SYSTEM MODELING INTRODUCTION

Introduction on UML for Industrial Systems

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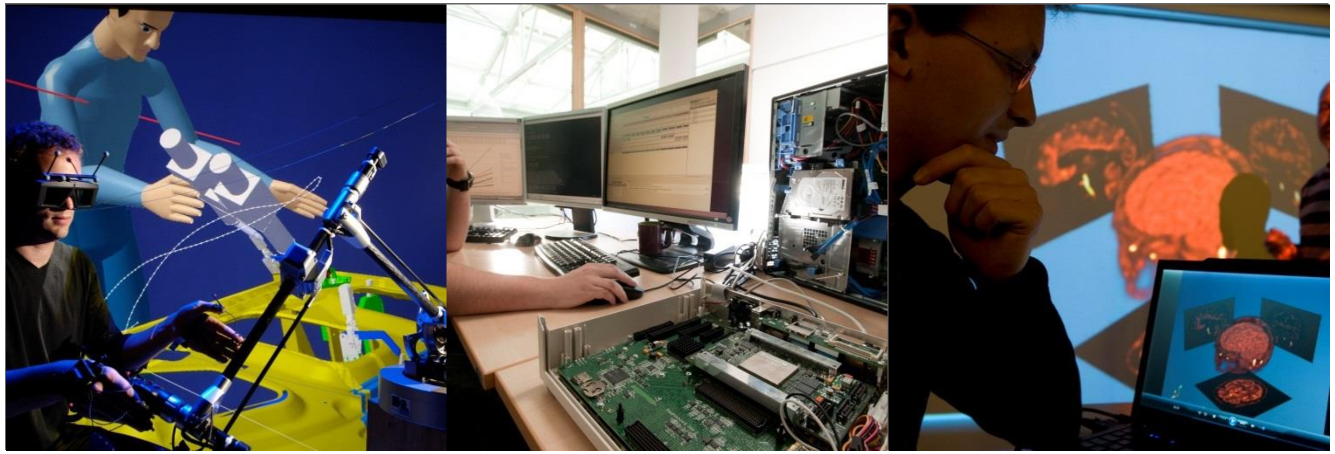
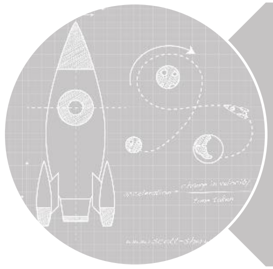
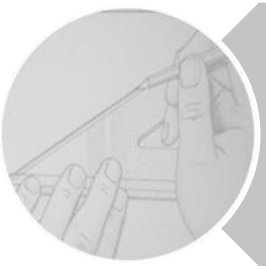


Introduction



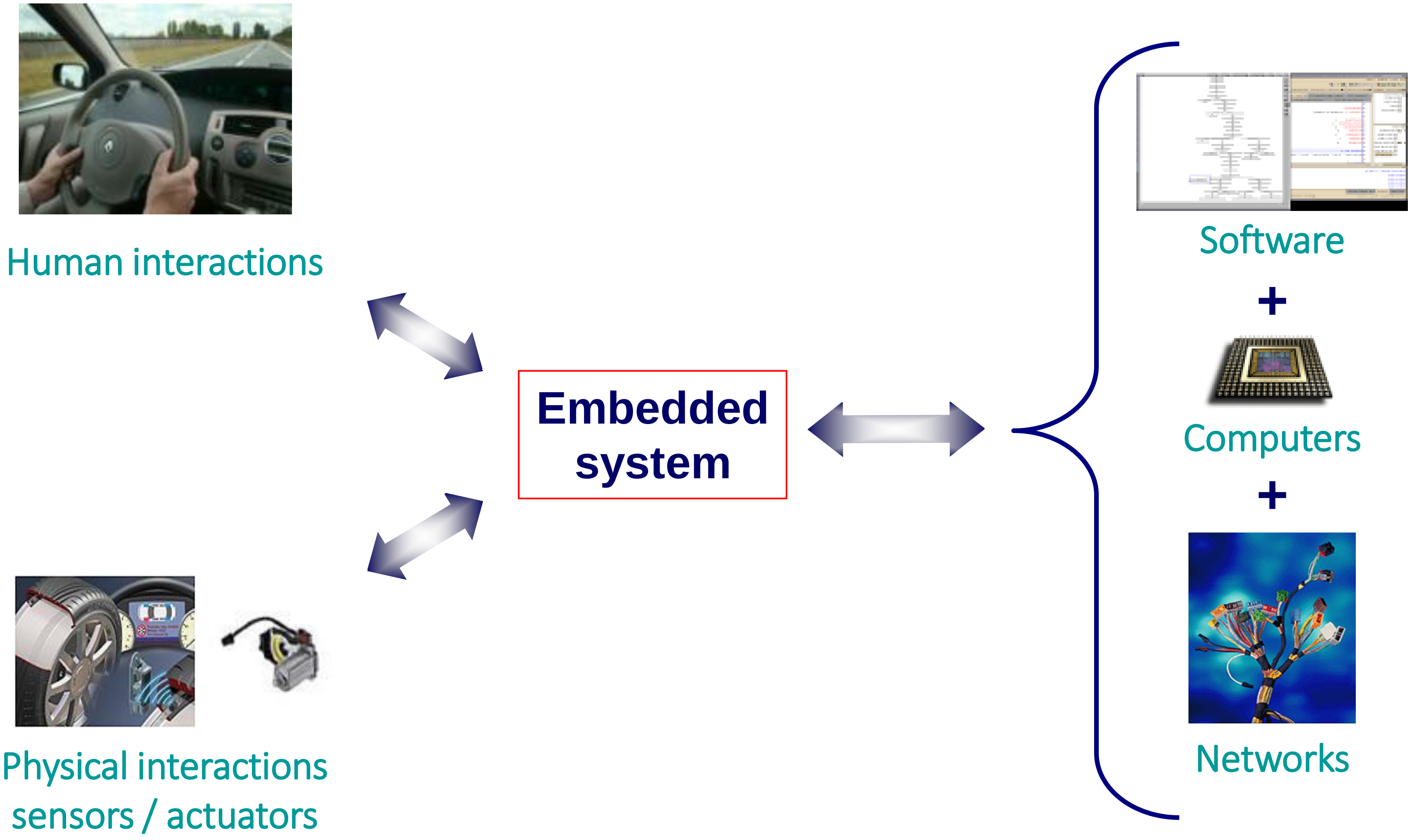
Basis is Modeling



Modeling with Which Language?

What is a System?

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



Human interactions

Physical interactions sensors / actuators

Embedded system

Software

+

Computers

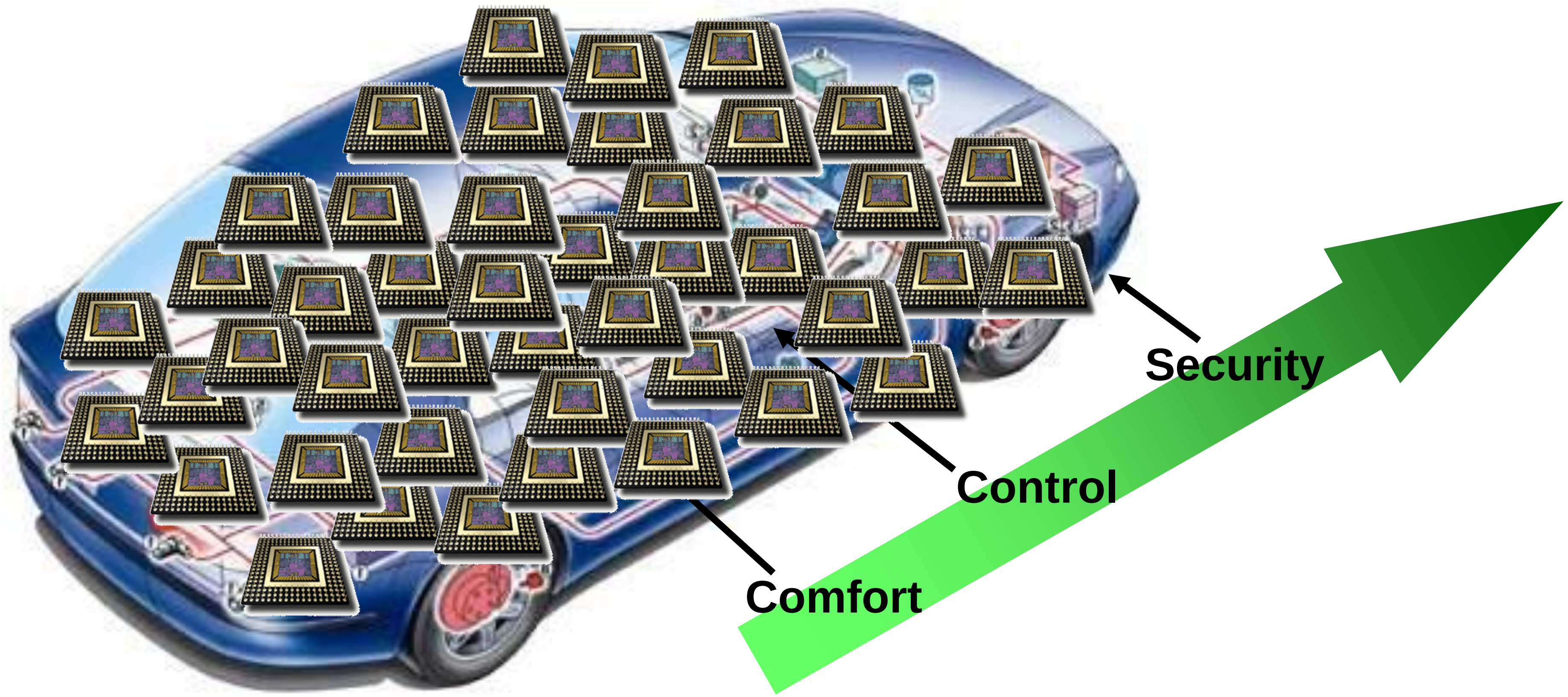
+

Networks

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

Innovation = more functions = more computation

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 c
of a software glitch that may not allow
airbags for passengers sitting in the ri
crash, reports a blog post at Zacks Inve

According to GM, the post says:

"...the front passenger i

ON SOFTWARE ENGINEERING, VOL. 39, NO. 6, JUNE 2013

What Industry Needs from Architectur
Lan ges: A Survey

Senior Member, IEEE, Henry
Antony Tang, Member, IE

nitions, concepts, languages, and tools i
chnologies and what is needed by their use
us. The same applies to software architecture
ent architectural languages have been introduce
unclear if they fulfill the user's perceived needs in
chitectural description, this study analyzes practitione
for software architecture modeling
ountries. Each

INVITED PAPER

Engineering Automotive Software

the gigabyte of costly software that will be used in intelligent cars of the future,
system and software development techniques and tools are required.

ANFRED BROY, INGOLF H. KRÜGER, ALEXANDER PRETSCHNER, AND CHRISTIAN SALZMANN

ABSTRACT | The amount of software in cars grows exponentially. Driving forces of this development are the availability of cheaper and more powerful hardware, as well as the demand for innovation through new functionality. The rapidly growing significance of software and software-based functionality is at the root of various challenges in the automotive industries.

KEYWORDS | Road vehicle electronics; software engineering; systems integration

I. INTRODUCTION

Just 30 years ago, the automotive industry witnessed the first deployment of tiny little bits of software in cars.

nodes. Only a minimum of abstraction was applied, and the focus was on minimum resource consumption. Applications were designed directly in machine code or the programming language C.

The basic architecture in cars was hence formed by ECUs for dedicated tasks together with their sensors and actuators. In order to optimize electrical wiring, bus systems were conceived and implemented. In the beginning, they mainly connected ECUs to sensors and actuators.

The Standish Group Report

CHAOS

Released by:
Technical Operations
International Council on Systems Engineering (INCOSE)

SPECIAL REPORT

AIR JAM: The U.S. Federal Aviation Administration spent $2.6 billion trying to upgrade its air-traffic-control system, only to cancel the project in 1994. Gridlocked skies are still with us today.

Why Softw
FAIL

We waste
each year
preventable

By Robert N. Charet

SYSTEM FAILURE

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 company acknowledged the fault and sought to compensate its custom
regulator would waive its right to issue legal pro
Fair Trading Act.

"We're pl

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ast updated at 21:44 GMT

rry users complain of fresh crash

C Radio 1 Newsbeat listeners described how the crash affected them

ackberry users have complained of a fresh crash hours after
e company which makes the smartphones, RIM, said all
rvices were "operating normally".

n Twitter angry users reported renewed issues with their handsets
d an inability to send messages and email.

e initial blackout saw Blackberry services across Europe, the
ddle East and Africa disrupted - but that has now spread to Latin
nerica.

M said the problems were caused by core and back-up switch
lures.

e tweeter summed up the mood of many: "Blackberry server down
GAIN?!!! you have got to be kidding me!!!!!"

Related Stories

Can the iPhone still scare rivals?

Microsoft services h by failure

Android 'most popular' purchase

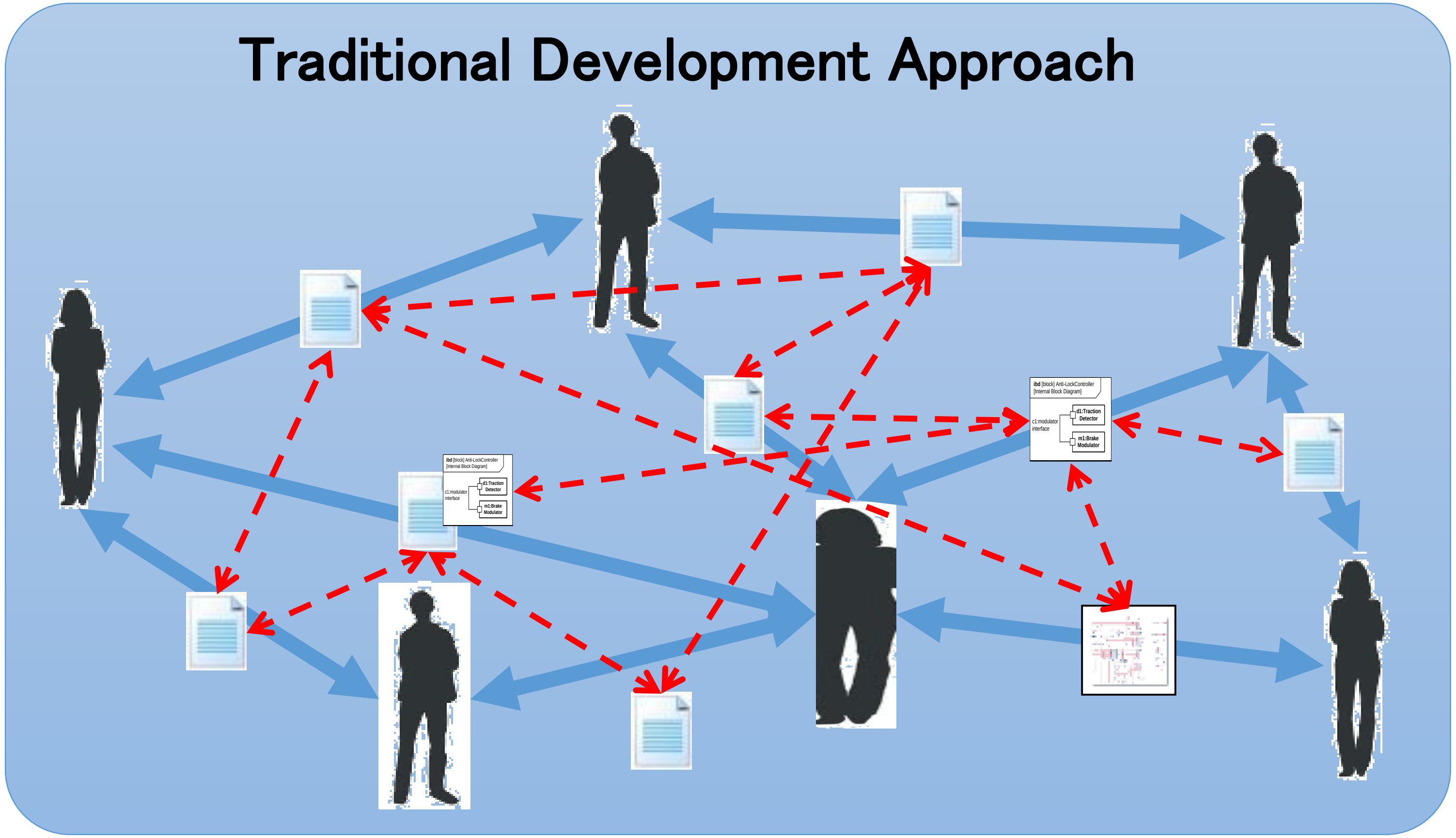
Why it Fails?

- ❍ Communication issues between numerous and various stakeholders.
- ❍ Time-to-market pressure vs. higher quality level.
- ❍ Ambiguous or incomplete 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 . . .

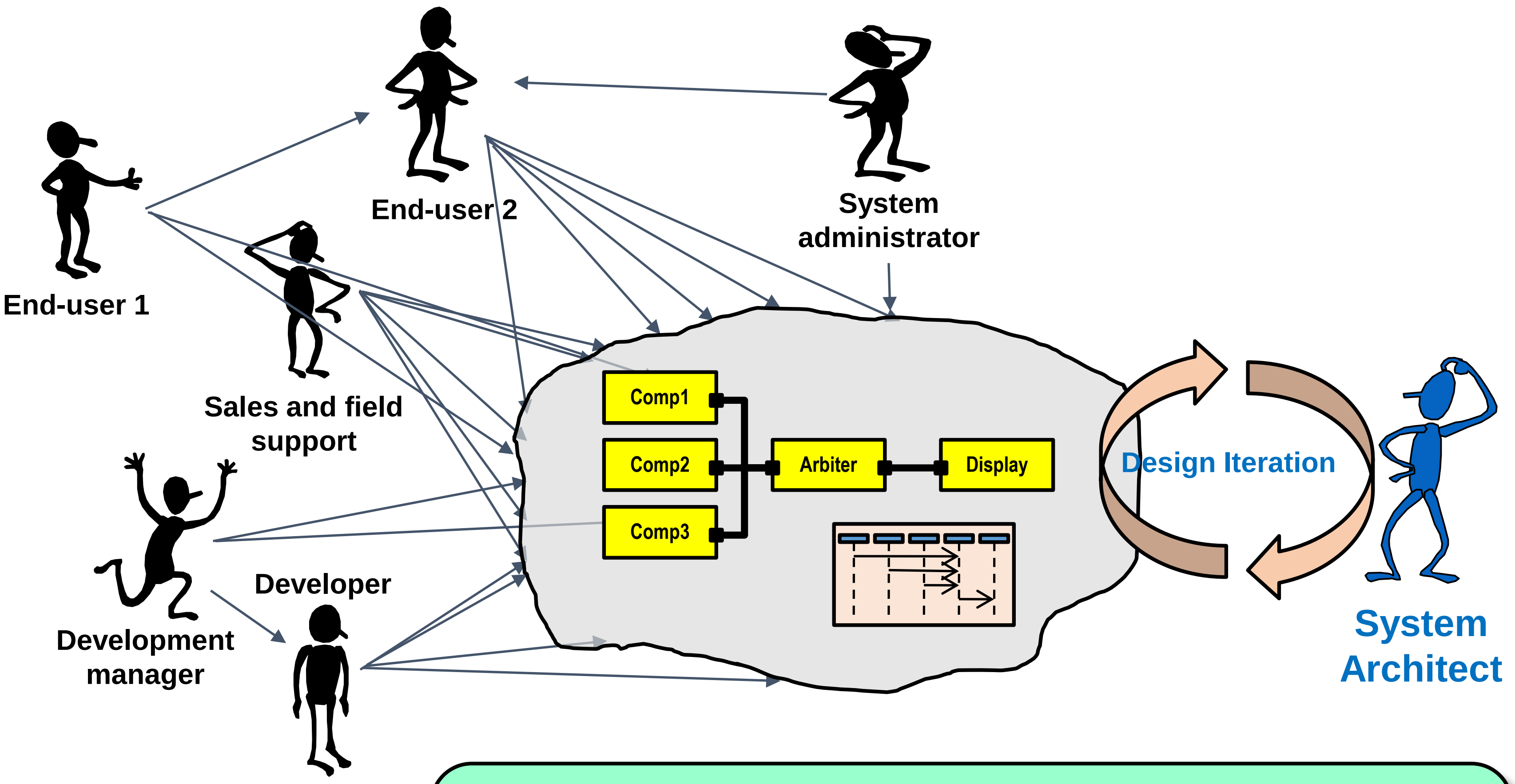
Problems of Traditional Approaches



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

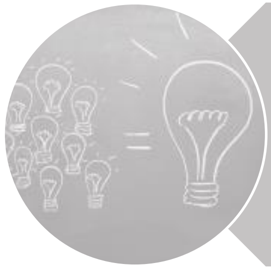
- Provides possibility to ensure system integrity
- Requires a “big picture” approach

→ 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

“ To architect is to model ”



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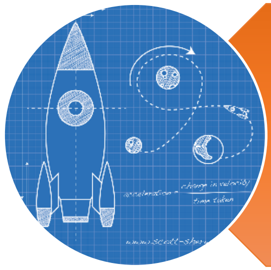
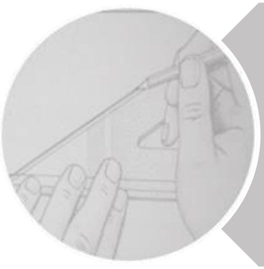


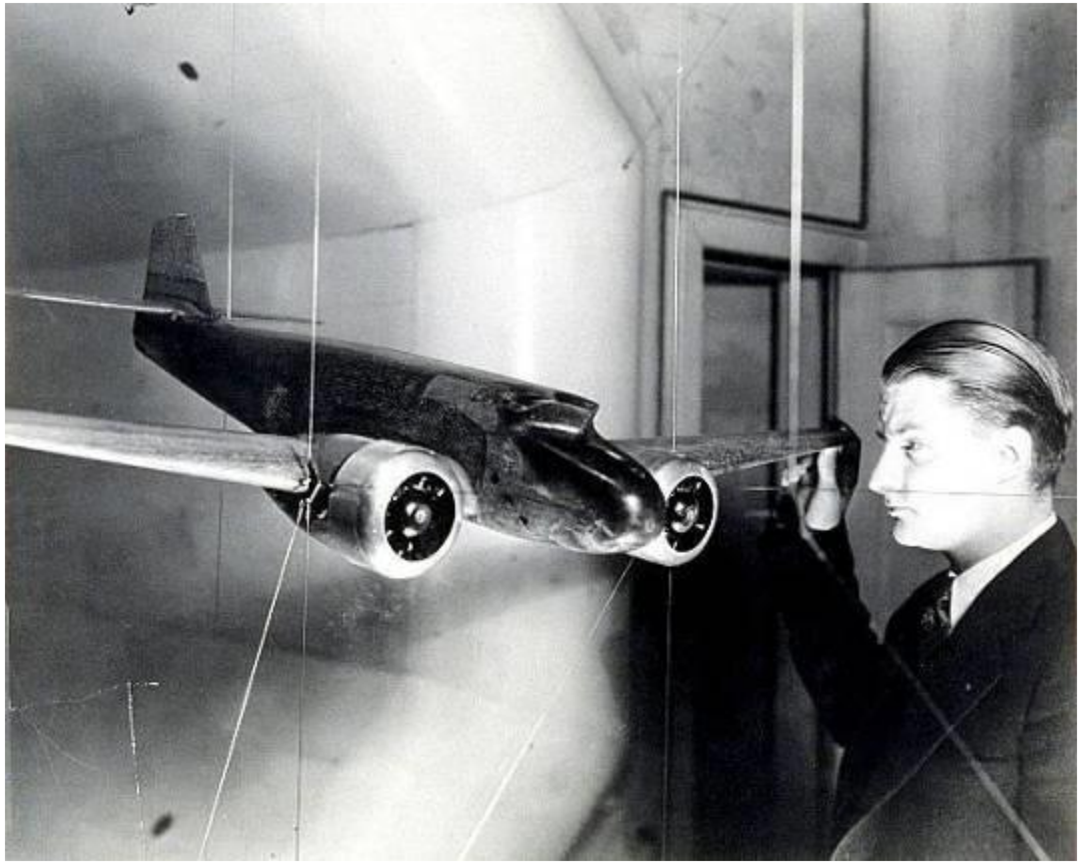
Basis is Modeling



Modeling with Which Language?

Models in Traditional Engineering

Probably as old as engineering



Extracted from B. Selic presentation

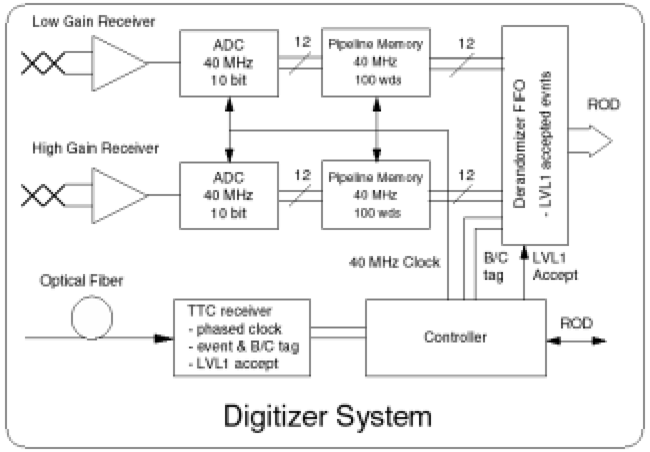
Engineering Models

Extracted from B. Selic presentation

Engineering model

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

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

Extracted from B. Selic presentation

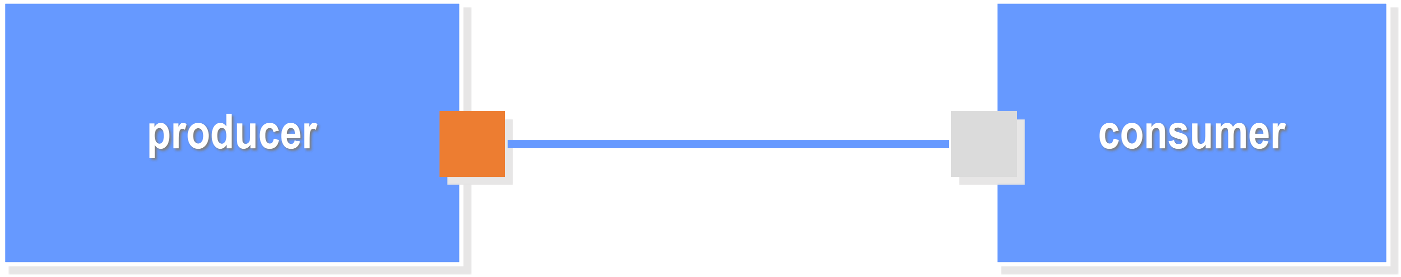
Code is also an abstraction

```
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?

Extracted from B. Selic presentation

Architecture clarity

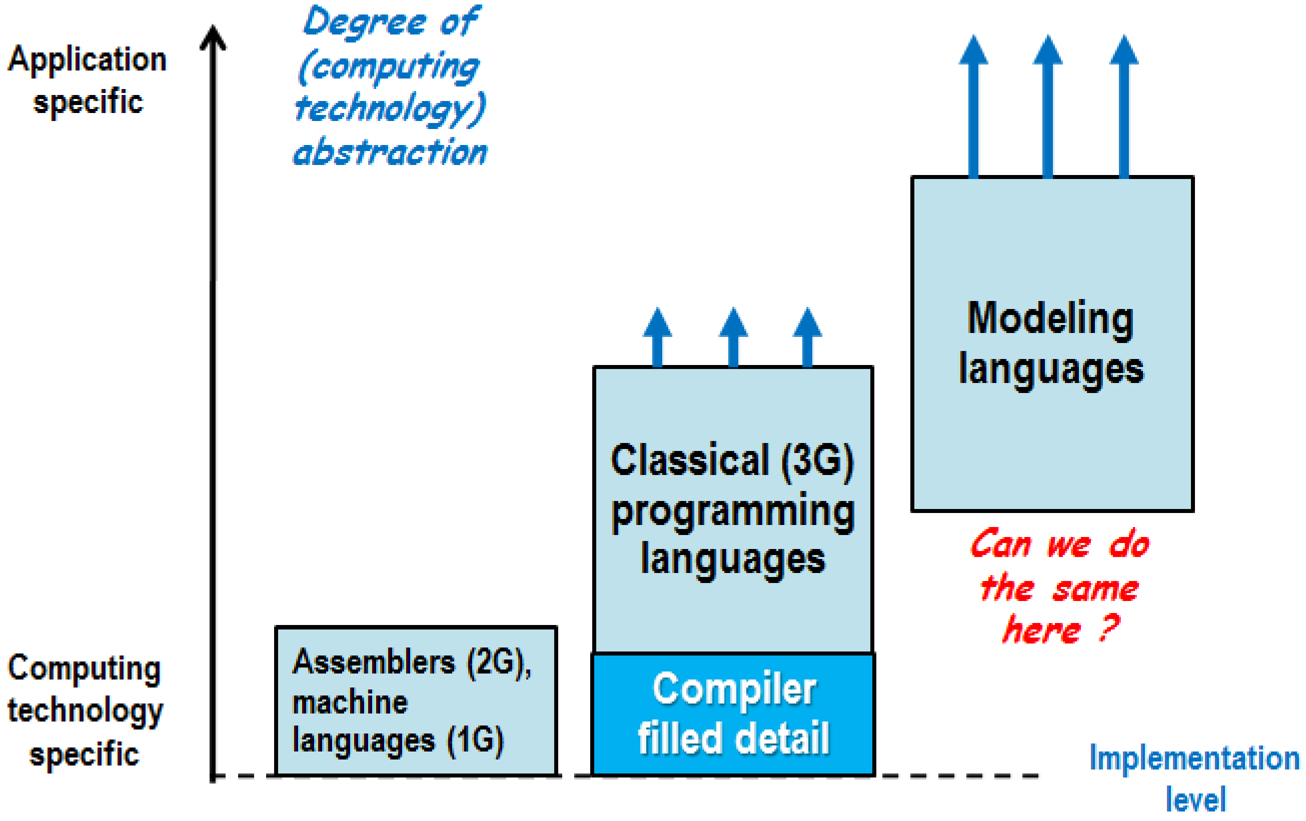


What about now?

Extracted from B. Selic presentation

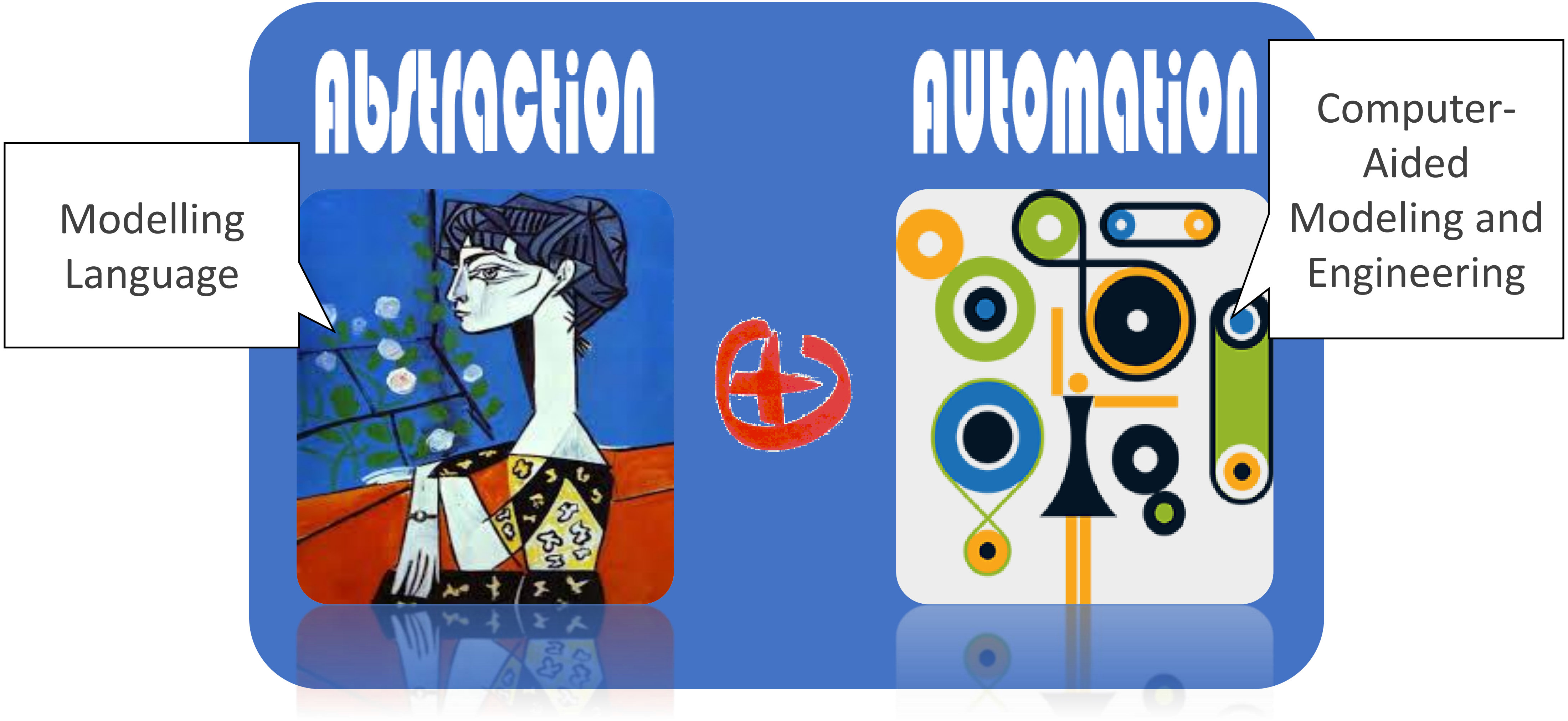
The Evolution of Computer Languages

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


Application specific
Degree of (computing technology) abstraction
Computing technology specific
Assemblers (2G), machine languages (1G)
Classical (3G) programming languages
Compiler filled detail
Modeling languages
Can we do the same here ?
Implementation level

Is code a model?

Two paradigms of MBE

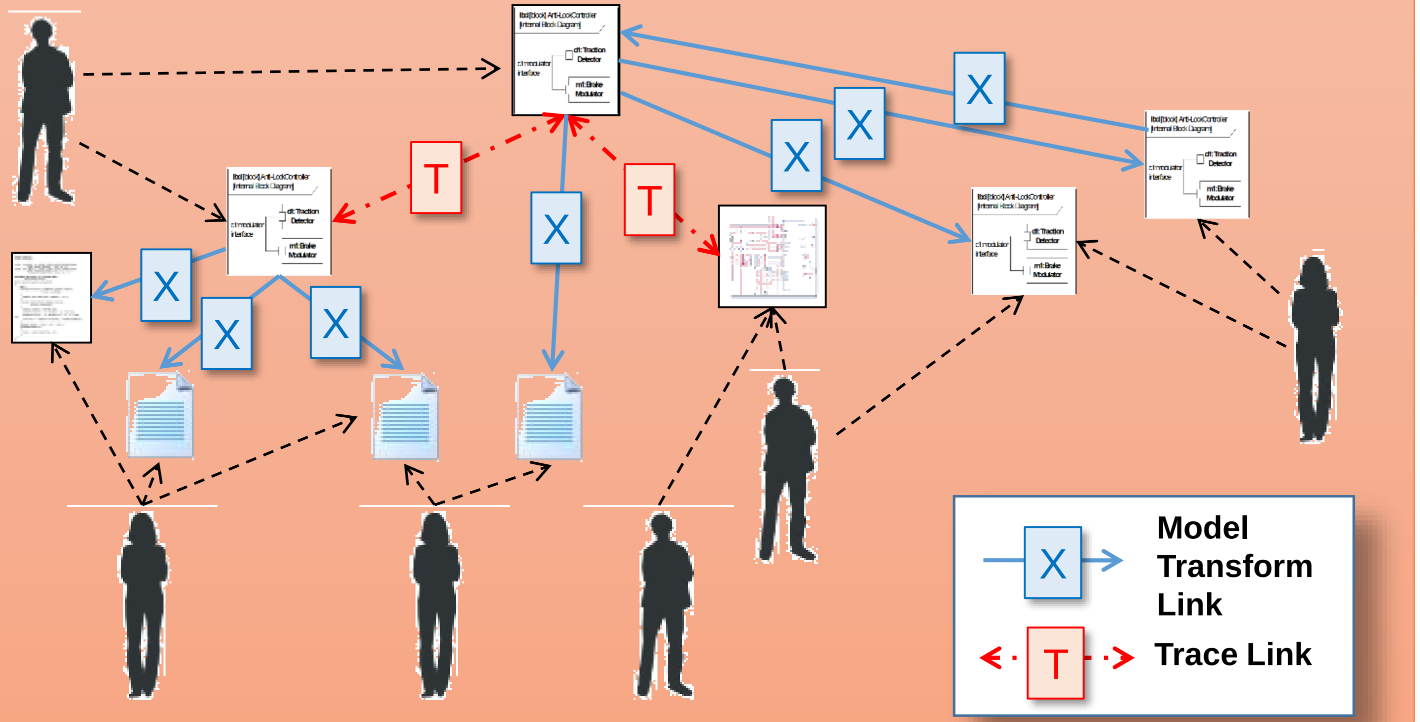


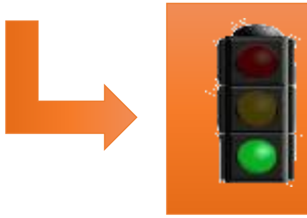
Modelling Language

Computer-Aided Modeling and Engineering

Why Model-Driven Engineering?

Model–based Development Approach

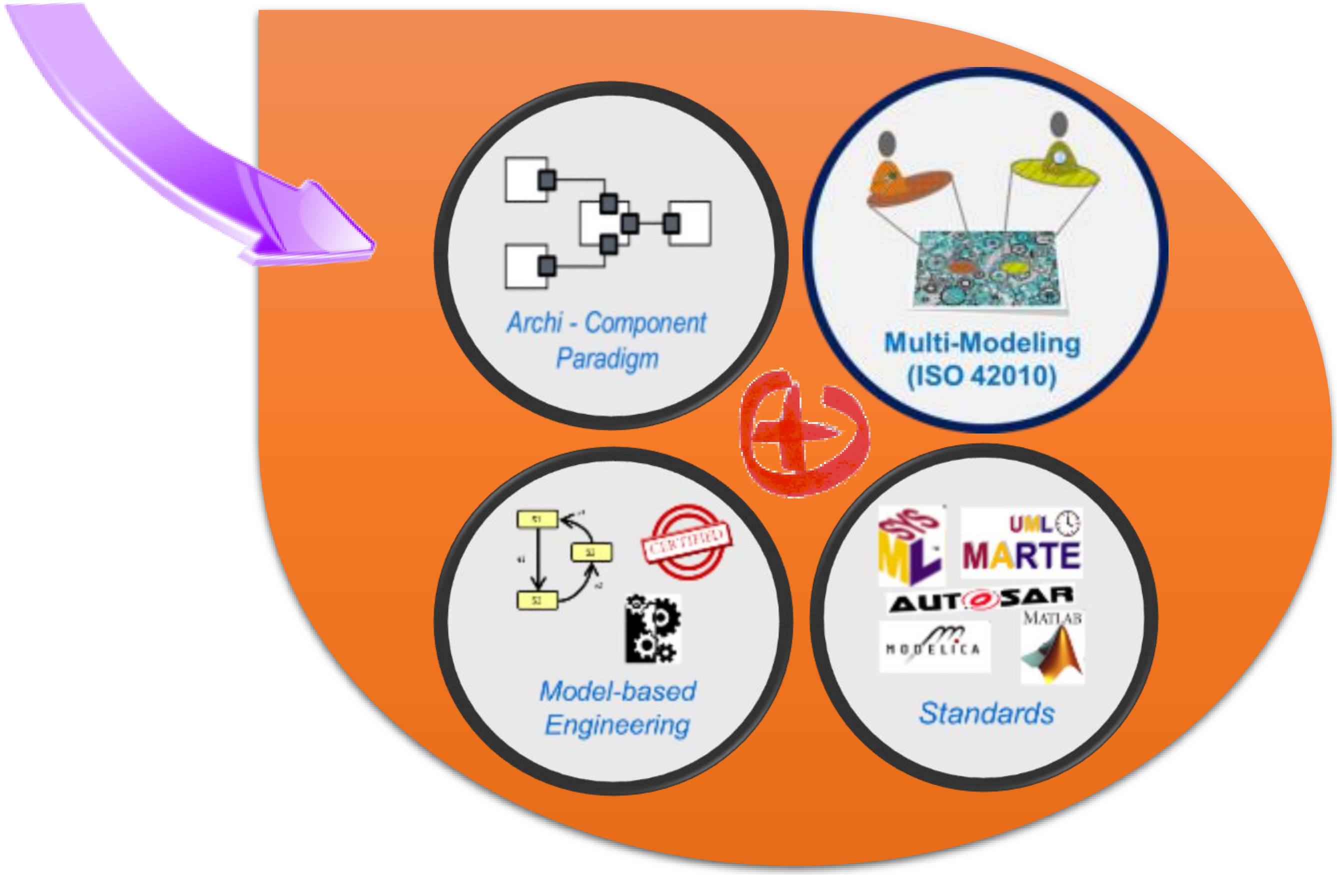




More efficient, More reliable,
and More scalable.

S. Gérard

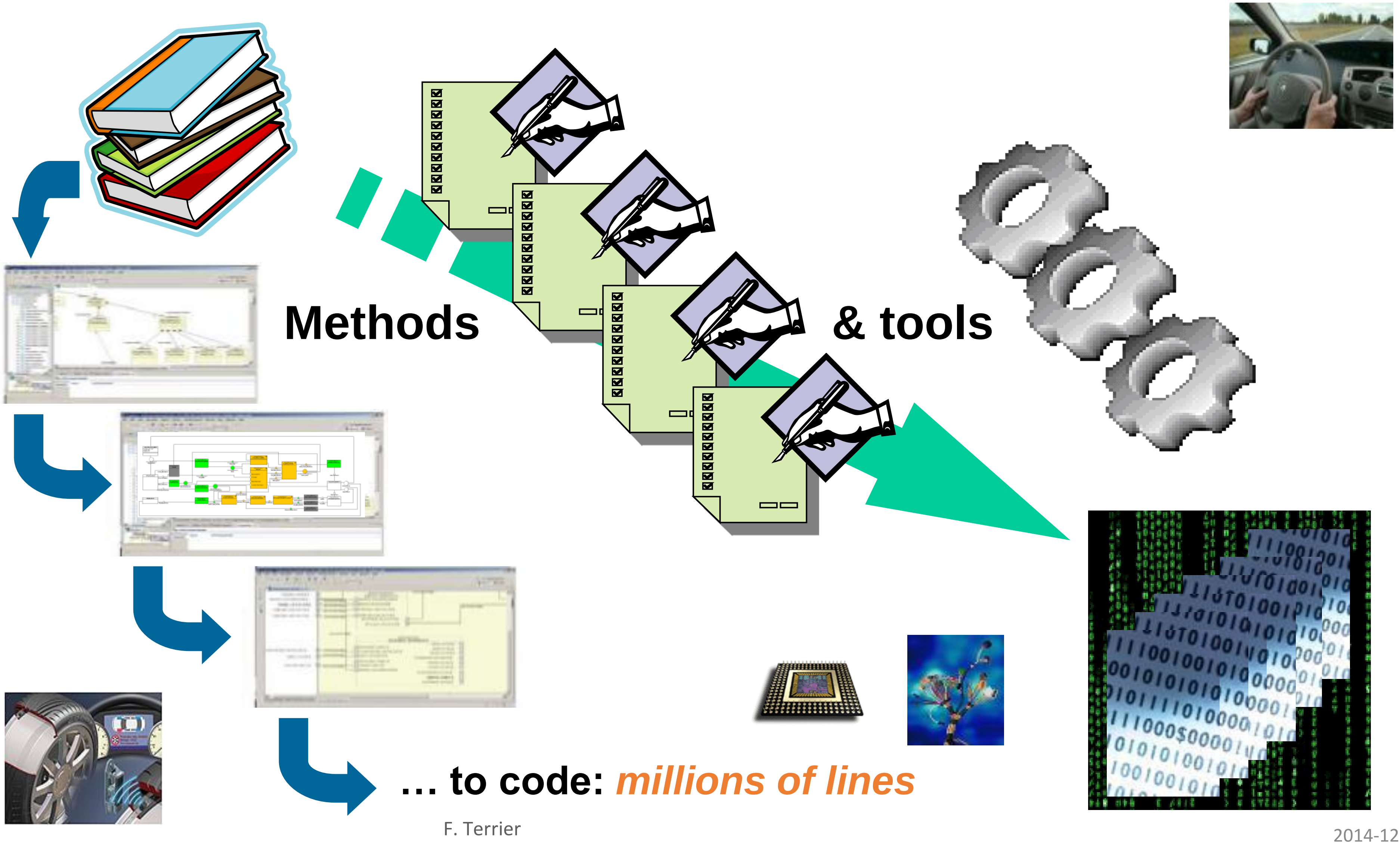
Going further for developing modern complex systems & software requires new advanced and innovative methods and tools



S. Gérard

Numerous, Complex, and Interdependent Software

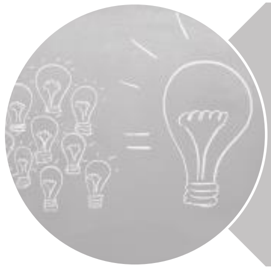
From requirement document: ***Hundreds of pages***



Methods

& tools

… to code: ***millions of lines***



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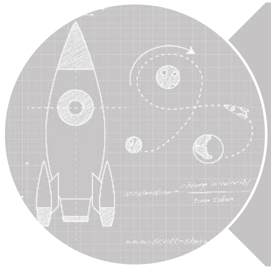

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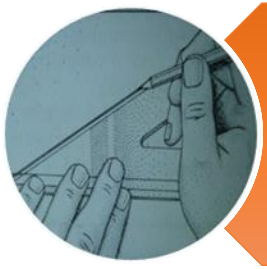


Modeling with Which Language?

Building

Worker(s)

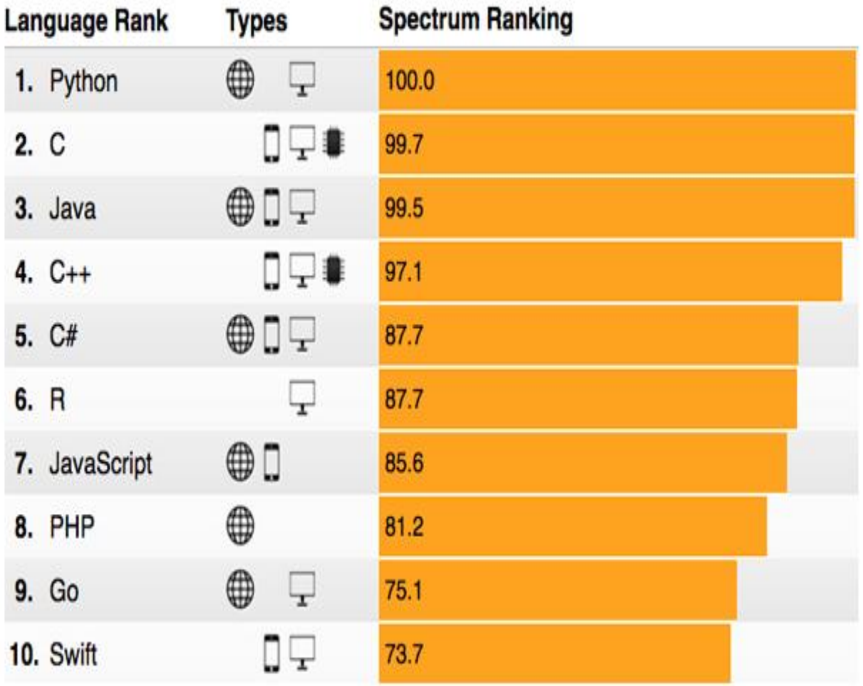
Architect

Computer science

Developer(s)

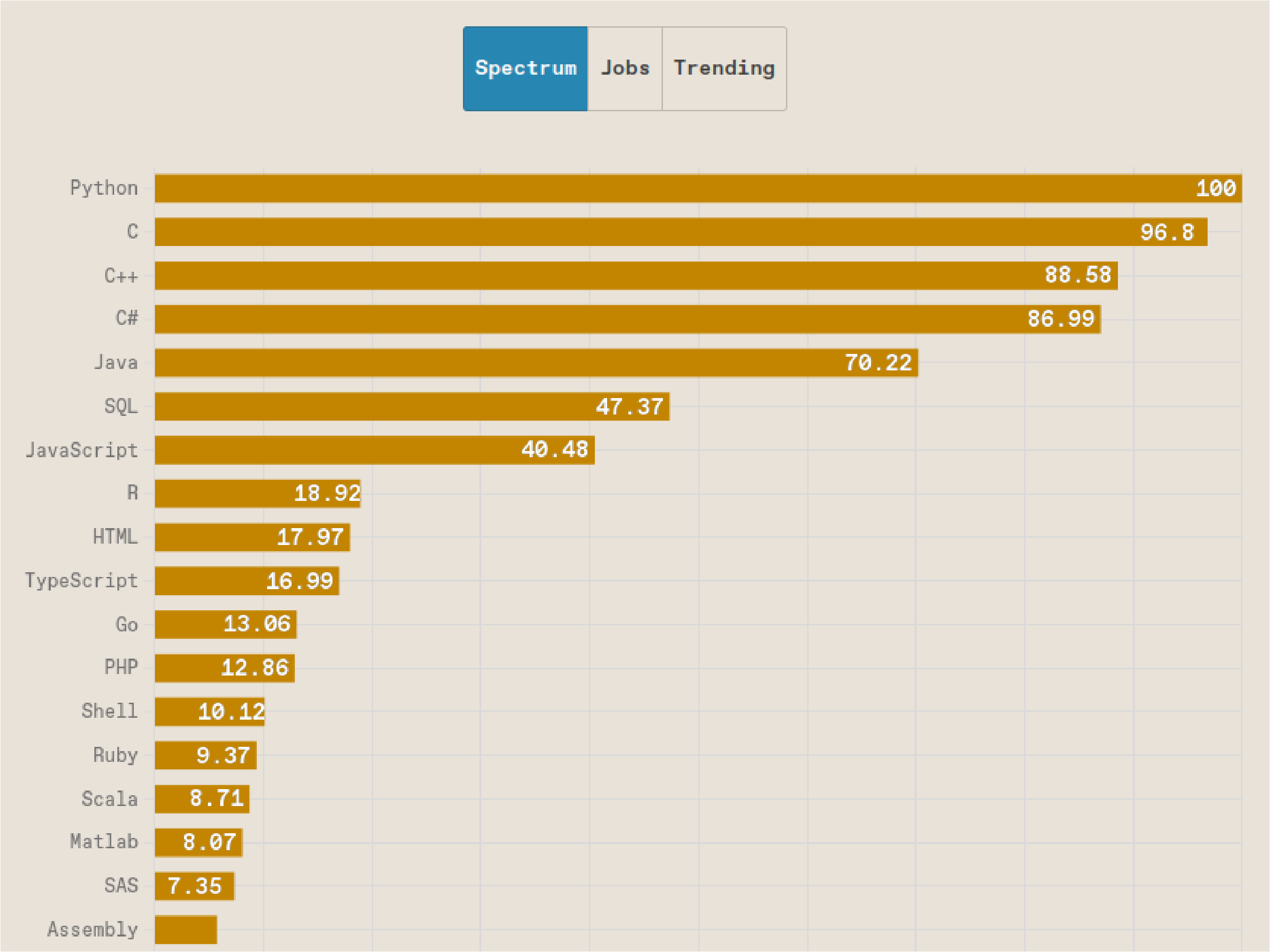
Designer, Architect

Popular programming languages



Language Rank	Types	Spectrum Ranking
1. Python	🌐 🖥	100.0
2. C	📱 🖥 ▮	99.7
3. Java	🌐 📱 🖥	99.5
4. C++	📱 🖥 ▮	97.1
5. C#	🌐 📱 🖥	87.7
6. R	🖥	87.7
7. JavaScript	🌐 📱	85.6
8. PHP	🌐	81.2
9. Go	🌐 🖥	75.1
10. Swift	📱 🖥	73.7

https://spectrum.ieee.org/computing/software/the-2017-top-programming-languages



https://spectrum.ieee.org/top-programming-languages-2022

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

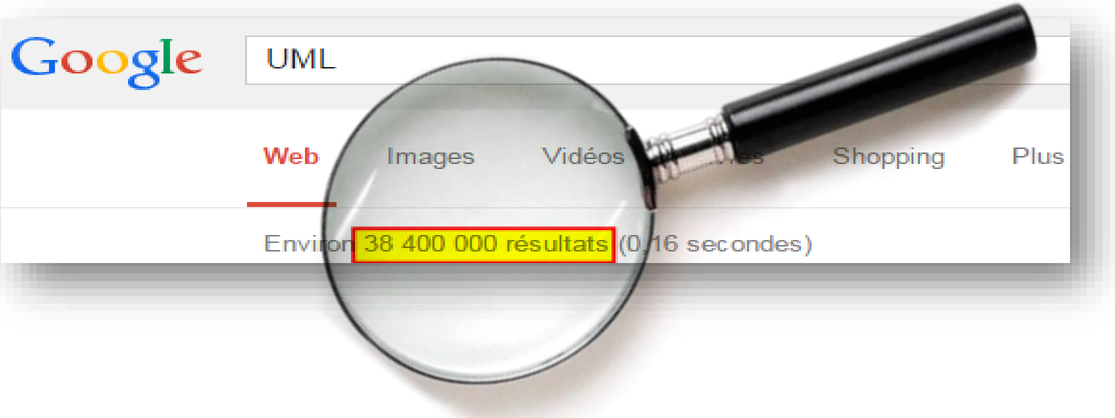
- A comprehensive set of standards in support of MBE including standard modeling languages

UML – Unified Modeling Language

- Standardized by Object Management Group
- https://www.omg.org/spec/UML
- Current version 2.5.1
- Mainly targeted for SW development domain
- **Extensible** via profiles, for instance SysML or MARTE (realtime)

What is the Unified Modeling Language?

- Mature modeling language
  - Initially based on experienced modeling language designers: the three amigos, Booch, Jacobson and Rumbaugh but also Coleman, Desfray, Embley, Gamma, Harel, Meyer, Odell, Selic, Shaer-Mellor, Wirfs-Brock, etc…
  - 20 year old modeling language (current version 2.5.1), continually maintained and updated by experts from various origins: end users, tool providers and academics
  - Historically object-oriented software modeling language
- A rich modeling language 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



Environ 38 400 000 résultats (0,16 secondes)

UML, a standard modeling language

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- The Object Management Group (OMG) has created the Model-Driven Architecture initiative
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papyrus

www.eclipse.org/papyrus

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