Oscar Slotosch, Validas AG

Enabling Development of Qualifiable Eclipse-based Tools: Vision and Concept

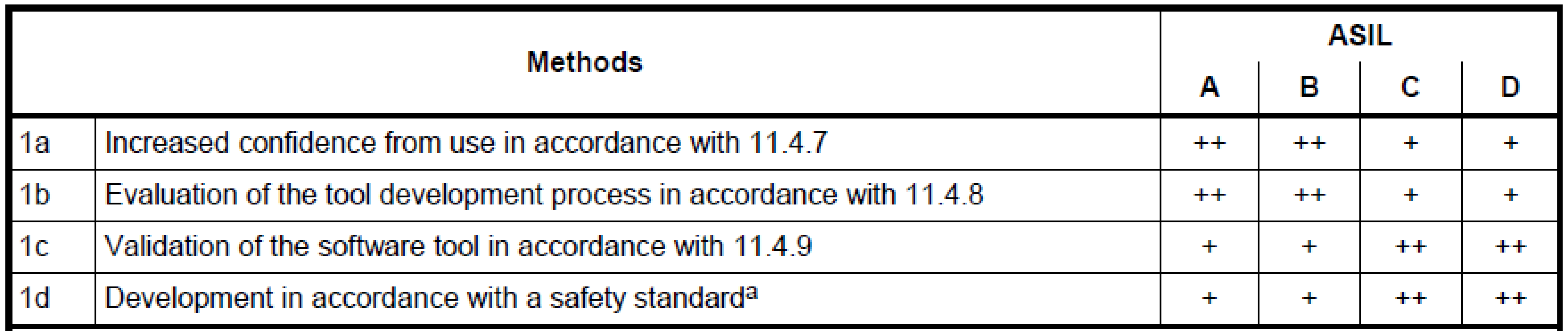
Content

- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model-based Tool Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

Tool Qualification (Summary)

- **Standards require tool qualification: ISO 26262, IEC 61508, DO, EN 50128**
- **Qualification process:**
  - Classify all used tools (Impact, Use-Cases, Artifacts)
  - Qualify critical tools
  - Use tools
- **Qualification Methods ISO 26262**

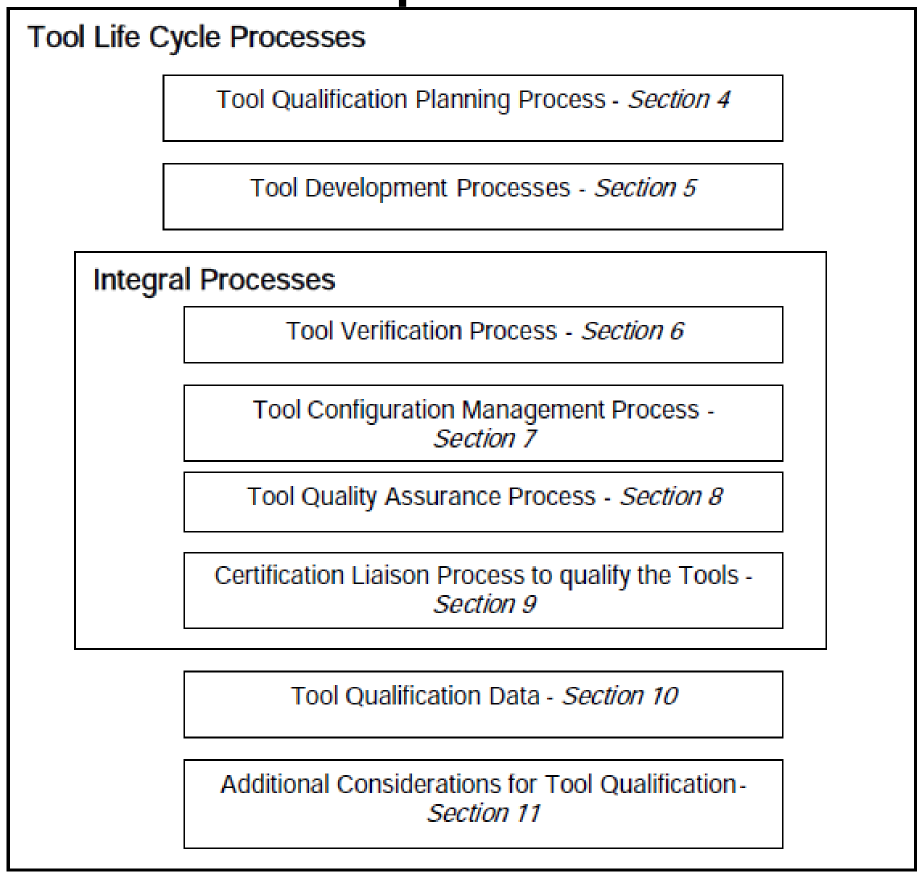
Table 4 — Qualification of software tools classified TCL3



Methods		ASIL A	ASIL B	ASIL C	ASIL D
1a	Increased confidence from use in accordance with 11.4.7	++	++	+	+
1b	Evaluation of the tool development process in accordance with 11.4.8	++	++	+	+
1c	Validation of the software tool in accordance with 11.4.9	+	+	++	++
1d	Development in accordance with a safety standard[a]	+	+	++	++

- **Qualification Method DO-330 Development in accordance with a safety standard:**
  - Processes Requirements
  - Required Documents
  - Required Verification
  - Required Qualification Process
  - …

DO-330 Required Processes

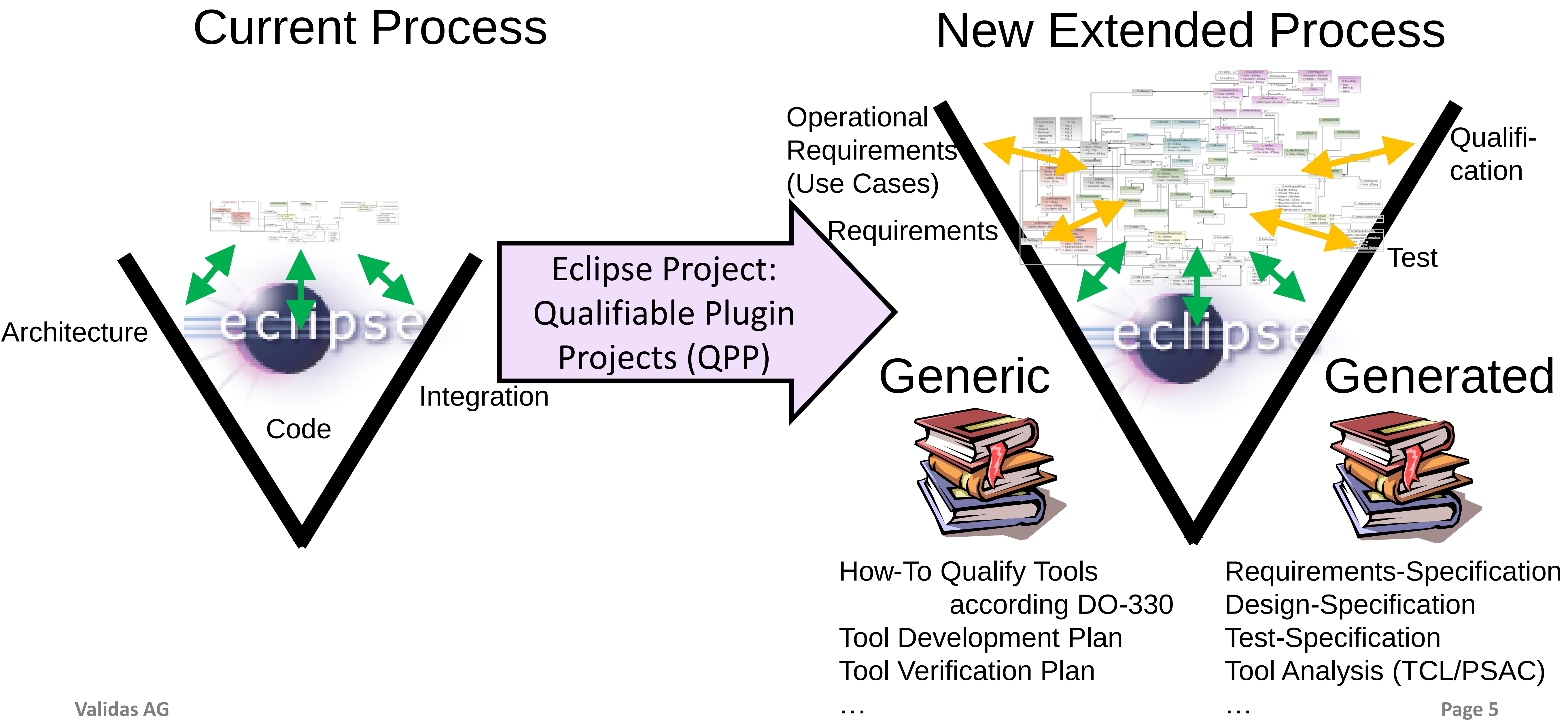

Tool Life Cycle Processes
Tool Qualification Planning Process - *Section 4*
Tool Development Processes - *Section 5*
Integral Processes
Tool Verification Process - *Section 6*
Tool Configuration Management Process - *Section 7*
Tool Quality Assurance Process - *Section 8*
Certification Liaison Process to qualify the Tools - *Section 9*
Tool Qualification Data - *Section 10*
Additional Considerations for Tool Qualification - *Section 11*

Content

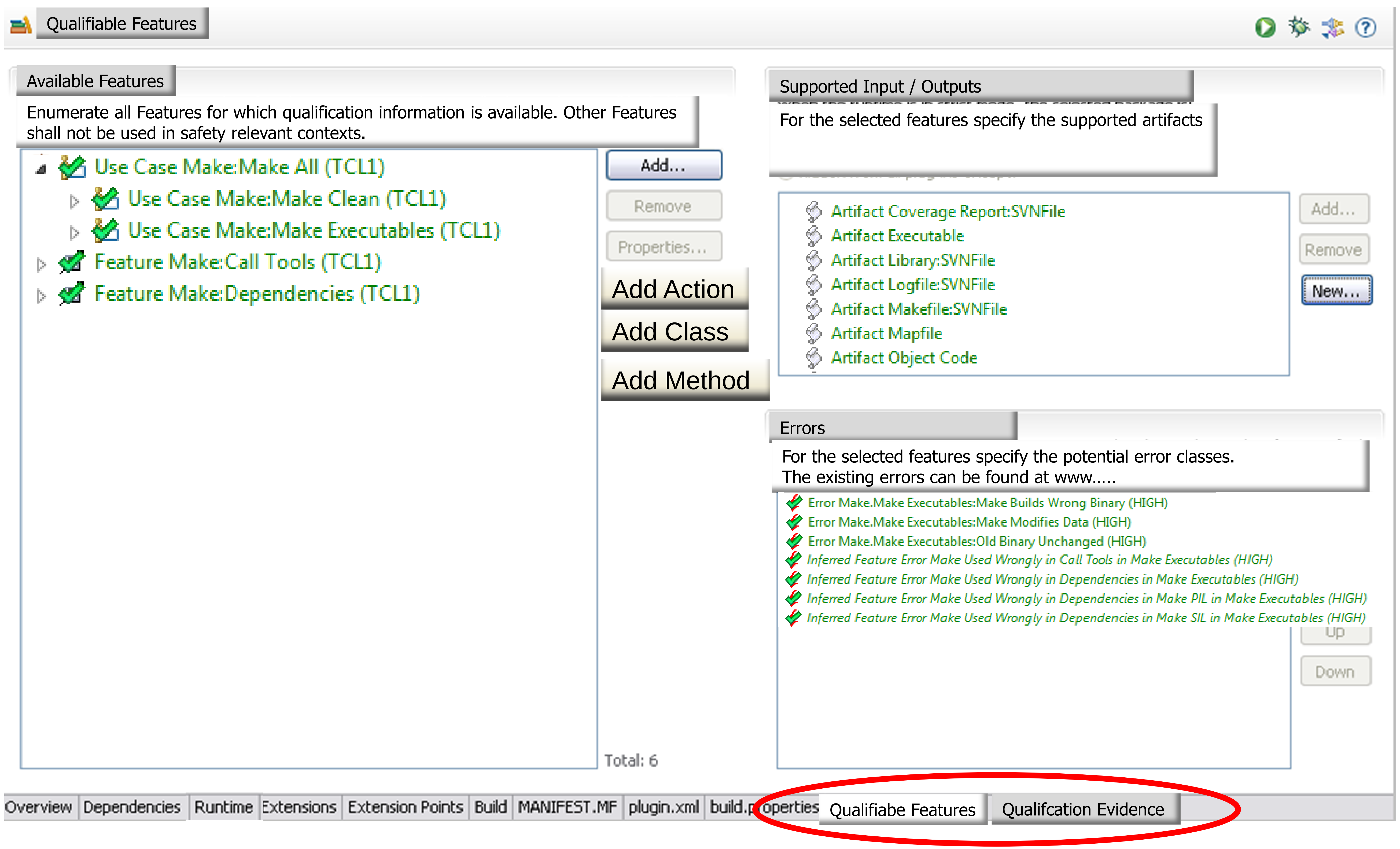
- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model-based Tool Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

Vision: Eclipse Development Process

- Currently Eclipse does not support qualification
- There is a road towards tool qualification for Eclipse, see http://wiki.eclipse.org/Auto_IWG_WP5
- DO-330 is a safety standard for tools



Vision: Eclipse Classification Data



Qualifiable Features

Available Features

Enumerate all Features for which qualification information is available. Other Features shall not be used in safety relevant contexts.

- Use Case Make:Make All (TCL1)
  - Use Case Make:Make Clean (TCL1)
  - Use Case Make:Make Executables (TCL1)
- Feature Make:Call Tools (TCL1)
- Feature Make:Dependencies (TCL1)

Add Action

Add Class

Add Method

Total: 6

Supported Input / Outputs

For the selected features specify the supported artifacts

- Artifact Coverage Report:SVNFile
- Artifact Executable
- Artifact Library:SVNFile
- Artifact Logfile:SVNFile
- Artifact Makefile:SVNFile
- Artifact Mapfile
- Artifact Object Code

Errors

For the selected features specify the potential error classes.
The existing errors can be found at www.....

- Error Make.Make Executables:Make Builds Wrong Binary (HIGH)
- Error Make.Make Executables:Make Modifies Data (HIGH)
- Error Make.Make Executables:Old Binary Unchanged (HIGH)
- *Inferred Feature Error Make Used Wrongly in Call Tools in Make Executables (HIGH)*
- *Inferred Feature Error Make Used Wrongly in Dependencies in Make Executables (HIGH)*
- *Inferred Feature Error Make Used Wrongly in Dependencies in Make PIL in Make Executables (HIGH)*
- *Inferred Feature Error Make Used Wrongly in Dependencies in Make SIL in Make Executables (HIGH)*

Proposed Role: Eclipse Validator

There is much (different) work to do such that we need a new kind of worker: The Validator

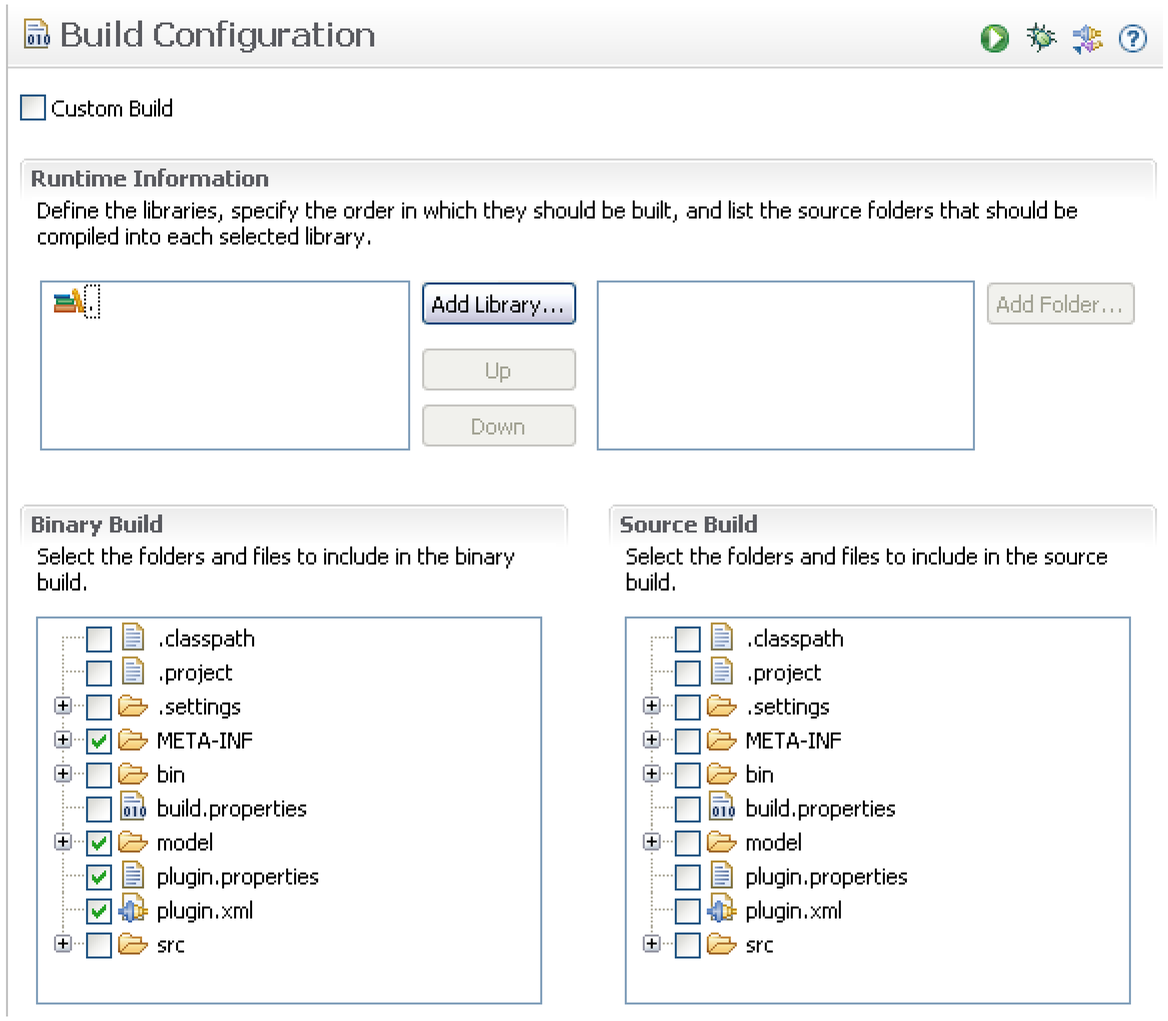
- **Should provide confidence**
- **Should be more formalized than a committer**
- **Should have qualifications e.g. by filling out questionnaires on**
  - Eclipse qualification process
  - DO-330
- **Should have responsibilities (answer to questions)**
- **Should earn “credits” for each successful validation action**
  - Executed reviews
  - Formulated requirements
  - Created use/test cases
  - Feedback
  - …
- **Comparable: Confidence in ebay:**

slotosch (25 ☆)

Positive Bewertungen (der letzten 12 Monate): 100%
[Wie wird der Prozentsatz positiver Bewertungen berechnet?]
Mitglied seit: 01.04.99 in Deutschland

3rd Build: Qualification Kit

- **Currently: 2 Builds available in Eclipse**
  - Source Build
  - Binary Build
- **Missing: Qualifiable Build Configuration with plugin specific**
  - Qualification information (TQL, DO-330 Model)
  - Test Cases / Coverage
  - Verification results
  - Documents
  - Involved Validators
  - …



Build Configuration

☐ Custom Build

Runtime Information

Define the libraries, specify the order in which they should be built, and list the source folders that should be compiled into each selected library.

Binary Build

Select the folders and files to include in the binary build.

- ☐ .classpath
- ☐ .project
- ☐ .settings
- ☑ META-INF
- ☐ bin
- ☐ build.properties
- ☑ model
- ☑ plugin.properties
- ☑ plugin.xml
- ☐ src

Source Build

Select the folders and files to include in the source build.

- ☐ .classpath
- ☐ .project
- ☐ .settings
- ☐ META-INF
- ☐ bin
- ☐ build.properties
- ☐ model
- ☐ plugin.properties
- ☐ plugin.xml
- ☐ src

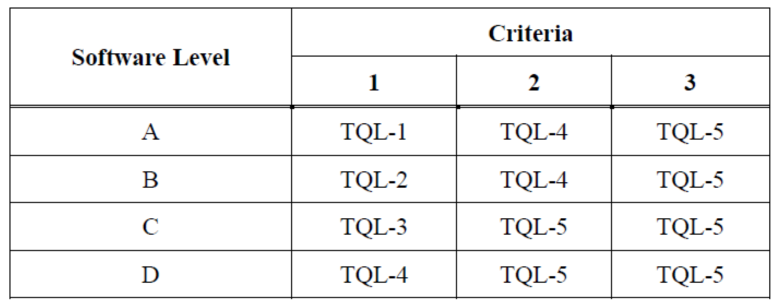
Content

- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model-based Tool Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

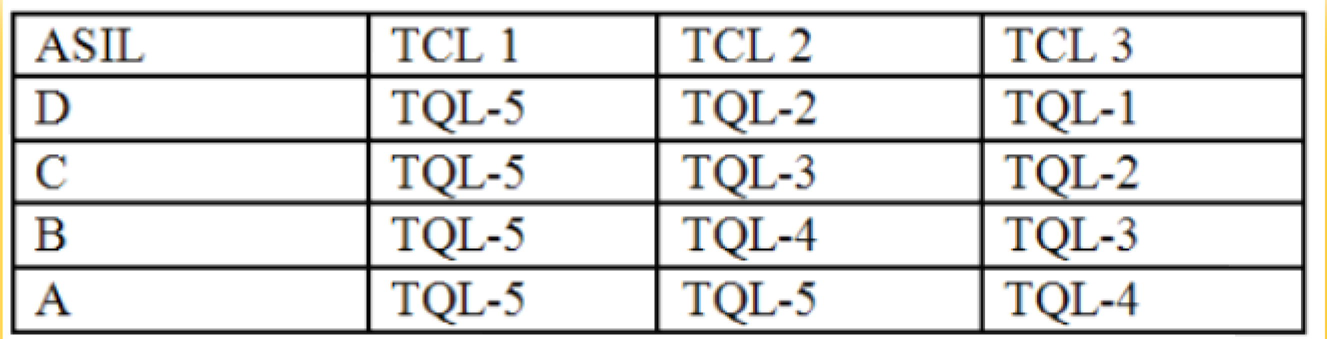
DO-330: Software Tool Qualification Considerations

- Is a safety standard applicable to all domains
- Has Tool Qualification Levels (TQL)s: TQL-1 (High), TQL-5 (Low)
- TQL-Level has to be defined from domain standards

Table 12-1 Tool Qualification Level Determination



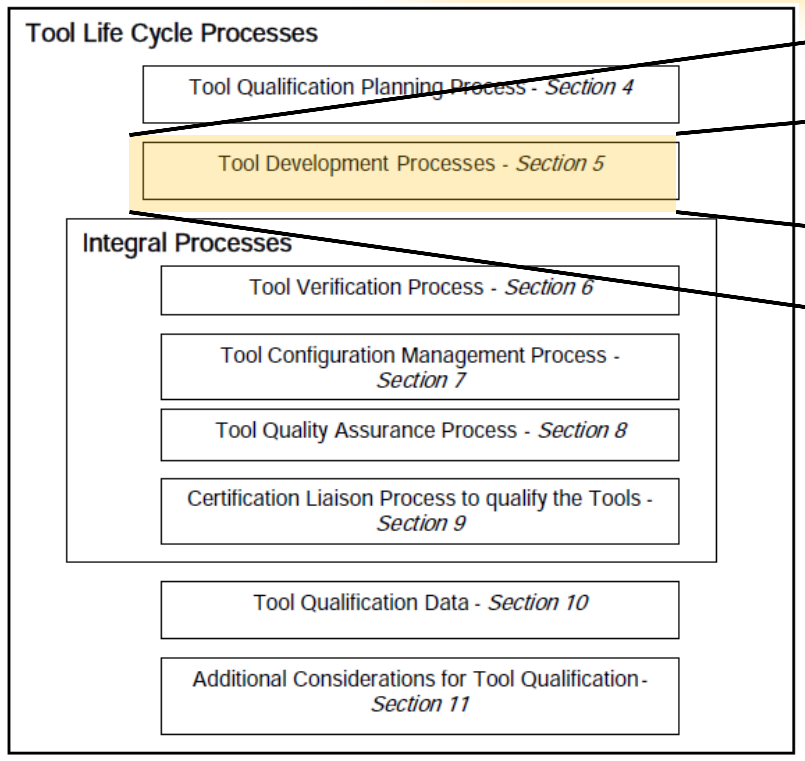
Software Level	Criteria		
	1	2	3
A	TQL-1	TQL-4	TQL-5
B	TQL-2	TQL-4	TQL-5
C	TQL-3	TQL-5	TQL-5
D	TQL-4	TQL-5	TQL-5



ASIL	TCL 1	TCL 2	TCL 3
D	TQL-5	TQL-2	TQL-1
C	TQL-5	TQL-3	TQL-2
B	TQL-5	TQL-4	TQL-3
A	TQL-5	TQL-5	TQL-4

Table 3: Determination of Tool Qualification Levels for DO-330

- **Requires**
  - Processes,
  - Activities and
  - Documents


Tool Life Cycle Processes
Tool Qualification Planning Process - Section 4
Tool Development Processes - Section 5
Integral Processes
Tool Verification Process - Section 6
Tool Configuration Management Process - Section 7
Tool Quality Assurance Process - Section 8
Certification Liaison Process to qualify the Tools - Section 9
Tool Qualification Data - Section 10
Additional Considerations for Tool Qualification - Section 11

Tool Development Processes (5.2):
- Tool Requirement Process
- Tool Design Process
- Tool Coding Process
- Tool Integration Process

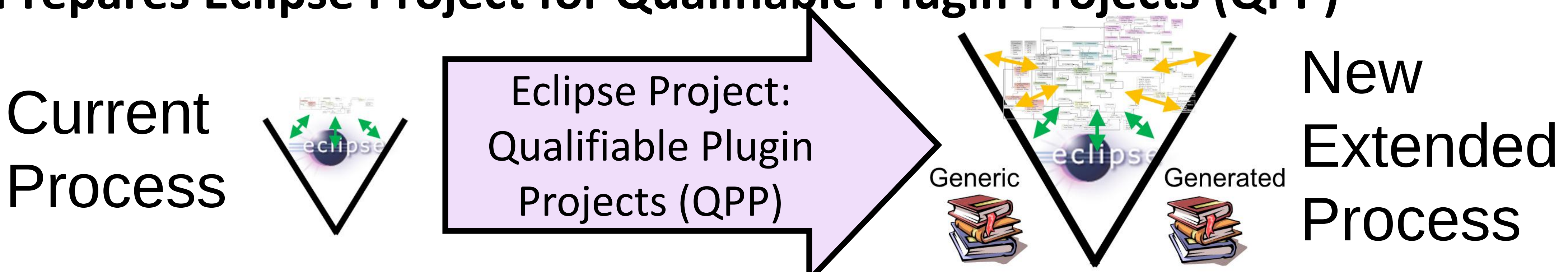
10.1.1: T f
Certifica
10.1.2: T
10.1.3: T
10.1.4: T
10.1.5: T
10.1.6: T
10.1.7: T
10.1.8: Tool Design Standards
10.1.9: Tool Code Standards
10.1.10: Tool Life Cycle Environment Configuration Index
10.1.11: Tool Configuration Index
10.1.12: Tool Problem Reports
10.1.13: Tool Configuration Management Records
10.1.14: Tool Quality Assurance Records
10.1.15: Tool Accomplishment Summary
10.1.16: Tool-Specific Information in Software Accomplishment Summary
10.1.17: Tool-Specific Information in Software Life Cycle Environment Configuration Index (SECI)
…

Content

- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model-based Tool Qualification
    - Roadmap Processes
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

Concept for Eclipse Project QPP

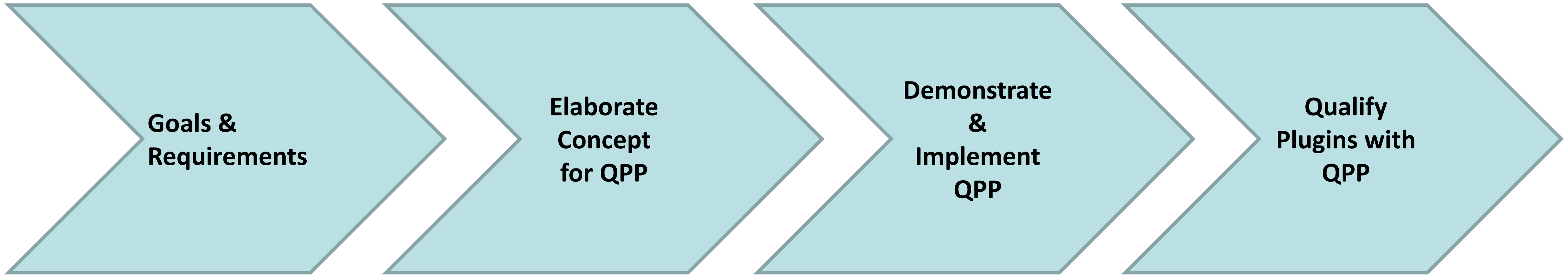
- **Prepares Eclipse Project for Qualifiable Plugin Projects (QPP)**



- **Uses a separate EMF-Model (DO-330-model) for prototyping**
- **Covers the complete DO-330 (bi-directional tracing)**
  - How-To-Qualify-Document (with DO-IDs)
  - Generic Documents
    - Tool Development Plan
    - Tool Verification Plan
    - …
- **Is developed within WP5: Tool Qualification in Automotive Industrial Working Group, see** http://wiki.eclipse.org/Auto_IWG_WP5
- **Roadmap:**
  - Goal: DO-330
  - Every two weeks: new steps (process for DO-330)
  - Presented and discussed in Telcos

Roadmap to the Concept/Project QPP

1. **Identify goals & requirements for tool qualification in Eclipse**
2. **Propose process / project (Concept)**
3. **Demonstrate & implement proposal**
4. **Establish proposal: Qualify (selected) plugins**

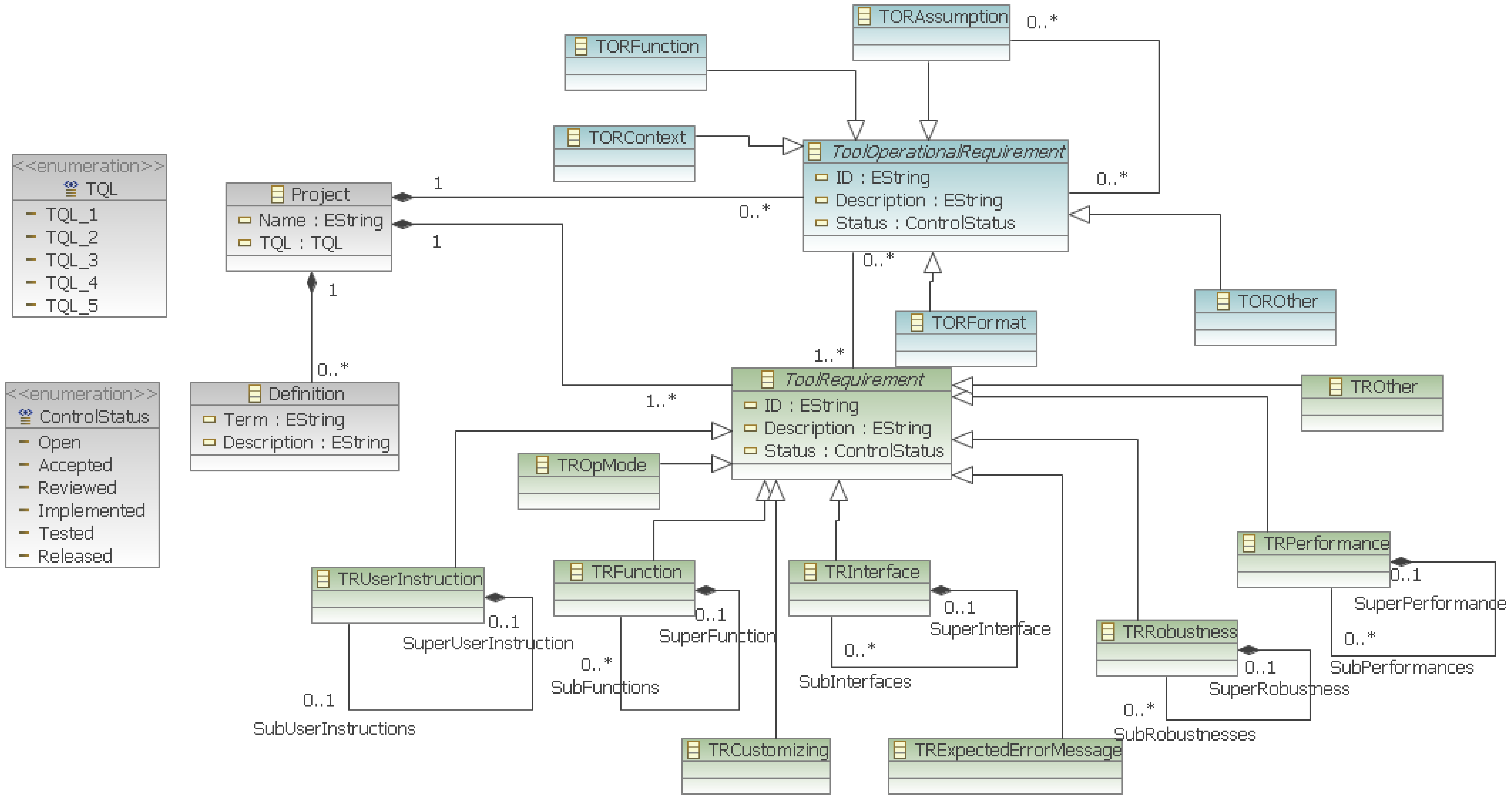


Content

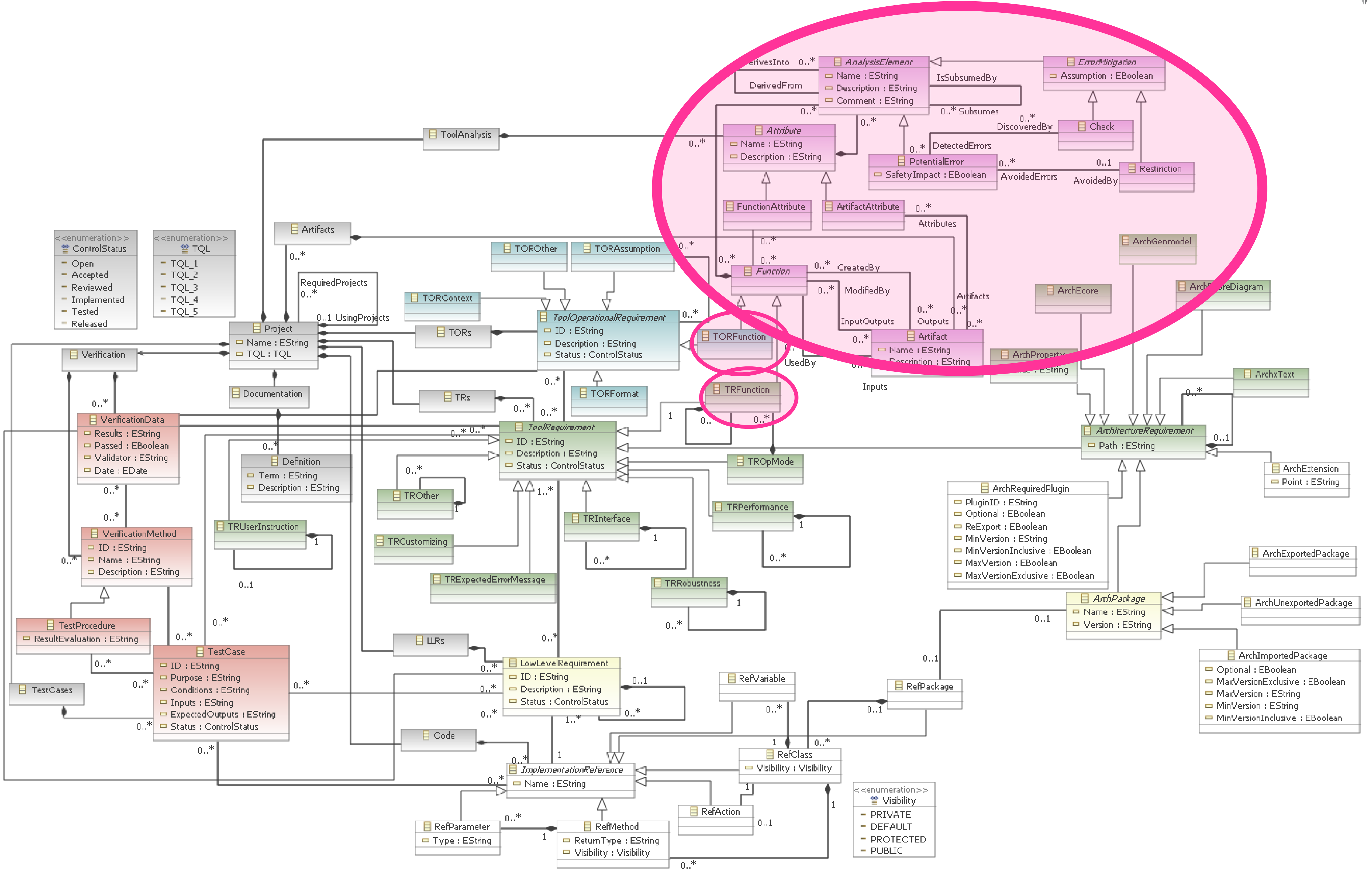
- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Eclipse Project: Qualifiable Plugin Projects (QPP)
  - Concept
    - Model Based Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

Model for Tool-Requirements

- **EMF-Metamodel for Tool Requirements**

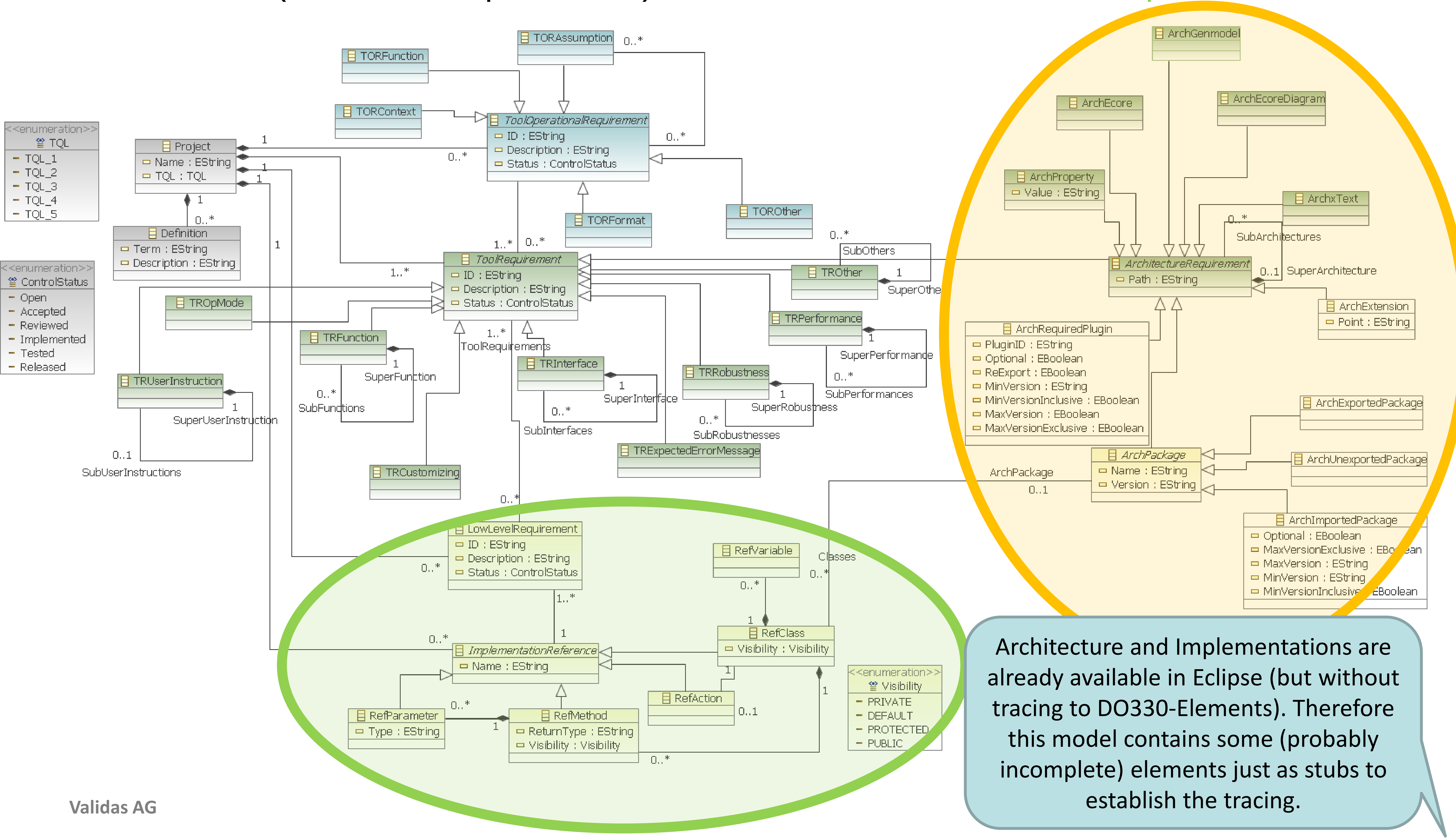


Planning: Analysis Model for PSAC



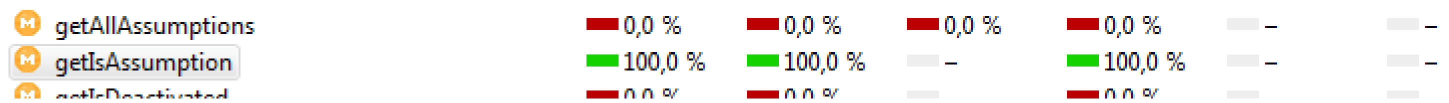
Design Model

The design model extends the requirements model by Architecture (also Tool Requirements) and LLRs with references to Implementation

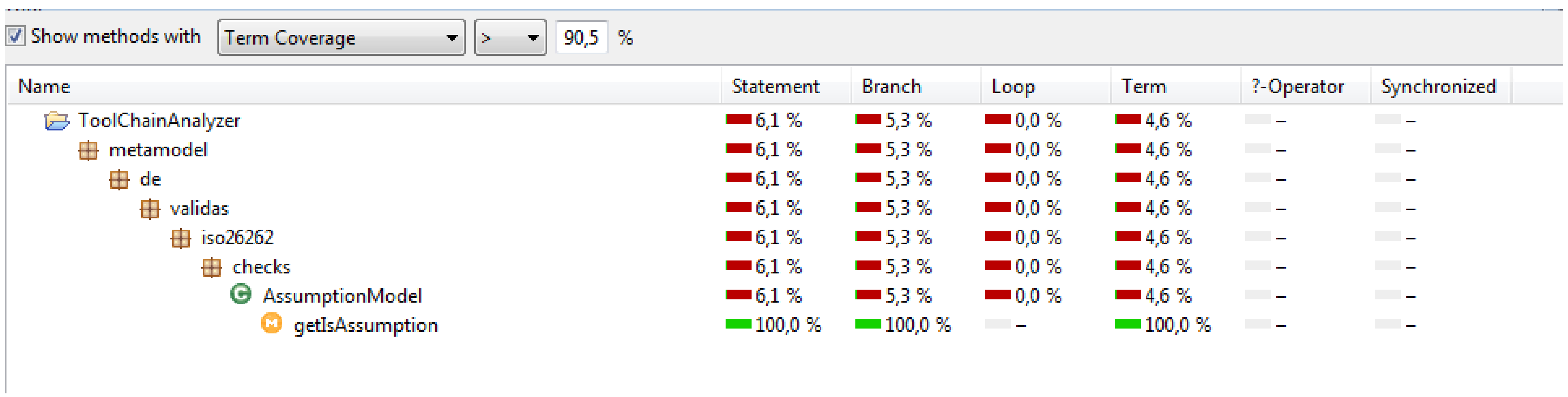


Architecture and Implementations are already available in Eclipse (but without tracing to DO330-Elements). Therefore this model contains some (probably incomplete) elements just as stubs to establish the tracing.

Test Coverage

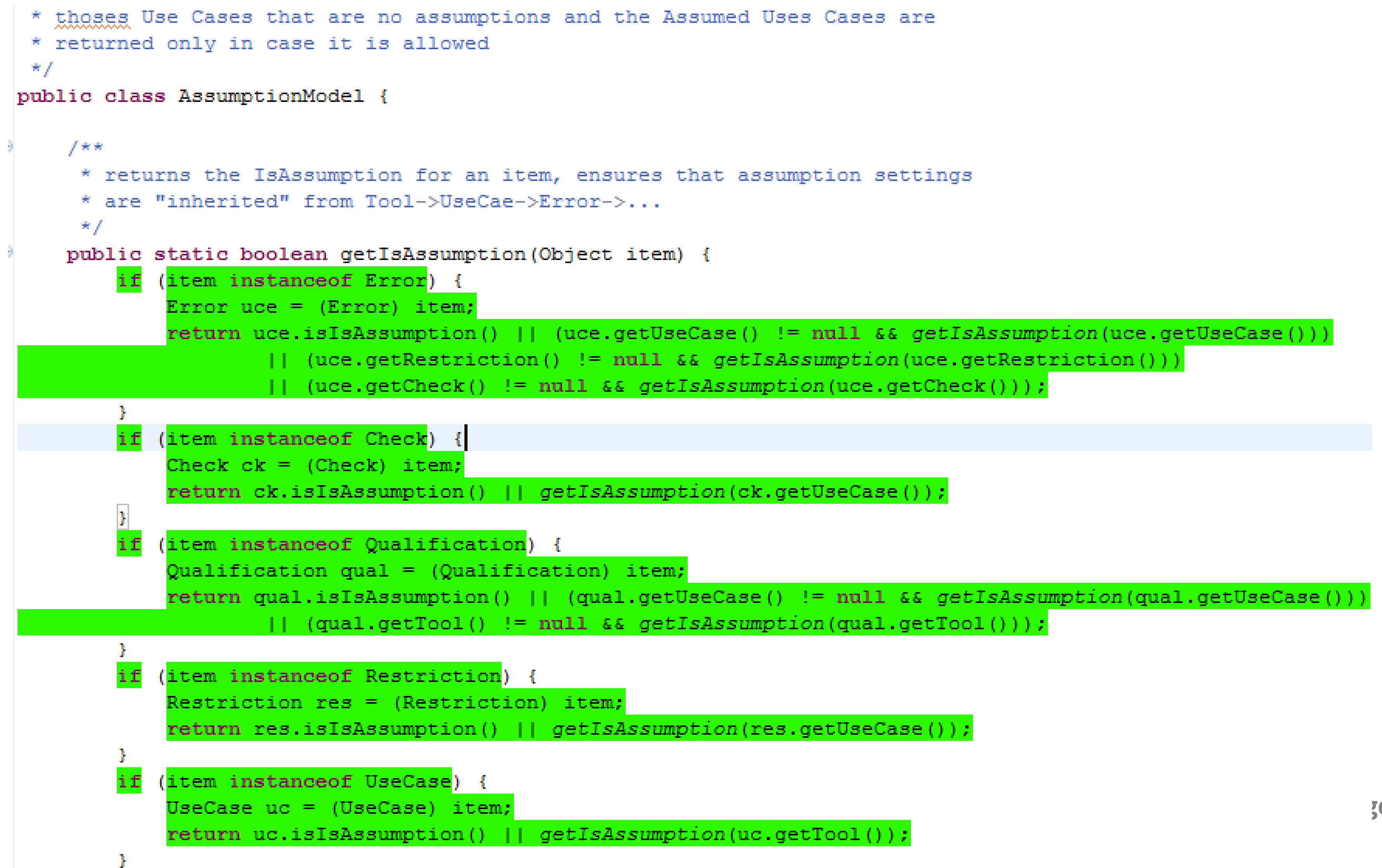


getAllAssumptions	0,0 %	0,0 %	0,0 %	0,0 %	–	–
getIsAssumption	100,0 %	100,0 %	–	100,0 %	–	–



Show methods with Term Coverage > 90,5 %

Name	Statement	Branch	Loop	Term	?-Operator	Synchronized
ToolChainAnalyzer	6,1 %	5,3 %	0,0 %	4,6 %	–	–
metamodel	6,1 %	5,3 %	0,0 %	4,6 %	–	–
de	6,1 %	5,3 %	0,0 %	4,6 %	–	–
validas	6,1 %	5,3 %	0,0 %	4,6 %	–	–
iso26262	6,1 %	5,3 %	0,0 %	4,6 %	–	–
checks	6,1 %	5,3 %	0,0 %	4,6 %	–	–
AssumptionModel	6,1 %	5,3 %	0,0 %	4,6 %	–	–
getIsAssumption	100,0 %	100,0 %	–	100,0 %	–	–

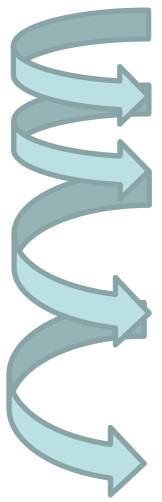


```
 * thoses Use Cases that are no assumptions and the Assumed Uses Cases are
 * returned only in case it is allowed
 */
public class AssumptionModel {

    /**
     * returns the IsAssumption for an item, ensures that assumption settings
     * are "inherited" from Tool->UseCae->Error->...
     */
    public static boolean getIsAssumption(Object item) {
        if (item instanceof Error) {
            Error uce = (Error) item;
            return uce.isIsAssumption() || (uce.getUseCase() != null && getIsAssumption(uce.getUseCase()))
                    || (uce.getRestriction() != null && getIsAssumption(uce.getRestriction()))
                    || (uce.getCheck() != null && getIsAssumption(uce.getCheck()));
        }
        if (item instanceof Check) {
            Check ck = (Check) item;
            return ck.isIsAssumption() || getIsAssumption(ck.getUseCase());
        }
        if (item instanceof Qualification) {
            Qualification qual = (Qualification) item;
            return qual.isIsAssumption() || (qual.getUseCase() != null && getIsAssumption(qual.getUseCase()))
                    || (qual.getTool() != null && getIsAssumption(qual.getTool()));
        }
        if (item instanceof Restriction) {
            Restriction res = (Restriction) item;
            return res.isIsAssumption() || getIsAssumption(res.getUseCase());
        }
        if (item instanceof UseCase) {
            UseCase uc = (UseCase) item;
            return uc.isIsAssumption() || getIsAssumption(uc.getTool());
        }
```

Tool Life Cycle for Qualifiable Plugins

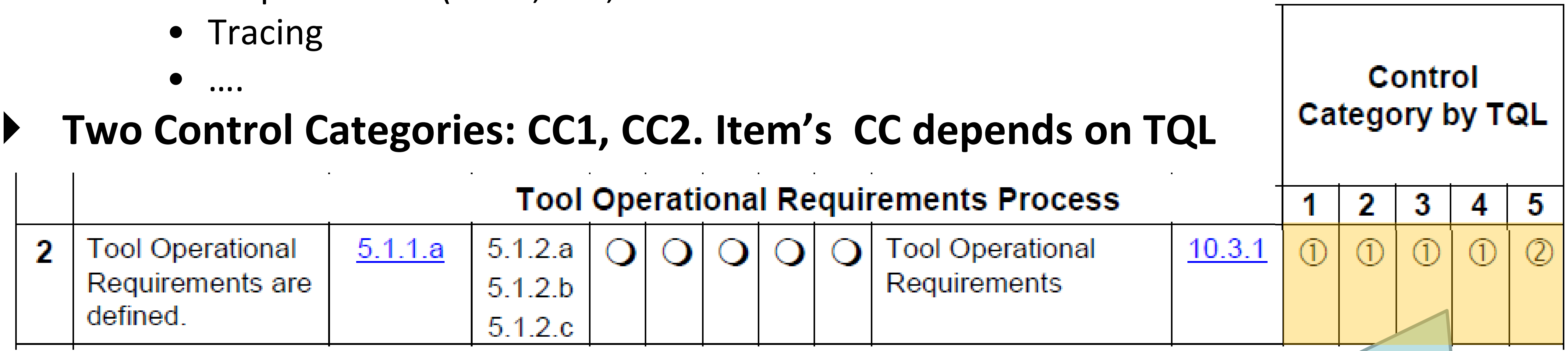
- **Combines the following processes:**
  - Planning (TORs)
  - Development (TR, LLRs)
  - Integration (Verification)
  - Configuration Management
  - Quality Assurance
- **Fits to existing processes (Project process, Release Process) by extending them with a "Qualification Stage"**
- **The following stages are defined (and can be determined automatically from the DO-330 model) such that every release has a well-defined qualification stage**



  - **Unqualified-Pre-Alpha Release** ("**Undefined**"): unknown qualification state
  - **Qualification Alpha-Release** ("**Analyzed**"): The TORs are defined and TQL is determined
  - **Qualification Beta-Release** ("**Feature-Complete**"): All requirements (TORs and TRs) are described and have traces to LLRs and Code
  - **Qualification Release Candidate** ("**Verification Defined**"): All required verification steps are defined. No open bugs of the category "Blocker" are available.
  - **Qualification Release**: ("**Successfully Verified**") Verification has been successfully executed and are documented within the qualification kit
- **Transition Criteria are formally defined, based on the DO-330 model**

Configuration Management

- **Configuration Items are all elements within the Qualifiable Eclipse Project**
  - Sources
  - Architecture
  - DO-330-model
    - Requirements (TORs, TRs,
    - Tracing
    - ….
- **Two Control Categories: CC1, CC2. Item's CC depends on TQL**

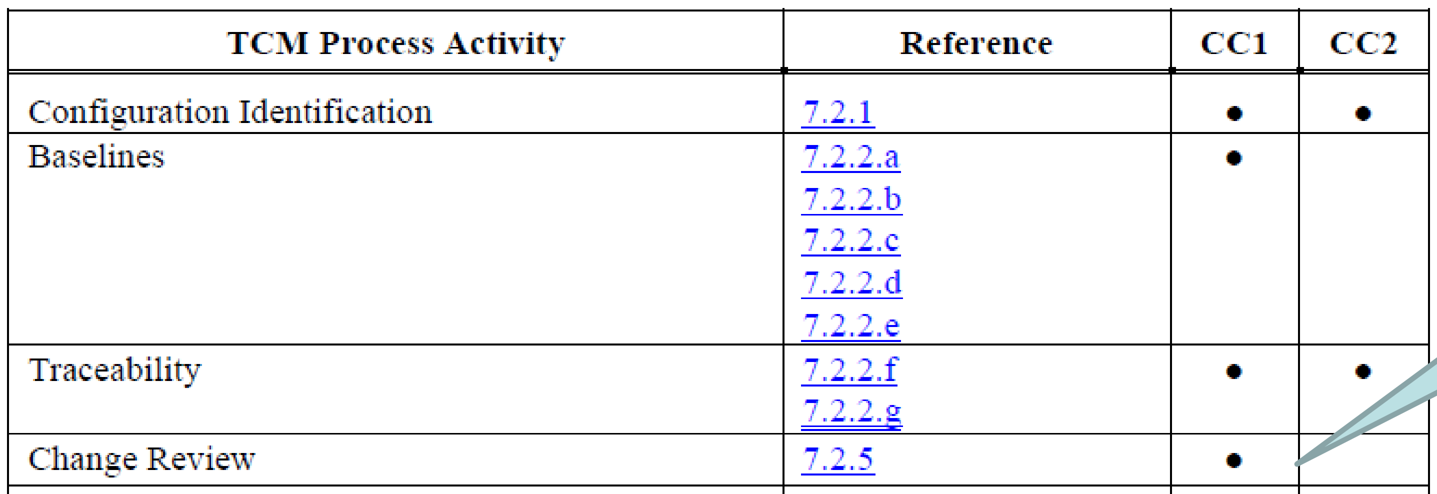


	Tool Operational Requirements Process										Control Category by TQL				
											1	2	3	4	5
2	Tool Operational Requirements are defined.	5.1.1.a	5.1.2.a 5.1.2.b 5.1.2.c	❍	❍	❍	❍	❍	Tool Operational Requirements	10.3.1	①	①	①	①	②

Example: TORs **changes** have to be **reviewed** for TQL-1 to TQL-4 but not for TQL-5

- **Definition of Control Categories (DO-330):**

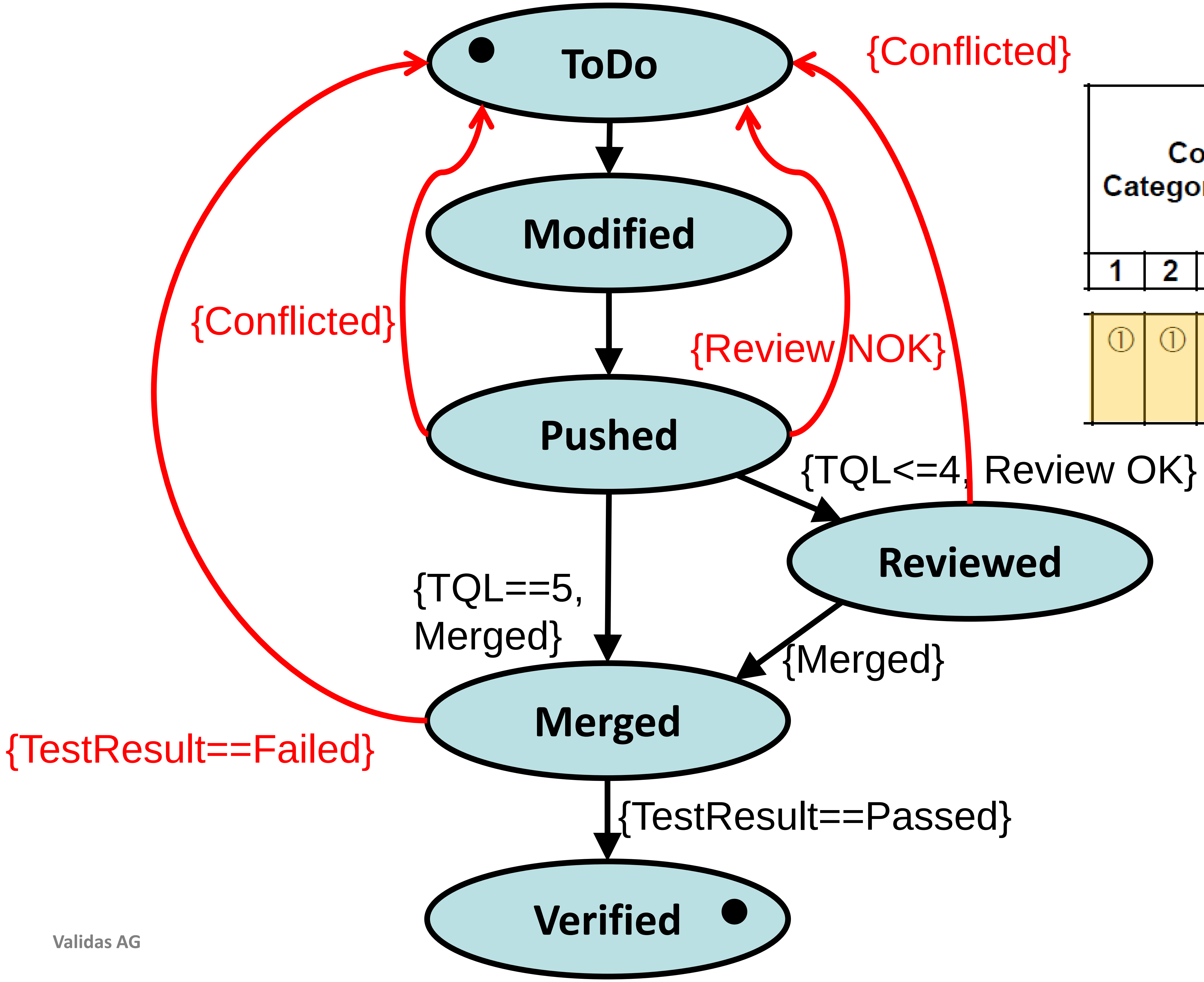
Table 7-1 TCM Process Activites Associated with CC1 and CC2 Data



TCM Process Activity	Reference	CC1	CC2
Configuration Identification	7.2.1	●	●
Baselines	7.2.2.a 7.2.2.b 7.2.2.c 7.2.2.d 7.2.2.e	●	
Traceability	7.2.2.f 7.2.2.g	●	●
Change Review	7.2.5	●	

Plugin Extension has to know this (Transition Criteria!)

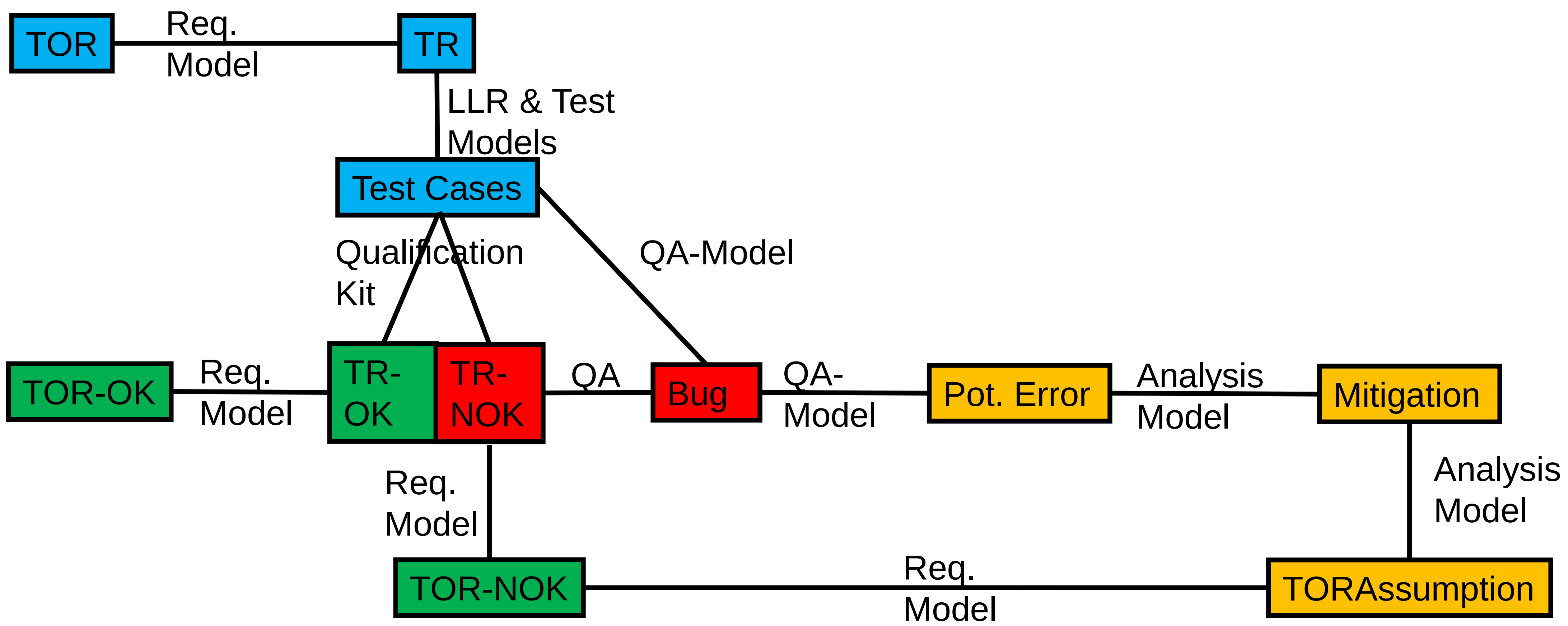
CM: Control Status of TORs (Proposed)



Control Category by TQL				
1	2	3	4	5
①	①	①	①	②

Qualification Liaison Process

- For all tools with qualification need
- Demonstrate that the tools conform to their requirements ("TOR"), even if qualification shows errors



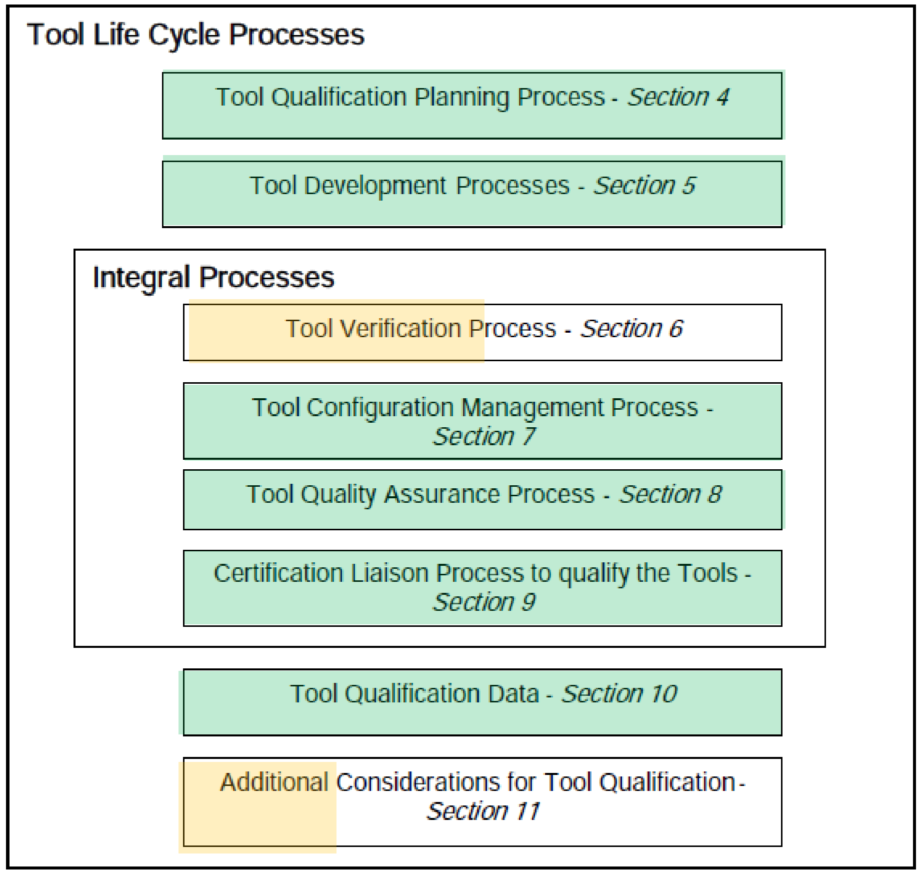
Content

- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model Based Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

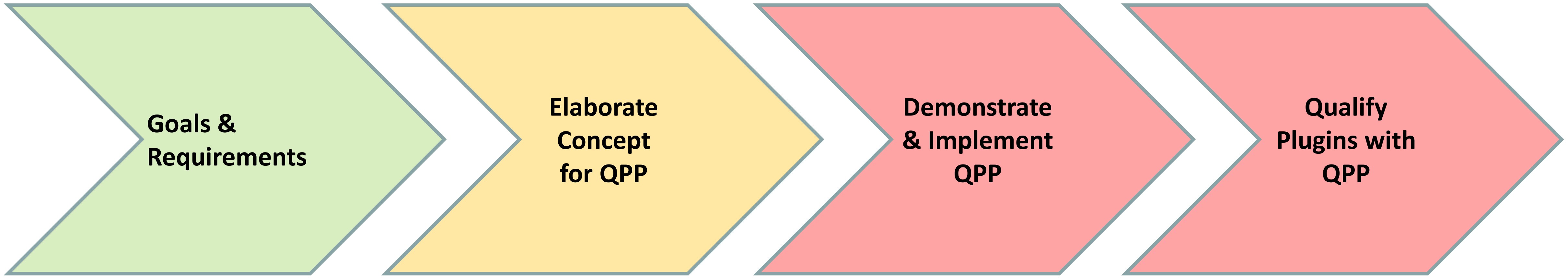
Roadmap - Status May 2012

1. Goals: DO-330
2. Concept: Eclipse Project QPP
3. Demonstrate & implement QPP
4. Qualify (selected) plugins

- **Status May 2012**



Tool Life Cycle Processes
Tool Qualification Planning Process - *Section 4*
Tool Development Processes - *Section 5*
Integral Processes
Tool Verification Process - *Section 6*
Tool Configuration Management Process - *Section 7*
Tool Quality Assurance Process - *Section 8*
Certification Liaison Process to qualify the Tools - *Section 9*
Tool Qualification Data - *Section 10*
Additional Considerations for Tool Qualification - *Section 11*



Goals & Requirements	Elaborate Concept for QPP	Demonstrate & Implement QPP	Qualify Plugins with QPP
Identified	In progress: 80% of DO-330	**Ready to start**	Ready to start (Prototyping)

- **Summary: Qualification is feasible and qualification (based on current prototype) could be started now**

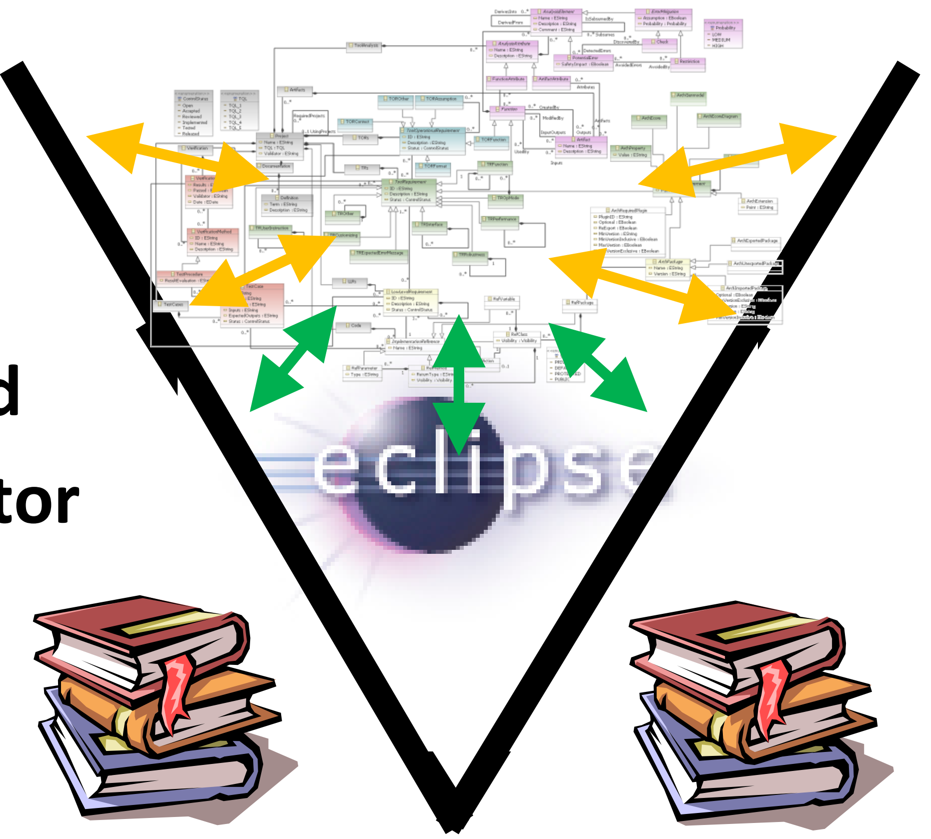
Content

- **Tool Qualification Requirements from Standards**
- **Tool Qualification Roadmap**
  - Vision
  - DO-330
  - Concept
    - Model Based Qualification
    - Examples
      - Processes
      - Documents
    - Status: May 2012
- **Summary**

Summary

- **Extended Eclipse (QPP) will support qualification including**
  - Classification: Tool Analysis -> Planning Process
  - Qualification: Process & Model for qualifiable plugin projects
  - Usage: Fulfill assumptions and apply qualification kits
- **Applicable to all relevant standards (ISO 26262, IEC 61508, DO-178C, EN 50128,..)**
- **Metadata extension for qualification information of plugins: DO-330 model**
- **Much work in progress**
  - Tracing to "How-To-Qualify" document
  - Modeling: gaps to current meta-information
  - Create documentations (TDP,TVP,TQP,TQR..)
- **First, second, third, fourth, fifth steps performed**
- **Proposed new role for that work: Eclipse Validator**
- **Many areas of DO-330 already covered**

Eclipse Project: Qualifiable Plugin Projects (QPP)



Thank You!

VALIDAS

Arnulfstraße 27
80335 München
www.validas.de
info@validas.de