# THALES





# Mastering large scale systems: the industrial challenge

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THALES offers Mission Critical Systems, based on a broad scope of technologies that need to meet the following challenges:

- Performance vs cost
- Environment constraints
- Security and safety
- Complexity

#### **Key figures**

- 25 000 people in R&D
- Of which > 10 000 in System Engineering
- Corporate research centres in France, GB, Netherlands, Singapore
- Overall spending ~2,4 B€
- 16 000 patents
- > 100 cooperations

### System expertise at the heart of THALES



# Type of systems: platforms 📀



- Complexity on large hardware design
- May embed electronic equipments where complexity mainly relies on technologies and algorithms
- Means typically based on Hardware/Software design tools, Technical Simulations, Requirements Analysis



### Type of systems: large electronic systems 🗲



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- Complexity comes from large numbers of highly interacting
  - Functions
  - Non functional constraints
  - Interfaces
- May include complex hardware aspects where complexity mainly relies on technologies
- Means typically based on Architecting practices, Model Based System Engineering and simulations from many disciplines



# Type of systems: large IT systems and SoS 📀



- Complexity comes from interactions between operational needs, capability services, business processes, organisations
- Means typically based on Architecture Framework and Business Process Modelling













- Multi-disciplinary
- Collaborative
- Interactive
- Parallel development
- Architecture centric



### Understanding customer and end-user needs (



# From operational to functional

- End-users, architects, operational experts, functional experts and human factors experts build and maintain a common understanding and confront it to typical scenarios
- System has to be analysed in its operational environment



### Modelling, Simulating : Early Verification 🗲



### **Early verification - IVV**

- Technico-operational simulation to validate end-users' needs understanding
- Technical simulation to validate non functional constraints
- Prototypes to validate human factors
- Training simulation for supporting system deployment
- Environment / equipment simulation for a progressive IVV
- Integration, verification, validation strategy to plan for early validation and prepare acceptance



## Non Functional Constraints, Performances (







### **Architecture optimisation**

- Architecture assessed against all technical and non-technical constraints
  - Safety, security
  - RAMT, environment
  - Technical (mass, weight, power, volume, vibration, thermal, EMC, lightning, frequency plan, etc)
  - Performances: system physical performances, computing
  - Obsolescence
  - Cost, schedule, risks, value analysis



### An architecture has multiple views 📀

- A view (or model) represents the whole system from a particular viewpoint
- Reduces perceived complexity through separation of concerns
- Architecture views are an end results of doing "architecting"











#### **Architecture**

 Relationship between all system components that bring its expected characteristics, static and dynamic

System architecture (

- A description that will be assessed against all other analysis
- Where many technical decision and key compromise are made



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From late discovery of design issues during IVVQ to early validation of the architecture





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Architect liaise together various stakeholders



### Organisational Aspects 🗲

#### **Global governance of R&D**

- Systems
- Software
- Processing
- Hardware

#### **Innovation centres**

- Thales Research & Technology
- CD&E centres

#### Deployment

- Methods and tools
- Common processes









#### Job family management

A common Technical Directorate and HR management all across the Group

#### **Roles & responsibilities**

- Design Authority
- Architect
- System engineer

#### Networking

Experts' networks to ensure flexibility in accessing key resources and to ensure knowledge and practices dissemination

#### **Training – Thales University**

- More than 50 % related to technical matters
- Coaching



Value technical jobs as much as managerial ones



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### Dealing with complexity requires to develop capabilities to

- Synchronise many disciplines and expertises
- Maintain a permanent link with end users' needs
- Deal with instability
- Deal with environment complexity
- Early verify solutions with strong modelling and simulation capability
- Implement delivery loops

Mastering system complexity:

a business priority



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