Agile Model-Driven Engineering

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Challenges

Exponential growth of software!
  – maximized in e-vehicles

Difficult to be *innovative* with external sw suppliers
  – requires tight, robust and well-defined APIs!
  – very very slow feedback loops, if not!

Off-the-shelf ≠ plug-and-play
  – due to complex dependencies
Increase in-house development

+ Control of software development
+ Speed

- Volvo Cars is not a C organization

The challenge is to create VCC++

- keeping the domain expertise
- not getting too large
MDE - Model-Driven Engineering

Let domain experts develop SW!
- Quality
- Reuse
- Speed

MDE is a strategy to utilize
Abstraction – Simulation – Automation
to facilitate sw-development and test

Note: Graphics is not the key!

Note also:
Next step is agile!
Implementation

- **SW abstraction** using Simulink
- **Simulation** using an executable environment
- **Automation** of code generation and integration
Specification

- System design abstraction
- Source model automation (prepare models)
Integration

- HIL (test rig) test using environment **simulation**
- **Automation** of regression test and data feedback
Agile MDE:

Agile development of car features

Agile development of tailor-made MDE framework

Continuous integration (automated)

Still no free lunch...

Seamless with MDE framework!

Fast feedback!

Progress can be measured
Problem zones!!

Architecture

- Architecture models

Running code

- Executable boundary models

Both transformations shall follow AUTOSAR (standard)

Several(!) not in-house parts of these transformations cause trouble

Agile MDE requires fast loops!

1h

Test (“MIL”)

Test (“HIL”)

\[ \text{1 function} \quad \text{1 pizza team} \]

\[ \text{requirements, formal verification} \]

\[ \text{belongs to (hw-) domain group which belongs to department, etc.} \]

\[ \text{4 months} \]

Source

- Executable sw models

Both:

\[ \text{belongs to (hw-) domain group which belongs to department, etc.} \]
For agile MDE
external organizations are both risk and business.
The CPU load

• Quality of generated code is no longer a problem
• Quality and efficiency of AUTOSAR system software is a serious problem

Running code ➔ Limping code 😞

• Complicated and undeveloped AUTOSAR meta model.
• Non robust interfaces & services.
• “Basic SW” (system) modules can be faster? Or?
Wishlist

MDE for embedded software:

1. Hide the complexity behind tight APIs (like in web development)
2. Hide the model transformations (like html to browser)

• Better and open-source tools
• kill-your-darlings standards!