

INDUSTRIAL USE OF MBE: LESSONS LEARNED AND FUTURE DIRECTIONS

Presented by Francis Bordeleau
francis.bordeleau@ericsson.com



OUTLINE

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

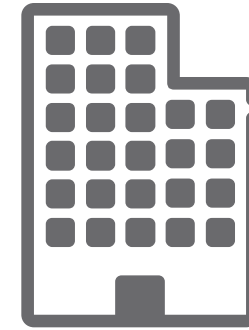
PERSONAL BACKGROUND



RESEARCH/
ACADEMIA
10 YEARS



CEO OF SME
10 YEARS



PRODUCT MANAGER
3 YEARS



TEACHING



CONSULTING



TELECOM



SDR



DEFENCE
AEROSPACE



OUR PRODUCTS

Most important component is software
World's fifth largest software supplier



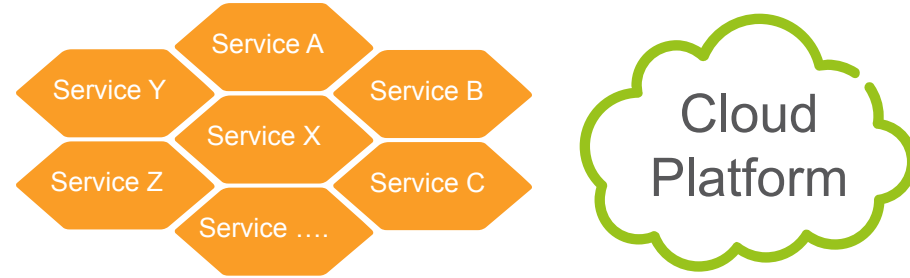
Large Scale System Development

ERICSSON SYSTEM DOMAIN



Software for system management and services

Service & Management



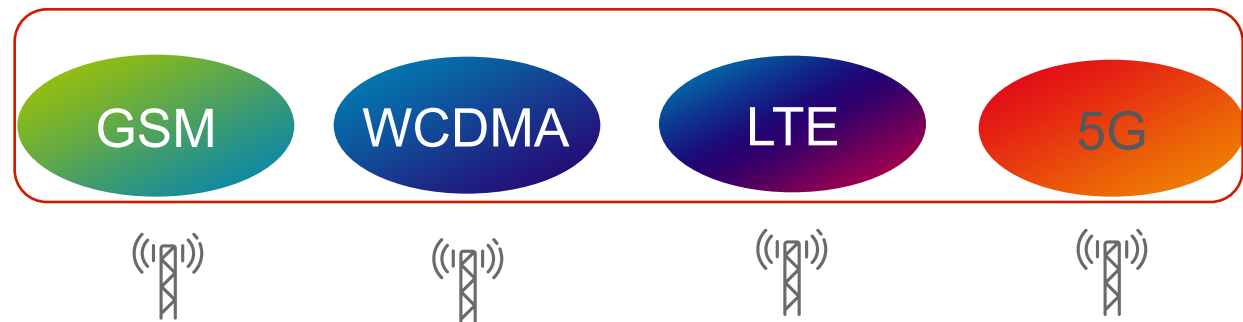
HW platforms and software for core network

Core Network



Diverse radio access platforms: HW and software

Radio Access



IPR and standards for system access

Devices



OPERATION & MAINTENANCE (O&M)



Modeling



Validation



Generation



Benefits

- Support for multiple profiles
- Automated transformations
- Advanced validation



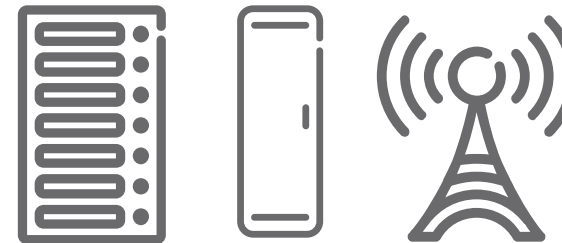
MODELING
TOOL

WE CAN HAVE
1000+ CLASSES
AND 10,000+
PROPERTIES



O&M INTERFACE

OUR DNA
MAKES MOBILE
COMMUNICATION
POSSIBLE!



MANAGED ELEMENTS

SYSTEM MODELING – MBSE



Modeling



Validation

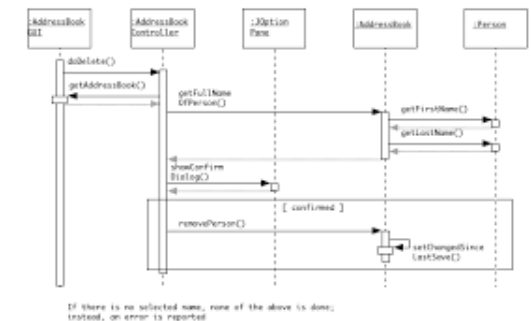
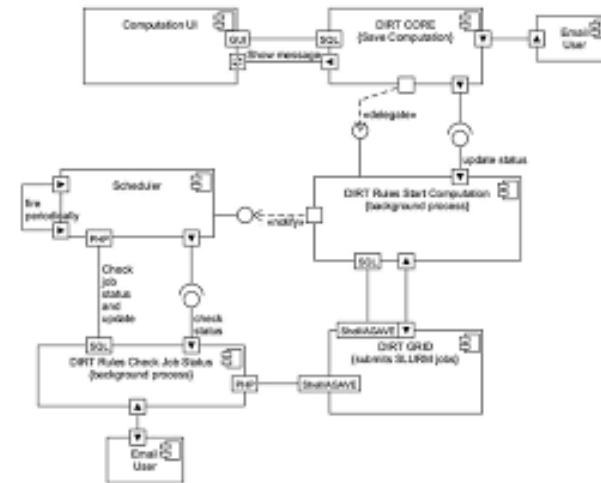
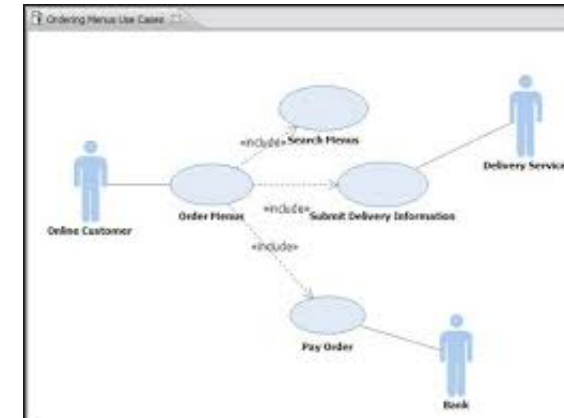
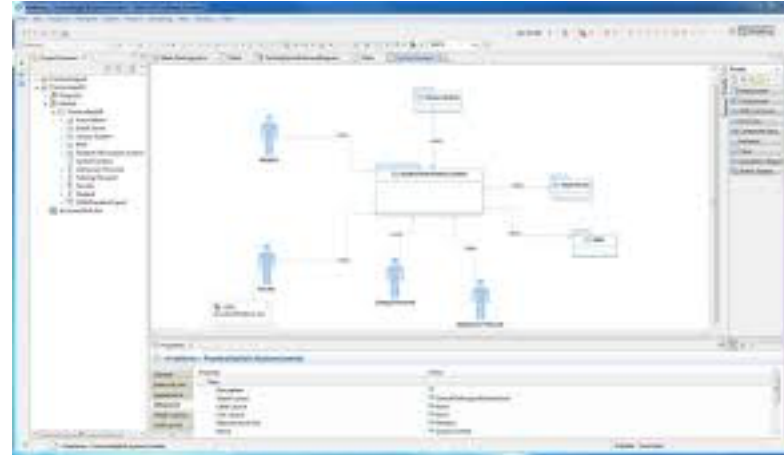


Generation



Benefits

- Reduce specification faults
- Move from document-driven process to “single source of information” approach



SW DESIGN/IMPLEMENTATION USING UML-RT



Modeling



Validation



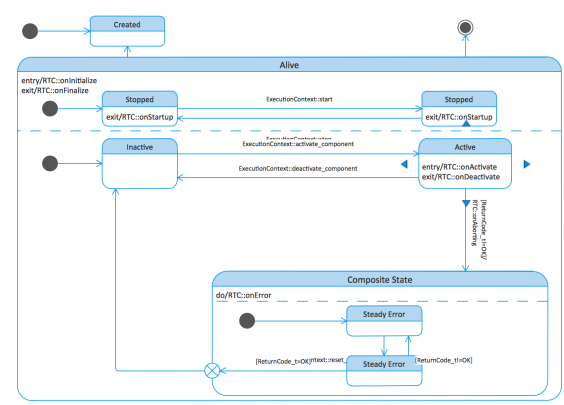
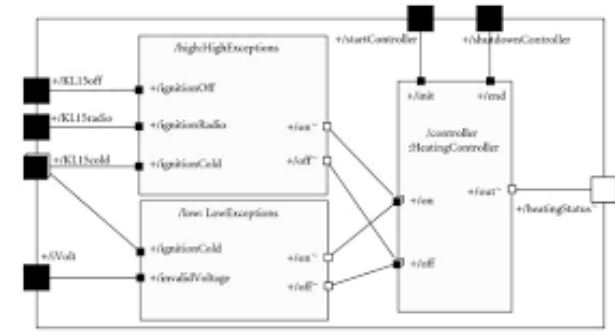
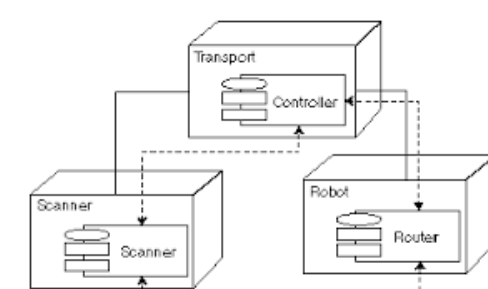
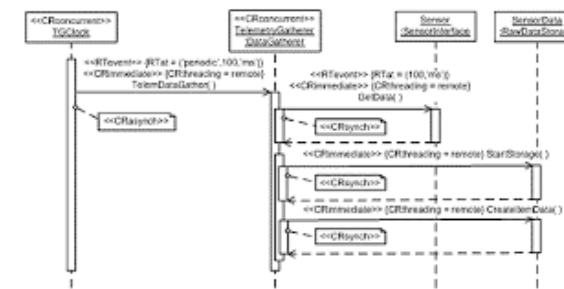
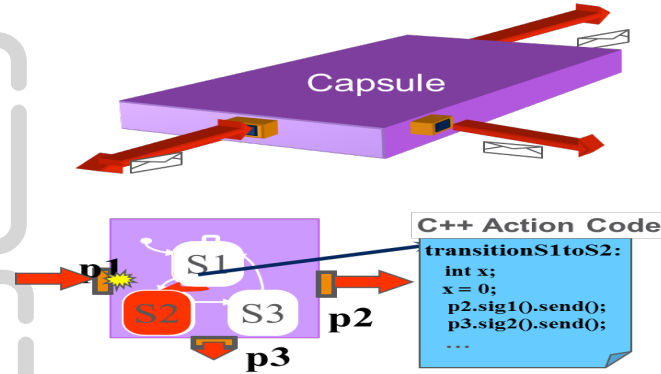
Generation

C++

Run-time system abstraction to hide underlying platform

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

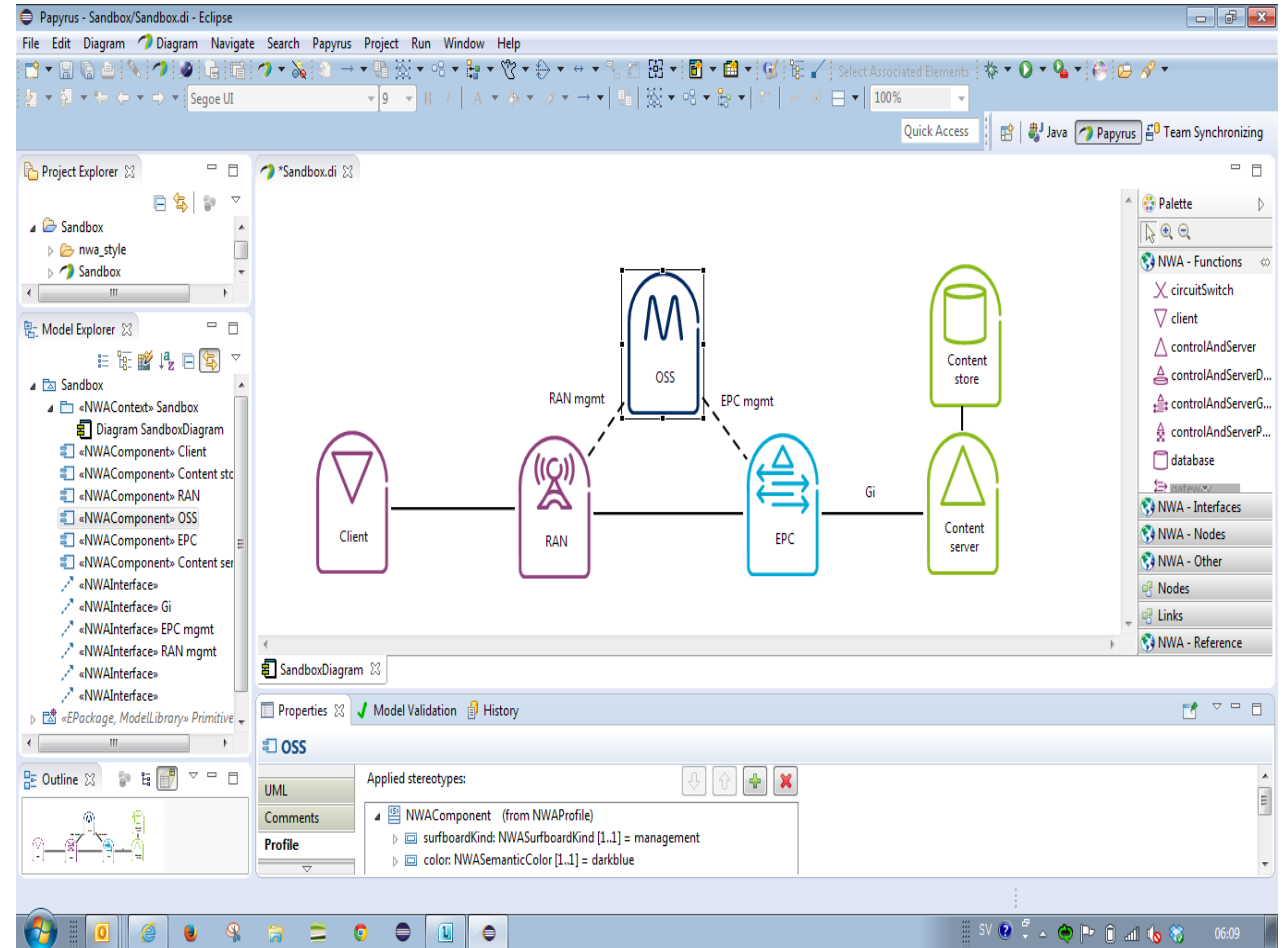
- In progress

Generation



Benefits

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



OTHER USAGES



Baseband



Enterprise Architecture



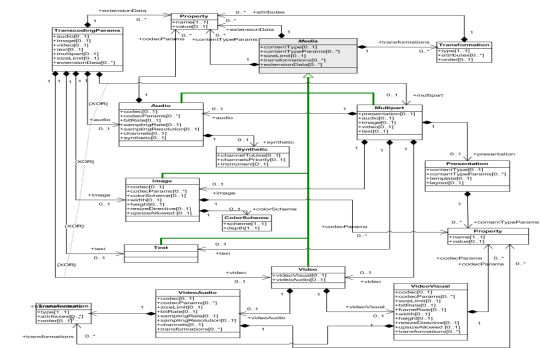
Model-Based Testing



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



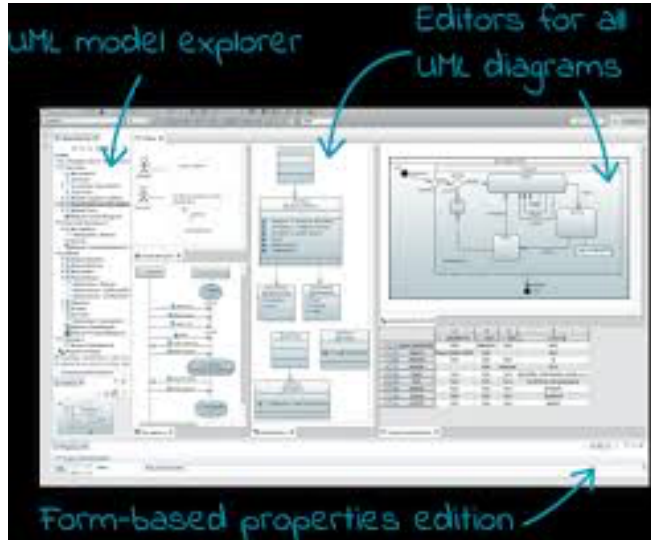
NEED A COMMUNITY



NO SIZE FITS ALL!



MBE OR AGILE?



or



MODELING OR CODING?



The screenshot shows the Eclipse IDE interface. The top part displays a UML class diagram with several classes and their relationships. Below the diagram, the Properties view shows various attributes for the selected class. At the bottom, a Java code editor shows the following code:

```
GeneratorTest.java  
31  
32 @Test public void testGeneratingHTML() throws Exception {  
33     Form form = loadESON("input-contact-form.eson", Form.class);  
34     FormHTMLGenerator routesGenerator = new FormHTMLGenerator();  
35     String gen = routesGenerator.html(form.toString());  
36     String expected = getResourceAsString("output-expected-form.html");  
37     assertEquals(expected, gen);  
38  
39  
40 }
```

or

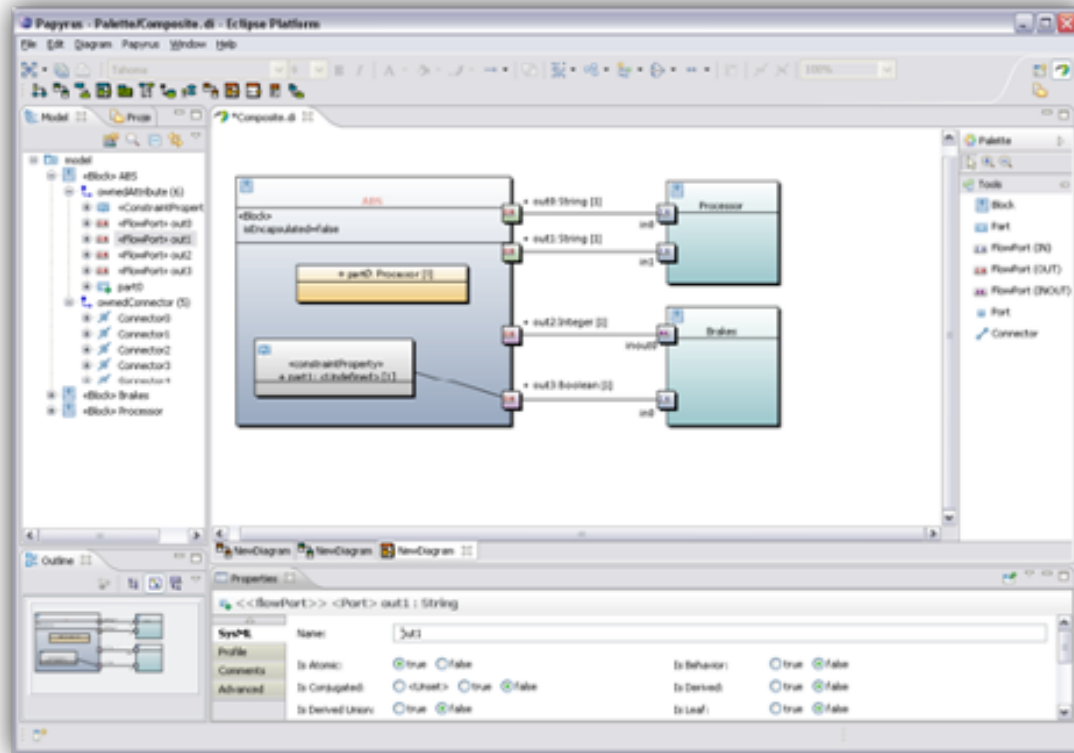
The screenshot shows the Eclipse IDE interface with a Java code editor. The code is as follows:

```
BankAccountTests.java  
package org.eclipse.banking.tests;  
  
import java.math.BigDecimal;  
  
public class BankAccountTests extends TestCase {  
    public void testDeposit() throws Exception {  
        BankAccount account = new BankAccount();  
        assertEquals(new BigDecimal(900), account.getBalance());  
    }  
  
    public void testOverdraft() throws Exception {  
        BankAccount account = new BankAccount();  
        try {  
            account.withdraw(new BigDecimal(100));  
        }  
    }  
}
```

The Package Explorer on the left shows the project structure. The Problems view at the bottom shows 6 errors:

Description	Resource	Path	Location
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 11
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 11
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 19
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 19
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 27
BankAccount cannot be resolved to a type	Banking/org/eclipse/banking/...	Banking/org/eclipse/banking/...	line 27

GRAPHICAL OR TEXTUAL?



or

```
1 package nui
2
3
4 class Form {
5   String name // ID
6   String titleLabel
7   contains Field[] fields
8 }
9
10 class Field {
11   String name // ID
12   String label
13   String model
14   FormFieldType ftype
15   boolean required
16   contains FormFieldPrefix
17 }
18
19 enum FormFieldType {
20   text, email, number
21 }
22
23
24
25
26
27
28
29
30
31
32 @Test public void testGeneratingHTML() throws Exception {
33   Form form = loadESON("input-contact-form.eson", Form.class);
34   FormHTMLGenerator routesGenerator = new FormHTMLGenerator();
35   String gen = routesGenerator.html(form).toString();
36   String expected = getResourceAsString("output-expected-form.html");
37   assertEquals(expected, gen);
38 }
39
40 }
```


UML OR DSL?



or

DSL

This is a misleading question!

COMPLEX WORLD

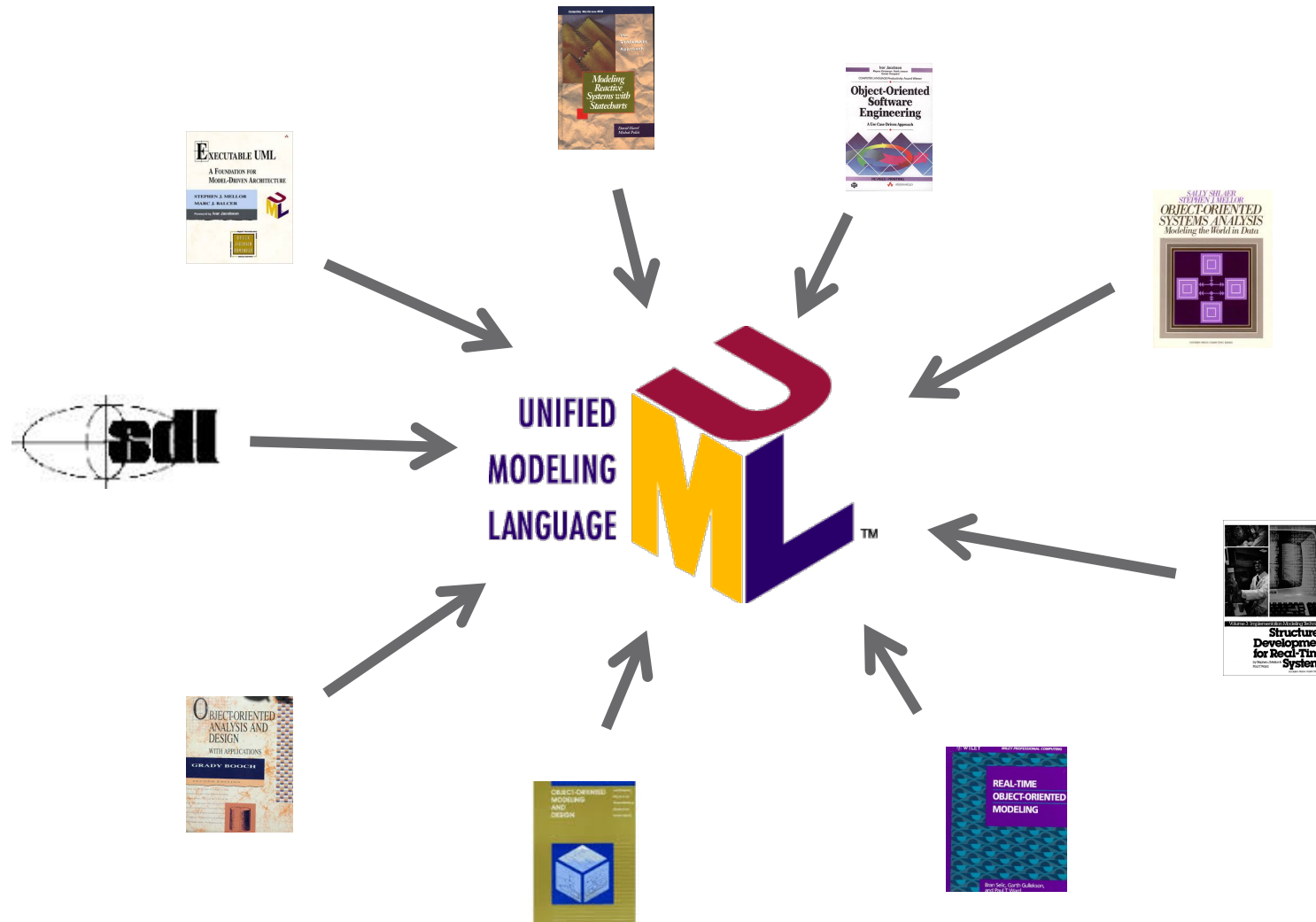


Reverse engineering
Software process models Agile software development
Reliability modeling and analysis Formal specifications
Software economics and metrics Agent oriented software engineering
Aspect oriented software engineering

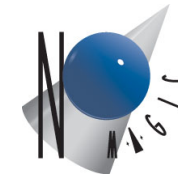
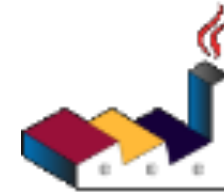
Software Engineering

Software engineering methodologies UML MDA and AADL
Software development tools Component based software engineering
Service-oriented computing
Object-oriented technology 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

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



Commercial Tools



- X Vendor lock-in
- X No ability to independently develop required capabilities

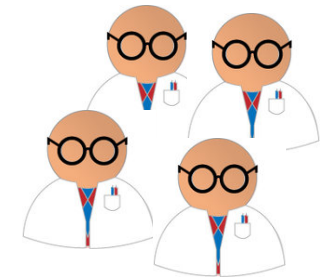
- X Proprietary technology
- X Legal and business issues



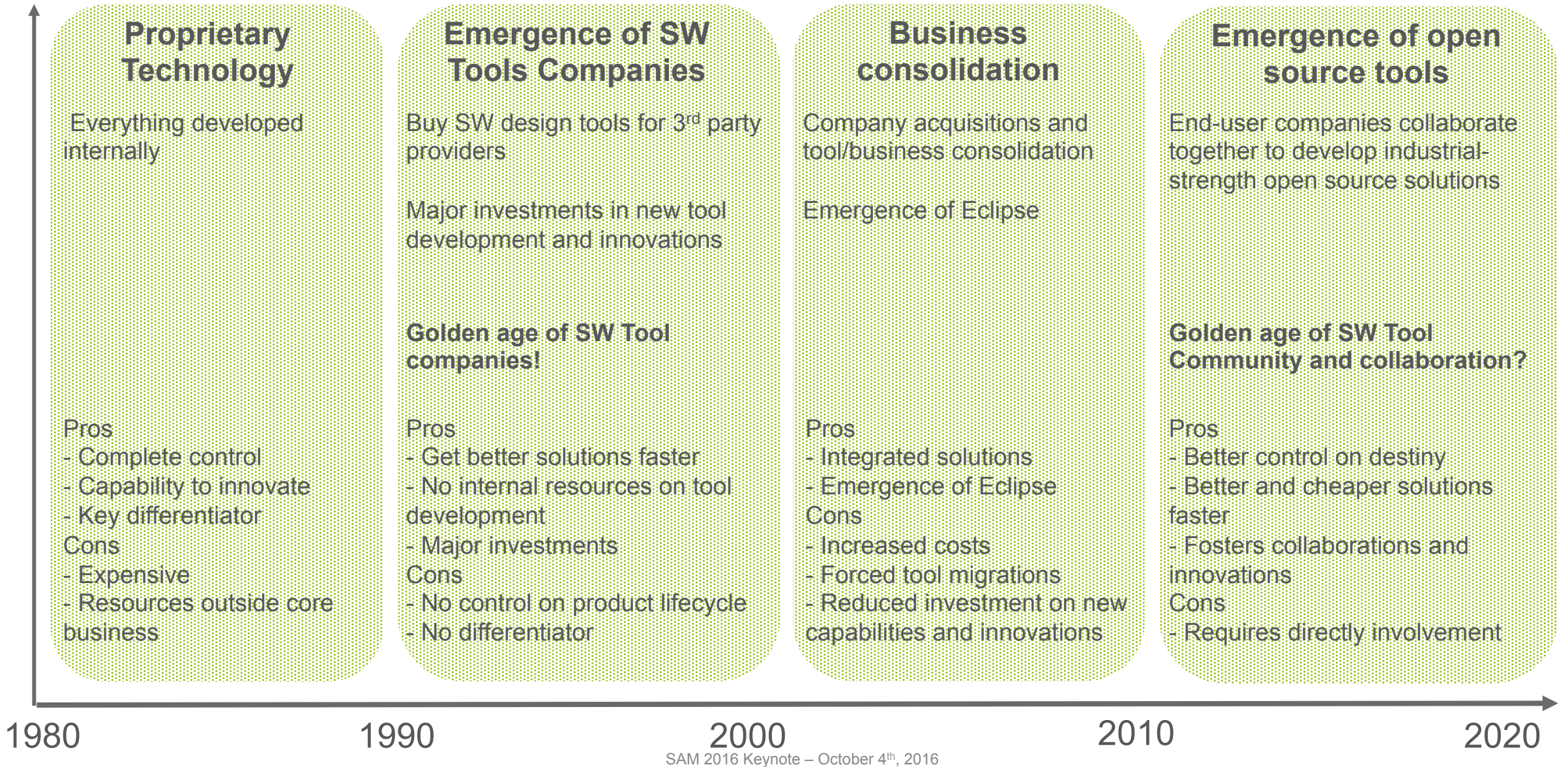
Research Tools



- X No open access to commercial tools



EVOLUTION OF SW DESIGN TOOLS





Where do we go from now?

SW IS EATING THE WORLD ... OPEN SOURCE IS EATING THE SW WORLD

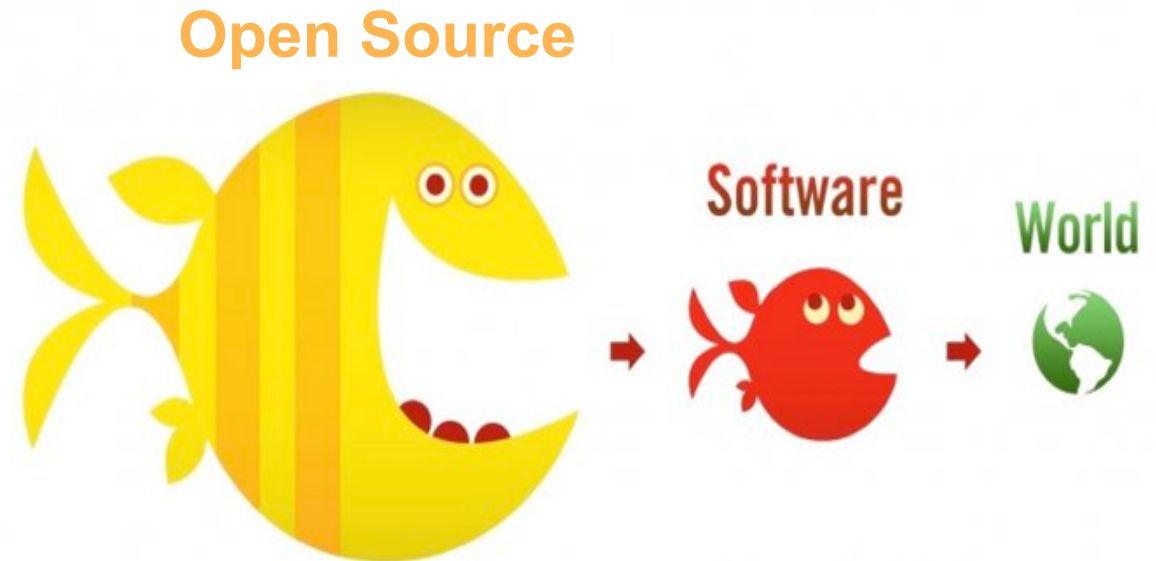


Market for highly specialized modelling tools starts to collapse.

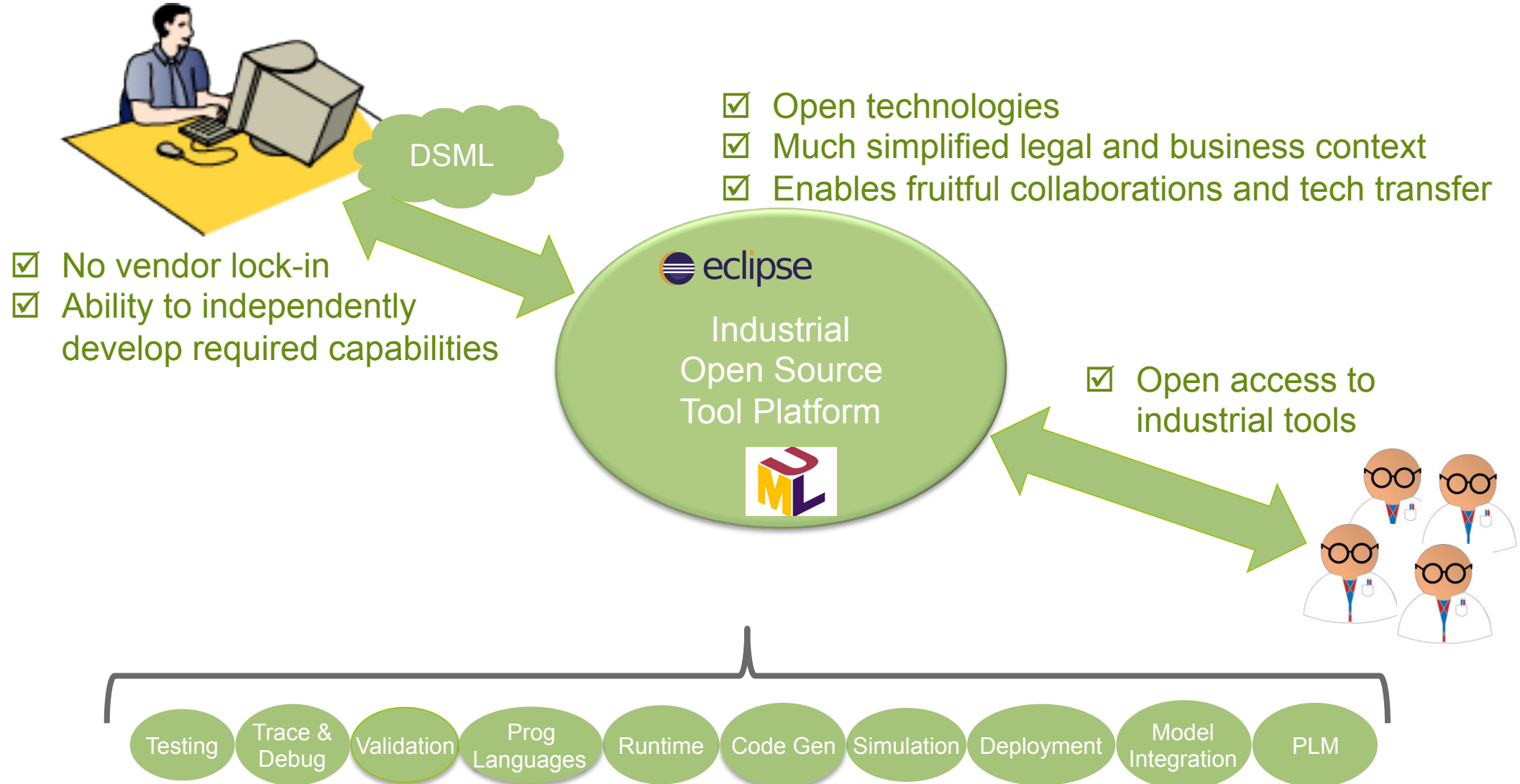
Tool vendor development investments shrinks or stops. No velocity on new features.

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

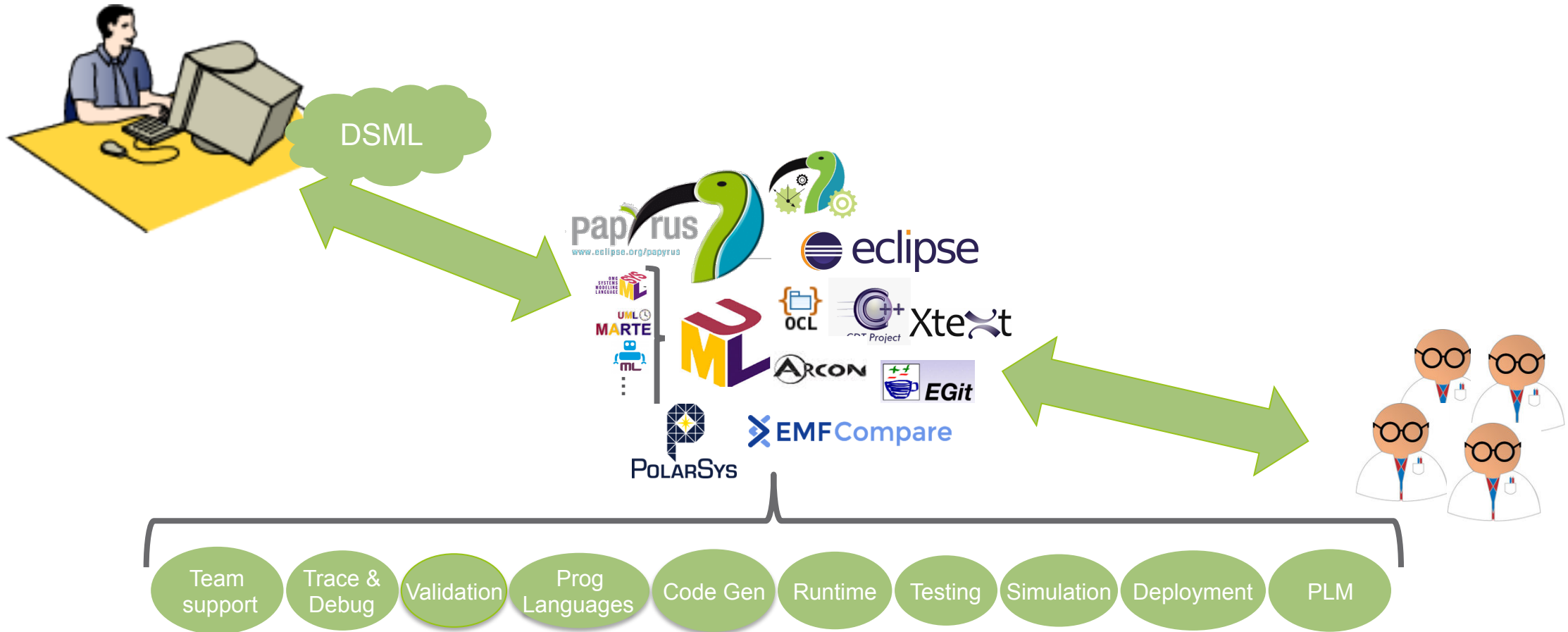
Company strategy veers towards favoring open source tools.



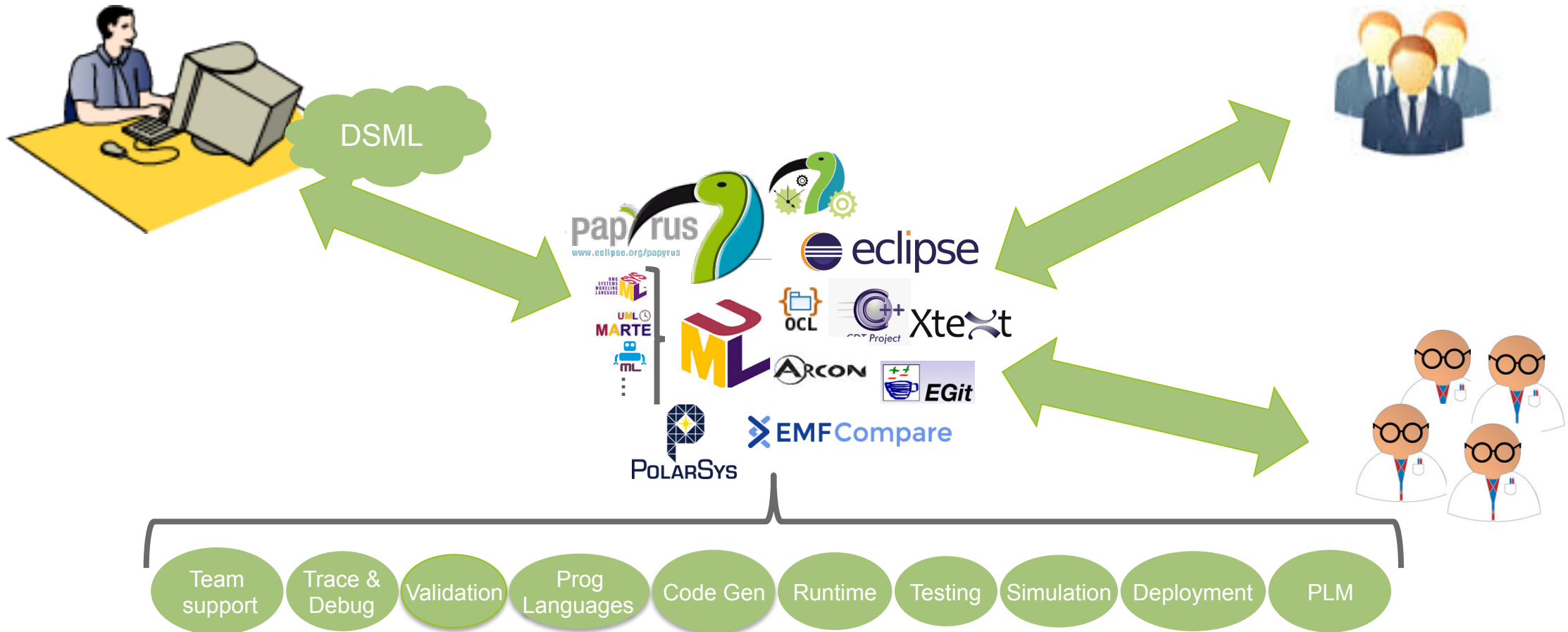
OPEN SOURCE IS A NECESSARY CONDITION!



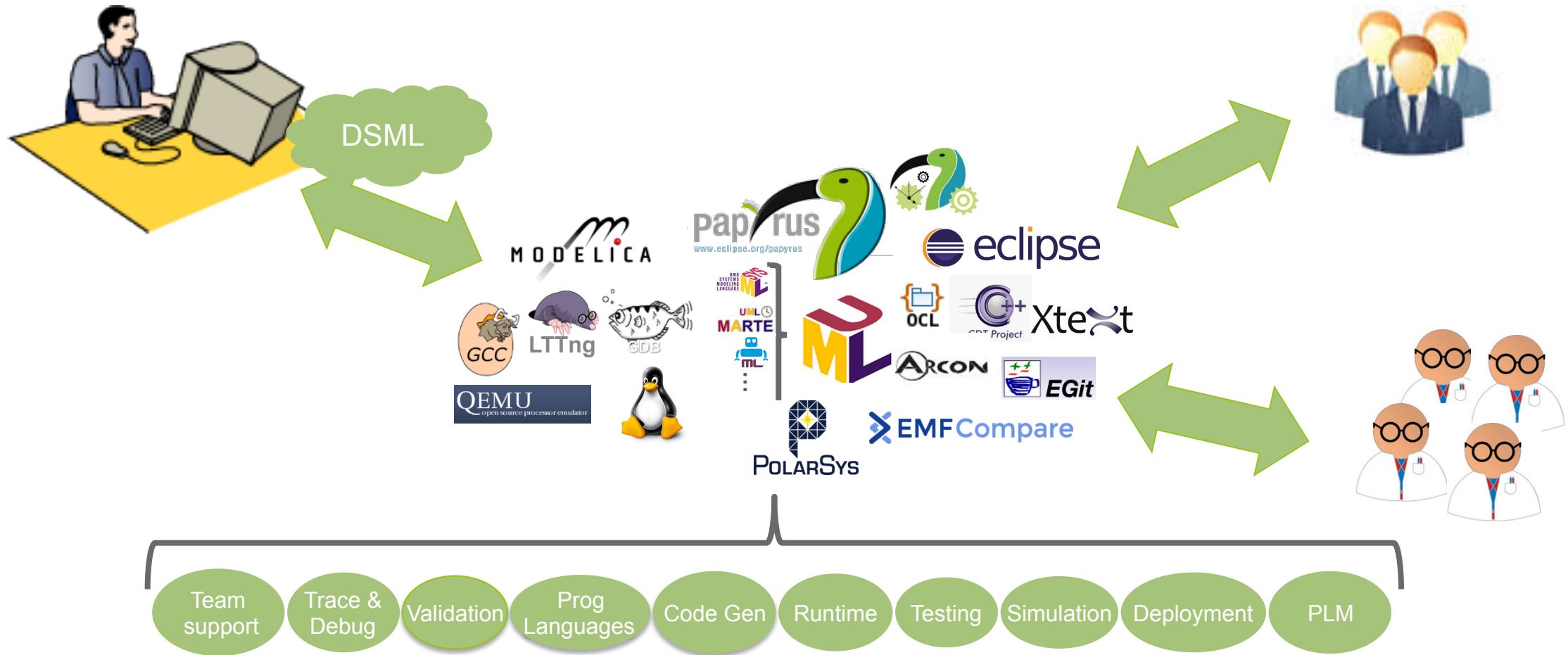
ECLIPSE AND PAPYRUS PROVIDE THE BASIS



... BUT OPEN SOURCE IS NOT SUFFICIENT! WE ALSO NEED A VIBRANT COMMUNITY!



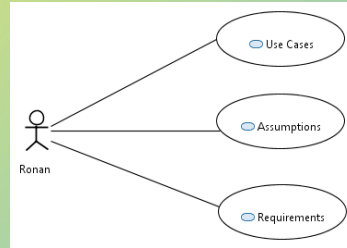
... AND AN OPEN ENVIRONMENT



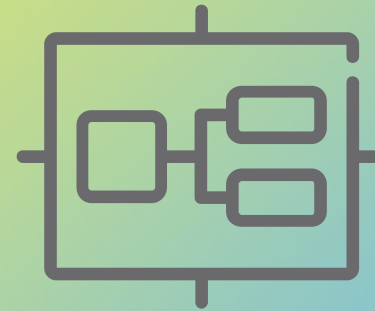
END-USER CONTRIBUTION



CODE



USE CASES



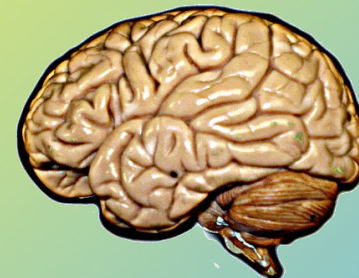
TEST MODELS



TESTING



BUGZILLA
REPORTS



EXPERIENCE

PAPYRUS IC



› Eclipse Polarsys IC founded in Jan 2016 – https://wiki.polarsys.org/Papyrus_IC

› User Lead members



› Supplier Lead members



list



› Participant members



Atos



COMBITECH



tmforum

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

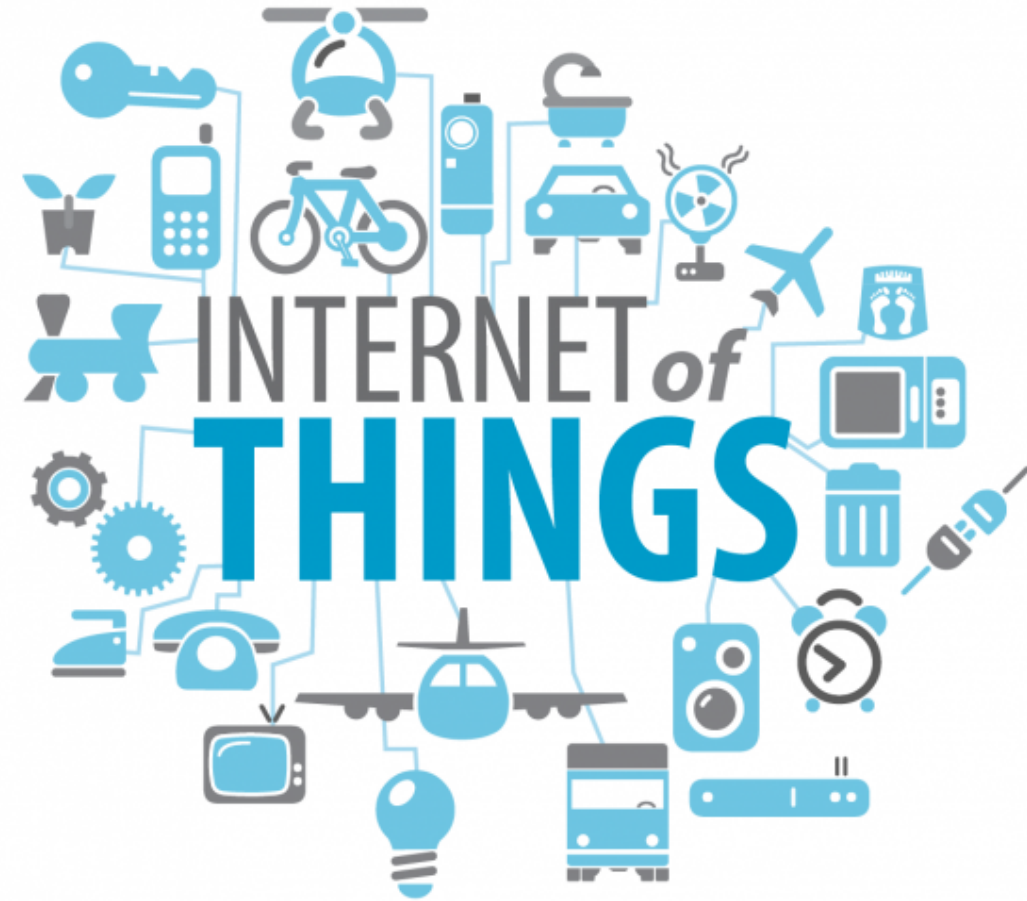


- › Development of industrial-grade open source solution
- › Joint development financing
- › Knowledge sharing
- › Promotion of open source solution
- › Development of the community
- › Standardization
- › Collaboration on research projects
- › Contribution to MBE education and training

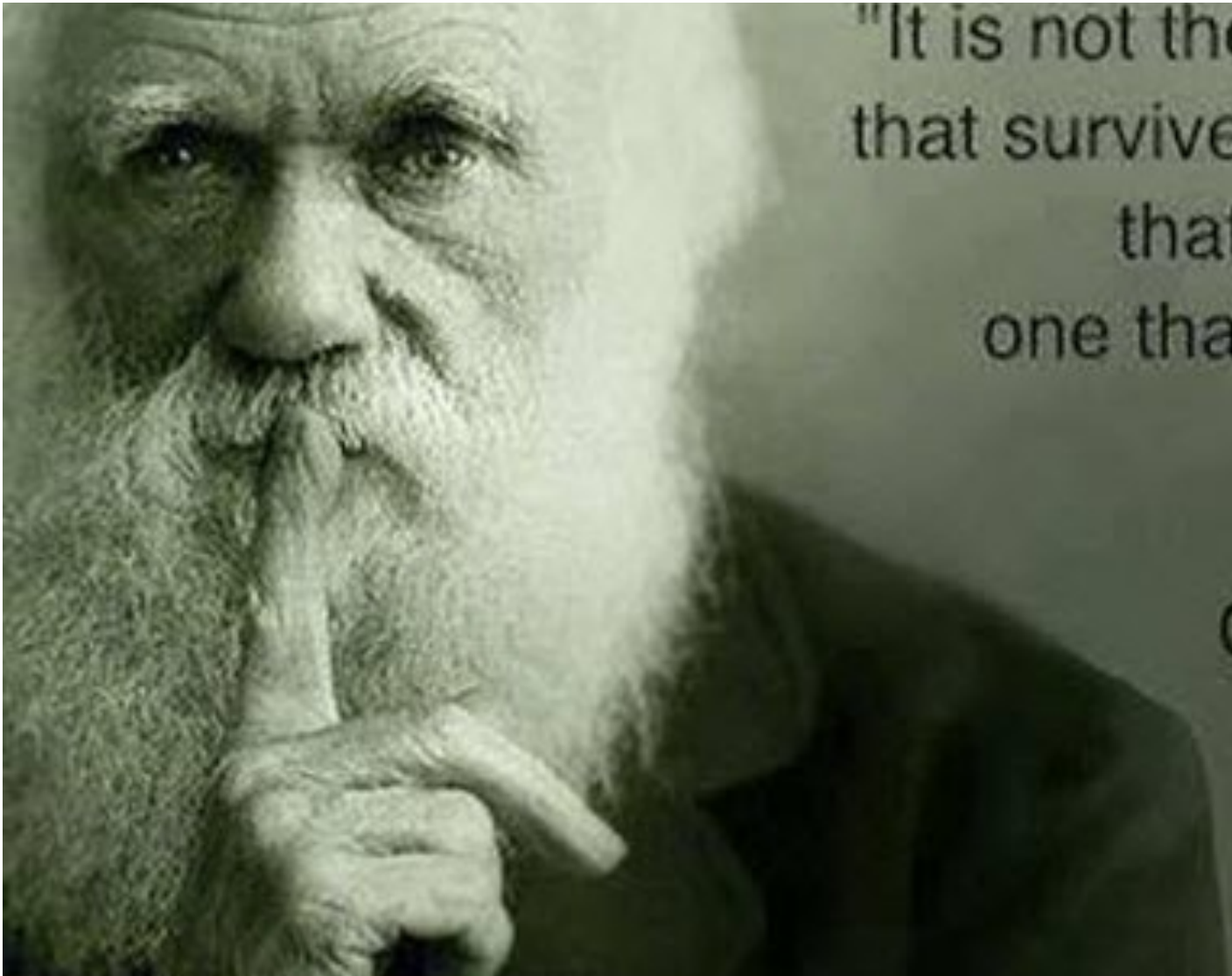


Future Challenges

5G AND IOT



BUSINESS AGILITY



"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

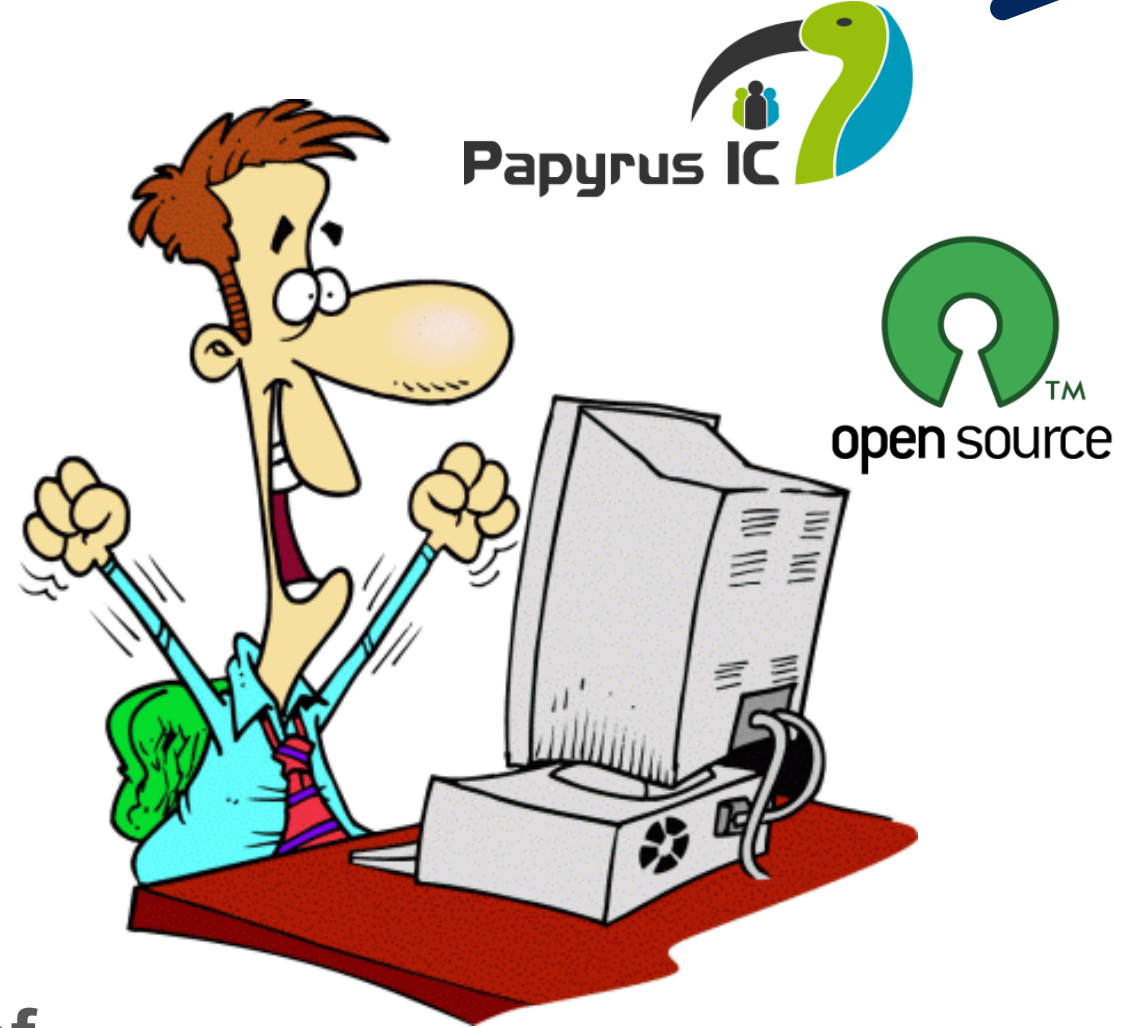
Improved tool usability

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!



ERICSSON