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UK Innovate 2010

The Rational Software Conference

Smarter software for a smarter planet.



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Experiences of using Model Based Systems Engineering

Andy Howells & Steve Bushell

MBDA



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Agenda

1. Introduction

2. MBSE Benefits

Improving how we **Deliver**

Improving how we **Communicate**

Improving our **Design** approach

Improving how we **Train**

3. Conclusion and Summary

4. Questions



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Introduction

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A Year on!!

Last year we presented our approach to MBSE

Developing our Process and Methods

The need for our own Architecture Framework

Started Pilot Study Work

International Alignment

Toolset Down Selection started

This presentation will mainly cover the benefits and observations we have seen over the past 12 months....



Introduction: So who are MBDA?

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

With an unrivalled product portfolio covering the whole range of requirements

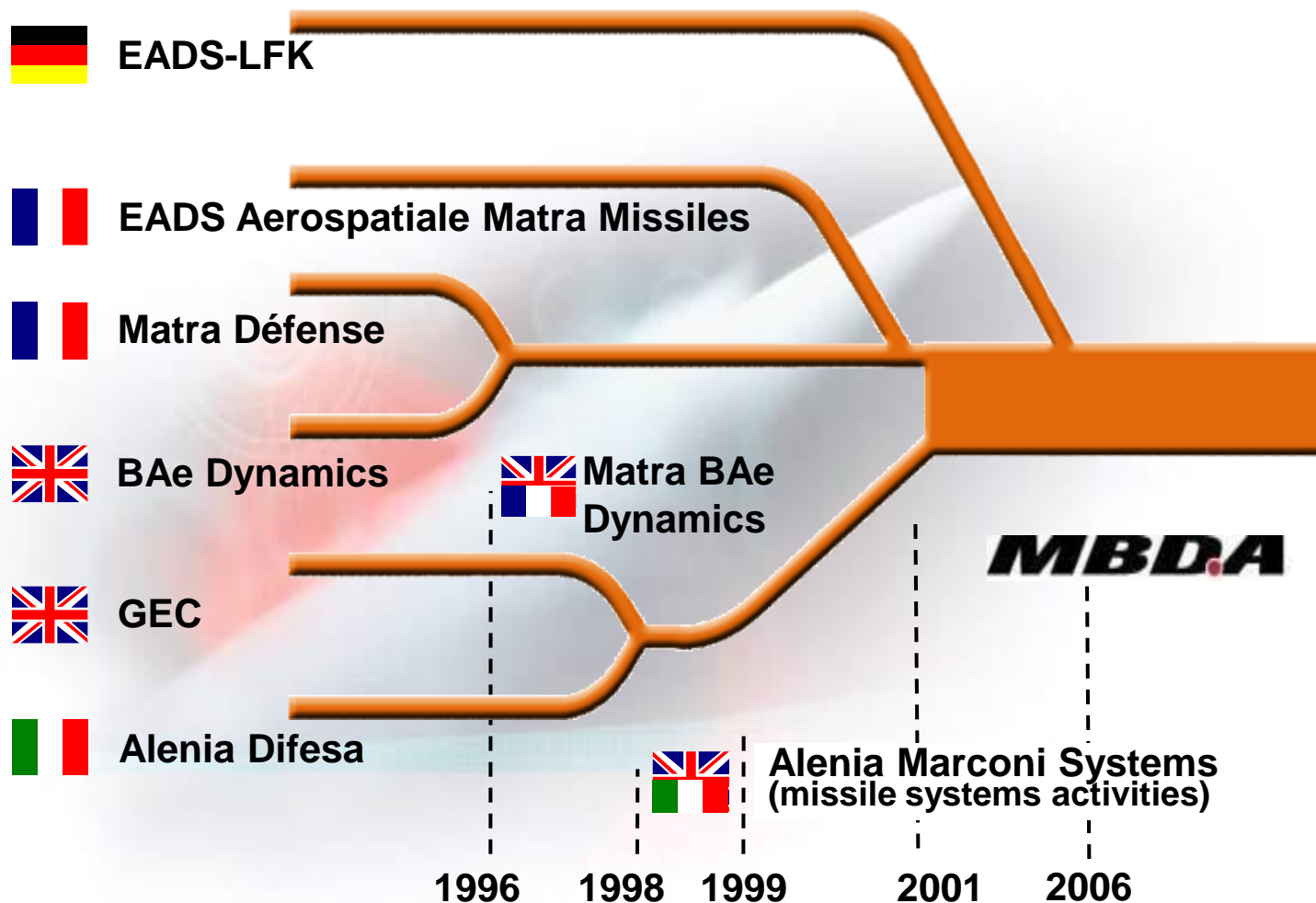
50+ missile system and countermeasure programmes in operational service

Extensive experience of international programmes

Supported by three major shareholders:
BAE SYSTEMS, EADS, Finmeccanica



Introduction: European industry consolidation



Introduction: The Evolving Types of Product that MBDA Design

Traditional Products

Technologically Difficult

vs

New Products

Complex

System built for a specific Purpose/Role

vs

Flexible and Agile Purpose/Roles

Subsystems custom built

vs

Replication and re-use driven

Little interaction between parts or with the outside world

vs

High level of information sharing with external entities

user Interaction limited to simple prescribed tasks

vs

Multiple users participation

Similar design effort needed in hardware and software

vs

Design effort predominantly in software



Introduction of MBSE into MBDA - Approach

Started investigating MBSE in 2002, latest Initiative started in 2008

International approach involving UK, France, Italy and Germany

Funded Capability Teams consisting of Internal and External Experts (IB...,

Phased Introduction

Initial Research and Industry best practice

Development of Process, Methods and Supporting documentation tailored around the product we develop

Pilot Studies

2010 saw the rationalisation of MBSE Toolset across the Company

Strong focus on managing complexity, improving design coherency and collaboration

Rational Rhapsody. Selected as MBSE tool of choice



MBSE/MDA differs from traditional “document centric” systems engineering, in terms of:

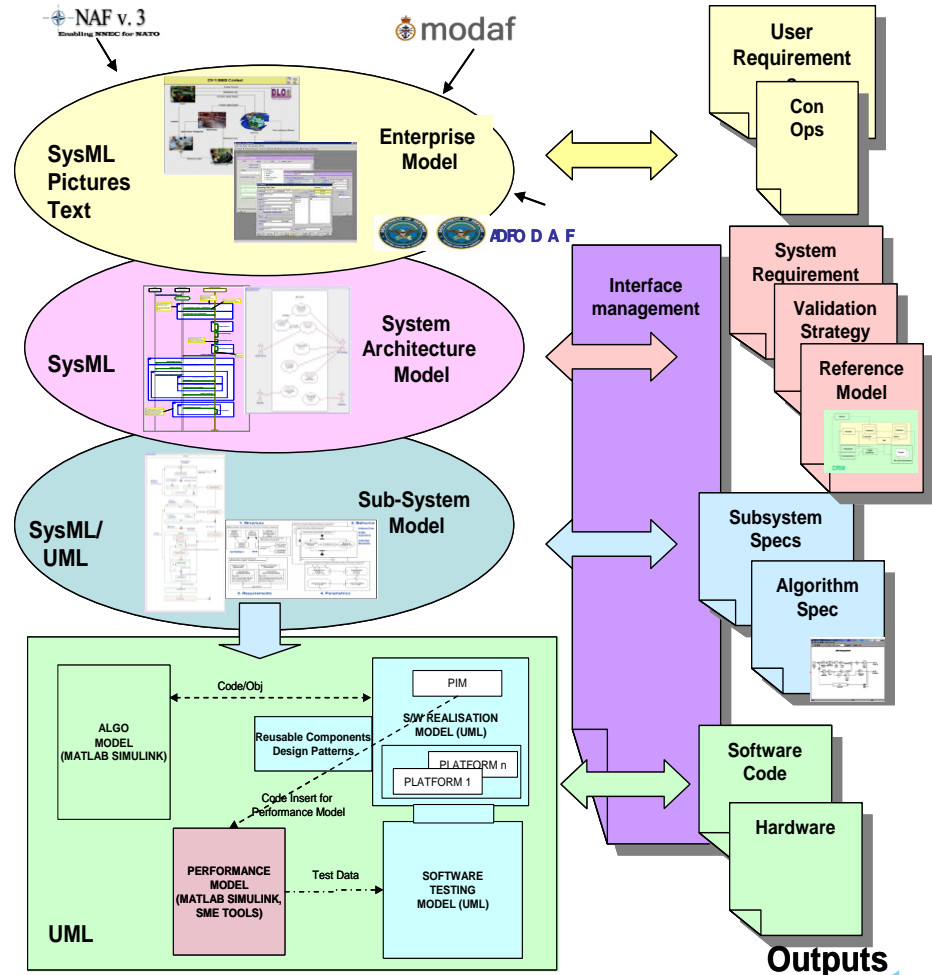
utilising a more graphical based approach focused on improving communication and managing complexity.

utilising and sharing models that capture key design information focusing on transversal consistency between skills but also consistency through the product development life-cycle.

Capability Team Activities

- 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

- Enterprise Analysis
 - System of Systems
 - Stakeholder Analysis
- Context System Analysis
 - Use Case Analysis
 - System Trade Studies
 - Behaviour Analysis
 - Physical Analysis
 - Functional Analysis
- System Arch. Analysis
 - Derive Sub-system Options
 - Sub-system Trade Studies
 - Sub-system Analysis
- Sub-system Development
 - Software Design
 - Hardware Design
 - Integration
 - Trials



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Experiences of using Model Based Systems Engineering

Improving how we deliver

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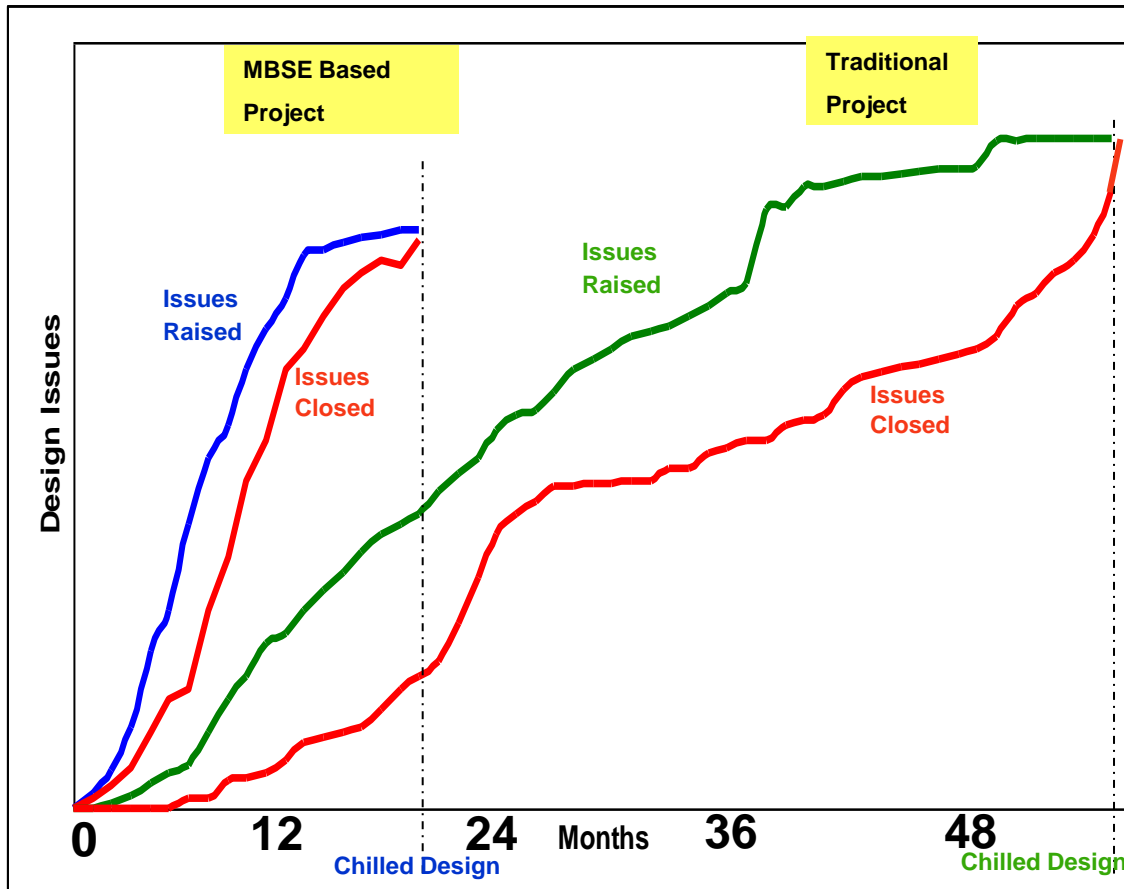
Improving how we deliver

Case Study 1 – Traditional vs MBSE Project

Case Study 2 – A simple example (Interface Study)



Case Study 1: Traditional vs MBSE Project Approach



MBSE Project

- Close Customer Working
- Many facilitated workshops based around Prioritised Use Case Analysis
- Issues resolved within days/weeks

Traditional (Textual Reqts)

- Regular Customer Design Reviews
- Design Studies main source of Issue resolution
- Issues resolved within Weeks/Months
- Several Design Issues remained at "Design Chill"



Case Study 2: Textual vs MBSE approach (Interface Study)

2 day study to assess the differences of a traditional (Textual Reqts.) and 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

64 new design issues identified

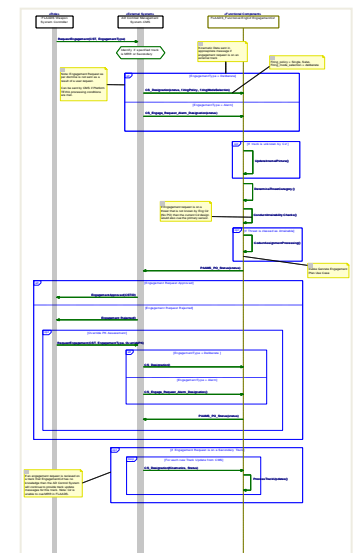
- 11 Sequences that were incorrectly positioned

- 12 missing messages Identified

- 23 new assumptions and queries raised

- 9 Messages identified in the design but not actually used!!

- 9 other Design Issues (affecting other issues not related with the I/F design)



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Improving the way we communicate

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MBSE – Communication Benefits



Four active International Programmes

Graphical Approach overcomes language issues (SysML)

Facilitates a common working environment

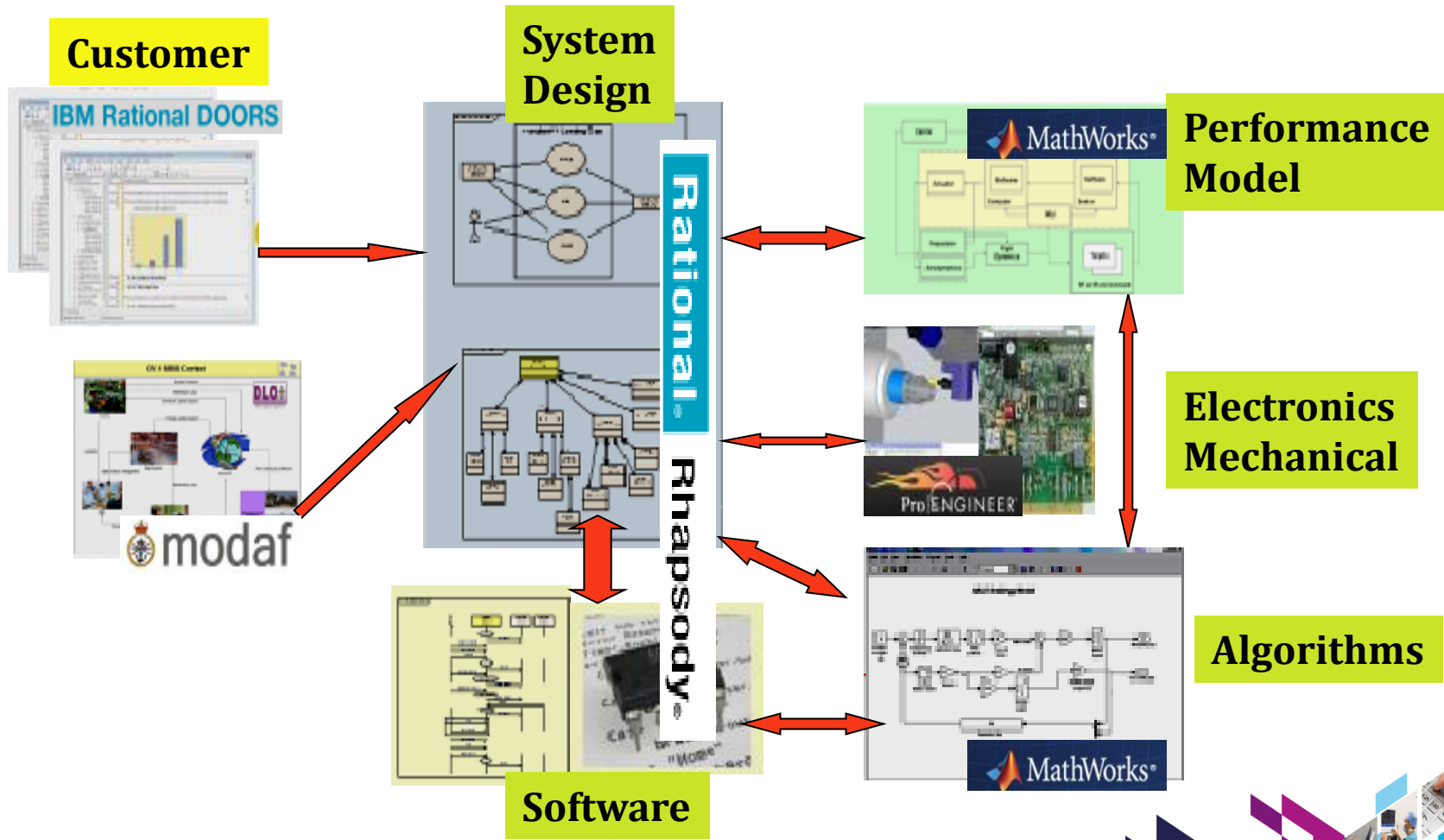
Breaks the “Stove Pipe” approach

Makes the System Design visible



Links with Engineering Disciplines

The use of a model based approach at system level facilitates consistency and coherency from the initial design activities through to the physical implementation at equipment level.



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Improving our design process

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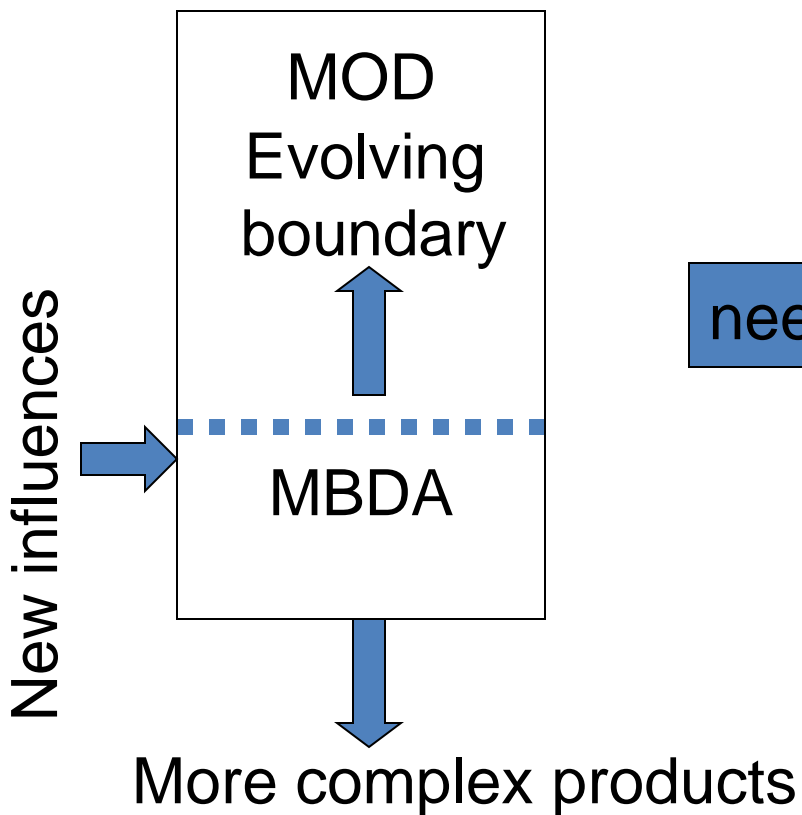
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Changing Environment - a new response

The Problem



Our Solution

An Enhanced,
& Model-based,
Approach to
Systems
Engineering

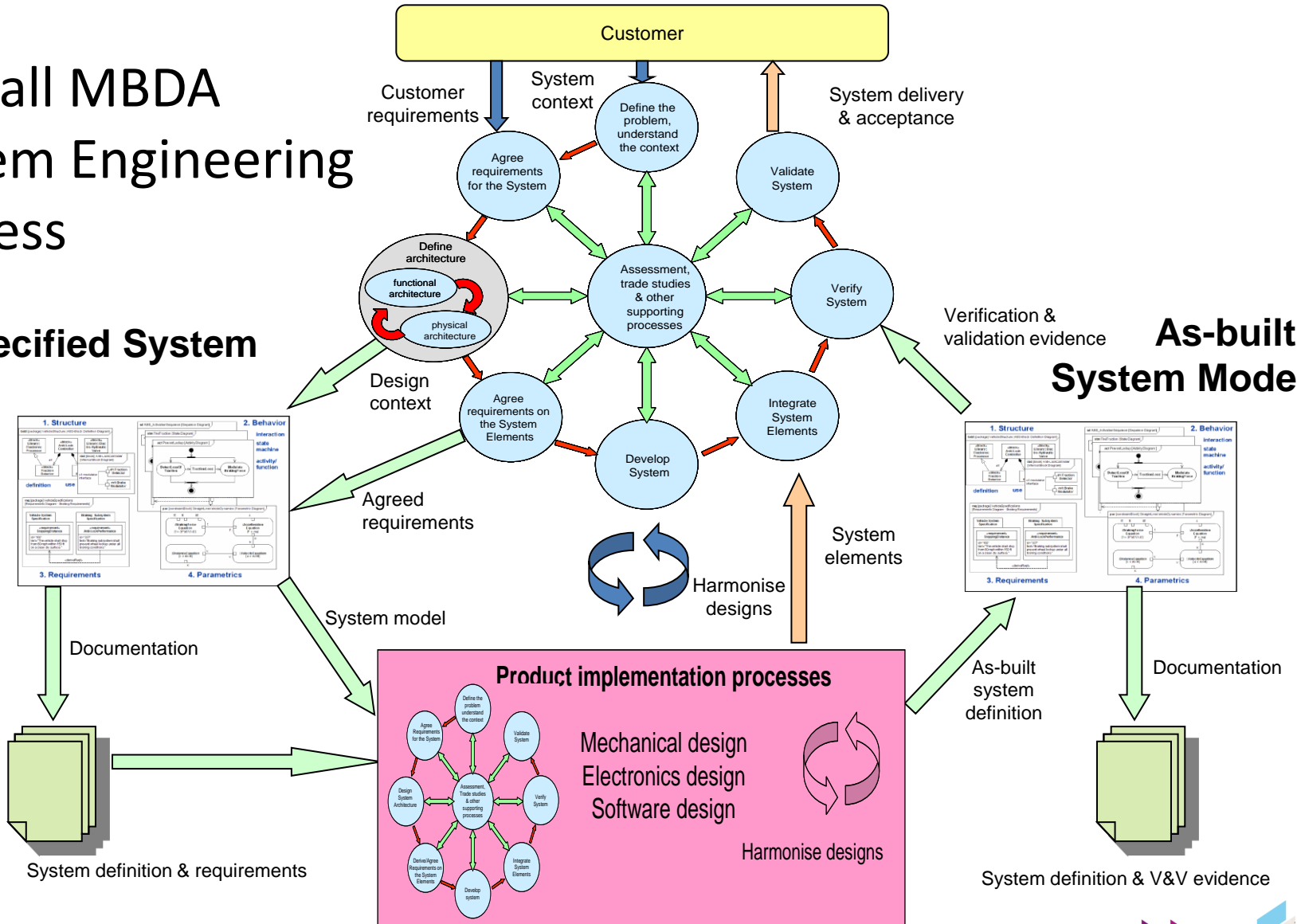
Robust to complexity
Tolerant of uncertainty
Consistent & adaptable
Allied to software
Supportive of re-use



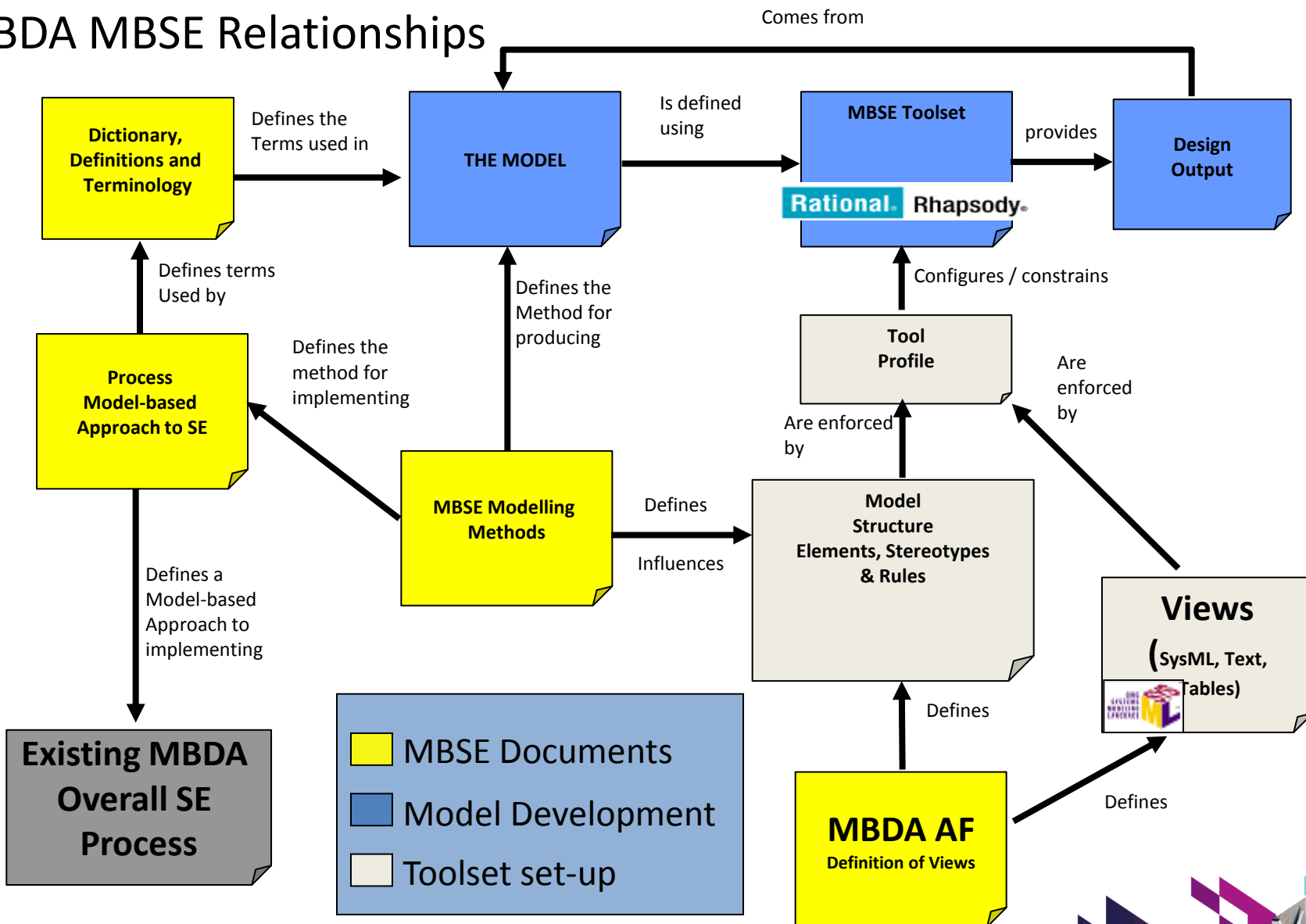
Overall MBDA System Engineering Process

As-specified System Model

As-built System Model



MBDA MBSE Relationships



- MBSE Documents
- Model Development
- Toolset set-up



MBSE Methods Document

International Document
Based on Process Document

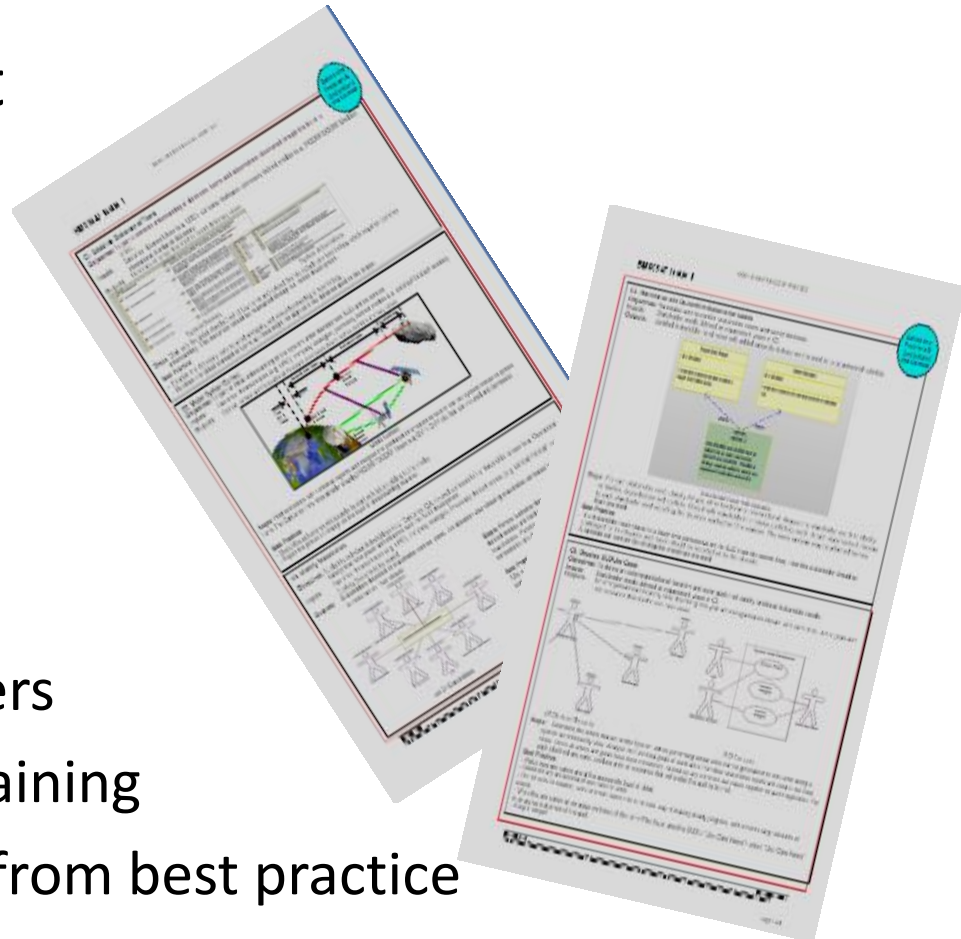
Process covers “What”
Methods cover “How”

Only 12 Pages!!

Step by Step Guide for Engineers

Coupled closely with MBSE Training

Practical examples developed from best practice



MBSE Toolset

In order to get the best from the Process and Method you need an Integrated Toolset!!

- Need to minimise information translation between tools
- Traceability of the design essential

But don't get hung up on the Tools

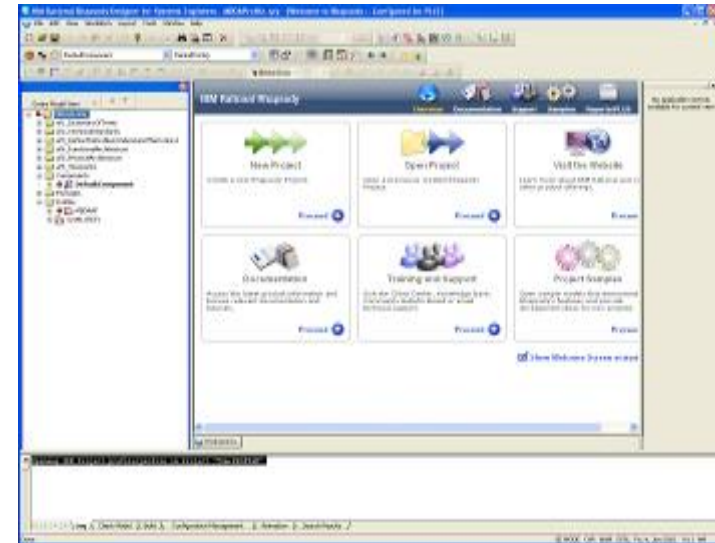
- Concentrate on the Process and Methods first!!
- Make the tools work for you
- Support from experts/tool vendors is essential!!

- Rational** Rhapsody
- Rational** DOORS
- Rational** Gateway
- Rational** ReporterPlus



MBDA AF Profile

- The Profile Constrains Rhapsody Functionality supporting the MBDA MBSE Process
- Creates a Common Package Structure
- Creates a Standard way of working across projects
- Profile allows standard templates (i.e. reporting, gateway) to be used across projects
- Profile allows standard Helpers (macros) to be developed to be used across projects



Common Structure

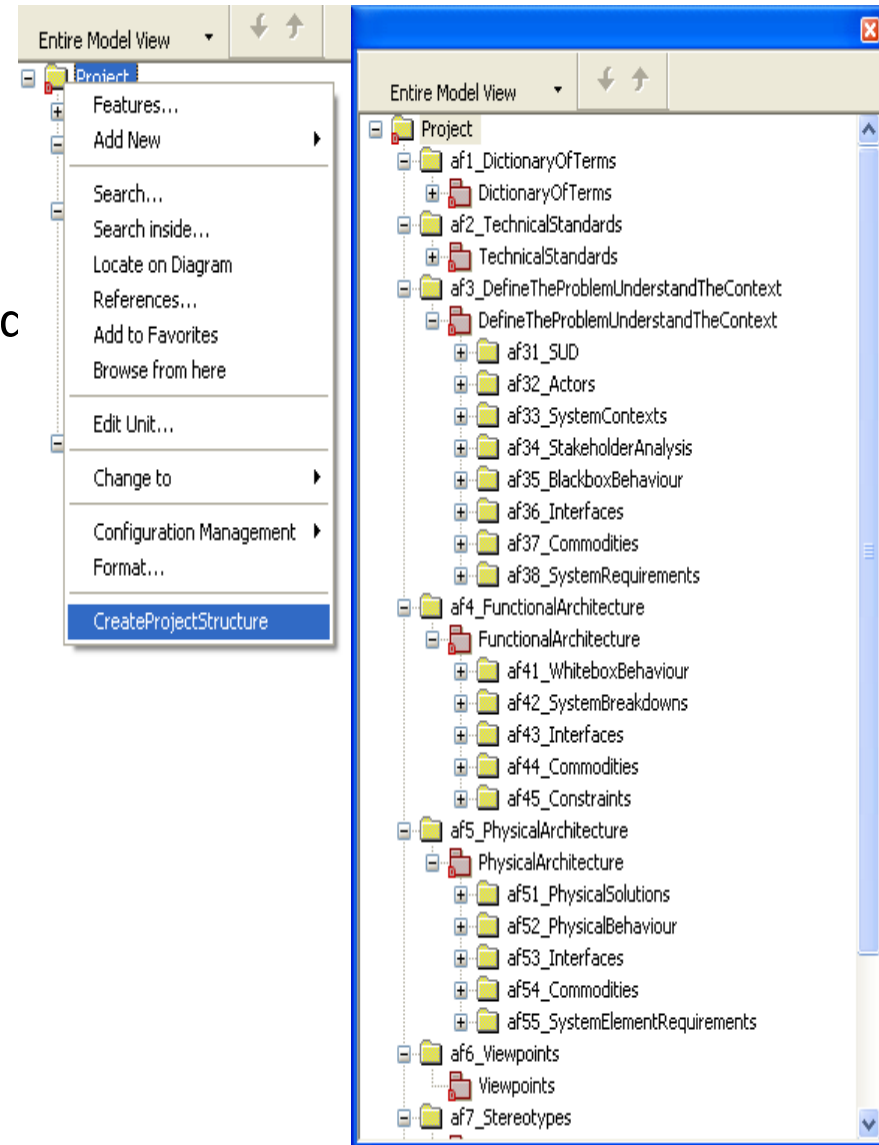
Structure Created by Default

Elements grouped by Process and Method

Easier for Engineers to Populate and review

Allows effective co-operation between distributed teams

Simplifies training approach and mobility



Functionality Tailored

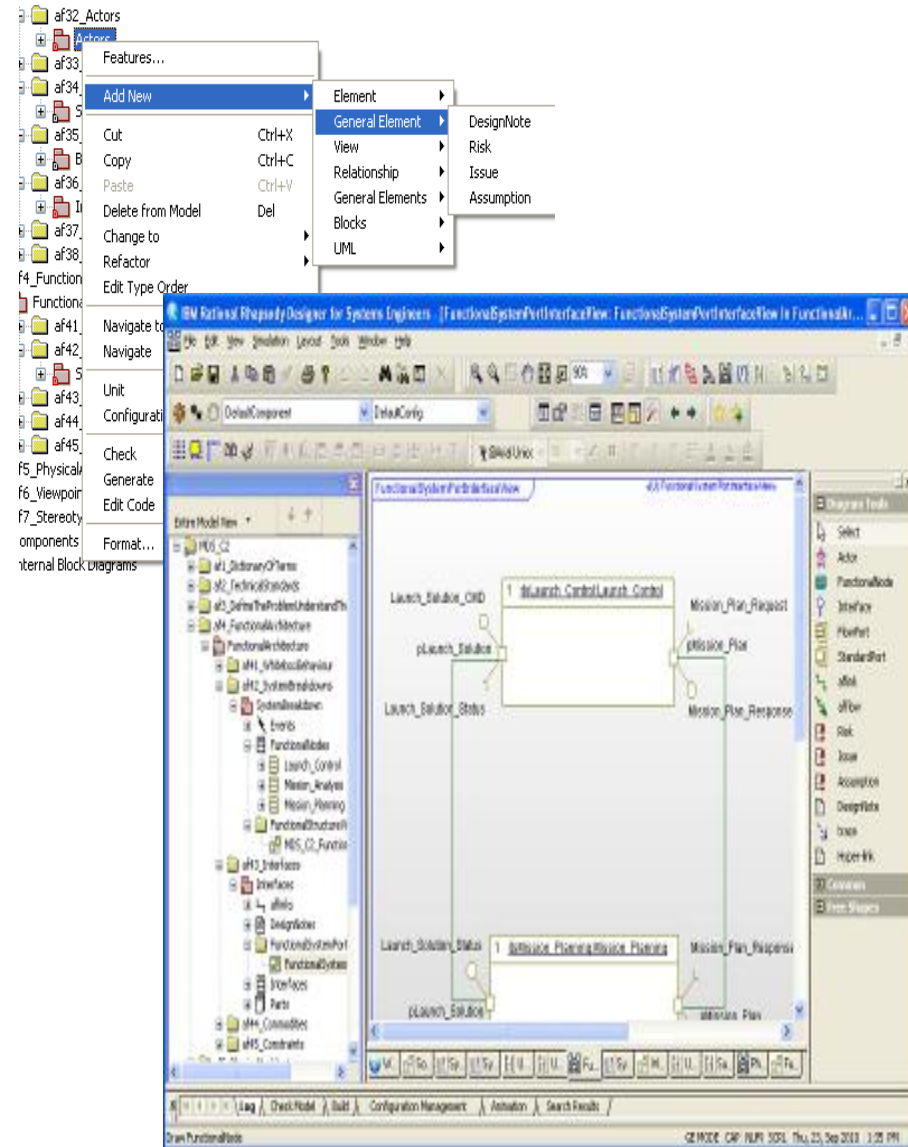
Toolbar provides guide to what should be put on the view

Elements based on Method guide

Only model elements relevant to a particular package may be added

Allows Implicit guide to the process and method

Simplifies training approach and mobility



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Improving the way we train

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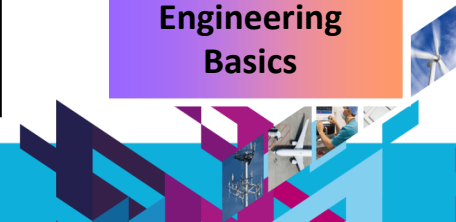
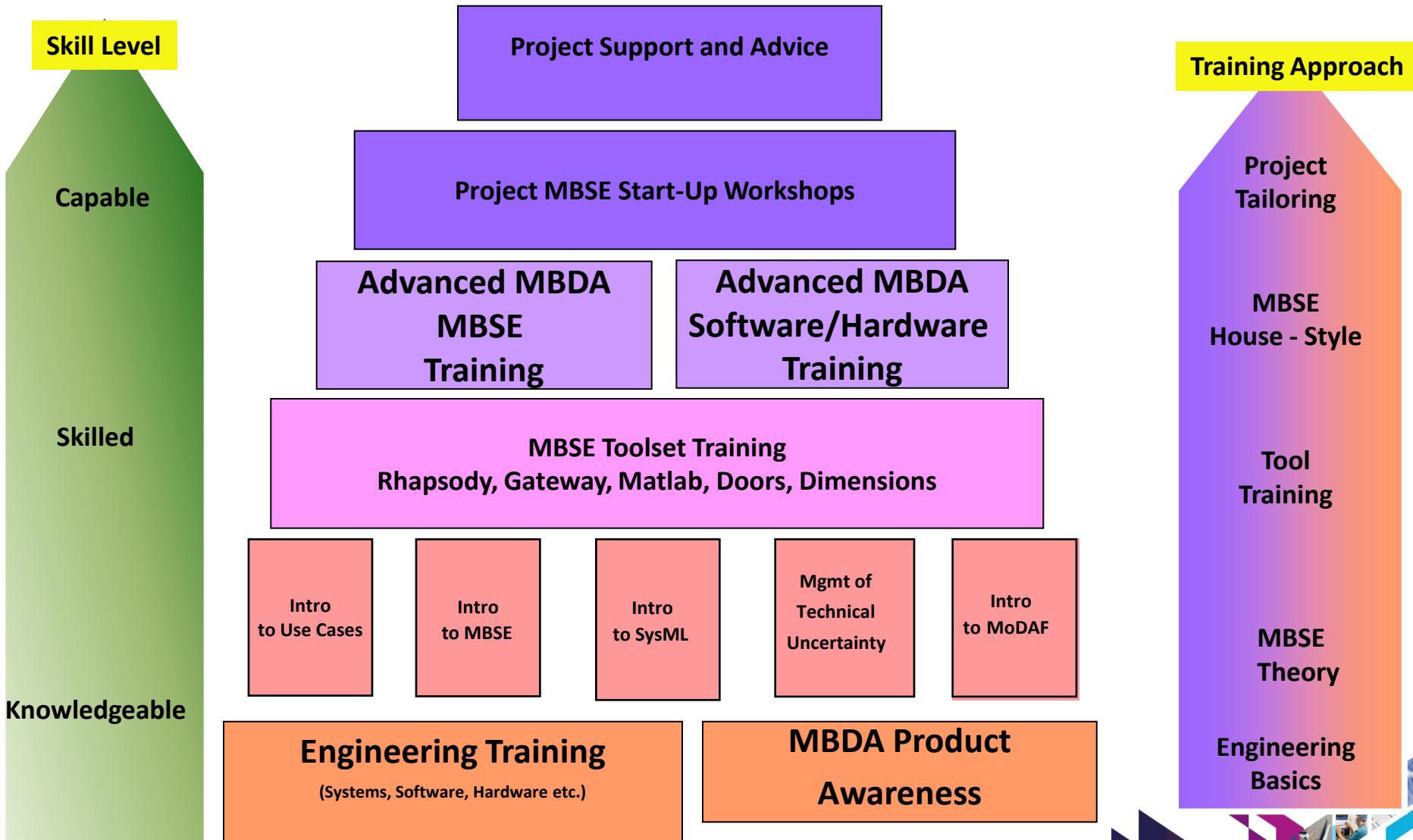
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MBSE/SysML/UML – Module approach to learning....



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

MBSE/Tool Training Approach

Integrated Training developed by External Vendor on behalf of MBDA

- Professional Trainer and MBSE Expert

- Experienced in delivering International courses

- Process and Method First

- Essential Tool Training (Concentrates on the Key features)

Advanced Toolset Training

- 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



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Summary and Conclusion

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Return on investment – Using MBSE Approach?

Potential Savings that we believe can be achieved using MBSE:

Articulate, test out & agree real customer requirements & drivers (**man years**)

Rapid prototyping of complex functionality (**man years**)

Better, faster first design standards (**fewer**)

Faster communication of information (design, requirements, data, code) (**man years**)

Auto-code generation & verification (**> man year**)

Fewer mistakes, read many, write once configuration (**man months**)

Greater automation of the V to certificate of design (**man months**)



Summary and Conclusions

MBDA has significantly invested in the introduction of MBSE
Committed to an International rather than National approach
Benefits observed so far include:

- Enhances our System Engineering Capability
- Reduction in development timescales
- Better management of Complexity
- Improved Design Coherency
- Improved communication between
 - International Teams
 - Disciplines (Integrated Teams)
- Promotion and support of Modularity and Re-Use
- Integrated Training and Support (Best in Class?)



MBDA MBSE Road Show 2010





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