SCALING AGILE IN MECHATRONICS-DRIVEN COMPANIES

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<th>Goal</th>
<th>Industrial Partners</th>
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<td>Systematically investigate</td>
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<td>expectations and challenges</td>
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<td>from scaling agile</td>
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<td>beyond pure software</td>
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<td>development</td>
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CASE STUDY: DATA COLLECTION

1. Individual and separate on-site workshops at each company
2. Survey with online questionnaire
3. Joint workshops with representatives from all companies
TOP EXPECTED BENEFITS OF SUCCESSFULLY SCALING AGILE DEVELOPMENT

1. Higher quality
2. Faster time-to-market
3. Shortening lead-times
4. Maximize output from existing development resources
5. Minimize risk to develop wrong things
COLLABORATION & FEEDBACK

Bottom-up: “scaling” agile practices from team-level to the product level

Top-down: “transforming” the involved processes to act more flexibly/agilely → transforming the organisation to support individual teams?

Once per project

3-6 months

2-4 weeks
TOP CHALLENGES TO ACCOMPLISHING SCALED AGILITY

1. Better collaboration between all disciplines
2. Changing the mindset in the organization
3. Differentiate lead-times
SURVEY RESULTS ON CHALLENGES

- Flexibility in testing facilities: 96%
- Efficiently structure the organization: 96%
- Understanding agile along the value chain: 96%
- Frequent releases requires good planning: 93%
- Adaptation to frequent releases: 93%
- Inflexible development process: 91%
- Mindset in the company: 91%
- Plan large–scale projects: 91%
- Poor predictability in SW development: 89%
- Overcoming established ways of working: 89%
- Missed specific expertise: 83%
- Long feedback loops: 83%
- Understanding large–scale architecture: 80%
- Manual testing: 80%
- Coordinate between different teams: 78%
- Product–specific functionality: 76%
- Focus on testing at the end: 76%
- Difficulty to avoid big–bang testing: 76%
- Production setup for volume: 76%
- Specific product–requirements: 76%
- Sell more with agile capabilities: 76%

Bars represent the percentage of respondents who found each challenge important, from 'not relevant' to 'very important'.
TOP CHALLENGES TO ACCOMPLISHING SCALED AGILITY

- Missing flexibility in current test facilities
- Adopting Agile in an organization’s mindset
- Collaboration between all disciplines
- Differentiate lead-times
RESULTS

Identified 27 challenges when scaling agile, in 4 areas:

• Leadership
• Collaboration
• System/product focus
• Customer focus

Where only the third area is unique for mechatronic systems
MISSING FLEXIBILITY IN TEST FACILITIES

Integration & system tests require mechanics, hardware and software

How to automate build and test, when build actually means \textit{physical} building?

How to do incremental and regression testing on mechanics?
Companies with a long history

Manufacturing setup for a new car model cost more than entire R&D budget
COLLABORATION BETWEEN DISCIPLINES

The profession of mechanical, control and software engineers is formed already at university

How about sales engineers? Marketing?

All disciplines are optimising their WoW

But not necessarily with the same objectives

Joint planning is the current solution
VOLVO Car Corp.
Electrical Engineering

GPDS ELECTRICAL PROCESS PLAN

Integration Status

DV Development... Function, System and/or Component available for initial development testing in IT.

DI Design Intent... Function, System and/or Component passed development testing and available for verification testing in IT.

PI Production Intent... Function, System and/or Component passed verification testing in IT, cleared for production.

PR Production Ready... Component passed verification testing in TT, cleared for production.

BP Bridging Part... Component cleared for production in M1 and cleared for testing in TT.

Component Architecture

**Electronics Control Unit (ECU)**

- **Interface**: Development Timing Requirements
  - **Functional**: All functional interfaces to be defined to E2-build to support M1-
  - **Electrical**: All electrical interfaces to be defined to E2-build to support M1-
  - **Mechanical**: All mechanical interfaces (i.e., bosses, flanges, brackets, etc.) to be developed according to I/OUs UN/UP component partitioning timing requirements
  - **HMI**: All HMI- and Styling Interfaces (A-surfaces) to be developed according to I/OUs UN/UP component partitioning timing requirements

**Production Part Approval Process (PPAP)**

- "PPAP 2" vs. "PPAP 3": A new PPAP process is defined in the M1.
  - **Process**: "PPAP 2" vs. "PPAP 3" compared.
    - "PPAP 2" replaces "PPAP 3" for most functions.
    - "PPAP 3" may be used for special cases, e.g., DVC.

**DVR Development Review Process**

- **DVR**: Development Review Process.
  - **Process**: DVR and PPAP process.
    - DVR replaces PPAP for most functions.
    - PPAP may be used for special cases, e.g., DVC.

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Overview of Volvo Cars stage-gate planning omitted on purpose!

For a very high level overview see e.g:

globalproductdevelo/pdf/
Global_product_development_process.pdf
COLLABORATION & FEEDBACK

Mechanical, hardware and systems development

Embedded software development

Module

Single Team

Project gates

Integration + V&V

Requirements

Delivery

Warranty
DIFFERENTIATE LEAD-TIMES
DIFFERENTIATED LEAD-TIMES

- Project start
- Manufacturing setup
- Start-of-production
- Team 1
- Team 2
- Team 3

Time
CONCLUSIONS

The most important challenges are not special for mechatronics industries
But some be different compared to other domains:

• Integration and system testing
• Complicated value chain
• How often manufacturing can handle deployment of new software
• Deep domain knowledge
NEXT STEPS

Further analysis of all data collected so far

Going from *descriptive* hypotheses to *prescriptive* models for large-scale agile development