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Developing the MBSE way of working at Thales UK

Dr Joe Silmon
Systems Engineer MBSE Specialist
Thales Ground Transportation Systems/Thales UK

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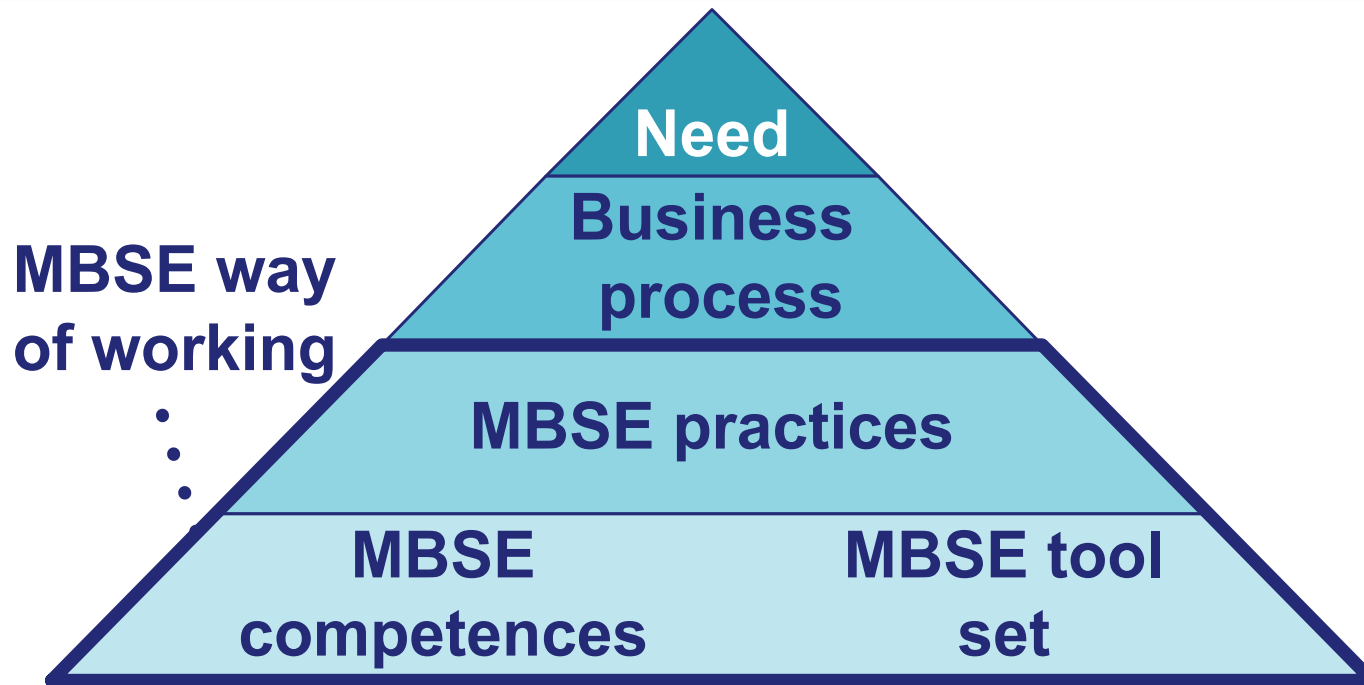**THALES**

Vision, goals and objectives

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Thales UK vision for model-based systems engineering

Every engineering team is sufficiently aware, trained, and equipped to optimise engineering performance by implementing a common Thales UK MBSE way of working, tailored as appropriate to the work in hand.

MBSE way of working

Need

Business process

MBSE practices

MBSE competences

MBSE tool set

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We can choose the degree to which we employ MBSE

Level 0: **No formal** **modelling**	Formal modelling activities are at best ad-hoc. Definition of the system is achieved with a combination of textual description (including traditional requirements) and pictures (unconnected graphical artefacts with no enforcement of traceability or consistency).
Level 1: **Communicate**	"Models provide semi-formal support to improve communication and reduce ambiguities. Model content is typically used for description purposes in textual requirements or documents. Engineering activities are not model-based, but models are likely to be a part of the engineering baseline"
Level 2: Master	"Models provide means to manage design complexity, better specify the solution, and secure interfaces. The model is the reference of the scope it covers. It is typically used to ensure design consistency and enable precise impact analyses. Several engineering activities are directly related to (dependent on) the model."
Level 3: **Optimise**	"Models help seek further competitiveness through automation." The model enables: • Automation of artefact production; • Collaboration with the customer including adoption of customer models; • Collaboration between subsystem owners; • Performance evaluation; • Coupling with speciality engineering tools.

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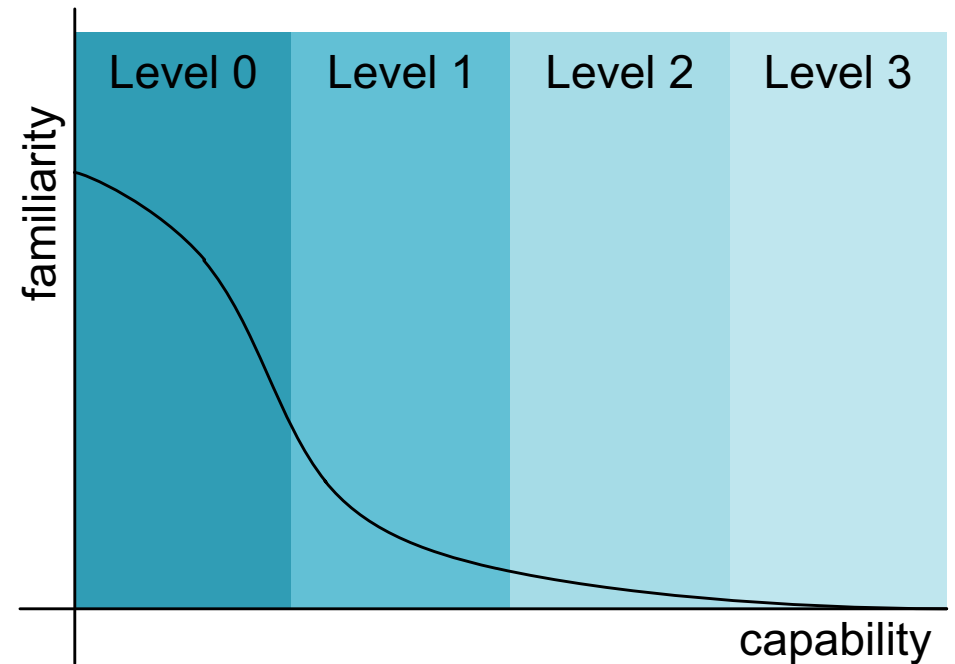**THALES**

The current state of MBSE in Thales UK

Mostly requirements/traditional methods

MBSE supported and championed by Group

> ARCADIA methodology

> Capella tool (publicly available open source)

Engineering approach driven by

> Team capability

> Customer methods/maturity

> Level of perceived need to change

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Planning MBSE

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Requirements for a modelling plan
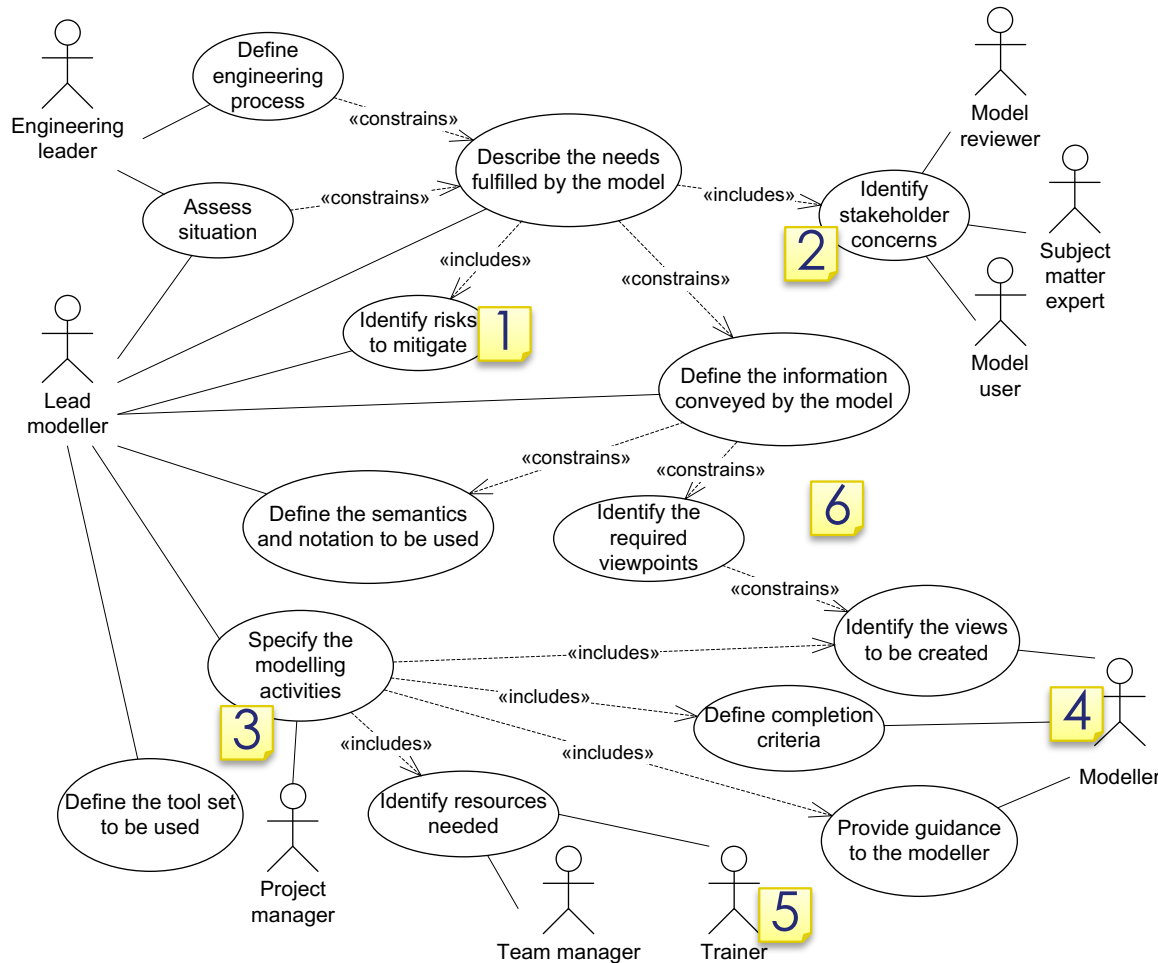
Points to note

1. Address actual project risks – part of the business case
2. Engage with stakeholders and gather their needs
3. Thorough work-package description
4. Comprehensive instructions to the modellers
5. Engagement of training and development to get the right skills in place
6. Model the model(!) – e.g. FAF

So what did we do?

- Briefed out a thorough planning approach
- Updated the MBSE practice
- Gave detailed guidance on a wiki

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Concept of operations

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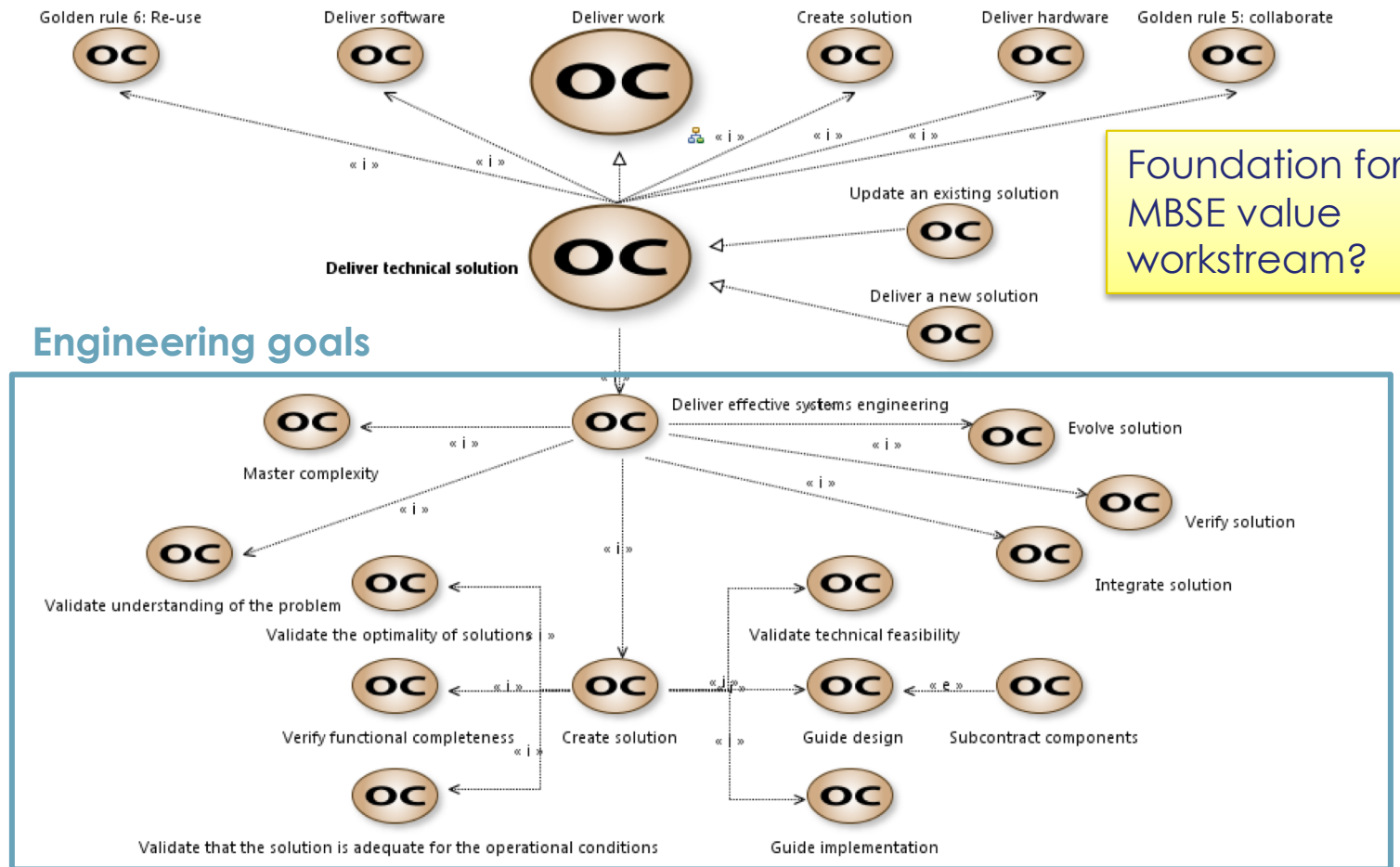# Developing technical solutions

To deliver a good technical solution, we need to achieve a common set of engineering goals

Each of these is supported by our way of working

These goals form a helpful framework for understanding how we do engineering

Golden rule 6: Re-use

Deliver software

Deliver work

Create solution

Deliver hardware

Golden rule 5: collaborate

Deliver technical solution

Update an existing solution

Deliver a new solution

Foundation for MBSE value workstream?

Engineering goals

Deliver effective systems engineering

Master complexity

Evolve solution

Verify solution

Validate understanding of the problem

Integrate solution

Validate the optimality of solutions

Validate technical feasibility

Verify functional completeness

Create solution

Guide design

Subcontract components

Validate that the solution is adequate for the operational conditions

Guide implementation

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Validate understanding of customer needs – mission detail

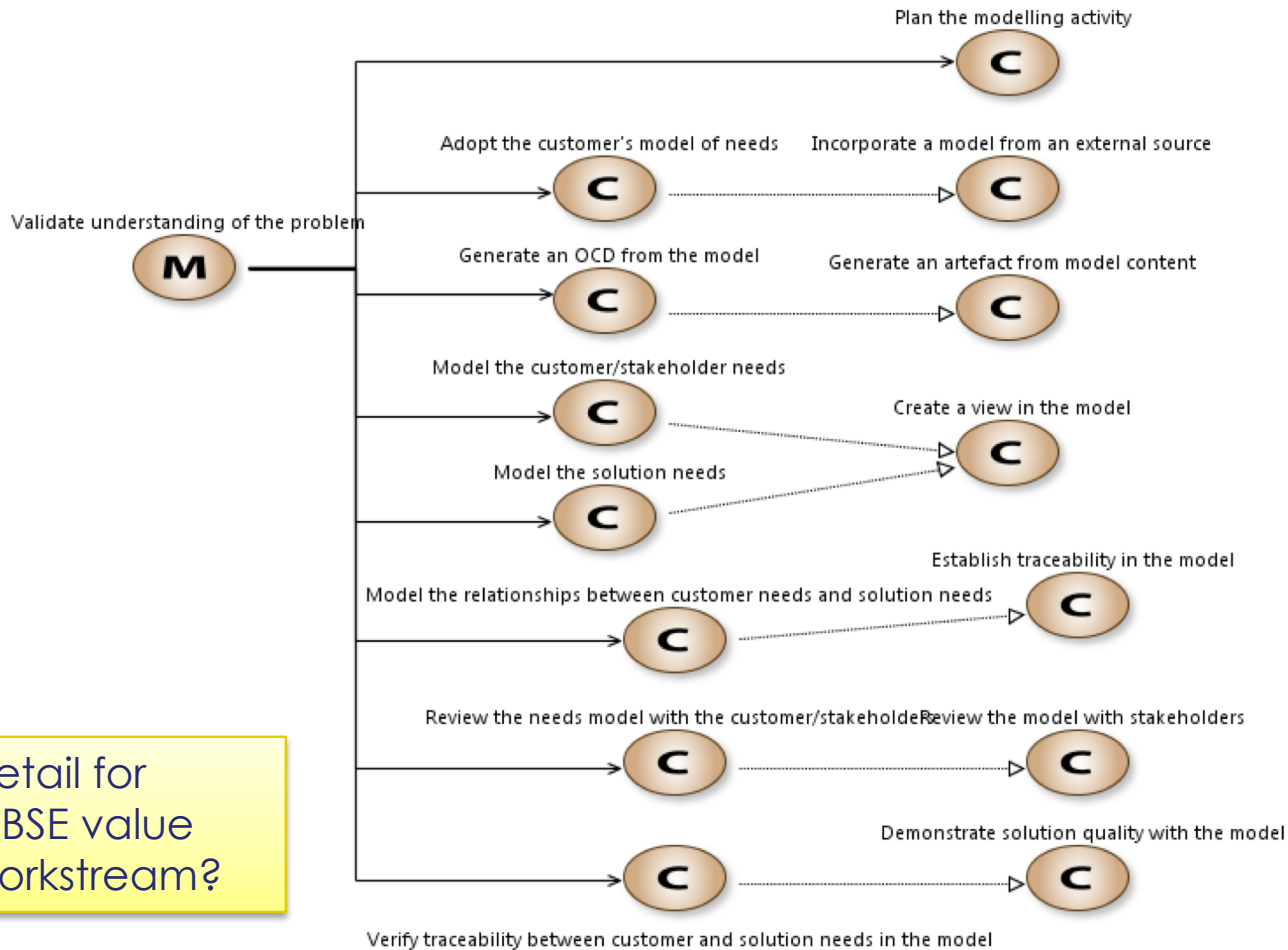|	
Goal	To arrive at a formal definition of the stakeholders' needs that is agreed by all stakeholders.
Starting conditions	A potential customer has expressed a need; Thales believes it can answer the need.
Ending conditions	Operational aspects of the solution are identified e.g. CONOPS, CONUSE, CONEMP. Needs or expectations of concerned stakeholders are captured and agreed. External interfaces are identified and characterised.
Minimum guarantee	Supplier roles (architects, design authorities) and customer roles (procurer, sponsor) in agreement on their understanding of the problem
Success guarantee	Design authority has confidence to proceed with bidding or with the work
Approver	Design authority (supplier), sponsor (customer)
Responsible	Lead engineering architect (e.g. Solution Architect)
Contributors	Other engineering architects (Hardware, Software, Service, Enterprise...), procurer, operator, installer, maintainer
Beneficiaries	Architects, engineers
Synopsis	The lead engineering architect leads the supplier team to plan the capture and analysis of stakeholder needs. Where required, the supplier team engages with the customer roles to answer queries and make clarifications or add detail to the agreed understanding of needs. The supplier and customer agree that the needs have been accurately and precisely captured.

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Concept of use

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Mission-capability mapping

The engineering missions use the same MBSE capabilities repeatedly, in different specific ways.

This example shows how generic capabilities are used during the mission **Validate understanding of the problem**.

These capabilities can be implemented to varying degrees (levels 0-3)

Detail for MBSE value workstream?

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The *MBSE* way of working capabilities/use cases

- **Plan the modelling activity**

- **Create a view in the model**

- **Generate an artefact from model content**

- **Transfer model content to an external model**

- **Incorporate a model from an external source**

- **Review the model with stakeholders**

- **Establish traceability in the model**

- **Demonstrate solution quality in the model**

- **Query the model**

Each of these capabilities can deliver some small benefit independently, but when used together, proportionally more benefit will be realised.

Each capability represents a scenario with start, end, and success conditions, and roles involved (RACI and beneficiaries)

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Roles in the MBSE way of working

Model user (ModUser)

Uses model content to inform other activities

Lead modeller (LMod)

Collects together support needed to deliver MBSE

Leads the planning and execution of modelling activity

Modeller (Mod)

Executes the planned modelling activities

Peer-reviews/checks the validity of other modellers' work

Model reviewer (ModRev)

Verifies the completeness and accuracy of model content

Subject matter expert (SME)

Contributes source information to the creation of model views

Modelling champion (MC)

Coordinates the modelling community locally

Encourages, guides and/or coaches other roles

Modelling referent (ModRef)

Defines the way of working

Coordinates people, process, tools and learning

Defines and delivers the learning needed for MBSE

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Detail of a capability – Generate an artefact from the model
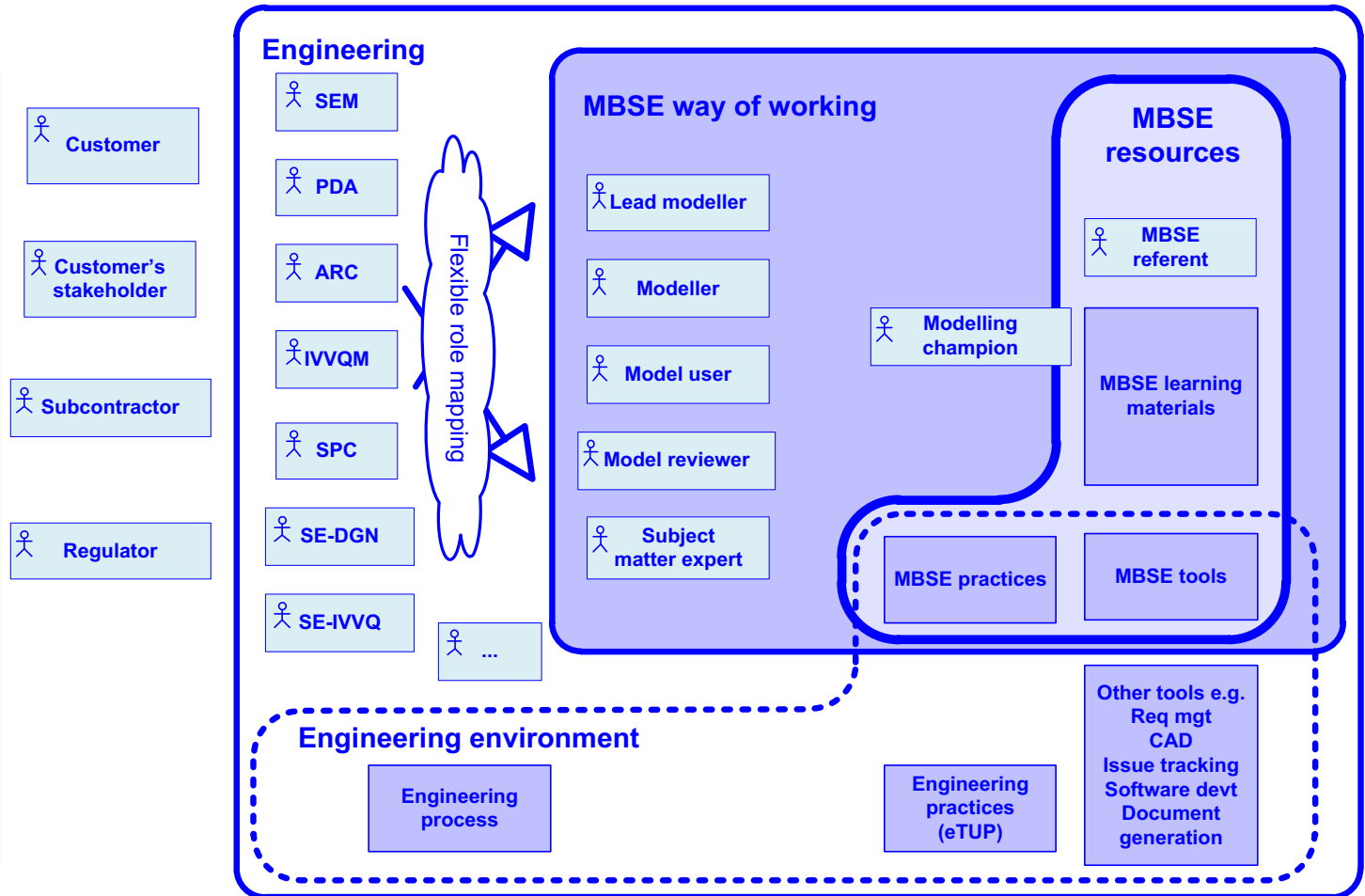
Goal	Meet stakeholder needs for information in a medium other than the modelling toolset.
Starting conditions	There exists a definition of the structure of the output artefact, including which items of model content are to be included.
	The engineering plans that define the creation and use of model content are consistent with each other and with the definition of the artefact.
	There exists a defined review process applicable to the artefact.
	The items of model content to be included in the artefact have been reviewed.
Ending conditions	The artefact has been accepted by the stakeholders.
Minimum guarantee	The artefact has been generated in accordance with its definition.
Success guarantee	The artefact has been reviewed by the design authority and stakeholders and they have agreed it meets their requirements.
Stakeholders	
Approver	Design authority and ModUser (where ModUser is external e.g. customer, subcontractor)
Responsible	LMod
Contributors	Mod
Beneficiaries	ModUser
Synopsis	The Mod uses the artefact's structure definition as a template.
	Alternative 1: in tooled environments, the Mod translates this template into the definition needed by the toolset, then runs an automated export of the selected model content.
	Alternative 2: in non-tooled environments, the Mod manually exports model views into the template.
	The Mod submits the artefact for review within the appropriate governing process.

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How the MBSE way of working fits in the wider engineering environment

The MBSE way of working is flexibly mapped to the existing engineering structure.

A business-level role might play one or more MBSE roles interchangeably, depending on what particular activity is being done.

Practices, tools, learning material and guidance are all available to teams as a standing resource.

Engineering

- Customer
- Customer's stakeholder
- Subcontractor
- Regulator

- SEM
- PDA
- ARC
- IVVQM
- SPC
- SE-DGN
- SE-IVVQ
- ...

Flexible role mapping

MBSE way of working

- Lead modeller
- Modeller
- Model user
- Model reviewer
- Subject matter expert

MBSE resources

- MBSE referent
- Modelling champion
- MBSE learning materials
- MBSE practices
- MBSE tools

Engineering environment

- Engineering process
- Engineering practices (eTUP)
- Other tools e.g. Req mgt CAD Issue tracking Software devt Document generation

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Concept of employment

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Implementation workstreams for MBSE

Early adopters

> Projects starting *now* and needing help

> Close bespoke support over next 12 months

> Monitored for performance and feedback

Routine adopters

> Dependent on base of materials, guidance, practice, resources

> Supported by development of resource

> Monitored for performance and feedback

Tools

> Support introduction of common engineering environment incl. MBSE tools

Learning

> Analysis of learning needs

> Development & delivery of learning

Resource

> Support to businesses in building their teams

Communications

> Awareness raising

> Engagement of stakeholders at all levels

> Sharing of progress & lessons with Group

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Learning strategy for MBSE

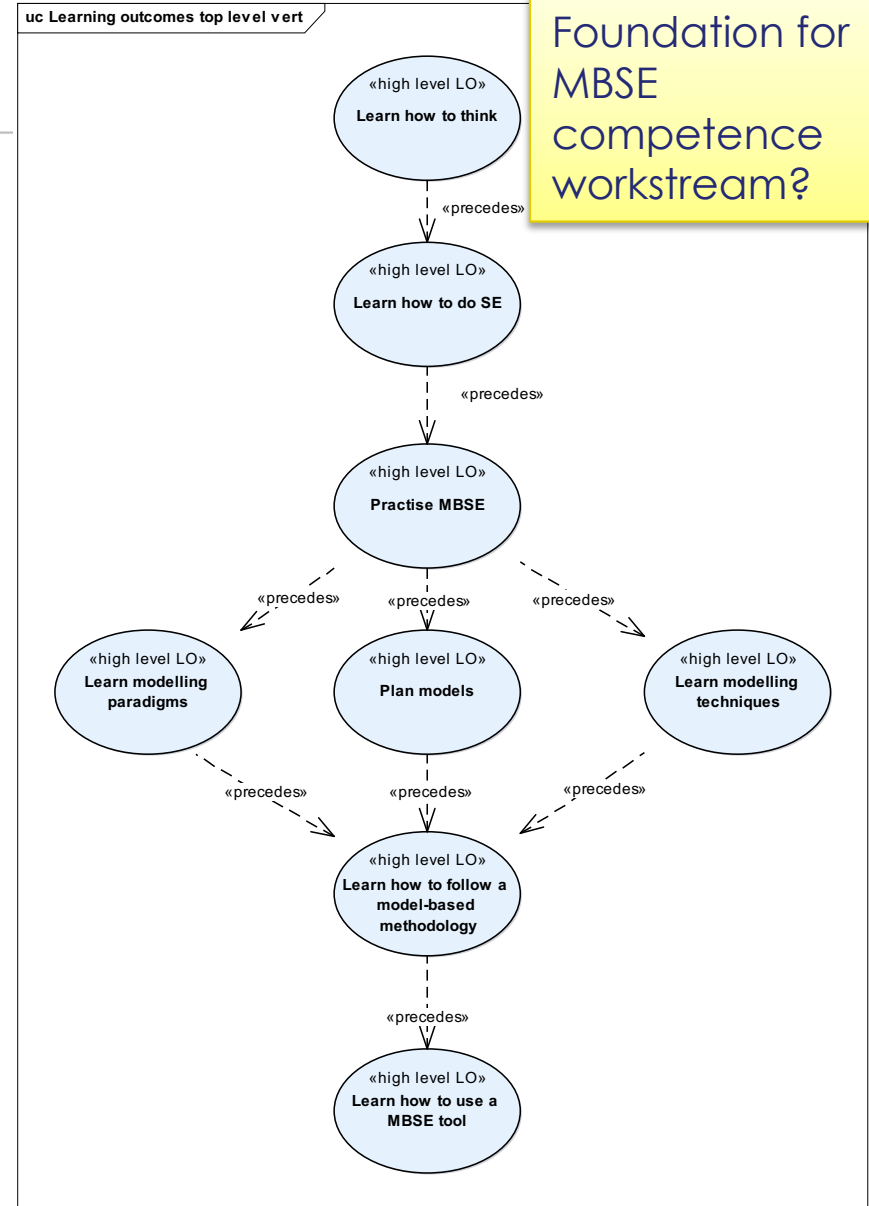**There is a rough order/sequence in the way someone learns to do MBSE**

> Basic system/critical thinking & behaviours

> Systems Engineering understanding

> Principles of MBSE

> Modelling techniques and skills

> Model-based methodologies

> Modelling tools

Current learning tends to start with the use of the tool

Future learning will recognise the importance of prior understanding before tooling

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uc Learning outcomes top level vert

«high level LO» Learn how to think

«precedes»

«high level LO» Learn how to do SE

«precedes»

«high level LO» Practise MBSE

«precedes» «precedes» «precedes»

«high level LO» Learn modelling paradigms | «high level LO» Plan models | «high level LO» Learn modelling techniques

«precedes» «precedes» «precedes»

«high level LO» Learn how to follow a model-based methodology

«precedes»

«high level LO» Learn how to use a MBSE tool

Foundation for MBSE competence workstream?

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End of presentation

Contact the Systems Modelling Referent for more information:

Joe Silmon
joe.silmon@uk.thalesgroup.com
07773 038 528
3rd floor South, GreenPark

www.thalesgroup.com

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