Experience from Introducing SysML into a Large Project Organisation

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Outline

- Rationale for writing this paper
- The Gripen NG project
- Rationale for modeling with SysML (in the Gripen NG project)
- Challenge areas
- Experiences made
- Summary

Disclaimer

- The content this paper/presentation is based on industrial experience in one project organization
- We are convinced that similar and more advanced practices are in use in industry
- However, the presentation may be of value for those planning to introduce SysML in large projects

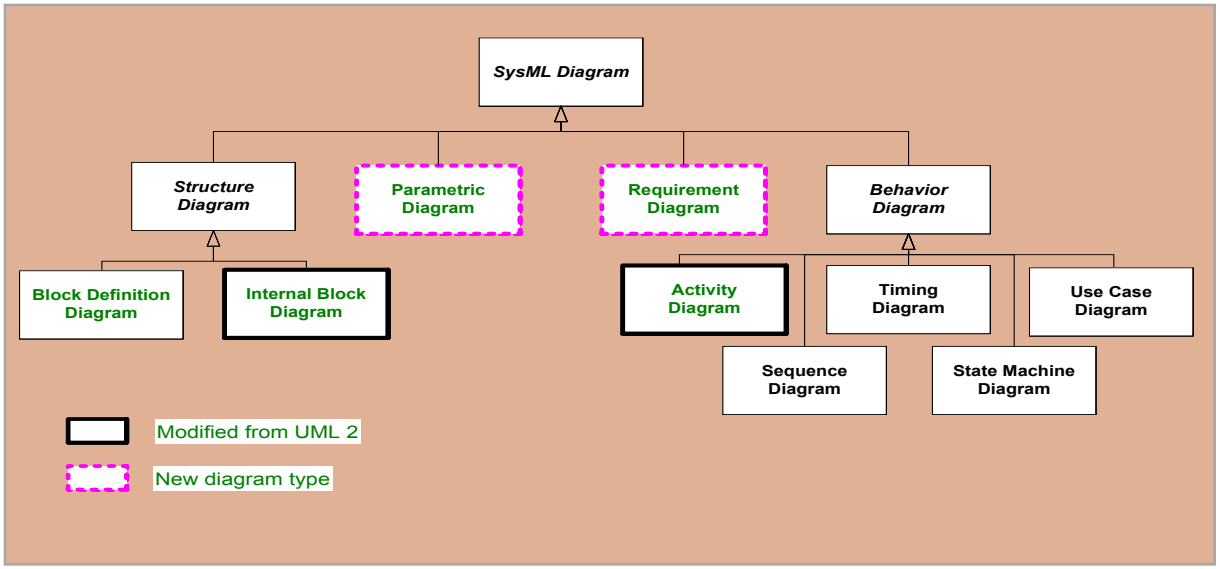
- Erik Herzog is the main contributor of this work

Rationale for writing this paper

- SysML has been around since ~2006
- There are few papers that describe experience from introducing SysML in large organizations
- At SAAB we have tried to introduce “MBSE” several times
  - Perhaps we will continue doing it also in the future
- This paper describes the approach taken for introducing SysML into the Saab 39 Gripen NG development project
- It may encourage similar papers from other practitioners

MBSE/SysML - A wealth of opportunities

- The transition to model based systems engineering opens up a wealth of new opportunities



Potential usages
- Requirements capture
- Design
- Engineering analysis
- V&V planning
- Code generation
- Model integration
- Documentation
- …

- We believe the key for success in introducing MBSE/SysML is to focus on a simple but yet value adding model usage

The Gripen system
Some properties

Process

- Sustained Engineering
- Growth potential
- Many suppliers
- Long lifecycle
- Product family
- Regulations and Standards (FAR/JAR, NATO, RTCA….)

Technical

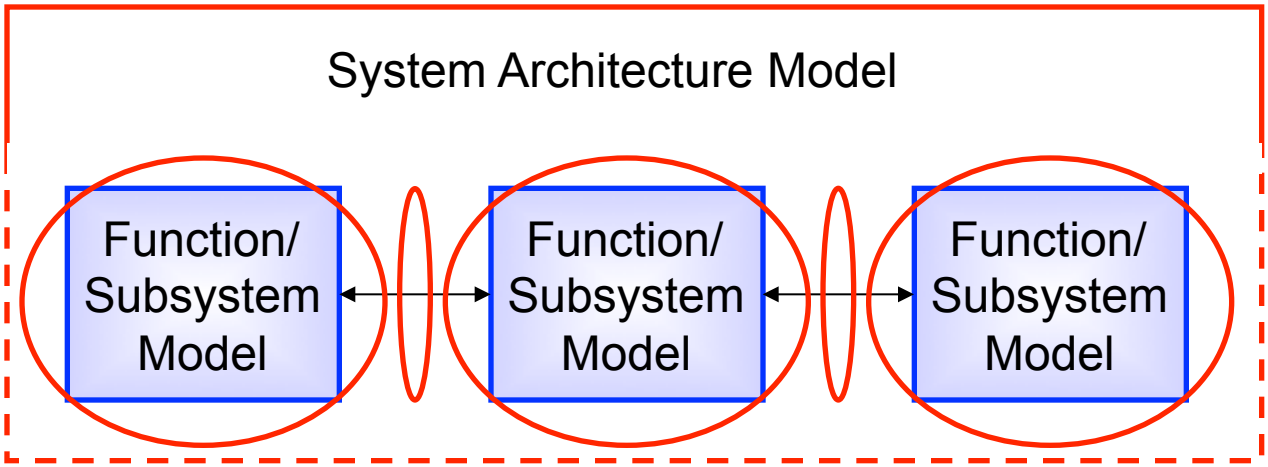
- ~3 M Lines of Code
- >30 computers
- Several data bus comm
- On-condition maintenance
- Redundant back-up systems
- Modularity for product line appr
- Role equipment (“plug-and-play”)

Gripen NG (Next Generation)

- NG is a new member of the Gripen product family
- Some of the modifications from previous version:
  - Modified airframe including larger fuel tanks
  - A new more powerful engine (General Electric F414G)
  - New position of the landing gears
  - Introduction of an ARINC-653 based avionics system
  - Shift to AESA (Active Electronically Scanned Array) Radar

SysML in Gripen NG

- The primary and initial objective with introducing SysML in the Gripen NG project is to improve the capture of system design
- System models are maintained at two abstraction levels
  - An overarching system architecture model
  - Multiple function/subsystem oriented models



Methodology introduction – Challenge areas

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Third parties

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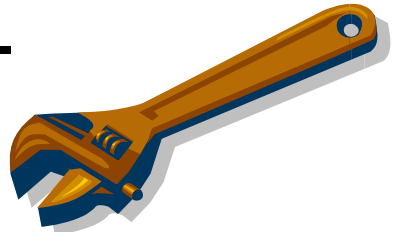

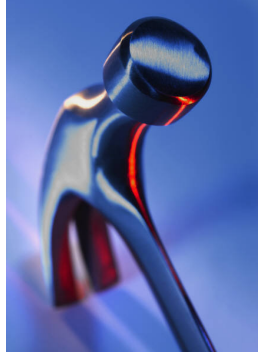

Tool integration

Third parties

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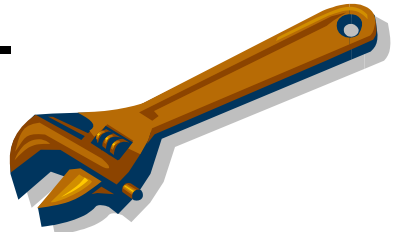

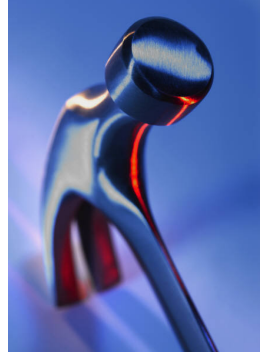

Tool integration

Third parties

Documentation/
readability

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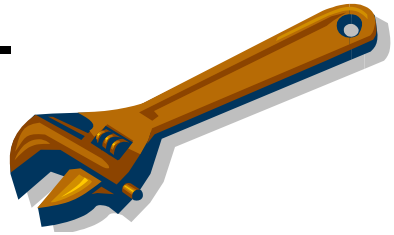

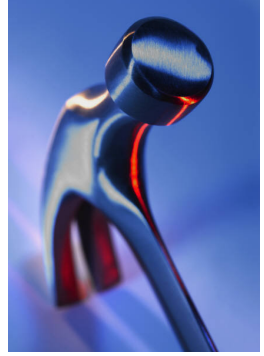

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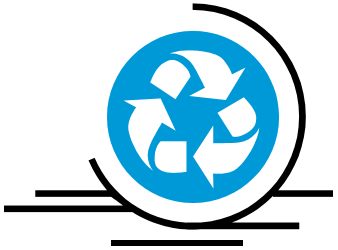

PDM integration

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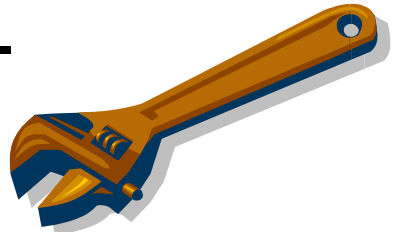

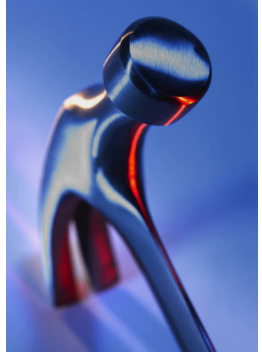

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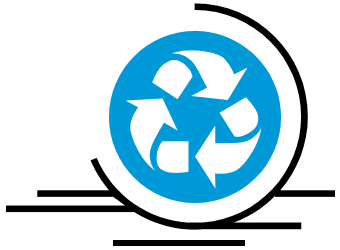
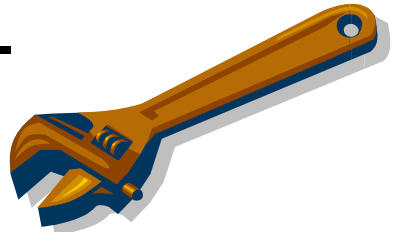


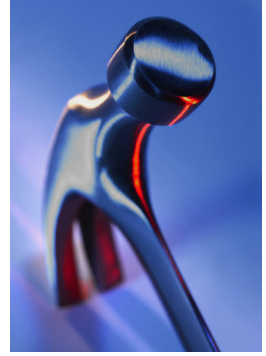
PDM integration

Documentation/ readability

Obsolescence

Methodology introduction – Influence direction





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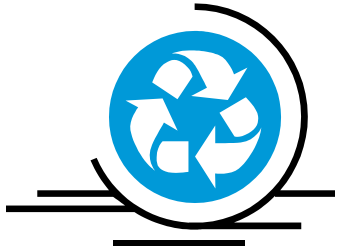

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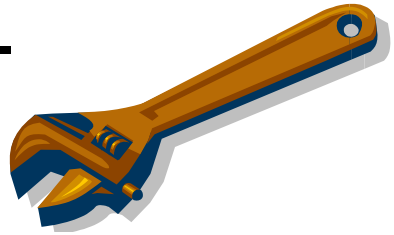

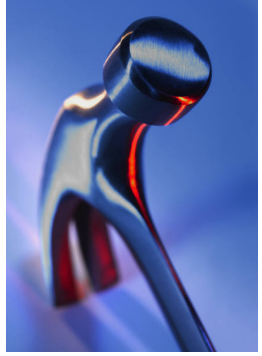

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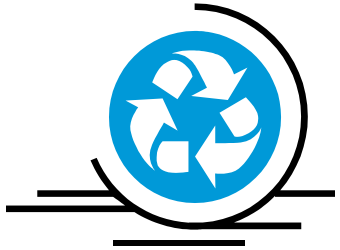

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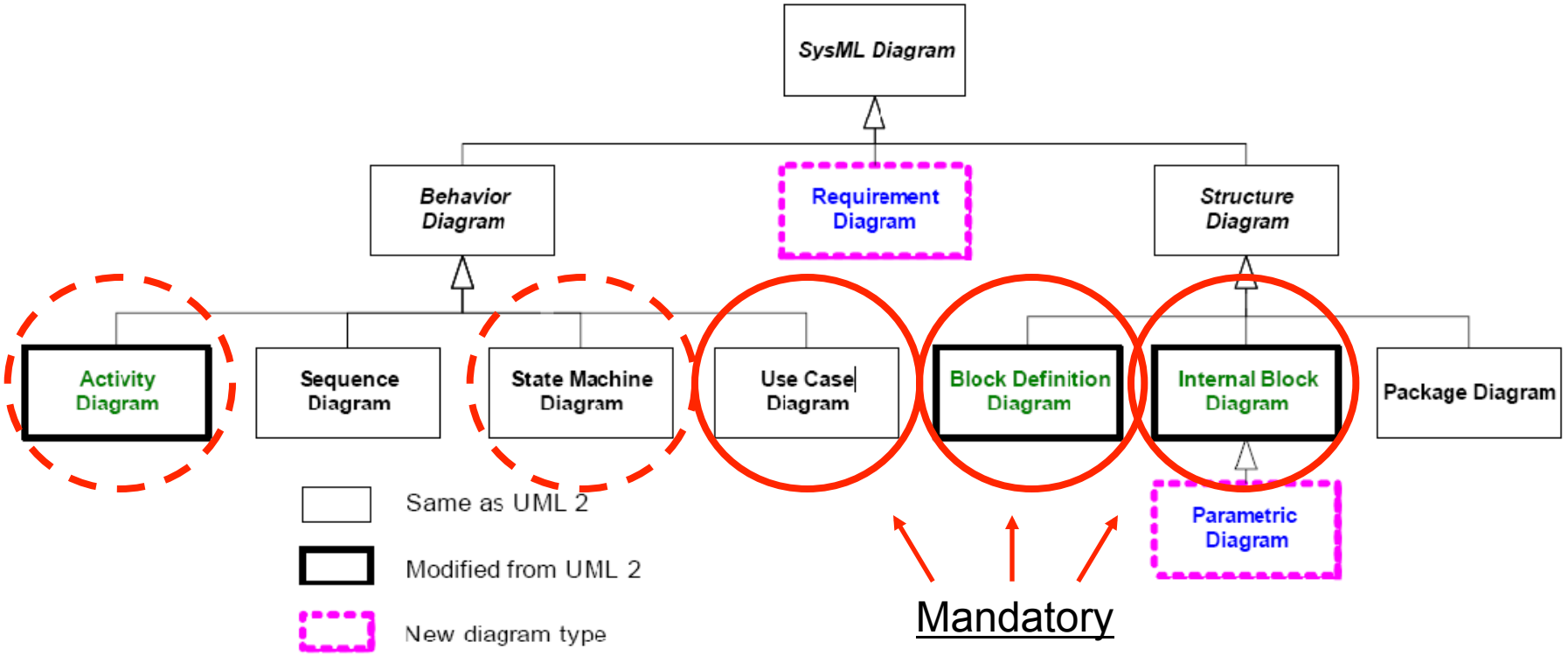
Used SysML subset



Model structure for documentation

SSDD outline (MIL-STD-498)

1. SCOPE
1.1 Identification
1.2 System overview
1.3 Document overview

2 REFERENCED DOCUMENTS

3 SYSTEM-WIDE DESIGN DECISIONS

4 SYSTEM ARCHITECTURAL DESIGN
4.1 System components
4.2 Concept of execution
4.3 Interface design

5 REQUIREMENTS TRACEABILITY

6 NOTES
6.1 Terms and abbreviations

Document template

Package "Scope" 1
- Controlled files 1..*

Package "System-wide design decisions" 1
- Controlled files 1..*

Package "System components" 1
- Controlled files 0..*
- **Block Definition Diagrams** 1..*
  - Picture + Description 1..*
  - Controlled files 0..*
  - **Blocks** 1..*
    - Name + Description 1..*
    - **Tags** 0..*

Package "Concept of Execution" 1
- Controlled files 0..*
- **Use Case Diagrams** 1..*
  - **Use cases** 1..*
    - Name + Description 1..*
    - Controlled files 0..*
  - **Statechart Diagrams** 0..*
    - Name + Picture + Description 0..*
    - Controlled files 0..*
  - **Activity Diagrams** 0..*
    - Name + Picture + Description 0..*
    - Controlled files 0..*

Package "Interface Design" 1
- **Internal Block Diagrams** 1..*
  - Picture + Description 1..*
  - Controlled files 0..*
  - **Parts** 1..*
    - Picture + Description 1..*
    - Controlled files 0..*

Package "Notes"
- Controlled files 1

Experiences made in the project

- Negative
  - Restrictions are difficult to accept for those with a longer experience in UML/SysML
  - Focus on documentation
- Positive
  - Clear scope for model usage, model purpose and the information that should be captured in the model
  - Freedom to use non model information entities where appropriate
  - Acceptance among third parties
- Implementation issues
  - Tools are not stable, migration to new versions have in some cases added capabilities that are not 100% backward compatible with the previous version
  - Tool documentation generation capabilities are very powerful, but with some spurious behavior

Summary

- SysML's potential is the greatest obstacle
- Select an easy to achieve objective for model introduction
- Apply as much as required, but as little as possible to improve one or a few key issues in the current development methodology
- The MBSE tool will need to co-exist with non-MBSE engineers and the existing infrastructure
- Make sure the co-existence is as simple as possible for the non-MBSE groups and tools

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