APIS IQ-Software

Manual

APIS Informationstechnologien GmbH

6th edition, September 2024

Preface

Welcome to *APIS IQ Software* (IQ = Integrated Quality), the software for FMEA, DRBFM, Risk Analysis, Functional Safety, and Requirement Management.

The *APIS IQ Software* family comprises the APIS server software and the APIS client software. The client software, which saw the light of day in 1992 and was supplemented with the *APIS CARM Server* ten years later, has become very popular. While the *APIS IQ Software* can work on its own and is applied this way by most of the companies, the CARM Server is an optional supplement to meet special business requirements.

The APIS server software requires the availability of a server to install the *APIS CARM Server* software. Depending on the configuration level, the server may provide various services (CSS = CARM Server Service, CSA = CARM Server Agent), e.g.

- *APIS CSS Module*
- *APIS CSA Web Publisher*
- *APIS CSA PDF Publisher*

A separate manual describes how to handle the server and the individual services.

The APIS client software is available in the following configuration levels:

- *APIS IQ-FMEA*
- *APIS IQ-FMEA-L*
- *APIS IQ-FMEA PRO*
- *APIS IQ-RM*
- *APIS IQ-RM PRO*

Function	Configuration level	IQ-FMEA	IQ-FMEA-L	IQ-FMEA PRO	IQ-RM	IQ-RM PRO
Customer requirement management		✓	✓	✓	✓	✓
System structure (Structure Tree, FFA, Graph Editor)		✓	✓	✓	✓	✓
Process Flow Diagram (PFD)					✓	✓
Control Plan (CP)					✓	✓
Function and Failure Nets (net editors, Graph Editor)		✓	✓	✓	✓	✓
Fault Tree Analysis		✓	✓	✓	✓	✓
FMEA (AIAG, VDA, Mil, AIAG/VDA, and MSR, etc.)		✓	✓	✓	✓	✓
DRBFM		✓	✓	✓	✓	✓
Action Tracking (schedule)		✓	✓	✓	✓	✓
Statistical analyses (Pareto, etc.)		✓	✓	✓	✓	✓
Object Inspector		✓	✓	✓	✓	✓
User-defined view		✓	✓	✓	✓	✓
Simultaneous Engineering				✓		✓
Team communication (e-mail, internet)		✓	✓	✓	✓	✓
Terminology management		✓	✓	✓	✓	✓
Multi-language support (ANSI)			✓	✓	✓	✓
Unicode and Asian operating languages				✓		✓
Cause and effect diagram		✓	✓	✓	✓	✓
CARM Server interface		✓	✓	✓	✓	✓
Functional Safety (IEC 61508/ISO 26262)				✓		✓
Mechatronics FMEA		✓	✓	✓	✓	✓
Boundary Diagram		✓	✓	✓	✓	✓
Parameter Diagram		✓	✓	✓	✓	✓
Audit Trail				✓		✓

Design for Six Sigma (PWM, HoQ)	✓	✓	✓	✓	✓
Interface to LDAP server	✓	✓	✓	✓	✓
FMEA scope analysis (Planning and Preparation)	✓	✓	✓	✓	✓
Results documentation	✓	✓	✓	✓	✓

The *APIS IQ Software* supports users optimally in activities from the field of risk analysis (FMEA, Process Flow Diagram, Control Plan, etc.). The redundancy-free data set facilitates consistent and efficient changes in different documents without the need for subsequent alignment. The software is optimally adjusted to the world of Windows and is a future-proof basis for being integrated into workflow and document management systems. It meets the expectations already regarding the reuse of documented knowledge.

Additional requirements for the server

The file-server on which the IQ-Software Prgram-data as well as the IQ-documents is being saved hast to provide a complete CIFS/SMB-inplementation including file- and record-locking.
The Microsoft installer must be of version 5.0 or later.

With Windows Server 2008 R2 / Windows 7 this requirement is fulfilled automatically.

For the use of the APIS IQ-Software in combination with a license-management-server please have a look at the data-sheet / manual to know more about the requirements. This can be found at our website in the section of the documents download.

System requirements

The following hardware and software components are required to use the *APIS IQ Software*:

- PC featuring a processor compatible with IA32 (x86)
- CD-ROM drive (optional)
- Windows 10, or later
- 500 MB hard disk space
- 1024 MB RAM minimum; display resolution 1024 x 768 pixels minimum

4 GB RAM, 2 GHz CPU and higher, and a display resolution of 1920 x 1080 pixels and more are recommended.

Installation

When installing the software, the single-user version and the network version must be differentiated. The most essential differences are the following:

- The **single-user version** or **NLX client** can be installed only to the local drive of your computer. Network drives can be used though to store data.

- With the **network version**, data and program can be stored either on any (local or network) drive. The network version is usually chosen, if several users are intended to work with the *APIS IQ Software* and their computers are interlinked. The program must be installed only once on the network and can be used by several users at the same time – as many as the acquired number of maximally active users. That saves time and effort – especially with regard to updating and maintaining the installed program, e.g. when service packs or updated are installed or functions enhanced.

First steps in the single-user installation:

If the software is supplied by download (standard), then download and save the installation directory (zip file). Extract the content of the directory and start the installation program by double-clicking on the file SETUP.EXE.

If you were sent a CD, the program to install the *APIS IQ Software* will run automatically after you inserted the CD. The "Auto-Run" function must be enabled for this purpose. If this is not the case, you have to start the program SETUP.EXE manually, which is located on the CD, e.g. by double-clicking on the file in the Windows Explorer.

> **Note:** To execute the installation, the required access rights must be granted by the operating system.

Proceed according to the instructions given in the dialog box to execute the installation steps and to install the program files and the selected components.

Installation of the network version and advanced options:

For the detailed description of the installation procedure for all versions of the *APIS IQ Software*, please refer to the following URL:

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Network compatibility

In the appropriate version, the *APIS IQ Software* is *network-compatible*. A program is referred to as network-compatible, if several users can use the program at the same time without one copy of the program being made for each of the users separately.

What is located on my computer after the installation?

The program directory (server or client) contains the files, which the *APIS IQ Software* consists of. Six subdirectories called DATA, HELP, JRE, LD, LIB, and WORKGROUP are available.

The DATA directory contains sample data for the *APIS IQ Software* as well as examples of ODBC and XML subjects. In case of the workplace installation (client installation), the files located in the DATA directory are copied into the local administration directory to be selected by the user when the *APIS IQ Software* is started for the first time.

The HELP directory contains the help files.

The WORKGROUP directory contains, among others, the following files:

File	Application
APIS-IQ70.CFG	Configuration file; company-specific workstation settings
NORMAL.FMT	Template file; company-specific document settings
SHAPES.ICE	File containing graphic symbols, which may be added to the symbol palette (C column, process flow symbols)
IQ-LAYOUTS.ICE	File to store different software configurations

The JRE and LIB directories contain Java components applied by the *APIS IQ Software*.

Conversion of existing file

Older IQ documents must be converted before you can edit them after a new version of the *APIS IQ Software* was installed. The *APIS IQ Software* does this step automatically. When an IQ document is opened for editing, the software checks the version the IQ document was created with and converts it, if necessary, automatically. You can also automatically convert all documents in a directory in one procedure.

Previous versions of the *APIS IQ Software*, however, will not be able to work with documents that have been converted into the current format.

If it is necessary to make the documents available to other users, who do not yet have the current program version, it is recommended to keep the documents created with the old version for a certain time. Upon the installation, another program directory than the one where the previous version of the *APIS IQ Software* is installed, can be assigned to the new version.

For new and changed features in case of a new version of the *APIS IQ Software*, please refer to the item "What's new in version…" on the online help page.

Important: Do not in any case edit the documents created with the *APIS IQ Software* using another editor, as this may result in the destruction of data and program errors.

Use the available interfaces to exchange data with other systems (chapter "Interfaces to other systems").

What can I do with the APIS IQ Software?

The *APIS IQ Software* is used to create QM documents, which are the documents known from regulations like IATF 16949, VDA, AIAG, IEC 61508, and ISO 26262:

- **FMEA forms**
- **Fault tables**
- **DRBFM documents**
- **Process Flow Diagrams**
- **Control Plans**
- **Schedules**
- **Statistical analyses**

Other documents can be created as well, e.g.:

- **Structure Trees**
- **Function Nets**
- **Failure Nets**
- **Cause and Effect Diagrams**
- **Fault Trees**
- **DRBFM spreadsheets**

In addition, the software features tools to optimize the creation of QM documents and support knowledge management:

- **Requirement management**
- **Personal Information Manager (PIM)**
- **Graph Editor**
- **IQ Explorer**
- **Assistant**
- **User-defined view**
- **Object Inspector**

To support modern workflow requirements, certain configuration levels of the *APIS IQ Software* provides the following Simultaneous Engineering tools:

- **Consolidation Desktop**
- **Changelog**
- **Summary of changes**

First steps

The user interface of the *APIS IQ Software* complies with the latest standards of Windows programs. If the user knows other Windows standard applications, e.g. Microsoft Word or Microsoft Excel, it should be simple to operate the *APIS IQ Software*, provided that he knows the most important concepts (see chapter "The most important concepts of the *APIS IQ Software*").

Furthermore, the *APIS IQ Software* provides the following support features:

The Assistant

The Assistant helps the user in performing the risk analysis by analyzing the current status of the document and then handing out advice on how to proceed. The Assistant as well as the Screen Show is enabled via the Help menu. For a detailed description of the Assistant, please refer to the online help page.

Helpful operating instructions

If you select a menu command with the mouse, the status line on the bottom left edge of the screen shows a brief explanation of the selected command.

The context menu that opens by clicking with the right mouse button shows the most important operations possible for the respectively selected object.

"Special Drag" (= drag using the right mouse button) is a very flexible and powerful possibility to transfer and link information.

The Properties dialog, e.g. in the context menu, enables the user to show and edit all aspects of the selected object, including the Assistant function.

Editors and functions of the APIS IQ Software

The following documentation provides an overview of the tools (editors) included in the *APIS IQ Software* and the concepts implemented by using them. For a detailed description of the functions and operation of the editors, please refer to the online help page of the *APIS IQ Software* to be activated via the Help menu or the function key F1. The online help page also features convenient search functions to discover interesting subjects.

Representation of system structure in the Structure Editor

The Structure Editor is used to build the model of the system structure, also called system structure or in short structure. The structure is the basis of further activities.

The Structure Editor represents the system structure in a "tree" that grows on screen from left to right. The tree shows how you can break down the total system into subsystems (also called "system elements"). The representation of the structure model is used for products/systems as well as processes.

The available functions and, if applicable, failures can be shown for each system element.

Functions and failure analysis

The system structure can also be built by means of the Function and Failure Analysis Editor, in short FFA Editor.

The FFA Editor represents the system structure in a compact form, which users of the Windows Explorer are familiar with. The Editor enables the representation of more information on screen than possible in the graphical representation of the Structure Editor.

Process Flow Diagram

The Process Flow Diagram (PFD) shows the sequence of steps in a (manufacturing) process. Each process step is represented by a symbol that may be labeled. The user can summarize the necessary symbols in a symbol palette.

The symbols used in the PFD can be connected with arrowed lines; line style and line width can be selected. Linear sequences can be represented as well as branching and merging.

The number of partial sequences to be represented simultaneously is unlimited, as is the number of process steps a diagram may contain.

Next to the (graphical) flow diagram, there is a correlated table, in which you can enter the following additional details regarding the individual process steps:

- Name and number of process element
- Name, number, and classification of process characteristics assigned to the process element
- Name, number, and classification of product characteristics assigned to the process element

The classification of characteristics is represented by symbols, which can be selected from a symbol palette as well.

Control Plan

In the Production Control Plan, the following pieces of test information are stored for the individual process steps:

- Number and name of the process step
- Machines, tools etc. required for the process step
- Product and process characteristics relevant to the process steps and their numbers
- Classification of characteristics (as symbols)
- Information on testing of characteristics (type of method, scope and frequency of testing etc.)
- Reaction plans in case of noncompliance with characteristic classification

There may be more than one Control Plan for each structure.

Function Net

The Function Net contains information on the causes and effects for the functions of a structure or a project. The Function Net graphically provides information about every possible cause and effect of a given function (the so-called "focus element") of the examined system.

Failure Net

The Failure Net contains information on the causes and effects for the failures of a structure or a project. The Failure Net graphically provides information about every possible cause and effect of a given failure (the so-called "focus element") of the examined system.

Graph Editor

The Graph Editor is a new editor available to represent and edit structures or rather function nets and failure nets as a whole.

Fault Tree Analysis (pursuant to DIN 25 424)

Fault Trees are derived from Failure Nets. They contain additional logical connections (AND, OR, NOT) between failures as well as failure probabilities for elementary failures. Based on these details, the Fault Tree calculates the failure probability of top-level failures.

Cause and Effect Diagram

The Cause and Effect Diagram combines the structure representation and the Failure Net information. It shows the position of the individual failures within the structure and, additionally, for each failure its direct effects and causes.

FMEA Form (AIAG, VDA, MIL, etc.)

The FMEA form contains the following information:

- Failure modes of the functions for one or more system elements

- Effects and causes of the failure modes

- S rating of effects and the classification information

- Preventive and detection actions, which are agreed for the causes or failure modes at the time of the analysis of the current state

- The effectiveness of these actions in the form of O and/or D rating

- The RPN (product of S, O, and D)

- Planned preventive and detection actions

- Responsibility and deadline for the preventive and detection actions

- Status of the planned actions and their expected effectiveness expressed by new O and D ratings

The information is represented in several different formats (VDA, AIAG, MIL and others). The user can easily switch between these different layouts; any of the forms can be equally used.

Forms offer many editing possibilities, e.g.:

- Any kind of comment (also graphics) can be stored and shown in the form

- Data can be translated into other languages directly in the form

- The contents of the FMEA form can be sorted and filtered in various ways

AIAG and VDA Form: A special type is the form for the alignment of AIAG and VDA, which is available in a separate editor.

Deadline Editor

The Deadline Editor lists the responsible person, the target completion date, and any additional information for each individual action and is therefore useful for the project management. The actions of a single or all forms in the current IQ document can be displayed optionally. Responsible persons can be notified by e-mail from the Deadline Editor. In addition to the default layout, there is a layout that can be used for Action Tracking in accordance with VDA 96.

The content of the Deadline Editor can be sorted and filtered in various ways.

Statistical analyses

The Statistics Editor supplies numbers and graphics based on the evaluation of risk in a system. The following analyses are available:

- **Pareto analysis**: Representation of the share of the most severe failures in the total risk (20/80 rule)
- **Pareto compact:** Simplified representation of the Pareto analysis
- **Difference analysis**: Shows the improvement of the risk evaluation because of completed actions and/or the potential improvement for not yet completed actions
- **Frequency analysis**: RPN frequency distribution within the scope of examination
- **Actions per responsible person**: Overview of actions assigned to the responsible person
- **Risk matrix**: Matrix representation of the frequency of rating combinations (e.g. O vs. D) with risk classes

Each of the evaluations can be adjusted to your needs by changing the parameters. The analyses can be saved and reused later.

Variants Matrix

The Variants Matrix provides a possibility to define and compare contents of the different variants in a structure. The lines of the Variants Matrix contain the objects of the structure, the columns contain the variants. Objects can be added to and/or removed from the variants by mouse-clicking in the cells of the matrix.

IQ Explorer

(FMEA) knowledge available within a company can be searched and reused with the IQ Explorer. It provides a number of powerful search functions to search in IQ documents. The search results can be copied into existing documents.

The IQ Explorer works similarly to the Windows Explorer. However, it offers a large number of additional options, since the IQ Explorer knows the structure of the relevant information and considers it in its search. In its simplest form, the IQ Explorer is used to search for QM documents, which contain a certain character

string. This search can also consider dates. In addition, the IQ Explorer features further complex search criteria, such as e.g.:

- Which object types should be included in the search (system elements, functions, failures, etc.)?

- Which additional requirements should these objects comply with (e.g. whether failures are to be found only, if they are failure causes and assigned with actions)?

- Should the search be conducted only in the current document or in all documents of one or more directories?

- Which directories of the file system should be searched?

- Should backup copies of the documents be included in the search?

- Should a similarity search be conducted that will have positive results even if there are differences in spelling (e.g. when you search for "dialogue box", but the word in the document actually is "dialog")?

The results of complex search queries can be saved and reused later.

Multi-language support (contents ANSI)

With multi-language support, contents of IQ documents can be managed in several languages as long as the one ANSI character set (=255 characters) is sufficient for them. It is possible to translate contents directly in the FMEA Form, the Control Plan or the Process Flow Diagram. Furthermore, multi-language support provides tools for the administration of multilingual contents. These tools can be used to identify untranslated objects and objects whose translation is not up to date.

Unicode

The contents of FME files and the user interface of the *APIS IQ Software* can be displayed in the PRO versions, even with character sets for which one ANSI character set is no longer sufficient.

Team communication (e-mail, internet)

This module provides the following options:

- Sending of e-mails to responsible persons and automation of status feedback
- Sending of forms by e-mail
- Publishing FMEA information for the internet and intranet using the Web Publisher

Assistant

The Assistant supports the user both in operating the program and in creating the FMEA. It guides the user step by step through the process creating the FMEA by means of assistant rules even if the user does not know all the details necessary for operating the program. Instead, the user may choose from a suggested list of tasks, and the Assistant will perform the execution of the necessary commands.

The support of the Assistant goes beyond that: It also provides methodical help, i.e. it supports the user in carrying out the FMEA pursuant to the rules described in the literature. In order to support company-specific or user-defined operational standards, the Assistant and its rules can be adapted to fulfil these needs, too.

Personal Information Manager (PIM)

The PIM helps you to organize your FMEA work. It may structure your work in a clearer manner by means of bookmarks, which are familiar from internet browsers. The PIM provides the user with the following specific options:

- Manage bookmarks for IQ objects
- Attach arbitrary comments to the bookmarks (including graphics and links)
- Arbitrary structuring of the bookmarks
- Manage several bookmark lists per document
- Manage private and public entries - the private part is linked to the current user
- Record automatically generated IQ-Objects

Parts Functions Matrix

The Parts Functions Matrix is an alternative possibility to anchor functions and/or characteristics to system or process elements. In the matrix, the rows contain the system/process elements of the examined structure and the columns contain the functions/characteristics. By mouse-clicking in a cell of the matrix, e.g. a function can be anchored to a system element.

Customer Requirements Editor

The Customer Requirements Editor shows requirements, e.g. from customer-supplier relationships or from standard documents such as IATF 16949, in a net similar to that used by the Function and Failure Net Editors.

Requirements Management Editor

The Requirements Management Editor lists the requirements in a table, similar to the Deadline Editor.

User-defined views

The editor helps the user to design own forms in order to present, print, filter, or edit parts of the data content. It is possible to name, store, and call up user-defined views.

Object Inspector

The Object Inspector shows all properties and structural relationships of an object. The properties can be edited in this editor. The Object Inspector provides a clear presentation of the values/attributes and links of the respective object. It is the suitable tool to edit the values/properties of an object. The Object Inspector is especially suited for collecting and editing variant-specific values as well as the management of multilingual data content of an object.

Block Diagram

The Block Diagram Editor provides the user with the possibility to import graphics from the Enterprise Architect© software. As an alternative, you may choose graphics in the SVG format from other sources. Sections may be defined in the graphics and assigned to IQ objects.

Parameter Diagram

The user may use the Parameter Diagram, in short P Diagram, to analyze a system in a specific manner. In addition to representing input and output parameters, it is possible to record control and noise factors and to show possible error states.

Audit Trail

The Audit Trail function enables the tracking of changes in FME files via an access authorization procedure. In this way, smaller and larger versions of a FMEA may be generated, which either run through part of or the entire procedure.

Design for Six Sigma (PWM, HoQ)

In the field of Design for Six Sigma (DfSS), the *APIS IQ Software* provides the Pairwise Comparison Matrix (PWM) and House of Quality 1-3 (HoQ). Customer requirements that were recorded already in the Requirements Management Editor, can be compared to the first CTQ characteristics in the PWM. In the House of Quality Editors, the CTQ characteristics (Critical to Quality) are subdivided into Critical Design Parameters (CDP) and Critical Process Parameters (CPP) and prioritized.

Management Report

The Management Report Editor can be used to create and manage status reports at regular intervals. The user can define the layout of the report to a great extent within the scope of predefined sections. Specific key figures can be determined and kept up-to-date automatically by means of filters, quality rules, and wildcard characters.

Interface to LDAP server

The interface is an option to establish a connection to the company LDAP server. Personal data (e.g. log-in details) can be reused by establishing access via the central database.

FMEA scope analysis (Planning and Preparation)

The FMEA scope analysis Editor is intended to support the user additionally in the creation of the FMEA. Various valuation categories can be assigned via a selection matrix in order to promote a structured working method.

Results Documentation

By means of a special template, the user may create a report in the Management Report Editor, which summarizes the results of the analysis. This summary may be used for documentation purposes.

Concepts of the user interface

The following windows may be open simultaneously:

- Personal Desktop (multiple times)
- Data Manager
- Forms/reports (management data)
- Form analyses
- CARM-Server Administration (Services Manager)
- Consolidation Desktop

Personal Desktop (PD)

In the Personal Desktop, a maximum of two views (editors) of the IQ data can be combined and synchronized, e.g. the structure view and the FMEA form. The editors can work with the same document or different documents (the latter allowing for the simple exchange of information between documents).

The area in which an editor is shown is called "workspace". Combinations of editors in workspaces can be saved to a function key.

The Personal Desktop remembers, which editor edited which data. Navigating through this list of views is possible, similar to an internet browser tracking the visited URL.

The Personal Desktop consistently supports Drag & Drop, including "Special Drag" (dragging with the right mouse button) to transfer attributes of an object.

Data Manager

The Data Manager is the standard interface to edit "administrative units" in the administration data section of an FME file. It is activated from the Personal Desktop via the administration menu.

The following administrative units are available:

- Persons and teams (for actions and requirements)

- Symbolic responsibilities and deadlines (for actions and requirements)

- Interested parties (are assigned to requirements)

- Catalogs (to administrate the vocabulary used with functions, characteristics, failures, actions, and requirements)

- Terminology and Translation (to standardize and translate the terms used)

- Notes list (to administrate notes categories, translations, and HTML links within the notes)

- Valuation catalogs (to standardize the risk evaluation)

- Palettes (to administrate the symbols used to indicate the type of process step and for classification in PFD)

- Risk matrices (to administrate risk matrix sets and their properties)

- AP catalogs (to administrate the Action Priority catalogs)

- Attributes/categories (to administrate user-defined attributes as well as a certain number of different categories)

- User-defined terms (to change the names for "Date", "Responsible", etc.)

- Machines (required in the Control Plan)

- Test equipment (required in the Control Plan)

- Assistant rules (allow for the formal examination of the FMEA dataset and suggest corrections)

The most important concepts of the APIS IQ Software

QM documents

What is a QM document?

QM documents are documents intended to record quality management activities concerning a product or a process. Many QM documents are specified in standards and publications, such as e.g. in VDA-FMEA, AIAG-FMEA or IATF 16949. One purpose of the *APIS IQ Software* is to conveniently create consistent QM documents. The concepts and procedures described in this chapter contribute to this.

What kind of QM documents can be created with the APIS IQ Software?

The following table provides an overview of the most important QM documents to be created with the *APIS IQ Software* and indicates the tools (= editors) to create and edit these QM documents respectively.

QM document	*Created with*
FMEA form: - pursuant to AIAG (2nd, 3rd, and 4th edition) - pursuant to VDA 86, 96, and 2006 - pursuant to MIL Task 101 / MIL Task 102	Form Editor
FMEA form: pursuant to AIAG-VDA	AIAG/VDA Form Editor
DRBFM form and worksheets	DRBFM editors
Process Flow Diagram	Process Flow Diagram Editor
(Production) Control Plan	Control Plan Editor
Schedule pursuant to VDA	Deadline Editor
Graphical Structure Tree	Structure Editor

Structure Tree in list view	Function/Failure Analysis Editor, Structure Editor
Function Net	Function Net Editor
Parts Functions Matrix	Editor for Parts Functions Matrix
Failure Net	Failure Net Editor
Fault Tree	Fault Tree Editor
Variants Matrix	Variants Matrix Editor
Deadline tracking	Deadline Editor
Statistical analyses	Statistics Editor
Customer requirements structure	Requirement Management Editor
Customer requirements checklist	Deadline Editor Customer Requirements

IQ documents

What is an IQ document?

An IQ document is a file with the extension FME. Any number of projects can be saved in this file.

If the *APIS IQ Software* is installed correctly, the IQ documents are registered in the operating system, i.e. the Windows Explorer shows an IQ document with its own icon and the column "Type" gives the description "IQ document".

Furthermore, that means that an IQ document can be opened by double-clicking, e.g. from Windows Explorer or as an e-mail attachment.

Note: Do **not** in any case open or edit an IQ document with a text editor or another program. This leads to program errors and data loss.

What are the contents of an IQ document?

Several projects/structures can be saved in an IQ document, along with all associated QM documents. Because of the redundancy-free, object-oriented approach of the *APIS IQ Software*, a QM document is nothing other than a view of the underlying data, i.e. the IQ document with all its IQ objects and relationships. Views like the FMEA Form, Process Flow Diagram, Control Plan, the graphical structure, Function and Failure Net, schedules etc. are therefore always fully integrated and thus aligned

in content. Changes made to IQ objects in one view lead to changes of the underlying data and automatically affect all other views containing the same information.

The information of an IQ document is subject to the shared terminology control and thus enables the intelligent re-use of information.

Certain information is global for an IQ document (the FME file), i.e. it affects all IQ objects and views in this document. These are in particular:

- *Valuation catalogs*: the default valuation catalog set in the IQ document is used in every instance where risk valuations are to be assigned, e.g. in the FMEA Form

- *Symbol palettes*: the default symbol palettes set in the IQ document are used in all views that apply symbols, e.g. in the Process Flow Diagram

- *Teams and persons*: the list to select persons from, who are responsible for actions, is always the same in all structures of the IQ document

- *Risk Matrix Sets:* consist of the three risk matrices SxO, SxD, DxO and a section showing the risk matrix rank (RMR).

Can several users edit the same IQ document simultaneously?

If your configuration level features the tools for simultaneous engineering, several users can edit the same document at the same time. For this purpose, the document is copied in a specific way (a "clone" is created). These clones can be edited simultaneously in the usual manner and merged (consolidated) later by means of the Consolidation Desktop.

If you do not work with a clone, the general rule is that the user who first opens an IQ document can edit its content without any restriction depending on the access rights. During this time, other users can open the document with read-only access.

Furthermore, there is the possibility to export a structure and reimport it after editing. To avoid conflicts caused by uncoordinated, simultaneous editing, the exported structure should be assigned with check-out status in the original document.

Projects

Projects are organizational units within an IQ document. They combine one or more structures that are related in content, e.g. the system, design and process structure of a product. The number of structures contained in a project is unlimited.

Structures

What is a structure?

A structure is a view of the data model applied by the ***APIS IQ Software*** and enables the representation of virtually all pieces of information relevant to the creation of QM documents. The structure consists of the IQ objects of the data model of the ***APIS IQ Software*** and indicates their interrelations and connections by means of symbols. The structure is absolutely redundancy-free (no double data management) and thus guarantees the consistency of all QM document contents.

The QM documents that can be created with the ***APIS IQ Software*** are nothing other than further different views of the underlying data.

A structure is an object with the following properties: name, owner, type (system, design, process), root element, and (optional) number.

The *name* of the structure is shown in various selection lists and in the title bar of the Structure Editor and the FFA Editor. It should be detailed and descriptive.

The *owner* of the structure can assign other users with access levels to "his" structure.

The *number* of the structure is used to create clear numbering for all IQ objects within the structure.

The *root element* is the "starting element" of the graphical tree. We recommend choosing a rather short name for the root element because of the limited space on screen. However, the ***APIS IQ Software*** itself does not restrict the length of the name of the structure or the root element.

What kind of relationships and objects exist in the structure?

The structure may contain the following IQ objects; a special symbol is agreed in the *APIS IQ Software* for most of them, which is applied in different locations of the graphical user interface:

Object / symbol	comment	Symbol
Project	… collects customer requirements and structures	
Structure	… correlates system elements in a graphical structure tree (relation "consists of" or "is part of")	
Variant	… is used to store several structures that differ only slightly, in a compact and redundancy-free manner	
System element Process element	… elements, of which the examined systems/processes consist (components, parts, subsystems, work steps or work sequences, processing cell, sub-process)	
Process Flow Diagram	… correlates process elements (relation "follows" or "is followed by")	
Function	… qualitative requirement of system and process elements	
Requirement	… quantitative requirement of functions	
Characteristic	… quantitative requirement of system and process elements; differentiated into product and process characteristics	
Function Net	… correlates functions and characteristics (relation "contributes to" or "depends on")	
Failure	… type of failure of functions or characteristics	
Failure Net	… correlates failures (relation "is caused by" or "causes")	

Prevention Action	… indicates how to avoid causes; its effectiveness is expressed by the O rating	
Detection Action	… indicates how to detect causes; its effectiveness is expressed by the D rating	
Revision state	… represents the continuous improvement process by indicating, which action is taken for a cause in the course of time	
Action group	… summarizes actions within a revision state to be able to document alternative actions that were discussed, but not implemented	
Responsible (person)	… is responsible for the implementation of actions	
Deadline	… indicates until when the action must be introduced	
FMEA Form	… summarizes the information on failure relations, failure risk, initiated and planned actions as well as their effectiveness in a form	
(Production) Control Plan	… describes the characteristics to be tested in the individual process steps and the specifications of such tests	
Operating condition	… for the system description in the Failure Net	
Failure detection	… for the system description in the Failure Net	
Failure reaction	… for the system description in the Failure Net	

The graphical structure tree

Components of the graphical structure tree

In the graphics window of the Structure Editor, the structure is represented as a tree that grows from left to right. We call this tree the **graphical structure tree**. It consists of system or process elements. The element on the farthest left of the graphical structure tree is also called the **root**.
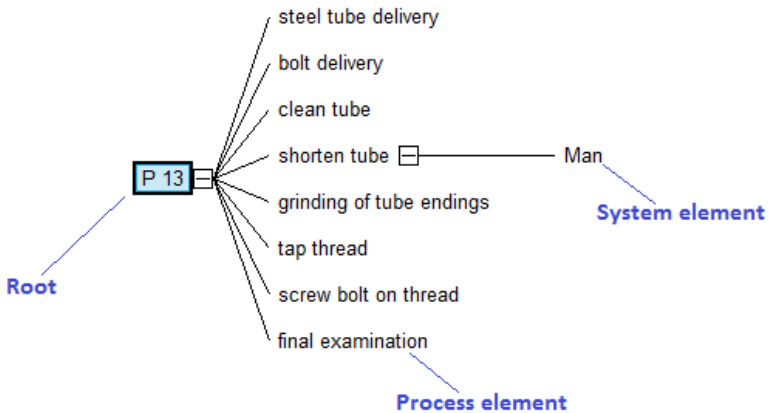
Folding operations in the graphical structure tree

In order to get a clearer view of comprehensive Structure Trees, parts of them can be folded and hidden from view. The effect of the different folding commands is demonstrated in the following abstract example:
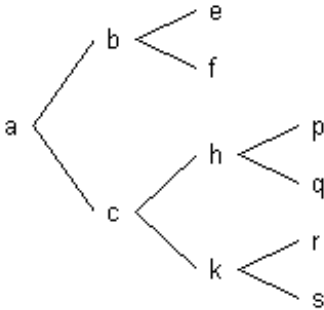
A folded part of the tree is marked as follows:

Sign for folded in part
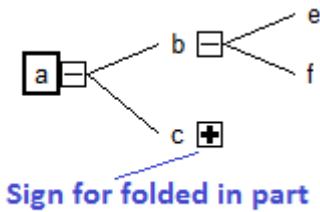
The commands described in the following are available in the View menu.

Unfold all

The entire graphical structure tree is unfolded.

Fold and unfold level

All elements at the same level of the tree as the selected element are folded. In the following example, the element *h* was selected before the command was executed.
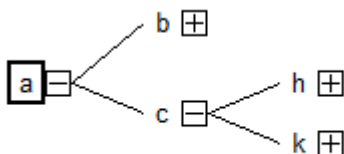
When you use the command again, the effect of the above command is reversed.

Show branch

The folded part of a tree is fully unfolded.

Show next level

The elements on the next level are shown; everything below that level is folded. In the following example, the root was selected before the command was executed.
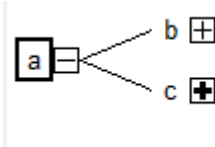
Hide branch

The entire branch starting from the selected element is hidden.

Anchoring

In the *APIS IQ Software*, different objects are always interrelated. Using the *IQ Software* terminology, you can say that (dependent) IQ objects are **anchored** to other (independent) IQ objects, i.e.:

- Functions and characteristics are anchored to system and process elements

- Failures are anchored to functions

- Actions are anchored to failures (more precisely: to their revision states and action groups)

The following figure shows the system element "Operator" of a process to which two functions and a process characteristic are anchored. One failure respectively is anchored to the characteristic and the functions, and revision states (the example shows initial states) with different actions are anchored to these failures.

```
⊟· ■ Operator {1}
    ⊟· ⊠ 📑Color coding in soldering applicance {1}
        ⊟· ⊗ ⚡Does not conform to color coding {1}
            ⊟· 📷Initial state
                ┈ ⊠ Color coding in soldering applicance {1}
                ┈ ⊠ Test for color blindness {1}
                ┈ ⊠ Use full spectrum lamp on work place {1}
                └ 🔍none {1}
    ⊟· ⊠ ⚙Function for causes {1}
        ⊟· ⊗ ⚡Strand is not inserted deep enough into solderingapplicance {1}
            ⊟· 📷Initial state
                ┈ ⊠ Limit stop for soldering auxiliary tool {1}
                ┈ ⊠ Defined striping length {1}
                └ 🔍Operator self test for insertion depth of skinnedstrand {1}
    ⊟· ⊠ ⚙Solder supply {1}
        ⊟· ⊗ ⚡Adds too few solder {1}
            ⊟· 📷Initial state
                ┈ ⊠ Operator training {1}
                └ 🔍Random sampling using tensile test {1}
```

It is important that a dependent (subordinate) object can never exist without the associated superordinate object in the *APIS IQ Software*. If necessary, the *APIS IQ Software* will automatically generate the missing superordinate object.

If, for example, an action is entered in an entirely blank FMEA form, then the *APIS IQ Software* generates the three IQ objects, on which the action depends, i.e. a failure, a function, and a system element. We refer to this type of connection as "automatic anchoring".

Reuse of IQ objects

What does reuse mean?

In the simplest case, reusing means copying already existing information. This operation is familiar from e.g. modern word processing programs: You copy text from an existing document and paste it into another document.

The *APIS IQ Software* features this type of copying text as well.

If, however, the user detects spelling mistakes after having copied a text section or wants to describe a situation differently, the user of the text system has no other choice than making the change twice, i.e. in the original text and the copied section.

The *APIS IQ Software* therefore features a far more useful concept, namely the concept of *reuse*. If, e.g., an object is reused instead of simply copied, then it is possible to correct spelling mistakes only once (and regardless in which occurrence) and all other occurrences will be corrected automatically.

The concept of reuse in the *APIS IQ Software* has many other advantages:

- Objects can be selected from catalogs
- Objects are subject to terminology control
- Objects take part in the inheritance
- Objects bring along all objects anchored to them
- Objects need to be translated only once

What kind of IQ objects can be reused?

The following objects of the data model can be reused as described above:

- System/process elements
- Functions
- Characteristics
- Requirements
- Failures
- Prevention actions
- Detection actions
- Control methods
- Reaction plans
- Operating conditions
- Customer requirements

In connection with reuse, certain terminology has become common use. If an IQ object is reused, you say it has "several occurrences". If the same function is reused twice in an IQ document, then it has three occurrences (in this IQ document).

Inheritance of failures

The *APIS IQ Software* provides inheritance of failures for reused functions. Existing failures are carried forward and, likewise, reused. Furthermore, if failures are introduced to a function with several occurrences, these failures are passed onto all

other occurrences on demand, i.e. further occurrences of the new failures are generated and anchored to the other occurrences of the function.

The following figure shows the confirmation dialog displayed by the **APIS IQ Software** for the following case: A new failure ("Grinding process is not started") is anchored to a function ("Start grinding process"), with this function having more than one occurrence (namely in the system elements "Grinding process seat of ball bearing" and "Grinding process seat of ball bearing and tread surface of shaft seal"):
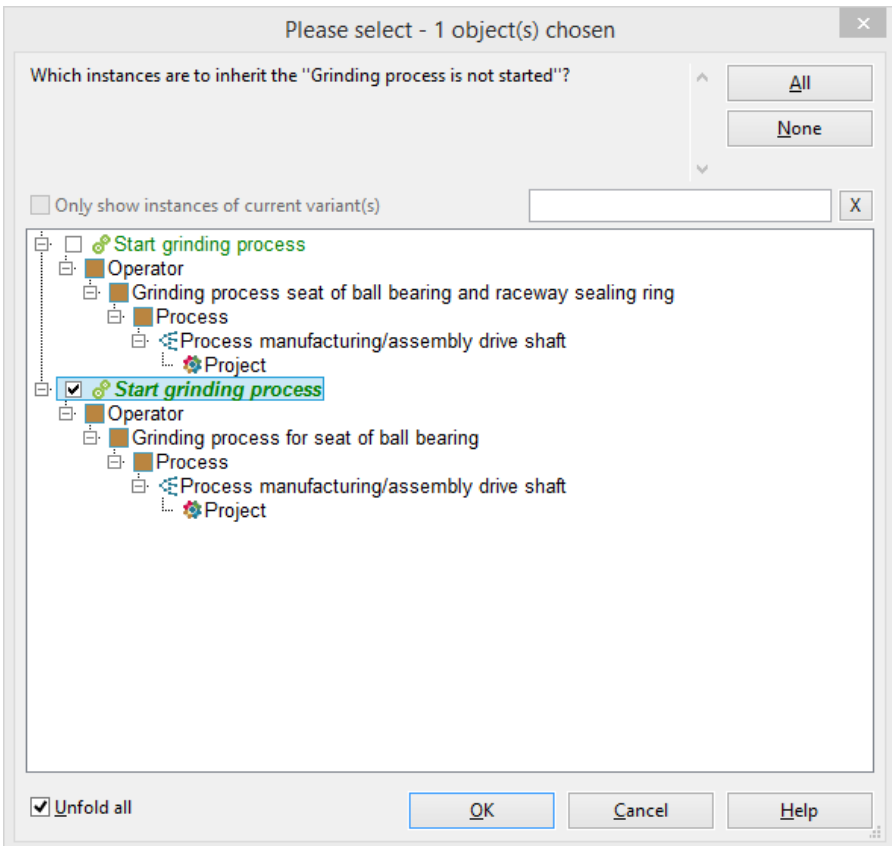
If a failure is deleted that is anchored to several occurrences of the same function, you will be asked likewise to decide from which occurrence of the function you want to remove the failure.

The following figure shows the confirmation dialog for the case, in which the failure that was just introduced is to be deleted again:
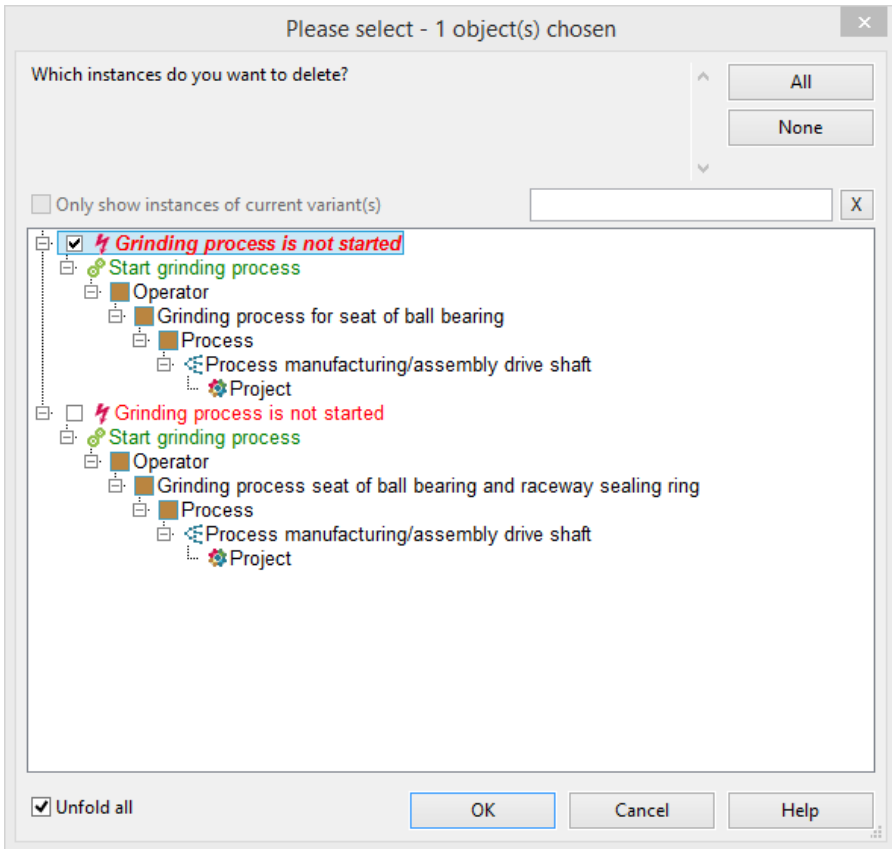
The user decides in both cases whether to execute the task for all IQ objects concerned or only for selected objects.

If the user does not want to or cannot decide which objects to change, he may confirm in the confirmation dialog to change only one object, namely the one selected when the operation was started. This behavior corresponds to a "fail safe strategy", the user changes conveniently a selected object and this object only. The user controls the changes made in other places via a confirmation dialog.

Reuse or copy?

The *APIS IQ Software* provides two options to reuse objects:

- Input Collector
- Direct dragging of reusable objects using the mouse (Drag & Drop)

It is possible, however, to copy only the text of an object without reusing the object. For this purpose, e.g. the Special Drag function can be used (Special Drag = Drag & Drop with the right mouse button instead of the left mouse button similar to the usual Drag & Drop).

Objects and object properties

The chapter "What are the contents of an IQ document?" describes the objects known to the *APIS IQ Software*. Informally speaking, an object is something to be clicked on in the user interface. Objects have different properties, e.g. a failure can have a severity rating. The S rating is one of the properties of the failure object. In general, the properties of an object can be shown and edited via the Properties dialog box. The properties dialog box is opened via the Windows default key combination `Alt + Enter`.

Document templates

With the template concept, the *APIS IQ Software* provides a simple option to define document-related settings as company-specific standards and distribute them throughout the company. In addition, the Workstation Settings of a user of the *APIS IQ Software* can be reset to company-specific default in a simple manner.

For this purpose, a file called `NORMAL.FMT` (FMT = FME template) is administrated in a workgroup directory, which contains the document-specific settings. When a new IQ document is created, the contents of this template are transferred into the new document. Thus, the document contains all default settings, which also "go along with it", e.g. when the document is copied, sent by e-mail etc. If changed settings of the document are to be reset, the content of the `NORMAL.FMT` file can be reloaded at any time.

The other way around, it is also possible at any time to transfer the settings from any document into the `NORMAL.FMT`. If e.g., self-defined valuation catalog is to be applied throughout a company, it is sufficient to transfer the valuation catalog into

the `NORMAL.FMT` file to make it available to all users. The necessary commands are provided in the "Tools" menu ("Update template…" and "Read template…").

Input collector versus Direct Input

The *APIS IQ Software* provides two different options to record information:

- **Direct Input**
- **Input Collector**

Direct input is best explained using the FMEA Form as a basis. If the user works in the FMEA Form with the Direct Input function enabled, data will be entered directly into empty fields ("cells") of the form. This way of working is similar to filling in a chart in MS Excel. The *APIS IQ Software* supports direct input not only in the various spreadsheet editors (for FMEA, Control Plan, Process Flow Diagram), but also in all other editors.

If, however, the user works with the Input Collector, it is possible to access the catalogs of reusable objects. Furthermore, the Input Collector is often more efficient when it comes to entering several pieces of information of the same kind in one step.

The *APIS IQ Software* provides various possibilities to work alternatively with or without the Input Collector. The simplest way is to use the following keyboard short-cut commands: `Ins` will always trigger the direct input of data, `Shift + Ins` will always open the Input Collector.

Terminology control

To facilitate the reuse of knowledge contained in APIS IQ documents, standardized terminology is required. The names of reusable objects (system/process elements, functions, characteristics, failures, and actions) should be uniformly assigned and used in the IQ documents. This is partly ensured by the *APIS IQ Software*, if the user applies the Input Collector and the catalog function when entering data. Nevertheless, it may happen, e.g. if several persons enter data, that different names are assigned to the same function/failure or the same name is entered several times.

The following cases may happen, for example:

1. User A has entered a function with the name "Ensure compressive strength" for a system element, whereas user B now enters a function called "Make sure compressive strength" for another system element. The function obviously has the same meaning in both cases. Using the *Terminology and Translation* Editor

in the Data Manager, the two different functions can be merged so that the *APIS IQ Software* regards them as reused and they are subject to inheritance again.

2. User A has entered a function with the name "Compatibility with other materials" for a system element, whereas user B now enters a function *with the same name* for another system element (e.g. because he did not see that the function already exists in the selection list). Again, Terminology Control allows for merging these terms.

User administration and access rights

User administration is integrated into the *APIS IQ Software*. The system saves various pieces of information about users (name, department, telephone number, and e-mail address). You can set, which fields are to be shown in QM documents and the order they are shown in.

For reasons of clarity, users can be grouped in teams. Teams and users are saved in the IQ documents, but they can also be transferred to or copied from the document template. Every IQ document contains at least one automatically created, special user, which is the **supervisor**.

Users can be assigned with passwords, as can the supervisor (!). In any case, the supervisor password is required to delete unknown passwords and reassign them. As long as users are not assigned with passwords, the *APIS IQ Software* is a fully open system; every user can – according to the access rights within the network – open and edit an IQ document. That changes as soon as passwords are used in the IQ document. That is to say, there is always a user logged in when an IQ document is edited. By default, this is the supervisor, but other users may login, too. Furthermore, the *APIS IQ Software* remembers for every IQ object, which user created and modified the object.

As soon as a password is assigned to a user to log in, one needs to know the password to be able to work with the IQ document. The User Administration can also be used to specify access rights for specific structures within an IQ document. In addition, those persons are stored in the User Administration, who are to be entered as responsible for actions in QM documents.

Please note: The *APIS IQ Software* features very effective access control methods based on passwords assigned to users. If the supervisor password is lost, there is no way of deleting unknown passwords anymore. If no user is available with (known) password, it is impossible to open a password-protected IQ document. The document

must be sent to the APIS Support to unlock. **The unlocking procedure will be charged and is connected with certain formalities**. Therefore, and for less administrative expense ("single point of administration" of passwords), we recommend using primarily the access mechanisms of your operating system.

Multilingual documents

The *APIS IQ Software* supports the possibility of storing the contents of an IQ document in several languages. This is interesting in particular to users, who operate globally. A typical scenario of the implementation of multilingual documents is the following:

- In France, an FMEA is created for a system, the reference language is French. Note: A **reference language** must be assigned to every IQ document. This is usually the language the document was created in; the document must contain a name for each translatable object.

- This document is to be processed in Brazil. For this purpose, Portuguese is assigned as the target language of the IQ document. Then, all objects of this FMEA (system elements, functions, failures, actions, etc.) are translated into the target language. This may be done either by means of Direct Input in the translation mode of the Forms Editor or by using the *Terminology and Translation* Editor in the Data Manager.

- From now on, IQ contents can be viewed optionally in French or in Portuguese. In many views, it is also possible to view both languages simultaneously.

- The structure can now be worked on in Brazil. As they do not work in the reference language French, each *new* object gets its Portuguese name *additionally* in the reference language. In this way, you can recognize quickly the changes made in Brazil, when working in the reference language French.

- The *APIS IQ Software* supports the user in synchronizing other language versions with the version written in the reference language. If a French term changes, the corresponding Portuguese term must be changed, too. Such changes can be recognized automatically by the program containing the administration tool for terminology and translation.

The following steps are important when working with multilingual documents.

When you create a new IQ document, the **reference language** for the document is specified.

Via the Menu command `Tools | Create a New Document Language`, other languages can be added for the current document. The *APIS IQ Software* then knows that every object may be given a name in the required translation language in addition to the name in the reference language.

The *APIS IQ Software* recognizes:

- Whether a translation is available for an object in the required translation language

- Whether the designation in the translation language is up-to-date

- Whether the designation in the reference language is up-to-date.

If another than the reference language is set to be displayed, the *APIS IQ Software* shows the term in the translation language for each object, if available. If there is no translation available yet, the term available in the reference language is used. The currently set language is shown in the status bar of each editor. The reference language of the document is marked by an affixed ">", e.g. "> `German`".

The following options are available to translate an object:

- Switch to the required translation language and rename the object in any editor

- Use the Terminology and Translation Administration Tool.

When working in a translation language, new objects can be created. Please observe that the *APIS IQ Software* in that situation cannot know the term in the reference language of these new objects, which must be available, though. Therefore, the new objects are assigned with the same name in the reference language that they were given in the translation language.

Versioning of information

"Versioning" means storing a certain processing state of data unchanged. This state is virtually frozen in the IQ document and can be viewed and printed, but not edited anymore under any circumstances. A working copy of the versioned data is created to enable users to continue their work, which is entirely independent of the version it was created from. Data can be versioned as often as you like. In this way, the complete development of the versioned object can be documented throughout its lifespan.

The following objects and views can be versioned in the *APIS IQ Software*:

- **Structures**
- **FMEA Forms**
- **(Production) Control Plans**

If a structure is versioned, it means that all the objects contained and their possible views (see above) are frozen. However, it is possible to version individual or all FMEA Forms or Control Plans within a structure. In extreme cases, a structure version may contain several versions of FMEA Forms or Control Plans.

When creating a version, the cover sheet is saved with the FMEA Form. The version of a form can be viewed and printed only; the content of the form cannot be changed anymore. It is, however, still possible to:

- Change the layout of the form
- Change the content language (if the content has been translated into other languages)
- Change the display options of the version
- Change the column width
- Generate the form-related analyses for the version
- Filter and sort the form.

Function Nets

Functions Nets describe how subordinate functions interact in a system in order to ensure the main functions, i.e. they correlate functions in cause and effect relationships. In Functions Nets, functions may have an unlimited number of causes and effects (sometimes referred to as "consequences"). A function that has only causes in a system, is called top-level function or main function. A function that has

only effects in a system, is called bottom-level function or basic function. In other words, Function Nets in the *APIS IQ Software* describe how the main functions are derived from the basic functions through the intermediate functions. The number of steps from the basic function to the top-level function is unlimited.

Failure Nets

Failure Nets describe the proliferation of failures in a system. They correlate failures in cause and effect relationships. In Failure Nets, failures may have an unlimited number of causes and effects (or consequences). A failure that has only causes in a system, is called top-level effect. A failure that has only effects, is called bottom-level failure or primary cause. In other words, Failure Nets describe how top-level effects arise from primary causes through intermediate steps or which effects are caused by a primary cause in a system. The number of steps from the primary cause to the top-level-effect is unlimited.

Revision States

The "E" in FMEA stands for (failure) "effects" (analysis). In the valuation and optimization phase of the FMEA, one has to describe how critical causes are or can be counteracted by means of actions. Usually, an analysis of the current state is performed (Which actions do currently exist? = assessment of the current state) and a target state is added, if necessary, to the actual state (Which new actions shall be introduced? = optimization). This target state is scheduled for a certain deadline and shall be regarded as introduced from the date of implementation. Thus, the former target state becomes the new current state.

The "typical" FMEA, as it is found in the FMEA Forms in accordance to AIAG and VDA 86, ends at this point. The *APIS IQ Software*, however, also supports the later system analysis according to VDA 96/2006 or VDA-AIAG, whose form facilitates the documentation of the continuous improvement process. Therefore, the *APIS IQ Software* does not use rigidly the terms of current state and target state. Rather, any number of revision states can be assigned to a failure or a function in the *APIS IQ Software*, one of which is always the current state; the others merely document past or planned states. There can be several action groups within a revision state, whereas only one action group is needed under normal conditions.

If you want to document that no improvement is needed for a revision state, you can enable the corresponding option in the properties dialog of the revision state. Thus,

you make sure that the "planned actions" columns in the FMEA Form pursuant to AIAG-FMEA are filled in automatically.

Action Groups

An action group comprises one or more prevention and detection actions and rates them with a shared RPN. All prevention actions in an action group together are evaluated with regard to their effectiveness and are assigned the same occurrence rating. The same procedure is applied to the detection actions with regard to the detection rating.

In the *APIS IQ-Software*, one revision state may contain several action groups. This possibility can be used to document e.g. alternatives considered by the FMEA team. If a revision state contains several action groups, all except one are to be marked as "rejected" for the final documentation.

Action groups appear in a revision state only, if more than one is available. Under normal circumstances, a revision state contains exactly one action group, which is not visible.

Interfaces to other systems

Various export formats are available to transfer the data to other systems. For the corresponding options, please open `File | Export`.

- **XML file (*.xml):** Exports the current structure into an XML file. The exported XML file is based on the MSR FMEA DTD. This document type description (DTD) is included in the scope of delivery and located in the subdirectory of the data directory.

    Note: Files in XML format can be reimported in the *APIS IQ Software*.

- **ODBC:** Exports the current structure into a format that works as an interface to relational data bases (e.g. to MS Access). For a more detailed description of the tables and an example of a query, please refer to the ODBC subdirectory.

- **HTML document:** Exports the current structure or the content of the current editor into an HTML file.

- **Windows metafile (*.emf):** Exports the form or the content of the current editor into an EMF file.

- **Several Windows metafiles (*.emf):** Exports the form into several EMF files (one file per page of the form).

- **Excel file (*.xls, *.xlsx):** Exports the content of the current editor into an MS Excel file (available for spreadsheet editors only).