AdaCore

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Lean R&D for Open Qualifiable Tools

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Thanks!
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First Tool Qualification Symposium

AdaCore – Open Source Tool Provider for High-Integrity Systems

Development Environment

Multi-language development suite (Ada, C/C++)

Validated compilers (1.4M test results / day)

Certified run-time

Src-to-obj code traceability study

Qualified verification tools (stack usage, coding standard, …)

QA & Testing for Embedded

Qualified structural coverage analysis

up to MC/DC (no instrumentation)

Advanced Static Analysis

High-security development (EAL 5-7)

Formal methods & verification

DO-178B/C, ECSS, EN-50128 Qual./Cert. Kits

http://www.adacore.com/customers

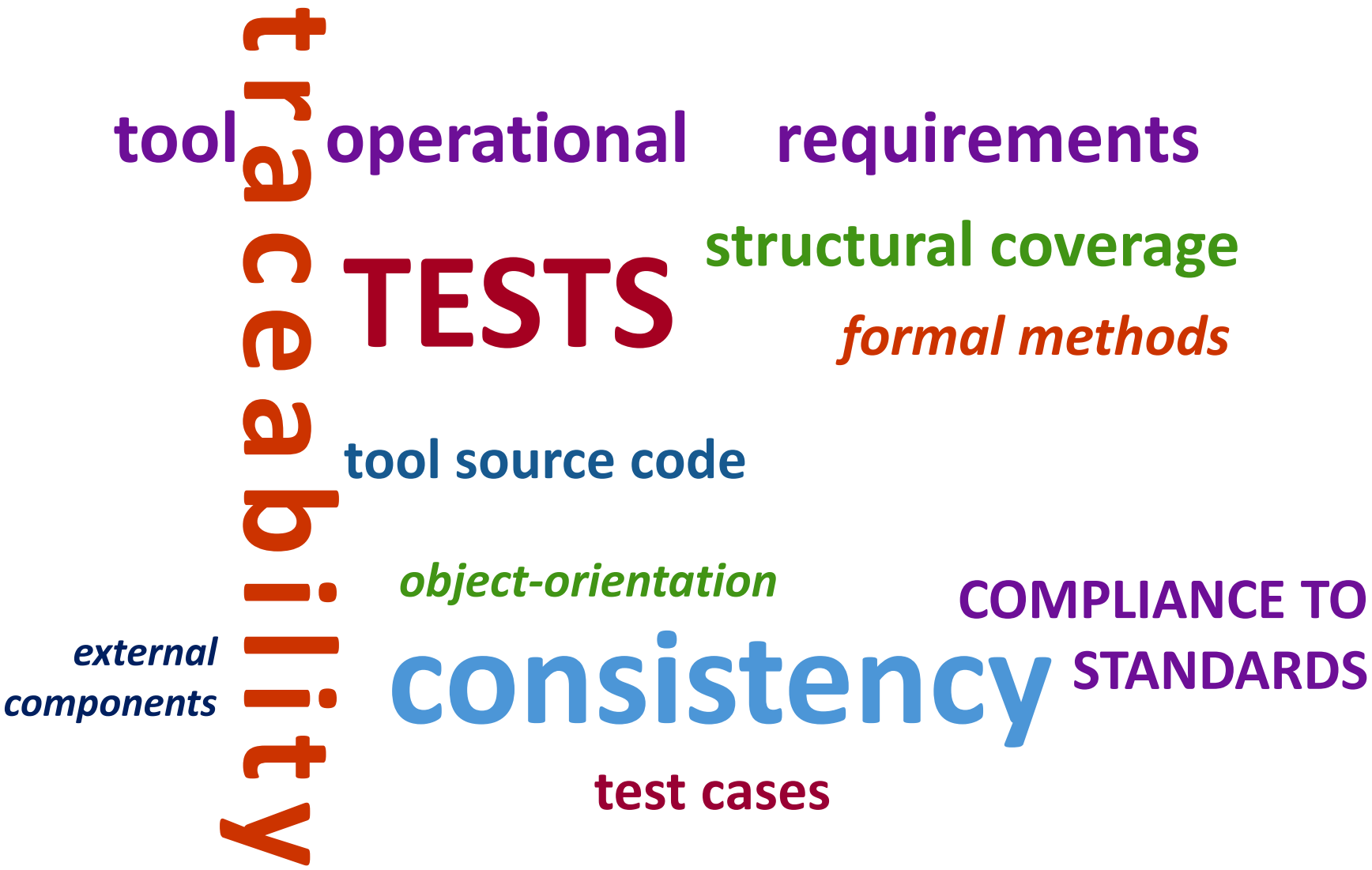
Warning! The meaning of "Tool Qualification" in this presentation!

- **Not a generic *"good enough"* stamp**
- **Always to avoid manual activities without manual review**
- **Always for a precise objective**
  - Coding standard verification
  - Structural coverage analysis
  - …
  - **In the case of a code generator**
    - *Manual review of source code (compliance/consistency)*
    - *Low-level requirement-driven testing*
    - *Structural coverage*

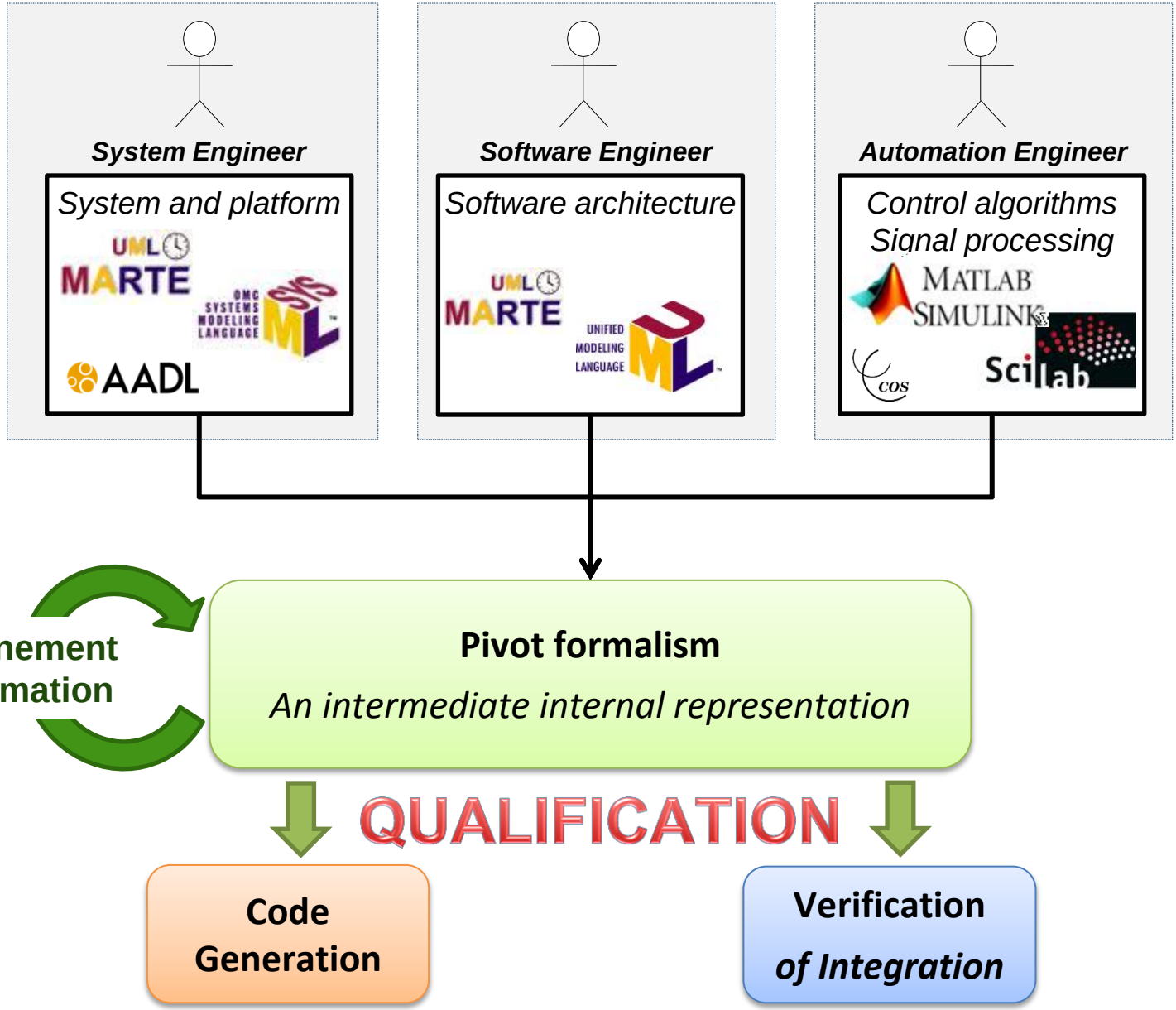
Is it really that difficult to qualify a code generator?

Project P - One core question

Is it really that difficult to qualify a code generator? Yes, it is



Some additional difficulties



DO-330 & other annexes

One of the first applications

Open

Role of the consortium and business model

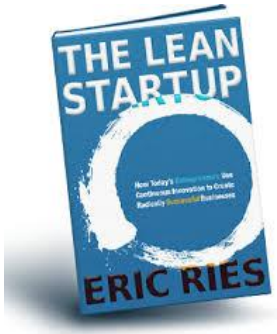
Minimize re-qualification effort

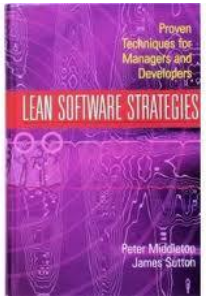
Add new input/output languages, bug fixes, …

Multi-domain

Avionics, space, automotive, …

From Fordism to Lean Manufacturing to the Lean Startup





agile

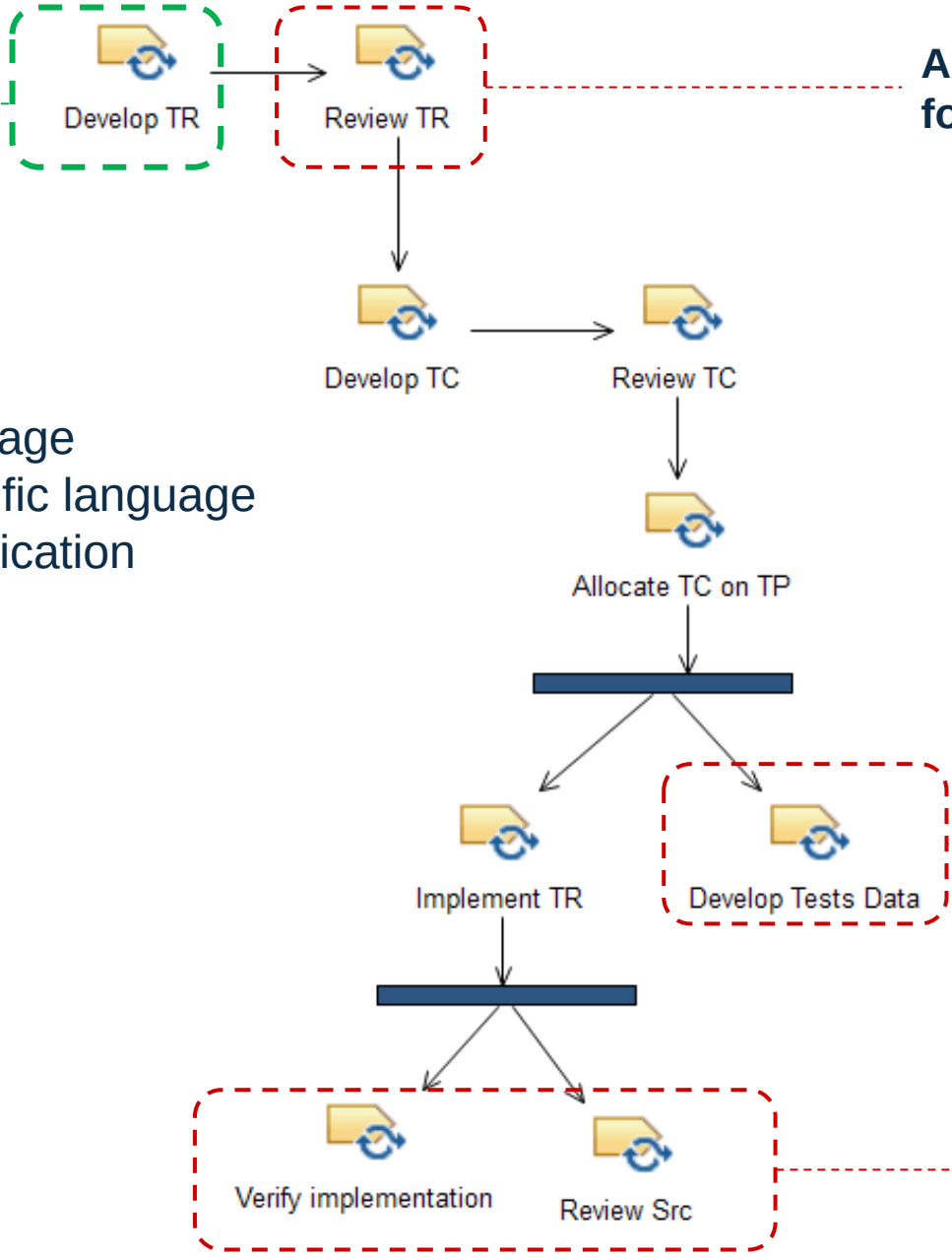
TOYOTA

FORD MOTOR CO.
DETROIT, MICH.

Our practical approach

1. Process modeling & process lines
2. Architecting of qualification material
3. Component-based development
4. Extensive use of metamodeling techniques
5. Advanced programming techniques
6. Constant measuring

Step 1 – Process modeling & process lines

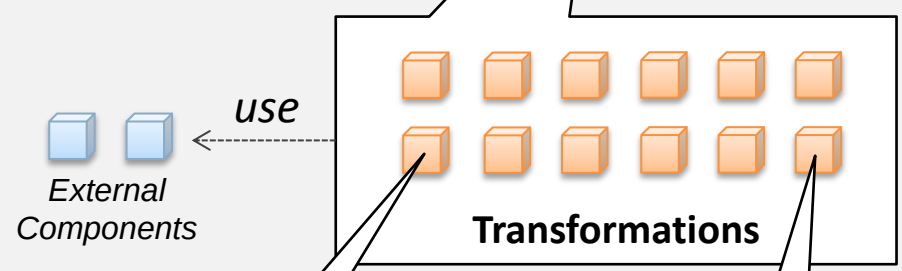


Alleviated if using formal specifications

Can use:

- Natural language
- Domain specific language
- Formal specification

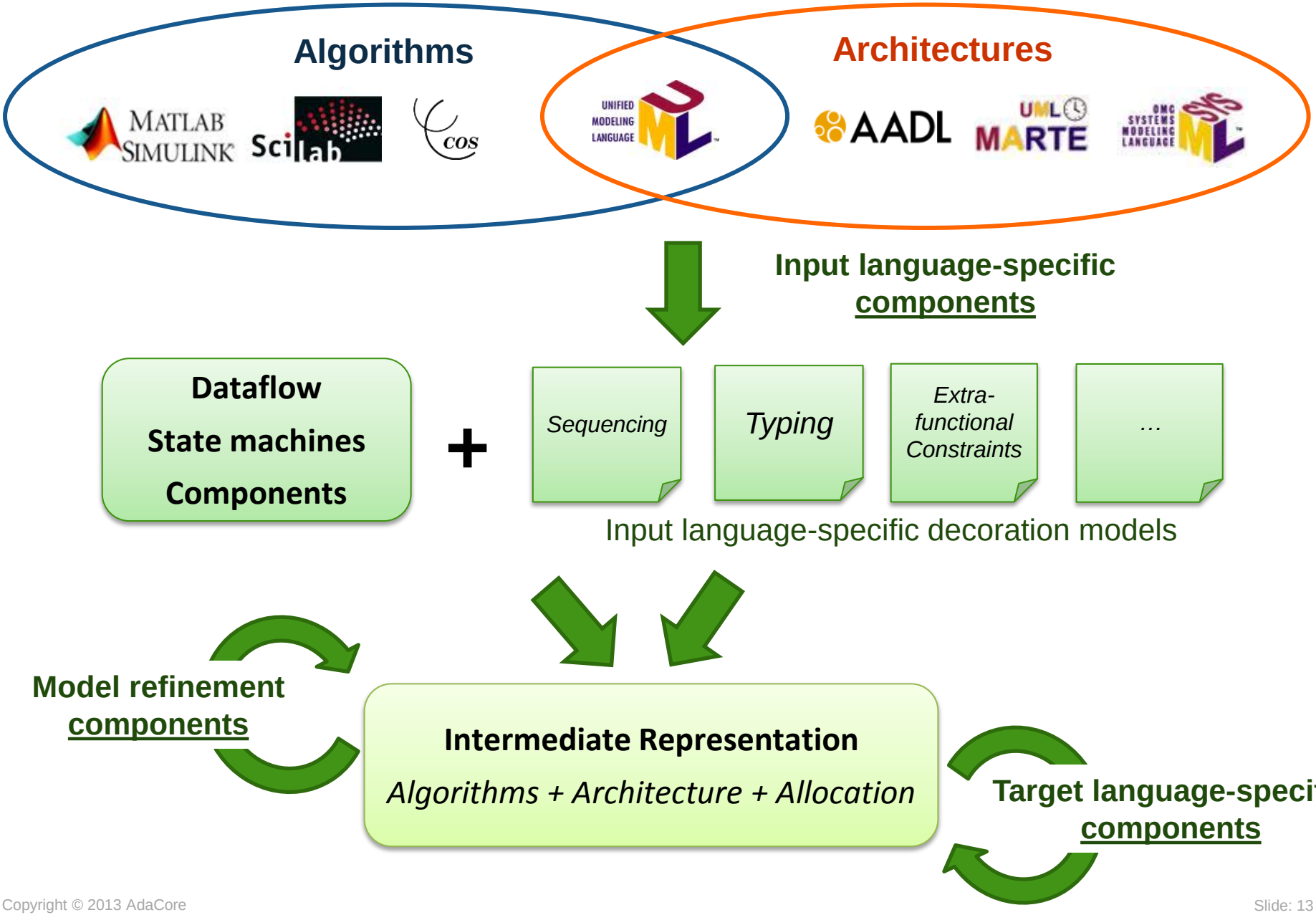
Step 2 – Architecting of qualification material



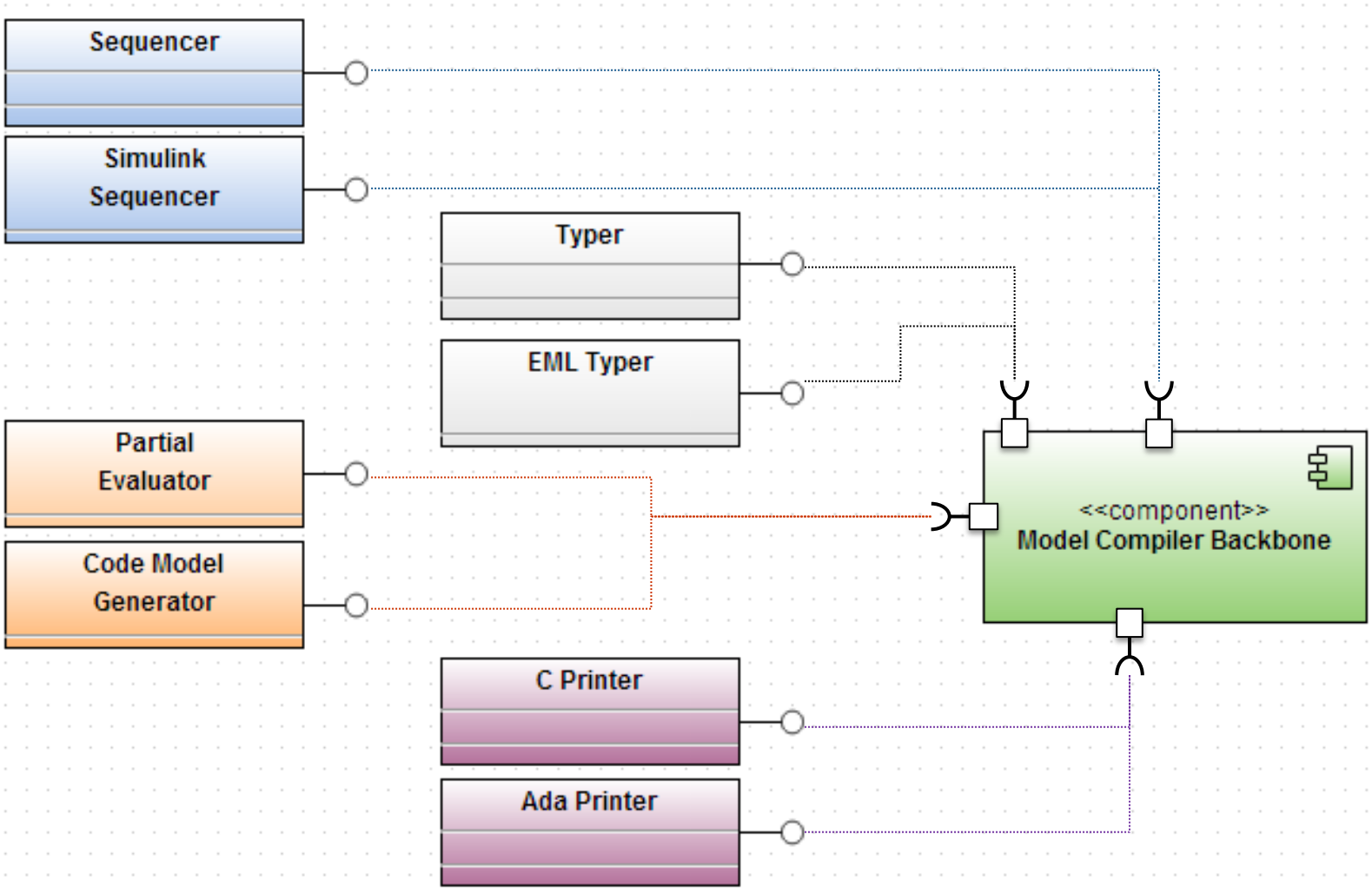
Tool Architecture
traceable to src subprograms

Tool Requirements
traceable to src subprograms

Step 3 – A Component-based approach for qualification-by-composition



Step 3 – A Component-based Approach for qualification-by-composition (I)



Multiple configuration

Composition of different components

Evolution of qualification material

To follow tool releases & emergence of new requirements

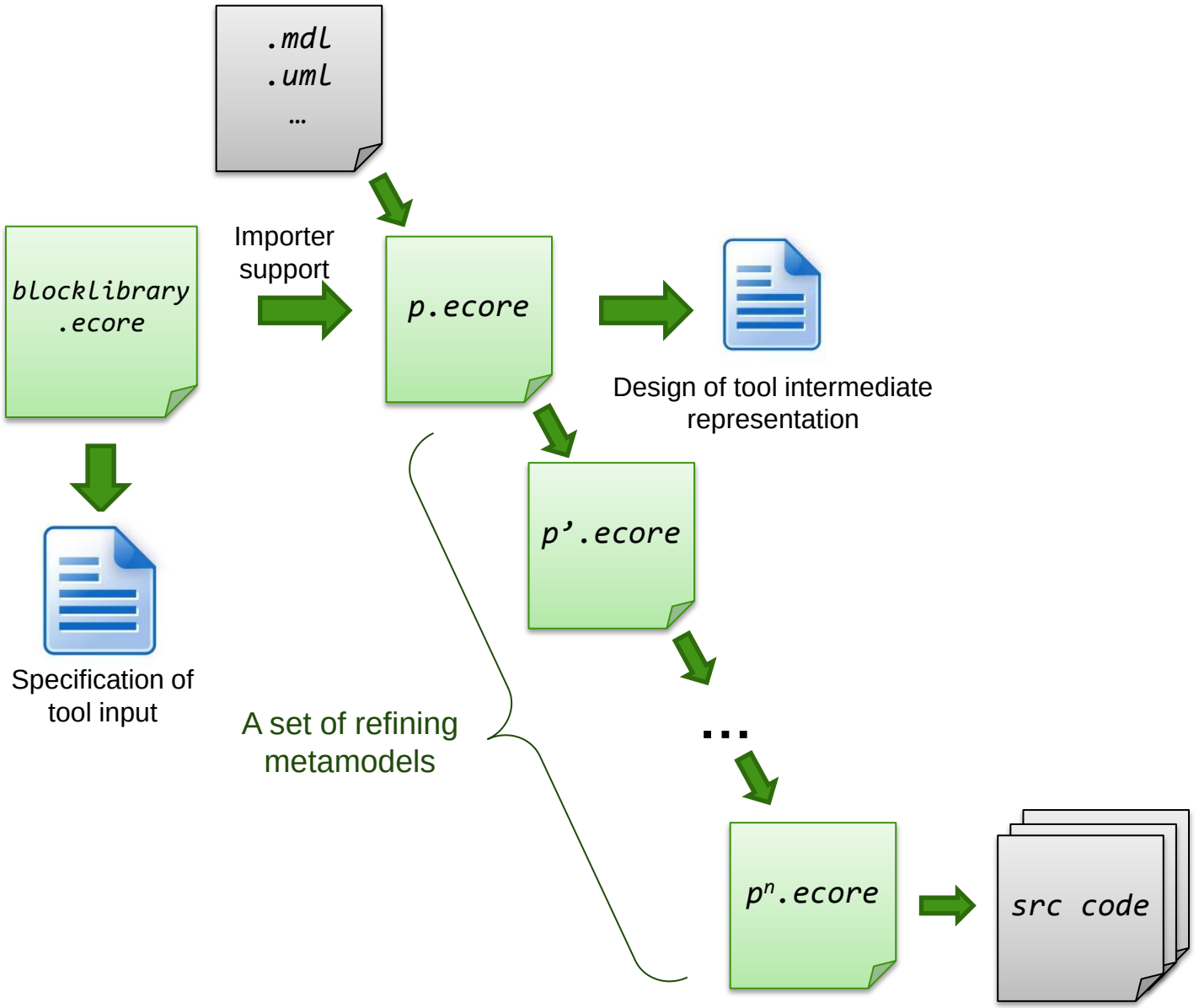
Continuous qualification

Qualification as part of common development activities

OPENCOSS, Safecer

FP/Artemis collaborations

Step 4 – Extensive use of metamodeling techniques



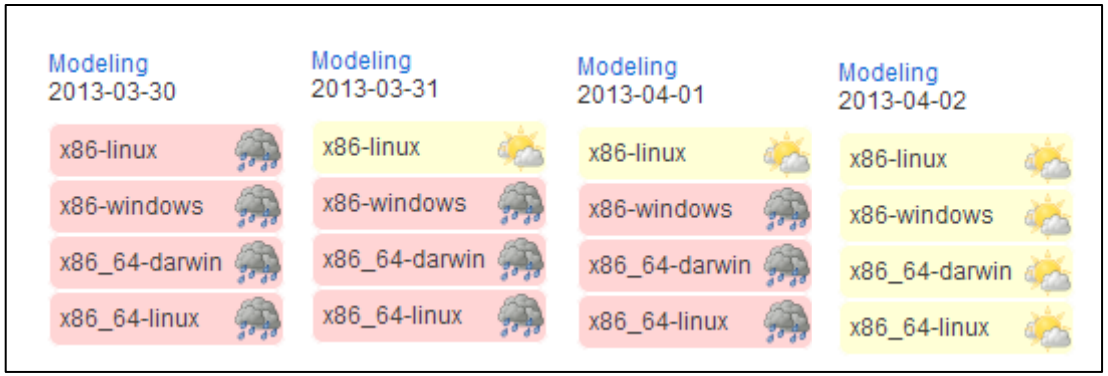
Note: EMF XMI is used as an interchange format, the P toolset does not depend on the EMF framework.

Tool Requirements ⇔ Pre/Post conditions

Unambiguous, Verifiable, Traceable

```
procedure Calculate_Total_Order
   (Self   : in out Sequencer;
    Blocks : Block_List)
with Post =>
   --  @tr TR_SEQ_1
   --  The executionOrder of each block shall be bigger than the
   --  one of the predecessors unless the block has internal memory
   --  or is a controlled block.
   (for all Elem of Blocks =>
       (if not Elem.Get_inControlPorts.Is_Empty then
           Elem.Get_executionOrder = -1
        else
           (if Elem.Is_DirectFeedThrough then
               (for all Pre of Get_All_Predecessors (Elem) =>
                   (if Pre.Is_DirectFeedThrough then
                       Elem.Get_executionOrder > Pre.Get_executionOrder))
            else Elem.Get_executionOrder = -1)));
```

Step 6 – Constant quality measurement



Continuous building &

Nightly test results

Qualification-specific metrics

Conclusion

- **A Lean path to the qualification of code generators**
  1. Process modeling & process lines
  2. Architecting of qualification material
  3. Extensive use of metamodeling techniques
  4. Component-based development
  5. Advanced programming techniques
  6. Constant measuring

- **Soon available to the community**
  - A first step towards collaborative tool qualification

www.open-do.org/projects/p