prostep ivip/VDA

ReqIF Benchmark 2020

Short Report

Version 1.0, 30.11.2020

Status: Final

Abstract

Requirements Management has been established to ensure seamless specifications along the product creation process. To manage complex specification processes and requirements dependencies companies introduced requirements management systems. The generic „Requirement Interchange Format (RIF)" was created to enable the exchange of information across different requirements management systems.

In summer 2008 the prostep ivip association initiated the project group IntRIF to increase the acceptance and application of RIF by transferring the recommendation into an international standard. With the successful standardization in April 2011 OMG ReqIF 1.0.1 has been published as the official successor of RIF.

Two project groups are currently working on the enhancement of the format and its application. In 2011 the ReqIF Implementor Forum was established for realizing a strong technological basis. In 2016 the community of user representatives then consequently made the next step: Specifying relevant use cases for ReqIF application in industry.

To evaluate the feasibility of requirement data exchange with ReqIF, benchmarks are conducted, the very first in 2018. The benchmarks were well received by the users and implementers, as they provided valuable information for the usage and further development of requirement management tools. In this third benchmark, the tested scenario is a customer/supplier data exchange with updates on customer side. The benchmark was run at prostep ivip site with support of the participating vendors. The criteria and test data were defined by the users.

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1 Introduction

Requirements Management has been established to ensure seamless specifications along the product creation process. To manage complex specification processes and requirements dependencies companies introduced requirements management systems.

To support a proper requirements exchange between partners using different tools, the project group "Simulation and Tools" of the HIS (Hersteller Initiative Software) specified the generic „Requirement Interchange Format (RIF)".

In summer 2008 the prostep ivip association initiated the project group IntRIF to increase the acceptance and application of RIF by transferring the recommendation into an international standard. With the successful standardization in April 2011 OMG ReqIF 1.0.1 has been published as the official successor of RIF.

prostep ivip established two project groups to further drive the ReqIF format:

The goal of the ReqIF Implementor Forum is to ensure interoperability between different ReqIF-based implementations. Therefore, the ReqIF-IF works very tight together with the newly established ReqIF Workflow Forum.

In 2016, the community of relevant user representatives consequently made the next step: Specifying relevant use cases for ReqIF application in industry.

Thus, major aim of the prostep ivip / VDA ReqIF-WF is to specify use cases as well as reference processes (customer-customer, customer-Supplier etc.) and, related to this, deriving process requirements and test cases. The work is performed in close collaboration with the ReqIF Implementor Forum.

To evaluate the feasibility of requirement data exchange with ReqIF, benchmarks are conducted, the very first in 2018. The benchmarks were well received by the users and implementers, as they provided valuable information for the usage and further development of requirement management tools.

In this third benchmark, the tested scenario is a customer/supplier data exchange with updates on customer side. The benchmark was run at prostep ivip site with support of the participating vendors. The criteria and test data were defined by the users.

Goal of the benchmarks is a neutral evaluation of the current capabilities in requirement data exchange with ReqIF. Additionally, issues that require further development of either the format itself or of the tested software tools will be identified and addressed.

2 Approach

The following sections describe the basic conditions for the benchmark.

2.1 Four Steps

Based on lessons learned from previous benchmarks, the ReqIF Workflow and ReqIF Implementor Forum agreed on the following four-step approach:

1. The ReqIF Workflow Forum clarified the target intent for the benchmark and provided details on the expected outcome.
2. The vendors made proposals for the ReqIF file scope, configuration settings and evaluation approach which in their eyes would best fit the requirements.
3. A proof of concept / test run for the benchmark was conducted, using agreed-on settings and test files, with close involvement of the vendors.
4. After the successful test run, the actual benchmark was conducted.

Figure 1 shows which tasks were performed by the involved actors during the benchmark.

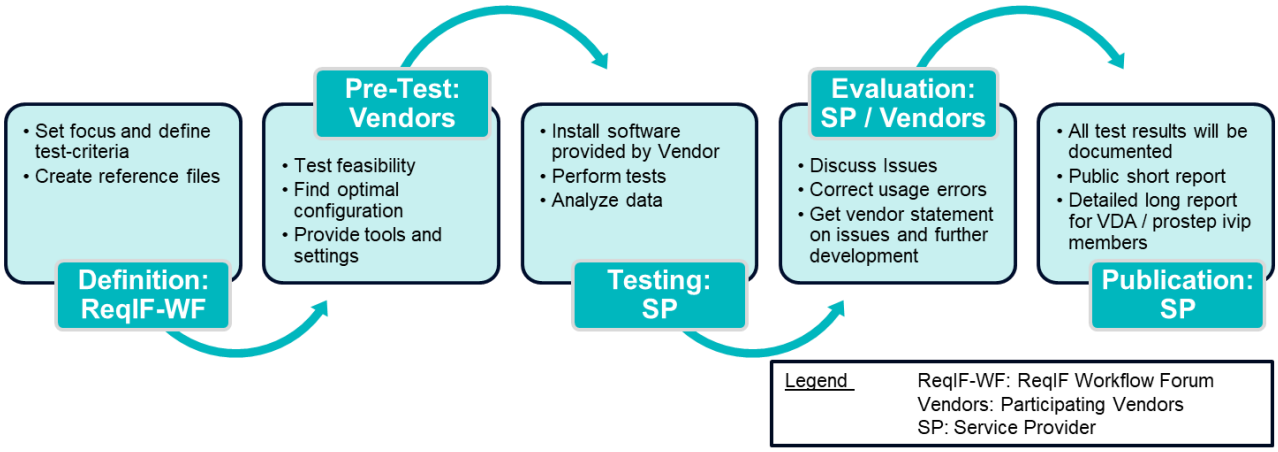

Figure 1: Process and Actors

The involved actors are the following:

- The prostep ivip ReqIF Workflow Forum (ReqIF-WF)
- The participating vendors from the prostep ivip ReqIF Implementor Forum (ReqIF-IF)
- PROSTEP AG (as service provider, SP)

The actions performed during the different steps were:

1. In the first step, the definition phase, ReqIF Workflow Forum members set the focus of each benchmark and defined the test criteria. Also, a set of ReqIF files was chosen as the initial input for the benchmark tests.
2. The second step was the Pre-Test, which was conducted by the participating ReqIF application vendors. In this phase, they tested the feasibility of given test files and test criteria. They hereby had to find and optimize their tool configuration to achieve best results. These resulting configuration settings were finally provided for the benchmark testing.
3. In the third step, the benchmark testing was conducted by PROSTEP. Software made available by the vendors was installed, tests were performed, and results were analyzed.
4. In the fourth step, the preliminary results were discussed with vendors to correct usage errors, to get statements regarding further development of the affected software and to resolve identified issues.

All results will be published in a publicly available short report and in a detailed long report that is available for all prostep ivip and VDA members.

2.2 Scenario: Data Exchange with Changes and Linked Artefacts (PING-PING)

This scenario reflects a requirements exchange process with updates on the exchanged data on customer side. The exchanged data package consists of multiple modules which are linked to each other. After the initial export from the customer the artifacts are changed in the customer's system.

The supplier imports the original artifacts first, then the updated artifacts. The changes must be adopted by the importing system and reported to the user.

The focus of the benchmark is the treatment of links between modules in the exchange process. Thus, the links will be changed during the process and in the first exchange, not all modules will be exported

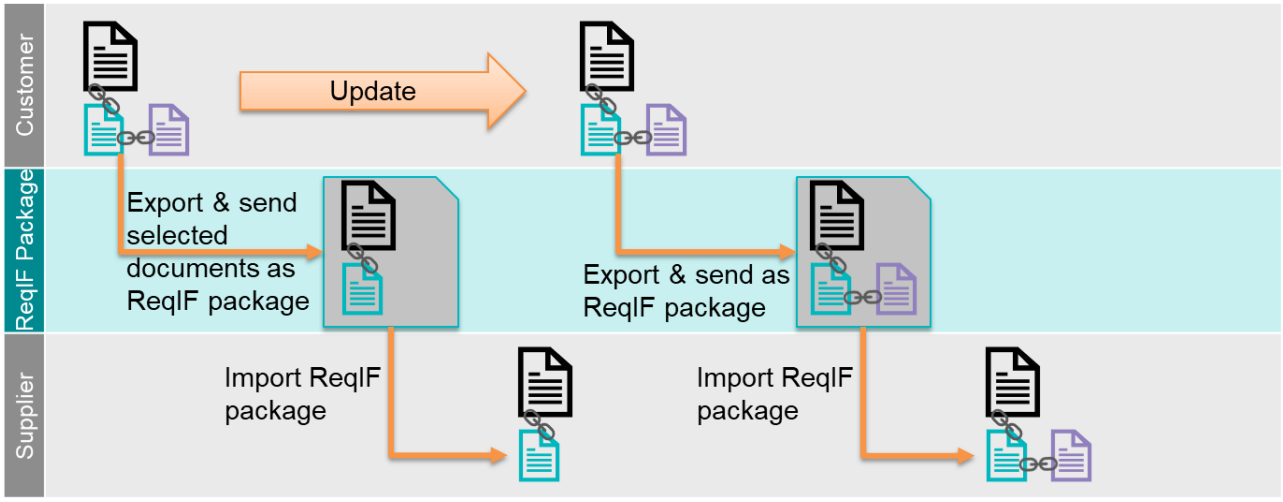

Figure 2: Ping-Ping Scenario

In the benchmark tests, the exported ReqIF package was checked for its validity before the imports were started.

2.3 Participants

All members of the ReqIF Implementor Forum were asked to participate. 3 requirement management system vendors and 1 vendor for data exchange connectors participated in the benchmark:

- Asaro Systems
- IBM
- INTLAND
- Siemens

The tested software is listed in Table 1. The test results are only valid for the versions given in the table. Issues detected during this benchmark may already be solved in versions released since the completion of the benchmark tests as issues are discussed with the vendors during the benchmark.

Table 1: Tested software

Vendor	Software	Version	Description
Asaro	ReqIF for Active Workspace	2020.05.4437	ReqIF connector for Teamcenter Active Workspace
IBM	DOORS	9.7.0.0	Requirement management system
IBM	DOORS NG	7.0.1	Requirement management system
IBM	IBM Engineering Requirements Management DOORS Family - Data Exchange Add On(eXchange) + IBM DOORS	5.6	ReqIF connector for DOORS

Vendor	Software	Version	Description
INTLAND	codeBeamer	10.1.0	Requirement management system
Siemens	Polarion	20 R1	Requirement management system
Siemens	Teamcenter Active Workspace	12.3/4.3	PLM system with requirement management functionalities

With these 7 software systems, 32 combinations for the data exchange are tested, as can be seen in the test case matrix (Table 2).

As check tool, Asaro Systems ReqIF Q-Checker was used. The Q-Checker checks the validity of the file, formatting, attribute, and datatype definitions and missing or unreferenced files.

The participating software vendors provided software and licenses for the duration of the benchmark. The software was installed on a local machine at PROSTEP or available to PROSTEP as a cloud-based service.

Table 2: Test case matrix

Customer Tool → / Supplier Tool ↓	Asaro ReqIF for Active Workspace + Siemens Teamcenter	IBM DOORS (built in)	IBM DOORS Next Generation	Data eXchange Add On + IBM DOORS	intland codeBeamer	Siemens Polarion
Asaro ReqIF for Active Workspace + Siemens Teamcenter	✓	✓	✓	✓	✓	✓
IBM DOORS (built in)	✓	✓	✓	✓	✓	✓
IBM DOORS Next Generation	✓	✓	✓	✓	✓	✓
Data eXchange Add On + IBM DOORS	✓	✓	✓	✓	✓	✓
intland codeBeamer	✓	✓	✓	✓	✓	✓
Siemens Polarion	✓	✓	✓	✓	✓	✓

2.4 Test Criteria

The test criteria and tolerances were defined by the ReqIF Workflow Forum. They are listed in the following Table 3.

Table 3: Test Criteria

Criterion	Description
Validity	Exported ReqIF files must be valid. Tests will not be continued with invalid files.
Completeness	The entire requirement module exported from the customer tool must be imported to the supplier tool.
Links	Three modules are linked to each other. The links must be imported and changes to the links adopted on the second import.
Embedded files	Files must be accessible from the attribute where they were originally embedded. Also, they must occur at the same position in the attribute value's content. Pdf, docx, pptx and xlsx files were used for the tests. Example: if in the customer's tool, the content is "Text1 <document> Text2", then in the supplier' tool, the order must be the same: first, Text1, then the document, then Text2.
Embedded images	In the supplier's tool, images must occur at the same position in the attribute value's content as in the customer's tool. Example: If in the customer's tool, the content is "Text1 <image> Text2", then in the supplier' tool, the order must be the same: first, Text1, then the image, then Text2. The content of the images must be the same, also the size. If the tool shows a scaled preview, the originally sized image must be accessible. JPEG, GIF and PNG image files were used for the tests.
Changes indicated on import	The user must be able to easily identify changes when a requirement module is updated. The importing tool should be able to visualize changes before, during or after the import.
Added requirements	Added requirement must be recognized and imported.
Identification of missing requirements	A requirement is removed in the customer system. The user needs to be able to identify the missing requirement on import in the supplier system. It is acceptable if the user can identify the specific missing requirement after the import.
Change of requirement text	Requirement text of respective requirement must be changed on import.
Change of attribute values	Values are changed, also to empty value. New values must be adopted on import.
Change of attribute type definition	The enumeration definition of an attribute type is changed. The change must be adopted on import.
Structural changes	The position of objects inside the module is changed. The change must be adopted on import.

Criterion	Description
no further changes	No further changes to the modules should be occur after the re-import to the customer tool.

The validity of the exported files was checked with the Asaro Systems ReqIF Q-Checker, all other criteria were checked within the requirement management system to which the ReqIF package was imported.

2.5 Reference Files

Before the benchmark tests, reference files were created. The ReqIF Workflow Forum members made sure that all relevant content is in the files, the ReqIF Implementor Forum members checked the created files for their validity.

For the testing of links, a section was added to the reference file used in previous benchmarks and two modules to the entire package. The original file will be addressed as module A, the other two as module B and C.

The package contains docx, pptx, xlsx and pdf files as OLE objects which will be referred to as document files further on. Different types of image files (gif, jpg & png) are embedded in the modules in the same way as the document files

For every requirement management system, a package with unique attribute identifiers was created.

2.6 Testing

The reference ReqIF packages were imported to the tested systems and it was checked whether the content was imported as expected. Adaptions to the imported modules were made to match the needs of the testing procedure. The requirements of this packages are the set with which the following export and import tests were performed. In this case, the systems acted as the customer tools.

The imported and revised requirement set was then exported to a ReqIF package. In the first step, only two of three modules were exported. This exported package was checked with the Asaro Systems ReqIF Q-Checker for validity.

Afterwards, the packages were imported to the other tested systems as well as re-imported to the originating system, now acting as supplier tools.

In the supplier tools, the tester checked the completeness of the modules, the accessibility of documents and images and the links and attributes relevant for the benchmark tests.

In the customer tools the modules were changed according to the benchmark's definition and all three modules exported to a ReqIF package.

The exported packages where then imported again to the supplier systems. It was then checked whether the changes were imported and if the user of the importing system could identify those changes.

2.7 Documentation

This short report is made publicly available; a long report with more detailed information is provided to the members of prostep ivip and VDA.

3 Results

In the following an overview of the results is given. The overview is separated in results for the first ping and for the second ping.

3.1 Overview First Ping

The focus for the first ping lies on the completeness of the exchanged specification. All requirements must be exchanged with the corresponding attributes and values. Embedded document and image files must be exchanged. Links between requirements in different modules must be exchanged when the linked modules are in the exchanged data packages.

Before the first ping, the reference files were imported to all systems. There were no issues with this import.

All exported files were valid ReqIF files according to the ReqIF XML schema.

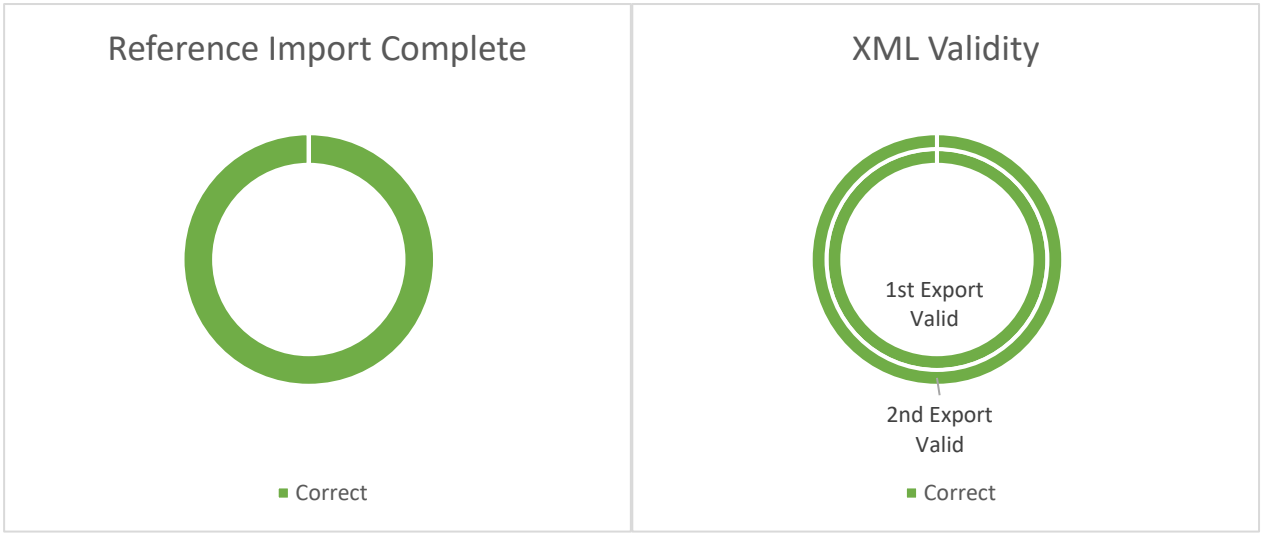

Figure 3: Results for reference import and validity of exports

All systems were able to import the specifications completely with all requirements and the relevant attributes.

Exchange of Embedded Files

Regarding the embedded files, in one export the document files were not represented correctly. Therefore, cases in which the files could not be imported are marked as not tested. Cases in which the importing tools tolerated the wrong representation and imported the files are marked as correct. In one case, the png image file could not be found by the importing tool.

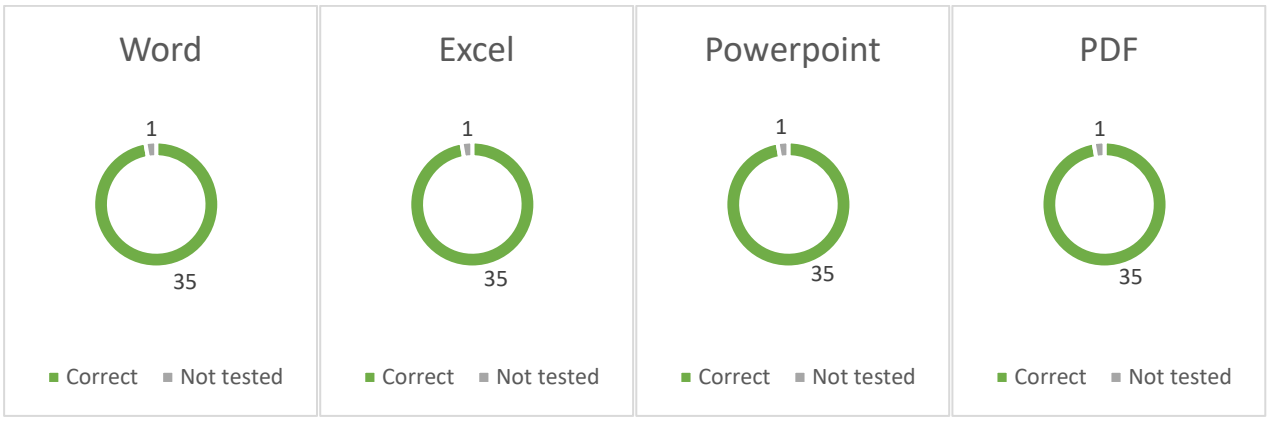

Figure 4: Results for exchange of embedded document files

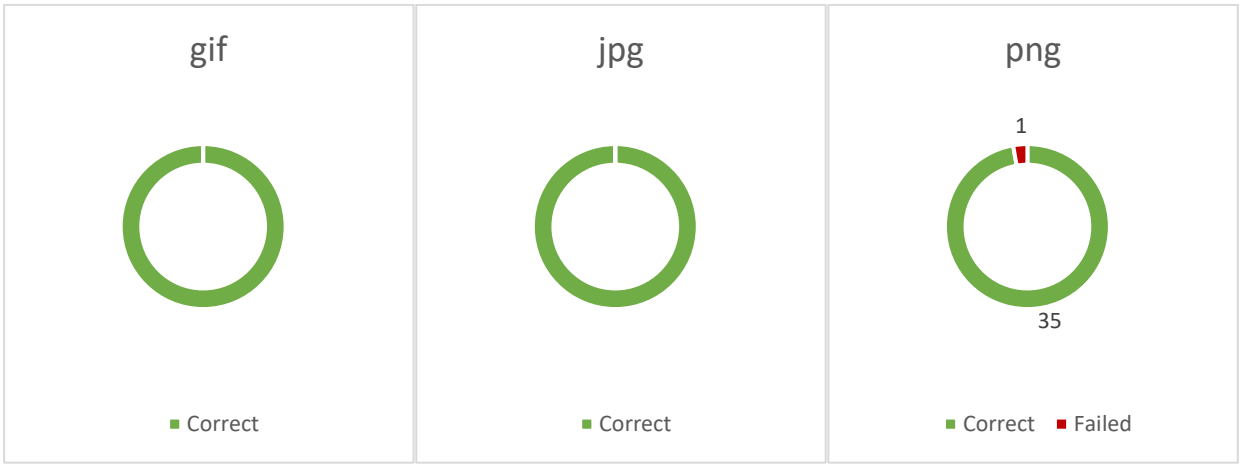

Figure 5: Results for exchange of image files

Exchange of Linked Requirements

The links between requirements within the same module were exchanged successfully in all cases. Links between requirements in different modules could not be completely restored on import in three cases. Links between requirements between an exported module and a module that was not exported have not been exchanged. The latter is the expected behavior.

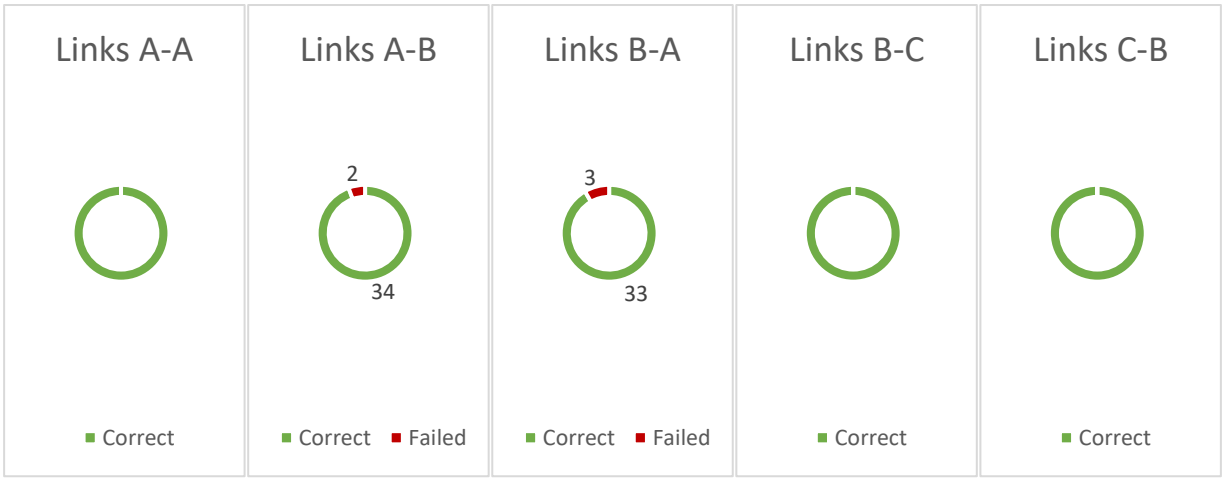

Figure 6: Results for exchange of requirement links

3.2 Overview Second Ping

The focus of the second ping lies on the way changes in the specification are handled and how the user of the receiving system can track those changes.

Again, all exported files were valid ReqIF files. In one case, the package was not recognized as an update to the already imported specification. In this case, the results are marked as not tested.

Exchange of Changed Requirements and Attributes

The changes in the requirement text and attribute values were successfully imported in all cases.

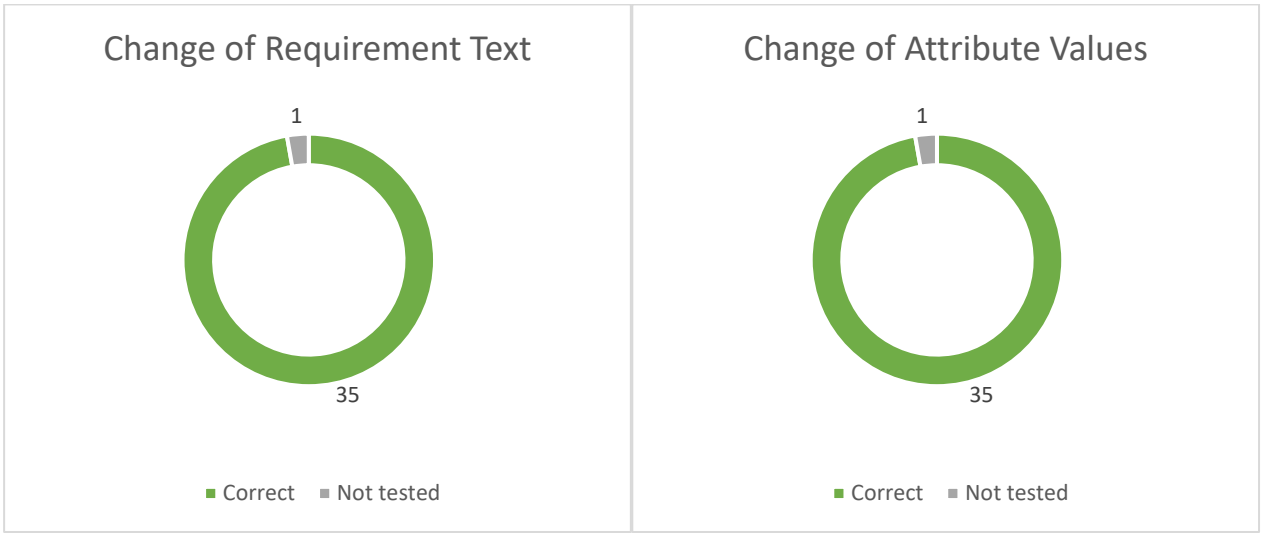

Figure 7: Results for changes in requirements and attributes

Changes to empty values were always successfully exchanged. If a source system was not able to set a certain attribute to an empty value or export an attribute, these attributes were not considered for the evaluation of the results.

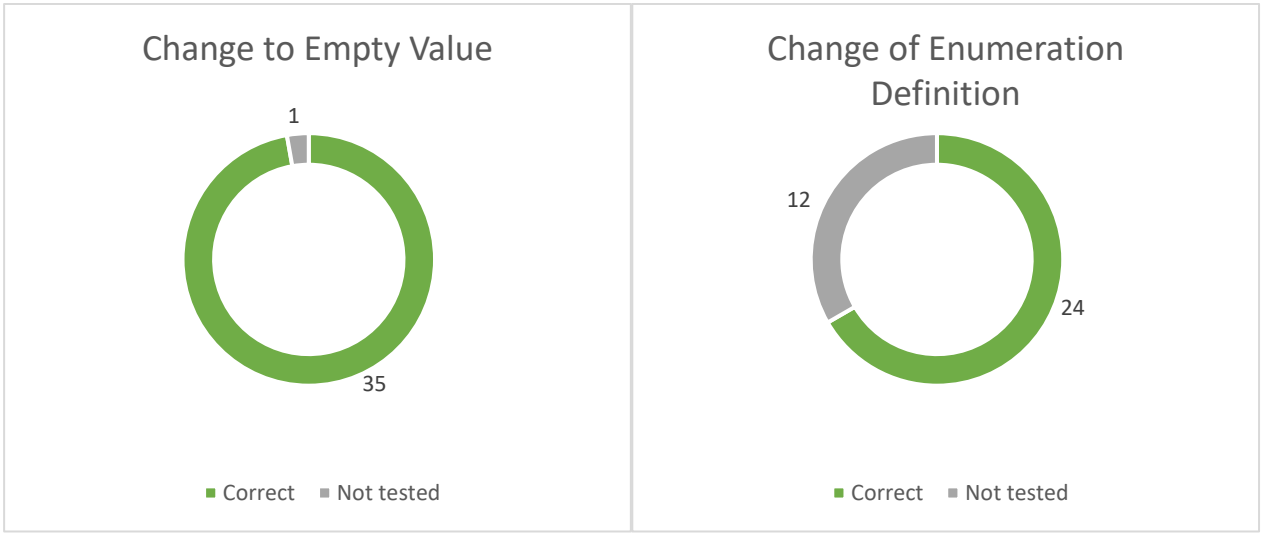

Figure 8: Results for changes of attribute values to empty and enumeration definition

In one tool the definition of enumerations is not possible without administrative rights to change the global data model. For this tool, the exchange of a changed enumeration definition was not tested. In the other cases, the enumeration was changed in the way it was in the source system, with one option added and another option removed or only the new option was added without removing the obsolete option. Both behaviors are rated as correct since it is sufficient for the defined use cases.

Exchange of Structural Changes

The changes to the document structure were exchanged correctly in all tested cases.

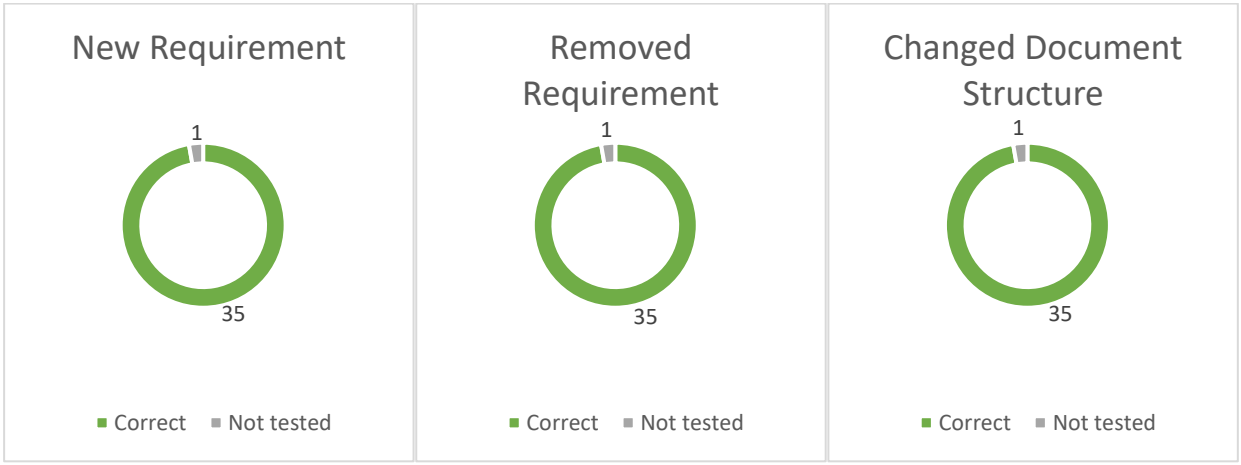

Figure 9: Results for changes to the document structure

Update of Links

For test cases in which links have not been imported in the first ping, the update of links was not tested. In 12 test cases for the links inside module A and in 4 test cases for the links between requirements in module A and B the new links were added, and the old links kept. This behavior is considered partially correct.

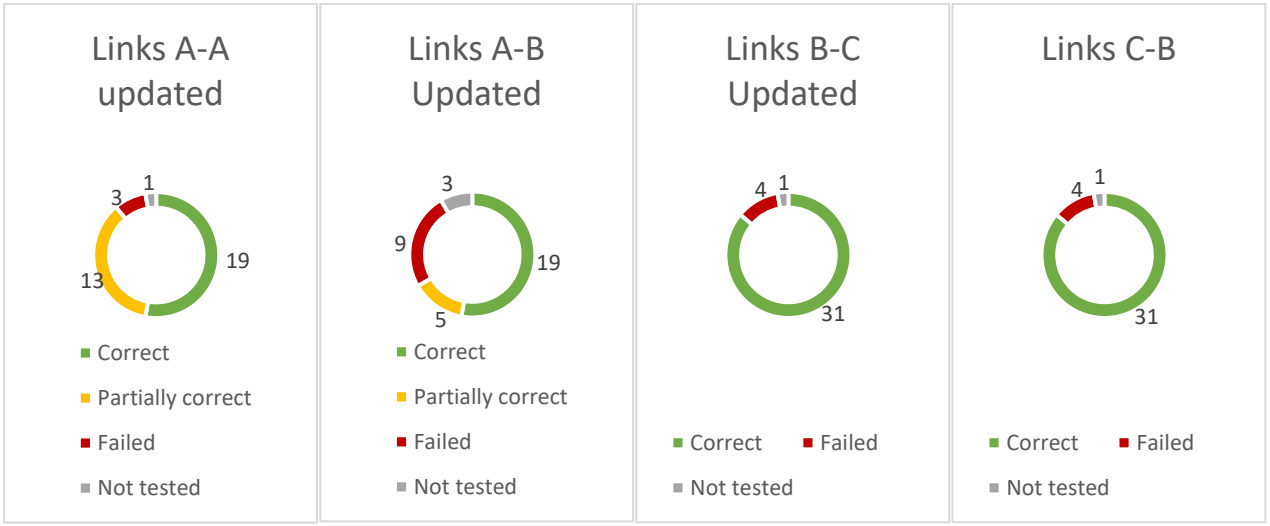

Figure 10: Results for changes of links

Identification of Changes

All tools offer functionalities to track changes to modules. It was possible to identify the missing requirement in all but one test case. In the same case, the changes could not be tracked. In one tool it was not possible to track the other changes.

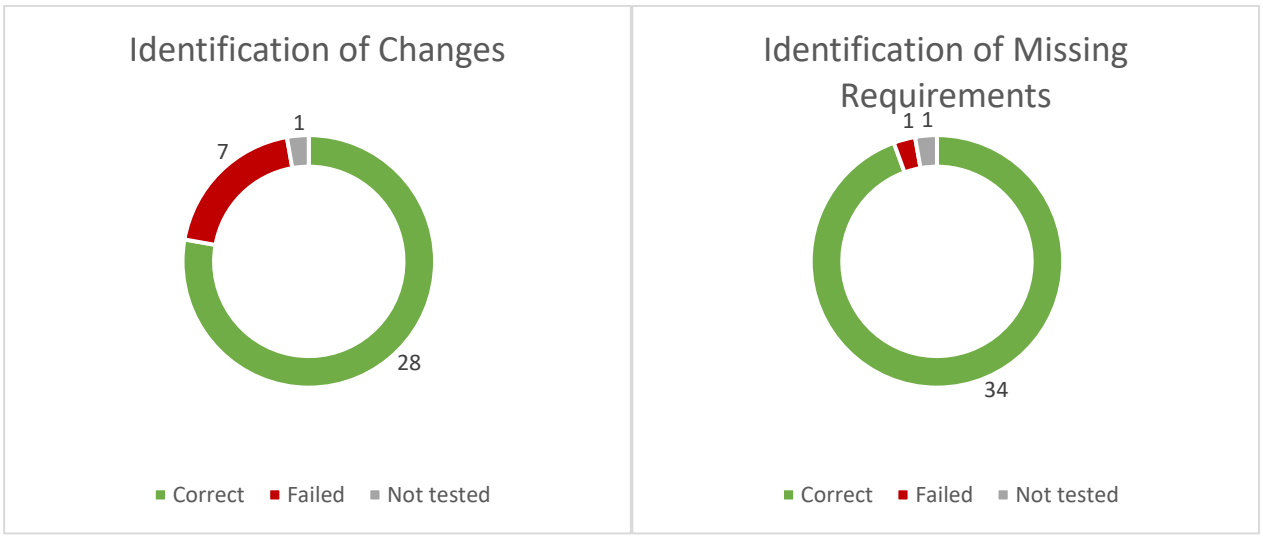

Figure 11: Results for identification of changes

4 Summary and Outlook

The benchmark shows the possibilities and limits of ReqIF for the defined requirement exchange process. Regarding the transfer of requirement data, further improvements can be seen since the last benchmark.

This benchmark also helped to identify issues in the requirement exchange process and raised awareness with the implementers and users of requirement management systems. The issues raised during this benchmark may be solved in further releases of the used software and the implementers will continue working together in the ReqIF Implementor Forum to improve the exchange across different systems. The users organized in the ReqIF Workflow Forum can use the information created in this benchmark to define use cases and requirements more explicitly.

Experience from this and previous benchmarks is used to create best practices for the ReqIF data exchange process, which will be available via the prostep ivip website.

In the future, further benchmarks will be conducted. These will be based on user-defined processes and requirements. System vendors may also propose topics that might be tested in a future benchmark. The next benchmark is planned for the years 2021 to 2022, with preliminary reports to be published end of 2021.

5 Acknowledgements

prostep ivip and VDA like to thank all participating companies, Asaro, IBM, INTLAND and Siemens PLM for providing software and licenses as well as technical support and advice during this benchmark.