MathWorks Automotive Conference 2015
Simon Fürst, 2015/09/24.

MODEL-BASED SOFTWARE DEVELOPMENT: AN OEM'S PERSPECTIVE.

BMW GROUP

MODEL-BASED SOFTWARE DEVELOPMENT AT BMW.

- Software development with MATLAB & Simulink is used in wide range for the vehicle software developed at BMW.
- BACE (BMW AutoCoding Environment) is BMW‘s central configuration of the MATLAB & Simulink tool chain.
  - It is currently in use by about 400 users.

Door Control

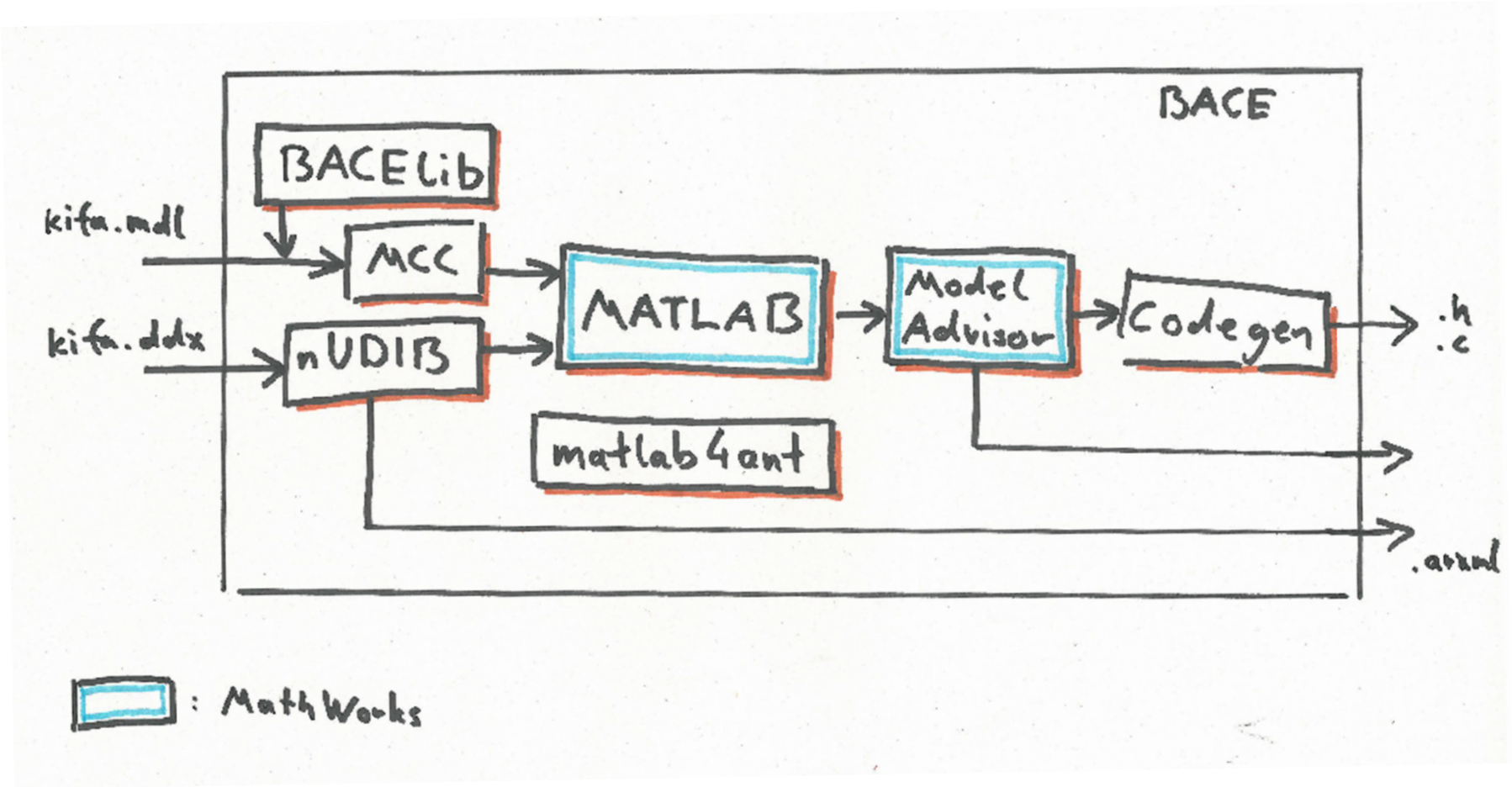
Energy Management, DAS functions, Seat-Belt-Reminder

Chassis Control functions

SW Components in Combustion and Electrical Engine Control, Battery Management

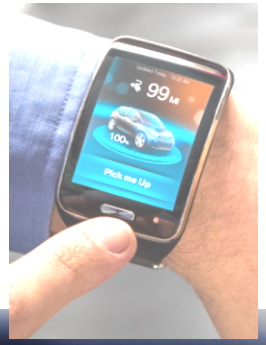
… and further SW in BMW motorcycles

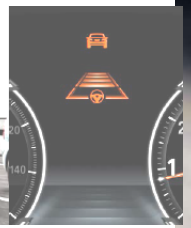
BACE FEATURES.

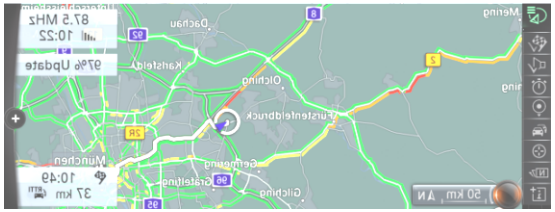


CHALLENGES.

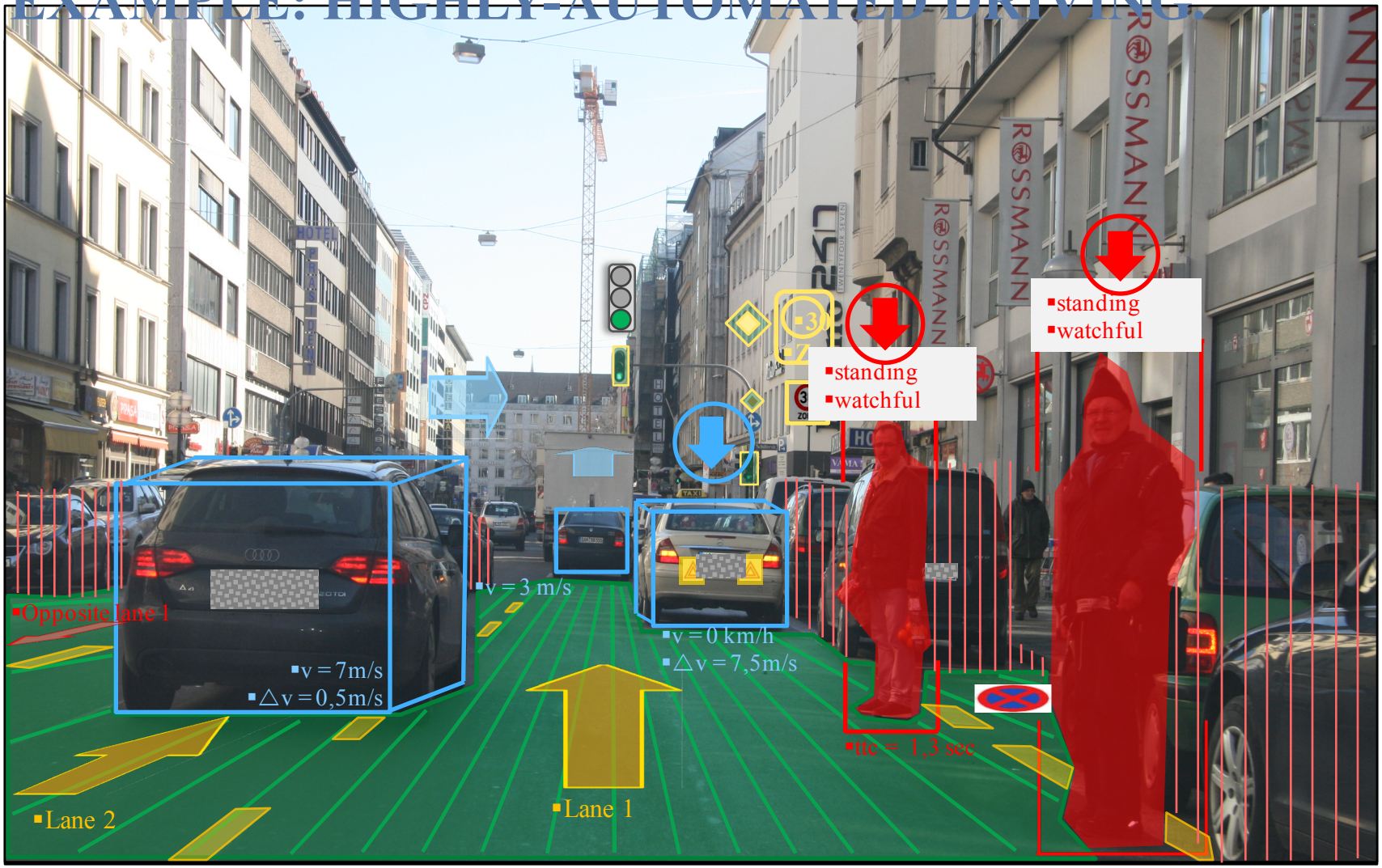
TIME-TO-MARKET DECREASES. EXAMPLES: E-MOBILITY AND CONNECTED MOBILITY SERVICES.







DIGITALIZATION - COMPLEXITY OF FUNCTIONS INCREASES.
EXAMPLE: HIGHLY-AUTOMATED DRIVING.

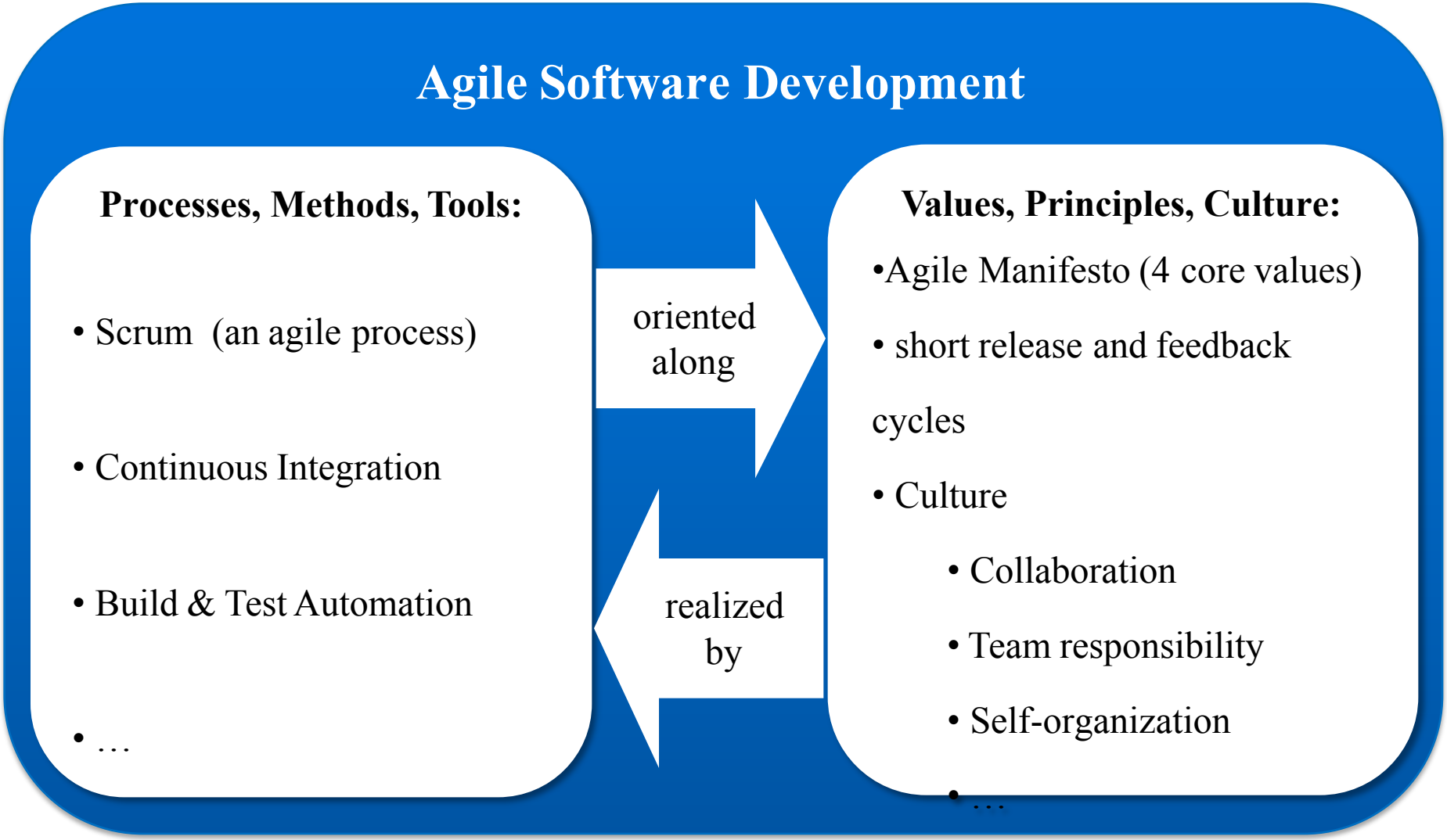


THESE CHALLENGES FOSTER USING AGILE DEVELOPMENT PROCESSES.

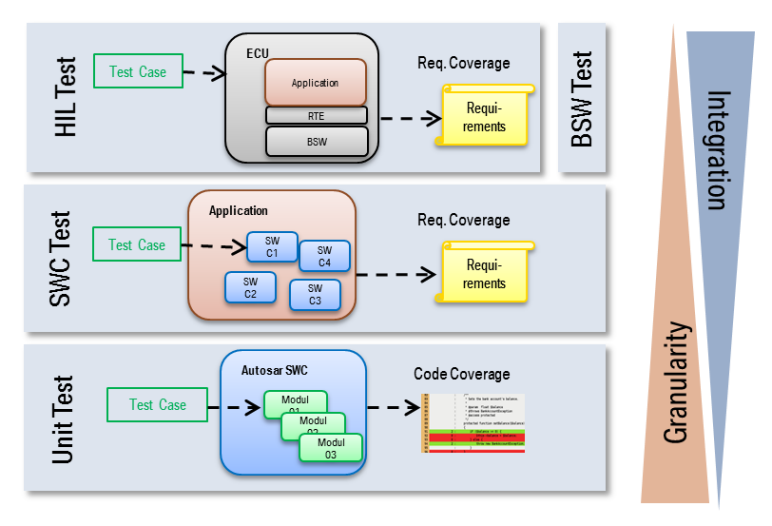
An analogy to motorsports

In motorsports	In an agile software project
It is crucial to	short release and feedback cycles
break in time	allow us to detect problems early
and to steer	and to solve them
in order to	in order to
reach the finish line faster.	develop the right function in the required quality and budget faster.

AGILE CONSISTS OF P/M/T AS WELL AS OF VALUES, PRINCIPLES AND CULTURE.



CONTINUOUS INTEGRATION INSTEAD OF BIG-BANG INTEGRATION.



- Plan and **integrate** continuously.
- Feature **fast feedback.**
- Check-in, compile and **test frequently.**
- Invest in **build-** and **test automation.**

Key features:
Adaptable, transparent.
Continuous integration enables to innovate faster and deals better with complexity.

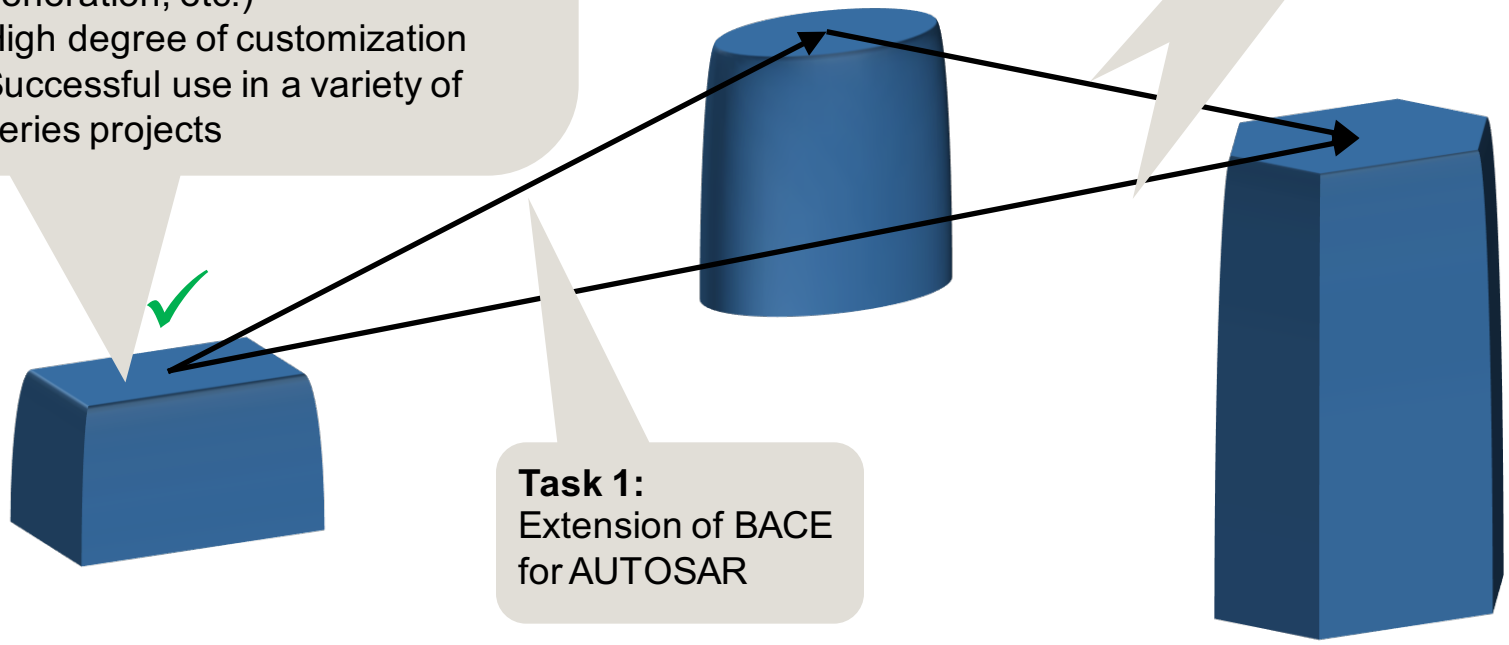
EXAMPLE ON (IMPORTANCE OF) CONTINUOUS INTEGRATION.

EXAMPLE FOR CI USAGE: DEVELOPMENT OF BACE FOR AUTOSAR CODE GENERATION, WITH MATHWORKS.

Starting point:
- BMW specific Toolbox BACE (BMW AutoCoding Environment), based on MATLAB, Simulink and Embedded Coder
- Used for non-AUTOSAR SW-development (modeling, code-generation, etc.)
- High degree of customization
- Successful use in a variety of series projects

Intermediate step: support for AUTOSAR only

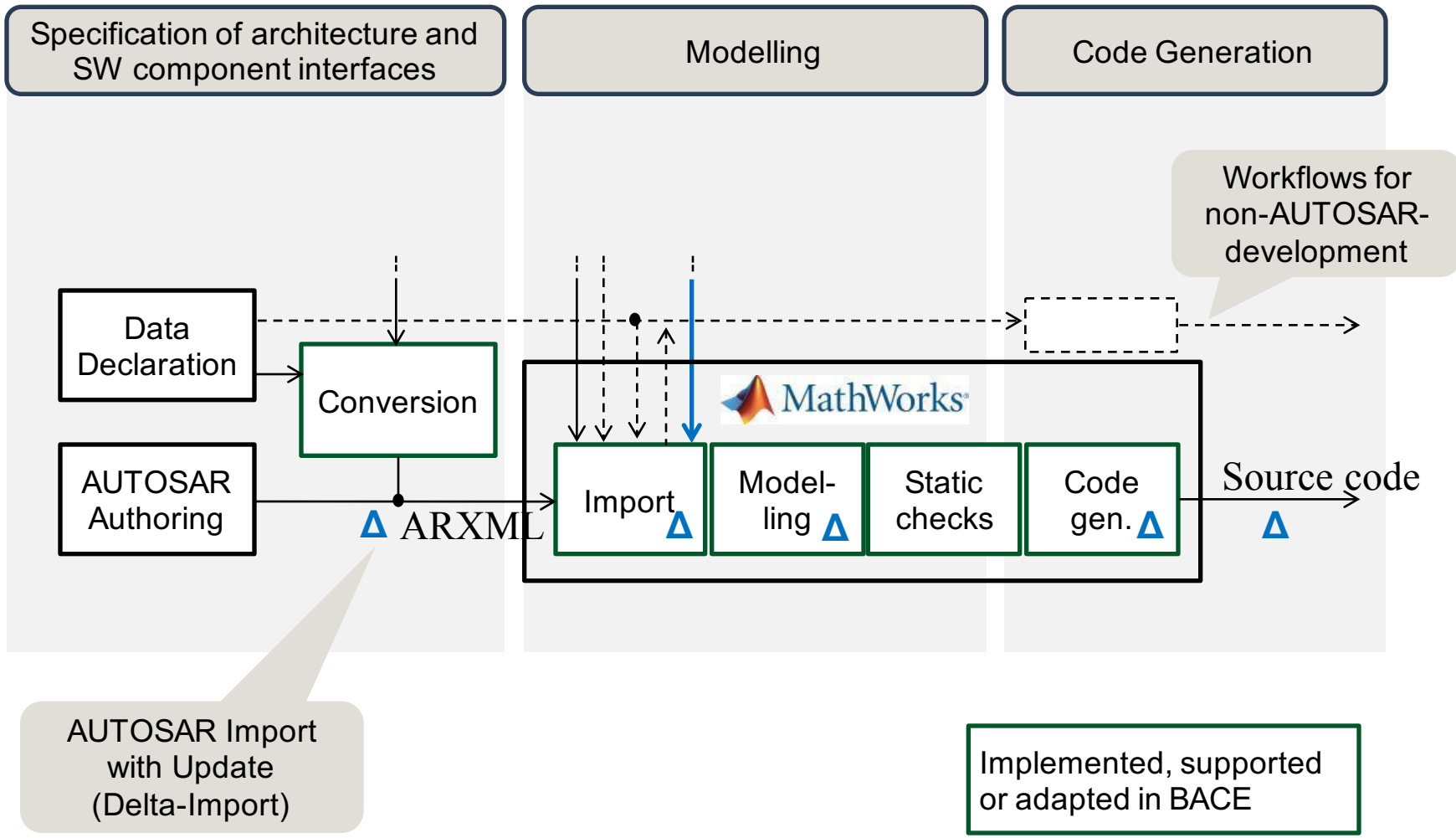
Task 2: Merge of the toolboxes for AUTOSAR- and non-AUTOSAR-based development



Task 1: Extension of BACE for AUTOSAR

[Seider, Validas AG]

BACE WITH AUTOSAR.
SOFTWARE DEVELOPMENT WORKFLOW.



[Seider, Validas AG]

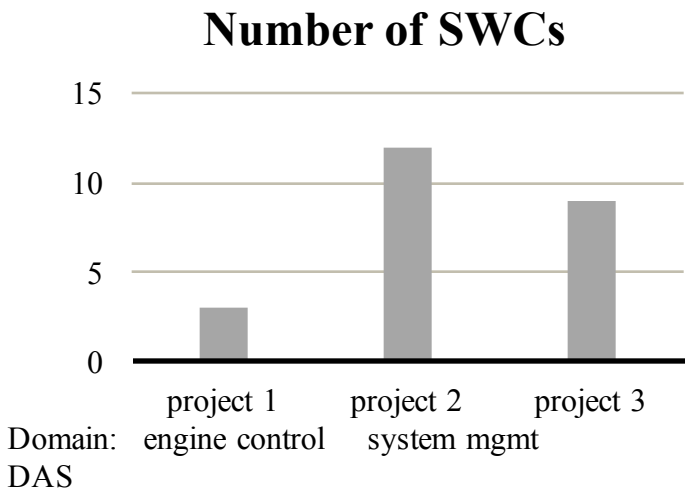
PILOT PROJECTS PROVIDED FAST FEEDBACK ON RELEASES.

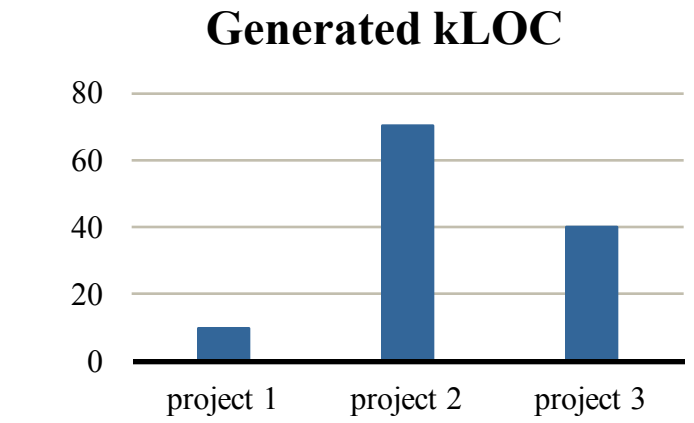
3 pilot projects

- From different BMW departments
- Milestone successfully completed
- 24 SW-Cs
- ~120.000 LOC generated from SW-C-models

Important:

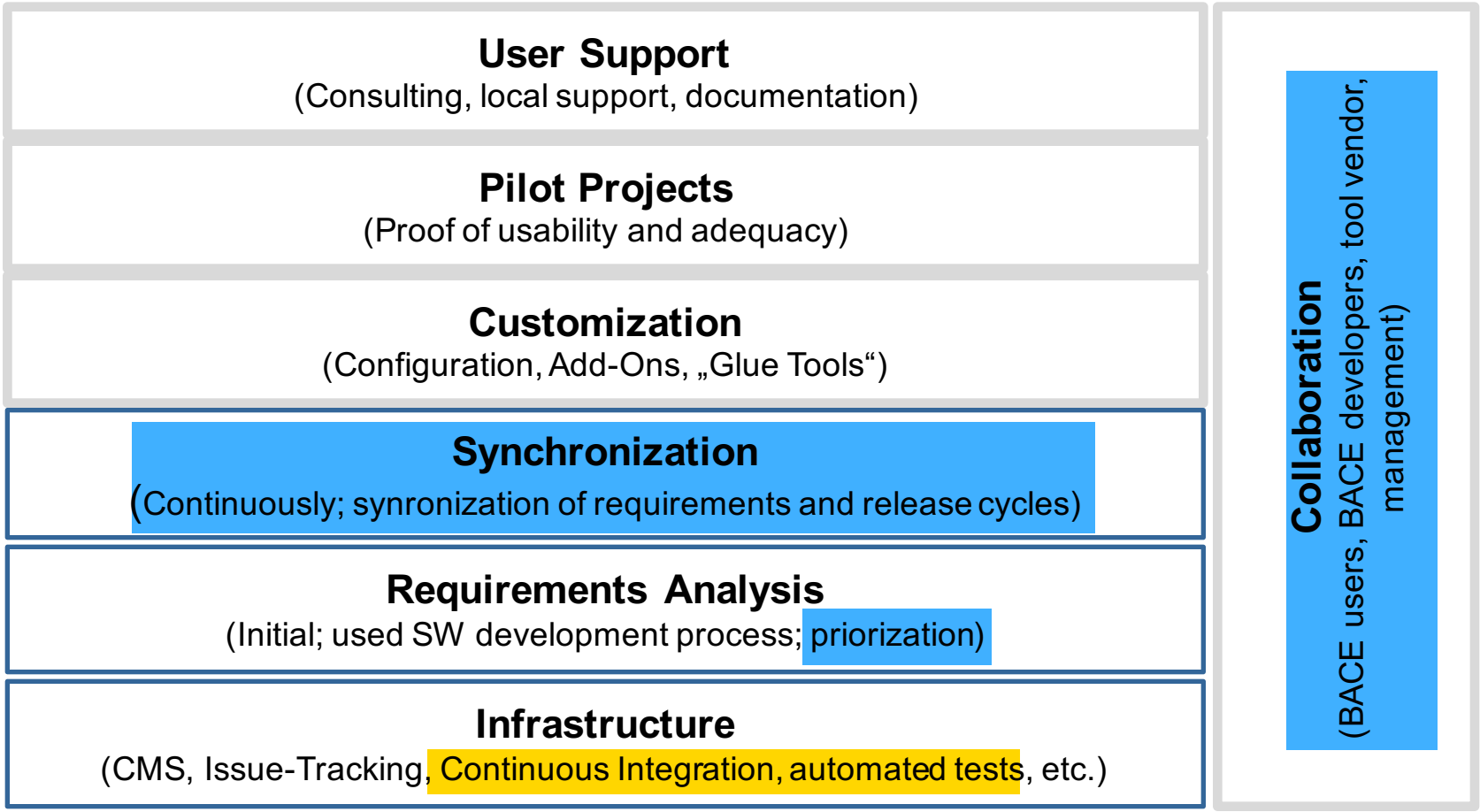
- Representative selection of pilot projects (AUTOSAR has many features)





[Seider, Validas AG]

SUCCESS FACTORS IN THE DEVELOPMENT OF BACE FOR AUTOSAR AND RELATION TO AGILE PRINCIPLES.



related to agile principles

related to Continuous Integration and agile

CONCLUSION AND SUMMARY.

AGILE AND MODEL-BASED DEVELOPMENT.

- Model-based development supports working on „the right level of abstraction“.
- It can
  - facilitate communication between domain experts and software specialists and
  - increase speed of development (generate instead of code).
- Both factors support agile development.
  - Communication and short development cycles are essential in agile development.
- Wish-list:
  A GERRIT based review process for Simulink models – as adoption of established practices from open-source development projects.

SUMMARY.

- A large part of the vehicle software at BMW is generated with embedded Coder from MATLAB & Simulink models.
- Support for Agile Development and Continuous Integration is central for the future evolution of this tool chain.

THANK YOU FOR YOUR ATTENTION.