



The
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Innovation and Knowledge

The Reuse Company Quality, Trace and Reuse



Requirements Quality Analyzer

www.reusecompany.com



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It's your knowledge, reuse it.



What is The Reuse COMPANY

In the Reuse Company's vision, knowledge reuse is fully integrated in every organization's productivity chain.

Our mission is to promote Systems/Software (S/S) and knowledge reuse within an organization, by offering processes, methods, tools and services that make it possible.

Our main efforts are oriented to Systems/Software Reuse, Traceability and Quality

We are a small European IT company, that have operated only in Europe until 2010.

2011's goal is the complete internationalization.





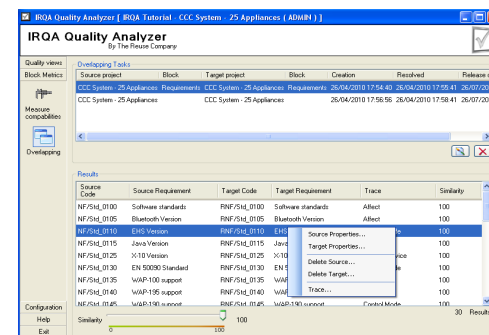
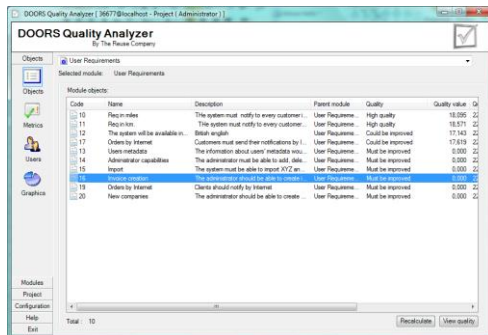
What is the Requirements Quality Analyzer - RQA

The Requirements Quality Analyzer is a software tool that aids quality assessment and improvement within requirements oriented software and systems projects.

RQA allows to define, measure, improve and manage the quality of requirements specifications in systems and software projects.

The assessment is modeled by evaluating metrics.

- Measures single requirements quality
- Measures requirements sets quality



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RQA Features

Metrics

- ▶ Metrics based model for measuring and improving quality
- ▶ Supports text based and NON text based measures
- ▶ Supports metrics for individual requirements and sets of requirements
- ▶ Customizable measures calculation engine

Functional Operation

- ▶ Multi roles operability (Engineer, Project Manager, QA Manager)
- ▶ Calculations can be performed on-line (on demand) or planned.
- ▶ Fully integrated with RMS

Semantics

- ▶ Formal semantic requirements meta-model
- ▶ Fully supports the customer's Domain representation (ontology)
- ▶ Domain Specific Language can be incorporated to the ontology

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Individual requirements supported metrics

- ▶ **Size**
- ▶ **Readability**
- ▶ **Conditional vs. imperative sentences**
- ▶ **Optional sentences**
- ▶ **Ambiguous sentences**
- ▶ **Subjective sentences**
- ▶ **Implicit sentences**
- ▶ **Abuse of connectors**
- ▶ **Negations**
- ▶ **Speculative sentences**
- ▶ **Design terms**
- ▶ **Flow terms**
- ▶ **Number of domain nouns and verbs**
- ▶ **Acronyms**
- ▶ **Hierarchical levels**
- ▶ **Volatility**
- ▶ **Number of dependences**

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Individual requirements supported metrics 1 / 3

- ▶ **Size:** expressed in paragraphs, chars, nouns or verbs. Long requirements will be difficult to understand
- ▶ **Readability:** number of letters between punctuation marks and some other formulas than indicate whether the requirement will be easy to read. Ease to read requirements generates less problems all over the project
- ▶ **Conditional sentences vs. imperative sentences:** avoid *would* and use *Shall, should* and *will* in the right way
- ▶ **Optional sentences:** maybe... Optional requirements must be stated by an attribute, never in the body of the requirement
- ▶ **Ambiguous sentences:** fast, user-friendly... What do the analyst, the coder and the customer understand by the same ambiguous sentence
- ▶ **Subjective sentences:** in my opinion, I think that... Don't show your ideas, but what the system should do

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Individual requirements supported metrics 2/3

- ▶ **Implicit sentences:** it must be provided by them... Too many pronouns make your requirements difficult to understand
- ▶ **Abuse of connectors:** and, or. Many times connectors reveal different needs enclosed within the same requirement, losing the atomic characteristic
- ▶ **Negations:** no, never... Two or more negations in the same sentence make it difficult to understand
- ▶ **Speculative sentences:** usually, almost always... Make the requirement imprecise
- ▶ **Design terms:** loop, hash... Remember, avoid How, concentrate in What
- ▶ **Flow terms:** while, if, else... Remember avoid How, concentrate in What

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Individual requirements supported metrics 3/3

- ▶ **Number of domain nouns and verbs:** domain terms and verbs should be involved into the requirement specification, nevertheless, too many different terms in the same requirement many times means multiple needs
- ▶ **Acronyms:** avoid those that don't belong to the domain representation
- ▶ **Hierarchical levels:** don't complicate your specification with too many indentation levels
- ▶ **Volatility:** if a requirement suffers many changes, you must be very careful with it
- ▶ **Number of dependences:** the same if your requirement is the source of too many dependences

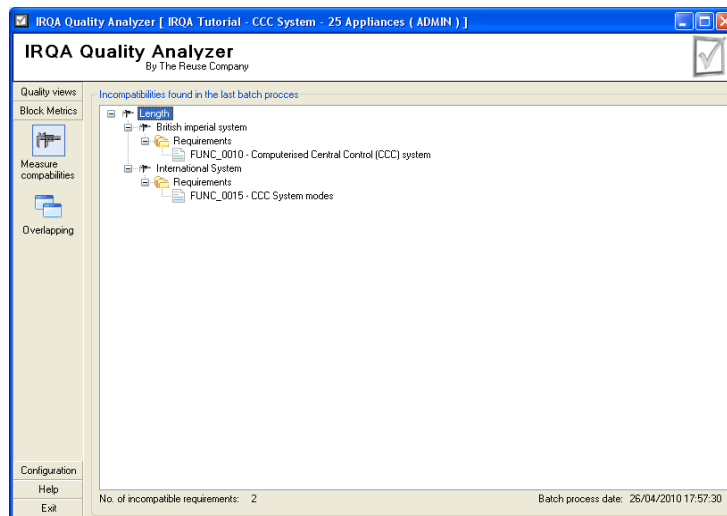
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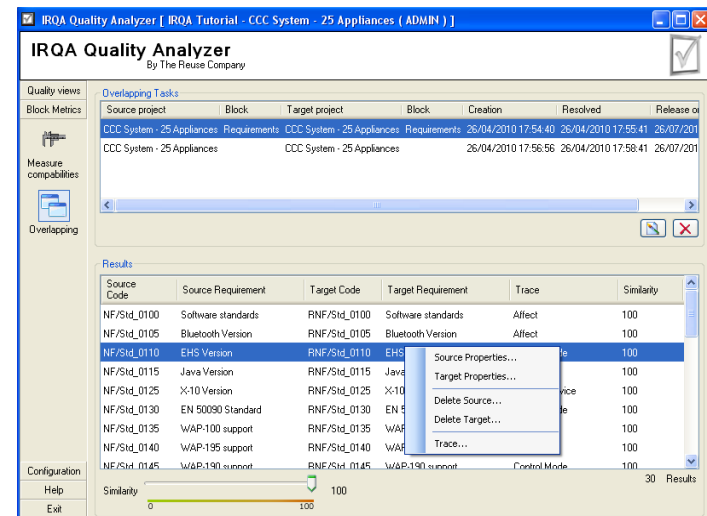
Requirements sets supported metrics

- ▶ Unlike individual requirements metrics, **global metrics** involve a whole set of requirements (a requirement project or module)
- ▶ These metrics are defined to take a global understanding of some common mistakes

Use of inconsistent units



Coupling matrix





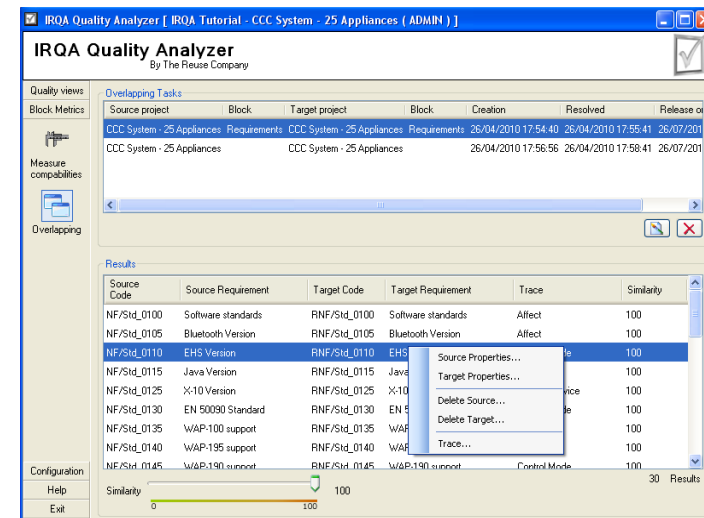
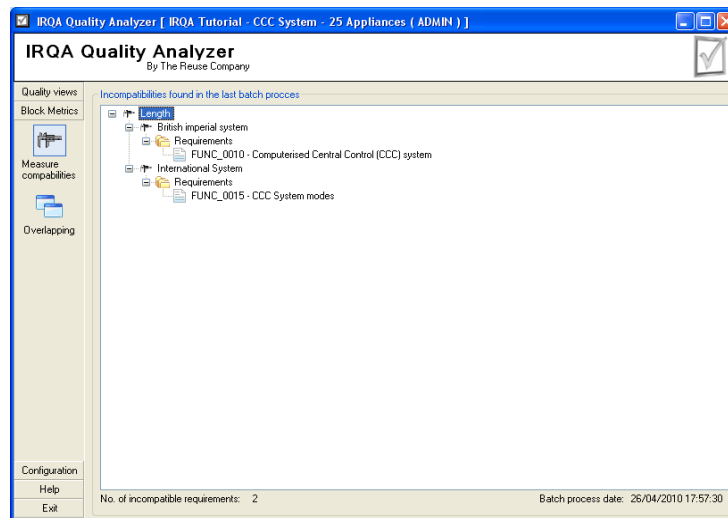
Requirements sets supported metrics

➤ Inconsistent units

The use of incoherent units in different requirements must be checked and notified. E.g. to use meters and inches, pounds and Kg., Celsius and Fahrenheit.

➤ Overlapping Matrix

Measure the possibility to include similar or overlapped requirements in the same of different projects.



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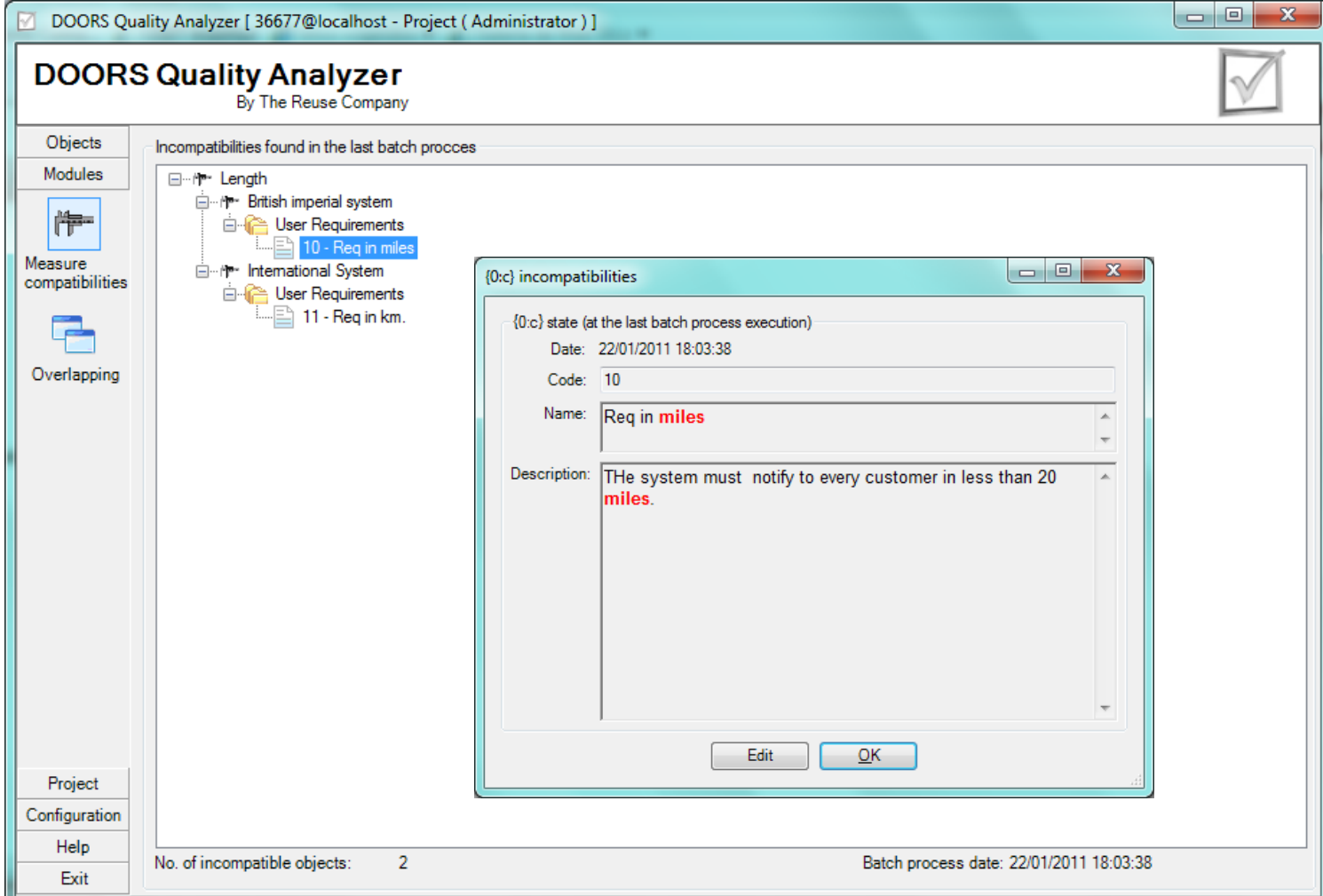
Requirements sets supported metrics : inconsistent units

- ▶ **Root problem:** inconsistent requirements could be difficult to find, therefore, the cost of finding them in later stages of the SDLC or even in a production environment is really high
- ▶ **Goal:** try to detect, in the same Requirements project, the use of non-consistent units (e.g. two different requirements measuring something in yards and meters)
- ▶ **Management:** RQA, out-of-the-box, already includes many of the most common measurement units. The user is able to extend this list at any moment
- ▶ **Solution:**
 - ▶ The pairs of requirements that include these inconsistent units are automatically identified by the tool
 - ▶ The user can now change the textual content of the requirements

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Requirements sets supported metrics : inconsistent units



The screenshot shows the DOORS Quality Analyzer interface. The main window displays a tree view of requirements under the 'Length' category, with two sub-categories: 'British imperial system' and 'International System'. Under 'British imperial system', there is a 'User Requirements' folder containing a requirement '10 - Req in miles'. Under 'International System', there is a 'User Requirements' folder containing a requirement '11 - Req in km'. A dialog box titled '{0:c} incompatibilities' is open, showing the following details:

- {0:c} state (at the last batch process execution)
- Date: 22/01/2011 18:03:38
- Code: 10
- Name: Req in **miles**
- Description: The system must notify to every customer in less than 20 **miles**.

Buttons for 'Edit' and 'OK' are visible at the bottom of the dialog box. The status bar at the bottom of the main window indicates 'No. of incompatible objects: 2' and 'Batch process date: 22/01/2011 18:03:38'.



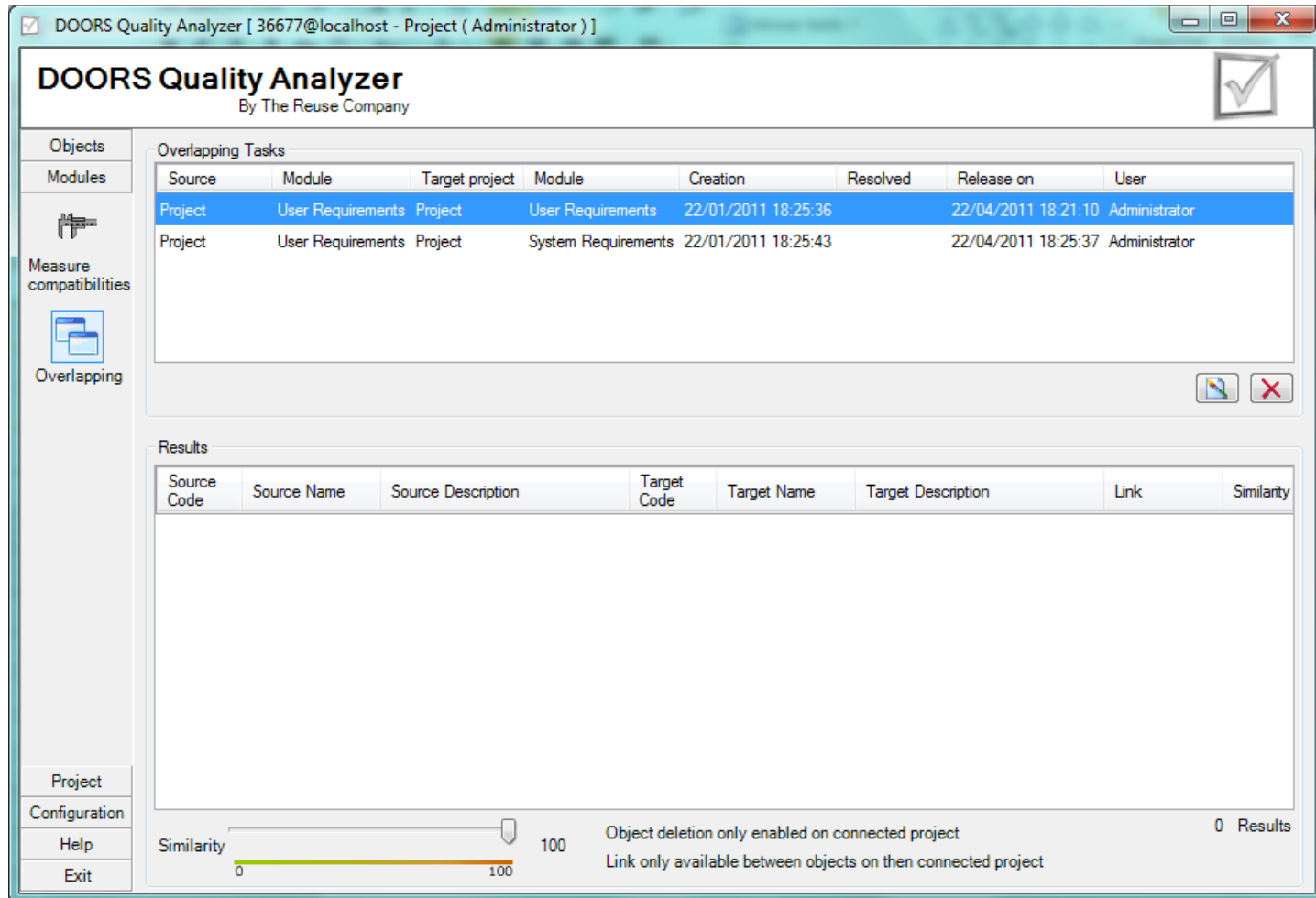
Requirements sets supported metrics : coupling matrix

- ▶ **Root problem:** coupled specification could be the source of inconsistent specifications, therefore, the cause of many rework and poor quality projects
- ▶ **Goal:** automatically detect coupling (overlapping) inside a single module or even among different modules or projects
- ▶ **Approach:**
 - ▶ Generate a semantic graph out of every single requirement: using linguistic techniques together with ontologies
 - ▶ This graphs don't relay on the words in the requirements, but in the real meaning (semantics) of a whole sentence
 - ▶ The tool compares those graphs to find out the semantic similarity among requirements
- ▶ **Solution:** once detected, the user can easily remove a requirement or add a trace relationship between both requirements

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Requirements sets supported metrics : coupling matrix



DOORS Quality Analyzer
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Objects
Modules

Measure compatibilities
Overlapping

Project
Configuration
Help
Exit

Overlapping Tasks

Source	Module	Target project	Module	Creation	Resolved	Release on	User
Project	User Requirements	Project	User Requirements	22/01/2011 18:25:36		22/04/2011 18:21:10	Administrator
Project	User Requirements	Project	System Requirements	22/01/2011 18:25:43		22/04/2011 18:25:37	Administrator

Results

Source Code	Source Name	Source Description	Target Code	Target Name	Target Description	Link	Similarity
0 Results							

Similarity 100
0 100

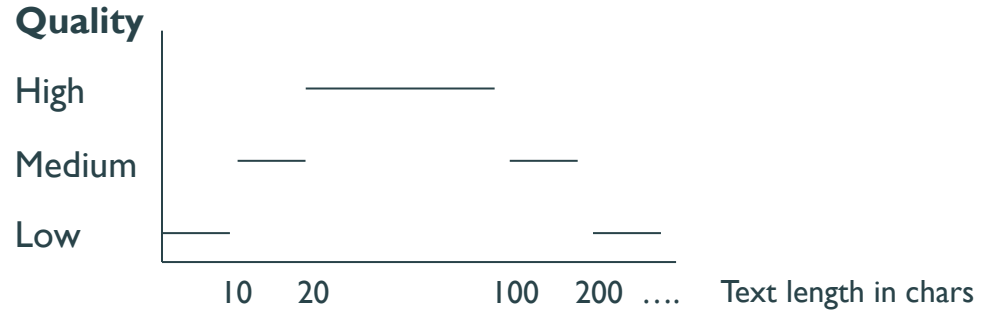
Object deletion only enabled on connected project
Link only available between objects on then connected project

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Quality Functions

▶ Convex quality function:



▶ Decreasing quality function:



▶ Increasing quality function:



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Functional Operation

- ▶ QA Team (defines the reference Quality policies)
 - ▶ Defines a set of quality functions for every metric
 - ▶ Defines the quality ranges (values) for every metric
 - ▶ Defines the default assignments of active metrics to engineer profiles

- ▶ Project Managers
 - ▶ Define the particular assignments of active metrics for particular projects
 - ▶ Define their own quality results to measure (graphs)

- ▶ Business Analyst
 - ▶ For every requirement and every metric, a numerical value is generated
 - ▶ Using a set of quality functions, every metric is qualified as: high, medium and low quality
 - ▶ An aggregated quality value is generated for every requirement

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User's Roles

RQA supports a multi-role functional operation within a software/systems intensive organization

Quality Assurance



Improve or verify quality within the organization

Quality policy

Quality evolution: thresholds

Process improvement: training, support

Project Manager



Improve project performances

Quality Cost Delays goals

Best practices fulfilling

Identify gaps: quality evolution vs teams

Process improvement: training, support

System Engineer



Improve work efficiency

Requirements Quality

Identify critical issues: bad formulations, ambiguous terms inconsistencies

Process improvement: self training

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Use Cases

RQA supports a multi-role functional operation within a software/systems intensive organization

Quality Assurance



I need to state my quality policy regarding requirements specifications
I want to settle thresholds to measure the quality evolution
I need to know how quality is evolving in my organization
Which quality aspects should we enforce by organizational training

Project Manager



The quality of my projects meets my expectations?
Are we fulfilling our best practices?
How is project quality evolving over the time?
Who is performing better/worst in my team?
Where should I focus team training?
Are project/team requirements consistent among them?

System Engineer



The quality of my requirements meets my expectations?
What requirements should be reviewed?
What features of the requirements should I review?
What terms should be avoided?
What are the most frequent mistakes in my requirements?
Where to start with in a peer-review?

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Quality assurance role



Quality Assurance

DOORS Quality Analyzer [36677@localhost - Project (Administrator)]

DOORS Quality Analyzer

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Objects: User Requirements

Selected module: User Requirements

Users statistics

User	High quality	High quality percent	Medium quality	Medium quality percent	Low quality	Low quality percent	N/A
JM	0	0,00 %	1	100,00 %	0	0,00 %	0
Fran	0	0,00 %	0	0,00 %	1	100,00 %	0
Administrator	2	25,00 %	1	12,50 %	5	62,50 %	0

Metric	High quality	Medium quality	Low quality	N/A	Max.	Min.	Average
Absolute Ambiguity	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Conditio...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Design ...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Domain ...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	1,00	1,00	1,00
Absolute Domain ...	0 (0,00 %)	0 (0,00 %)	1 (100,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Flow Se...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Imperative	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	1,00	1,00	1,00
Absolute Incompl...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Negativ...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Absolute Speculat...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Acronyms	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Connectors	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Dependencies	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Implicity	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	0,00	0,00	0,00
Nested levels	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	1,00	1,00	1,00
Number of chars ...	1 (100,00 %)	0 (0,00 %)	0 (0,00 %)	0 (0,00 %)	39,00	39,00	39,00

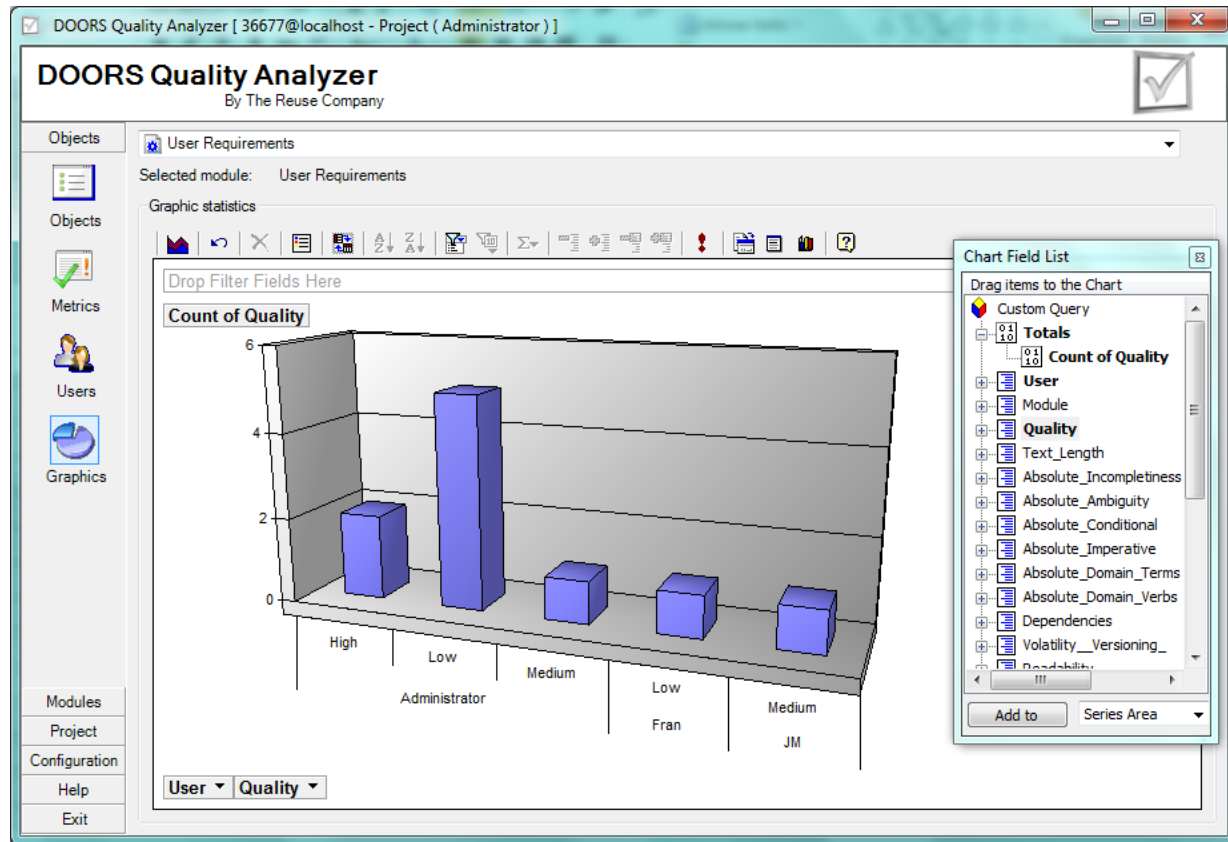
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Project manager role



Project Manager



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Business analyst role

Object quality assessment

DOORS Quality Analyzer

By The Reuse Company

Original quality assessment: Could be improved Original quality date: 22/01/2011 20:17:53

New quality assessment: Should be revised New quality date: 22/01/2011 20:50:12

Object data Metrics Textual metrics Quality forums

Metric	Value	Quality	Recomendation	Affects overall quality
<input checked="" type="checkbox"/> Text Length	10	Must be revised	Text length is too low	<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Incompleteness	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Ambiguity	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Conditional	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Imperative	1	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Domain Terms	3	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Domain Verbs	2	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Dependencies	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Volatility (Versioning)	6	Must be revised	The requirement is too much volatile	<input type="checkbox"/>
<input checked="" type="checkbox"/> Readability	11	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Design Sentences	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Flow Sentences	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Absolute Speculative Sentences	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Acronyms	0	OK		<input type="checkbox"/>
<input checked="" type="checkbox"/> Paragraphs	2	OK		<input type="checkbox"/>

Help < Previous Next > Save in DOORS Close



Business Analyst



Quality improvement process: PDCA

- ▶ Valid and invalid thresholds can be established in a flexible way:
 - ▶ According to the company's culture and way of working
 - ▶ Different threshold for every set of requirements:
 - ▶ Project / block / module

- ▶ Some metrics can be disabled if needed

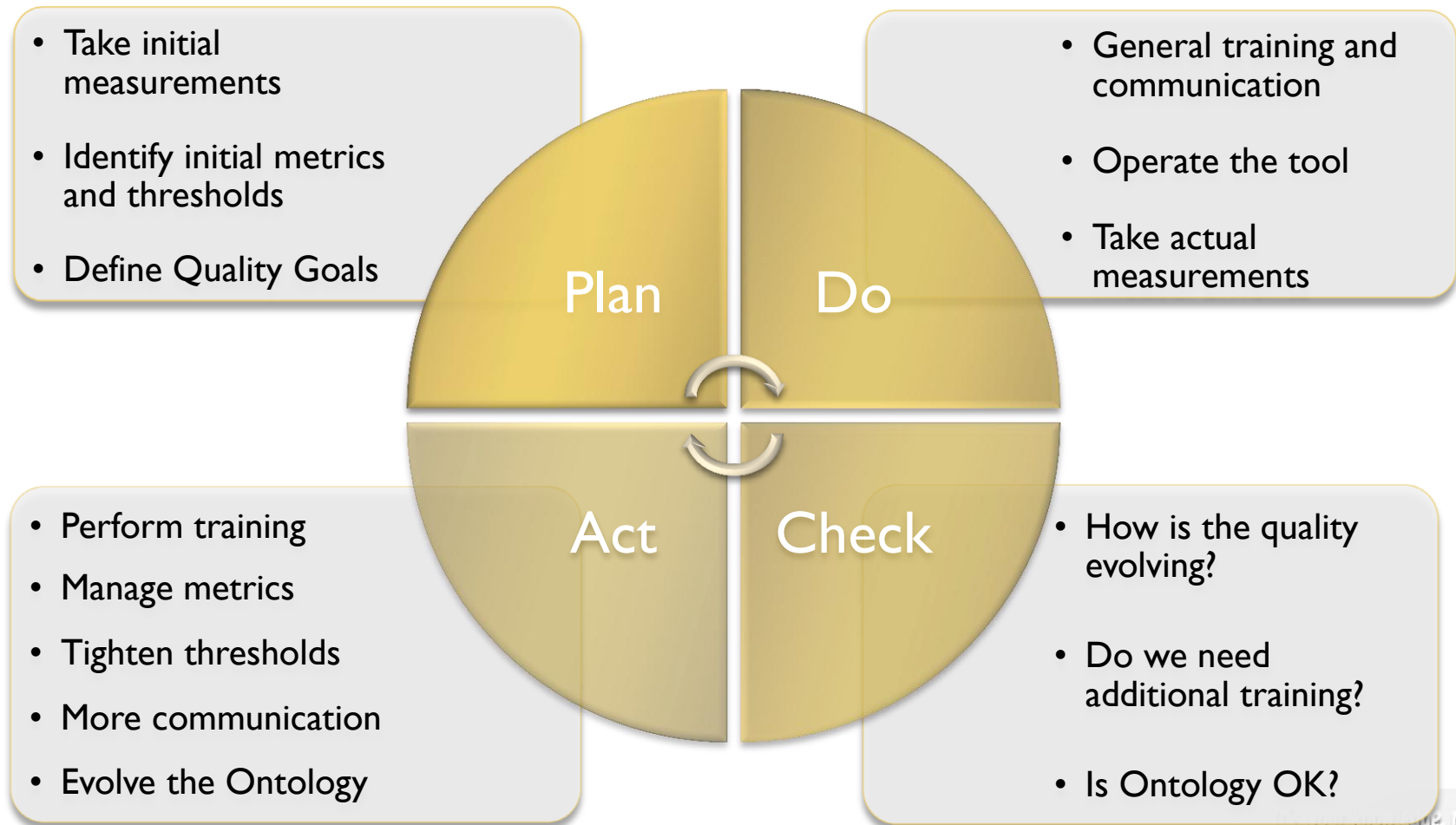
- ▶ As we flow around the improvement cycle, the maturity level is improving

- ▶ How to implement an improvement cycle:

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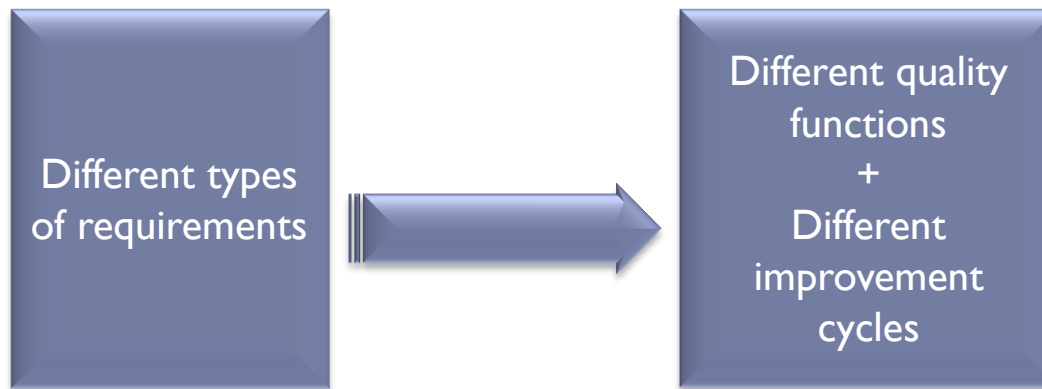


Quality improvement process: PDCA





Quality improvement process

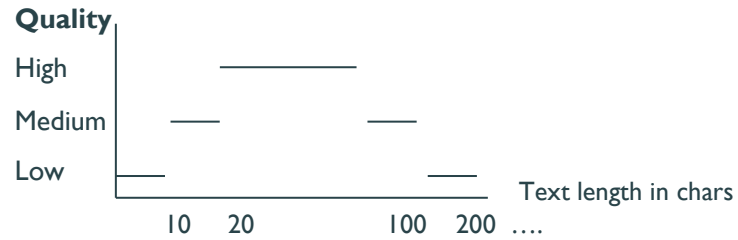
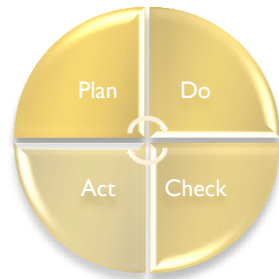


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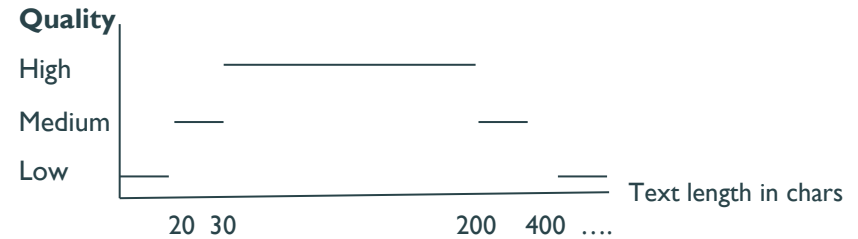
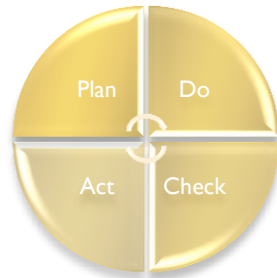


Quality improvement process

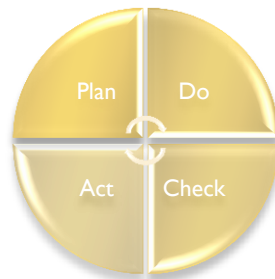
User requirement



System requirements



Component requirements

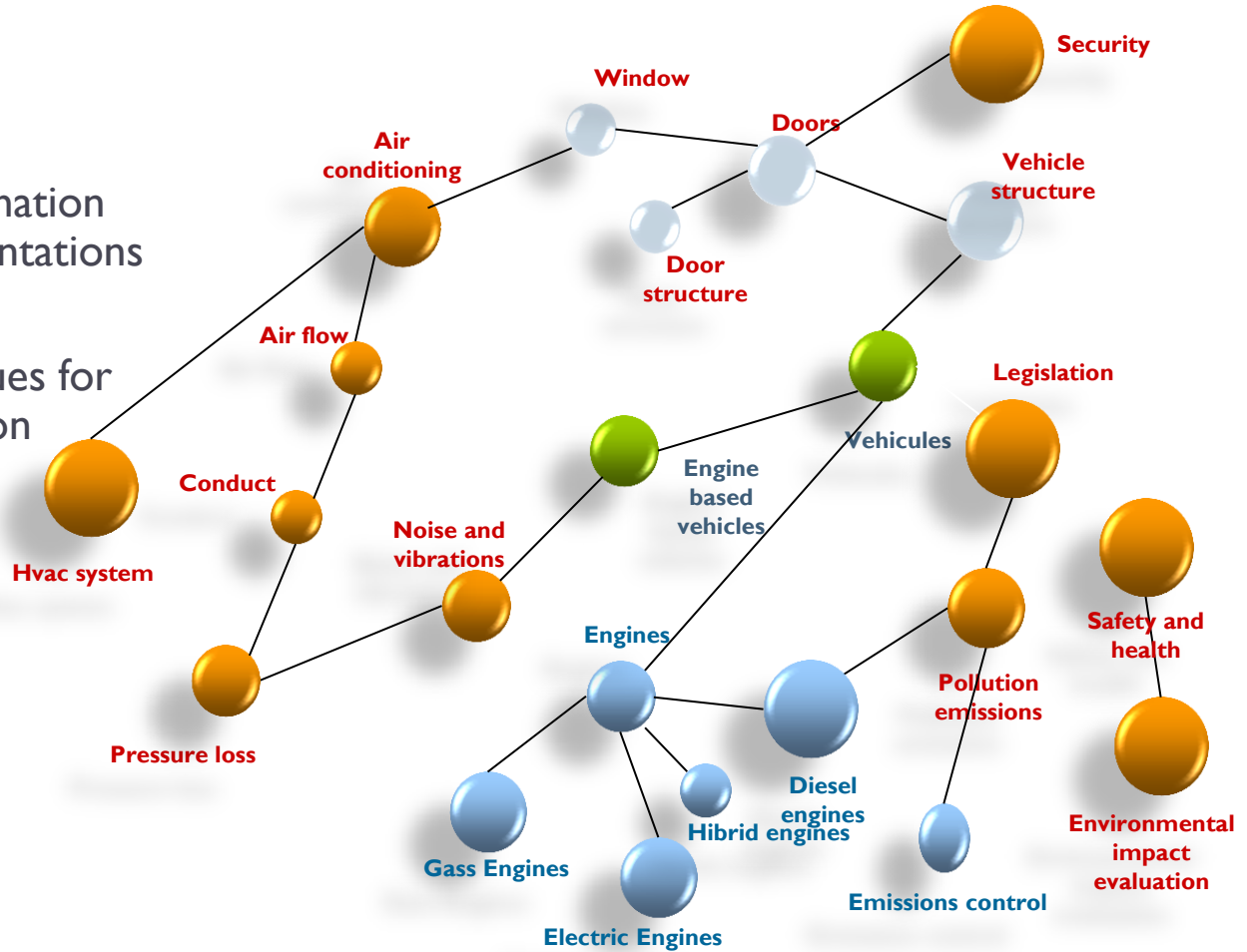




RQA Semantics

RQA makes use of:

- Requirements transformation towards formal representations
- Ontologies
- High level NLP techniques for enhancing transformation



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Requirements formal representation

► Semantic graphs: an example

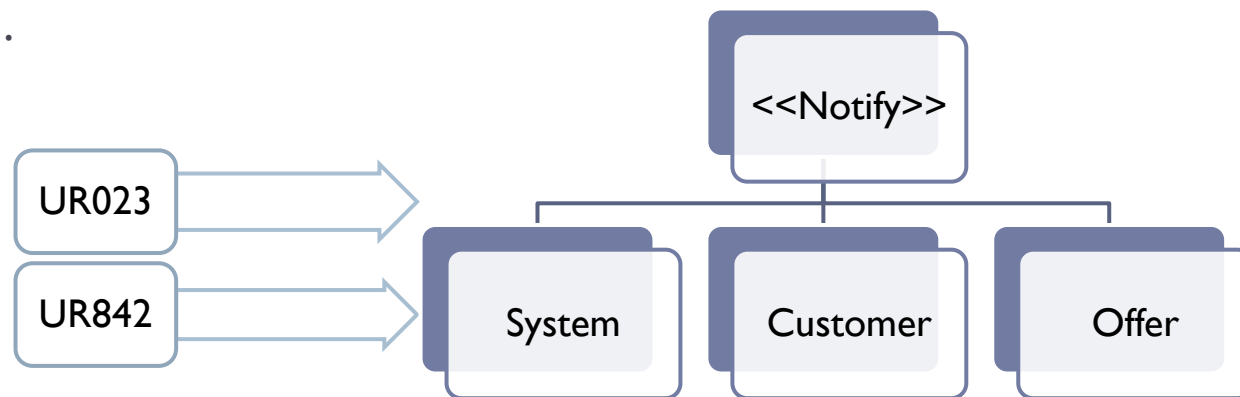
UR001:

UR023: The system shall send weekly notifications to the customers including our offers

URxxx: ...

UR842: The application shall be able to notify periodically all of our offers to our clients

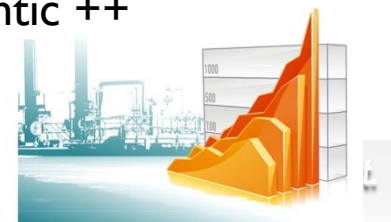
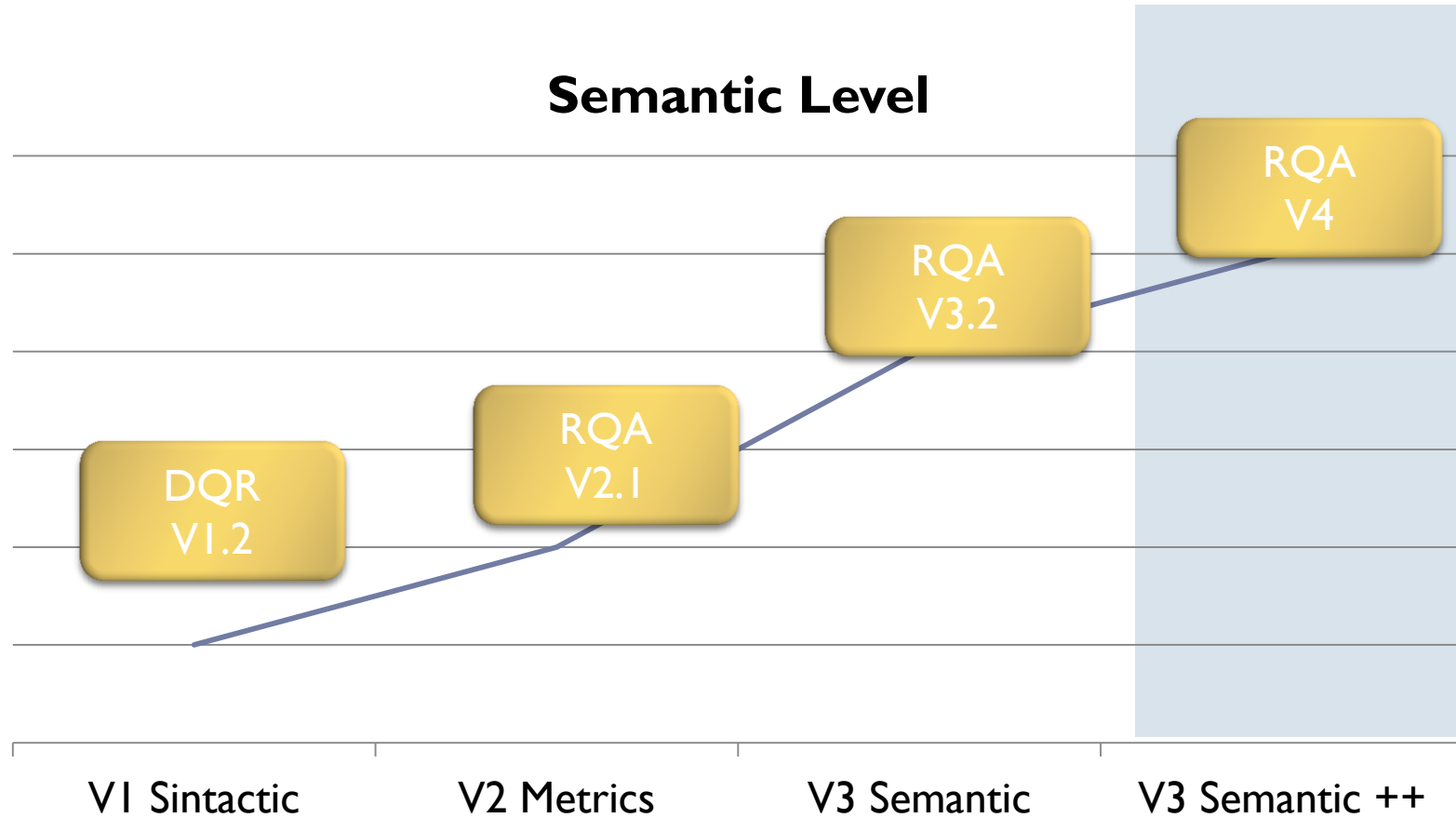
UR999: ...



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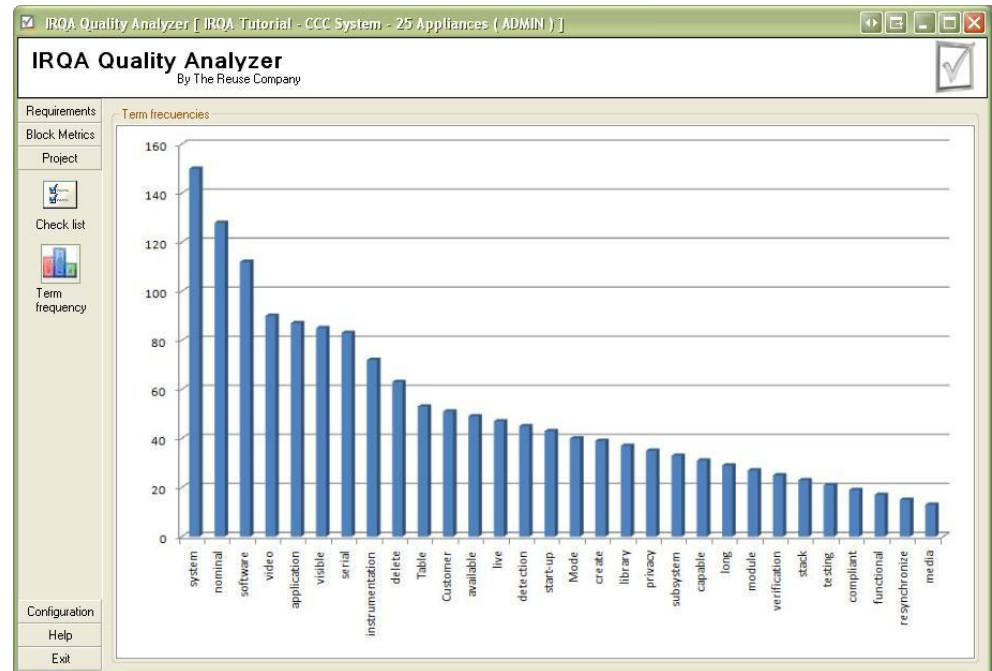
The near future of RQA





The near future of RQA

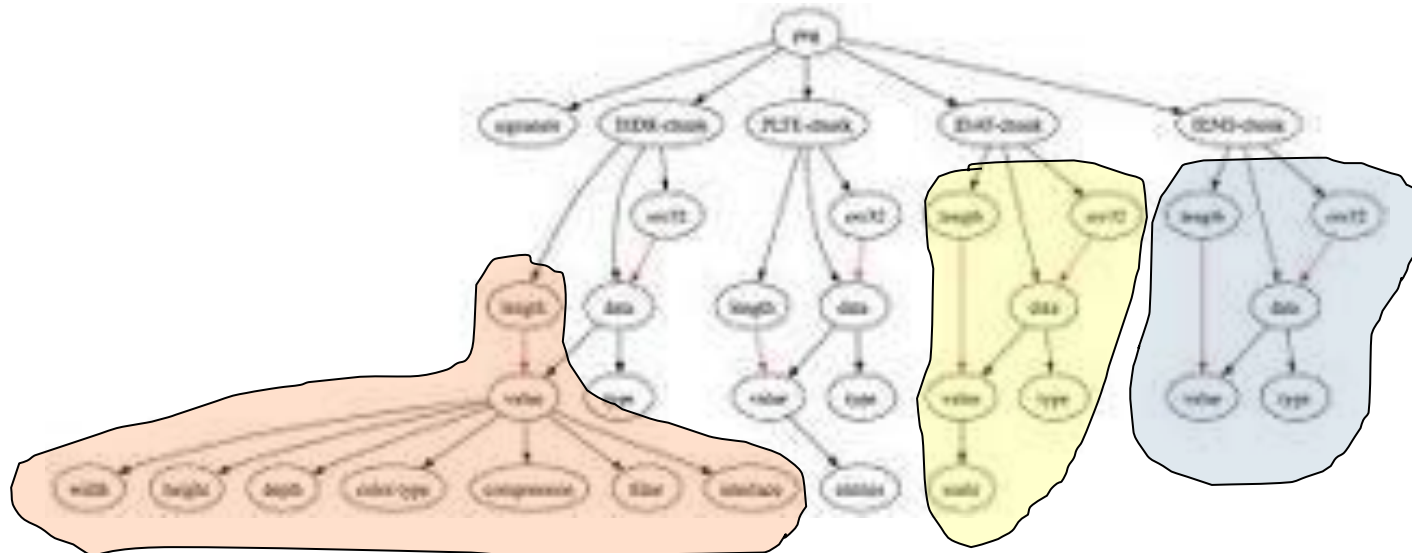
- ▶ Most frequent concepts and actions:
 - ▶ The list of most frequent terms arises the conceptual model out of the requirements specification
 - ▶ Counting occurrences by the same term regardless singular-plural, masculine-feminine...
 - ▶ Using synonyms due to the fact that different terms could have the same meaning (concept)
- ▶ Harvesting of actors, classes, use cases,..





The near future of RQA

- ▶ Domain Coverage Degree / Non explicit domain terms:
 - ▶ Those terms that appear in our domain, but not in our specification
 - ▶ % of specification terms covered by the domain model family
 - ▶ Are we missing something in our specification?

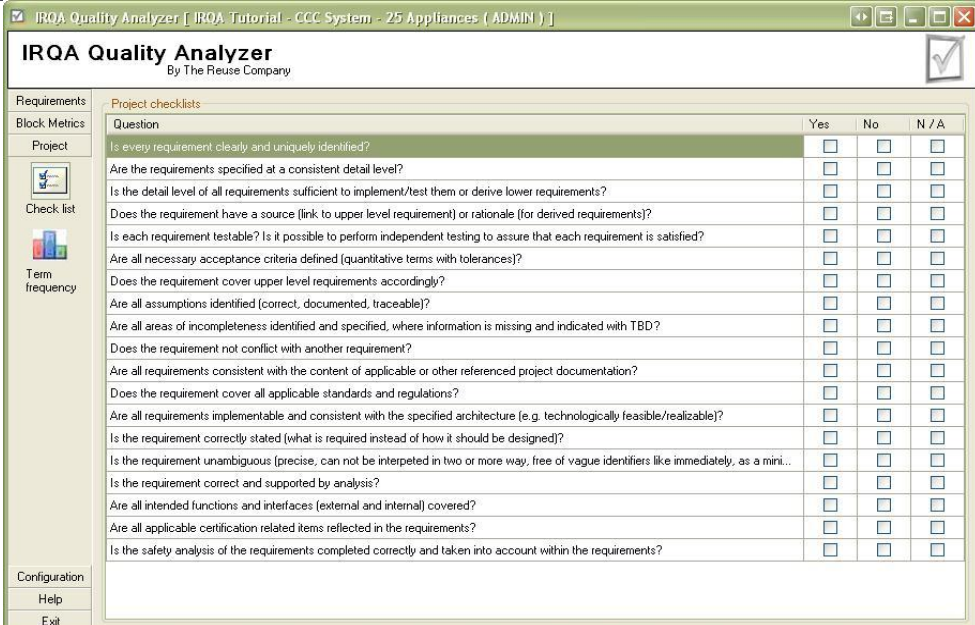


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The near future of RQA

- ▶ Global checklists will soon be shared among projects
 - ▶ Customized checklists
 - ▶ Created by the QA // Assigned to every project by PM // Filled by any Analysts
 - ▶ Including some actions that must be done or checked
 - ▶ Including different kinds of requirements or relationships (sometimes forgotten)



IRQA Quality Analyzer
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Requirements: Project checklists

Question	Yes	No	N / A
Is every requirement clearly and uniquely identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are the requirements specified at a consistent detail level?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the detail level of all requirements sufficient to implement/test them or derive lower requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the requirement have a source (link to upper level requirement) or rationale (for derived requirements)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is each requirement testable? Is it possible to perform independent testing to assure that each requirement is satisfied?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all necessary acceptance criteria defined (quantitative terms with tolerances)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the requirement cover upper level requirements accordingly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all assumptions identified (correct, documented, traceable)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all areas of incompleteness identified and specified, where information is missing and indicated with TBD?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the requirement not conflict with another requirement?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all requirements consistent with the content of applicable or other referenced project documentation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the requirement cover all applicable standards and regulations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all requirements implementable and consistent with the specified architecture (e.g. technologically feasible/realizable)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the requirement correctly stated (what is required instead of how it should be designed)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the requirement unambiguous (precise, can not be interpreted in two or more way, free of vague identifiers like immediately, as a mini...)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the requirement correct and supported by analysis?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all intended functions and interfaces (external and internal) covered?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all applicable certification related items reflected in the requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the safety analysis of the requirements completed correctly and taken into account within the requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Configuration
Help
Exit



The near future of RQA

- ▶ Ambiguity Suggestion system
 - ▶ Several valid expressions are suggested once an ambiguous term is detected

- ▶ Requirements Hierarchy shape:
 - ▶ How does parent-child relationship appear in the document?

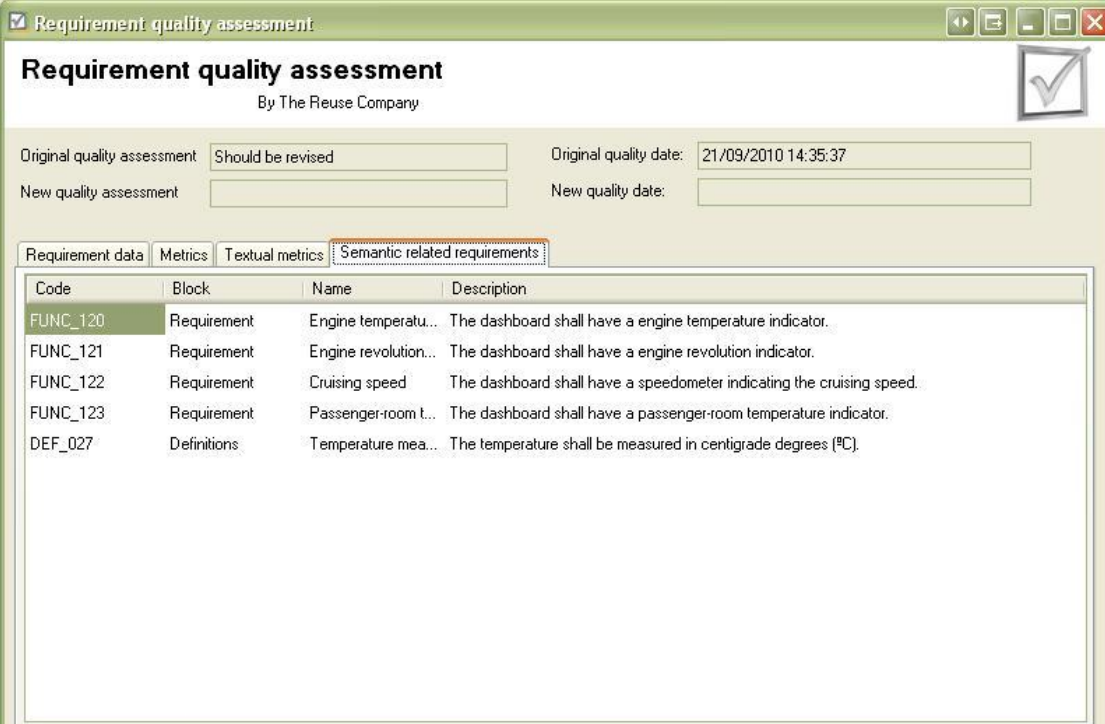
- ▶ Requirements editor:
 - ▶ Based on standard grammars
 - ▶ Based on some common actions
 - ▶ Based on your own domain terms
 - ▶ Fully customizable

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The near future of RQA

- ▶ Semantically related requirements
 - ▶ Semantically related requirements given a particular one



Requirement quality assessment
By The Reuse Company

Original quality assessment: Original quality date:

New quality assessment: New quality date:

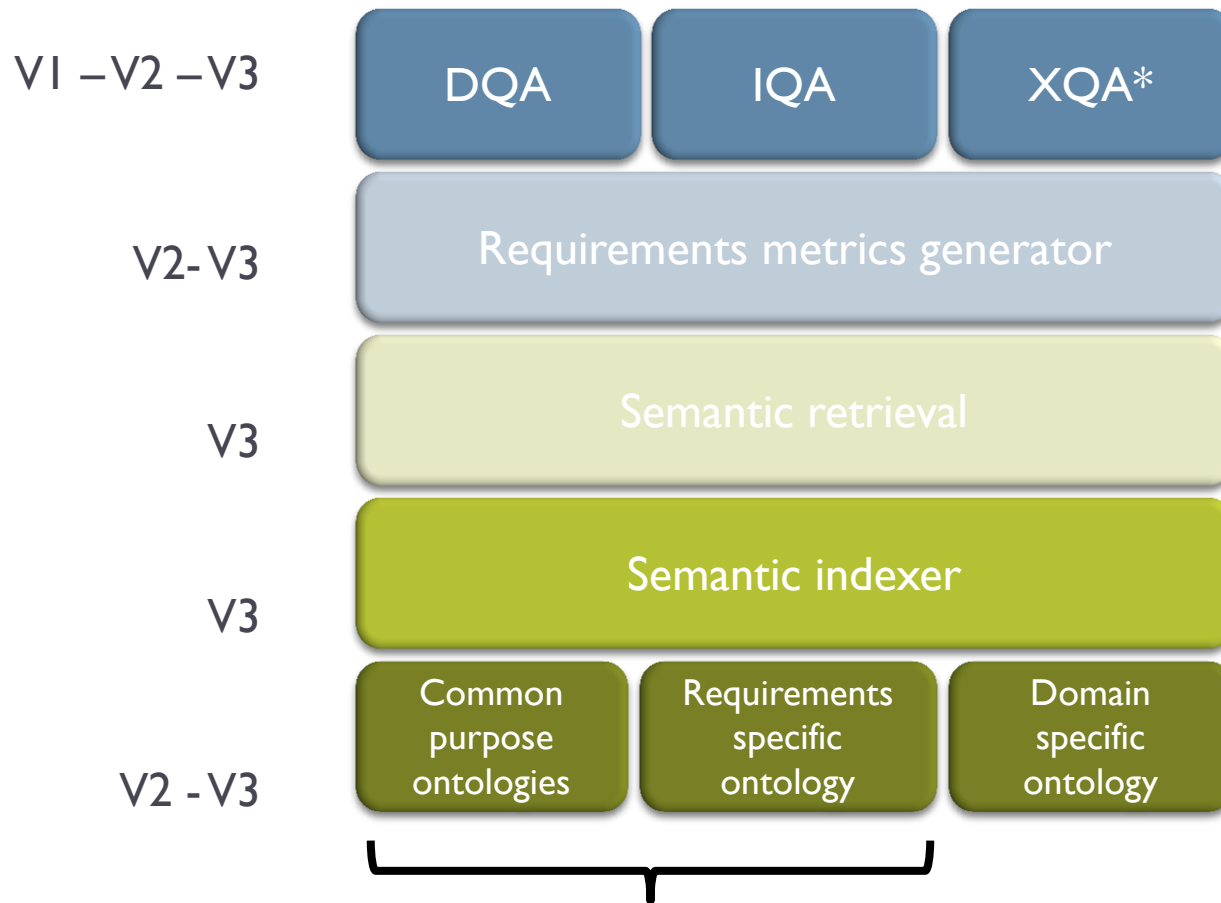
Requirement data | Metrics | Textual metrics | **Semantic related requirements**

Code	Block	Name	Description
FUNC_120	Requirement	Engine temperatu...	The dashboard shall have a engine temperature indicator.
FUNC_121	Requirement	Engine revolution...	The dashboard shall have a engine revolution indicator.
FUNC_122	Requirement	Cruising speed	The dashboard shall have a speedometer indicating the cruising speed.
FUNC_123	Requirement	Passenger-room t...	The dashboard shall have a passenger-room temperature indicator.
DEF_027	Definitions	Temperature mea...	The temperature shall be measured in centigrade degrees (°C).

Buttons: Help, Save, Close



Architecture and Software Environment



IN-Built Conceptual Domain Model

It's your knowledge, reuse it.



RQA operating architecture

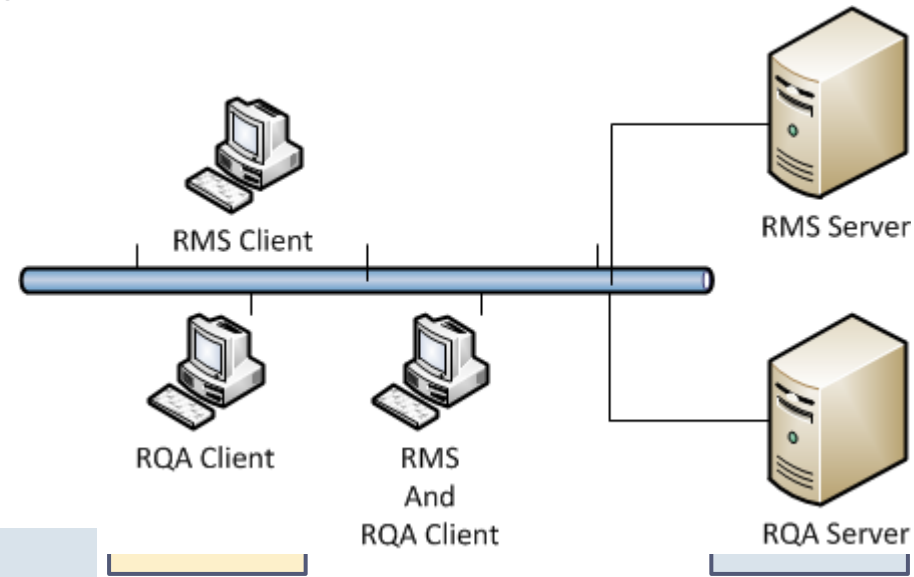
Project based operating environment

Client:

- ▶ Windows XP, Vistas or Windows 7
- ▶ .Net Framework 3.5 sp.1

Server:

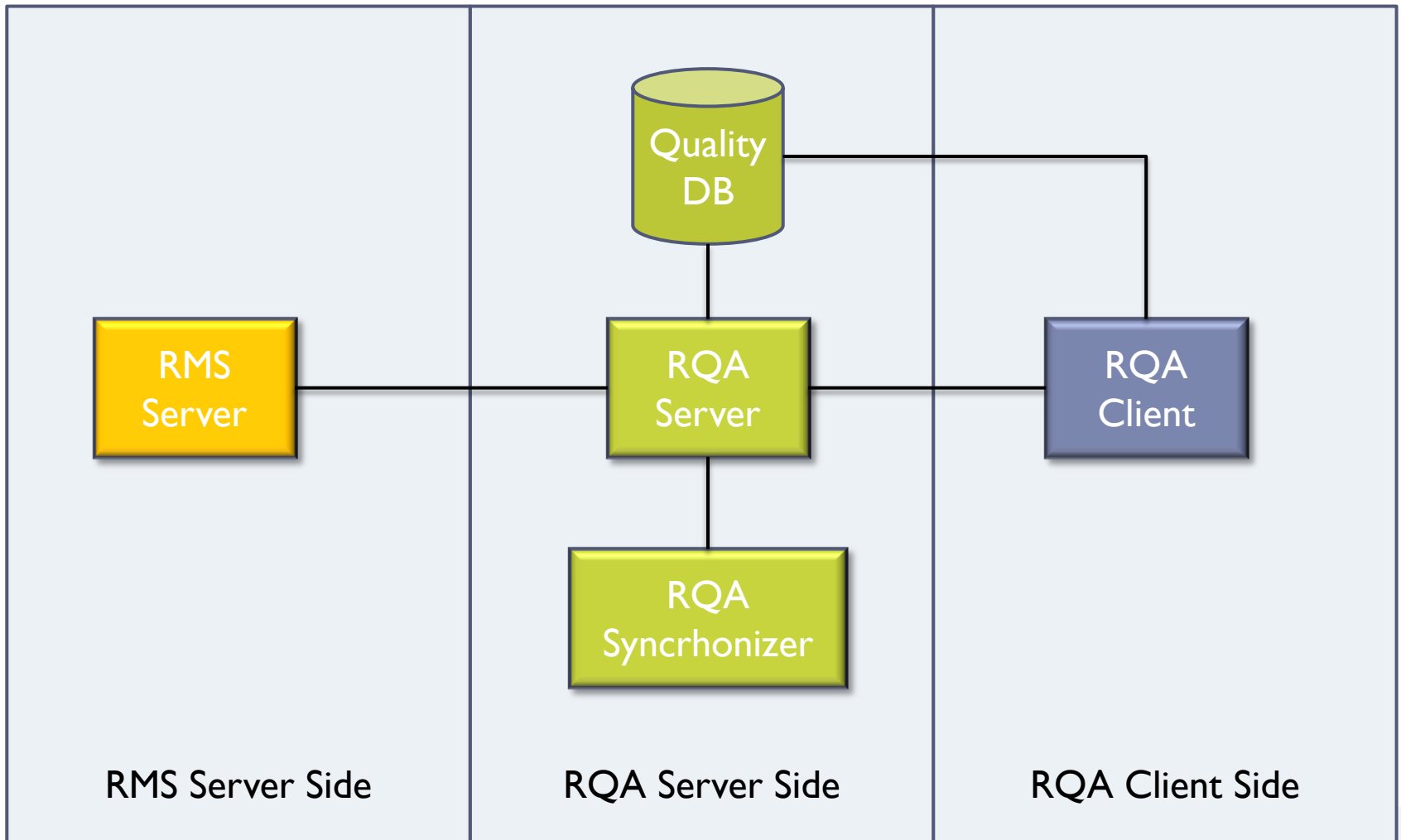
- ▶ Windows 2003 Server or 2008 Server
- ▶ .Net Framework 3.5 sp1
- ▶ SQLServer 2005, SQLServer 2008 or MS Access



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RQA Architecture and Software Environment





What RMS does RQA support



DOORS



DQA Product



IRQA

IQA Product



**MICROSOFT EXCEL
(2Q2011)**

XQA Product

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Requirements Quality Analyzer

- ▶ Further information about Requirements Quality Analyzer:
 - ▶ contact@reusecompany.com
 - ▶ <http://www.reusecompany.com>



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