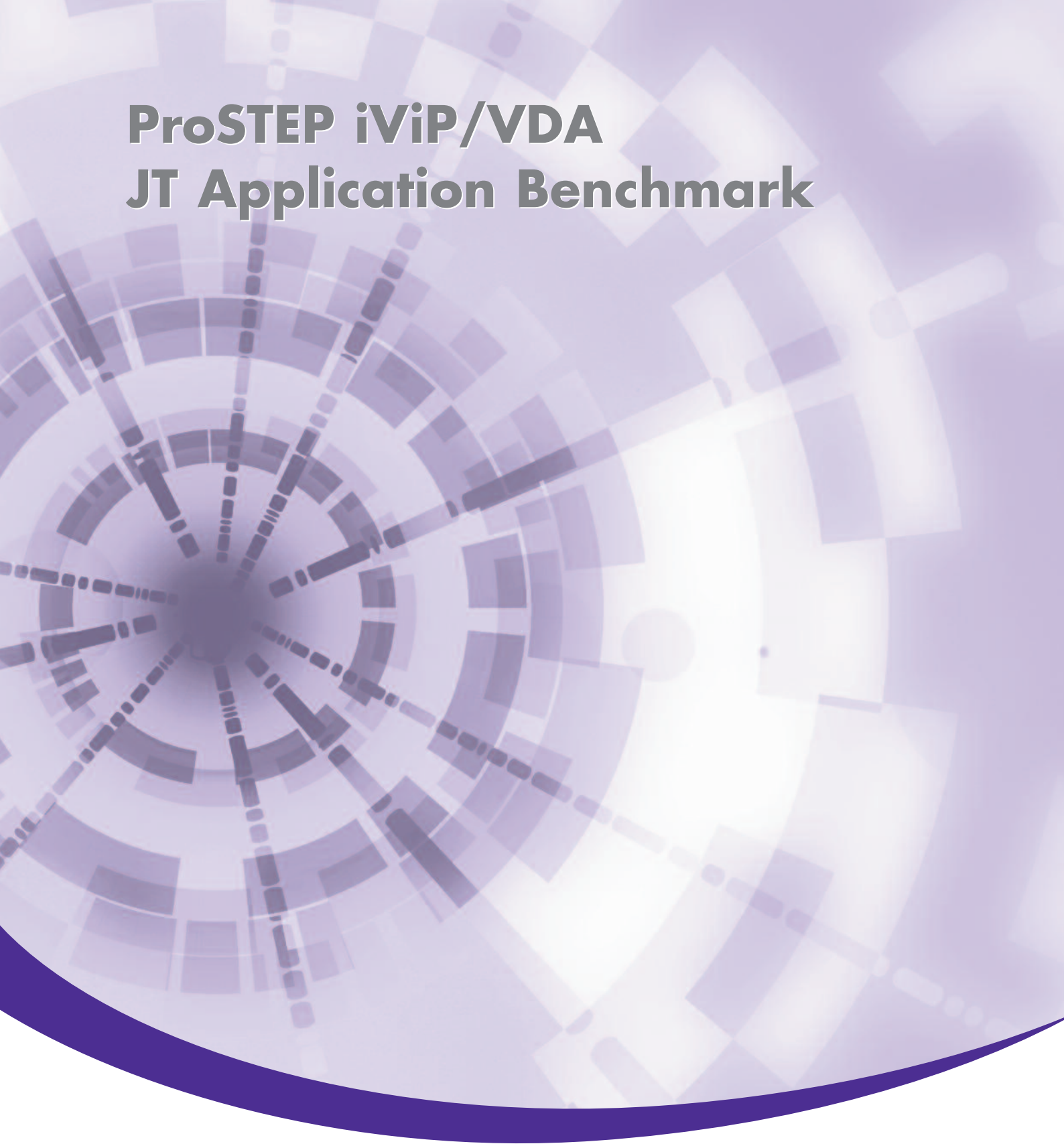
ProSTEP iViP/VDA
JT Application Benchmark



6th JT Application Benchmark

SHORT REPORT

ProSTEP iViP

Contents

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1 Introduction

JT has become a widely used format for product visualization during the product development process. The ProSTEP iViP Association and the German Association of the Automotive Industry (VDA) have launched three JT-related projects in succession, which are being coordinated with each other: The ProSTEP iViP / VDA JT Workflow Forum, the ProSTEP iViP / VDA JT Application Benchmark and the ProSTEP iViP / VDA JT Implementor Forum. In August 2010, the ProSTEP iViP Association submitted the latest JT specification (version 9.5) to the ISO for standardization. JT 9.5 was published by ISO as ISO 14306:2012 in December, 2012.

As the latest in a row of six benchmarks, the JT Application Benchmark was carried out in 2015 to achieve an independent evaluation of the progress being made with regard to the development of JT translators. The object of testing was ISO 14306:2012 (JT 9.5). Additionally, the interoperability between JT and the STEP AP242 Business Object (BO) Model XML schema (published as ISO Standard ISO 10303-242:2014) was also part of the benchmark. Thus, this 6th benchmark covers results far beyond state-of-the-art technology.

The benchmark was managed by the JT Workflow Forum and JT Implementor Forum. Because the benchmark is an independent activity, it was financed directly by the two organizations, the ProSTEP iViP Association and the VDA, and not by the participating companies whose products were tested. It is a neutral comparison of trendsetting JT applications with regard to the selected test criteria. Therefore, the results of the benchmark cannot only be used to evaluate the application of JT in PLM environments, but also for improvement of the interoperability of the applications.

As such applications are undergoing a permanent development; the benchmark can only give a snapshot of the functions and qualities of the applications.

2 Approach

The JT Application Benchmark is a common activity of the ProSTEP iViP Association and the VDA. Goal of the benchmark is a neutral comparison of actual JT applications. Focal points of this 6th benchmark were the testing of CAD-JT and JT-CAD translators as well as testing the state of the art regarding the interaction of JT and STEP AP242 XML.

2.1 Four steps

Based on the Lessons Learned from previous benchmarks, the JT Workflow and JT Implementor Forum agreed on the following four-step approach:

1. The JT Workflow Forum clarifies the target intent for the benchmark and provides details on the expected outcome (e.g. the PMI style should be translated correctly).
2. The vendors make proposals for the JT file scope, configuration settings and evaluation approach which in their eyes will best fit the requirements.
3. A proof of concept / test run for the benchmark will be conducted, using the agreed-on settings and test models, with close involvement of the vendors.
4. If the test run is successful, the actual benchmark will be conducted.

2.2 Building blocks

This benchmark was composed of two independent building blocks, the CAD-JT-CAD benchmark and the JT with AP242 XML benchmark:

Figure 1: Benchmark building blocks

In the CAD-JT-CAD benchmark, the results of CAD to JT translations and the results of JT to CAD translations were evaluated.

- CAD to JT translations: Translation of CATIA V5-6R2014, Creo2 and NX9 CAD models to JT with quality checks regarding geometry (XT-BREP), tessellation, PMI and attributes.
- JT to CAD translations: Translation of the JT models that were created during the first translation step back to CATIA V5-6R2014, Creo2 and NX9 CAD models with quality checks regarding geometry (XT-BREP), tessellation, PMI and attributes.

JT with STEP AP242 XML benchmark:

- Import of STEP AP242 XML assembly files with referenced JT models into target applications with focus on Product Structure and Assembly Attributes (Meta Data).
- Export from source applications to STEP AP242 BO Model XML with referenced JT models.

2.3 Documentation

This short report is made publicly available; a long report with more detailed information is provided to the project members.

3 Criteria

The criteria were defined by the JT Workflow Forum. Details, especially the validation methods, were elaborated in collaboration with the JT Implementor Forum.

3.1 CAD-JT-CAD benchmark

The CAD-JT-CAD benchmark was an extended re-test of the 3rd JT application benchmark in 2012, where the CAD to JT translation was benchmarked. The used CAD source formats for the CAD to JT translations and the target CAD formats for the JT to CAD translations were CATIA V5-6R2014, Creo 2 and NX 9. The used JT format for all translations was JT (ISO 14306:2012).

3.1.1 Geometry criteria

Regarding the correctness of geometry it was checked if the center of gravity, volume and surface of the resulting geometry were the same as in the source geometry. The BREP data had to be stored as XT-BREP.

3.1.2 Tessellation criteria

Regarding the correctness of the created tessellations, it was checked if the settings for Level of Detail (LOD) creation were conforming to the content harmonization guidelines of the JT Workflow Forum. Also, the colors in the target model of the translation had to be consistent to the colors in the source model.

3.1.3 PMI criteria

Regarding the correctness of PMI translation, the following criteria were checked:

- The graphical representation of PMI annotations had to be consistent in CAD and JT.
- All links between geometry and PMI had to be kept.
- Additionally, for the Catia translations, links between PMI elements had to be kept.
- The presentation of PMI had to be machine-readable ("Semantic PMI").
- The PMI had to be organized in the same model views as in the source model.
- Different types of PMI had to be converted correctly.

3.1.4 Attribute criteria

Regarding the correct translation of metadata from CAD to JT, two categories of attributes were checked:

- The CAD properties, defined in the JT ISO specification
- The translator information, defined in the JT-IF Implementation Guideline (chapter "Translator Information")

3.2 JT with STEP AP242 XML

In the second part of this benchmark, the import and export of product structures using STEP AP242 XML files with referenced JT geometry files were tested.

The criteria were grouped in the categories XML criteria, attribute criteria and product structure criteria. These are described in the following subchapters.

3.2.1 XML criteria

The written XML file should be conforming to the STEP AP242 BO Model XML schema (ISO 10303-242:2014). The criterion was fulfilled if the validation of the XML file against the schema succeeds. If the check tool reported a validation error, this criterion was not fulfilled.

3.2.2 Attribute (meta data) criteria

Attributes on assembly level in the source model should be converted completely and correctly in the target model.

3.2.3 Product structure criteria

The main focus of this benchmark was to validate if product structures can be written as STEP AP242 XML files. The test criteria were the following:
The product structure should not be changed. Multiple instances of parts should be handled correctly and the placement and orientation of parts should be as in the source model.

4 Testing

The benchmark tests were executed at PROSTEP to assure neutral testing and documentation. The vendors provided the software to be benchmarked and licenses for the runtime of the benchmark testing and evaluation.

4.1 Configuration and settings

The vendors of the translators were asked to provide the configuration and settings that would fit best to the benchmark criteria.

4.2 CAD-JT-CAD benchmark

Table 1 gives an overview of the participating vendors in the CAD-JT-CAD benchmark. It also shows who participated in the CAD-JT tests or in the JT-CAD tests.

4.2.1 Tested translators

Table 2 gives an overview of the translators tested in the CAD to JT test of this CAD-JT-CAD benchmark. It also shows which CAD systems were supported by each translator. Table 3 gives an overview of the translators tested in the JT to CAD test of this CAD-JT-CAD benchmark. It also shows which CAD systems were supported by each translator. A short summary for each check tool is listed in the following sub-chapters.

Vendor	CAD-JT	JT-CAD
CoreTechnologie	Yes	No
Elysium	Yes	Yes
PTC	Yes	Yes
Siemens PLM	Yes	Yes
Theorem	Yes	Yes
T-Systems	Yes	Yes

Table 1: Vendor participation in the CAD-JT-CAD benchmark

Vendor	Translator	Version	CATIA V5-6R2014	Creo 2	NX 9
CT CoreTechnologie	3D_Evolution	4	x	x	x
Elysium	Asfalis	EX 6.1	x	x	x
PTC	Creo	3	-	x	-
Siemens PLM	JT bi-directional translator for CatiaV5	9.4	x		
Siemens PLM	JT translator for ProE/Creo	11.1		x	
Siemens PLM	NX	9			x
Theorem	CADverter	18.2	x	-	-
T-Systems	COM/FOX	6.1.5	x	-	-

Table 2: Benchmarked JT translators and supported CAD formats in the CAD to JT tests

Vendor	Translator	Version	CATIA V5-6R2014	Creo 2	NX 9
Elysium	Asfalis	EX 6.1	x	x	x
PTC	Creo Parametric	3	-	x	-
Siemens PLM	JT bi-directional translator for CatiaV5	9.4	x	-	-
Siemens PLM	NX	9			x
Theorem	CADverter	18.2	x	-	
T-Systems	COM/FOX	6.1.5	x	-	

Table 3: Benchmarked JT translators and supported CAD formats in the JT to CAD tests

4.2.2 Test models

The used test models were updated versions of the NIST test models that were already used in the 3rd JT application benchmark in 2012. The test models were all built from scratch and without conversion steps from one CAD format to another. That was also the reason for the different model centers and count of PMI views.

The used test models were available for the following CAD system versions and later versions of the listed systems:

- CATIA V5 R21
- NX 8
- Creo 2
- Solidworks 2012

Figure 2 exemplary shows the CATIA V5 test model.

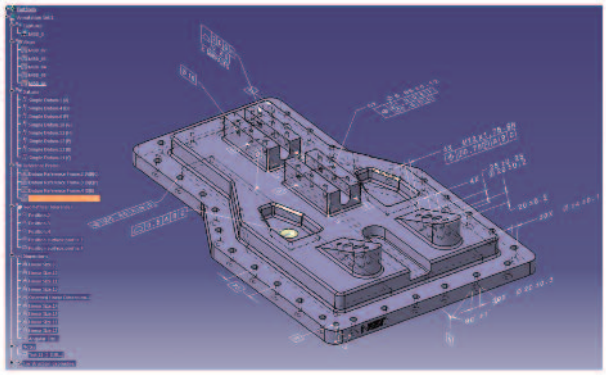

Figure 2: Catia V5 test model

4.2.3 Check Tools

It was preferred to use check tools rather than perform manual checks.

The decision which check tool should be used was made by the JT Workflow Forum. Since ITI TranscenData and Transcat PLM were not participating in the CAD-JT-CAD benchmark, their tools CADIQ and LiteBox3d with LiteComply were chosen to ensure independent results. Manual checks were done by using the native CAD systems and Teamcenter Visualization (Siemens PLM).

4.2.4 Testing procedure

Figure 3 gives an overview of the CAD-JT-CAD benchmark testing procedure. The quality of each individual step was checked and the errors that had occurred in the first step did not affect the results of the second step.

4.3 JT with STEP AP242 XML benchmark

4.3.1 Tested Translators / Viewers

Since the STEP AP242 Business Object Model XML became an international standard end of 2014, a thank goes to all involved vendors for their participation despite the early development status.

4.3.1.1 CT CoreTechnologie – 3D_Evolution

Tested Version: 4.0

3D_Evolution is a standalone tool for data conversion, analysis and repair. The Conversion Engine supports all primary systems and data formats such as CATIA, Creo, NX, Ideas, SolidWorks, Robcad, JT, STEP, and many more.

4.3.1.2 T-Systems – COM/FOX

Tested Version: 6.1.5

COM/FOX is a translator for CATIA V5. It is able to translate CATIA V5 files to and from multiple neutral data formats, including JT and STEP AP242 XML.

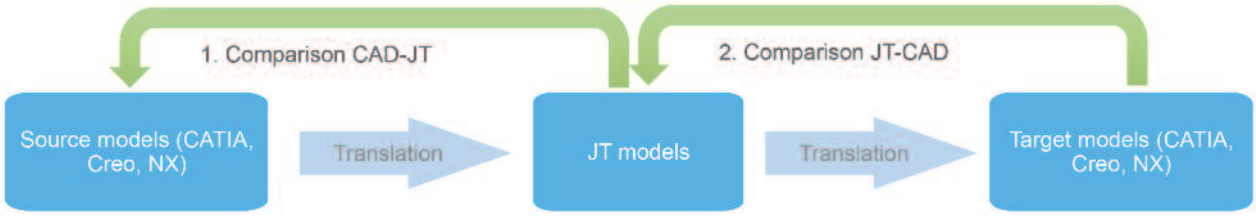

Figure 3: Testing procedure for CAD-JT-CAD benchmark

4.3.1.3 Transcat – LiteBox3D

Tested Version: 1.6.3

LiteBox3D is an easy and free to use JT viewer, based on the specification of the JT ISO standard. Moreover, PLMXML and STEP AP242 XML files can be opened.

4.3.1.4 Siemens PLM: JT bi-directional translator for CatiaV5

Tested Version: v9.4

The JT Bi-directional Translator for CATIA V5 can be used to translate CATIA V5 files to JT files and JT files to CATIA V5 files.

4.3.1.5 betaCAE – ANSA

Tested Version: 15.3.1

ANSA is a CAE preprocessing tool in Finite Element Analysis. Applications include the generation of models for Crash, Durability, NVH, CFD and other research areas. It is compatible with many major CAD/CAE interfaces used in the industry.

4.3.1.6 PROSTEP – OpenPDM STEP AP242 Adapter

Tested Version: 7.170.27

The OpenPDM STEP AP242 Adapter enables reading and writing of STEP AP242 BOM XML files. The structure and meta data contained in a PLM system can be exported and imported. Referenced files and documents are also included in the import/export.

4.3.1.7 Theorem – Cadverter

Tested Version: 18.2

The CATIA V5i to JT CADverter is a Bi-directional direct database converter CATIA V5 and the JT file format.

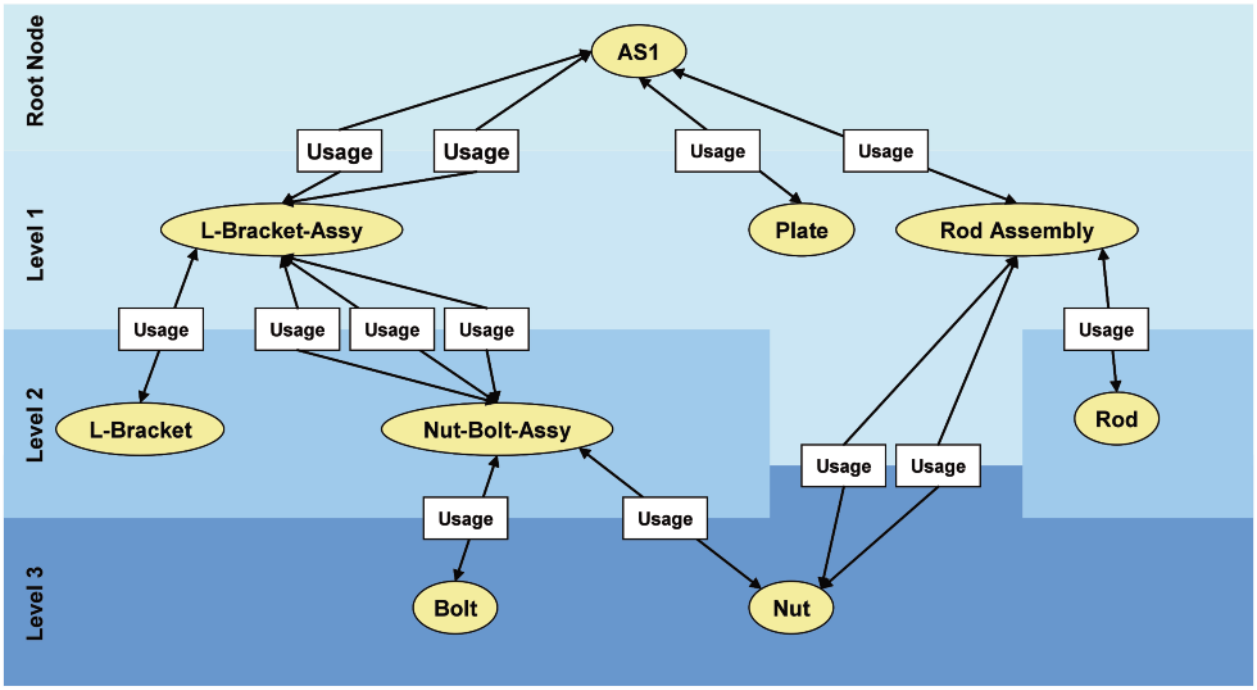

Figure 5: JT with STEP AP242 XML: Assembly structure of the test model

4.3.2 Test model

The geometry of the assembly test model, which was defined in ISO 10303-44, was simple (cf. Figure 4) and not evaluated explicitly, as the focus was on the exchange of the assembly structure, the correct positioning of the components and the assembly attributes.

Regarding the involved translators, the test model for the JT with STEP AP242 XML test was a CATIA V5R22 CATProduct.

4.3.3 Used check tools

Altova's XMLSpy 2009 was used to validate the generated XML files against the STEP AP242 XML schema and as viewer for the manual check of the assembly attributes and the product structure.

4.3.4 Testing procedure

The second building block of this JT Application Benchmark was divided into three comparison steps. In the first step, the created XML file was validated against the STEP AP242 XML schema and the product structure and the assembly attributes in the XML file were compared to the source CAD model.

In the second step, the product structure and the assembly attributes of the derived CAD models from the second translation step were compared to the XML file from the first translation step. Finally, the CAD models from the second translation step were compared to the source CAD model.

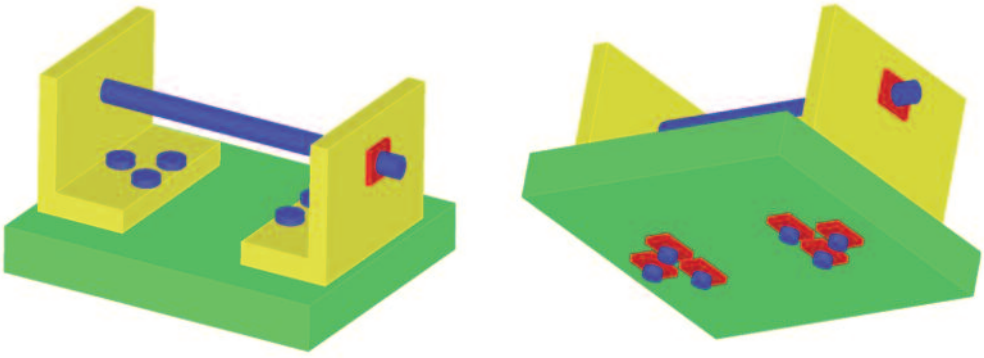

Figure 4: JT with STEP AP242 XML: Test model

5 Results

In the following chapters, an overview of the test results for the different Building Blocks is given.

5.1 CAD-JT-CAD benchmark results

5.1.1 CAD-JT test results

In the first step of the CAD-JT-CAD benchmark, the quality of the CAD to JT translations was evaluated (cf. chapter 3.1 CAD-JT-CAD benchmark). Figure 6 gives an overview of the test results. For detailed results, please refer to the long report.

The tests showed very good results for the translation of geometry and attributes. For PMI translation, changes in the graphical representation (style) as well as errors in the semantic description of annotations occurred in several cases.

5.1.2 JT-CAD test results

In the second step of the CAD-JT-CAD benchmark, the quality of the JT to CAD translations was evaluated (cf. chapter 3.1 CAD-JT-CAD benchmark). Figure 7 gives an overview of the test results. Detailed results are given in the long report.

Again, the test shows satisfying results for the translation of geometry. The test results for PMI are mostly negative. This is partially caused by a lack of support of PMI in JT to CAD translations by the tested software. It is also caused by different concepts of implementation and usage of PMI in the different CAD systems.

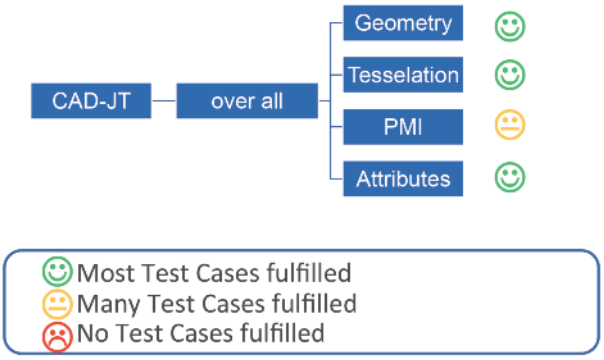

Figure 6: Overview of CAD-JT test results

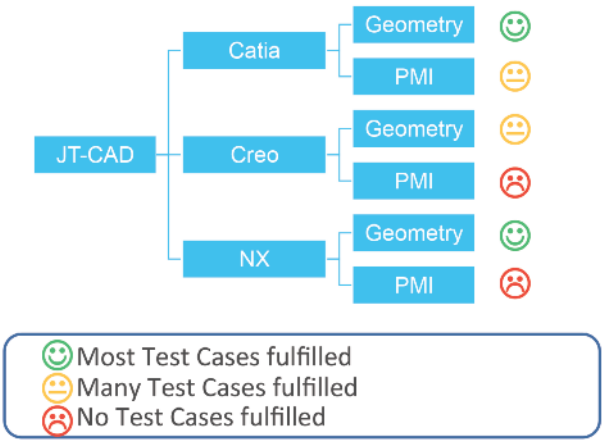

Figure 7: Overview of JT-CAD test results

5.2 JT with STEP AP242 XML benchmark results

Figure 8 gives an overview of the JT with STEP AP242 XML benchmark results. In the figure, the rating of the results is associated with the process steps of the benchmark testing.

Overall, the results were very good regarding the validity of the created XML files and translation of product structure. However, there were major issues with the translation of attributes. In many cases the attributes were not yet supported by the tested translators. The target applications were mostly able to read the attributes stored in the imported files.

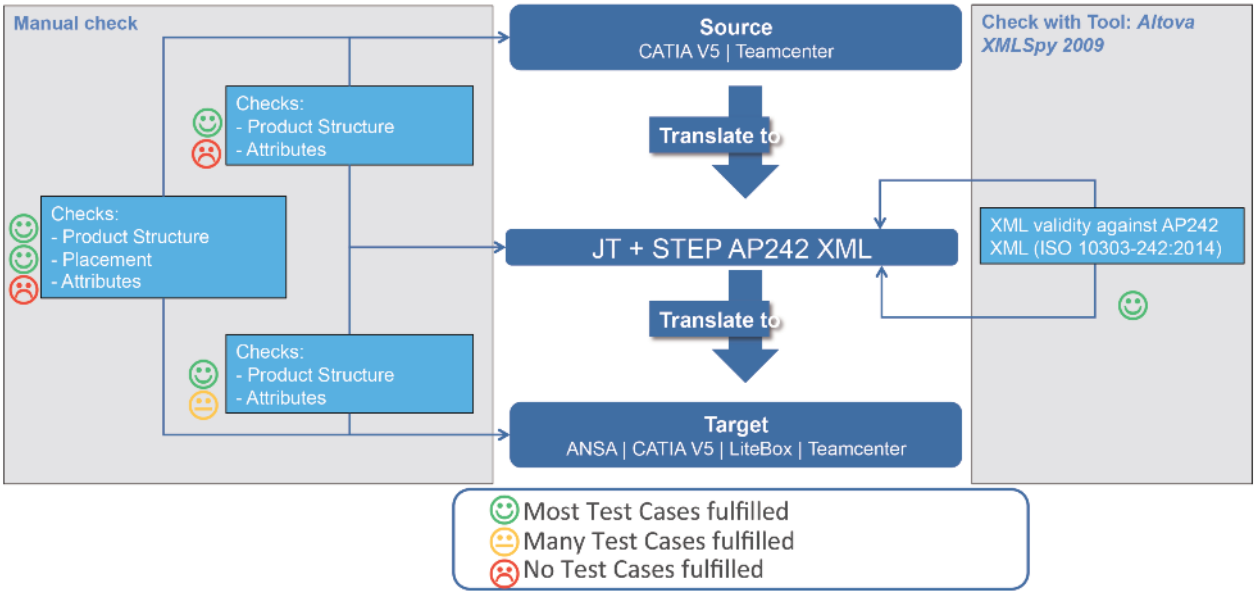

Figure 8: Overview of JT with STEP AP242 XML benchmark results

6 Summary and outlook

The benchmark has proven the capabilities of JT translators. It has shown that the quality and completeness of JT translations from and to other CAD formats is very high. Nevertheless, there are still issues with the translation of PMI, especially on the import of JT files to the CAD systems. Due to these issues, the JT Workflow Forum and the JT Implementor Forum will work together to develop guidelines for the exchange of PMI information in 2016.

Another focal point of this benchmark was to bring forward the use of JT in context of the new STEP AP 242 BO Model XML schema. A STEP AP242 XML file containing product structure information should reference JT files as geometry nodes. JT and STEP as a combination of standardized data formats could be used for engineering and planning processes as well as archiving; achieving solutions independent from proprietary data formats. The tests show that the combination can be used to exchange assembly structure data. An issue is the current lack of support of assembly level properties by some of the translators.

Due to the close cooperation between the software vendors and testers, issues found during the testing could be directly communicated. This allows the vendors to consider the benchmark results in the current development. With issues discussed in the JT Workflow Forum and the JT Implementor Forum, a common understanding of the users' requirements is achieved. Also, the discussion of issues and results among the vendors will lead to improved interoperability between the various tools.

7 Acknowledgements

We would like to thank the software vendors who provided their software for the benchmark testing and supported the installation and configuration of their software. We would also like to thank the vendors of the check tools for supporting the analysis of the benchmark data.

ProSTEP iViP Association
Dolivostraße 11
64293 Darmstadt
Germany

Phone: +49-6151-9287-336
Fax: +49-6151-9287-326

psev@prostep.com
www.prostep.org

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