



ReqIF Benchmark 2019

prostep ivip Short Report
ReqIF Benchmark 2019

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1 Introduction

Requirements Management has been established to ensure seamless specifications along the product creation process. In order 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, mayor 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 prove the applicability of the ReqIF format, the project groups have decided to perform benchmarks. The first benchmark in 2018 focused on basic functionalities. The first benchmark was well received by the users and implementers, as it provided valuable information for the usage and further development of requirement management tools.

In this second benchmark, the tested scenario is a simple roundtrip without changes to the specification structure by customer or supplier. 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 models, 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.

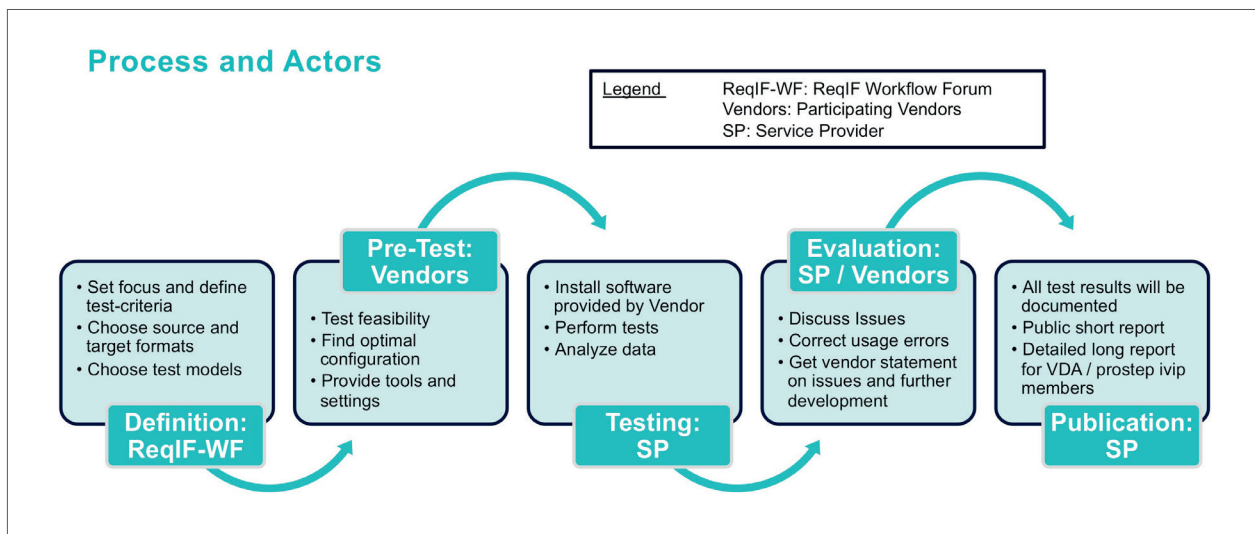


Figure 1: Extended V-Model for MBSE (Buchholz et al. 2018, p. 7)

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: Simple Roundtrip Without Changes to the Specification Structure by Customer or Supplier (PING-PONG)

Based on the use case “Stakeholder Request Clarification” two scenarios were defined by the ReqIF-WF. In the first scenario, the exchange of a specification with formatted content is tested. This scenario was the base for the first benchmark. This second benchmark is based on the second scenario defined by the ReqIF.

In this scenario, a customer creates a requirements specification document in one requirements management system. The document is then exported to a ReqIF package and send to the supplier. The ReqIF package is then imported into the supplier’s requirements management system, which may be a different system or the same as the customer’s system. The supplier then changes defined attributes for communication with the customer. The changed attributes are exported to ReqIF and sent back to the customer. The customer imports the changed attributes to his requirements management system and checks the changes.

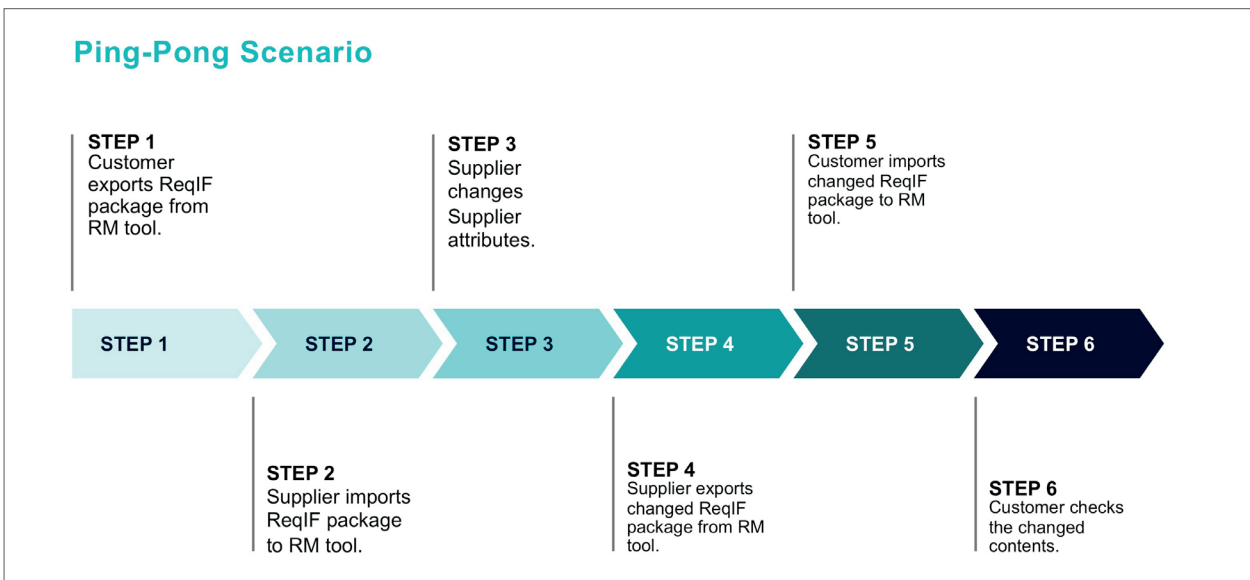


Figure 2: Ping-Pong Scenario

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. 5 requirement management system vendors and 1 vendor for data exchange connectors participated in the benchmark:

- :em AG
- Asaro Systems
- IBM
- INTLAND
- PTC
- 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.

VENDOR	SOFTWARE	VERSION	DESCRIPTION
Siemens	ReqMan	2019.2	Requirement management system
Asaro	Connector	2019.5	ReqIF connector for Teamcenter Active Workspace
IBM	DOORS	9.6.1.11	Requirement management system
IBM	DOORS NG	6.0.6.1 iFix002	Requirement management system
INTLAND	codeBeamer	9.4	Requirement management system
PTC	Integrity Requirements Connector	3.4	ReqIF connector for DOORS and Integrity
PTC	Integrity	11.2	Requirement management system
Siemens	Polarion	19.0	Requirement management system
Siemens	Teamcenter Active Workspace	12.1/4.1	PLM system with requirement management functionalities

Table 1: Tested software

With these 9 software systems, 64 combinations for the data exchange are tested, as can be seen in the test case matrix (Table 2).

Customer Tool → Supplier Tool ↓	Asaro ReqIF for Active Workspace + Siemens Teamcenter		em AG ReqMan		IBM DOORS (built in)		IBM DOORS Next Generation		Intland codeBeamer		PTC Integrity Requirements Connector + IBM DOORS		PTC Integrity Requirements Connector + PTC Integrity		Siemens Polarion	
	PING	PONG	PING	PONG	PING	PONG	PING	PONG	PING	PONG	PING	PONG	PING	PONG	PING	PONG
Asaro ReqIF for Active Workspace + Siemens Teamcenter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Siemens Polarion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IBM DOORS (built in)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IBM DOORS Next Generation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Intland codeBeamer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PTC Integrity Requirements Connector + IBM DOORS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PTC Integrity Requirements Connector + PTC Integrity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Siemens Polarion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2: Test case matrix

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 at a machine at the vendors site to which PROSTEP was granted remote access.

2.4 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.

The files contained:

- structured headings
- indented text
- bullet points
- numbered lists
- tables
- special characters
- embedded documents (PowerPoint, Word and Excel)
- images (gif, jpg, png)
- formatted text (including different font styles)
- text with fore- and background colors

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

2.5 Test Criteria

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

CRITERION	DESCRIPTION
Validity	Exported ReqIF files must be valid.
Completeness	The entire requirement module exported from the customer tool must be imported to the supplier tool.
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. 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.

CRITERION	DESCRIPTION
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.
Changes in supplier status	The value of the attribute "ReqIF-WF.SupplierStatus" is changed in the supplier tool. Changes should be imported to the customer tool.
Changes in supplier comments	The value of the attribute "ReqIF-WF.SupplierComment" is changed in the supplier tool. Changes should be imported to the customer tool.
Comments with attached image	The value of the attribute "ReqIF-WF.SupplierComment" is changed in the supplier tool and an image is attached to this attribute. Changes should be imported to the customer tool and the image should be accessible from the attribute.
Comments with attached docx	The value of the attribute "ReqIF-WF.SupplierComment" is changed in the supplier tool and a .docx file is attached to this attribute. Changes should be imported to the customer tool and the file should be accessible from the attribute.
customer attributes unchanged	The value of the attribute "ReqIF-WF.CustomerComment" is changed in the supplier tool. Changes should not be imported to the customer tool, as this attribute should only be changed by the customer.
no further changes	No further changes to the module should be occur after the re-import to the customer tool.

Table 3: Test Criteria

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.

2.6 Testing

The reference ReqIF packages were imported to the tested systems and it was checked whether the content was imported as expected. 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. 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 module and the accessibility of documents and images. Then, the defined attribute values (see Table 3) were changed.

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. It is divided in a section for the customer to supplier results (Ping) regarding the validity of ReqIF packages, completeness of the import and accessibility of embedded documents and images; and the roundtrip results (Ping-Pong) regarding the exchange of requirement modules with changed attributes and documents and images attached to these.

3.1.1 Ping Results

In the Ping test, only one tool created invalid ReqIF packages which caused issues on the import to the other tools regarding the import of embedded files and images. One tool did not accept the invalid package for import. In one additional case, the import failed completely. In all other cases, the ReqIF packages were valid and imported completely. Figure 3 shows the results for the different criteria.

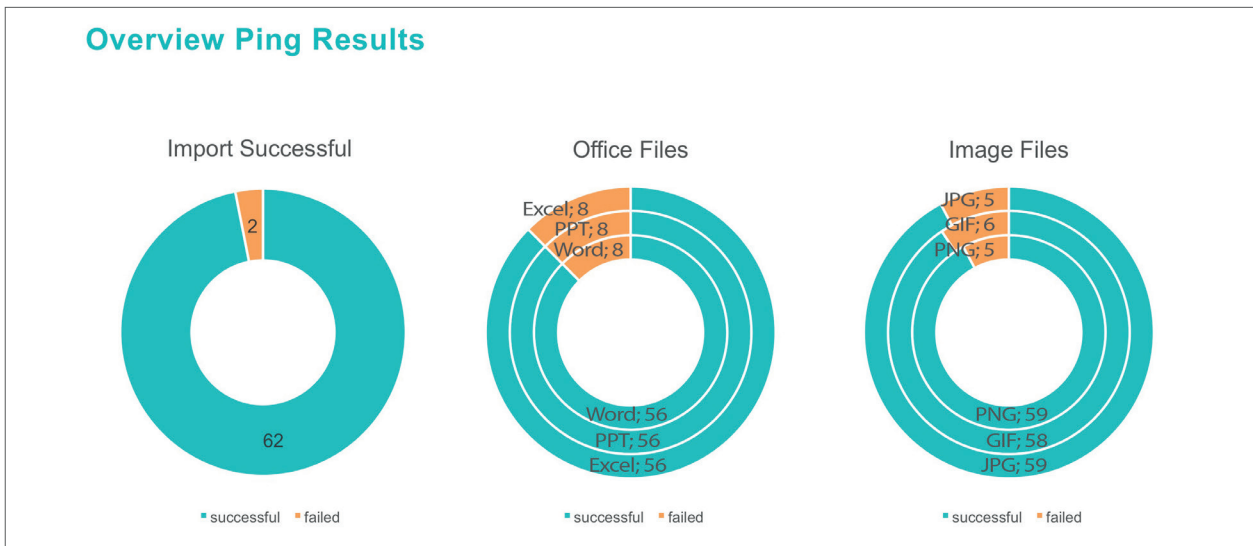


Figure 3: Overview Ping Results - Import Successful: import completed; Office Files: embedded docx, pptx and xlsx files transferred; Image Files: embedded image files transferred

The transfer of embedded files was a retest of the previous benchmark. Compared to the results of the first benchmark, an improvement is clearly visible. In 2018, the transfer of office files failed in almost half of the tests and the transfer of image files in about a third of the tests (see reports of ReqIF Benchmark 2018).

3.1.2 Pong Results

The chosen attributes could be edited in all participating requirement management tools. Also, all tools offer settings to choose which attributes are exported and imported. It was always necessary to map the internal attributes of the requirement management tool to the attributes defined in the ReqIF file. Again, one tool did not write valid ReqIF files on export.

In 4 cases, the reimport to the customer tool failed completely. For these cases, the criteria are counted as failed. If a functionality was not supported by one of the tools in these test cases, the criterion is counted as "not supported/ tested". In one case the import to the supplier tool could not be edited and the following steps were not tested.

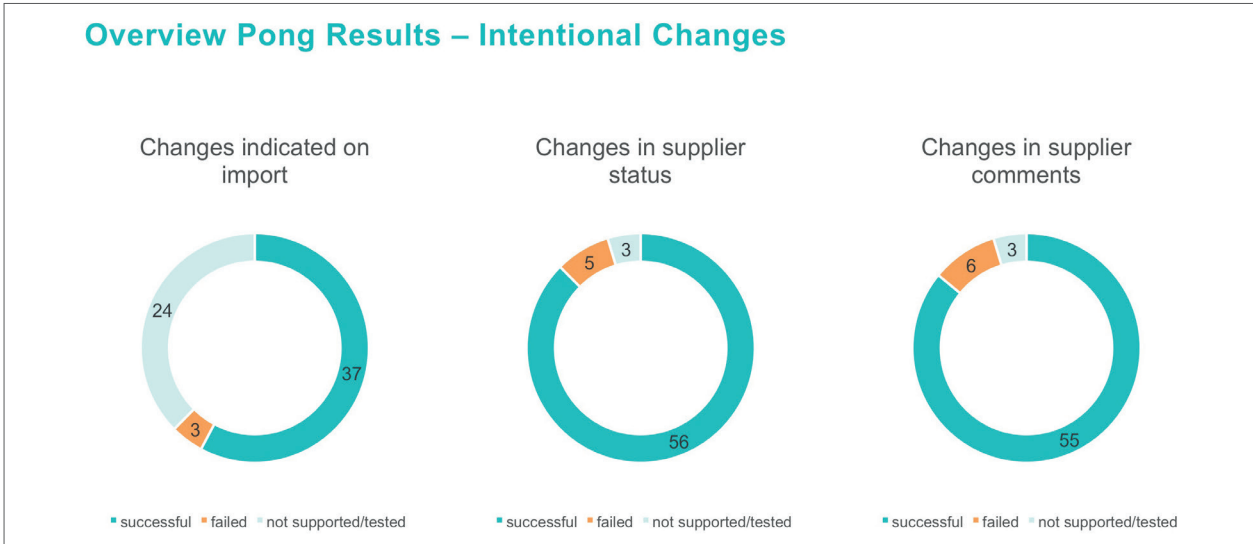


Figure 4: Overview Pong Results - Intentional Changes

3 of 8 tools do not offer a functionality to analyze changes during updating a requirements module. The changed attributes were transferred successfully in most cases. In one case, the status attributes were transferred, but not the comments.

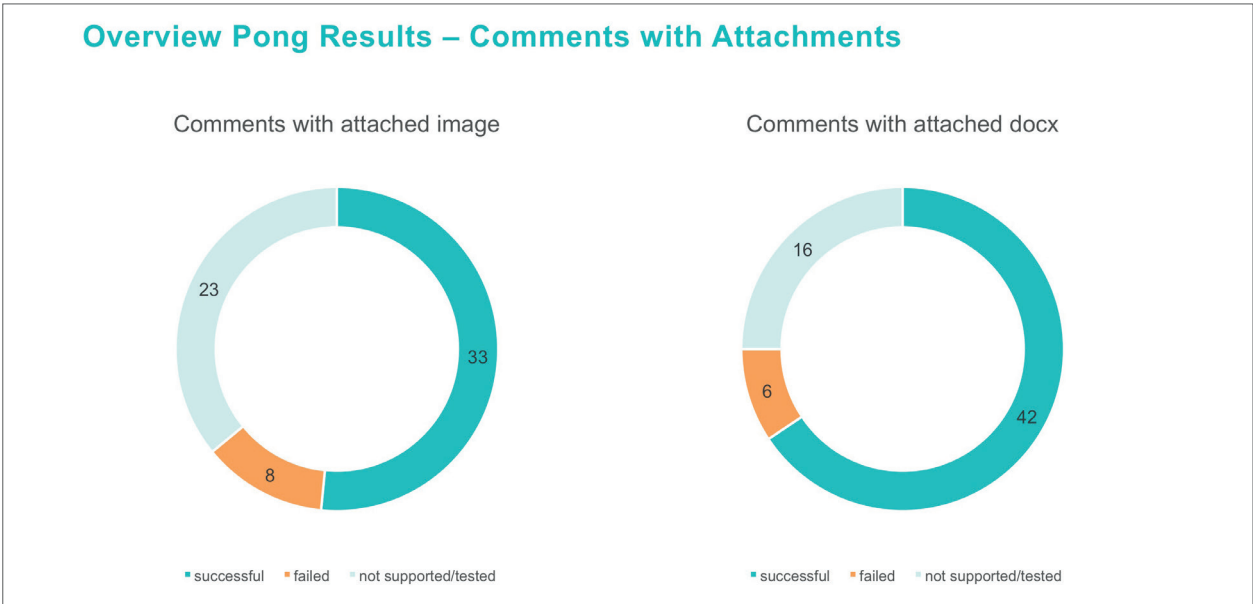


Figure 5: Overview Pong Results - Comments with Attachments

Not all systems support attachments on other attributes than the requirement description. The failed transfers of the attached docx files are correlating with the overall failed transfers of changed attributes. The images were not transferred in 2 additional cases.

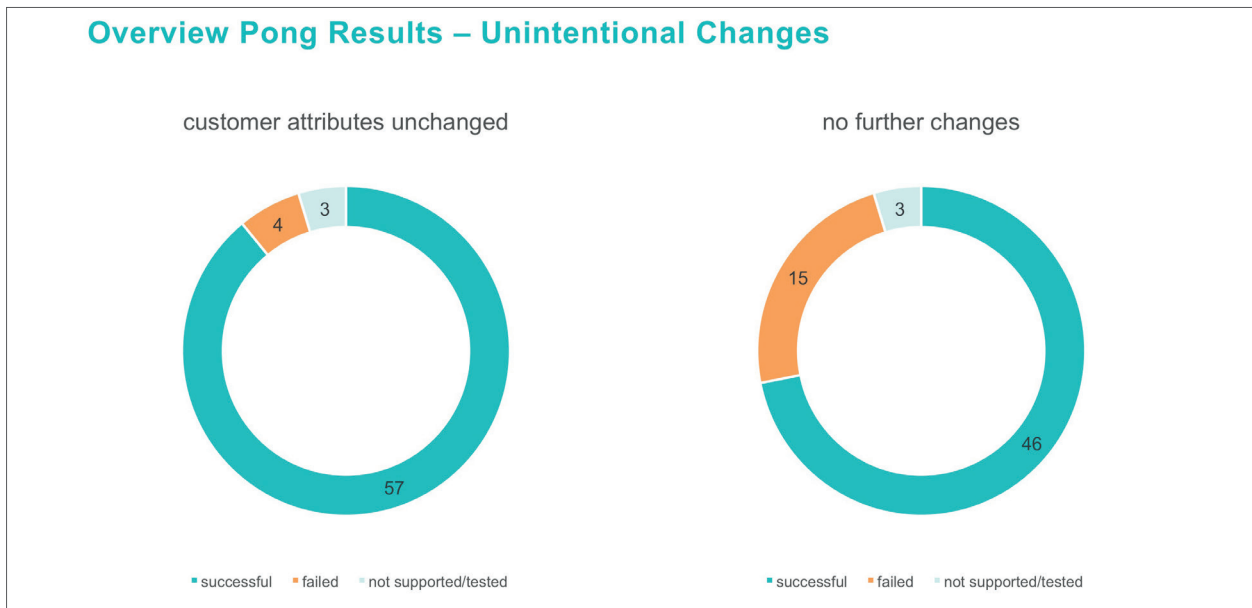


Figure 6: Overview Pong Results - Unintentional Changes

All tested systems allow selection of attributes before an import. Thus, unwanted changes in the customer attributes can be avoided and the failed test cases are the test cases where the reimport failed generally. Regarding further changes, the structure of the module was changed, and attachments were lost or added.

4 Summary and Outlook

This benchmark has shown that it is dependent on the combination of requirement management systems how well requirement management data is transferred with the ReqIF format. A Ping failed in 2, a Ping-Pong is not possible in 9 of 64 combinations. This is caused by different representation of the information in the systems, different approaches to the requirement management process and different coverage of the tested functionalities.

Compared to the previous benchmark, the tested tools showed improvements in the exchange of requirement data, especially regarding documents and images embedded in the requirement description. For the communication between supplier and customer this benchmark has shown that using requirement attributes in the ReqIF files is feasible. During the exchange, different attribute mappings in the systems and the supported functionalities of the different systems need to be considered.

This benchmark 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.

For 2020, a third benchmark is planned. Results and experiences of the previous benchmarks will be considered for the planning of the 2020 benchmark.

5 Acknowledgements

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



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