APIS IQ-Software

Manual

APIS Informationstechnologien GmbH

Introduction

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

The family of *APIS IQ-Software* covers two lines: the APIS Server Software and the APIS Client Software*.* The Client Software is well known. It was first introduced in 1992, and ten years later it was supplemented by the *APIS CARM-Server*. While the *APIS IQ-Software* functions separately and is therefore used in most companies, the CARM-Server is an optional extra where special company requirements can be met.

The APIS Server-Software expects that a server exists, on which the software *APIS CARM-Server* can be installed. Depending upon the stage of development this server can make the following services available (CSS = CARM Server Service, CSA = CARM Server Agent), e.g.

- *APIS CSS Module*
- *APIS CSS Action Tracking*
- *APIS CSA Web-Publisher*

The handling of the server and the individual services are described in a separate manual.

The APIS Client-Software can be acquired at different extension levels. These are the following:

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

Function	Extension stage	IQ-FMEA	IQ-FMEA-L	IQ-FMEA PRO	IQ-RM	IQ-RM PRO
Requirements Management				✓		✓
System Structure (Structure Tree, FFA, Graph Editor)		✓	✓	✓	✓	✓
Process Flow Diagram (PFD)					✓	✓
Control Plan (CP)					✓	✓
Function Nets / Failure Nets / Graph Editor		✓	✓	✓	✓	✓
Fault Trees Analysis (FTA)		✓	✓	✓	✓	✓
FMEA (AIAG, VDA, Mil, etc.)		✓	✓	✓	✓	✓
DRBFM		✓	✓	✓	✓	✓
Action Tracking (Deadline Editor)		✓	✓	✓	✓	✓
Statistic Evaluations (Pareto, etc.)		✓	✓	✓	✓	✓
Object inspector		✓	✓	✓	✓	✓
User-defined view		✓	✓	✓	✓	✓
Simultaneous Engineering				✓		✓
Functional Safety (IEC 61508 / ISO 26262)				✓		✓
CBT with standard learning units		✓	✓	✓	✓	✓
Core Team Communication (E-mail, Internet)		✓	✓	✓	✓	✓
Terminology Control		✓	✓	✓	✓	✓
Multi-Language support (ANSI)			✓	✓	✓	✓
Unicode and asian languages				✓		✓
Cause and Effect Diagram		✓	✓	✓	✓	✓
CARM Server interface		✓	✓	✓	✓	✓
Functional Saftey				✓		✓
Mechatronics FMEA		✓	✓	✓	✓	✓

APIS IQ-Software optimally supports the users at work within the scope of Risk Management (FMEA, Process Flow Diagram, Control Plan, Functional safety). The redundancy-free handling of data makes consistent, efficient changes possible in different documents without additional adjustments. The software is adapted and optimised for the Windows environment and offers a safe basis for integrated Workflow and Document Management Systems. At this stage, all expectations for re-use of the documented knowledge have been fulfilled.

Minimum System Requirements

In order to be able to use the *APIS IQ-Software*, certain hardware and software components are required:

- PC with a IA32 (x86) compatible processor
- Microsoft Windows XP SP3, Windows 7 or Windows 8
- Hard disk with 300 MB free space
- CD ROM drive
- At least 1024 MB of free memory (RAM) and a screen resolution of at least 1024 x 768 pixels

4 GB RAM and a screen resolution of at least 1600 x 1024 pixels are recommended.

Installation

When installing *APIS IQ-Software,* the user can choose between an installation of a single user version or a network version. The main differences are:

- A **single user version** or an **NLX-client** can be installed only on the local drive of your computer. However, it is possible to store data on a network drive.
- With a **network version,** both the data and the program can be put on any drive (local or network). Normally, if several users are networked, and are intended to work with the *APIS IQ-Software*, then the network version is most appropriate. The program must be installed only once in the net and is nevertheless – within the constraints of the maximum number of active users – accessible by several users at the same time. That saves disk space and work – particularly with the update and maintenance of the installed program, e.g. if service packs are installed or functionality is extended.

First steps for a single user installation

The program files for the *APIS IQ-Software* must be installed from CD ROM.

After inserting the CD the installation program for the *APIS IQ-Software* is run automatically as long as the "Auto-Run" feature is activated. If this is not the case, then the installation may be started manually by executing the file SETUP.EXE that is on the CD, e.g. by double-clicking the file in Windows Explorer.

Prerequisite: The user must have the necessary access rights for the operating system to be able to install the program.

To continue with the installation procedure, follow the instructions on screen to install the program files and the selected components.

Installation of a network licence and additional options:

For a detailed description of the installation procedure of all versions of the *APIS IQ-Software* (single user and network) please see the document available on the internet at:

http://iq.apis.de/installation-en

Network Support

The *APIS IQ-Software* is *network enabled.* A program is called network enabled if several users can use the program at the same time without having to copy the program for every user.

What is on your computer after the installation?

The files that make up the *APIS IQ-Software* are within the program directory (Server or Client). There are six subdirectories with the names DATA, HELP, JRE, LEARNING, LIB and WORKGROUP.

The DATA directory contains example data of the *APIS IQ-Software* as well as examples of ODBC and XML. With a workstation installation (client installation), the files existing in the DATA directory are copied into the local management directory which is chosen during the installation by the user.

The HELP directory contains the files for the "Help" menu. The files needed for IQ-Computer Based Training ("learning units") are stored in the LEARNING directory.

The WORKGROUP directory contains the following files:

File	Purpose
APIS-IQ65.CFG	Configuration file; company-specific workstation settings
NORMAL.FMT	Template file; company-specific document settings
SHAPES.ICE	File with graphic symbols, which can be used for Symbol palettes ('C'-Column, Symbols for Process Flow)
IQ-LAYOUTS.ICE	File for storing different configurations of the software

The JRE and LIB directories contain Java components, which are used by the *APIS IQ-Software*.

Converting existing data

After installing a new version of the *APIS IQ-Software*, older IQ documents must be converted before they can be edited.

The *APIS IQ-Software* performs this step automatically. When opening an IQ document for editing, the software examines the version the IQ document was created in and converts it automatically if necessary. In addition, all IQ documents within a directory can be automatically converted in one batch operation.

Previous versions of *APIS IQ-Software* can no longer work with documents that were converted into the most recent format.

If it is necessary to make the IQ documents available to other users who do not yet have the current program version, we recommend keeping the documents created with the old version during the transition period. To safeguard existing IQ documents generated by a previous version of the *APIS IQ-Software*, it is suggested to establish separate directories for old and new (converted) files so that in the future one can work with them again in the old version.

Improvements and changes to the previous version of the *APIS IQ-Software* can be found in Online Help under the menu option "What's new in Version ...".

Important: Do not edit documents created with the *APIS IQ-Software* with another editor/software. This leads to the corruption of the data and to program failures.

The existing interfaces can be used for exchanging data with other systems (Chapter: "Interfaces to other systems")

What can you do with the APIS IQ-Software?

With the *APIS IQ-Software* QM documents can be created. These are known from reference texts, such as the ISO/TS 16949, VDA, AIAG, IEC 61508 and ISO 26262 manuals:

- **FMEA Forms**
- **Failure tables**
- **DRBFM Forms**
- **Process Flow Diagrams**
- **Process Control Plans and/or Control Plans**
- **Plans for Deadlines**
- **Statistical Evaluations**

Apart from these, further QM documents can be compiled:

- **Structure Trees**
- **Functions Nets**
- **Failure Nets**
- **Cause and Effect Diagrams**
- **Fault Trees**
- **DRBFM Worksheets**

The following tools are available which can optimise the creation of QM documents and assist in the management of information:

- **Requirements Management (MORE)**
- **Personal Information Manager (PIM)**
- **Graph Editor**
- **IQ-Explorer**
- **Assistant**
- **User-defined views**
- **Object inspector**

For the support of contemporary requirements with regard to the workflow, the *APIS IQ-Software* provides these tools for simultaneous engineering (available only in specific extension stages):

- **Consolidation desktop**
- **Overview and Details of differences**
- **Summary of modifications**

First steps

The *APIS IQ-Software* utilises the standard user interface that is known from standard Windows applications like Microsoft Word or Microsoft Excel. Therefore, users should be able to easily recognise and use the most important concepts of the *APIS IQ-Software* (see chapter "The most important concepts of APIS IQ-Software").

The following items help new users to quickly become acquainted with the *APIS IQ-Software*:

Computer Based Training (CBT)
CBT-Tools are designed to actively teach the user different aspects of working with the *APIS IQ-Software* in several learning units. The scope of supply includes modules that introduce the handling of the software and the concepts of the FMEA.

Some helpful control references
If a menu command is selected using the mouse, a short description of the respective menu command is indicated within the status bar that is seen at the bottom of your window.

The context menu which is opened with one click of the right mouse button displays the most frequent commands that are likely to be executed for this object, depending on which object is selected.

"Special Drag" (dragging with the right mouse button instead of the left) is a very flexible and powerful way for transferring and linking information.

The properties dialogue box, e.g. found in the context menu, displays all properties of the highlighted object and allows to change the values of the properties. Furthermore, the properties dialogue gives access to the Assistant feature for guided user interaction.

The Editors of the APIS IQ-Software

The following documentation gives an overview of the tools (editors) available within the *APIS IQ-Software* and the concepts that can be realized with each of these tools. The detailed description of functionality and operation of the editors is available in the Online help of the *APIS IQ-Software*. This help can be activated via the help menu or the F1 function key. Additionally, the Online help enables the user to search for specific topics of interest.

System Structure Representation in the Structure Editor

Within the structure editor the user develops a system structure model, also called the system structure or just the structure. The structure is the basis for further work.

The structure editor displays the system structure as a "tree" which grows on the screen from left to right. This tree shows how the overall system can be divided into subsystems (also called "system elements"). This presentation is used both with product/systems and with processes.

For each system element, the existing functions and, if necessary, the failures of this element can be displayed within the structure editor.

Function and Failure Analysis

A system structure can also be developed with the function and failure analysis editor (called FFA Editor for short).

The FFA Editor represents the elements of a system structure in a compact tree form that is similar to the view style seen in Windows Explorer. It is possible to represent more information on the screen in the FFA Editor than in the graphical representation of the structure editor.

Process Flow Diagram

Within the Process Flow Diagram (PFD) the individual steps of a (manufacturing) process are placed in succession as a flow chart. Each process step is represented by a symbol, which can be selected from a symbols palette that the user can define.

The symbols used in the PFD can be connected with arrowed lines whose line type and line strength can be chosen. Linear sequences as well as bypasses and combinations of both can be represented.

The number of parallel steps in a process and the number of process elements that can be contained within a diagram is unrestricted.

Beside the (graphical) flow chart there is a table in wich the following additional information can be entered for the individual process steps:

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

The classification of the requirements (characteristics) is represented by symbols that likewise can be chosen from the symbol palette.

Control Plan

Within the Control Plan you can find the following information for each individual process step:

- Numbers and name of the process step
- Required machine, tools, etc. for this process step
- Product and process requirements relevant for this process step as well as their number
- Classification of the characteristics (as symbols)
- Information on the characteristic tests (kind of action, sample size and frequency, etc.)
- Reaction plans if the requirement specification is not fulfilled

For each structure there can be more than one Control Plan.

Function Net

The Cause/Effect information for functions of a structure and/or project is stored in the Function Net. The Function Net shows all causes and effects that are possible, for a given function of the system (called the "Focus Element") in a graphical representation.

Failure Net

The Cause/Effect information for the failures of a structure and/or project is stored in the Failure Net. The Failure Net shows all causes and effects that are possible, for a given failure of the system (called the "Focus Element") in a graphical representation.

Graph Editor

The Graph Editor is a new tool to display and edit structures, function or failures nets in their entirety. In this way, the context of a function or failure can become much clearer than in the Function or Failure Net editors.

Fault Tree Analysis (according to DIN)

Fault Trees are derived from the Failure Net. Additionally, they contain logical connections (AND, OR, NOT) between the failures as well as failure probabilities for elementary failures. With this information, the Fault Tree computes the failure probability for top-level failures.

Cause and Effect Diagram

The Cause and Effect Diagram combines the structure representation with 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 Formsheet (AIAG, VDA, MIL, etc.)

The FMEA Formsheet contains the following information:

- Failure Modes of the Functions for one or more System Elements
- Potential Effects and Potential Causes of different Failure Modes
- The Severity of the Potential Effects and the Classification information

- The Preventive and Detection Actions listed as Current Controls which are entered for the Potential Causes or Failure Modes
- The effectiveness of these actions in the form of Occurrence (O) and/or Detection (D) values
- 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- values

The information is represented in several different formats (layouts) (VDA, AIAG, MIL among others). The user can easily switch between these different layouts.

Forms offer many editing possibilities, e.g.:

- Any kind of comments (also graphics) can be stored and viewed in the form
- The translation of the data into other languages can be made directly in the form
- The contents of the FMEA Formsheet can be sorted and filtered in various ways

Deadline Editor

The Deadline Editor lists the responsible person for each individual action, the target completion date and any additional information, and is therefore useful for project management. The actions of a single (or all) Formsheets within the current IQ document can be displayed. From the Deadline Editor, responsible persons can be notified by email. Besides the default layout there is a layout that can be used for Action Tracking in accordance with VDA 96.

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

Statistical Evaluations

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

- **Pareto Analysis**: Representation of the portion of the most severe failures within the total risk (20/80-Rules)
- **Pareto compact**: Simplified visualization of the Pareto Analysis
- **Difference Analysis**: Shows the improvements of the risk valuations due to completed actions and/or the more recent state of actions not yet completed
- **Frequency Analysis**: RPN Frequency distribution within the data
- **Actions for Responsible Persons**: Overview providing information of actions assigned to the responsible person
- **Risk Matrix**: Matrix representation of the frequency of valuation combinations (e.g. O vs. D) with risk classes

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

Variants Matrix

The Variants Matrix offers the possibility of defining and comparing contents of the different Variants within a Structure. The IQ-Objects of the structure are contained within the rows of the Variant Matrix and the variants can be found within the columns. IQ-Objects can be added to and/or removed from the variants by clicking with the mouse in the cells of the matrix.

IQ-Explorer

Existing (FMEA) knowledge can be searched and reused with the IQ-Explorer. It has a number of powerful search features usable within IQ documents. The search results can be copied into existing documents.

The IQ-Explorer works similarly to Windows Explorer. However, a large number of additional possibilities are offered since the IQ-Explorer knows and can use the relevant structure information within its search. In its simplest form the IQ-Explorer is used to look for QM documents in which certain text is contained.

This search can also consider dates. Besides that, there are further complex search criteria in the IQ-Explorer, e.g.:

- Which kinds of IQ-Objects shall be included in the search? (system elements, functions, failures etc.)
- Which additional conditions these IQ-Objects are to meet (e.g. whether failures are only to be found if they are causes of other failures and have actions assigned to them)
- Whether the search is to take place within the current document only or in all documents of one or more several directories
- Which directories of the file system are to be searched
- Whether backup copies of the documents are to also be included in the Search
- A similarity search will have positive results even if there is a difference in spelling (e.g. if you are searching for the word 'dialogue box', but in the document it is 'dialog').

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

Multi-language support (contents ANSI)

With multi-language support, contents of the IQ documents can be managed in several languages as long as the one ANSI character set (=255 characters) is sufficient. It is possible to translate contents directly in the FMEA Form, in the Control Plan or in the Process Flow Diagram. In addition, the multi-language support offers tools for the administration of multilingual contents. With these tools, untranslated IQ-Objects and also IQ-Objects whose translation is not up to date can be identified

Unicode

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

Team-Communication (E-mail, Internet)

This module offers the following possibilities:

- Automatic sending of E-mails to responsible people regarding the status and feedback

- Sending Forms by E-mail

- Publishing the FMEA information for the Internet or Intranet using the Web Publisher

Assistant

The Assistant supports the user both with operating the program and with constructing the FMEA. It guides the user with the help of Assistant Rules step by step through the process of FMEA creation even if the user does not know all details necessary for the operation of the program. Instead, the user can choose from a proposed list of tasks, and then the Assistant performs the necessary steps to complete them.

The support of the Assistant goes even further: it also gives methodical help, i.e. it supports the user when creating the FMEA in accordance to the rules described in the literature. In order to support company or user defined operational standards, the Assistant and its rules can be adapted to fulfil those needs, too.

Personal Information Manager (PIM)

The PIM helps to organise your FMEA work. By means of bookmarks, which have been popularised by internet browsers, it can clearly structure the work. Within the PIM the user has the following possibilities:

- 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 entry is assigned to the current user

- Record automatically generated IQ-Objects

Parts Functions Matrix

The Parts Functions Matrix offers an alternative possibility for anchoring functions and/or characteristics at system or process elements. Within this matrix the system / process elements from the specific structure are located within the rows and the functions / characteristics are found within the columns. By mouse-click within a cell of the matrix, a function can be anchored to a system element.

Requirements Editor

The Customer Requirements Editor displays requirements, e.g. from customers, suppliers, or from standard documents such as ISO/TS 16949, in a net similar to that used by the Function and Failure Net Editors.

Requirement Management

The Requirement Management Editor lists the requirements in a table, similar to the Deadline Editor for actions.

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 relations of an object. The properties can also be changed in this editor. The Object Inspector offers a clear presentation of the values/attributes and links of the respective object in a tabular form. It is the appropriate tool for editing the values/attributes of an object. The Object Inspector is especially well suited for capturing and editing of variant specific values as well as the management of multilingual data content of an object.

Concepts of the user Interface

The following windows can be opened simultaneously:

- Personal Desktop (multiple times)
- Data Manager

- Forms/Reports (Management data)
- Formsheets – Evaluations
- CARM-Server Administration (Services Manager)
- Consolidation Desktop

Personal Desktop (PD)

Within the Personal Desktop two views (editors) of the IQ-Data can be combined and synchronised, e.g. a structure view and a FMEA Formsheet. The editors can work with the same IQ document or with different IQ documents (allowing for simple information exchange between documents).

The area in which an editor is shown is called a "work space". Combinations of editors in work spaces can be stored as a keyboard shortcut in a function key.

The Personal Desktop remembers all views that were opened in the course of a meeting, i.e. which data was edited and in which editor. It is possible to navigate through this list of views, similar to an Internet browser that tracks visited addresses.

The Personal Desktop supports Drag & Drop (dragging and dropping) including "Special Drag" (drag with right mouse button instead of left) for transferring attributes of an object.

Data Manager

The Data Manager is the standard interface for "Administration Units" in the administration data area of an FME file. It is activated from the Personal Desktop via the administration menu. There are the following Administration Units:

- Persons and teams (for actions and requirements)
- Symbolic responsibilities and deadlines (for actions and requirements)
- Requestors (are assigned to customer requests)
- Catalogues (for the administration of the vocabulary used with functions, characteristics, failures, actions and customer requests)
- Terminology/Translation (for standardising the terms used as well as for translating)
- Notes List (for the administration of notes categories, translations and HTML links within the notes)

- Valuation catalogues (for standardising the risk valuation)
- Palettes (for the administration of the symbols which are used in PFD for indicating the kind of the process step and for classification)
- Risk matrices (for the administration of risk matrix sets and their properties)
- Attributes/categories (for administering user-defined attributes as well as function and action categories)
- User-defined terms (to be able to change the names for „date", „responsible", etc.)
- Machines (needed in the Control Plan)
- Inspection Equipments (needed in the Control Plan)
- Assistant Rules (determine the strategy of the Assistant)

The most important concepts of APIS IQ-Software

QM documents

What is a QM document?

QM documents are documents with which Quality Management activities concerning a product or a process are recorded. Many QM documents are specified in standards and publications, e.g. in VDA-FMEA, AIAG-FMEA or ISO/TS 16949. One purpose of *APIS IQ-Software* is to comfortably provide consistent QM documents. The concepts and procedures described in this chapter contribute to that.

Which QM documents can be created with APIS IQ-Tools?

The following table gives an overview of the most important QM documents that can be created with *APIS IQ-Software,* and it points out with which Tool (Editor) can create these QM documents.

QM document	*Created with*
FMEA Formsheet according to - AIAG (2nd, 3rd and 4th edition) - VDA 86, 96 and 2006 - MIL Task 101 / MIL Task 102	Forms Editor
DRBFM Formsheet and Worksheets	DRBFM Editor
Process Flow Diagram	PFD Editor
Control Plan	Control Plan Editor
Plan for Deadlines according to VDA	Deadline Editor
Graphic Structure Tree	Structure Editor
Structure Tree in List view	FFA Editor, Structure Editor
Function Net	Function Net Editor

Parts Functions Matrix	Editor for Parts Functions Matrix
Failure Net	Failure Net Editor
Fault Tree	Failure Tree Editor
Variants Matrix	Variants Matrix Editor
Deadlines Overview Editor	Deadline Editor
Statistic Evaluations	Statistics Editor
Requirement Structure	Requirements Editor
Requirements Check List	Editor for Requirement Management

IQ documents

What is an IQ document?

An IQ document is a file with the extension `FME`. Multiple projects can be saved within this file.

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

This means that an IQ document can be opened with a double click, e.g. from Windows Explorer or as an attachment from an E-mail.

Note: An IQ document should *never* be opened with a text editor or another program. This leads to program errors and to data loss.

What are the contents of an IQ document?

Within an IQ document several projects / structures can be saved, along with all associated QM documents. Because of the redundancy-free, object-oriented approach of *APIS IQ-Software* a QM document is not different from one view to another because it contains the same data, i.e. the IQ document with all its IQ-Objects and relationships. Views like the FMEA Formsheet, Process Flow Diagram, Control Plan, the graphical Structure Tree, Function and Failure Nets, Plans for Deadlines etc. are always completely integrated and thus contain the

same information. Changes made to IQ-Objects in one view automatically have effects on all other forms that contain the same information.

The information in an IQ document are subject to a general Terminology Control and makes the intelligent re-use of information possible.

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

- *Valuation Catalogues*: the Valuation Catalogue set up within the IQ document is used by default everywhere where risk valuations are to be assigned, e.g. in the FMEA Formsheet

- *Symbol Palettes*: the Symbol Palettes set up within the IQ document by default is used by all views that use symbols, e.g. in the Process Flow Diagram

- *Teams and Persons*: the selection list for responsible people for actions is always the same in all structures of the IQ document

- *Risk matrix sets*: these consist of the three risk matrices OxD, OxS, DxS and the risk matrix rank table (RMR)

Can several users work on the same IQ document at the same time?

If your extension stage has the tools for the simultaneous engineering, several users can work on the same document at the same time. To do this, the document is copied in a specific way (a "clone" is made). These clones can be worked on in parallel in the usual way and afterwards be merged (consolidated) again with the help of the Consolidation Desktop.

If you do not work with a clone, then the following will apply: the user who first opens an IQ document can change its content without any restriction depending on his access rights. During this time other users can open the document for read access only.

There is also the possibility to export a structure and import it back after editing. In order to avoid conflicts caused by uncoordinated, simultaneous editing the exported structure should be given check-out status in the original document.

Projects

Projects are organisational units within an IQ document. They combine one or more structures that are related, e.g. the System, Design and Process Structure for a product. The number of structures contained in a project is not limited.

Structures

What is a Structure?

APIS IQ-Software uses the Structure as a data model which encompasses / contains all information that is relevant for the creation of QM documents. The Structure consists of IQ-Objects of the data model of *APIS IQ-Software* and their relations to each other. The Structure is absolutely redundancy-free and thus guarantees the consistency of all QM document contents.

The QM documents that are created with *APIS IQ-Software* are only different views of this Structure and its data.

A Structure has the following attributes: Name, Owner, Type (System, Design, Process), Root Element and number (optional).

The *Name* of the Structure can be viewed in various selection lists and in the title bar of the Structure Editor and the FFA Editor. It should be detailed and recognisable.

The *Owner* of the Structure can assign other users' access levels on "their" Structure.

The *Number* of the Structure is used in order to produce clear Numbering for all IQ-Objects within the Structure.

The *Root Element* is the "starting element" of the graphical tree. We recommend choosing a shorter name for the root because of the limited space on the screen a long name will restrict the space to view the structure. However, *APIS IQ-Software* does not have any restrictions on the length of the Structure Name or the Root.

Which IQ-Objects and relations are there within the Structure?

Within the Structure the following IQ-Objects can be contained; for most of them a special Symbol is used in *APIS IQ-Software* and is used in different places within the graphical user interface:

Object	Comments	Symbol
Project	… for the collection of Requirements and Structures	
Structure	… visual representation of System Elements in relation to each other (relation: "consists of" resp. "is part of")	
Variants	… are used in order to store several Structures compactly which differ only slightly from each other and are redundancy free	
System Element Process Element	… the elements of the system at hand i.e. the components / process steps (parts, sub-components, process steps, man, machine, method, environment and materials) within the system / process	
Process Flow Diagram	… visual representation of Process Elements in relation to each other (relation: "follows" resp. "is followed by")	
Function	… qualitative requirements of the System and Process Elements	
Requirement	… quantitative requirements of the System and Process Elements; differentiated according to Product and Process Characteristics	
Function Net	… a visual representation of Functions and Requirements in relation to each other (relation "contributes to" resp. "depends on")	
Failure	… Failure of the Function or Requirement (Malfunction)	

Failure Net	… visual representation of Failures in relation to each other (Relation: "Causes" and "Effects")	
Preventive Action	… indicates how Failures are avoided; their effectiveness is represented by the 'O' value	
Detection Action	… indicates how Failure Causes are discovered, their effectiveness is represented by the 'D' value	
Revision State	… represents a stage of the continuous improvement process by indicating what Actions for Failure Causes, were implemented over time.	
Action Group	… documentation of the risk by evaluation of one or more Preventive / Detection Actions, which produces an RPN.	
Responsibility (Person)	… team member who is held responsible for the implementation of a Detection or Preventive Action.	
Deadline	… time allotted for the completion of Actions.	
FMEA Formsheet	… summary of the information contained within the Failure Net, Failure risk, current and/or planned Actions as well as their effectiveness in a tabular style.	
Control Plan	… describes the characteristics of individual process steps that have specifications as well as tests, controls and reactions to a non-conformance	
Operating Condition	… for the system description in a failure net	
Error Detection	… for the system description in a failure net	
Error Response	… for the system description in a failure net	

The Graphical Structure Tree

Components of the Graphical Structure Tree

Within the graphics pane of the Structure Editor the Structure is represented as a tree that grows from left to the right. We call this tree the **Graphical Structure Tree**. It consists of System or Process Elements. The element standing furthest to the left of the graphic Structure Tree is called the **root**.
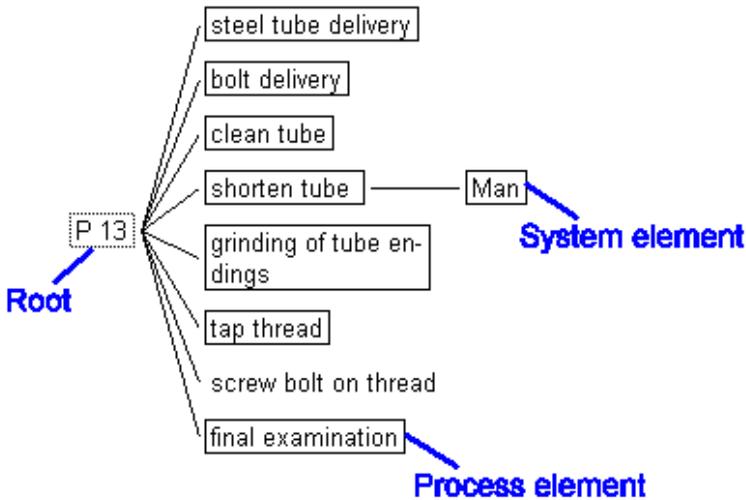
Folding Operations in the graphical Structure Tree

In order to get a better overview of the Structure Tree parts can be folded and hidden from view. The effect of the different instructions for folding is demonstrated in the following abstract example:
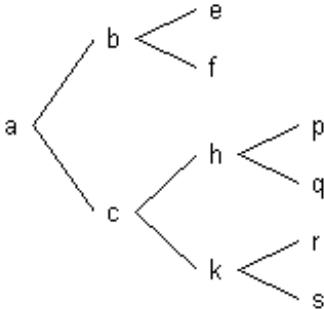
A folded part of a tree is marked as follows:

Sign for folded in part
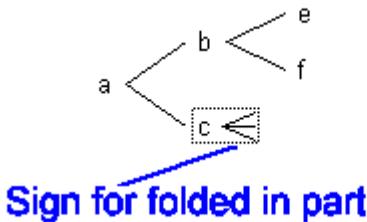
The following commands described are found in the view menu.

Show All

The entire graphic Structure Tree is unfolded.

Fold and Unfold Level

All elements that are on the same level of the tree as the marked element are folded. In the following example the element *h* was marked before the instruction had been given.
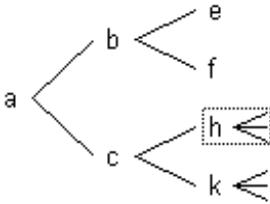
If the command is again used, then it unfolds all elements that are on the same level as the marked element.

Show Branch
A folded part of a tree is completely unfolded.

Show Next Level
The elements of the next level are shown; for the selected branch and one level only. In the following example the root was marked when the instruction was given.
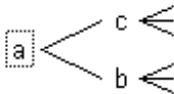
Hide Branch

The entire branch starting from the selected IQ-Object is folded.

Anchoring

In *APIS IQ-Software* objects possess relationships with other objects. Using *IQ-Software* terminology, it can be said that (dependent) IQ-Objects are anchored to other (independent) IQ-Objects, thus:

- Functions and Characteristics are anchored to System and Process Elements
- Failures are anchored to Functions
- Actions are anchored to Failures (more precisely: to Revision States and Action Groups)

The following illustration shows a System element "Operator" of a Process to which two Functions and a Process Requirement are anchored. A Failure is anchored to the Requirement and/or Functions, and with these Failures there are Revision States (the example shows Initial States) with different Actions anchored, respectively.

```
⊟ ■Operator
   ⊟ ⊠ ▣ Color coding in soldering appliance
      ⊟ ⊞ ⚡ Does not conform to color coding
         ⊟ O=6 D=7 RPN=336 ⊡Initial State 29.10.2000
            ├ ⊠ Color coding in soldering appliance
            ├ ⊠ Test for color blindness
            ├ ⊠ Use full spectrum lamp on work place
            └ ◩ ◱NONE
   ⊟ ⊠ ⚙ Insert strand into soldering jack using auxiliary tool
      ⊟ ⊞ ⚡ Strand is not inserted deep enough into solderingappliance
         ⊟ O=3 D=8 RPN=216 ⊡Initial State 29.10.2000
            ├ ⊠ Limit stop for soldering auxiliary tool
            ├ ⊠ Defined striping length
            └ ◱ Operator self test for insertion depth of skinnedstrand
   ⊟ ⊠ ⚙ Solder supply
      ⊟ ⊞ ⚡ Adds too few solder
         ⊟ O=4 D=8 RPN=288 ⊡Initial State 29.10.2000
            ├ ⊠ Operator training
            └ ◱Random sampling using tensile test
```

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

If, for example, an action is created in a completely empty FMEA form, then the *APIS IQ-Software* produces for this the three IQ-Objects on which the action depends, i.e. for Failure, Function and a System Element. We refer to this type of connection as "automatic anchoring".

Re-use of IQ-Objects

What does re-use mean?

In its simplest form, reusing means copying from already existing information. We are already familiar with this due to modern word processing programs: one can copy text from an existing document and add it into the same or a new document.

The **APIS IQ-Software** offers this kind of text copying functionality to you.

However, after copying a passage of text one can realize that it contains a misspelling. When working with a text system you then have to correct the misspelling twice, i.e. within the original text passage and the copied version.

In *APIS IQ-Software* there is a far more useful concept i.e. the *re-use* of data. For example, if an object is reused instead of only just copying the text, then a misspelling needs to be corrected only once (no matter where this is performed) and all other occurrences will be corrected automatically, no matter where they are.

The concept for reusing in *APIS IQ-Software* offers many other advantages:

- Objects can be chosen from catalogues
- Objects are subject to the Terminology Control
- Objects take part in inheritance
- Objects bring along all dependent IQ-Objects anchored to them
- Objects must be translated only once

Which IQ-Objects can be reused?

The following Objects of the data model can be reused in the method described above

- System/Process elements
- Functions
- Characteristics
- Failures
- Preventive actions
- Detection actions

In connection with reusing certain terminology is used. If an IQ-Object is reused, you say it has "several occurrences". If, within an IQ document, the same function is reused twice it then has three occurrences (in the IQ document).

Inheritance of Failures

APIS IQ-Software provides inheritance of Failures for reused functions. Existing Failures are carried forward and, likewise, reused. Furthermore, if Failures are introduced within a function with several occurrences, these Failures can be distributed to all other occurrences, i.e. more occurrences of the new Failures are produced and anchored at the other occurrences of the function.

The following illustration shows the dialogue box displayed by *APIS IQ-Software* for the following case: a new Failure ("grinding process is not started") is anchored to a function ("start grinding process"), whereas that function has more than one occurrence (in the Structures "process manufacturing/assembly drive shaft" and "grinding process for seat of ball bearing"):
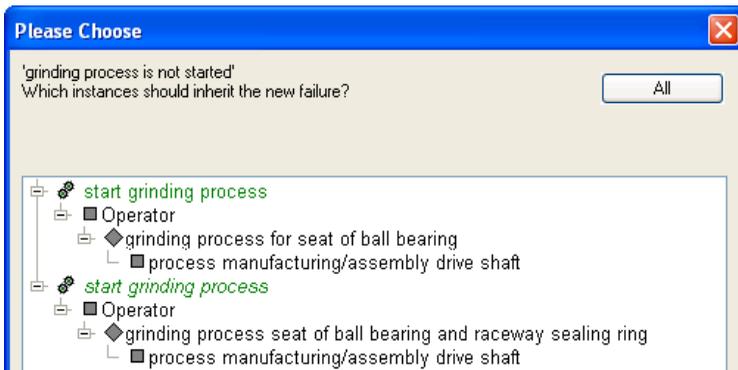
If a Failure that is anchored to several occurrences of the same function is deleted, you will be asked to decide from which occurrences of the function the Failure is to be removed.

The following illustration displayed the dialogue box in the case in which a Failure is to be deleted:
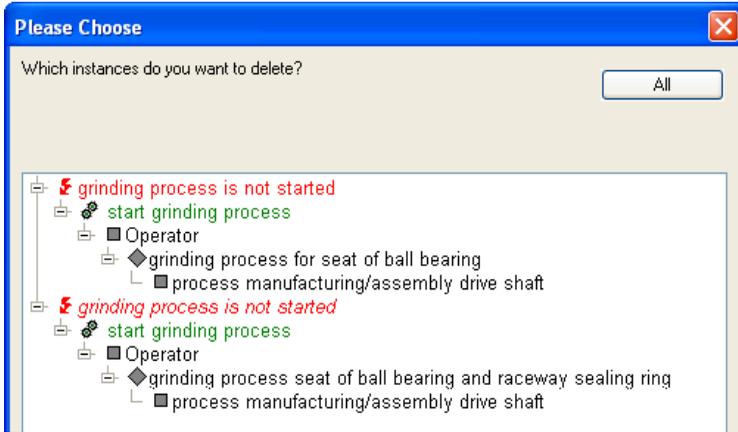
In both cases the user can decide whether to complete the task with all IQ-Objects concerned or only with the selected.

The user has the opportunity to make *no* decision about which IQ-Objects are to be changed, or can confirm within the dialogue box the IQ-Objects that the changes are to be applied to, i.e. just one instance or every instance. This behaviour corresponds to a "Fail Safe strategy", the user can conveniently change a desired IQ-Object and this only. The user controls the changes made in other places via this dialogue box.

Reusing or copying?

In order to reuse IQ-Objects there are two possibilities in the *APIS IQ-Software*:

- • The Input Collector
- • Direct dragging of re-usable IQ-Objects with the mouse (Drag & Drop)

It is possible, however, to copy only the text of an object without reusing the object. For this, Special Drag can be used (Special Drag = Drag & Drop with the right mouse button in place of the left mouse button as with normal Drag & Drop).

IQ-Objects and Object Attributes

The chapter "What are the contents of an IQ document?" describes the IQ-Objects that the *APIS IQ-Software* knows. Informally speaking, an IQ-Object is something that one can click on from within the user interface. IQ-Objects have different attributes, e.g. failure can exhibit a severity. The severity is one of the attributes of the Failure object. In principle, the attributes of an IQ-Object can be seen and

edited via the Properties dialogue box. The properties dialogue box can be opened with the Windows default key combination `Alt + Enter`.

Document Template

With the Template concept *APIS IQ-Software* offers a simple means to set and distribute, throughout the company, default settings (company specific standards). Additionally, the Workstation Settings of a user of *APIS IQ-Software* can be reset to a company-specific default in a simple manner.

This is administered in a Workgroup Directory in a file, called `NORMAL.FMT` (FMT = FME Template), in which the document-specific settings are contained. If a new IQ document is created, the contents of this Template are transferred into the new IQ document. Thus, all Default Settings are contained in the document and also "move with it", e.g. if that IQ document is sent by E-mail. If there have been changes within the settings of a document, the Template contents can be reloaded at any time from the `NORMAL.FMT` file.

It is also possible to transfer settings from any IQ document into the `NORMAL.FMT` at any time. If, for example, a company requires a previously defined Valuation Catalogue is to be used, it is possible to transfer this Valuation Catalogue into `NORMAL.FMT` in order to make it available for others. The commands needed for this are found in the pull-down menu "Tools" ("Update template…" and "Read template…").

Input Collector versus Direct Input

For the collection of information with the *APIS IQ-Software* two different possibilities exist:

- **Direct input**
- **Work with the Input Collector**

Direct input can best be explained using the FMEA Formsheet as a basis: if a user works in the FMEA Form with Direct Add active, data will be entered directly into empty fields ("cells") of the formsheet. This functionality is similar to that found in MS Excel.

APIS IQ-Software supports the direct input not only in the various Formsheet Editors (for FMEA, Control Plan, Process Flow Diagram) but also in all other Editors.

If, however, a user works with the input collector, they have access to libraries of the re-usable IQ-Objects of *APIS IQ-Software*. In addition, the input collector is often more efficient, if several items of information of the same kind are to be entered in one step.

APIS IQ-Software offers different possibilities in order to work alternatively with or without the Input Collector. The simplest way is to use the following keyboard short-cut commands: `Insert` will always result in a direct entry of data, `Shift + Insert` will always open the Input Collector.

Terminology Control

In order to make reusing the knowledge contained in APIS IQ documents possible uniform terminology is recommended. The names for re-usable IQ-Objects (system/process elements, functions, characteristics, failures and actions) should be uniformly assigned and used within the IQ documents. *APIS IQ-Software* partially guarantees this if the user enters data through the input collector with catalogue. But if different people work on the data within a system, it is possible to enter, for example, different names for the same function/failure or the same term could be entered several times.

The following cases could happen:

1. User A entered a function with the name "check quality of pressure" at a system element whereas User B then enters a function with the name "test pressure quality" at another system element. Obviously these functions have the same meaning. With the Terminology/Translation editor in the Data Manager the two different functions can be merged so that *APIS IQ-Software* regards them as reused and they are subject to inheritance.

2. User A entered a function with the name "compatibility to other materials" at a system element, and User B enters a Function *with the same name* for another system element (e.g. because they did not notice the existing function in the selection list). The Terminology Control can merge these terms as well.

User Management and Access Rights

User administration is integrated into *APIS IQ-Software*. The system saves different information about a specific user (name, department, telephone number and email address). You can decide on the specific Fields that will appear in QM documents and on their order.

For ease of organisation, users can be grouped into teams. Teams and team members can be saved within the IQ documents, they can also be transferred into the Template and then re-used at a later time. In each IQ document at least one special user exists by default, this is known as the **Supervisor.**

Passwords can be assigned to the users, also for the supervisor (!). The supervisor password is required in order to delete the passwords of other users. As long as no passwords are assigned for users *APIS IQ-Software* is a completely open system: each user can – according to their access rights within the network –open and change an IQ document. This changes as soon as passwords are used within the IQ document. When working with an IQ document, a user is always logged in. The supervisor is the default user, however different users may also login. Furthermore, the *APIS IQ-Software* remembers within the data model for each IQ-Object, which user has created and modified the object.

As soon as a password is assigned for a user, they must enter it to be able to work with the IQ document. The Teams and Persons Administration can also be used to specify Access Rights for particular structures within a given IQ document. In the Teams and Persons Administration people who are to be listed as responsible for actions in QM documents are saved as well.

Please Note: *APIS IQ-Software* has a very effective method for access control that is based on passwords assigned to users. If the supervisor password has been lost, there is no way of deleting forgotten passwords. If no user is available without password or with a known password, it is not possible to open a password-protected IQ document. This IQ document must be sent to the APIS Support to get unlocked. **This incurs a cost and requires certain formalities.** We recommend, for this reason and also for ease of management ("single point of administration" for passwords), to primarily use the access mechanisms of your operating system.

Multilingual documents

APIS IQ-Software supports the possibility of storing the contents of an IQ document in several languages. This is particularly of interest for such users who

are globally active. A typical scenario of the employment of multilingual documents follows:

- In France an FMEA is created for a System, the reference language is French. TIP: For each IQ document, a reference language must be given. This is normally the language in which the document was created; in the document there must be a name for each translatable object.

- This document will be processed in Brazil. In order to do this, Portuguese is assigned as the target language for the IQ document. All IQ-Objects of this FMEA (System Element, Functions, Failures, action etc…) are now translated into the target language. This can take place either by means of direct input in the translation mode of the Forms Editor, or by using the Terminology/Translation editor within the Data Manager.

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

- In Brazil work can continue on the structure. Since work does not happen in the reference language, each new *IQ-Object* has its Portuguese name *added* into the reference language. Therefore, when working in the reference language French, the changes made in Brazil can be quickly recognised.

- *APIS IQ-Software* supports synchronisation of different language versions in comparison to the reference language. If a French term changes, a change must also be made to the corresponding Portuguese term. Such changes can be recognised automatically by the program with the tool for the administration of 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.

Through the Menu command `Tools | Create a New Document Language` other languages can be added to the reference language. The *IQ-Software* now knows that for each IQ-Object in addition to the reference language term, there can also be another term entered within the desired translation language.

APIS IQ-Software **recognizes:**

- Whether there is already a term for the object in the translation language
- Whether the term is current in the translation language

- or, whether the reference language term is current

If you choose to display a language other than the reference language, the *APIS IQ-Software* shows the term in the translation language for each object, *if there is a translation*. If no translation is found, the term existing in the reference language will be used. The current language is shown within the Status Bar of each editor. The reference language of the document is characterised by a ">" placed in front, for example "> German".

To translate an IQ-Object, there are several possibilities:

- Change the desired translation language and rename the object in any editor
- Use the Administration Tool for terminology and translations. To do this it is not required to change into the translation language.

If a user works in a translation language, new IQ-Objects can also be produced. Pay attention to that in this situation. The *APIS IQ-Software* does not know the reference language term of these new IQ-Objects; this, however, must exist. Within the reference language, the new IQ-Objects will get the same term they were given in the translation language.

Versioning of Data

"Versioning" means to take a snapshot in time of a defined processing state of the data. The conditions within the IQ document are frozen as they were at that time and can be viewed and printed but not modified in any circumstances. Of course, you can continue to work on your original data. Versioning can take place at any time. That way a user can document the complete development course of the versioned object over its entire life span.

Creating Versions is possible in IQ-RM for the following IQ-Objects and/or views:

- **Structures**
- **FMEA Forms**
- **Control Plans**

If a structure is versioned, then that means that all contained IQ-Objects and their possible views (see above) will be frozen. It is also possible to version, within a structure, individual or all FMEA Forms. In extreme cases, several versions of FMEA Formsheets can be contained within a Structure Version.

Along with the FMEA Formsheet, a Cover Sheet is saved when creating a version. Formsheet Versions can only be viewed and printed. Contents of the form cannot be modified any longer. However, it is still possible to:

- Change the form layout
- Change the language of contents (if contents are translated into other languages)
- Change the display options for the version
- Change the column widths
- Create the form-referred evaluations for the version
- Filter and sort the form

Function Nets

Functions Nets describe how subordinate functions cooperate in a system in order to ensure main functions. They bring functions into a cause-effect relationship. Within the Functions Nets, functions can have an unlimited number of causes and effects (sometimes referred to as "consequences"). The functions that only have causes in a system are called Top-Level-Functions or main functions. The functions that only have effects in a system are called Bottom-Level-Functions or basic functions. In other words, the 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 between a basic function and a Top-Level-Function is unlimited.

Failure Nets

Failure Nets describe the failure linkages in a system. They bring failures into a cause-effect relationship. Within the Failure Nets, failures can have an unlimited number of causes and effects and/or consequences. We call failures that only have causes in a system Top-Level Failures. We call failures that have only consequences, Bottom-Level Failures or elementary failures. The Failure Nets describe how Top-Level Failures develop in steps from elementary failures (Fault Tree View) or which effects are caused by an elementary failure in a system (Event Tree View). The number of steps between an elementary failure and a Top-Level failure is unlimited.

Revision States

The "E" in FMEA stands for (failure) "Effects". In the valuation and optimisation phase of the FMEA, one describes how critical Failure Causes are or can be handled by actions. Usually a Current-State analysis is performed (What actions do currently exist? = risk assessment/evaluation) and a Target-State is added to oppose it (What new actions shall be introduced? = risk reduction/optimisation). This Target-State is planned for a certain Deadline and can be introduced, when needed, at any time. Thus the former Target-State will become the new Current-State.

The "classical" FMEA, as it is in the FMEA Forms in accordance to AIAG and VDA 86, ends here. However *APIS IQ-Software* also supports the later system analysis according to VDA 96 / 2006 whose form makes the documentation of a continuous improvement process possible. Therefore, the *APIS IQ-Software* does not insist on the terms of the Current-State and the Target-State. In the *APIS IQ-Software* it is possible to attach as many Revision States as desired to a failure and/or Failure Cause for which only one is always the current state; the others are just a historical record of completed or planned actions. Within a Revision State there can be several Actions Groups whereas under normal conditions only one Actions Group would be necessary.

In a case in which you would like to document that no planned actions are to be implemented, one can activate the appropriate option from within the properties dialogue box of the specified Revision State. This ensures that the column for planned Actions within the FMEA Formsheet is filled in automatically, in accordance to AIAG FMEA.

Actions Groups

Actions Groups contains one or more Preventive and Detection Actions and rate them with a common RPN. All Preventive Actions in an Action Group are evaluated together regarding their effectiveness and receive the same occurrence. The same procedure is taken with the Detection Actions concerning the detection.

In *APIS IQ-Software* a Revision State can contain several Actions Groups. This possibility can be used to document alternatives considered by the FMEA Team. If there are several Actions Groups in a Revision State all of them except one are to be marked as "abandoned" (discarded) for the RPN calculation.

Actions Groups are only visible within a Revision State if there is more than one. Under normal circumstances, a Revision State contains only one Actions Group that is not seen.

Interface to other systems

Different export formats are available for the transfer of the data to other systems. For the corresponding options, please refer to `File – Export`:

- **XML-file (*.xml)** – Exports the current structure into a XML-file. The exported XML-file is based on the MSR FMEA DTD. This document Type Description (DTD) is contained in the scope of delivery and is situated in a subdirectory of the data directory. When installing the software the DTD-file can be selected.
  Remark: Files in XML-format can be re-imported into the *APIS IQ-Software*.

- **ODBC** – Exports the current structure into a format that serves as interface to the relational databases (e.g. to MS Access). A description in more detail of the table is situated in the subdirectory ODBC together with an example for a query.

- **HTML-document** – Exports the current structure or the content of the current editor into a HTML-file.

- **Windows Metafile (*.wmf)** – Exports the current structure or the content of the current editor into a WMF-file.

- **Several Windows Metafiles (*.wmf)** – Exports the formsheet into several WMF-files (one file per formsheet page).

- **Excel-file (*.xls)** – Exports the contents of the current editor into a Microsoft Excel file (only available for table editors).