FROM RESEARCH TO INDUSTRY

cea tech

list

SYSTEM MODELING

Introduction

2015-09-14

François Terrier

FIRST WHAT IS A SYSTEM?

➔ **Complex** and **heterogeneous** systems
responding to real-world events

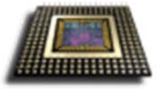
Human interactions

Physical interactions
sensors / actuators

Embedded system

Software

+



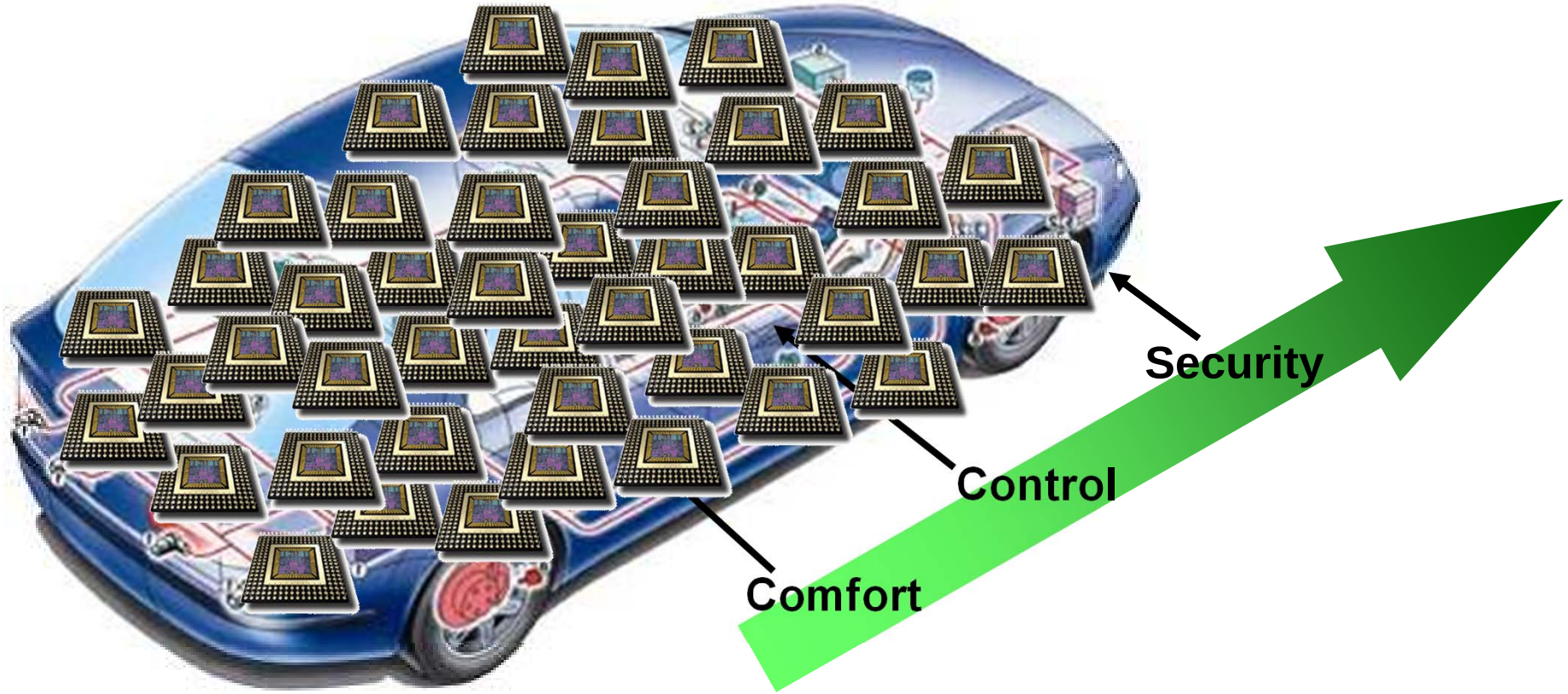
Computers

+

Networks

Systems are everywhere, deeply involved in our daily life and inter-connected.

➔ *Some numbers…*



→ *Tenth of interconnected processors*

→ *Hundreds of processing in parallel*

→ *Thousands of exchanged data*


GM Recalls 50,500 2011 Cadillac SRXs Over Airbag-related Software Glitch
By Robert Charette
Posted 22 Jun 2011 | 12:48 GMT
GM is recalling 50,500 Cadillac SRX
of a software glitch that may not allow
airbags for passengers sitting in the rig
crash, reports a blog post at Zacks Inve
According to GM, the post says:
"...the front passenger
The Standish Group Report
CHAOS
What Industry Needs from Architectur
nes: A Survey
Engineering Automotive Software
SYSTEM FAILURE
Why Softw
FAIL
SPECIAL REPORT
Telecom continues whirlwind of settlements with incorrect broadband meter readings
Oct. 19 (BusinessDesk) – Telecom has continued its rush to settle outstanding disputes ahead of next month's vote to split the company, reaching a deal with the Commerce Commission to repay broadband customers overcharged for incorrect meter readings.
The country's biggest phone company paid out $2.7 million to some 47,000 customers who were overcharged after a software glitch meant people hit their data limits early, the antitrust regulator said in a statement.
Telecom and the commission reached a settlement after the phone compan
acknowledged the fault and sought to compensate its custom
regulator would waive its right to issue legal pro
Fair Trading Act.
Released by:
Technical Operations
International Council on Systems Engineering (INCOSE)
TECHNOLOGY
rry users complain of fresh crash
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Why it fails

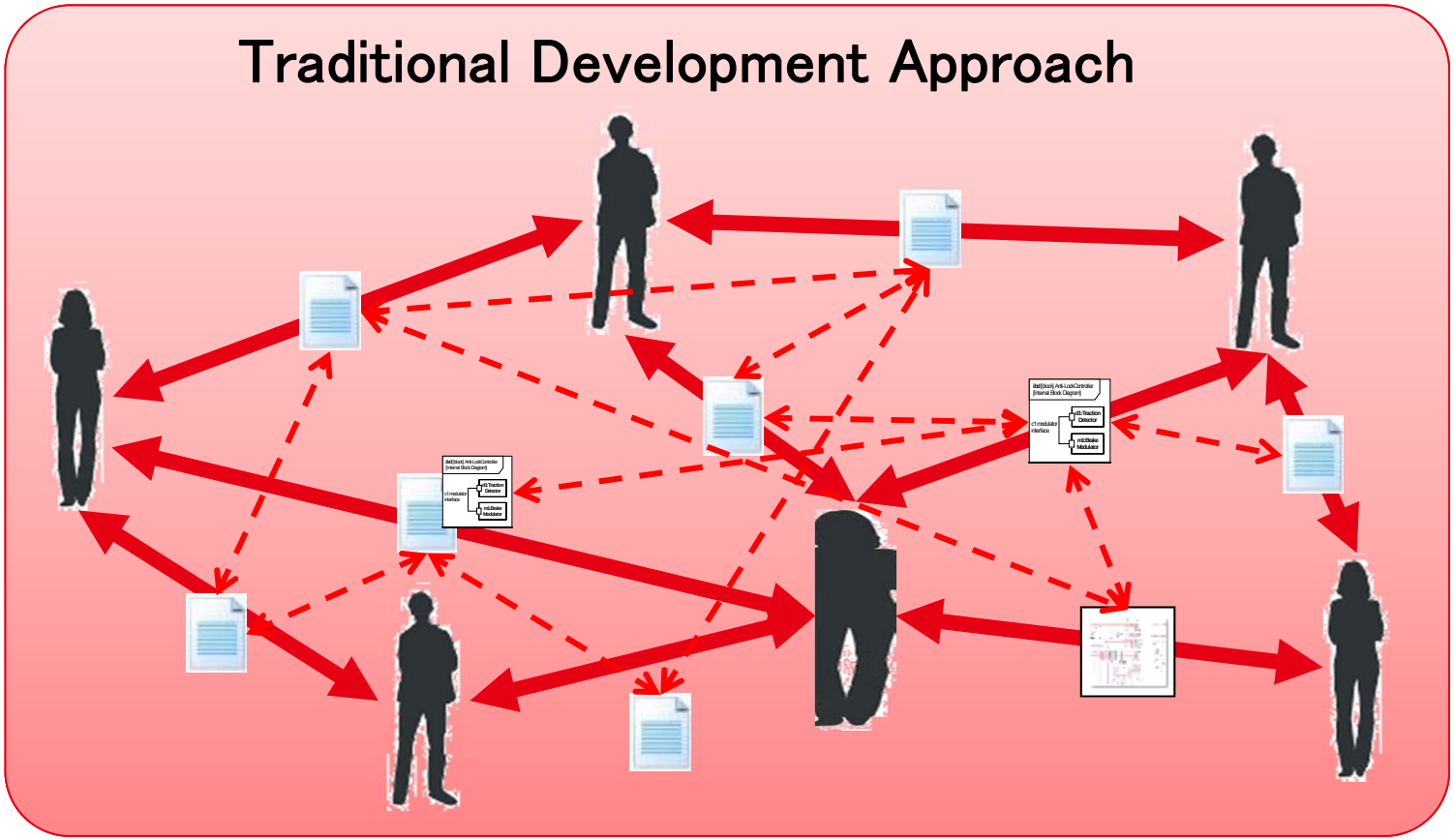
- Communication issues between numerous and various stakeholders.
- Time-to-market pressure vs. higher quality level.
- Ambiguous or uncompleted descriptions of system.
- Non-availability of expertise for complex analysis.
- Manual-based methodologies.

(Note: this list is of course not exhaustive)

Complexity, Complexity, **Complexity, Complexity, Complexity ...**

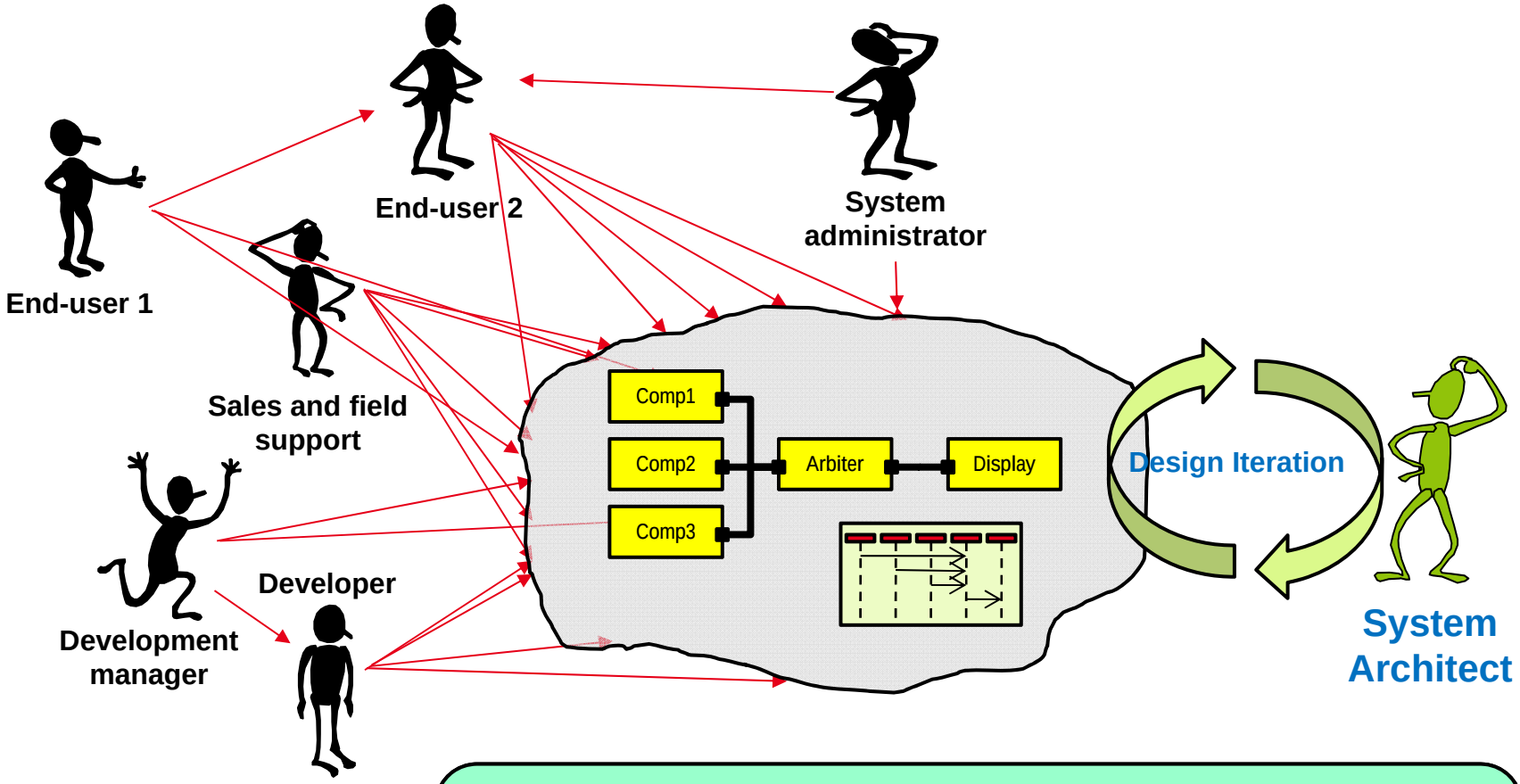
Why model driven engineering?

Traditional Development Approach



Unreliable / Inefficient / Non-scalable

HOW ARCHITECTURE HELPS DEFINE REQUIREMENTS



Many requirements conflicts and necessary tradeoffs are only detected through analysis of candidate architectures.

A SYSTEM-LEVEL APPROACH IS NEEDED: ARCHITECTURE!

DESIGN THE SYSTEM AS A *WHOLE* RATHER THAN AS *AN AGGREGATE OF SEPARATELY DESIGNED* SUB-SYSTEMS

- Provides possibility to ensure system integrity
- Requires a “big picture” approach

➔ an ***architecture specification***

ONE DEFINITION OF ARCHITECTURE [IEEE STANDARD 1471] :

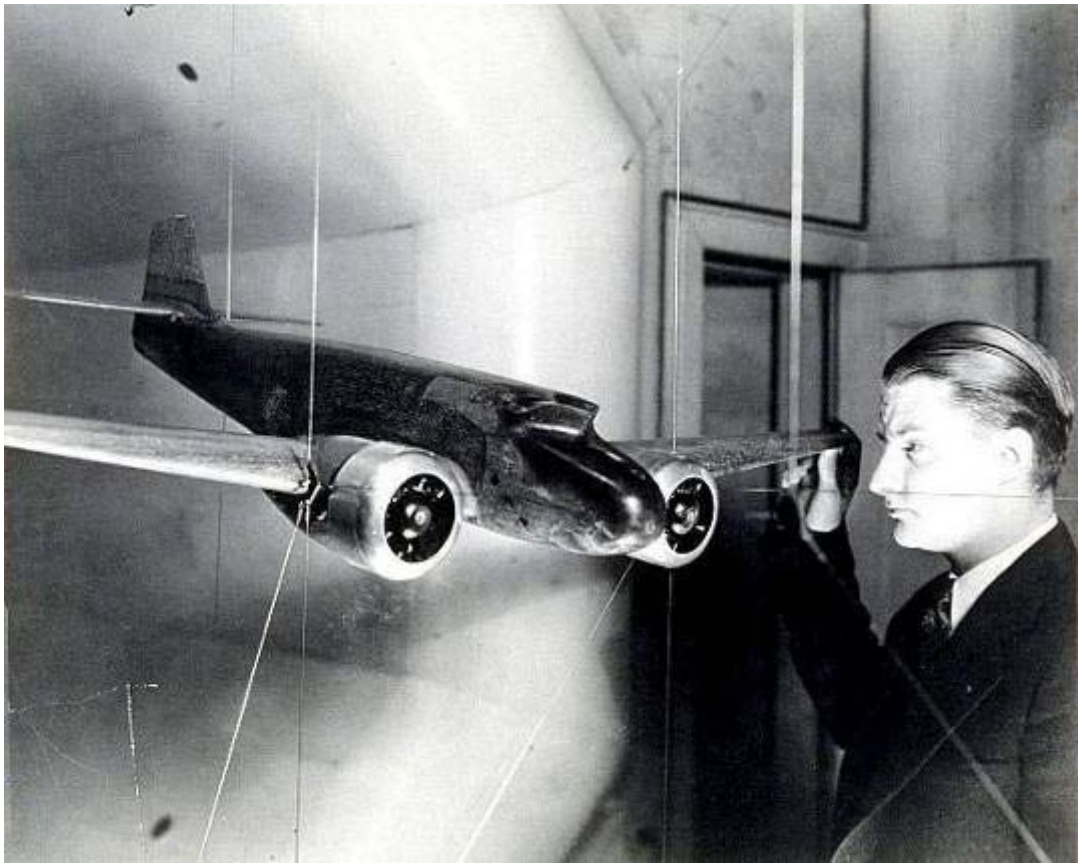
“The **fundamental** *organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution”*

⇒ Architectural specifications ***abstract out*** non-fundamental detail

“ To architect is to model ”

BASIS IS MODELING

PROBABLY AS OLD AS ENGINEERING

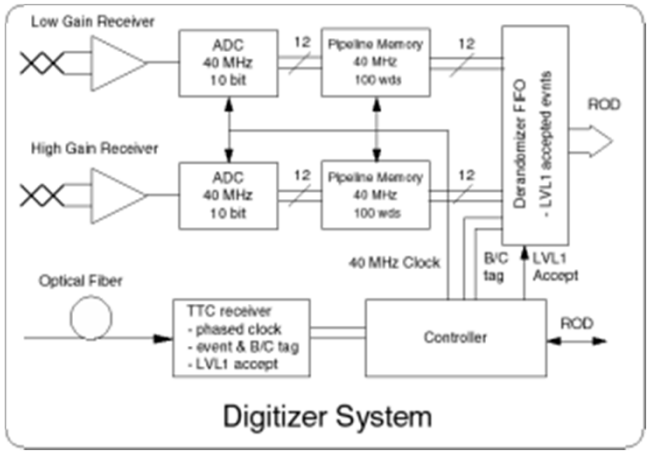


Extracted from B. Selic presentation

ENGINEERING MODEL

- A reduced representation of some system that highlights the properties of interest from a given viewpoint

Modeled system



Functional Model

WE DON'T SEE EVERYTHING AT ONCE

WE USE A REPRESENTATION (NOTATION) THAT IS EASILY UNDERSTOOD FOR THE PURPOSE ON HAND

A BIT OF SOFTWARE…

Extracted from B. Selic presentation

```
SC_MODULE(producer)
{
sc_outmaster<int> out1;
sc_in<bool> start; // kick-start
void generate_data ()
{
for(int i =0; i <10; i++) {
out1 =i ; //to invoke slave;}
}
SC_CTOR(producer)
{
SC_METHOD(generate_data);
sensitive << start;}};
SC_MODULE(consumer)
{
sc_inslave<int> in1;
int sum; // state variable
void accumulate (){
sum += in1;
cout << "Sum = " << sum << endl;}
```

```
SC_CTOR(consumer)
{
SC_SLAVE(accumulate, in1);
sum = 0; // initialize
};
SC_MODULE(top) // container
{
producer *A1;
consumer *B1;
sc_link_mp<int> link1;
SC_CTOR(top)
{
A1 = new producer("A1");
A1.out1(link1);
B1 = new consumer("B1");
B1.in1(link1);}};
```

Can you spot the architecture?

…AND ITS MODEL

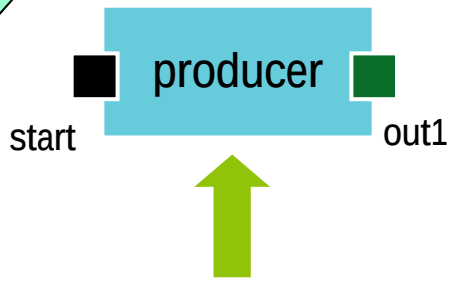
Extracted from B. Selic presentation

Can you spot the architecture?

AN APPROACH TO SOFTWARE DEVELOPMENT IN WHICH THE FOCUS AND PRIMARY ARTIFACTS OF DEVELOPMENT ARE MODELS (AS OPPOSED TO PROGRAMS) AND BASED ON TWO TIME-PROVEN METHODS

(1) ABSTRACTION

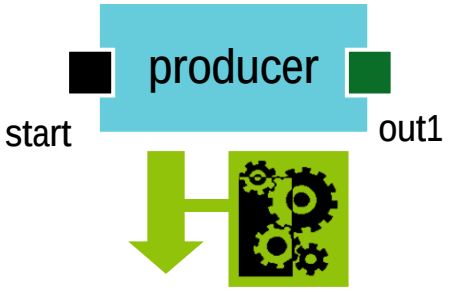
Realm of modeling languages




```
SC_MODULE(producer)
{sc_inslave<int> in1;
int sum; //
void accumulate (){
sum += in1;
cout << "Sum = " <<
sum << endl;}
```

(2) AUTOMATION

Realm of tools




```
SC_MODULE(producer)
{sc_inslave<int> in1;
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void accumulate (){
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```
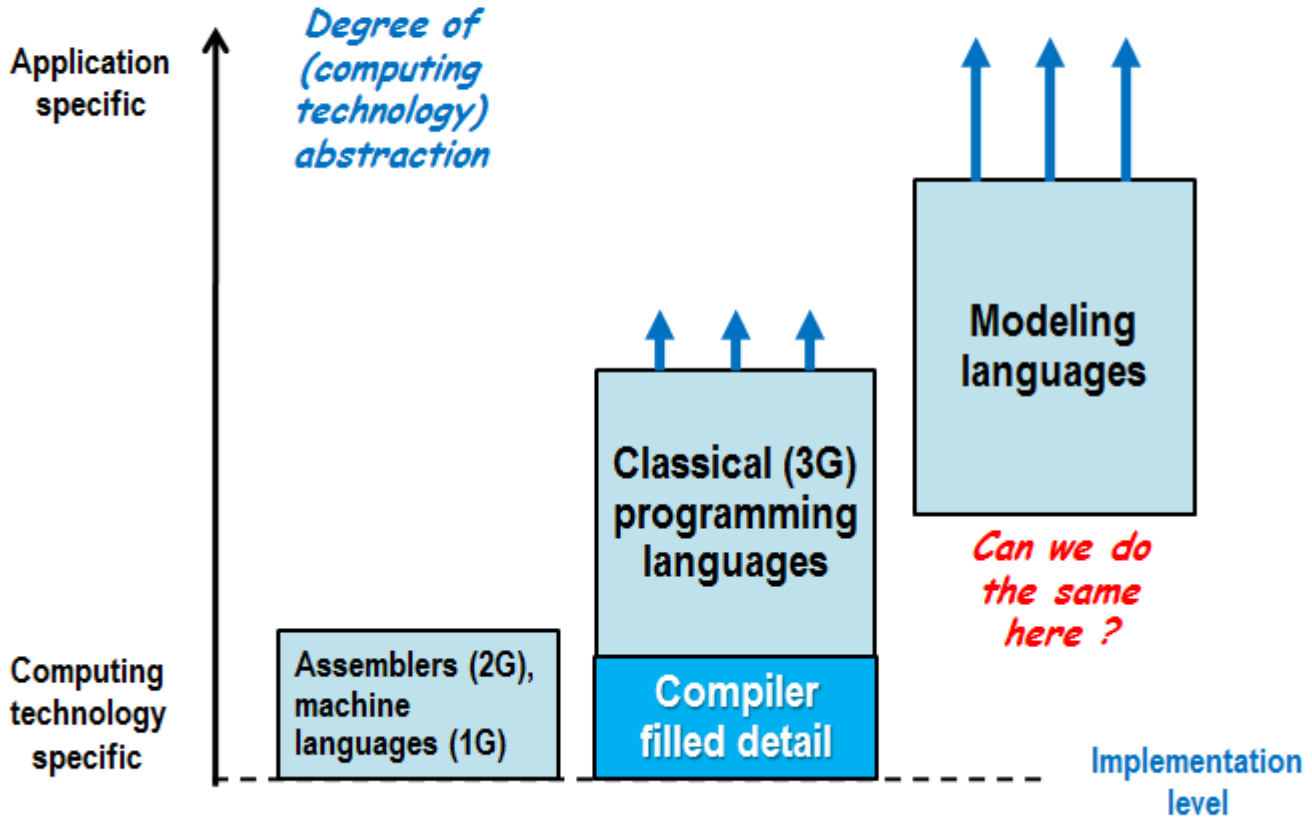
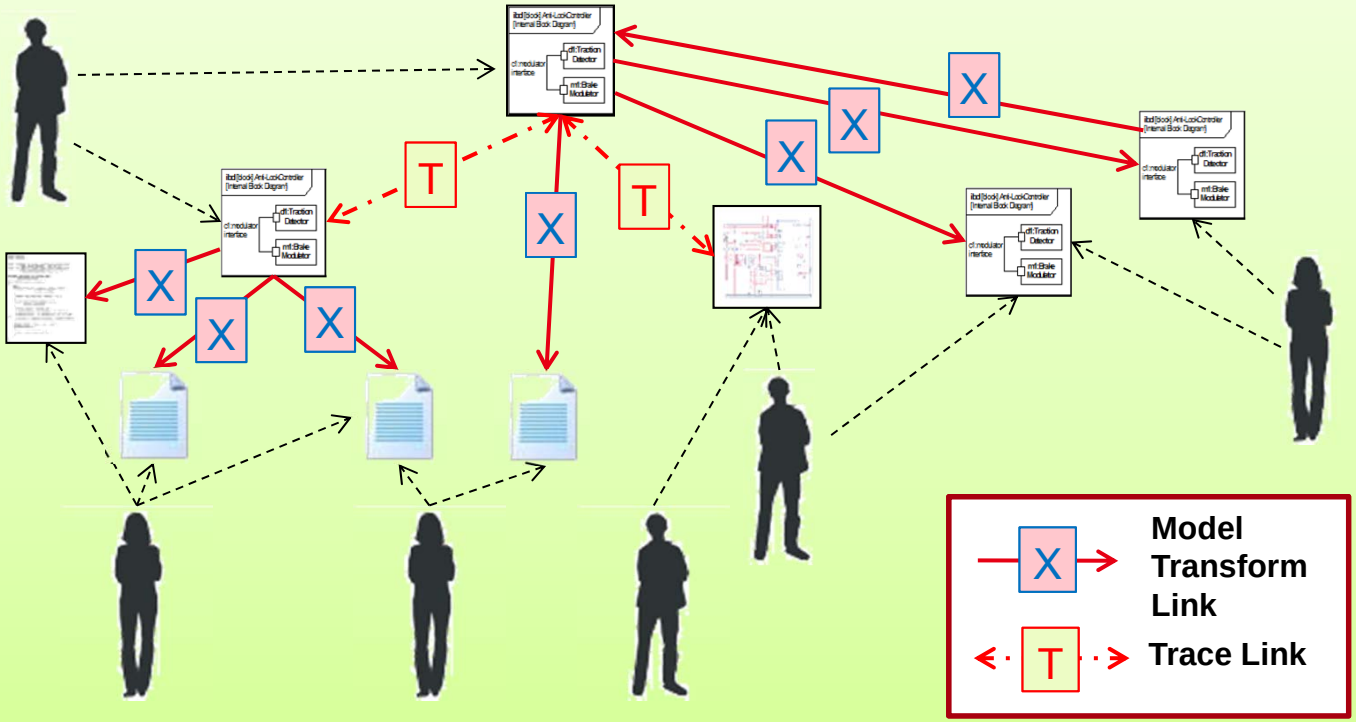

The Evolution of Computer Languages

- Much of the evolution of computer languages is motivated by the need to be more human-centric (i.e., descriptive)



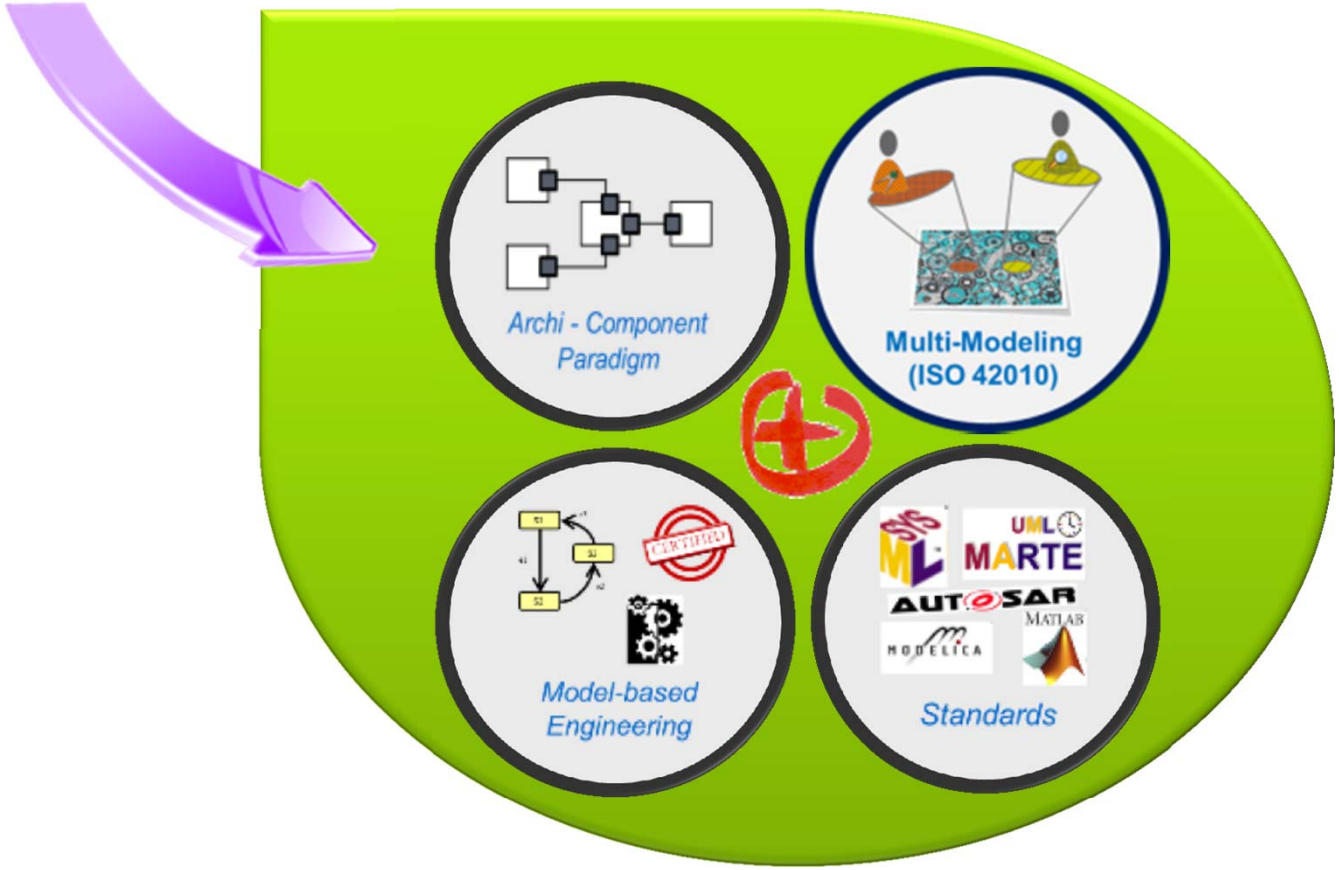
TWO MAIN PRINCIPLES BEHIND MDE

Model-based Development Approach



More efficient, More reliable,
and More scalable.

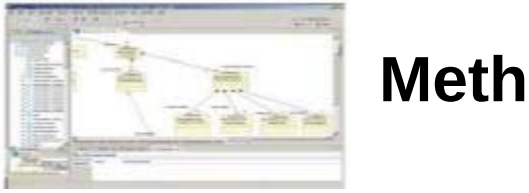
Going further for developing modern complex systems & software requires new advanced and innovative methods and tools

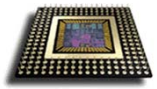


➔ NUMEROUS, COMPLEX & INTERDEPENDENT SOFTWARE

From requirement document: ***Hundreds of pages***

Methods **& tools**





… to code: ***millions of lines***

Modeling with which language?

… AND NOW WHAT ABOUT STANDARDS?

Standards have traditionally provided major boosts to technological progress !

BUT STANDARDS ENABLE ALSO VENDOR INDEPENDENCE

- Users have a choice of different vendors (no vendor “tie-in”)
- Forces vendors into competing and improving their products

THE OBJECT MANAGEMENT GROUP (OMG) HAS CREATED THE MODEL-DRIVEN ARCHITECTURE INITIATIVE:

- A comprehensive set of standards in support of MBE including standard modeling languages:

UML2, SysML and MARTE

“For standard-based modeling, UML is a GOOD choice.”

Mature modeling language

- Initially based on very experienced modeling language designers: the three amigos, Booch, Jackobson and Rumbaugh but also Coleman, Desfray, Embley, Gamma, Harel, Meyer, Odell, Selic, Shaer-Mellor, Wirfs-Brock, etc.
- A 20 year old modeling languages (current version:2.5) continually maintained and updated by very advanced experts coming from vairous origin: end users, tool providers and academics.

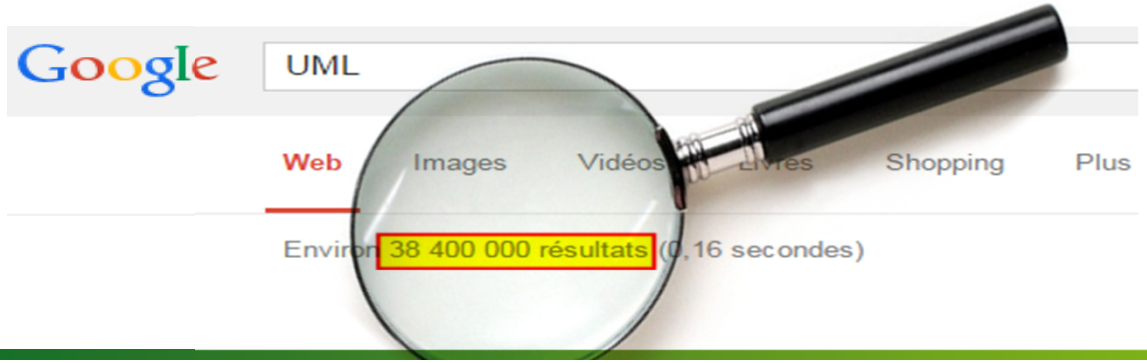
A rich modeling languages covering a large set of concerns

- e.g., architecture, automata, data-flow, scenario and use case.

Internationally popular and in-use

- UML is widely educated, disseminated and implemented…

…all around the world.



BUT UML IS ALSO A CUSTOMIZABLE STANDARD!

ORIGINALLY INTENDED FOR MODELING SOFTWARE-INTENSIVE SYSTEMS

- UML models capture different views of a software system (information model, run-time structure/behavior, packaging, deployment, etc.)
- Inspired primarily by the concepts from object-oriented languages (class, operation, object, etc.)

HOWEVER, THE GENERAL NATURE A LARGE SCOPE OF ITS CONCEPTS MADE UML SUITABLE FOR EXTENSIONS TO OTHER DOMAINS.

Domain Specific Modeling by profiling the UML2!

www.eclipse.org/papyrus

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