

MB4SE harmonisation roadmap status

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000 A computerized representation (integrated set of 0 models) that serves as the real-time digital counterpart of a physical object or process. 0 "Model-based systems engineering (MBSE) 0 is the formalized application of modelling to 0000 support system requirements, design, **Digital Engineering Ecosystem** analysis, verification and validation activities Infrastructure **Digital Thread Examples:** Hardware Tools Requirements Analysis Software Workforce beginning in the conceptual design phase Architecture Development Networks Design and Cost Trades · Design Evaluations and Approach and continuing throughout development and Optimizations Processes System, Subsystem, and Component - Development, testing, manufacturing, etc. Definition and Integration Methods later life cycle phases." - Model-based systems engineering (MBSE), Cost Estimations · Training Aids and Devices modeling languages, etc. Practices Development (INCOSE SE Vision 2020) Developmental and Operational **Digital Threads** DevSecOps, etc. **Digital Artifacts** Tests Product Support ----

Digital Twin

Digital Model Examples:

Requirements model

- Structural model
- Functional model
- Architecture model
- · Business process model
- Enterprise model
- · Human performance models
- Product life cycle models

Specifications

Technical drawings

Design documents

Analytical results

Digital Artifact Examples:

Interface management documents

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MBSE is the key enabling technology used to implement digital engineering

Data

Technologies Covered



key to win the time – quality – complexity – cost battle is to *improve communication*:

- **Time**: we must *communicate more often* (iteration, access to consistent data)
- **Quality**: we must *continuously increase* the *confidence* of the information exchanged
- **Complexity**: we need to *succinctly communicate* (abstraction, depth, purpose)
- Cost: we need to detect / prevent potential problems as early as possible

model-based systems engineering (MBSE) addresses these concerns by:

- providing an *explicit notation to create models* (abstractions of the real world),
- providing means to *continuously verify the model* (to check internal consistency),
- providing means to validate models early (to check external consistency)

aim is to establish an *authorative source of truth*:

- across all disciplines (including pm and pa)
- across all life cycle phases
- across the supply chain

Technologies Covered



Тес	chnology Domain		chnology Sub- main	Te	chnology Group	Coverage (Partial/Total)	Comments
ID	Name	ID	Name	ID	Name		
8	System Design and Verification	A	Mission and System Specification	I	Specification Methods and Tools	Partial	Related: TD10-A-I TD21-E-II TD25-A-I TD25-C
8	System Design and Verification	В	Collaborative and Concurrent Engineering	II	Multidisciplinary Data Exchange for Collaborative Engineering	Partial	Related: TD21-E-II
8	System Design and Verification	С	System Analysis and Design	11	Multidisciplinary Analysis	Partial	Related: TD21-E-II
9	Mission Operation and Ground Data Systems	С	Ground Data Systems	I	Mission Control System, Automation, Mission Planning, Simulators and Station M&C and Data Centre Architecture	Partial	
9	Mission Operation and Ground Data Systems	C	Ground Data Systems	11	and Technologies Preparation and Procedure tools for Ground Data Systems	Partial	Related: TD25-A-I

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Technology Harmonisation – well established process





- For details see <u>https://technology.esa.int/page/harmonisation</u>
- Model Based for System Engineering is part of harmonisation cycle 2024.2
- Coordinated in close collaboration with the MB4SE advisory group



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Harmonisation dossier – main challenges





- 1. Methodology and process
 - No common adopted methodology
 - Weak embedding in current engineering processes and (applicable) standards

2. Languages and tools

- Large diversity in notations, languages and tools (rapidly evolving) high adoption threshold (useability concerns)
- Many tailor-made (but silo-ed) solutions exist or are being developed (local optima, globally decoupled)

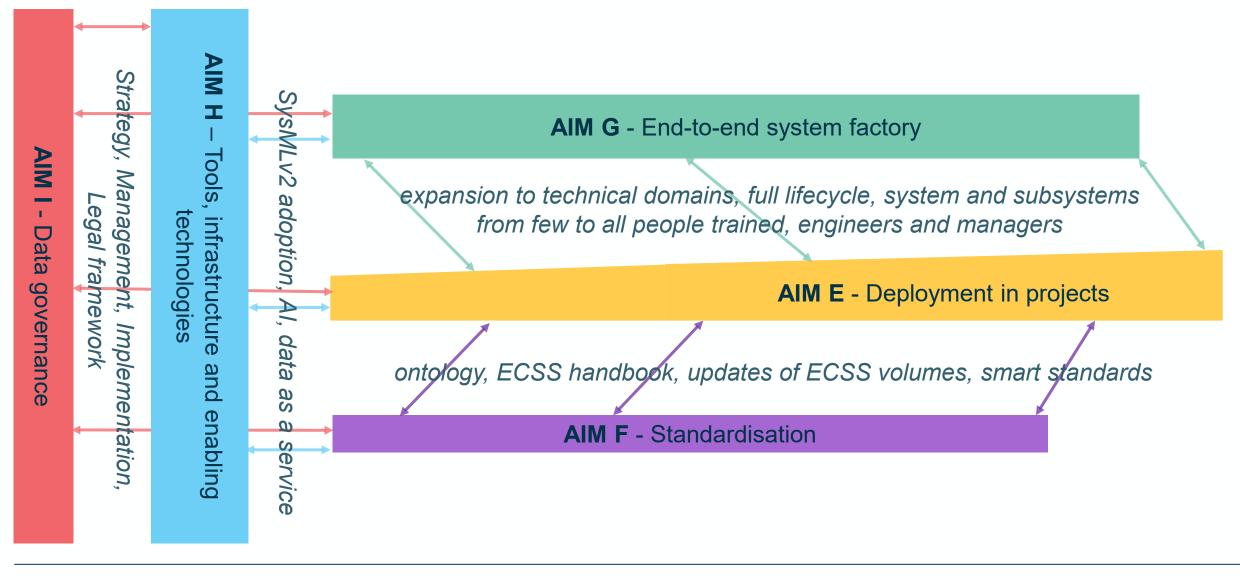
3. Infrastructure and data governance

- Poor interoperability hampering extended enterprise data exchange
- Intellectual property concerns and data security constraints

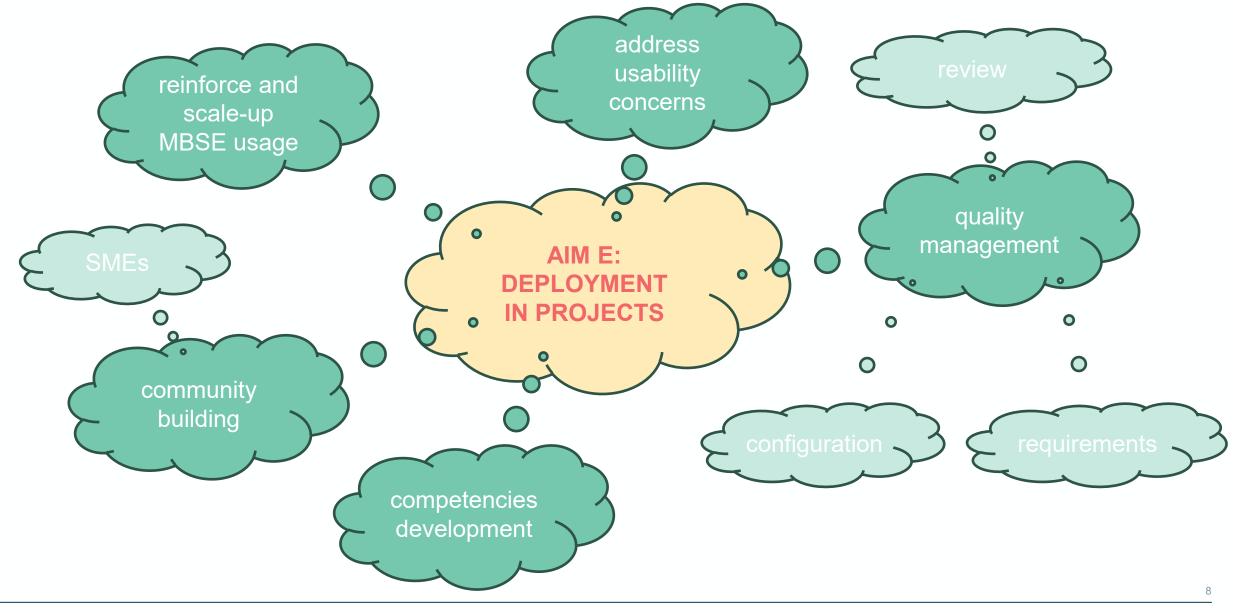
4. People

- Difficult transition from document based to digital engineering (legacy)
- Developing new skills and implementing new processes while maintaining "business as usual"

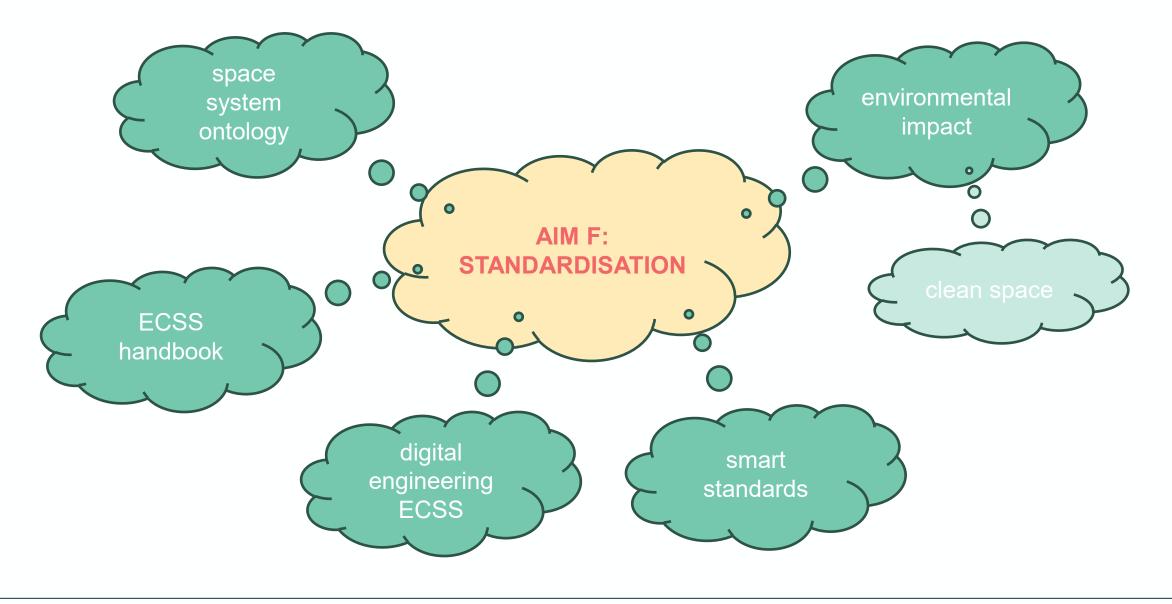
Harmonisation dossier 2024.2: top-level strategic aims





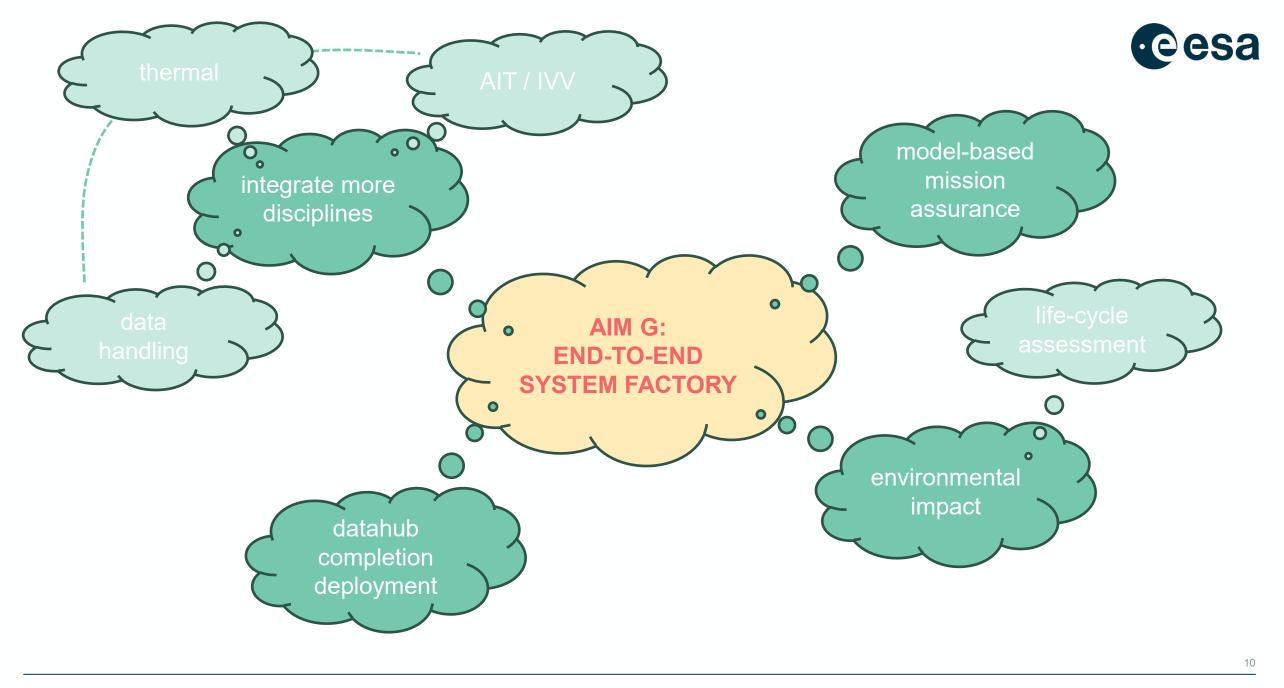




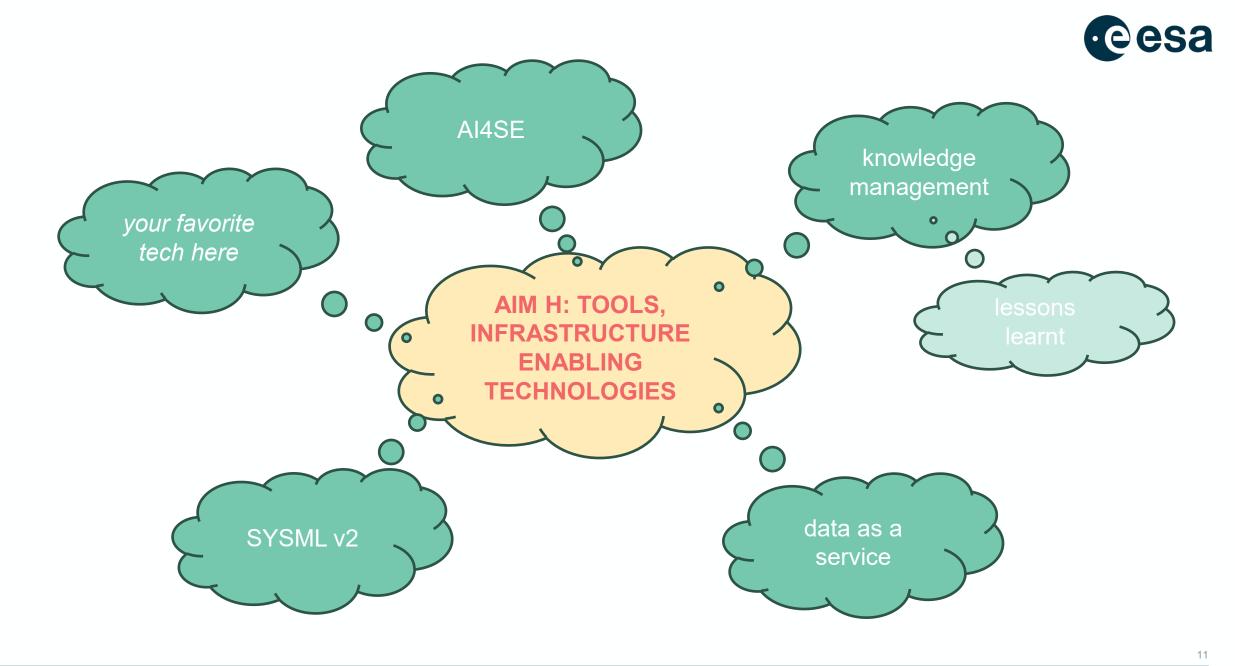


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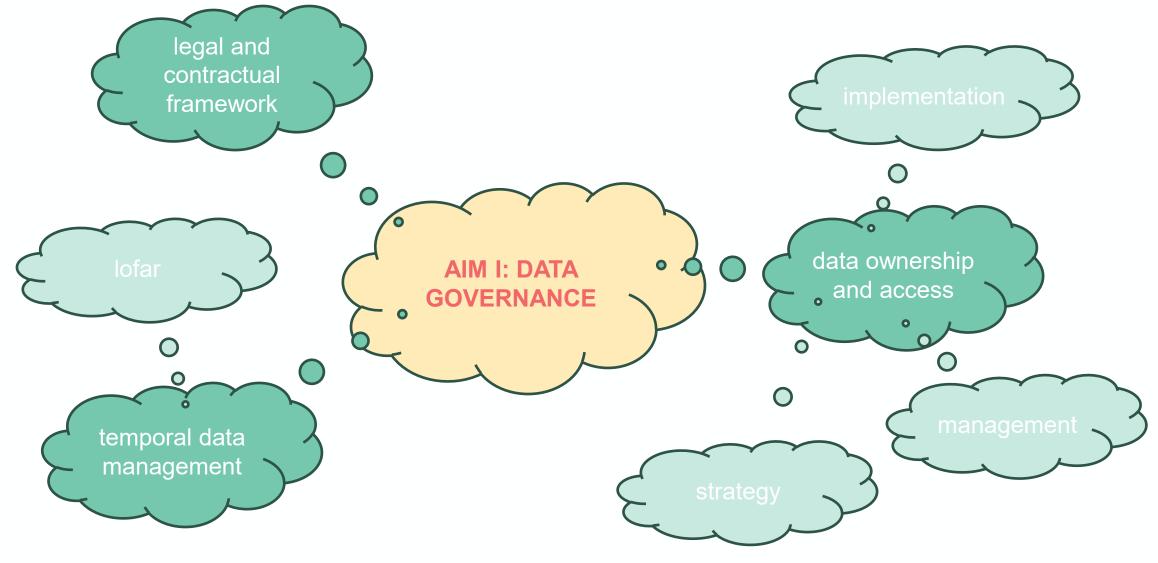


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Draft roadmap 2024.2 – current status



- 18 activities remaining from 2020.1 roadmap (13.4 MEuro)
- Aim E (Deployment in projects) : 11 activities proposed (9.85 Meuro including de-risk and flagship project(s))
- Aim F (Standardisation) : 3 activities proposed (1.4 MEuro)
- Aim G (End-to-end system factory) : 15 activities proposed (7.8 MEuro)
- Aim H (Infrastructure, tools and enabling technologies) : 19 activities proposed (12.5 MEuro)
- Aim I (Data governance) : 5 activities proposed (2.1 MEuro)

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THANKS FOR YOUR ATTENTION!





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