INDUSTRIAL USE OF MBE: LESSONS LEARNED AND FUTURE DIRECTIONS

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OUTLINE

• PERSONAL BACKGROUND
• ERICSSON USAGE OF MBE
• LESSONS LEARNED
• WHERE DO WE GO FROM NOW?
• FUTURE CHALLENGES
• SUMMARY
PERSONAL BACKGROUND

RESEARCH/ ACADEMIA
10 YEARS

CEO OF SME
10 YEARS

PRODUCT MANAGER
3 YEARS

TEACHING

CONSULTING

TELECOM

SDR

DEFENCE
AEROSPACE
Most important component is software
World’s fifth largest software supplier
Large Scale System Development
Software for system management and services

HW platforms and software for core network

Diverse radio access platforms: HW and software

IPR and standards for system access

Software for system management and services

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Diverse radio access platforms: HW and software

IPR and standards for system access
WE CAN HAVE 1000+ CLASSES AND 10,000+ PROPERTIES

OUR DNA MAKES MOBILE COMMUNICATION POSSIBLE!

MODELING TOOL

O&M INTERFACE

MANAGED ELEMENTS

OPERATION & MAINTENANCE (O&M)

Modeling
- IBM
- Papirus

Validation
- OCL
- Java
- Adocus

Generation
- JSON
- HTML
- Swagger
- YANG

Benefits
- Support for multiple profiles
- Automated transformations
- Advanced validation
SYSTEM MODELING – MBSE

Modeling

Validation

Generation

Benefits
- Reduce specification faults
- Move from document-driven process to “single source of information” approach
SW DESIGN/IMPLEMENTATION USING UML-RT

**Modeling**

**Validation**

**Generation**

**Benefits**
- Battle design implementation complexity using a subset of UML called UML-RT
- Capsule and state-machine abstractions provide very powerful abstractions for dealing with reactive embedded systems.
NETWORK ARCHITECTURE (NWA)

Modeling
- With NWA proprietary DSL

Validation
- In progress

Generation

Benefits
- Replace PowerPoint as main design tool
- Model versioning
- Potential development of advanced validation

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OTHER USAGES

Baseband

Enterprise Architecture

Model-Based Testing
THE IMPORTANCE OF MODELING

› UML modeling is currently used within Radio development unit for the following systems:
  - WCDMA – 80-90% of the SW + System design RBS
  - LTE – Large parts of the SW
  - GSM – System design RBS
  - Platform – 20% of the SW + System design parts

› The above business based on MBE corresponds to around 60% of the Ericsson yearly turnover of more than 200 Billion SEK ($ 27 Billion)

› Now working on development tool plan for 5G
Lessons Learned
TOOLS NEED TO BE FIT FOR THE JOB
USER EXPERIENCE (UX)?

- Tool usability
- Missing capabilities regarding key aspects
- Support for customization and DSL
- Need more and better integrations
NEED A COMMUNITY
NO SIZE FITS ALL!
MBE OR AGILE?

or

Software Engineering
MODELING OR CODING?

or
GRAPHICAL OR TEXTUAL?
UML OR DSL?

or

This is a misleading question!
Software Engineering

- Reverse engineering
- Software process models
- Agile software development
- Reliability modeling and analysis
- Formal specifications
- Software economics and metrics
- Agent oriented software engineering
- Aspect oriented software engineering

Software engineering methodologies
- Software development tools
- Service-oriented computing
- Object-oriented technology
- Component based software engineering
- Knowledge-based software engineering

- Software maintenance
- Autonomic and self-managed software
- Software assurance
- Domain specific software engineering

- Validation and verification
- Software architecture and design
- Software testing
- Software security engineering
- Software architecture
- Requirements elicitation
- Software evolution
ONLY GOAL IS TO HAVE THE BEST DEVELOPMENT ENVIRONMENT!
MODELING LANGUAGE EVOLUTION
TOOL EVOLUTION

• Each tool is providing a different specific set of capabilities
• A lot of investment… but no real evolution!
• Lack of key capabilities
• Why? Lack of research results?
Research/Tech Transfer: Very Low ROI

- Vendor lock-in
- No ability to independently develop required capabilities
- Proprietary technology
- Legal and business issues
- No open access to commercial tools
EVOLUTION OF SW DESIGN TOOLS

Proprietary Technology
- Everything developed internally
- Pros: Complete control, Capability to innovate, Key differentiator
- Cons: Expensive, Resources outside core business

Emergence of SW Tools Companies
- Buy SW design tools for 3rd party providers
- Major investments in new tool development and innovations
- Golden age of SW Tool companies!
- Pros: Get better solutions faster, No internal resources on tool development, Major investments
- Cons: No control on product lifecycle, No differentiator

Business consolidation
- Company acquisitions and tool/business consolidation
- Emergence of Eclipse
- Pros: Integrated solutions, Emergence of Eclipse
- Cons: Increased costs, Forced tool migrations, Reduced investment on new capabilities and innovations

Emergence of open source tools
- End-user companies collaborate together to develop industrial-strength open source solutions
- Golden age of SW Tool Community and collaboration?
- Pros: Better control on destiny, Better and cheaper solutions faster, Fosters collaborations and innovations
- Cons: Requires directly involvement

Timeline:
1980 - 1990 - 2000 - 2010 - 2020
Where do we go from now?
SW IS EATING THE WORLD
... OPEN SOURCE IS EATING THE SW WORLD

Market for highly specialized modelling tools starts to collapse.

Tool vendor development investments shrinks or stops. No velocity on new features.

“Work-in-progress” open source tools are favored.

Company strategy veers towards favoring open source tools.
OPEN SOURCE IS A NECESSARY CONDITION!

- No vendor lock-in
- Ability to independently develop required capabilities
- Open technologies
- Much simplified legal and business context
- Enables fruitful collaborations and tech transfer
- Open access to industrial tools

Industrial Open Source Tool Platform

DSML

Testing, Trace & Debug, Validation, Prog Languages, Runtime, Code Gen, Simulation, Deployment, Model Integration, PLM

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ECLIPSE AND PAPYRUS PROVIDE THE BASIS
... BUT OPEN SOURCE IS NOT SUFFICIENT! WE ALSO NEED A VIBRANT COMMUNITY!
... AND AN OPEN ENVIRONMENT

DSML

Team support  Trace & Debug  Validation  Prog Languages  Code Gen  Runtime  Testing  Simulation  Deployment  PLM
END-USER CONTRIBUTION

CODE

USE CASES

TEST MODELS

TESTING

BUGZILLA REPORTS

EXPERIENCE

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PAPYRUS IC

› Eclipse Polarsys IC founded in Jan 2016 – [https://wiki.polarsys.org/Papyrus_IC](https://wiki.polarsys.org/Papyrus_IC)
› User Lead members

› Supplier Lead members

› Participant members
MISSION/VISION

WHAT it does
Develop a **customizable and extensible industrial-grade open source MBE tool suite** based on the Papyrus/Eclipse platform, other key open source technologies, and leading industry standards

WHO it does it for
For companies developing software-based systems, from **Enterprise Software** to **Internet of Things (IoT)** and **Cyber-Physical Systems (CPS)**

HOW it does what it does
By fostering and leveraging collaborations between members of a **vibrant community** composed of **end-users**, **suppliers**, and **research/academia**
OVERALL GOALS

› Development of industrial-grade open source solution
› Joint development financing
› Knowledge sharing
› Promotion of open source solution
› Development of the community
› Standardization
› Collaboration on research projects
› Contribution to MBE education and training
Future Challenges
5G AND IOT

What 5G will provide

- Multi domain performance
- Energy Performance
- Critical machine type of communications
- Global standard
- Mass market personalized TV
- Massive machine type of communications
- Foundation for efficient industries and society

INTERNET of THINGS
"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change."

Charles Darwin
WHAT IS THE ROLE OF MBE?
MBE IS KEY

- Improved tool usability
- More capabilities regarding key aspects
- First-class support for customization and DSL
- More and better integrations

Can’t achieve the required level of business and development agility without MBE!
KEY CHALLENGES

› Company culture
  - Culture change – migration to open source requires a real culture change

› Community
  - Provide the required infrastructure to enable the growth of the community
  - Creation of a consortium to lead/govern the development of Papyrus and open source modeling solution

› Product management/Governance
  - Manage requirements and priorities
  - Ensure delivery of top industrial-grade solution

› Papyrus to support a broad range of customizations and DSMLs
  - Ensure that we don’t create a set of divergent products

Open source is not free, it requires involvement and investment
Unfortunately, it is not a silver bullet!
SUMMARY

› Ericsson has been using MBE at a large scale for over 20 years
› Lots of benefits, but tools are still a main issue
› Open source is the only practical way to full MBE
› Papyrus provides the proper basis for this vision
› A vibrant and extensive community is key
› Contributions from research/academia are essential
› An outstanding opportunity to put in place the solution we all need

Success is the only option!
There is no alternative!