



IBM Innovate 2012

Deploying MBSE into an International Company

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Session Track Number 1882

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Agenda

- Introduction to MBDA
- The Problem Space - Why MBSE?
- Strategy and Approach
 - Communication and Collaboration
 - Design
 - Training and Rollout
 - Delivery
- Case Studies
 - Real Life Experiences
- Improvement Areas
- Summary
- Q&A



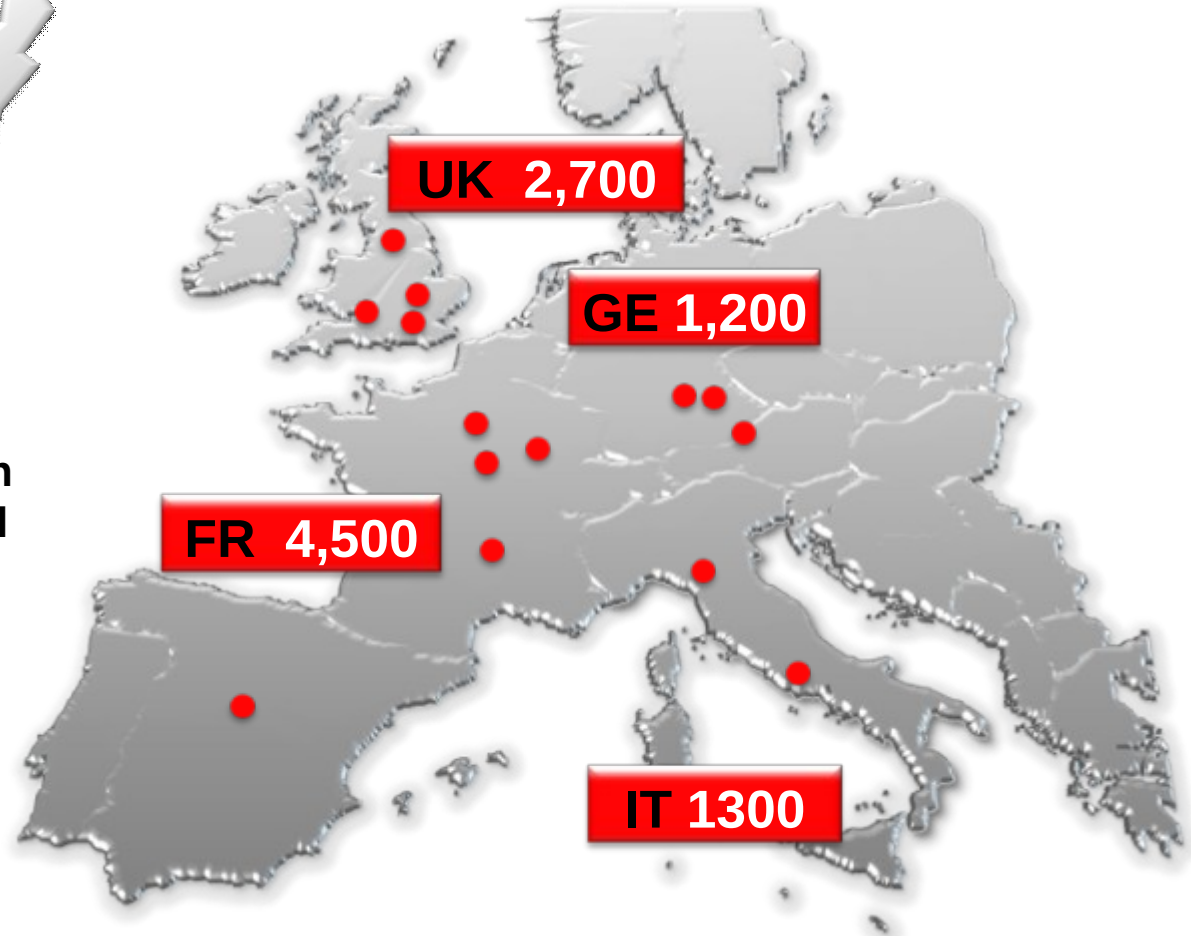
MBDA - Centres of excellence

10,000 people worldwide, **60%** in Technical/Engineering functions



Created in 2001, MBDA is an industry leader and a global player in the missile and missile systems sector.

Over 45 Systems in Operational Service





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Defining the Problem Space

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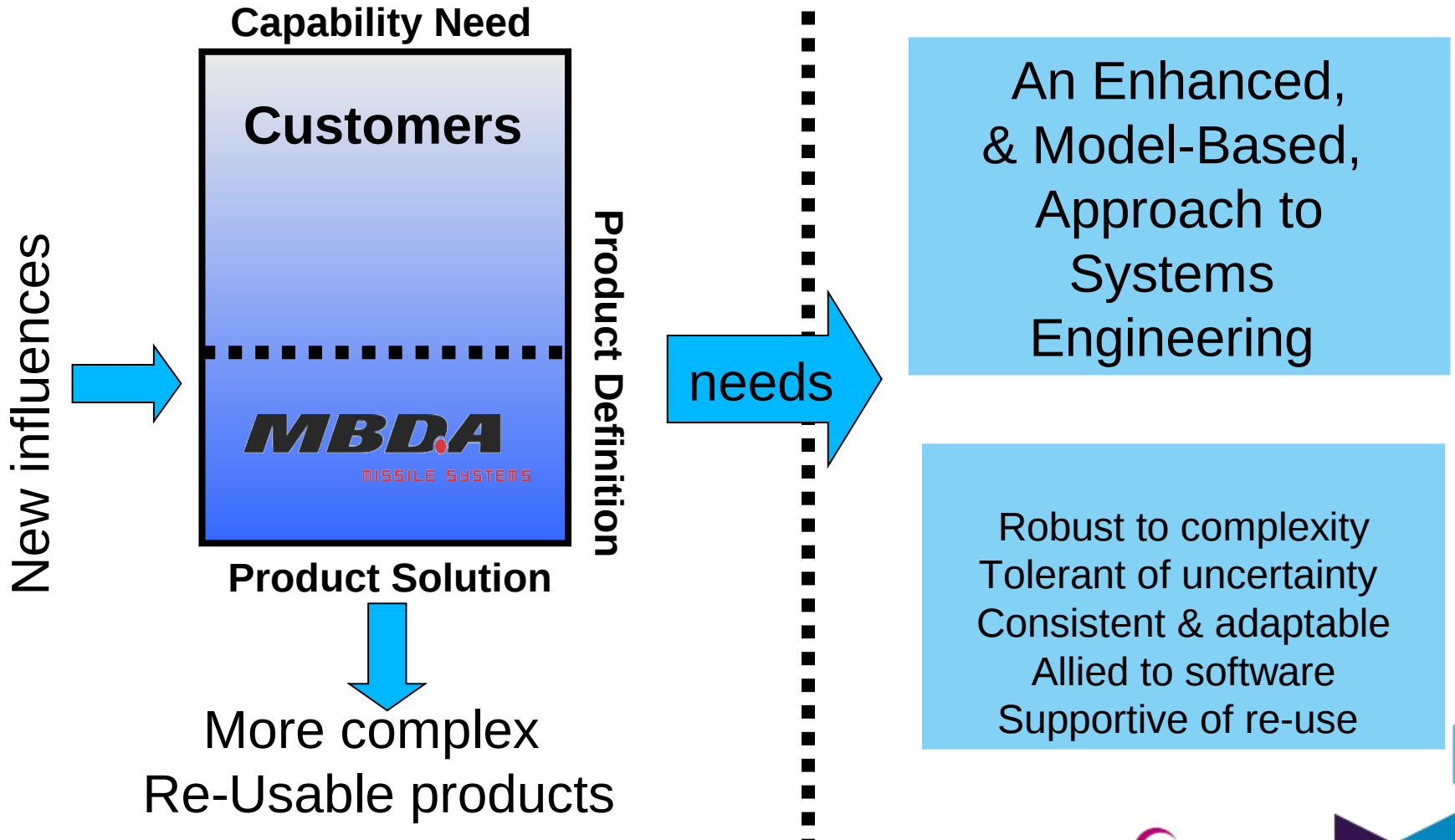
Why do we Need to Change? The Evolving Types of Product that MBDA Design

Traditional Products Technology driven	vs	New Complexity driven
System Built for a specific Purpose	V	Flexible and Agile Roles
Sub-systems specifically built for each product	V	Sub-Systems Modularity and Re-Use Driven
Little Interaction between Parts or with the Outside World	V	High Level of information sharing with external entities
User Interaction limited to simple prescribed tasks	V	Multiple User participation
Similar design effort required for Hardware and Software	V	Design effort predominately in Software with increasing complexity

Changing Environment - A New Response

The Problem

The Solution



Introduction of MBSE into MBDA

2002 – MBDA started investigating MBSE on a national basis

- Systems to Software focus
- Pilot Studies

2008 – Senior management sponsored initiative:

- National to International Focus
- MBSE part of a wider Product Lifecycle Collaborative Environment (PLCE)

2010 – Rationalisation of MBSE toolset across the company and international training developed

2011 – Internationally agreed process, methods, MBDA-AF and progressive rollout across MBDA

 Selected as MBSE tool of choice





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International Approach – Improving Communication and Collaboration

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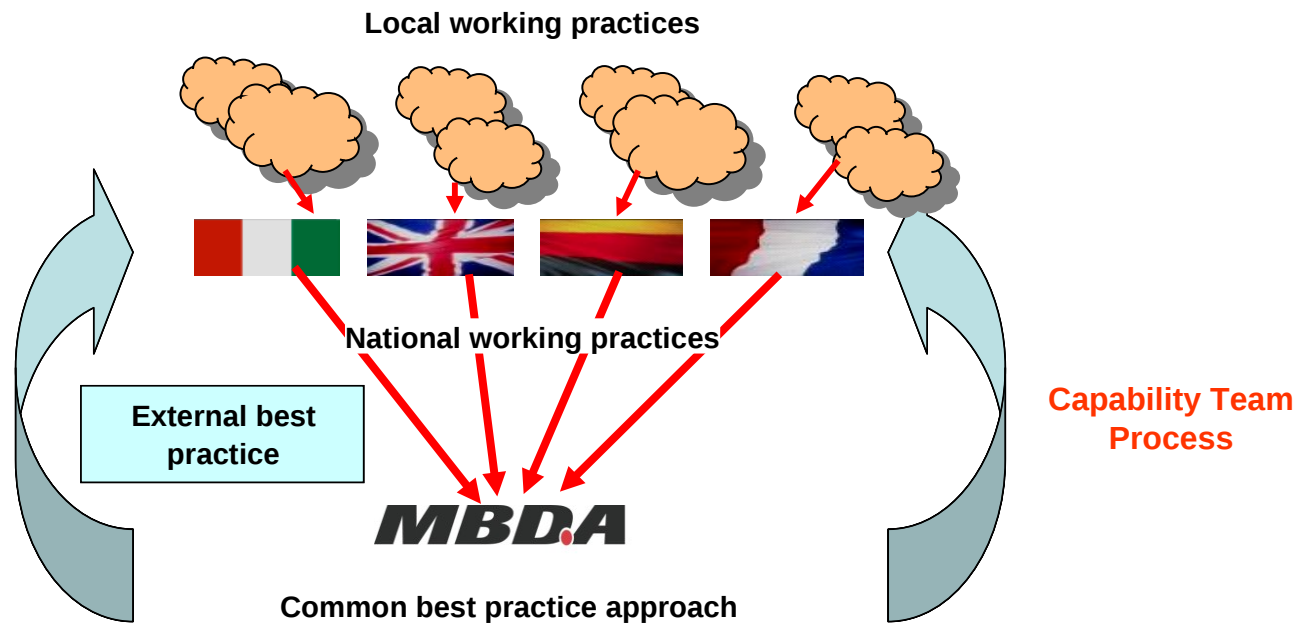
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MBSE – International Approach

- Built up a well funded International Capability Team
 - National Experts established
 - Regular meetings/reviews
- Implemented Careful and flexible planning
- Attempted to turned cynics into preachers!!
- Involved consultants appropriately
- Broke down social and cultural barriers

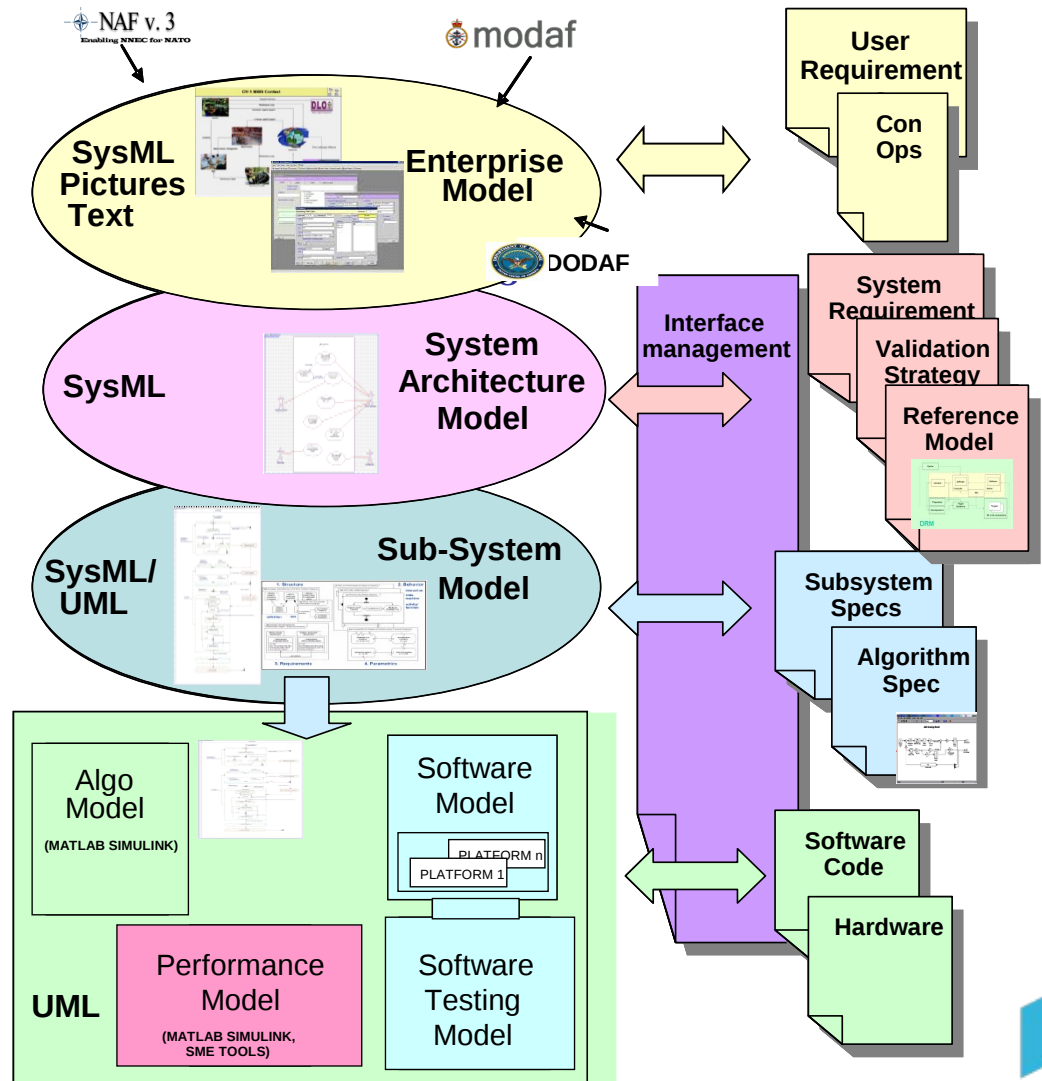
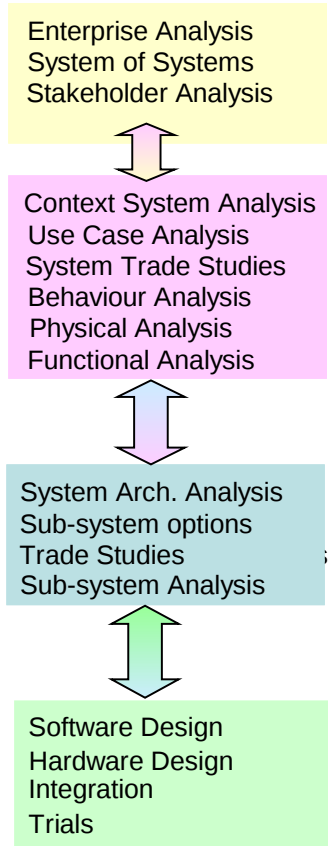


MBSE Capability Team – Context and Activities

Capability Team Responsibilities

- International Promotion of MBSE/MDA
- Development and application of
 - Process and Methods transversally
 - MBDA Architectural Framework
- Training Development
- Project Start-up Support
- Ongoing expert advice and Support including Management of External Vendors
- Tools support and tailoring

Activities



MBSE – Communication Benefits

Observations from International working groups:

- Re-established and strengthens System Engineering principles
- Breaks the International and discipline “Silo” approach (Common Language)
 - Graphical Approach overcomes language issues (SysML)
- Facilitates a common working environment
- Makes the “System Design” visible
- Design patterns established



1st MBDA International MBSE Workshop



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Improving how we design

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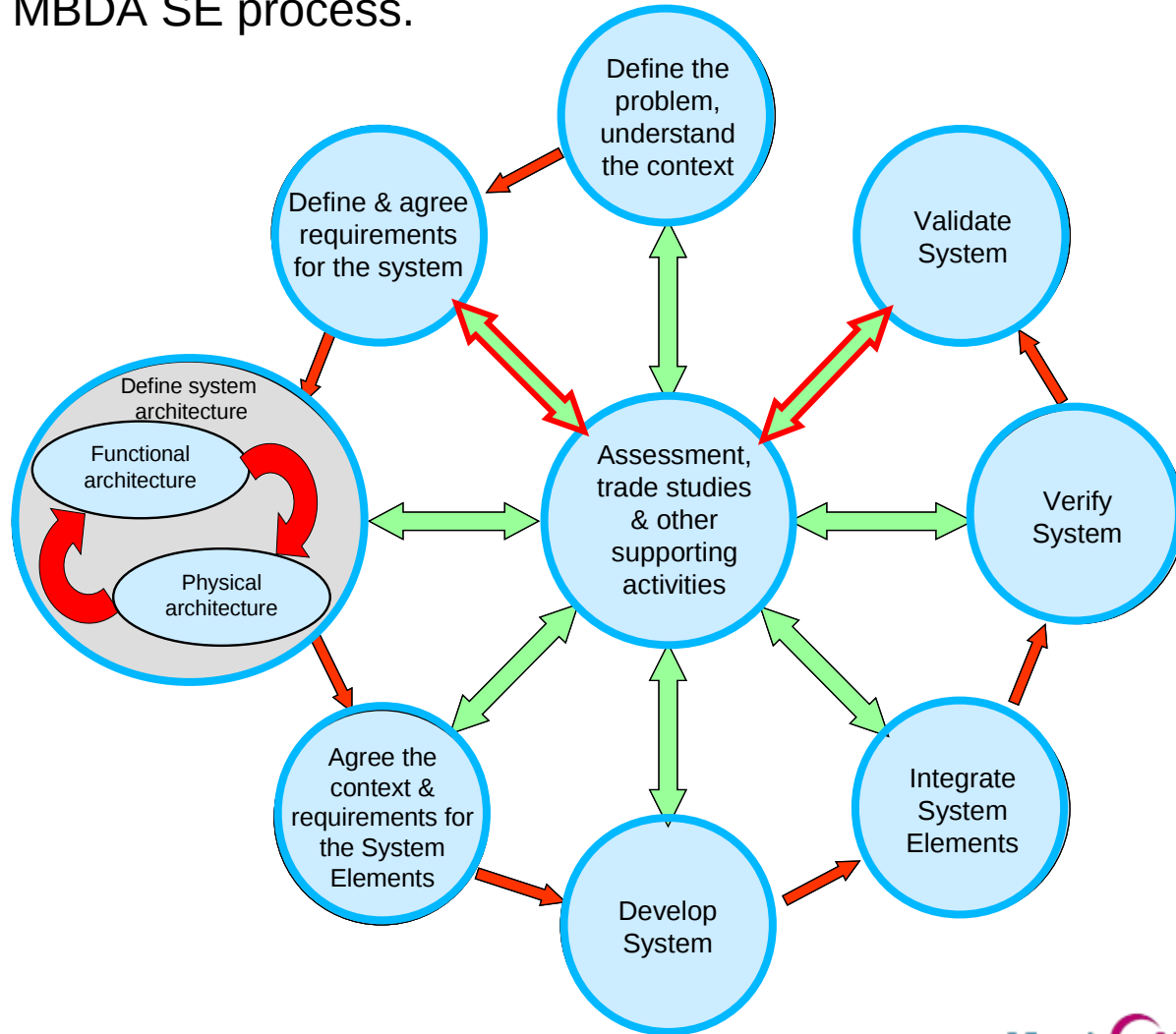
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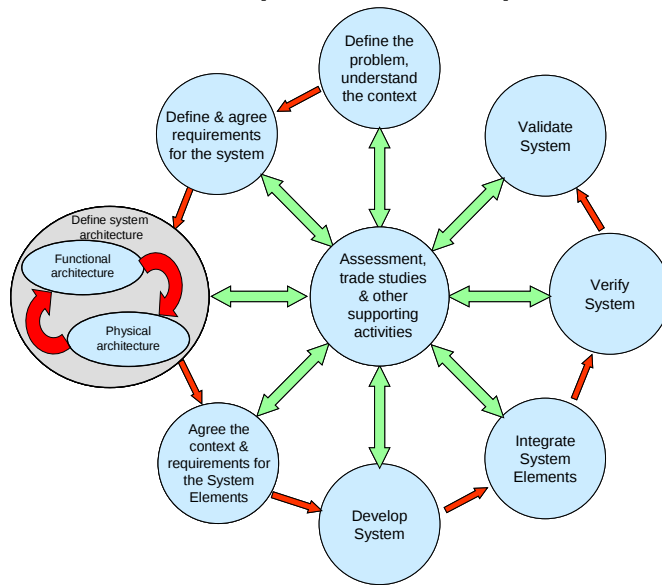
MBDA System Engineering Process

The MBSE approach has been developed to complement and improve the existing MBDA SE process.

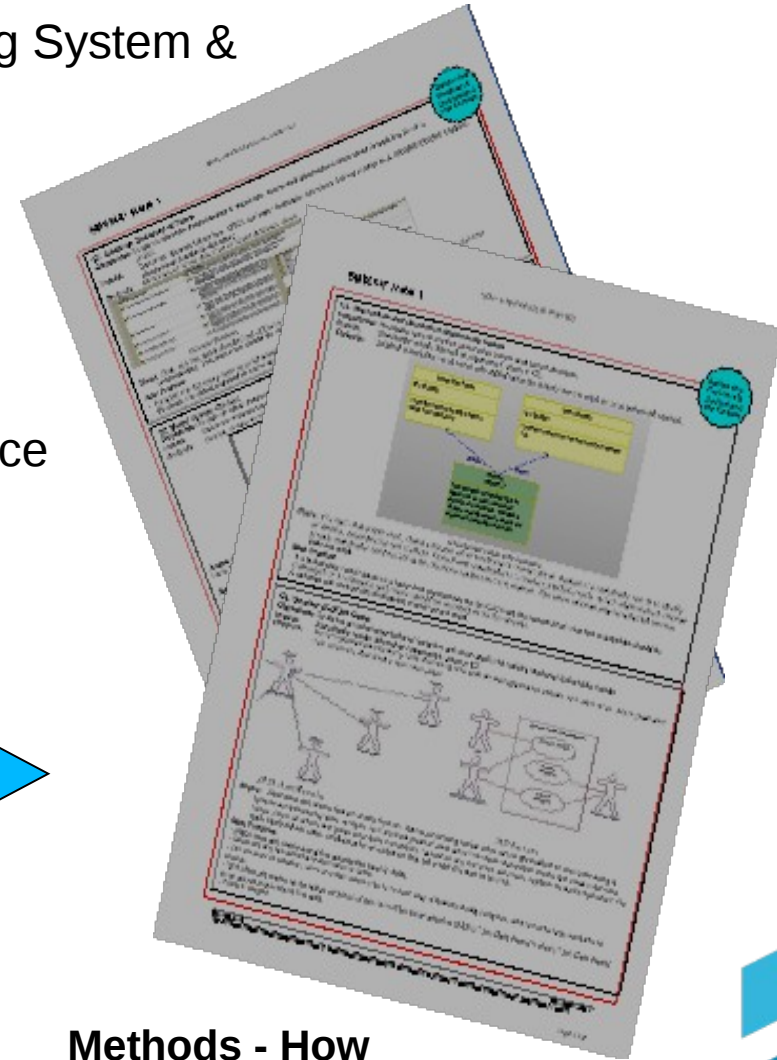


Model Based System Engineering (MBSE) Method Documents

- Step by Step International Documents covering System & Software development
- Based on Process Document
- Compact and Easy to Read
- Coupled closely with Training
- Practical examples developed from best practice



Process - What

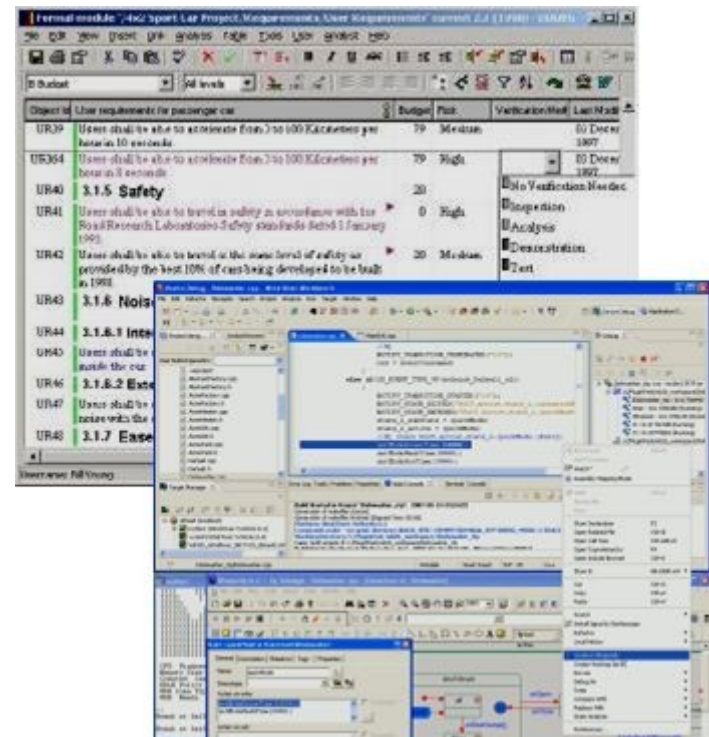


Methods - How

MBSE Toolset

- An Integrated toolset chosen to implement our Process and Methods
- Key MBSE Toolset qualities
 - Compatible with our customers and engineering discipline toolsets
 - Ensure traceability through the design to embodiment
 - Minimise information translation between tools
 - Deliver coherency and consistency
 - Customisable to our needs
 - Internationally supported

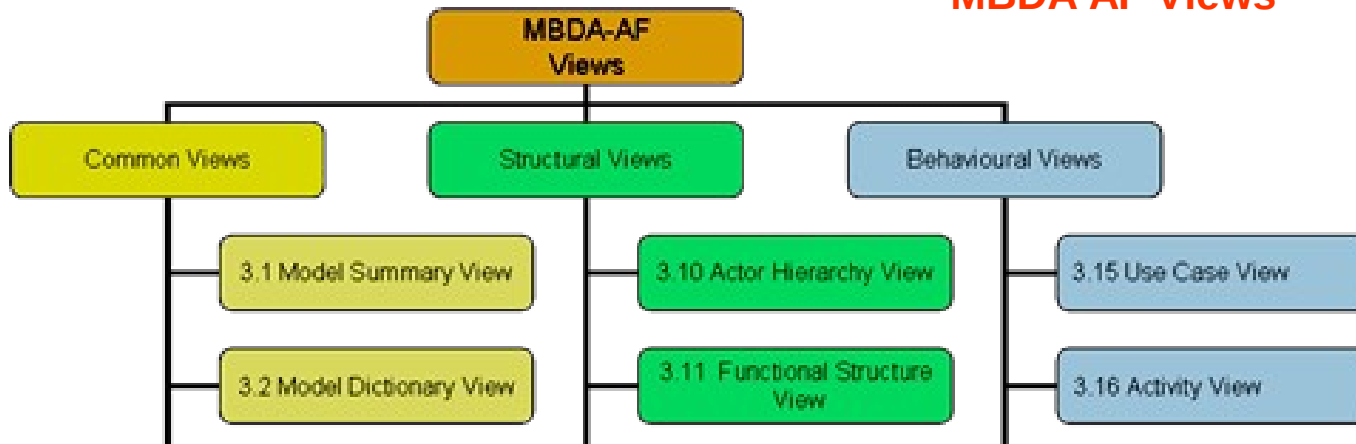
- Rational.** Rhapsody
- Rational.** DOORS
- Rational.** Gateway
- Rational.** ReporterPlus & RPE
- Rational.** Rational Team Concert



MBDA AF Profile

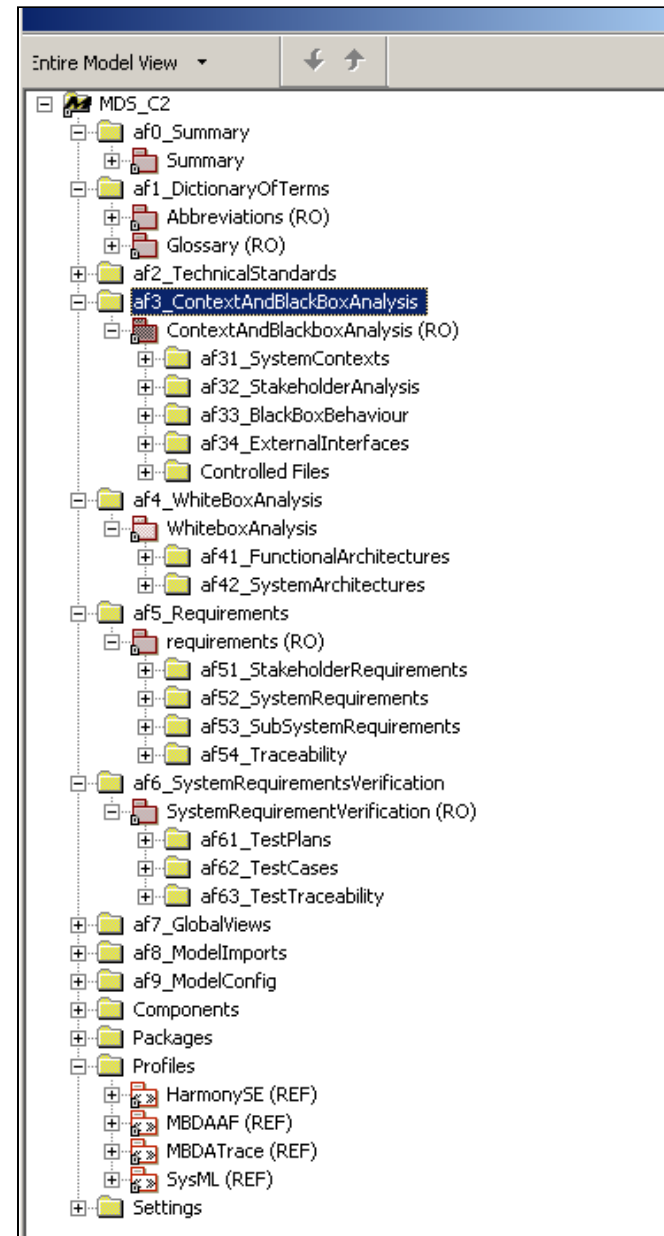
- The Profile constrains Rhapsody functionality supporting the process
- A series of views utilising Text, Pictures and SysML
- Compatible with our customer frameworks e.g. MODAF, DODAF
- Builds on the existing Rhapsody profiles e.g. SysML, Harmony
- Creates a standard and simplified way of working

MBDA AF Views



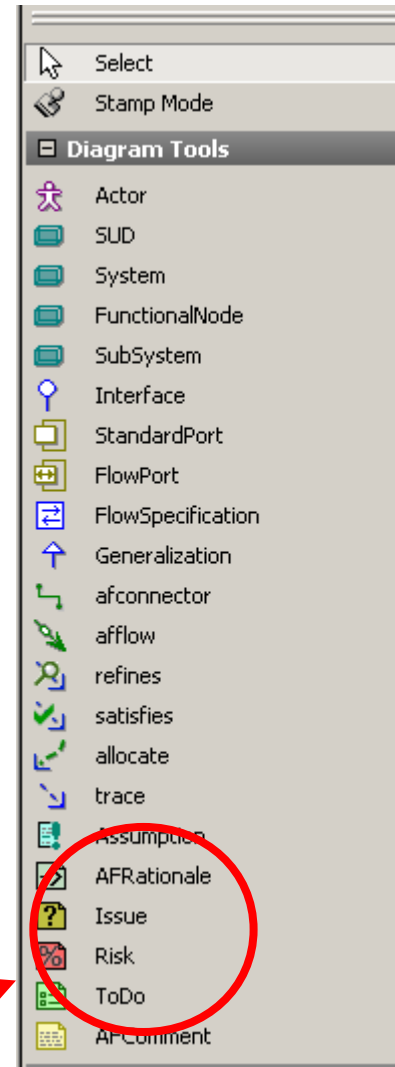
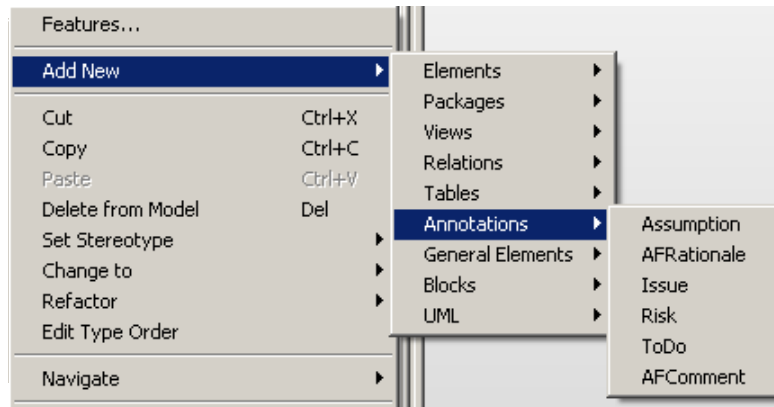
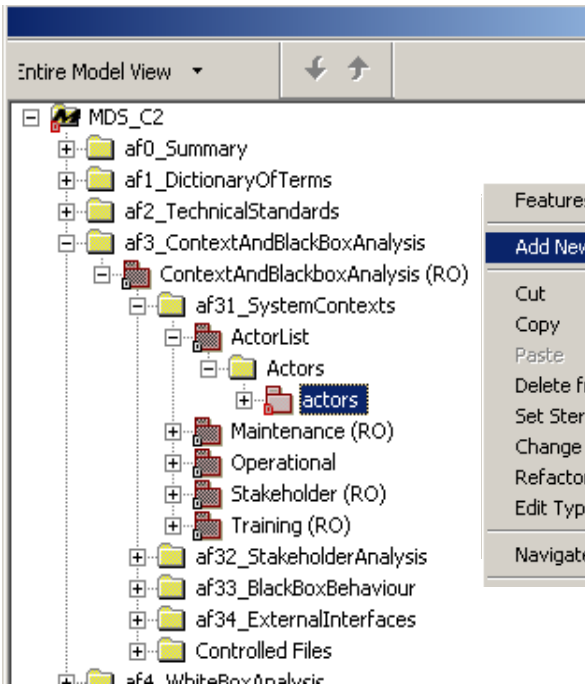
Common Rhapsody Structure

- One structure for all National and International Projects
- Closely coupled with the MBDA process and method:
 - Easier for engineers to populate and review
 - Aids modularity and re-use of model packages/elements
- Allows effective co-operation between distributed teams
- Simplifies training approach and mobility



Rhapsody Functionality Tailored

- Toolbar provides guide to what should be put on the view
- Elements based on Method guide
- Only model elements relevant to a particular package may be added
- Allows Implicit guide to the process and method
- Aids coherent and consistent model development
- Simplifies training approach and mobility





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Improving how we train

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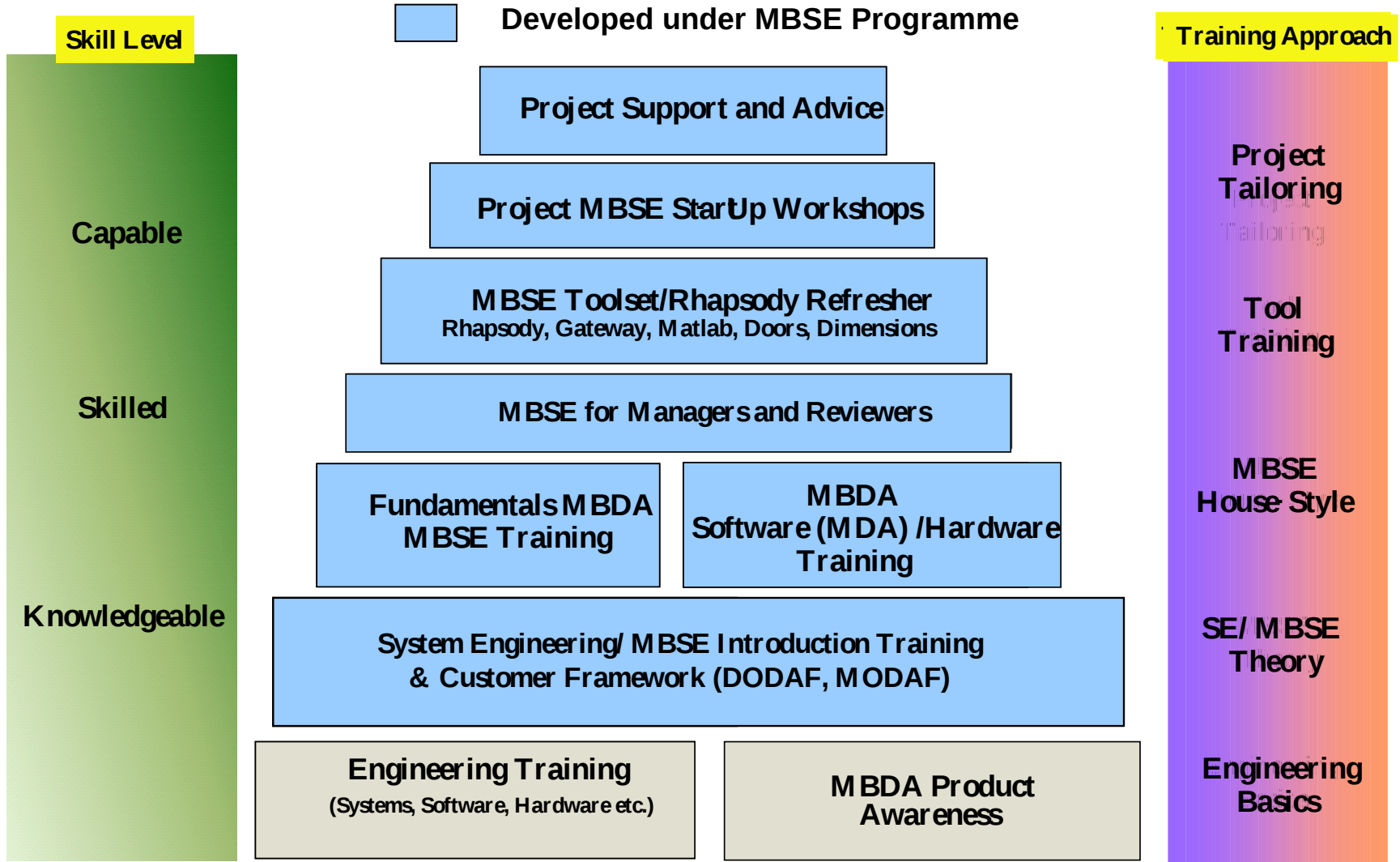
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MBSE/SysML/UML – Modular approach to learning....

- MBSE/Tool Training Approach
 - Integrated Training developed by External Vendor on behalf of MBDA
 - Process and Method First
 - Essential Tool Training (Concentrates on the Key features)
 - Practical Advanced Toolset Training
 - In-house course developed targeted at practising engineers
 - Supported by IBM Technical Experts that fully understand how we wish to apply MBSE
 - Project Start-up Activities
 - IBM Support integrated with MBDA Capability Team





One training programme across four nations



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- **Case Study 1 – Sub System Development Study**
- **Case Study 2 – Traditional vs MBSE Project**
- **Case Study 3 – Interface Definition**

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Case Study 1: Sub System Development - MBSE Study

Context

- Study to compare traditional (Textual based) and MBSE (Graphical Based) approaches:
 - Complex System Behaviour
 - Software Intensive
- Assessment of MBSE for the development of one functional aspect of a complex Sub System
 - Develop and issue an Software Requirement Specification (SRS)
 - Produce good quality Ada software code

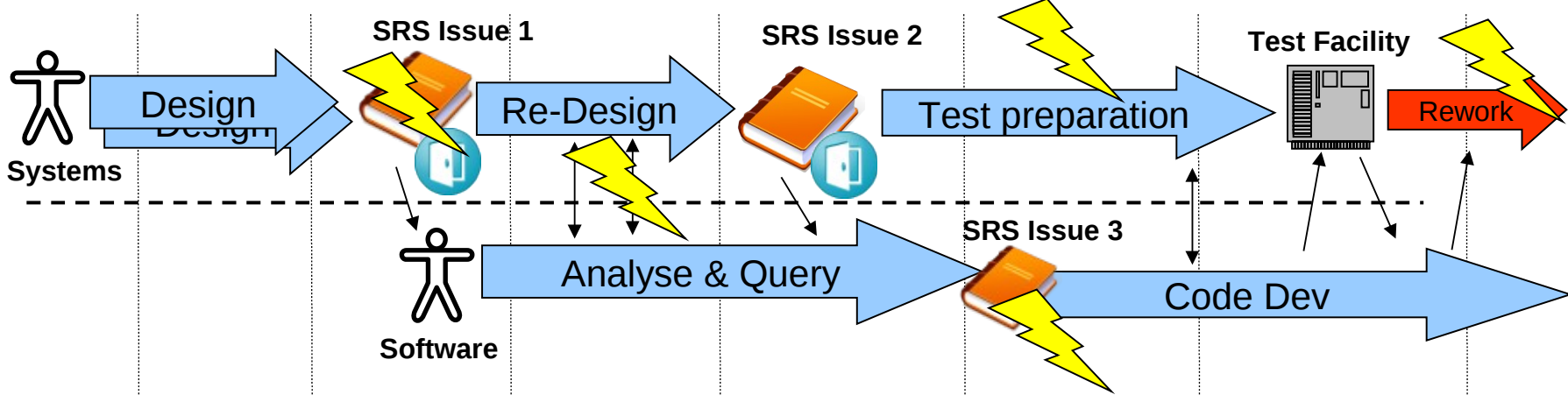


MBDA
MISSILE SYSTEMS

Case Study 1: Sub System Development

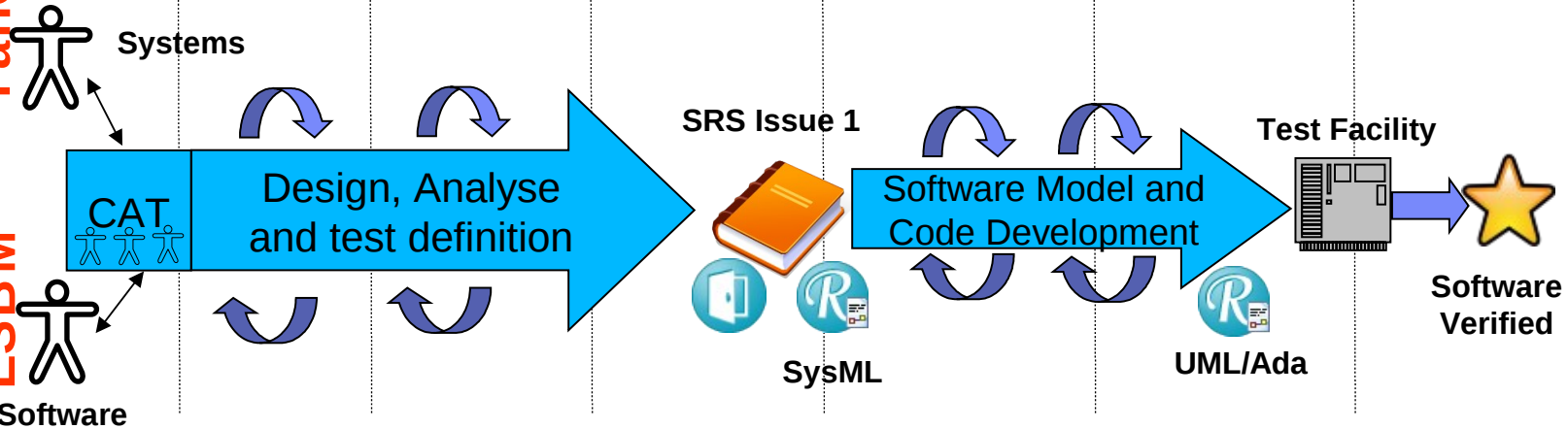
Weeks

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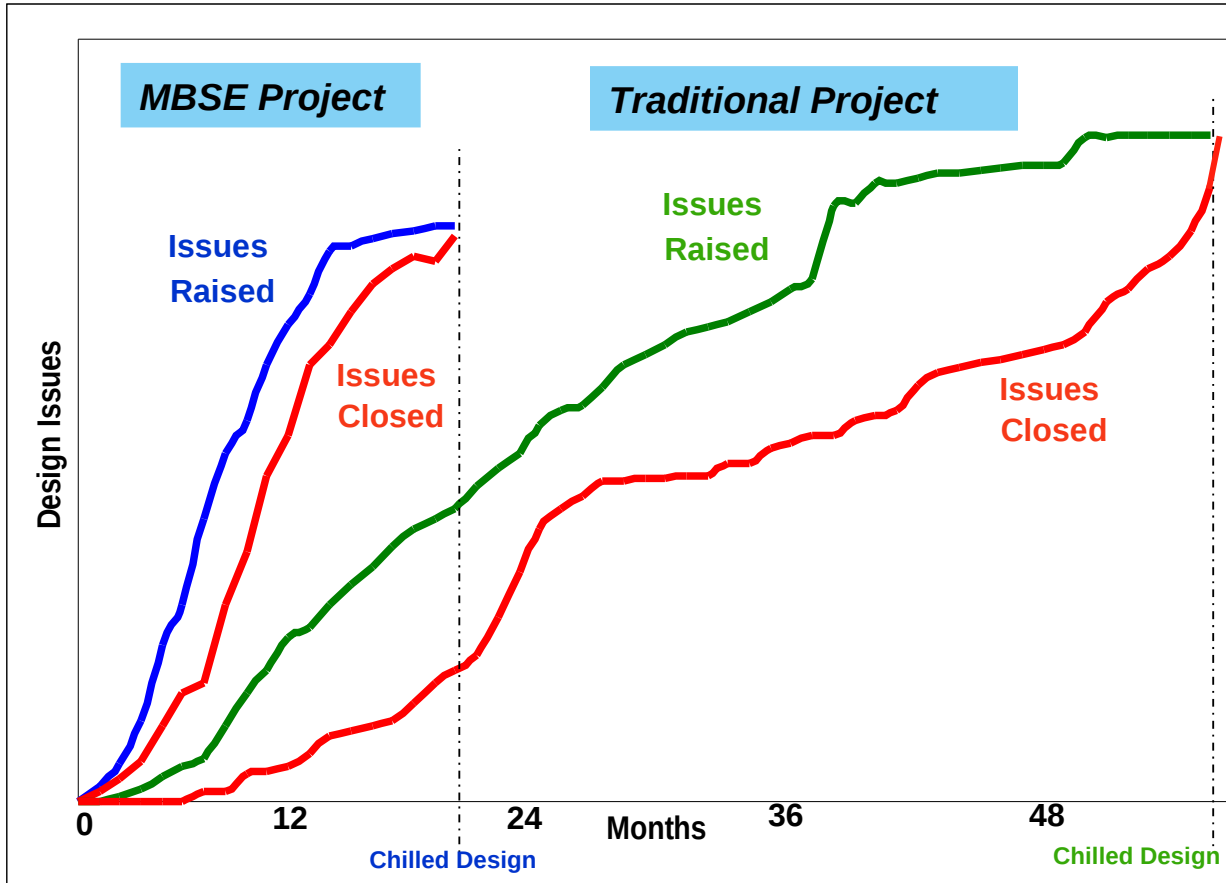
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ESBM



Lean/Agile Common Architecture Team

Case Study 2: Traditional vs MBSE Project Approach



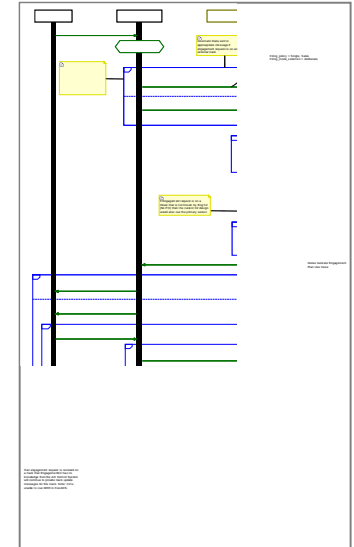
“The structured MBSE approach adopted has provided high visibility of system requirement partitioning, decomposition, evolution and interfacing enabling the generation of a tighter, better defined and justifiable system requirement set in a relatively short timescale.”

Chief Systems Engineer



Case Study 3: Interface Definition

- MBSE approach for the definition of a Complex Weapons System Interface.
 - Input was a series of External Contractor Requirements, Spreadsheets and presentations capturing the current status of the Interface Design.
 - Interface Modelled in Rhapsody mostly using Sequence Diagrams
- Summary of Results
 - 50+ Design issues identified, including:
 - 11 Sequences that were incorrectly positioned
 - 12 missing messages Identified
 - 23 new design assumptions and queries raised
 - 9 Messages identified in the design but not actually used!!



“.....it typically takes 1 to 3 years to define the data bus structure down to bit level. I would estimate that the IDS is currently about 85-90% complete and this has only taken 3 months using an MBSE approach...”

Head of System to Platform Integration

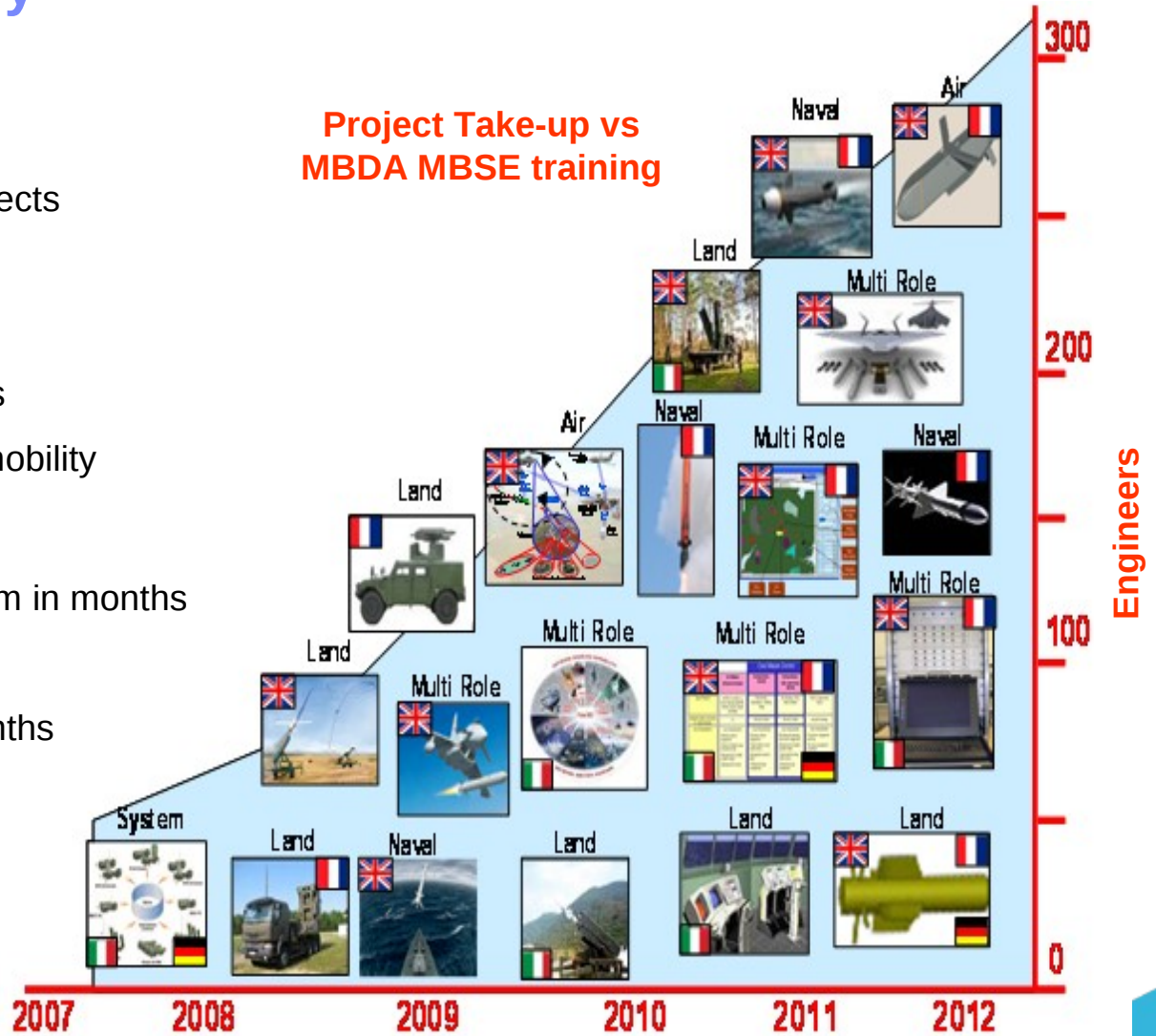
MBSE Product Delivery

Benefits

- Improvement in Communication
- Improved delivery of national projects
- Part of integrated MBDA
- Reduced business risk
- More effective international teams
- Team Integration and improved mobility

Examples

- Design command & control system in months
 - Previously years
- Define platform interface in 3 months
 - Previously years
- Update software in 2 days
 - Previously weeks
- Transfer effective people in a day





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Improvement Areas and Summary

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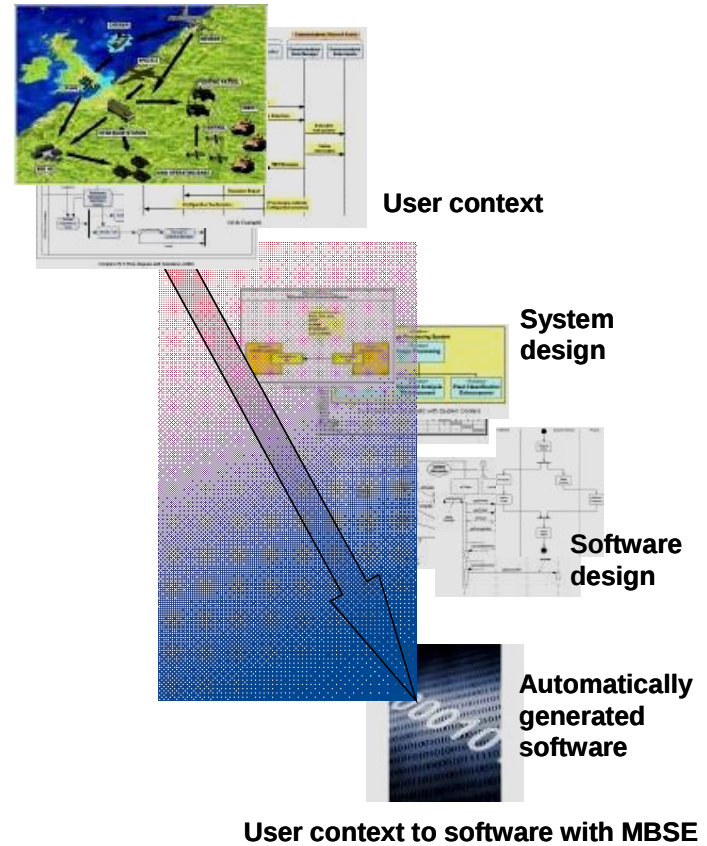
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Improvement Areas and “Hot Topics”

- Development and Improvement Areas for 2012:
 - Design and Requirements Traceability
 - Systems to Software Handover
 - Specialist Skills Integration e.g HF, Safety
 - Interface Development (SysML 1.3)
 - Parametric/Constraint analysis and capture
 - Verification and Validation



Key Success Factors

- The MBSE success factors:
 - We had Managing Director (MD) Sponsorship
 - Clear leadership, delegated authorities
 - Shared values & ownership
 - Respect & trust (Culturally aware)
 - Identified local champions early
 - Created an Innovation and learning culture
 - Individual best-practice valued
 - Key issues were identified and resolved
 - Involved young people (Future Lead Engineers)
 - Used Consultants and Strategic training partners effectively



Roll-out June 2010



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MISSILE SYSTEMS

MBSE Summary

1. Increased customer confidence through delivering on our promises.
2. Facilitates effective team working and communication
3. “Four nations, One approach, One method, One MBDA”.



Concept to demonstration: 15 months



Shareholder Award Ceremony 2011

"MBSE has enabled multi-disciplinary teams to work together, facilitating rapid system integration and acceptance of the system by the Customer."

Chief Engineer

QUESTIONS

MBDA
MISSILE SYSTEMS

Next  NOW!



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