

ELM Experiences Engineering Complex Systems at MBDA

Ian Clark & Mark Bennison, MBDA Missile Systems

- Introductions
- Our Business Journey
- Our Experiences
- Questions

Introductions

- Mark
- Ian
- MBDA



Mark Bennison BSc (Hons) CEng MIET MBCS CITP
Head of Digital Technologies & ALM

- Career in brief

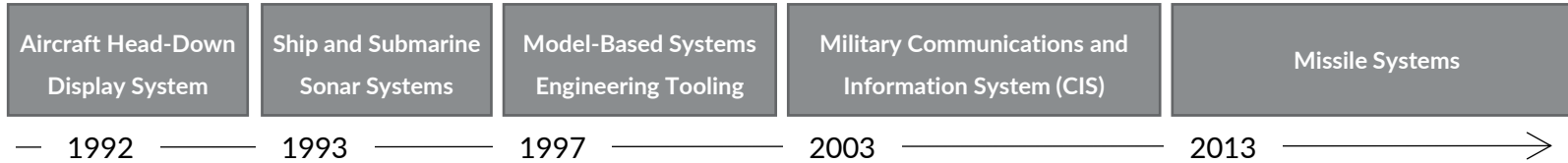
- Started in 1986 as a software engineer working on Nimrod AEW, cancelled 2 months later...
- Spend many years designing and developing RTOS for various products
- Mid 1990's moved into systems engineering and held various positions: consultant, technical management, Chief Engineer ... mostly on military communications equipment
- 2005 moved into a role providing technical assurance/scrutineering across all MBDA's products; also redeveloped the product engineering processes
- 2018 role change to own and improve the MBDA ALM solution
 - ELM, DOORS, Rhapsody, pure::variants, Eggplant, ...



Current focus upon:

- Governance of the model based engineering tools, digital continuity and data architecture
- Definition and implementation of the “to-be” digital thread & data model

Ian Clark – model-based engineering since 1992 – ELM user since 2014

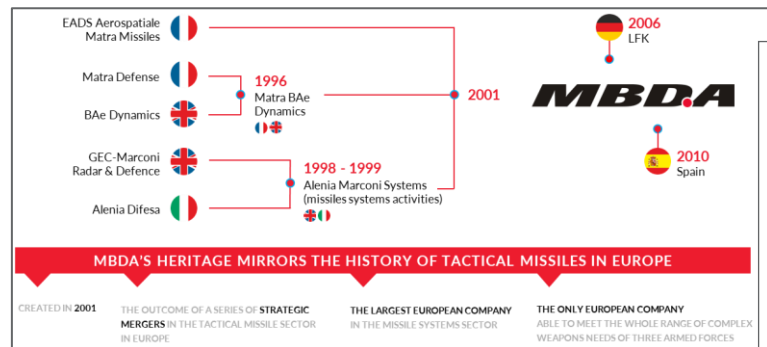


- *Model Based Engineering practitioner, manager and advisor of Aerospace and Defence Software and Systems development*
- *Six years Project Manager at Artisan Software Tools developing Real-time Studio modelling toolset.*
- *Currently, System Architect on one of MBDA's Development Programmes and an MBDA Systems Engineering Technical Expert*
- *INCOSE member since 2004. Member of INCOSE UK Architecture and MBSE Working Groups (co-chair MBSE-WG 2017-22).*



“a unique and successful model of a European integrated defence company at the core of the sovereignty of our nations”

OUR HERITAGE



OUR VISION

To be the European Complex Weapons
LEADER & A GLOBAL PLAYER

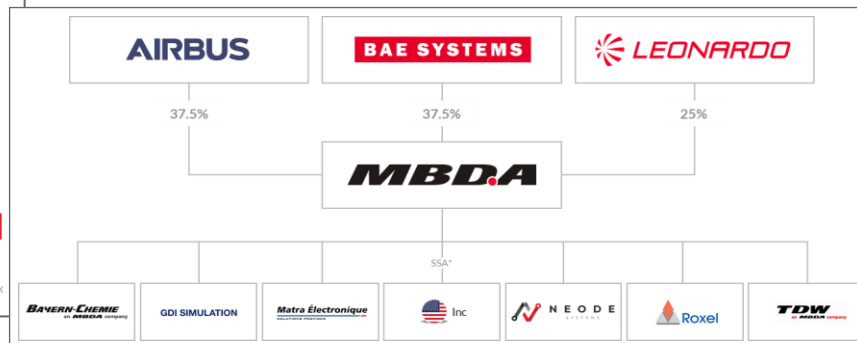
OUR MISSION

To operate as a trusted part of the defence community by providing our home nations and their allies with decisive military capability **TO PROTECT NATIONAL SECURITY** and enable **STRATEGIC INDEPENDENCE**

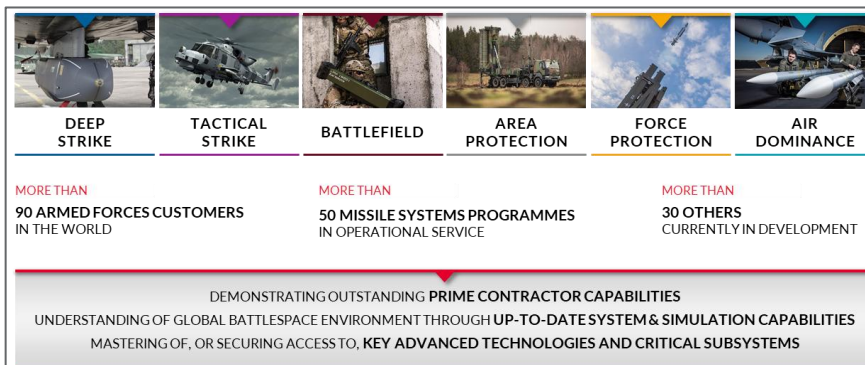
ELM Experiences Engineering Complex Systems

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TODAY

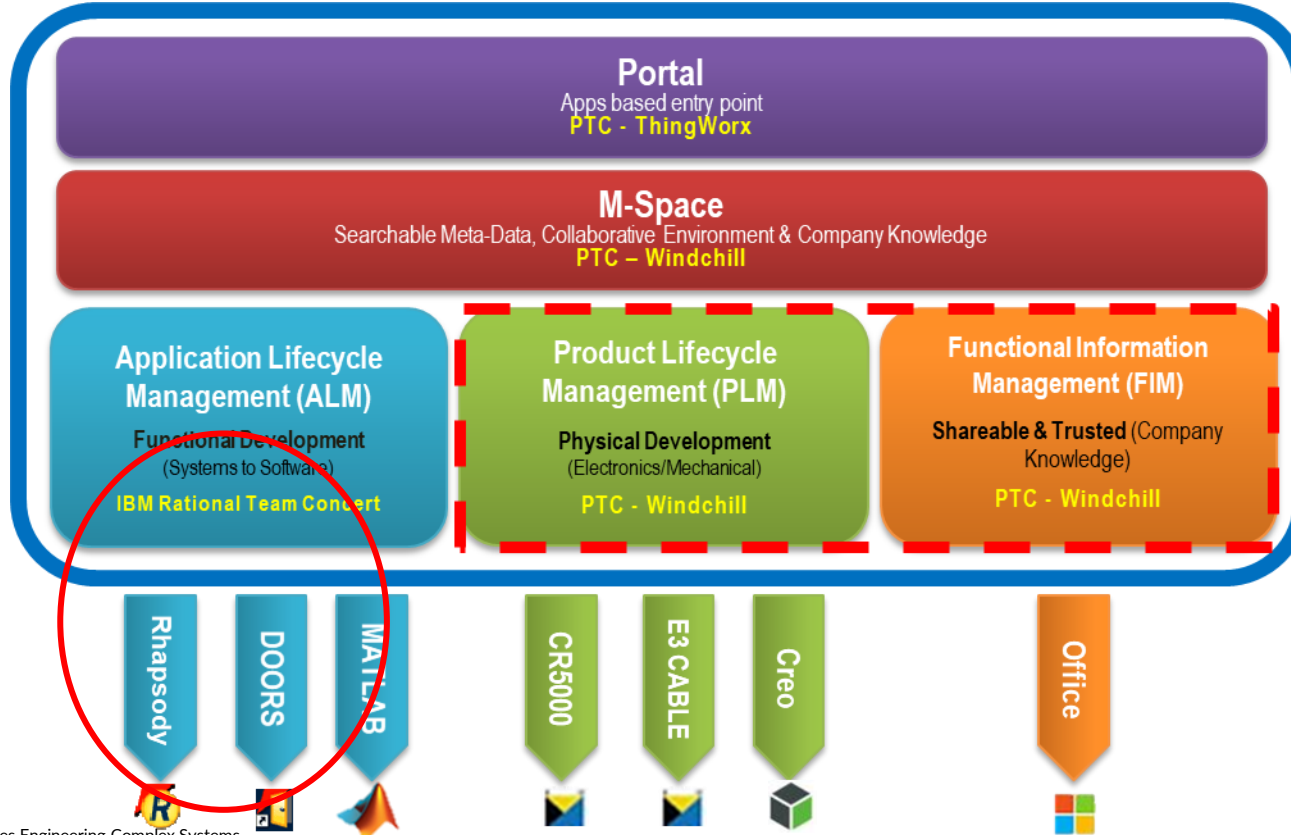


OUR POSITIONING

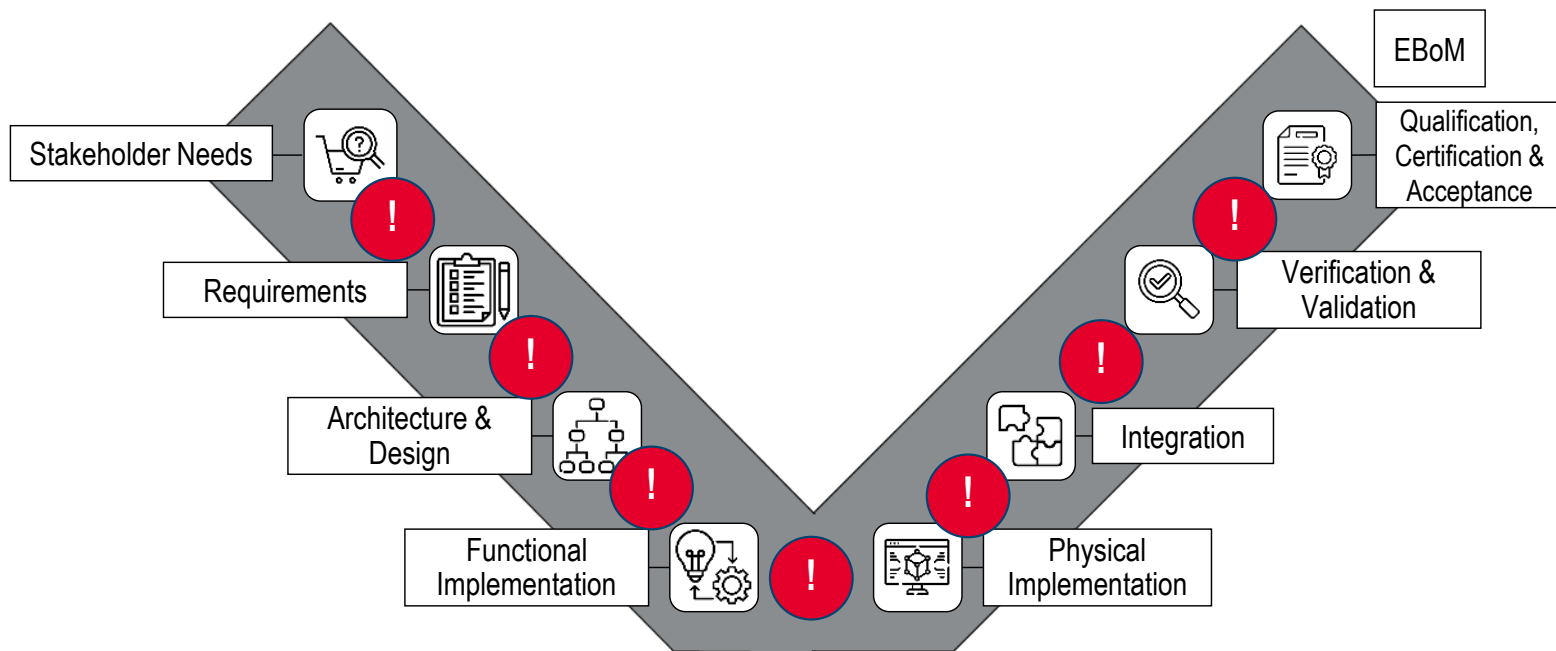


Our Business Journey

Where we were: Our engineering information architecture circa 2018



Engineering Workflow



Diagnosis



Engineering data is fixed inside internal and/or contractual silos – it is hard to access and exploit



Engineering technology 'core' is too fragmented, fragile and at a high risk of becoming obsolete

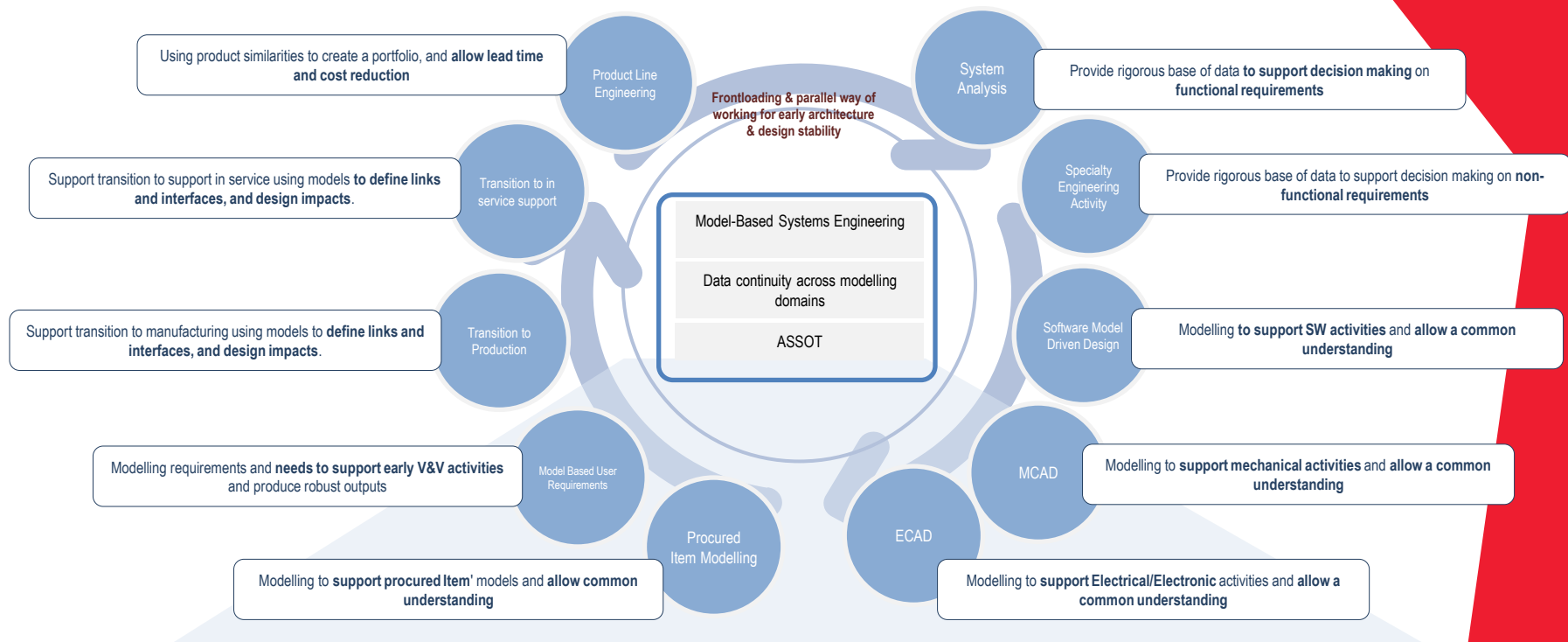


We remain with industrial era processes and culture despite efforts to change



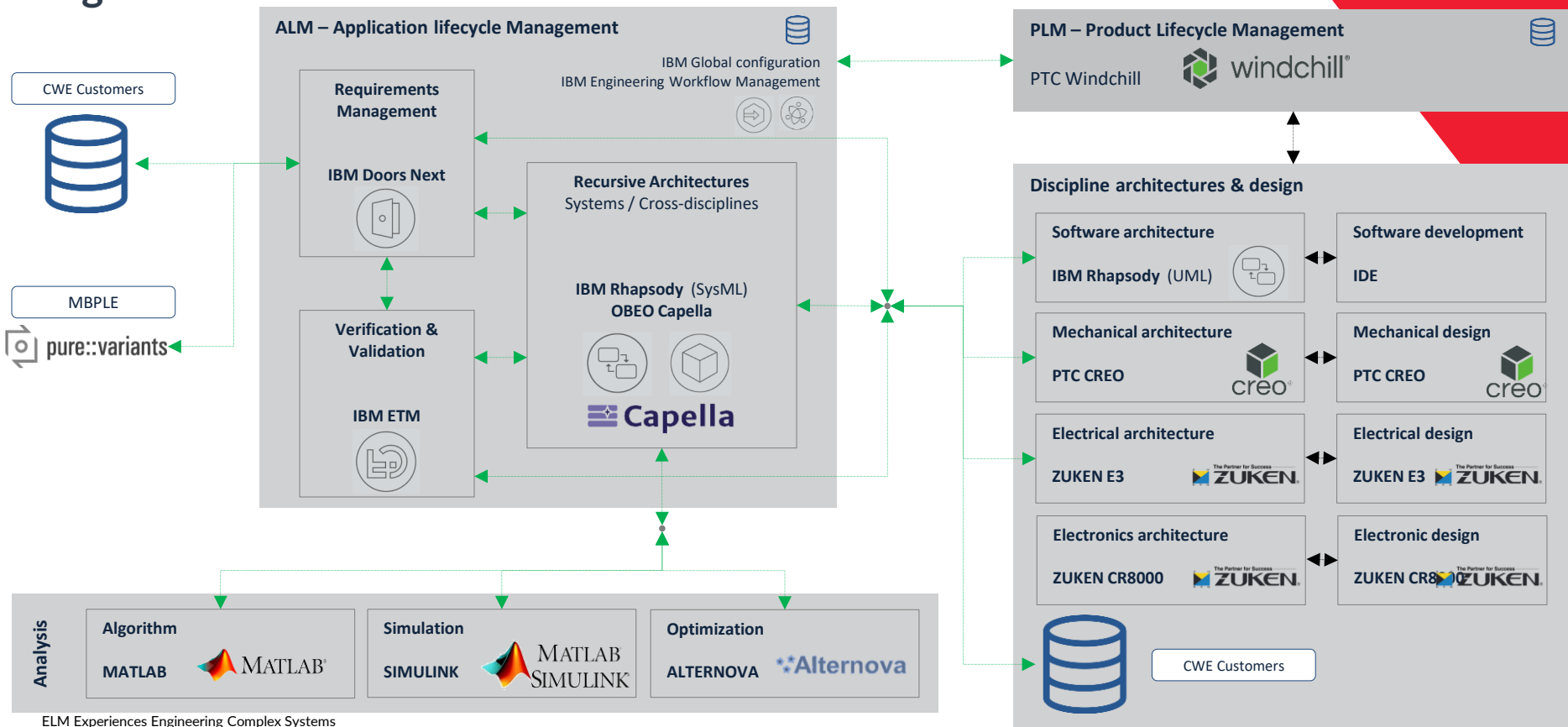
There is a digital skills gap across product development, and beyond

Digital Engineering Transformation



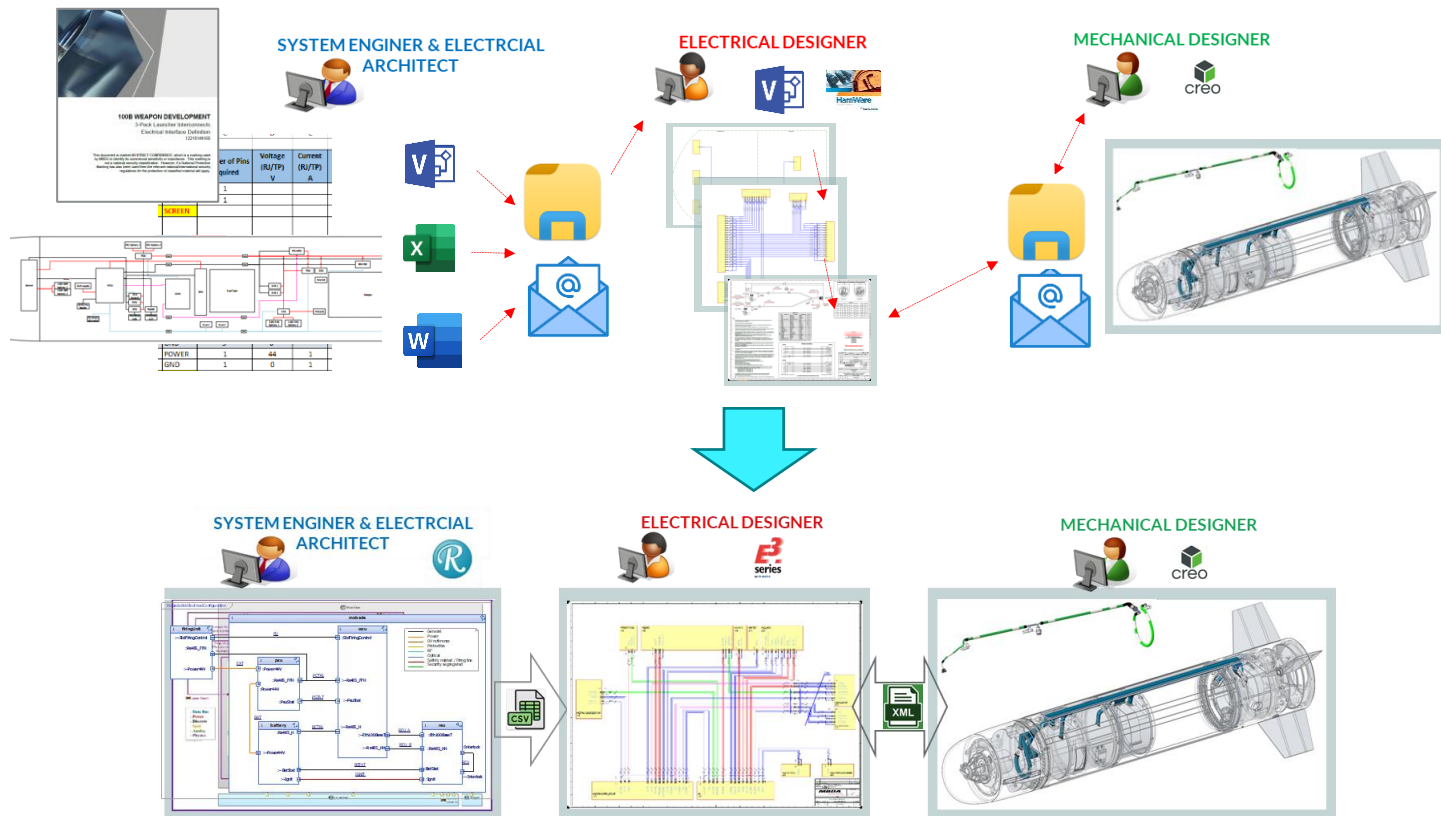
Putting Model-Based Systems Engineering, ASSOT and Digital & Data Continuity at the heart of End-to-End Model Based Engineering

Digital Architecture



ELM Experiences Engineering Complex Systems

Digital Continuity Example



Our Experiences *(so far . . .)*

- Our Complex Systems and ELM Environment
- The Requirements Space
- The Architecture & Design Space
- Key Benefits and Challenges so far

Our Complex Systems



Systems Architecture/
System Design

- Safety
- Security
- Human Factors
- Integrated Support
- . . .



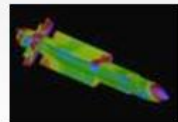
Mission Planning



HMI



C2



Aerodynamics
& Stealth



Guidance,
Control &
Navigation



Image
Processing
& Counter-
measures



Lethality

AIR



SEA



LAND



Armed Forces based perspective: Air, Navy, Army

Our ELM Environment

IRAD & Concepts

Requirements: ERM DOORS Next

Proving: ETM

Architecture & Design:
Engineering Systems Design
Rhapsody

Stakeholder Needs

Requirements

Architecture &
Design

Functional
Implementation

Physical
Implementation

Integration

Verification &
Validation

EBoM

Qualification,
Certification &
Acceptance

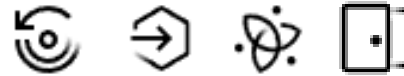


Workflow,
Configuration and
Dashboards: **EWM**



Global
Configuration: **GCM**

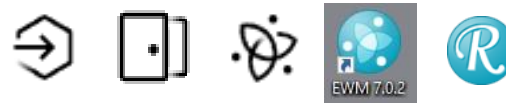




The Requirements Space

- Engineering Requirements Management (DOORS Next) – for our requirements engineering
 - Leveraging our processes, procedures and skillsets from years of DOORS 'Classic' usage
- Engineering Workflow Management (EWM) – for the configuration, change and baseline management of our requirements
 - Also the Task Management, Monitoring and Reporting – *valuable for our leaders/managers (no excuse)*
- Unique Requirement objects – re-usable across Requirement Specifications
 - Don't have to make and manage copies (within same project)
 - Enables us to have variant specifications for variant products – with common requirements
 - Change management impact assessment across multiple specifications/products is fundamental!
 - The actual 'Specifications' can be configurable and recoverable within the ELM environment
- Concurrent multi-user day-to-day activities in DOORS Next:
 - Stakeholder collaboration capturing and managing all our Systems' requirements – *our ASSOT**
 - Baselining requirement and collective 'specifications' (e.g. for multiple related products) for review and release
 - Maintaining requirements through a change initiation and management process

* ASSOT – Authoritative Single Source Of Truth



The Architecture & Design Space

- Engineering Systems Design (Rhapsody) – modelling our systems' architectures and designs – generating 'some' code
 - Rhapsody Model Manager (RMM) – integrating Rhapsody to EWM – behind the scenes for the masses (i.e. *minimal User Interface*)
 - Using Eclipse Client for the Configuration of our Rhapsody models – *additional skill set*
- EWM – for the configuration, change and baseline management, and *browsing* of our models
 - Also the Task Management, Monitoring and Reporting – *valuable for our leaders/managers (no excuse)*
- Model configuration in EWM:
 - Project Area – per project (has Team Areas)
 - Team Area – per project team (contains Streams) – *very useful to plan, prepare, manage and control our modelling*
 - Stream – per Architecture/Design (contains Components) – in most cases made up of multiple models (*different discussion, different day*)
 - Component – per model '**the basic configuration unit for a model**' (i.e. *we use reference models different discussion, different day*)
- Concurrent multi-user day-to-day activities in Rhapsody and EWM with ERM:
 - Creating and configuring our models
 - Updating and delivering models into 'project area streams' on the 'central server'
 - Associating (i.e. creating relationships) Architecture and Design to Requirements in our models – *in a configured controlled environment*
 - Baselining models for review and release
 - Generating documents from our models – *early days for this and still maturing overall competencies*

Key Benefits

- **Requirements** are no longer being engineered in stovepipes – the toolset facilitating the visibility, collaboration, co-specification and impact assessment into Architecture & Design and our V&V (i.e. our 'Proving') – our Requirements Engineering is maturing
- **Architecture and Design** is a centrally configured and controlled set of artefacts (primarily models) linkable to configured requirements and in time to our Proving – our Model Based Engineering is maturing
- **Workflow** planning, implementation and monitoring with the EWM Work Items and Dashboards is very visible and usable – our Planning and Management is improving
- **Product Development** delivery and quality is improving in meeting project and programme milestones – from 'seeing it' and 'doing it'
- **Competencies** of our people, using the tools and the methods are maturing – i.e. our Systems Engineering is maturing!

Key Challenges (currently being worked on and we are learning!)

- ELM Global Configuration Management (GCM) – understanding our needs across our extensive lifecycle teams, their activity and delivery
- EWM Change Management – control, planning and impact with cross-domain/team collaboration and usage (i.e. Requirement in Architecture in Design in Implementation)
- EWM and GCM Baselining – locally with dependents (e.g. Requirements- Architecture) and globally across the Lifecycle (i.e. Product)
- Project 'ELM back-office' capabilities – planning, coverage and competencies not at the forefront for key stakeholders
- Project user competencies – actively staying on top of this and maintaining and maturing these
- Project secret/controlled data – the setup and management of this to enable tight control of access and requirement/model integrations

Questions

Thank you for your attention and contribution