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Model-Based Tool Qualification

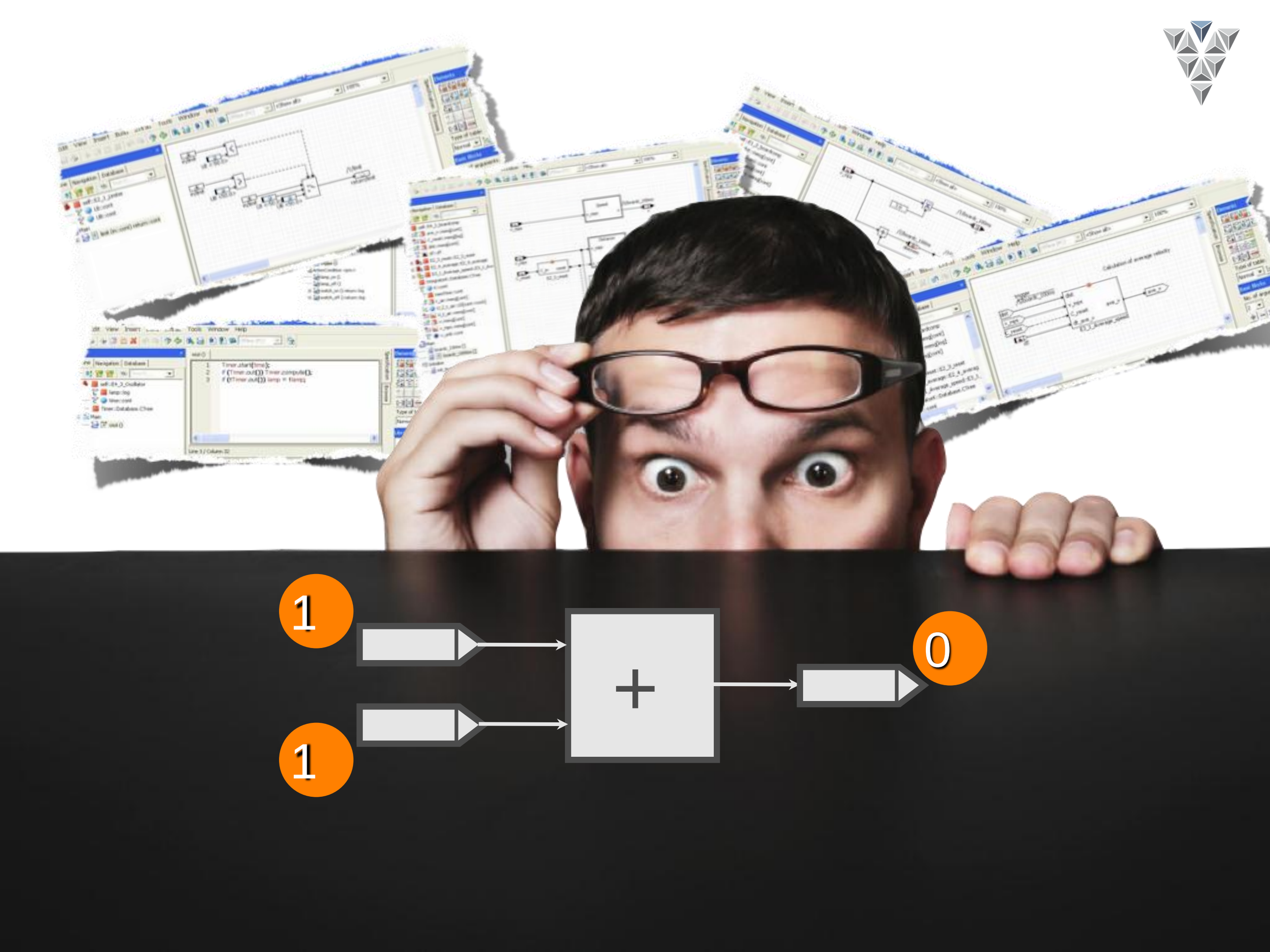
The Roadmap of Eclipse towards Tool Qualification

Content

- **Introduction: Validas & Eclipse Automotive IWG WP5**
- The roadmap of Eclipse towards Tool Qualification
- Model-Based Tool Qualification
  - Overview
  - Model & Automatization
  - Documentation generation
- Example: Ongoing demonstrator
- Business model (proposal): Pay per qualification
- Summary

Validas AG About Us

- We are a technology consultancy for quality assurance of embedded systems
- Our core competences are model based development, model based testing, test automation, **tool qualification**
- We develop innovative software engineering methods, implement them in form of tools and processes and we support our customers in their application.
- We are members of AUTOSAR and Eclipse Foundation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Goals for Eclipse IWG

- **Exchange & share knowledge**
  - Motivate developers & community to provide qualifyable plugins
- **Provide classification support to users of Eclipse tools**
- **Support the development of qualifyable tools ("Qualification Kits")**
  - Validation
  - Safety-Standard (DO-330)
- **Apply this to reference tools ARTOP, EMF,… ?**

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Roadmap - Status June 2012

1. Goals: DO-330
2. Concept: model-based tool qualification
3. Demonstrate & implement with an Eclipse Project: QPP (Qualifiable Plugin Projects)
4. Qualify (selected) plugins

Identified

Status: Feasible and 100% of DO-330 covered

Ready to start

Ready to start (Prototyping)

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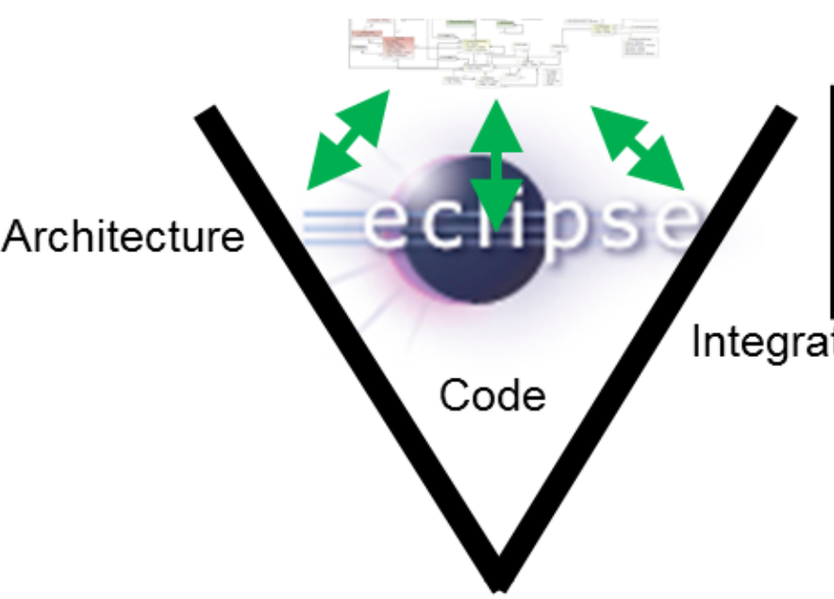
Development With Eclipse?

- 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

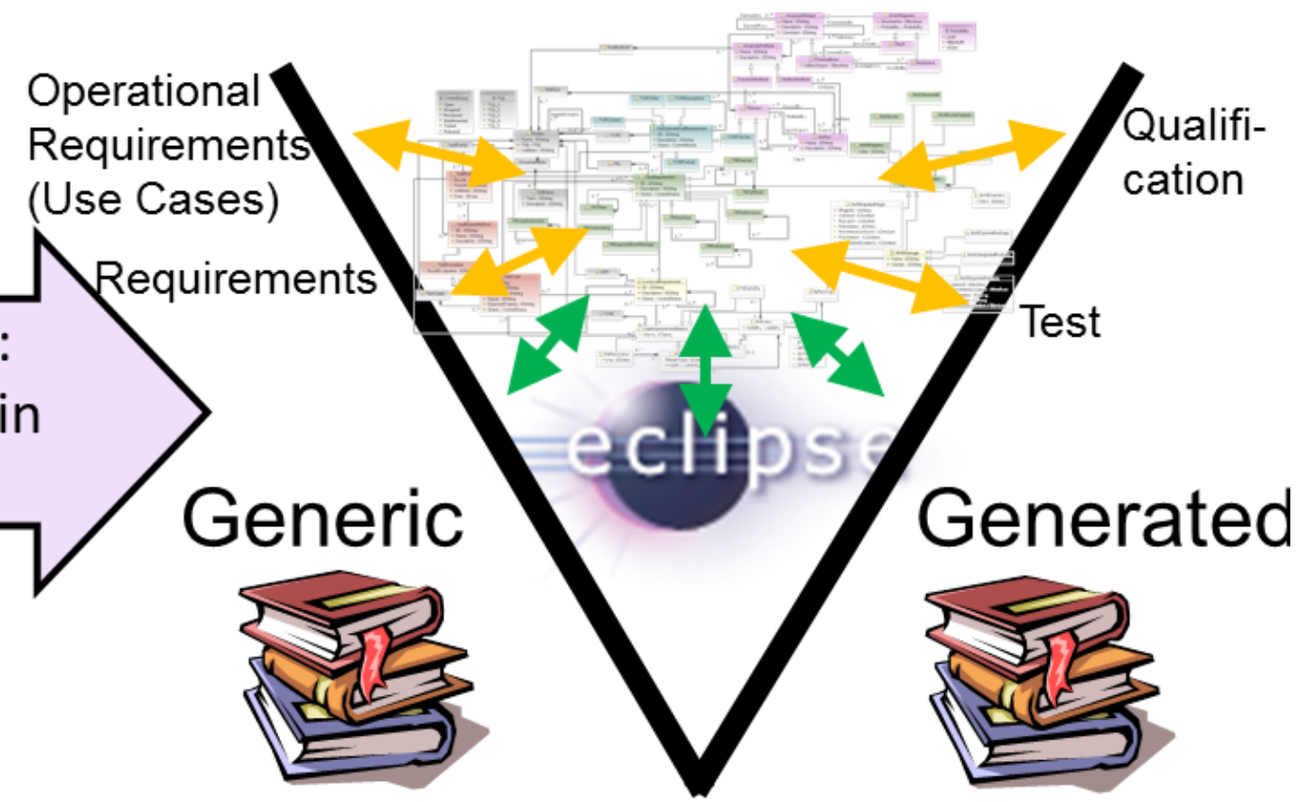
Model-based Tool Qualification

Current Metamodel



Eclipse Project: Qualifiable Plugin Projects (QPP)

New Extended Metamodel



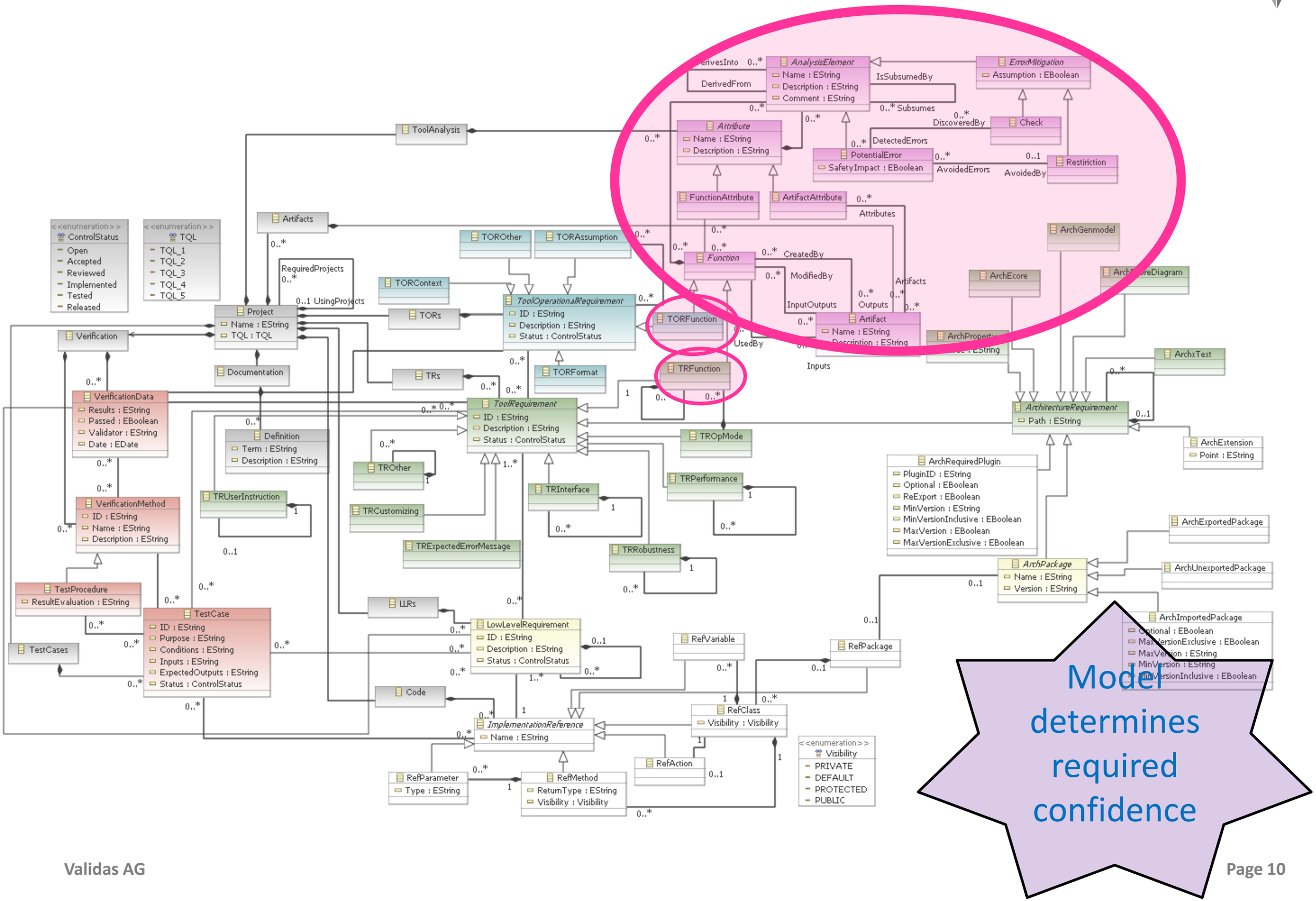
Generic

How-To Qualify Tools according DO-330
Tool Development Plan
Tool Verification Plan
…

Generated

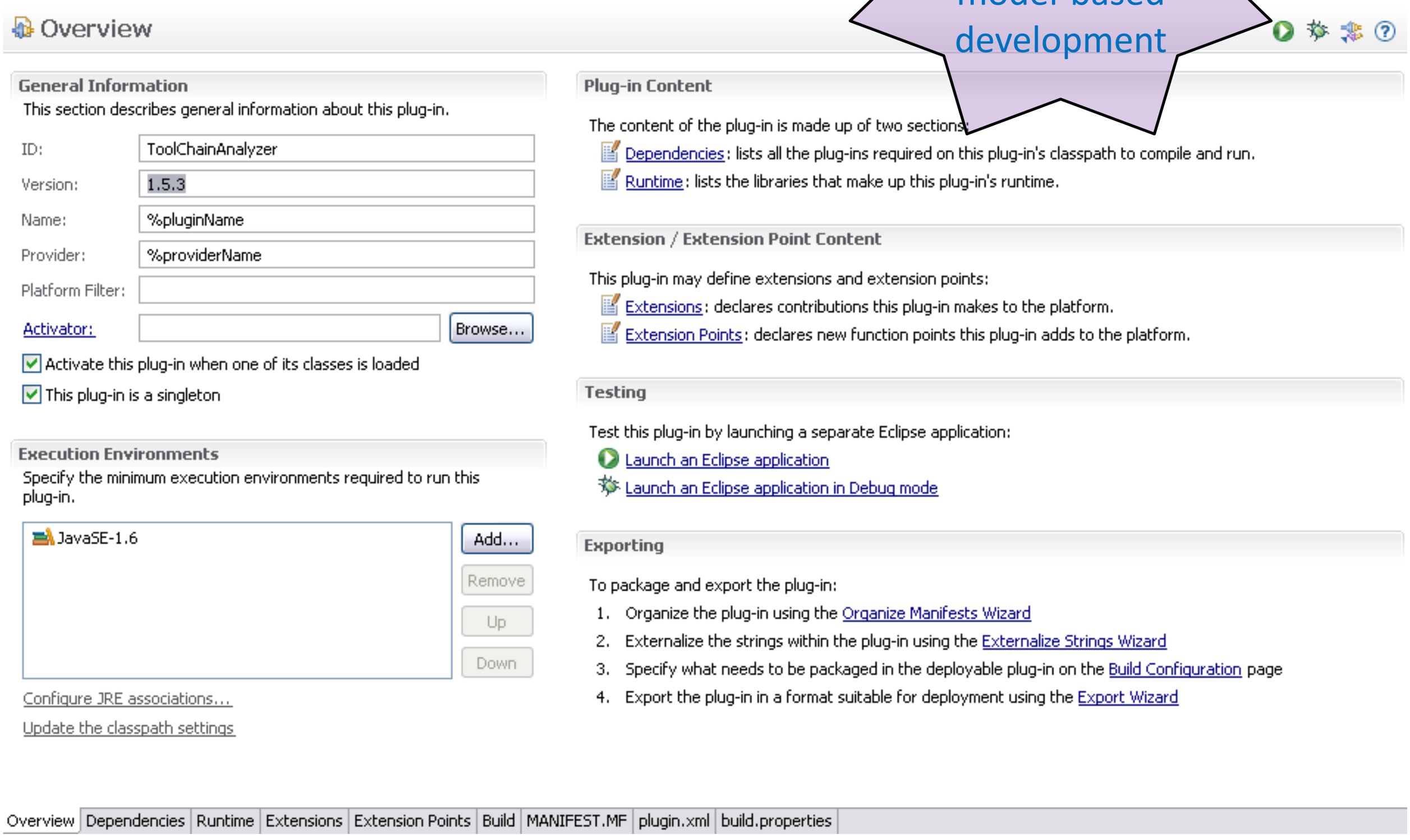
Requirements-Specificatio
Design-Specification
Test-Specification
Tool Analysis (TCL/PSAC)
…

Planning: Analysis Model for PSAC



Current Eclipse Metadata

Eclipse is (partially) model-based development



Vision: Eclipse Classification Data

Qualifyable 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... | Remove | Properties...

Add Action

Add Class

Add Method

Total: 6

Qualification model extends current Eclipse models

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

Add... | Remove | New...

Errors

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

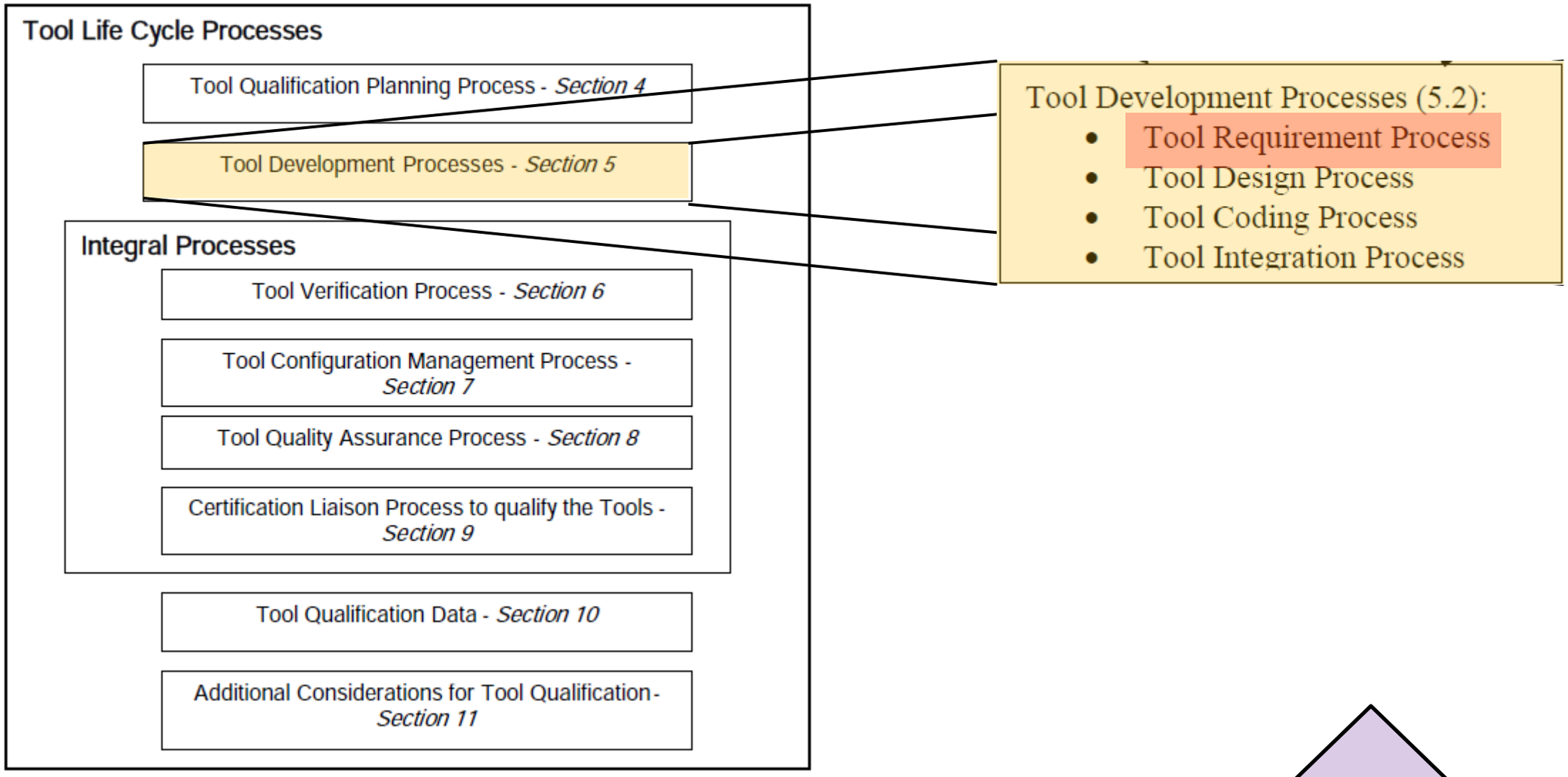
- Error Make.Make Executables:Make Builds Wrong Binary (HIGH)
- Error Make.Make Executables:Make Modifies Data (HIGH)
- Error Make.Make Executables:Old Binary Unchanged (HIGH)
- *Inferred Feature Error Make Used Wrongly in Call Tools in Make Executables (HIGH)*
- *Inferred Feature Error Make Used Wrongly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

Up | Down

Overview | Dependencies | Runtime | Extensions | Extension Points | Build | MANIFEST.MF | plugin.xml | build.properties | Qualifiabe Features | Qualifcation Evidence

DO-330 Topics

- **Structure of DO-330**

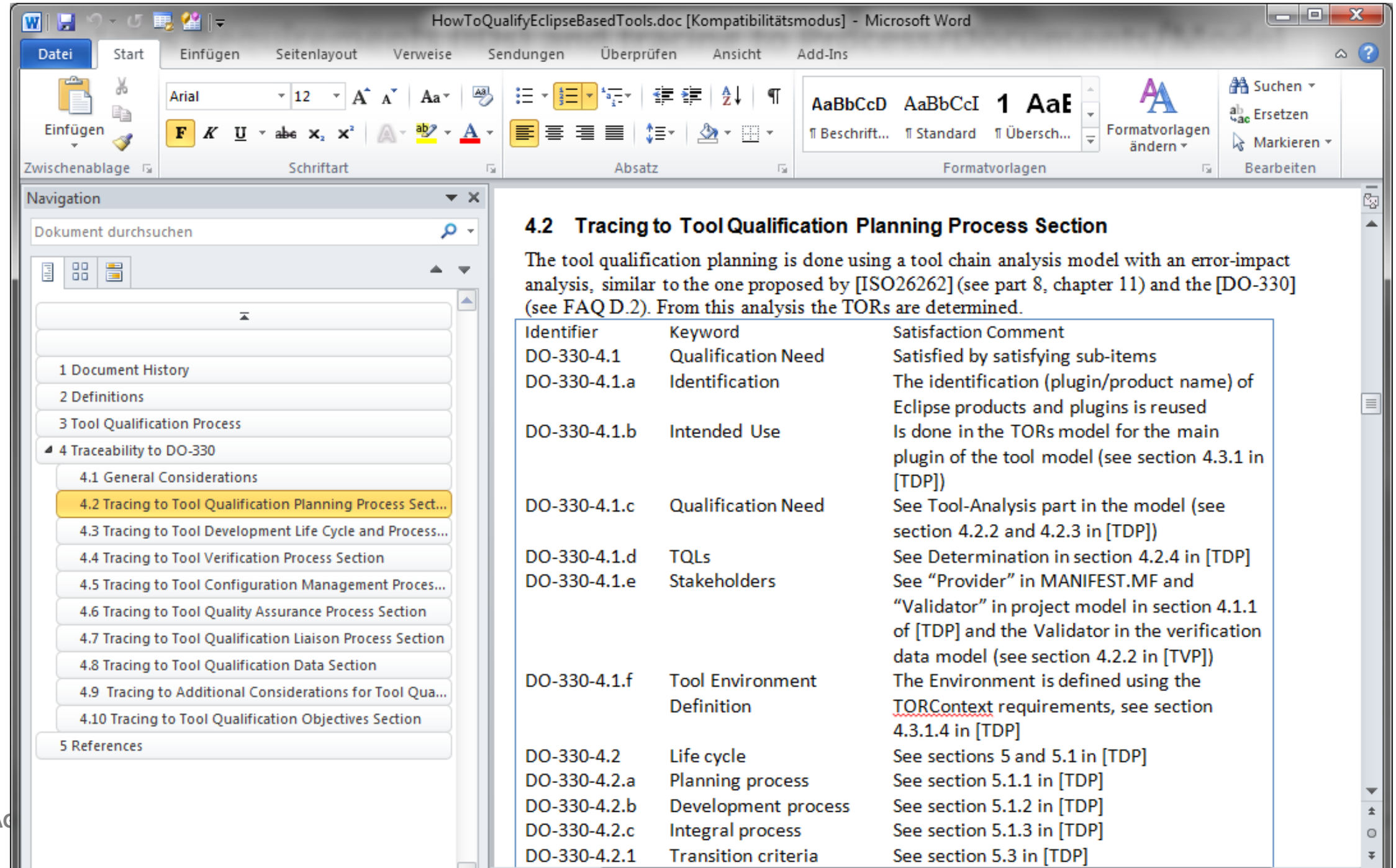


Model supports all parts of DO-330

Checklist for DO-330 compliance (refined)

Tracing to DO-330

- **Document created: “How-To Qualify Eclipse-based Tools”**
- **Contains Requirements (IDs) and tracing to Process/Documents/Model**



Planning: “How-To Qualify” Document

- **General explanations**
- **Conformance to DO-330 (bidirectional Tracing)**
  - Structures according to DO-330
  - Identification of Requirements
  - Tables for Tracing
  - Tracing against IDs is also contained in other Documents like TDP, TVP,…
- **Bidirectional tracing ensures that not too much is models/requested within Eclipse qualification process**

How-To Qualify
Eclipse-Based Tools
Version 0.2

Tracing to DO-330

Tool Development Plan
for every
Qualifiable Eclipse Plugin
Version 0.6

If the tool plans have been adopted the compliance to DO-330 has updating the tracing in [HowTo] and their projects. Satisfies DO-330-T1-6, DO-33

Bidirectional Tracing

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Identifier	Keyword	Satisfaction Comment
DO-330-4.1	Qualification Need	Satisfied by satisfying sub-items
DO-330-4.1.a	Identification	The identification (plugin/product name) of Eclipse products and plugins is reused
DO-330-4.1.b	Intended Use	Is done in the TORs model for the main plugin of the tool model (see section 4.3.1 in [TDP])
DO-330-4.1.c	Qualification Need	See Tool-Analysis part in the model (see section 4.2.2 and 4.2.3 in [TDP])
DO-330-4.1.d	TQLs	See Determination in section 4.2.4 in [TDP]

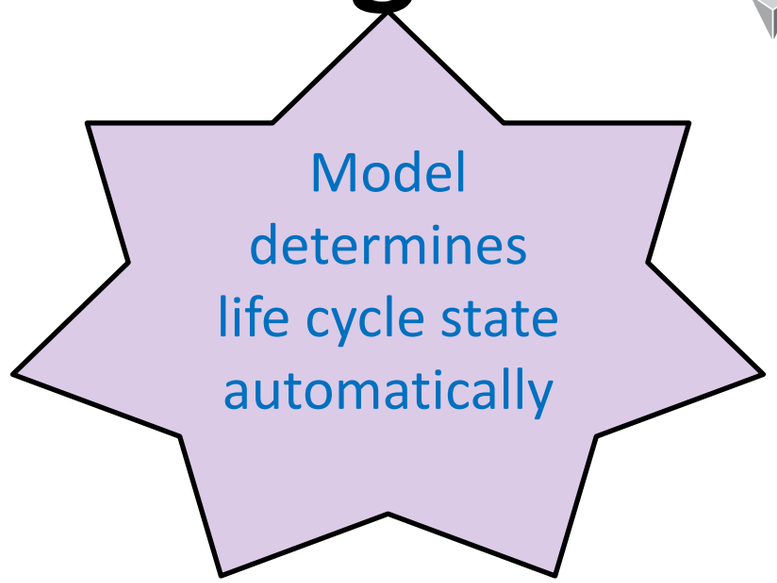
Table 2: Tracing Table to Tool Qualification Planning Process

Tool Development Plan

- **General Process Description for Qualifiable Eclipse Plugins**
- **Compliant to DO-330**
- **Can be adapted by developers (DO-330 compliance!)**
- **Contains description of how to use the model, i.e. standards for**
  - Requirements: TORs, TRs
  - Design, Architecture: TRs, LLRs
  - Implementation
- **Specific documents can be generated from the DO-330 model, the architecture and the (enriched) implementatio**
  - Requirements for <Tool Name>
  - Design for <Tool Name>
  - …
- **Examples for some specific document exists**
- **Similar document for verification: Tool Verification Plan**

Tool Development Plan
for every
Qualifiable Eclipse Plugin
Version 0.6

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**

Tool Life Cycle Transition Criteria

- **Defined in the "Tool Development Plan"**
- **Required by DO-330-4.2.1, DO-330-4.2.2, DO-330-4.3.b**
- **Quite formal definition (can be checked automatically) based on the DO-330 model of the tool**
- **Example (truncated): Transition to Qualification Alpha State ("Analyzed")**

- The *Project* has a nonempty *Name*, *Provider, Validator*,
- The *Project* has a *ControlStatus=Reviewed*
- The *Project* has the following TORs specified (in a *TORs* container):
  - At least one *TORFunction* defined. All *TORFunction* elements have
    - nonempty *ID*
    - nonempty *Description*
    - *ControlStatus=Reviewed*
  - At least one *TORContext* defined. All *TORContext* e
    - nonempty *ID*
    - nonempty *Description*
    - *ControlStatus=Reviewed*
  - At least one *TORFormat* defined. All *TORFormat* e
    - nonempty *ID*
    - nonempty *Description*
    - *ControlStatus=Reviewed*

All *TORFunction* elements should have

- at least one *PotentialError* in the *AnalysisElements* composition
- For every potential error in the *TORFunction* which has an assigned mitigation (check/restriction) the shall be an artifact flow (to/from) the mitigation's *TORFunction*, if the mitigation's *TORFunction* is different from the *TORFunction* of the *PotentialError*.
- A set of "derived errors", consisting of
  - all errors (*AnalysisElements* of kind *PotentialError*) of the assigned *FunctionAttributes* and
  - all errors (*AnalysisElements* of kind *PotentialError*) of the *ArtifactAttributes* of the *Artifact* are *CreatedBy* or *ModifiedBy* the *TORFunction*. Note that if a *TORFunction* has several outputs with the same *ArtifactAttribute* element assigned, than the errors of the *ArtifactAttribute* are multiple times in the set with a different *ID* that refers to the *Artifact* in which they can occur.
- For each derived error in the set there is either
  - a copy of the *PotentialError* contained in the *TORFunction* or
  - another *PotentialError* contained in the *TORFunction* that subsumes the derived error, i.e. has the *PotentialError* of the *AnalysisAttribute* in the association *Subsumes*.

Model defines tool life cycle transitions (formally)

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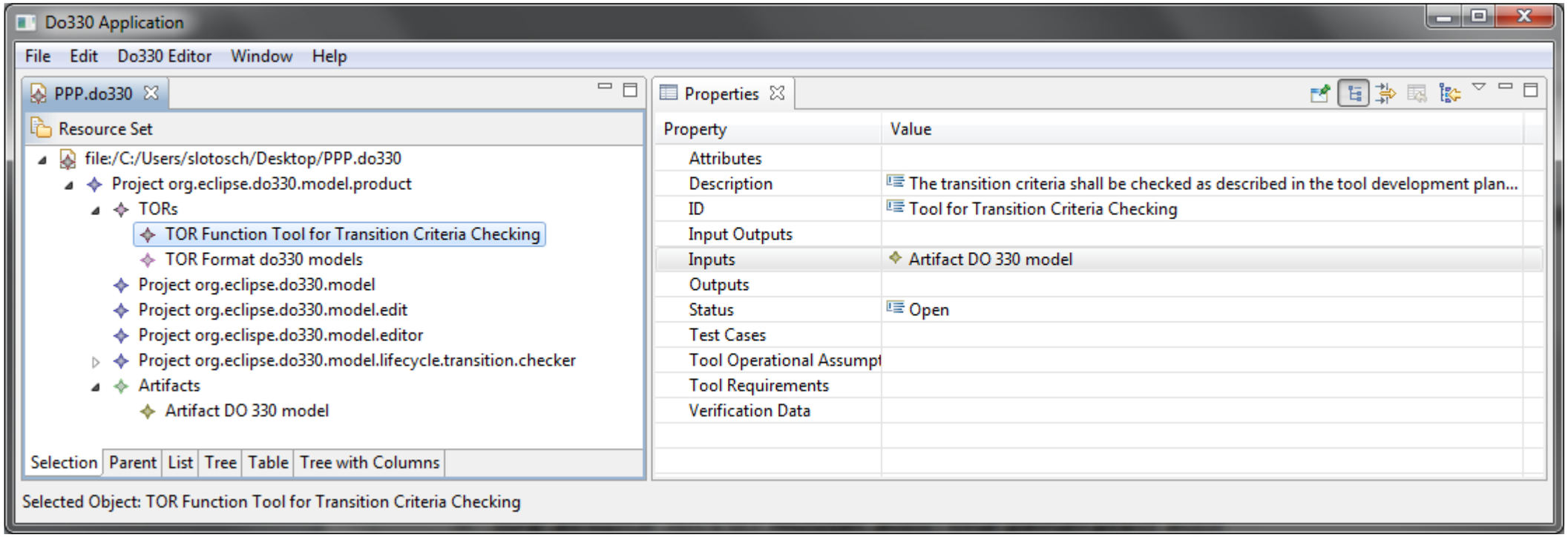
Demonstrator

- **Eat your own dog food**
- **Demonstrator: DO-330 transition criteria checking**
  - Can be reused for Eclipse-Integration (QPP)
  - Can be used for tool qualification
  - Efforts monitoring
  - Access to all concept documents and models
- **Milestones defined**
- **Start model-based tool qualification**

Demonstrate model-based development / qualification



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Business Model: Pay Per Qualification

Still not clear how Eclipse qualification kits can be produced and used in an open way for user and provider

- **Pay per Qualification:**
  - The owner of a qualification kit gets money when the kit is applied
    - Part 1: The analysis model, required for further classification (pay once to get it)
    - Part 2: The qualification kit (pay every time you run the kit)
  - Qualification kits are available in a "qualification store"
  - Application would include the application of the kit's from required plugins (at least part 1)
  - Some % from the money is collected for infrastructure topics
- **This would make qualification kits of highly used plugins very valuable**
  - Companies / persons could invest in qualification kit's like they invest into tools
  - User groups can invest together into their kits
- **This would restrict investment into qualification only for the first phases to set up the infrastructure: QPP & qualification store**

Business model is NOT model-based

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Summary

- DO-330 is a safety standard for tools: Automotive, Avionics, …
- Eclipse is (partially) model-based
- Qualification requires an extended model: Requirements , Tests,..
- Model can be used for
  - Generation of documentation
  - Checks & automatization
- Eclipse is on the road towards enabling of tool qualification
- Ongoing work

First Tool Qualification Symposium

- **Presentations**
  - Tool user & tool provider
  - Qualification requirements & qualification kits
  - Experiences from different domains & different industries
  - Practical experiences & practical support
- **Keynote speech from F. Pothon**
  - Tool Qualification Considerations and Certification Credits of Qualified Code Generators
- **Location: Munich Airport**
- **Registration and further information:**
  - http://toolqualification2013.eventbrite.com
- **Organization: Validas AG**
  - tqs@validas.de

Thank You!

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