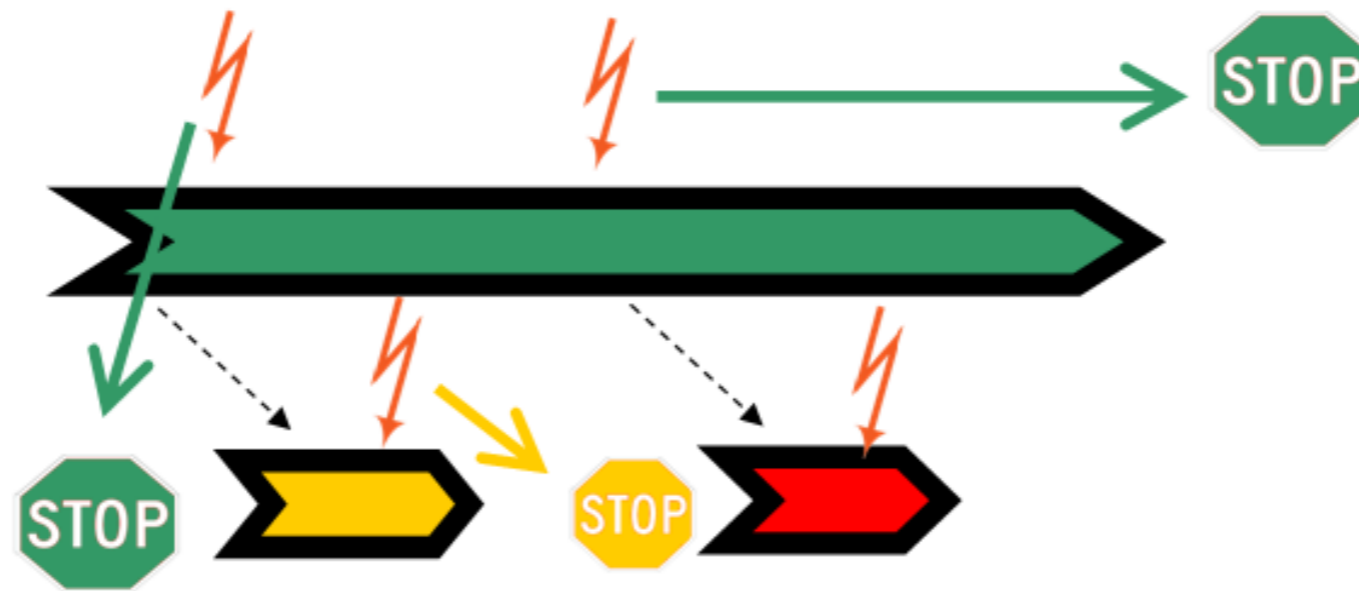


# Applying ISO26262 to Tool Qualification



Dr. Oscar Slotosch, Validas AG

Marco Reiling, Wind River

# Content: Tool Chain Analysis



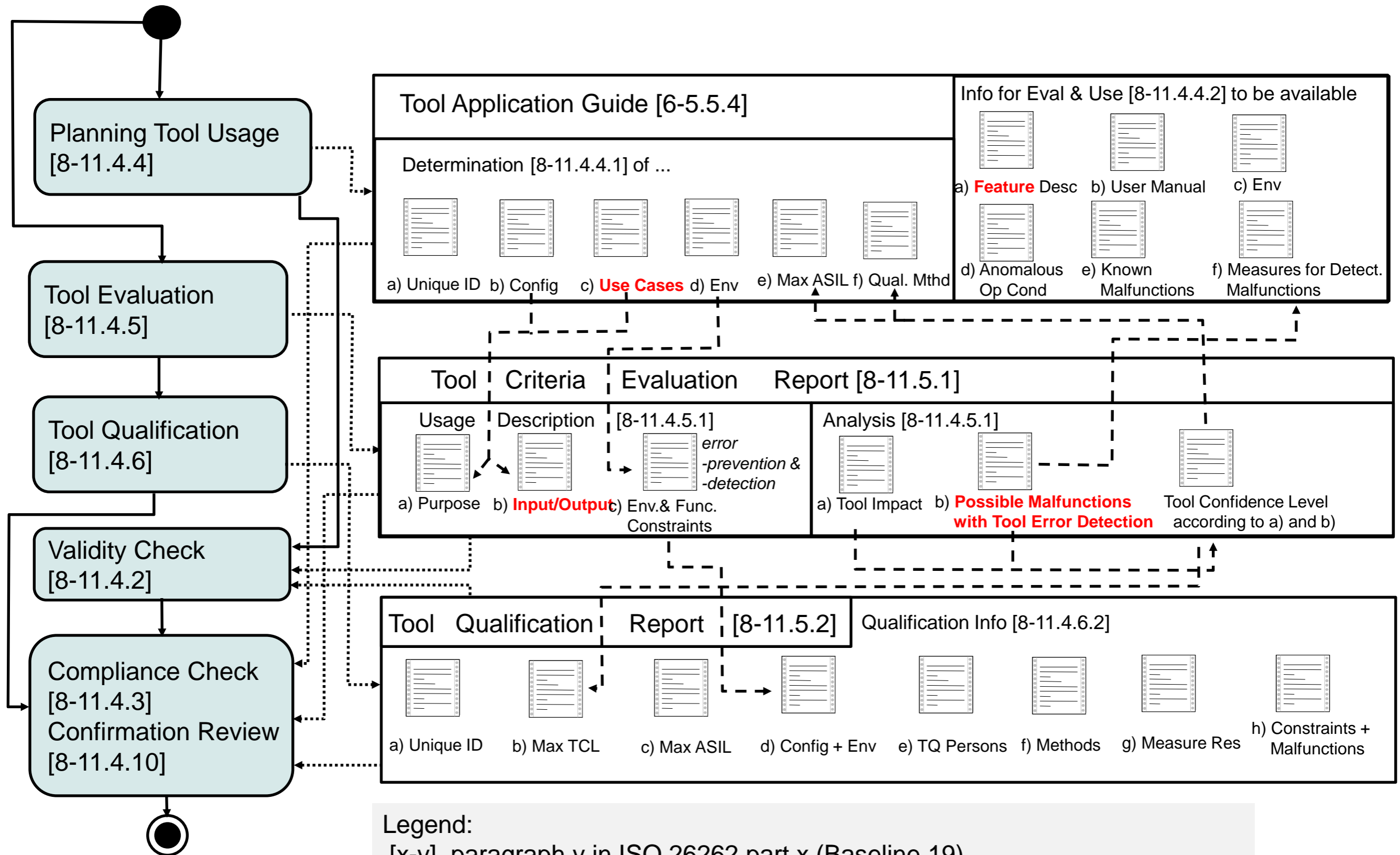
- ▶ Motivation: ISO 26262: Tool Confidence
- ▶ Method: Tool Chain Analysis
  - General Error Model
- ▶ Validas Tool Chain Analyzer
- ▶ Wind River Diab Compiler Qualification Kit

# Content: Tool Chain Analysis



- ▶ **Motivation: ISO 26262: Tool Confidence**
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# Confidence in Use of Tools 26262-8



Legend:  
 [x-y] paragraph y in ISO 26262 part x (Baseline 19)



# ISO 26262-8, Chapter 11: „Confidence in the use of software tools“

▶ **Classification in „Tool Confidence Level (TCL)“**

▶ **Tool Impact (TI)**

– TI1: no impact => Tool is TCL1



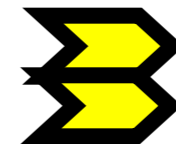
– TI2: some impact

- Tool Error Detection/prevention probability (TD)

– TD1:high confidence => Tool is TCL1



– TD2:medium confidence => Tool is TCL2



– TD3: low/unkown confidence => Tool is TCL3



▶ **Justification? Dokumentation?  
Confirmation Review!**

Table 2 — Qualification of software tools classified TCL3

Methods		ASIL			
		A	B	C	D
1a	Increased confidence from use according to 11.4.7	++	++	+	+
1b	Evaluation of the tool development process according to 11.4.8	++	++	+	+
1c	Validation of the software tool according to 11.4.9	+	+	++	++
1d	Development in compliance with a safety standard <sup>a</sup>	+	+	++	++

# Content: Tool Chain Analysis



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# Modeling Method / Process for TCA



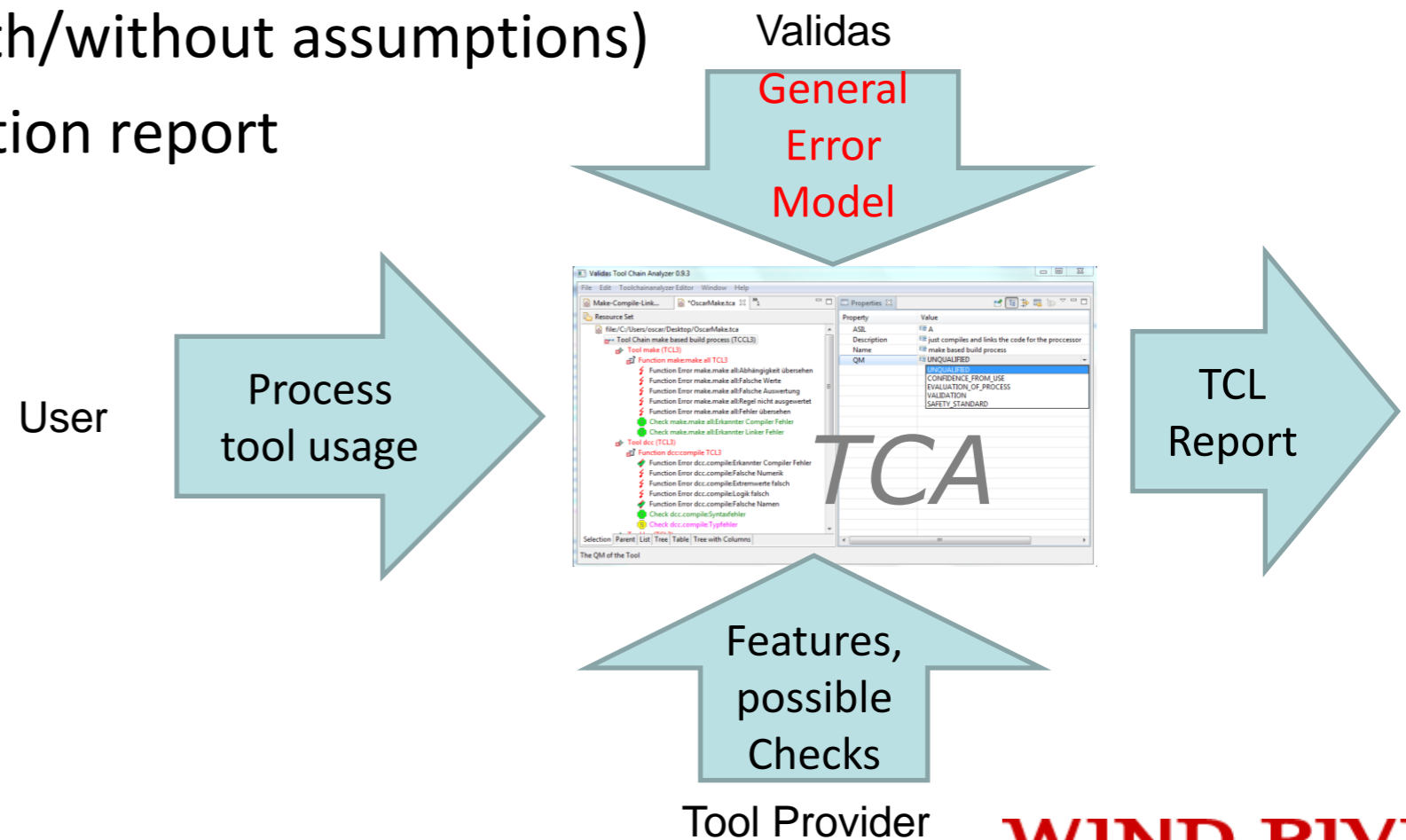
## 1. Planning:

1. Build a formal model of tool usage based on tool and process information
2. Validate the model (Review, Checklists)

## 2. Tool Evaluation

1. Systematically build an error model (black box / glass box)
2. Model detection and prevention (including assumptions)
3. Validate assumptions and error/detection/prevention model
4. Compute the TCL (with/without assumptions)
5. Generate tool evaluation report

## 3. Tool Qualification



# Tool Chain Analysis & Error Model

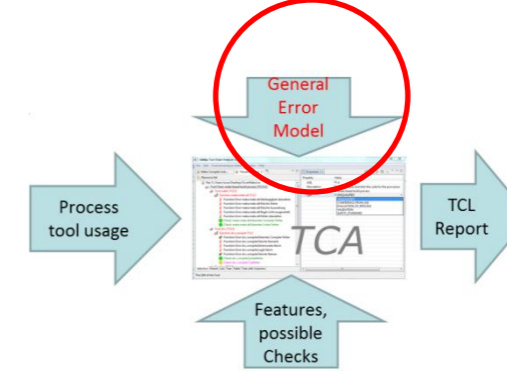


## Motivation / Requirements for Error Model

- ▶ ***One* error model describes possible tool errors in *every* tool**
- ▶ **Error model should be extensible (for new kinds of tools)**
- ▶ **Error model should cover all potential errors**
- ▶ **Error model should be acceptable (agreeable and simple to apply)**
- ▶ **Error model should cover the existing (known) errors**
  
- ▶ **Systematic (“Repeatable”) approach needed**



# General Error Model



## ► Creation Process

- Inductive: From known errors to classes of potential errors (“Observing”)
- Deductive: From tool to potential errors (“Analytic Approach”)
  - Black-Box Approach: Consider Tool Outputs
    - Default errors for typical artifact attributes (XML, Code,...)
  - White-Box Approach: Consider Tool Structure (features & tool components)
    - Default errors for typical tool attributes (Optimizing / Parsing / Searching /...)

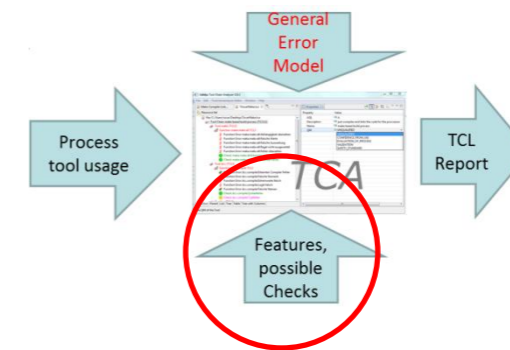
Validation of error model

error model with Default Classes

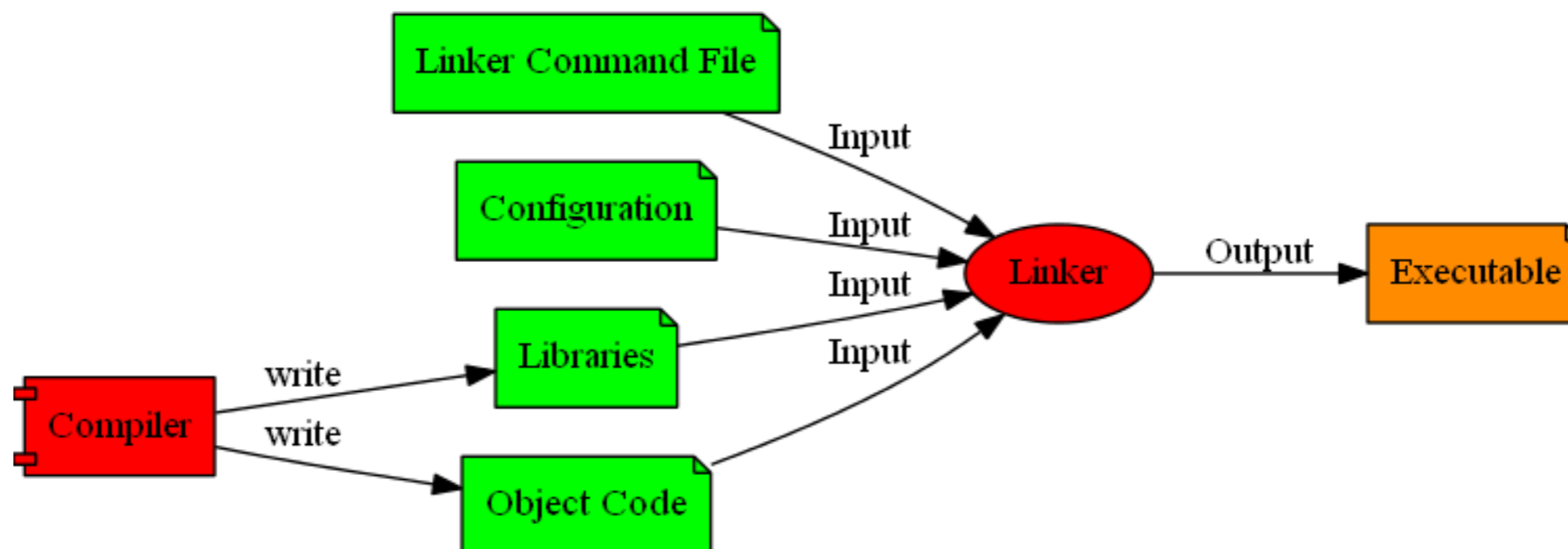
## ► Management:

- Relation between errors: “Subsuming”
- Assignment of errors to tool chain

# Tool / Feature Model



- ▶ Tool provider / expert creates this model
- ▶ Based on tool analysis
- ▶ Consisting of
  - Tools
  - Features with
    - input/output artifacts
    - Potential errors
    - Mitigation possibilities with probabilities (HIGH / MEDIUM / LOW)
      - Checks
      - Restrictions



# Process/Use Case Model



▶ User creates this model

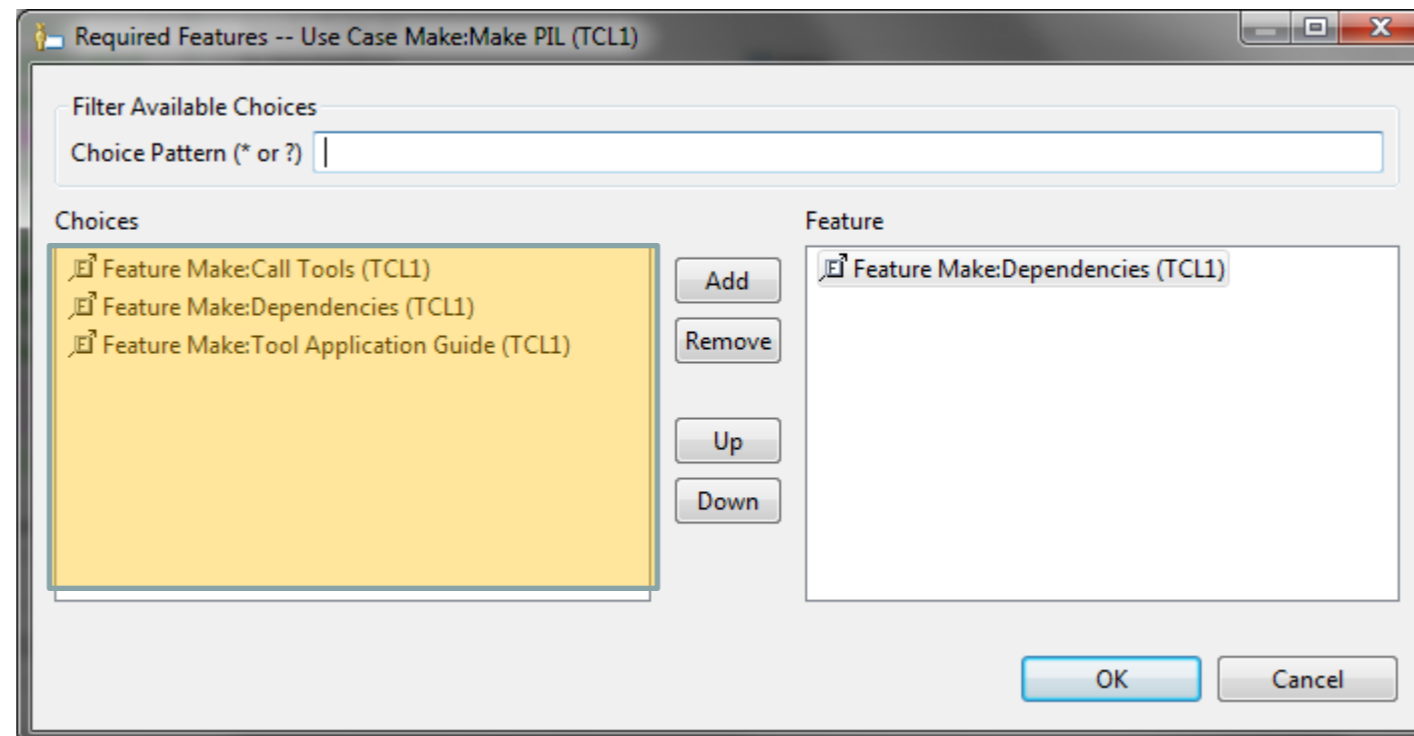
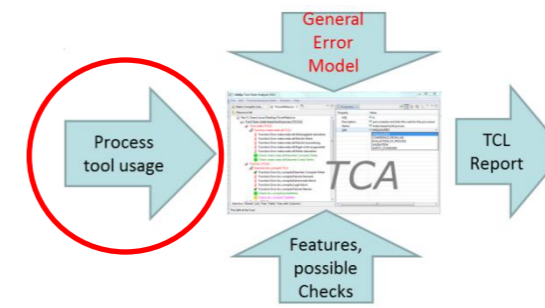
▶ Based on his process

▶ Consisting of

- Tools
- Artifacts
- Use-Cases with
  - input/output artifacts

- Required features (available from Tool model)

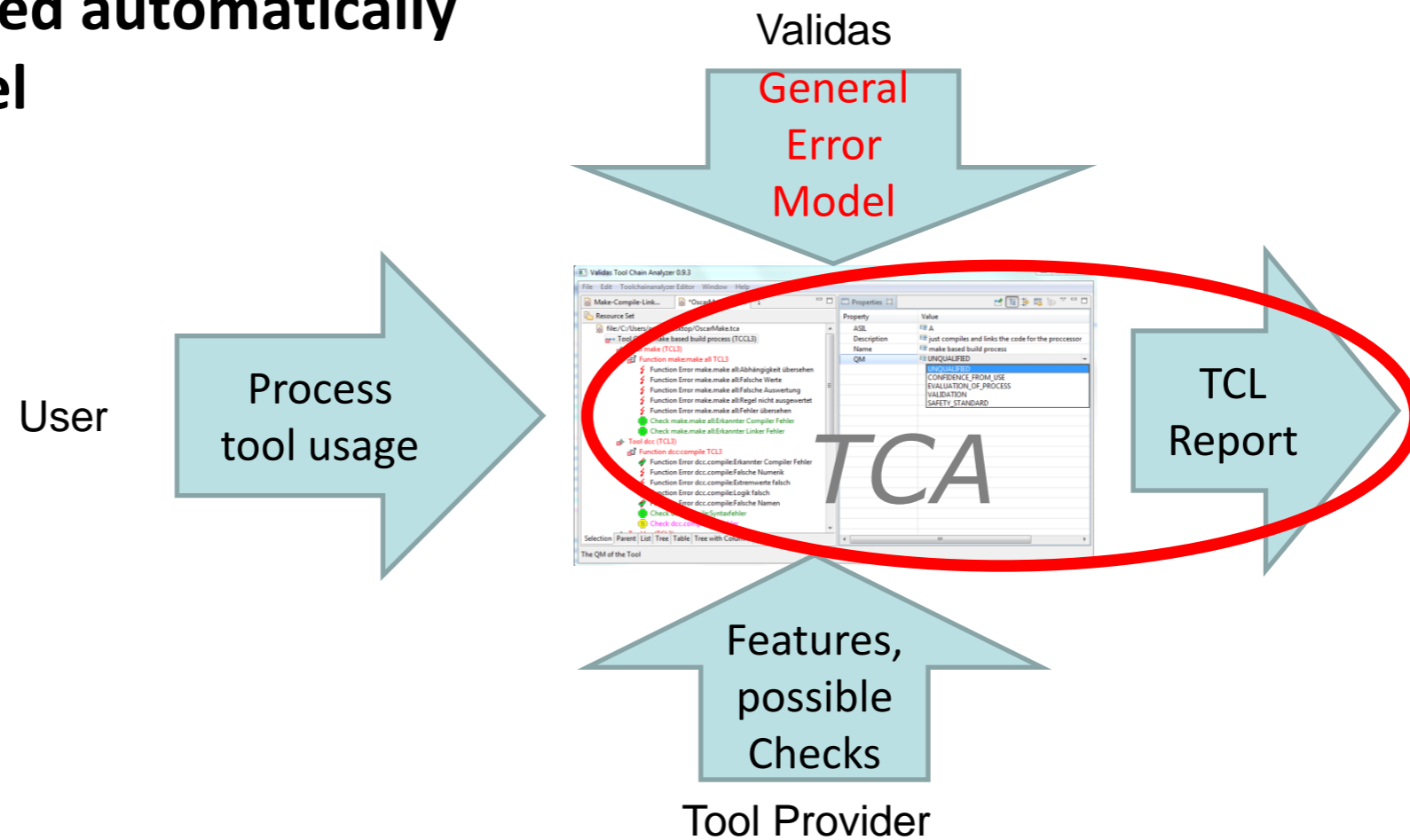
Potential errors are inferred from required features (including proposals for mitigations)



# Determine Tool Confidence Level



- ▶ Can be computed automatically from the model



- ▶ Create a report to document the results

# Content: Tool Chain Analysis



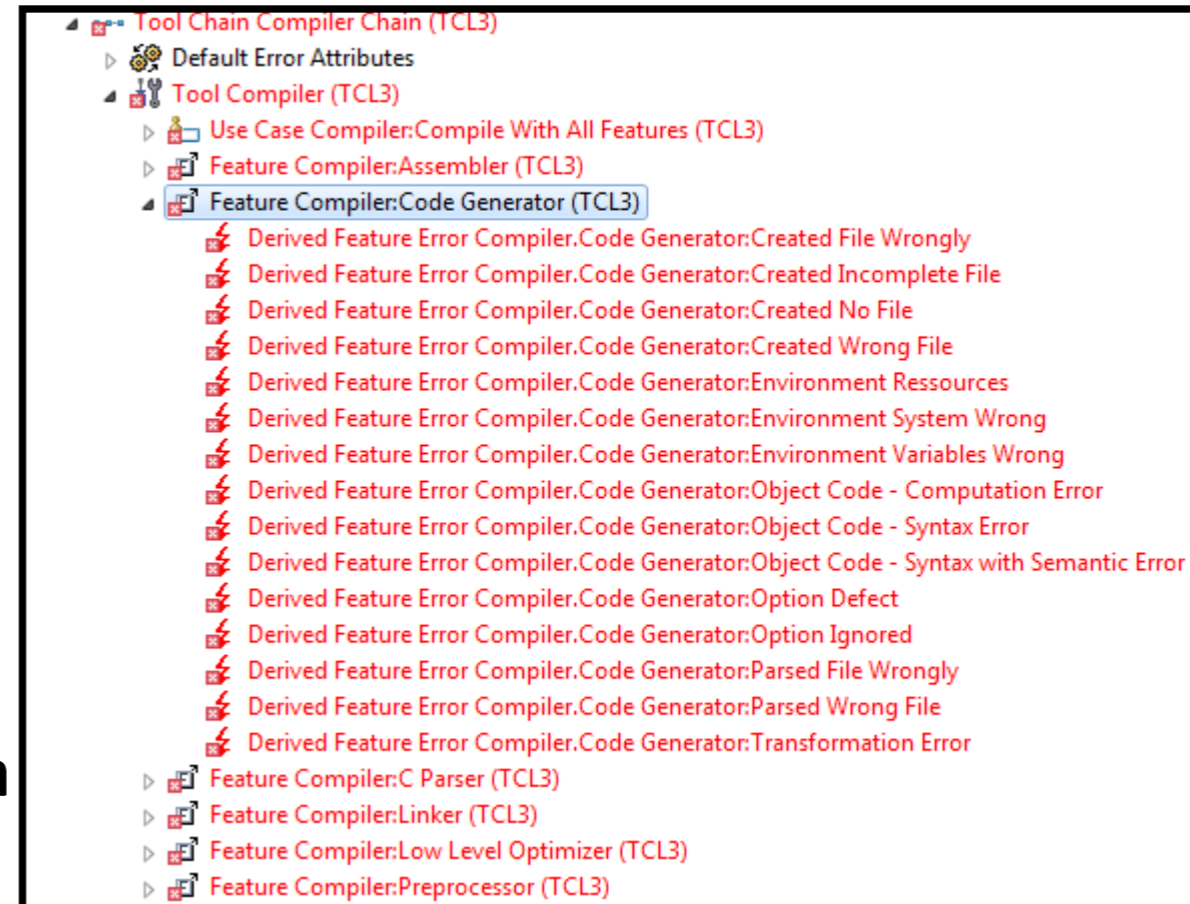
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# Tool Chain Analyzer (TCA)



- ▶ Automatically determines the TCLs of tools and tool chains
- ▶ Bases on a formal model of
  - Tools
  - Use cases (and features)
  - Errors
  - Detection/prevention mechanisms
  - Artifacts (inputs & outputs)
  - Qualifications for tools & features
- ▶ Supports generic error models
- ▶ Checks the validity of qualifications with a
- ▶ Generates reports (.docx)
- ▶ Developed from Validas AG within European research project RECOMP
  - Rich client, based on Eclipse modeling framework
- ▶ Evaluation available at [www.validas.de/TCA152.zip](http://www.validas.de/TCA152.zip)

## Derived Error Model in TCA



# Content: Tool Chain Analysis



- ▶ Motivation: ISO 26262: Tool Confidence
- ▶ Method: Tool Chain Analysis
  - General Error Model
- ▶ Validas Tool Chain Analyzer
- ▶ **Wind River Diab Compiler Qualification Kit**



# Wind River Diab Compiler



- ▶ **Provides Classification Information**
  - Features
  - Potential Errors
- ▶ **Provides Qualification Support (Qualification Kit)**
  - Instrumented Compiler
  - Tests
  - Application Method
- ▶ **More Details will be presented at <http://www.embedded-konferenz.de/>**

## WIND RIVER



**Embedded Konferenz 2012**

- ▶ Sichere Geräte entwickeln
- ▶ Android einsetzen
- ▶ Entwicklungseffizienz steigern

3. Juli 2012  
Stuttgart, Mövenpick Airport Hotel



# Summary



- ▶ Systematic method to fulfill the ISO 26262 tool requirements
- ▶ Generic Error Model for repeatable results
- ▶ Validas Tool Chain Analyzer
- ▶ Wind River Diab Compiler Qualification Kit

# Thank You!



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