/a	yes	yes	yes	planned Q1-2019
Texture 3D	n/a	n/a	yes	no	in progress	plan to be confirmed
Single Material	n/a	n/a	yes	yes	yes	planned Q4-2018
Multi-Material	n/a	n/a	yes	yes (per object)	yes	planned Q1-2019
Graded Material	n/a	n/a	yes	no	yes	no
Other via meta-data	n/a	n/a	n/a	n/a	yes	plan to be confirmed
Feature: Slices						
slice definition + Mesh of 3Dshape	n/a	n/a	n/a	n/a	yes	yes

Note: above plan is not a commitment and is subject to change

Which Release ?

- ▶ STL: already supported for long, no change
- ▶ AMF:
 - ▷ geometry in R2015X and V5-6R2015,
 - ▷ property (color, texture, material) in R2016X and V5-6R2016
- ▶ 3MF:
 - ▷ Geometry in R2017X and V5-6R2017
 - ▷ Slicing in R2017X (from DELMIA Apps)
 - ▷ Color in R2018X-FD01



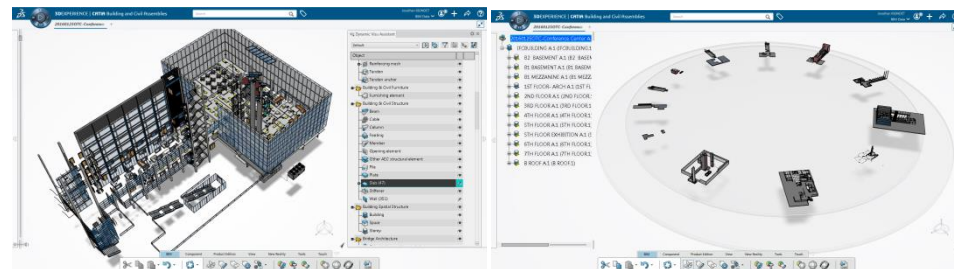
3DEXPERIENCE®

Digital Collaboration for Architecture, Engineering and Construction (AEC)

IFC exchange with 3DEXPERIENCE



3DEXPERIENCE
CATIA Building and Civil Assemblies



IFC file content is imported in 3DEXPERIENCE as CATIA AEC objects.

3DEXPERIENCE IFC allows to **aggregate, review, modify, exchange**:

- **Architectural Model**
- **Structural Model**
- **MEP Model**

Coming from various systems



IFC exchange capabilities with 3DEXPERIENCE

	EXPORT	IMPORT
	R2018X	R2018X
IFC 2x3 schema	YES	YES
IFC4 schema	YES	YES
IFC Part21 files	YES	YES
IFC ZIP	YES	YES
Building Structure (Site, building, wall, ...)	YES	YES
Terrain	YES	YES
Piping/ HVAC	YES (1)	YES
Electrical	YES (1)	YES (1)
Bridge (mapping with Building Structure)	YES	YES
Alignment IFC4x1	YES	YES
Faceted Geometry	YES	YES
Procedural Geometry (ExtrudedAreaSolid, ...)	NO	YES
Tessellated Geometry IFC4	YES	YES
AdvancedBRep IFC4	YES	YES
Nurbs geometry IFC4	YES	YES
Graphic attributes (color, ...)	YES	YES
GIS (IfcSite)	YES	YES
GIS (IfcCoordinateReferenceSystem)	YES	YES
PropertySets	YES	YES
QuantitySets	YES	YES
Custom PropertySets (with XML mapping)	YES	YES

(1) Only geometry

