Safety-critical systems design: the TASTE tool-chain

Julien Delange <julien.delange@esa.int>

Maxime Perrotin <maxime.perrotin@esa.int>

High-integrity software constraints

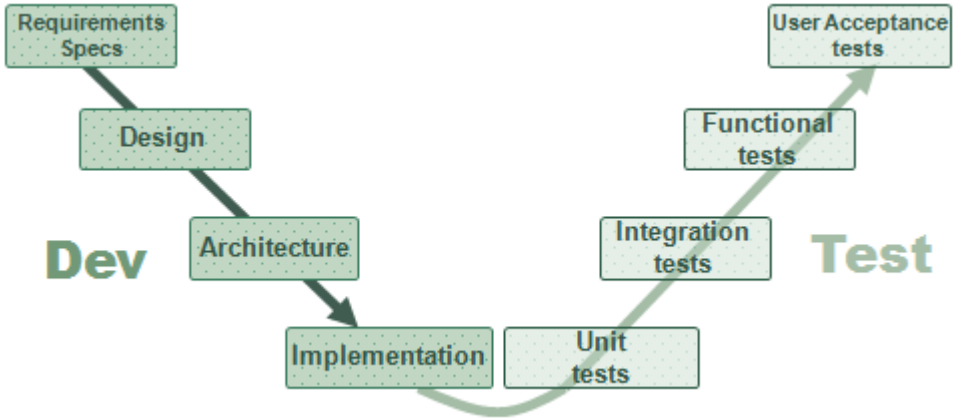
- Real-Time determinism

- Safety & security

- Memory & processing constraints

Usual development process: myth

1. Specifications by designers



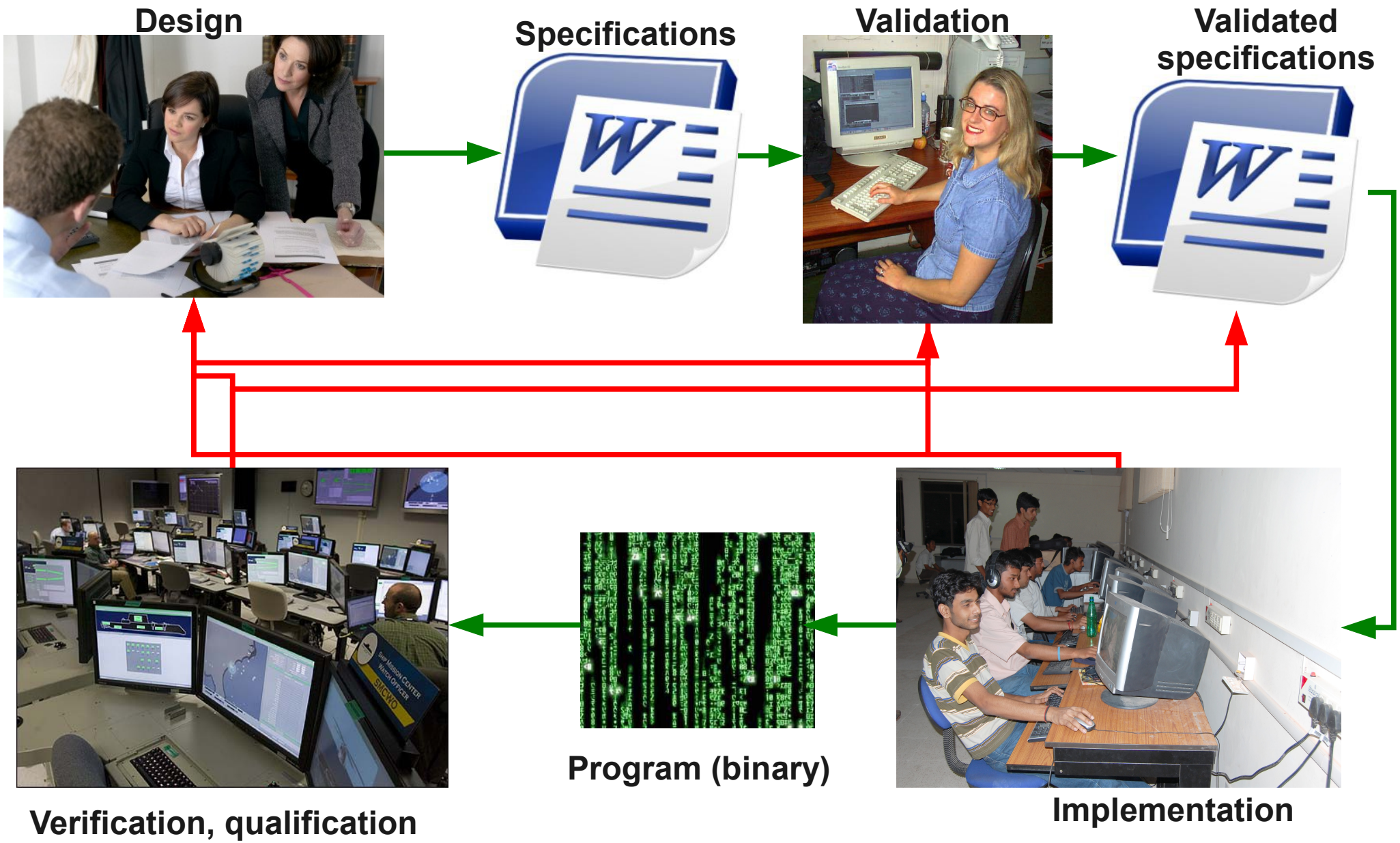
2. Validation by engineer

3. Development by voodoo coders

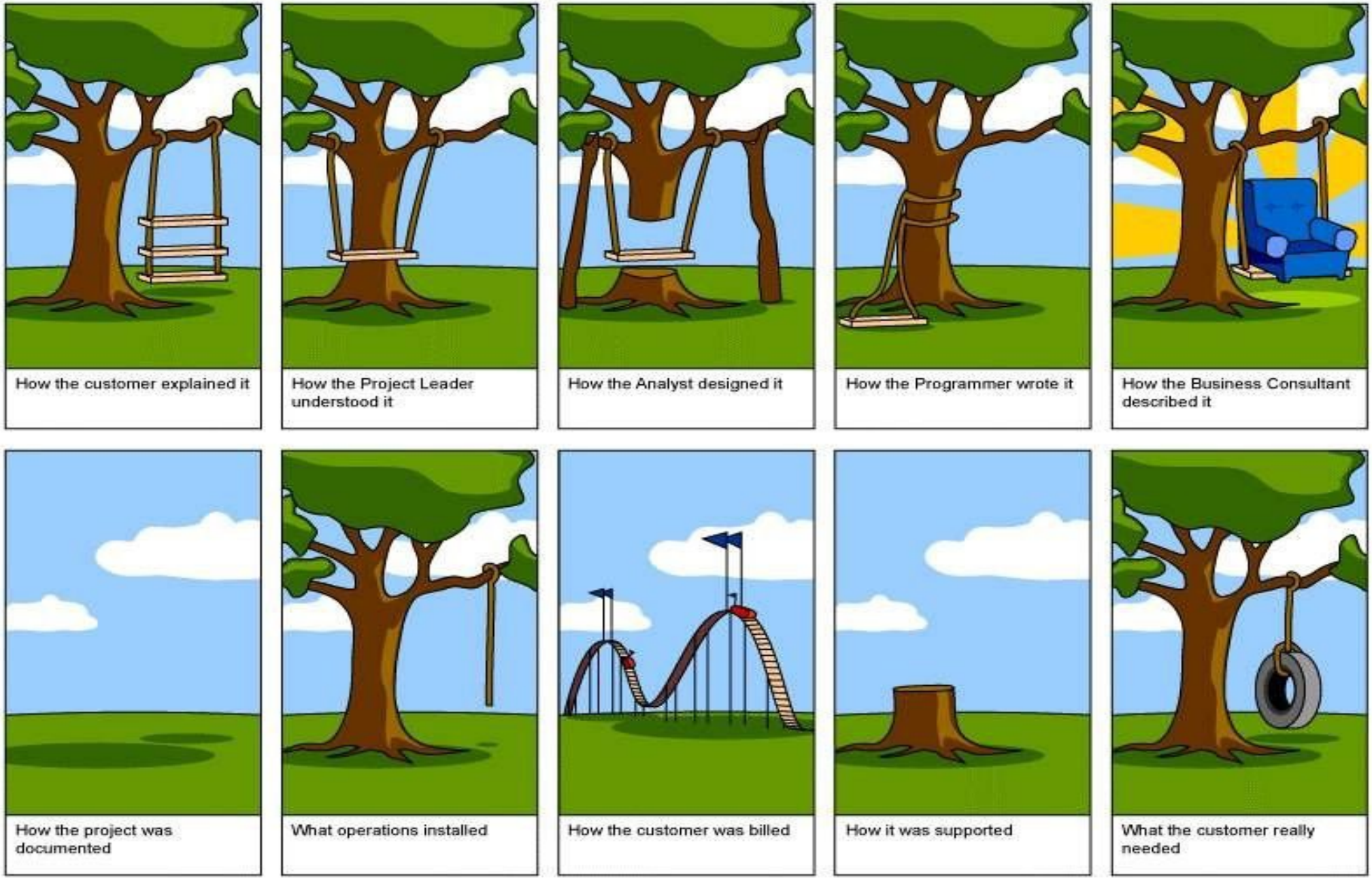
4. Tests, verification by engineers

5. Release by business consultants/sales dept.

Usual development process, overview



Usual development process, reality (1)



Usual development process, reality (2)

Funny but ...

- **Nor for life-/mission- critical systems**

- **Must do the *dirty* and *boring* work**

- **And do it *correctly***

In addition ...

- **Requirements and constraints increase**
  - **Number of functions and their impacts**
  - **Costs (money, time)**
- **Allocated resources decrease**
  - **Budget**
  - **Time, release to market**
- **Cannot use traditional methods**

Key points

- Validation
- Automation
- Verification

Ideal development process

1. Specifications by designers
2. Validation by ~~engineer~~ analysis tools
3. Development by ~~voodoo coders~~ code generators
4. Tests/verif by ~~engineers~~ execution analysis tools
5. Release by business consultants/sales dept.

TASTE guidelines

- **Abstract** software & hardware
- Focus on **engineering concerns**
- **Validate & verify** as early as possible
- **Automate** as much as possible

TASTE process

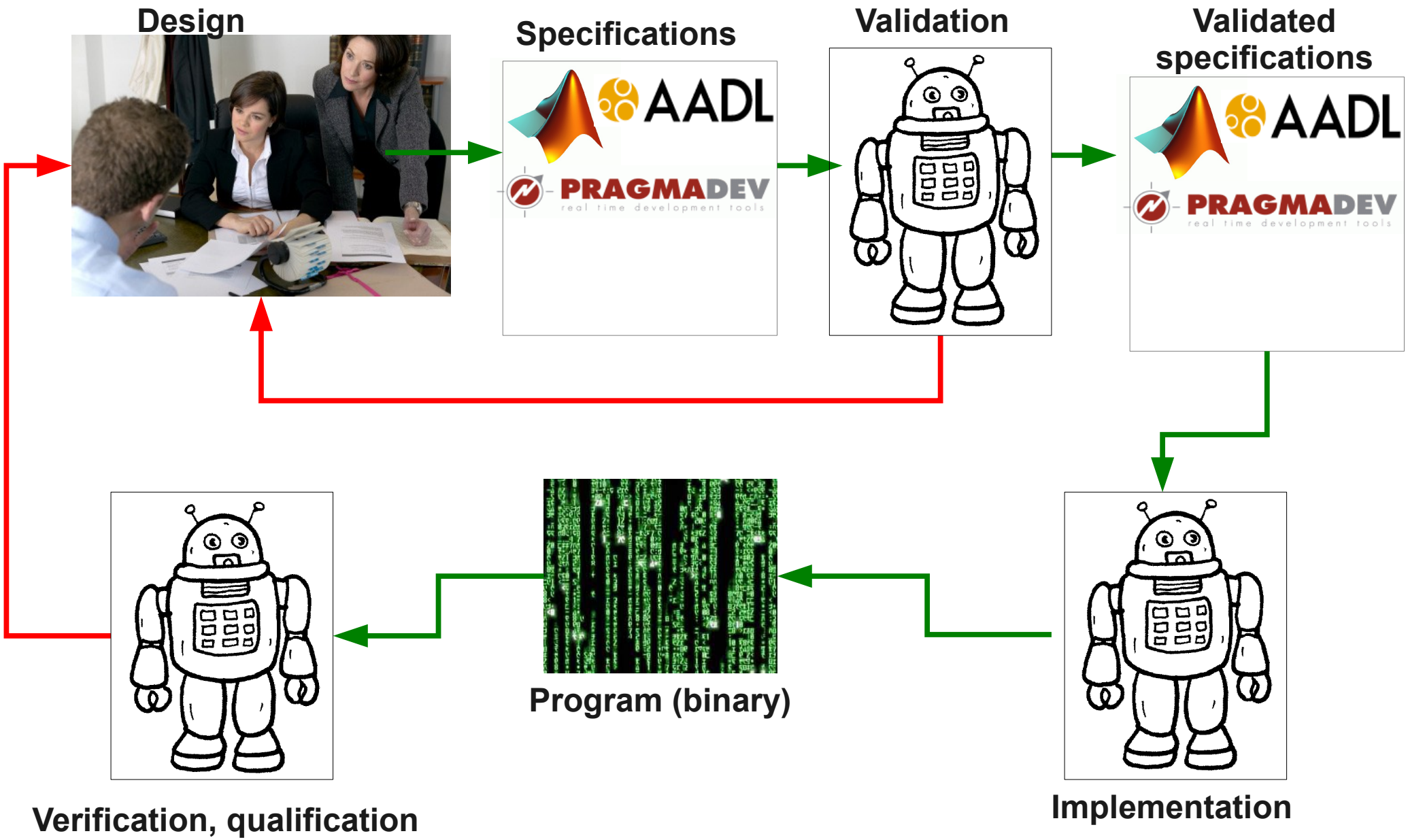
1. Define **system interfaces**

2. Abstract **soft & hard aspects**

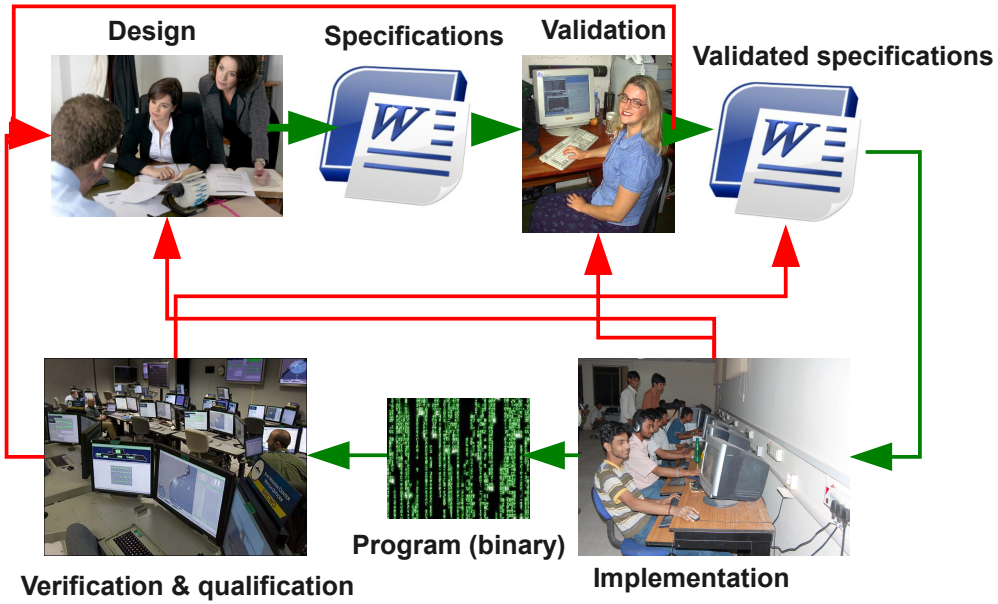
3. **Validate & verify** requirements

4. **Generate application using ACG**

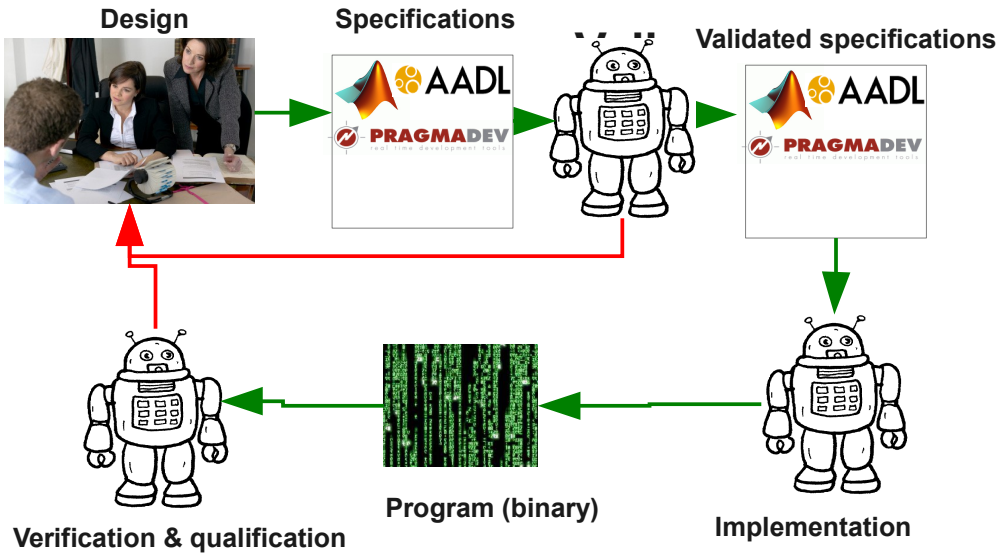
TASTE development process



TASTE benefits



Traditional process



TASTE process

TASTE workflow

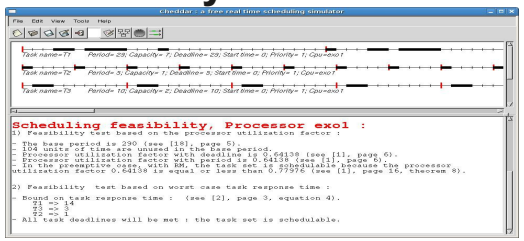
Specifications

- Interfaces specifications
- Software models
- Deployment models

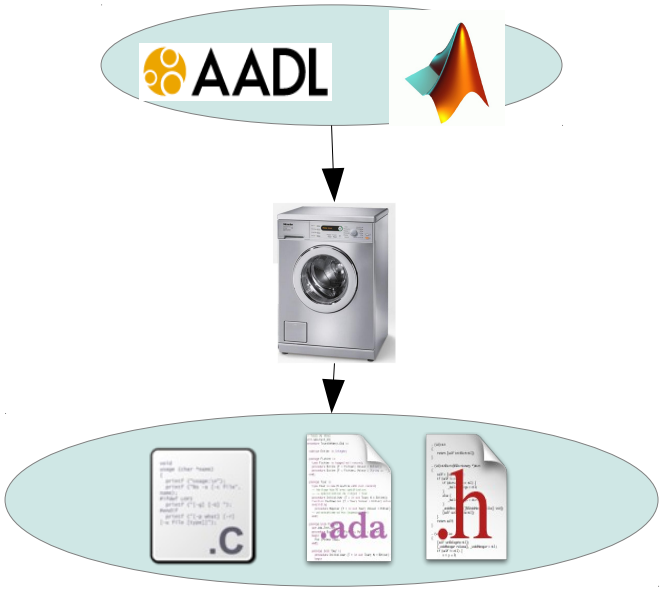
AADL

Validation

- Scheduling
- Trade-off analysis
- ...

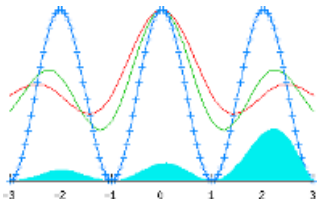


Automatic Code Generation



Verification & Qualification

- System execution
- Documentation generation
- Run-time analysis
- Software metrics acquisition



TASTE technologies (1)

1. System interfaces: **ASN.1**

2. Soft specifications: **C/Ada, Simulink, SDL**

3. Hard deployment & conf**: AADL**

TASTE technologies (2)

Specifications

AADL

PRAGMADEV
real time development tools

Validation

- Cheddar
- MAST
- Ocarina/REAL

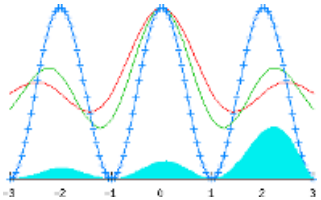
Automatic Code Generation

- ASN1 Compilers
- Ocarina
- Matlab/Simulink
- ...

PRAGMADEV
real time development tools

Verification

- COUVERTURE
- Qemu
- Gprof
- GNUplot



QEMU

TASTE use-case

ARM movement acquisition

Data transmission through PCI

TASTE system

- Data acquisition from devices
- Heterogeneous software (Simulink, RTDS, bare-C)

Data transmission through ethernet

ARM movement reproduction

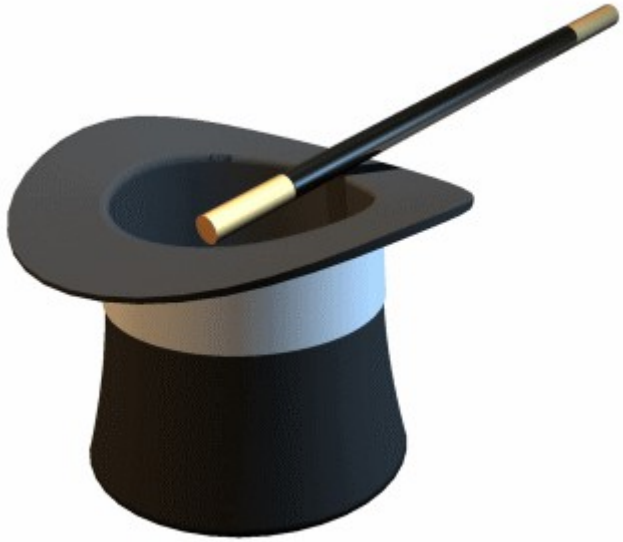
Demonstration

1. Interfaces and functions specifications

2. System validation

3. Automatic implementation

4. Verification



Conclusion

- ✔ **OSS tool-chain** for safety-critical systems
- ✔ Support by **industry & academia**
- ✔ Evaluation with **real developments**

Perspectives

- Enrich validation aspects
- Design OSS application code generators
- Improve verification tools

http://www.assert-project.net/taste