

PTC Integrity™ Requirements Connector™

The Requirements Exchange Platform

PTC Integrity Requirements Connector (IRC) enables an effective and efficient method to synchronize requirements across projects, departments and enterprise boundaries. Deploying IRC across an organization ensures that requirements are communicated, processed, easily acted upon and contribute to the success of your projects. This whitepaper explains the primary reasons why IRC is indispensable in today's world of distributed product development.

Requirements are assets that must be shared between multiple stakeholders to ensure a successful completion of a project. A mature requirements management practice is one of the most important factors of successful product development. As a result, requirement creators and consumers must be in a position to seamlessly share requirement and specification documents in a form that can be readily acted upon by all involved. Requirement Management tools provide good solutions for collaboration within a project team, but provide only limited solutions to the problem of sharing requirements across internal Information Technology (IT) or corporate supply-chain boundaries.

Over the past decade, various industry standards and internet-inspired technologies have been developed and implemented by software tool vendors. One example of this type of standard is Open Services for Lifecycle Collaboration (OSLC) which is managed by the OASIS group. OSLC enabled software provides RESTful interfaces for data that allow engineering lifecycle tools to share information with one another. OSLC is a practical solution for environments where a full-time live IT connection can be maintained, and PTC is working to develop OSLC interfaces into a significant percentage of its portfolio. There are, however, circumstances where live IT connections are not practical or available due to corporate IT governance. For example, an aircraft

manufacturer may need to share requirement data with its supply chain, but due to security restrictions cannot allow suppliers direct access to its network. In these situations effective, efficient and reliable exchange of data is mission critical to project success.

The focus of this paper is a solution for the challenges associated with the exchange of requirement information in the above non-live situation.

Auto manufacturers and their tier suppliers face the data exchange problem daily. With the ever increasing complexity of onboard electronics, the industry faces major difficulties in completing projects on time and on budget. Under the auspices of Herstellerinitiative Software (HIS) – a joint initiative of the German automotive manufacturers including Audi, BMW, Daimler, Porsche and Volkswagen – a working group was created and tasked with creating a standard to resolve the problems associated with exchanging requirement and specification data. The resulting Requirements Interchange Format (ReqIF) is based on the Extensible Markup Language (XML), which itself is both machine readable text and formatted for easy human reading.

Current curation of the ReqIF standard is the responsibility of the Object Management Group (OMG).

PTC IRC: Collaboration In Action

PTC Integrity Requirements Connector (IRC) is the result of collaboration between HIS core members and Atego (now PTC). IRC was the first commercial software solution for tool-independent data exchange using ReqIF. IRC allows the smooth exchange and synchronization of requirements across Requirement Management applications such as PTC Integrity Lifecycle Manager (ILM) and IBM® Rational® DOORS®. Document exchange takes place without loss of data or format. OLE objects such as MSWord®, Excel® or images can also be extracted and exchanged correctly. With large deployments in place at most German car manufacturers and their suppliers, IRC contributes to the adoption of ReqIF as an open, de facto industrial standard and has become the reference implementation of the standard.

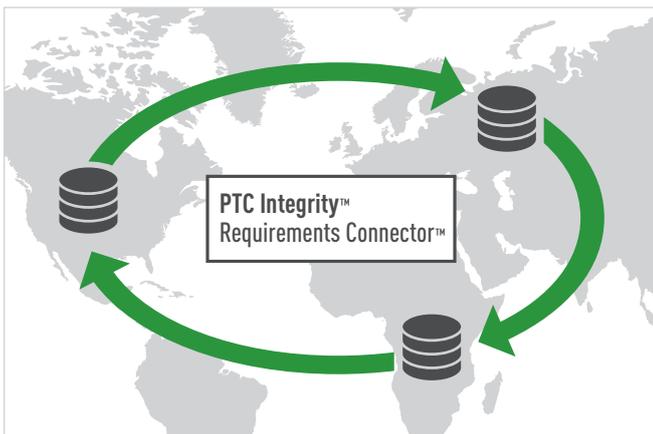


Figure 1: PTC Integrity Requirements Connector is used to exchange and synchronize requirements stored in different RM databases - both internally between business units, and externally with different business partners.

IRC is designed to be an open, extensible requirements integration platform using ReqIF as its main representation paradigm. IRC is built upon the Eclipse platform. The IRC core model contains all application logic necessary to execute each main operation; Export, Import and Synchronize. Figure 2 illustrates the conceptual architecture of IRC.

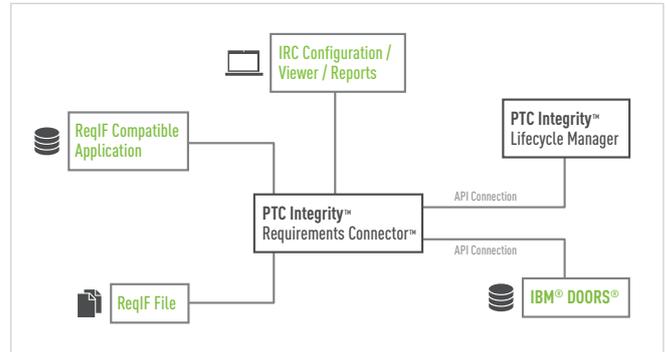


Figure 2: IRC Conceptual Architecture

A number of adaptors (Eclipse plug-ins) connect to the core and ensure that different requirement tools can communicate with the core IRC application. In order to ensure a low learning curve for users, commands can be started either from the IRC desktop or the end point requirements management tool. New adaptors may be created and added thanks to the flexibility of the underlying Eclipse platform. Additionally, IRC provides a number of utilities to the user such as a ReqIF viewer with differencing, an XML viewer and HTML and RTF reporting.

Collaboration with Requirements

As requirements are elicited and refined, negotiating and maintaining agreement with all stakeholders is critical to project success. Requirements validation is the process of establishing that the requirements elicited provide an accurate account of the stakeholder needs.

It is vital that requirements are communicated to all stakeholders so that negotiation and resolution occurs. IRC enables requirement collaboration by:

- Removing information silos caused by proprietary data storage of a particular requirement management tool
- Storing the extracted data in XML format which is human readable or transferable via modern methods such as FTP, Dropbox®, content management system or even Email

IRC ensures that requirements are available to all supply chain stakeholders from project request-for-information (RFI) to final delivery, and provides the basic set of tools needed to visualize the exported documents without referring to a specific requirement management application. Requirements can then be changed in each stakeholder’s end-point requirement tool of choice without violating network/application security policies in place at each partner.

Authoring and Change Governance

When requirements may be easily exchanged and modified, the issue of governance and data management is important to consider and define. As experienced requirements engineers can attest, modifications made to requirements must be auditable so that deltas can be traced back to UserID and date-of-change. The owner of a specific requirements document(s) will be quickly overwhelmed if every stakeholder makes uncontrolled changes to the project requirements.

IRC provides two primary governance mechanisms to ensure that changes to requirements documents are enforced during requirements negotiation:

- IRC enforces ReqIF Access Policies on requirement information
- IRC strictly validates changes against the original IRC exchange configuration

The ReqIF standard defines access policies for all elements (object, attribute and link definitions as well as object, attribute and link hierarchy) present in the exchanged documents. IRC enforces these policies, ensuring that only authorized users can make necessary changes.

Practically, access policies are not always sufficient to audit requirements files; ReqIF files are XML documents that may be modified by any tool able to read text. It is for this reason IRC provides a second mechanism for governing data changes. IRC systematically validates documents against the original exchange configuration used to export requirements when a synchronization task is performed. Only the permitted changes will be processed, with any other modifications ignored and highlighted to the user in the IRC User Interface.

IRC ensures that, even if the ReqIF file is manually modified, only authorized changes will be permitted. A complete change history and audit report is also created during each operation.

Negotiating Requirements: Tracking Reviews and Comments

ReqIF and IRC support round-trip document synchronization. A requirements document exported from Requirements Management tool ‘A’ can be changed in Requirements Management tool ‘B’ and synchronized back to the original application.

Reviewing and commenting on requirements are essential capabilities during the initial project negotiation as well as during ongoing product development. Figure 3 illustrates a typical requirements review scenario.

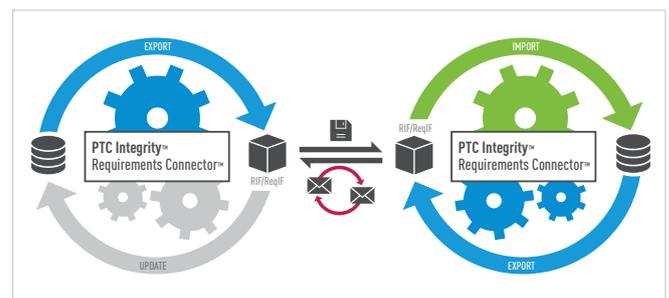


Figure 3: Typical Requirement Review showing its repeatable rountrip nature.

An OEM prepares a requirements document and exports the document with IRC from the corporate Requirements Management tool. The ReqIF package is then distributed to one or more business partners. Each partner uses IRC to import the ReqIF package into their own corporate Requirements Management tool; note that the requirements tools do NOT need to be the same. IRC ensures that the requirements document is presented correctly to all requirements tools. The supplier-partner can now review and comment on the requirements as mutually agreed upon with the OEM. When review is complete, the supplier-partner exports an updated ReqIF package and returns it to the OEM. The OEM need only update their original requirements document with the new changes.

IRC enables this controlled workflow because all exports must be pre-configured. The resulting configuration data ensures that IRC knows under what conditions an export is performed and stores all data needed for a round-trip update of the original document.

Managing Traceability Across the Supply Chain

Traceability is the ability to record and navigate relationships between artifacts produced during product development processes. It is especially vital for critical systems which must satisfy a range of functional and non-functional requirements, including safety, reliability and availability. IRC ensures that trace links can be exchanged and manipulated in a controlled manner. Tests may be traced to requirements and requirements decomposition may be explicitly presented.

For example, as every experienced engineer knows, requirements must be testable, i.e. tests validate requirements. Taking as an example the V model development flow (Figure 4), user acceptance testing validates user needs, system testing validates the system requirements, component testing verifies the designs, etc...

Although the ReqIF standard was not designed to specifically encompass tests, it is possible to translate text-based descriptions of test suites, tests cases and test procedures into a structured IRC document. IRC can then be utilized to link requirements to test information across tool chains and suppliers. IRC demonstrates the possibility of this type of exchange between the Test Management capability built into Integrity Lifecycle Manager and, for example, DOORS which is designed for requirements management only.

It is in this way that IRC enables effective and efficient exchange and synchronization of requirements and tests across engineering disciplines, reducing project risk and increasing project success.

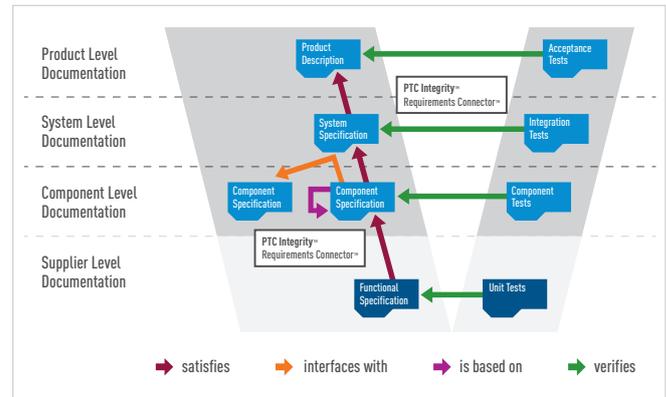


Figure 4: Example Supply Chain V Model

Streamline Your Workflow and Reporting

IRC provides multiple mechanisms to ensure that fundamental workflows for requirements exchange and reporting are repeatable and fully integrated into the existing tool chain.

First, IRC exposes commands for import, export and synchronization that can be easily integrated into various platforms or tools. Additionally, IRC tasks can be directly invoked through PTC supported adaptors to Integrity Lifecycle Manager and DOORS. This allows casual users to perform tasks in a familiar tool UI.

Second, as noted earlier in this paper, ReqIF files are XML formatted text documents and as such standard XML technologies may be applied to ReqIF files. For example, a ReqIF package may be transformed into other proprietary or XML formats for importation into a home-grown corporate IT system.

Third, IRC enables the creation and storage of audit reports and documentation with industry-common formats such as HTML and RTF.

Produce Archives to Help Meet Statutory Requirements

In industries such as aerospace, health sciences and in safety critical systems in general, regulatory requirements prescribe that companies store their product's intended use information and project requirements for long periods of time. IRC enables a solution to this problem by ensuring that requirements are transformed into the open, textual ReqIF format independent of a user's current tool of choice.

This ReqIF documents may be archived with the guarantee that requirements data can be accessed long after the original requirements authoring tools have gone out of support, thus safekeeping your development investment.

Summary

Integrity Requirements Connector is a stand-alone requirements data synchronization solution that enables exchange of requirements across different tools, tool versions and IT barriers. By using PTC IRC's key abilities:

- Peer to peer collaboration
- Fast access to data content
- Offline synchronization of requirements across business boundaries
- Open, extensible exchange platform
- Controlled and auditable changes

Companies are reducing their total cost of ownership for requirements management tools, while increasing their return on investment (ROI) through fast 'time-to-value'.

If you would like to learn more about IRC, please visit PTC.com/application-lifecycle-management or contact your local PTC client team.

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