Lalitha Abhaya, Airbus DS
Eric Gauthier, Thales Group

ISO/IEC/IEEE 24641:MBSSE

www.incose.org/IW2023

1 Introduction

2 Content Summary

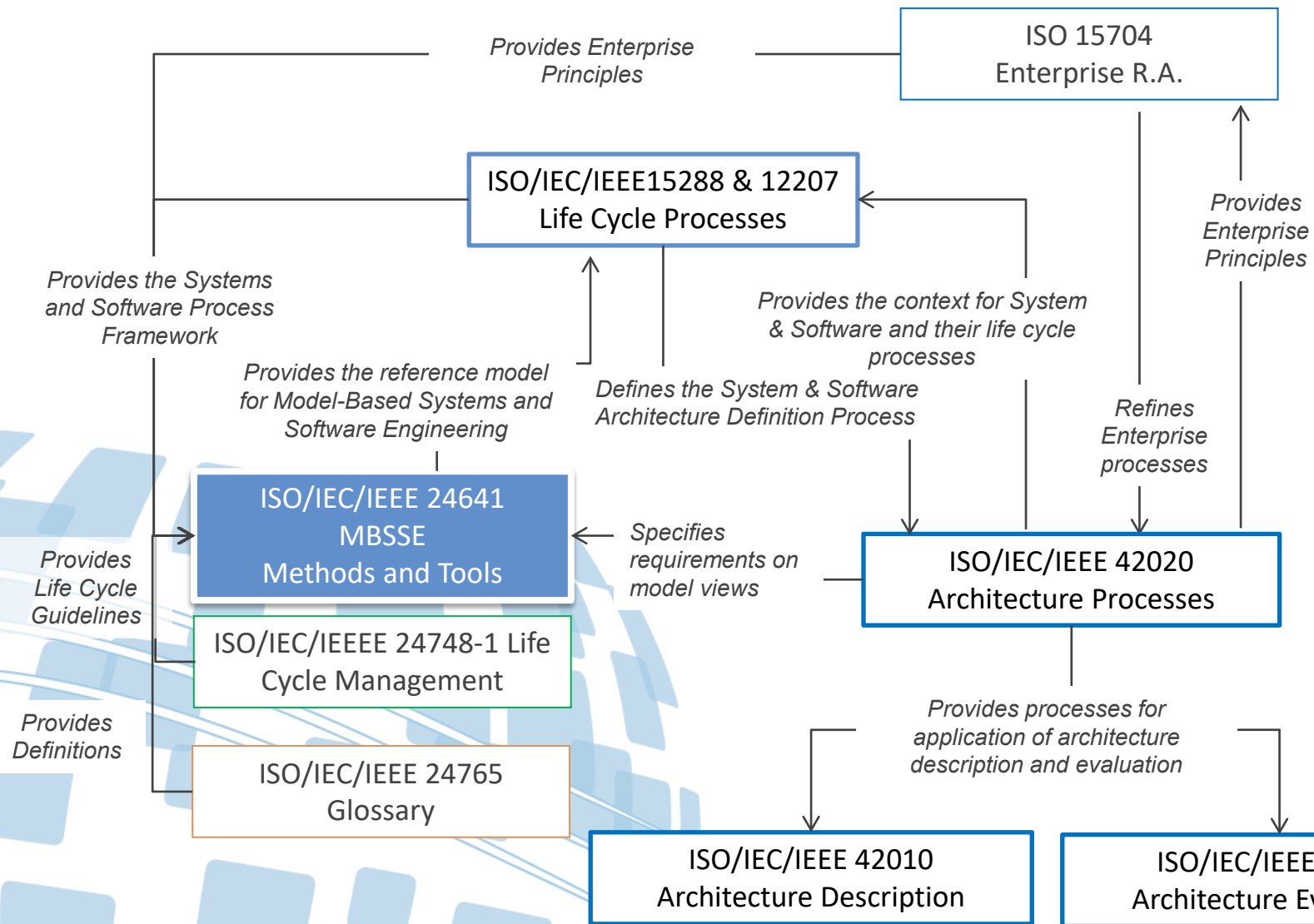3 Conclusion & perspectives

4 Status

Need for this Standard

Source : Annex C.2

- MBSSE is a Systems and Software Engineering approach centered on **evolving models**, which serve as the "main / major source of knowledge" about the system or software entity under consideration.

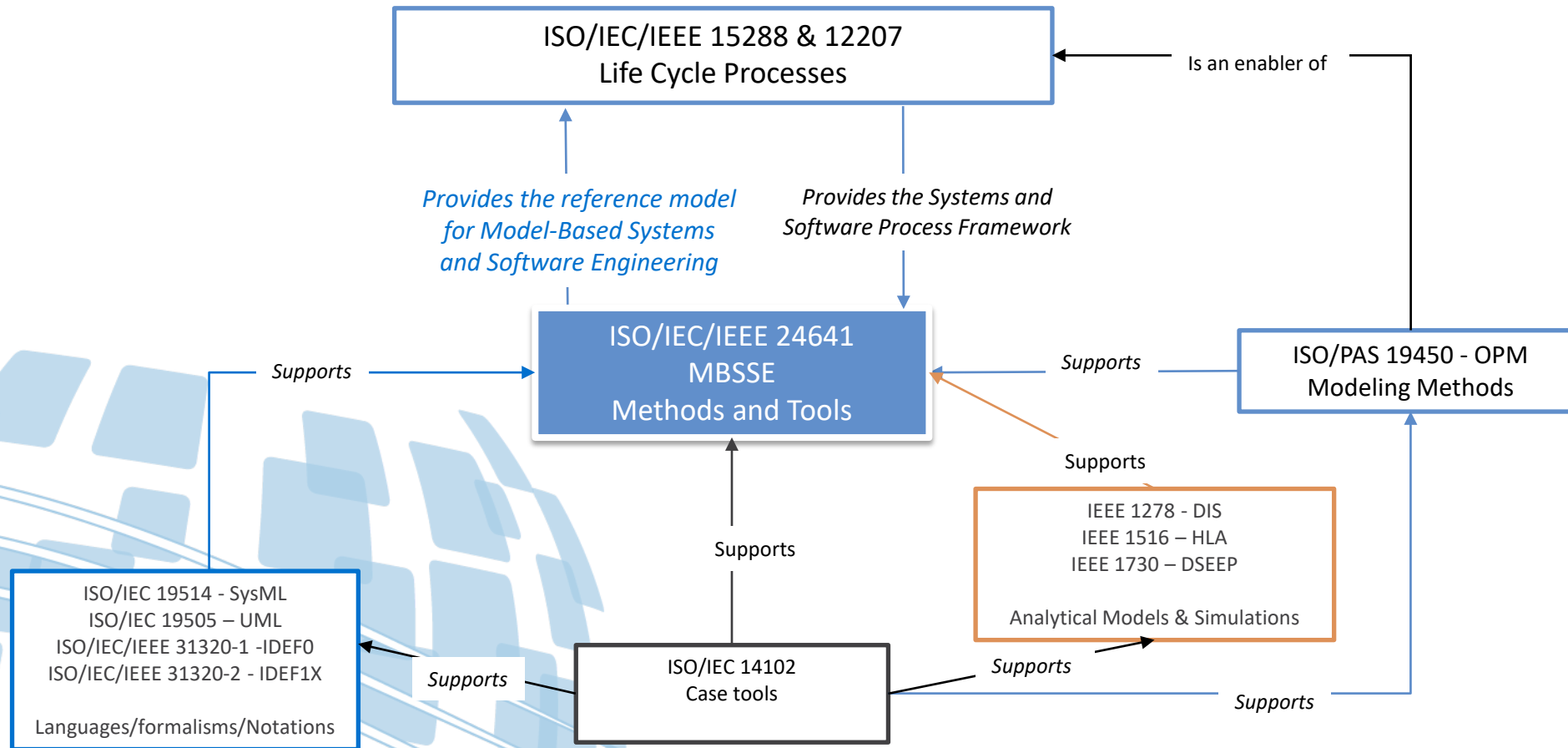- Many standards exists on SE/SW processes, methods, modelling languages,…

Relations with main International Standards

Provides Enterprise Principles

ISO 15704
Enterprise R.A.

ISO/IEC/IEEE15288 & 12207
Life Cycle Processes

Provides the Systems and Software Process Framework

Provides the reference model for Model-Based Systems and Software Engineering

Provides the context for System & Software and their life cycle processes

Defines the System & Software Architecture Definition Process

Provides Enterprise Principles

Refines Enterprise processes

ISO/IEC/IEEE 24641
MBSSE
Methods and Tools

Specifies requirements on model views

ISO/IEC/IEEE 42020
Architecture Processes

Provides Life Cycle Guidelines

ISO/IEC/IEEEE 24748-1 Life Cycle Management

Provides Definitions

ISO/IEC/IEEE 24765
Glossary

Provides processes for application of architecture description and evaluation

ISO/IEC/IEEE 42010
Architecture Description

ISO/IEC/IEEE 42030
Architecture Evaluation

- Current standard
  Covers overall MBSSE
  processes at a higher
  level

28-janv.-23

www.incose.org/IW2023

4

Source : Annex E.1

Relations with auxiliary International Standards

ISO/IEC/IEEE 15288 & 12207
Life Cycle Processes

Is an enabler of

Provides the reference model for Model-Based Systems and Software Engineering

Provides the Systems and Software Process Framework

ISO/IEC/IEEE 24641
MBSSE
Methods and Tools

Supports

ISO/PAS 19450 - OPM
Modeling Methods

Supports

Supports

ISO/IEC 19514 - SysML
ISO/IEC 19505 – UML
ISO/IEC/IEEE 31320-1 -IDEF0
ISO/IEC/IEEE 31320-2 - IDEF1X

Languages/formalisms/Notations

Supports

IEEE 1278 - DIS
IEEE 1516 – HLA
IEEE 1730 – DSEEP

Analytical Models & Simulations

Supports

ISO/IEC 14102
Case tools

Supports

Supports

Source : Annex E.2

Scope

- International Standard, developed by ISO/IEC Joint Technical Committee 1/Standardization Subcommittee 7 (Systems and Software Engineering)/Working Group 4 (Tools and Environment) detailing reference model, processes, methods and tool capabilities for MBSSE
    - Terms and definitions related to MBSSE;
    - Process Reference Model for organizing all MBSSE-specific processes;
    - MBSSE-specific processes for model-based systems and software engineering
    - Methods to support the defined tasks of each process; and,
    - Tool capabilities to automate or semi-automate tasks or methods.

Objectives

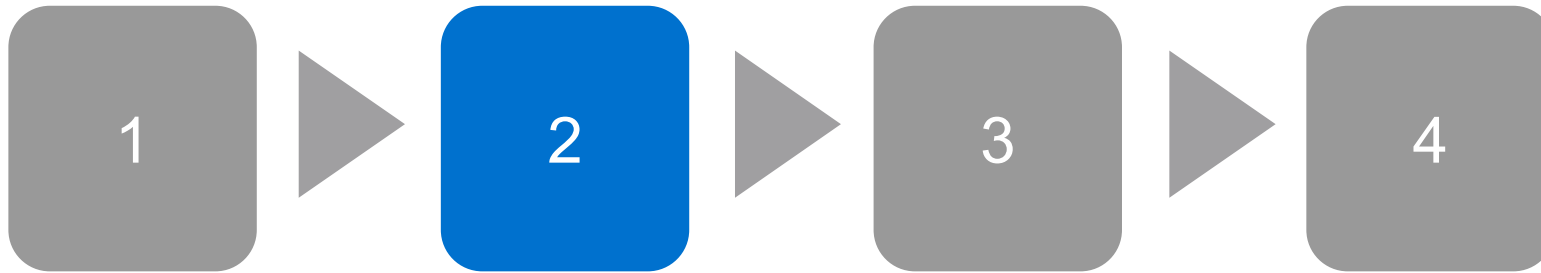Improving the "Engineering capability" of an organization thanks to MBSSE

Build useful models
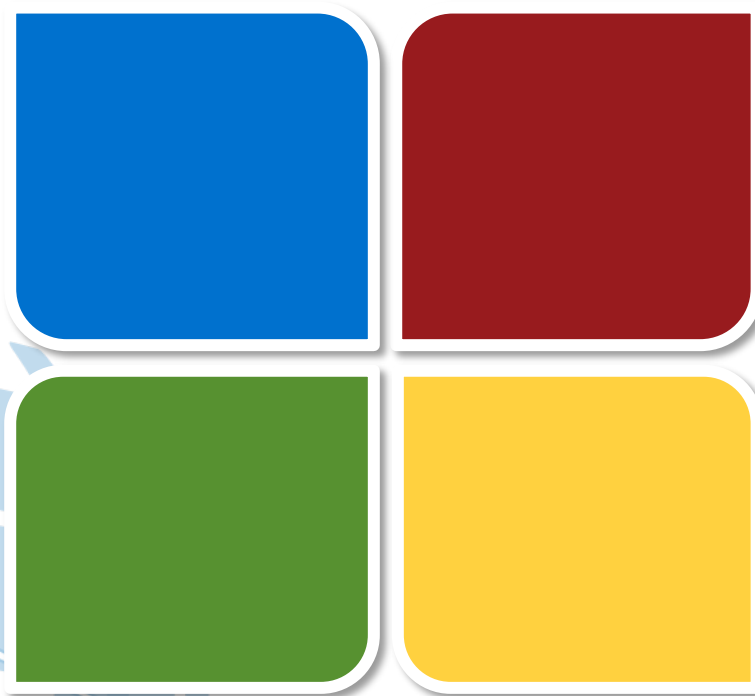
Continually improve knowledge on the system of interest

Provide only the required level of information

Collaborative modelling, targeting understandability among all stakeholders

MBSSE Reference model

Plan MBSSE

| Define the scope and objectives of MBSSE | Plan model development and governance | Plan resources and assets | Manage knowledge reuse |

Perform MBSSE

- Perform business and mission analysis
- Perform operational analysis
- Perform function analysis
- Perform system structure design
- Perform system analysis
- Perform domain design integration
- Perform system verification and validation

Build Models

| Produce system models | Verify models | Simulate systems using models |
| Produce discipline-specific models | Validate models | Make decisions using models |

Support Models

| Manage technical quality | Manage configuration | Manage data and models | Share models for collaboration |

Reference model & relationships

Plan MBSSE

Rules, syntax, semantics
Quality metrics

Build Models

Select SSE concerns to be addressed by models

Perform MBSSE

Produce system models

Produce discipline-specific models

Verify models

Simulate systems using models

Define plans to manage models and support modelling

Validate the coverage of SSE concerns

Validate models

Quality and monitoring metrics

Support Models

Provide predictions, decisions
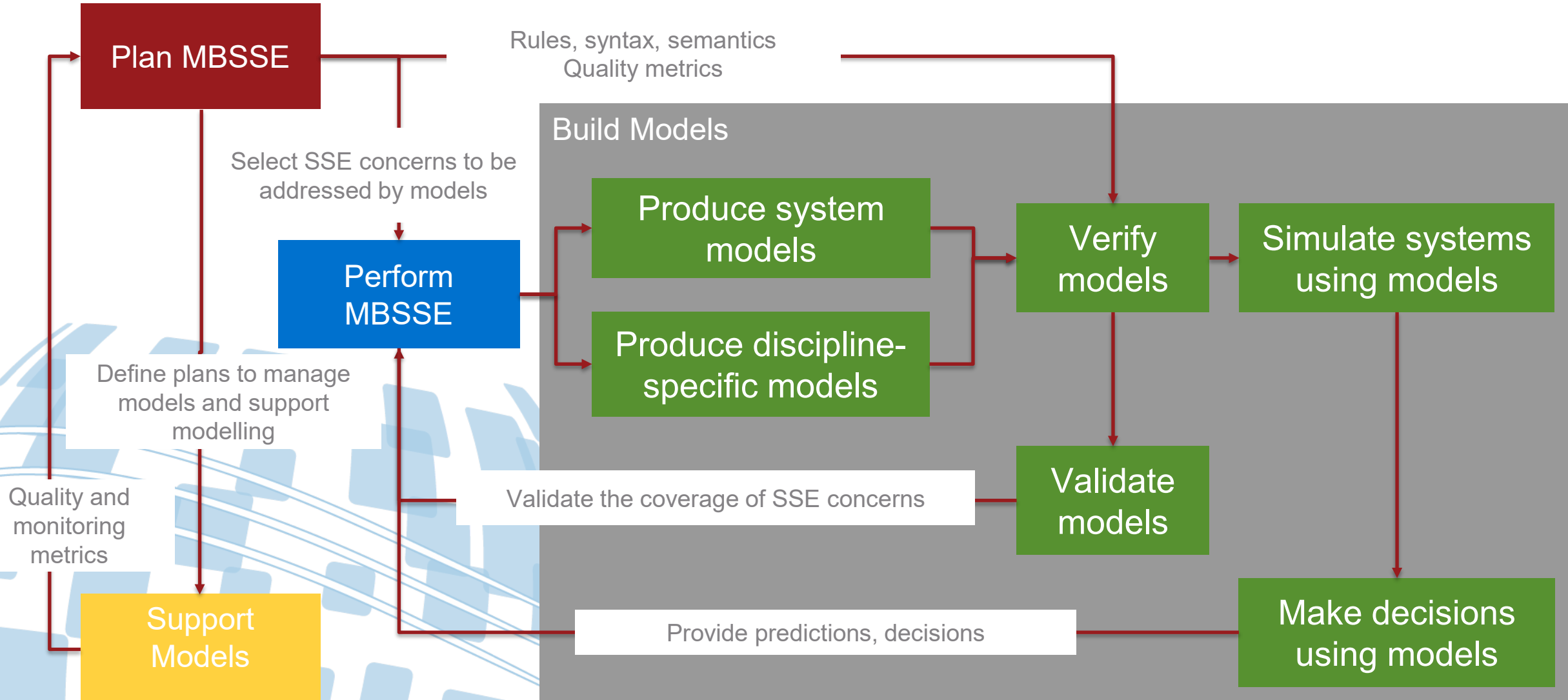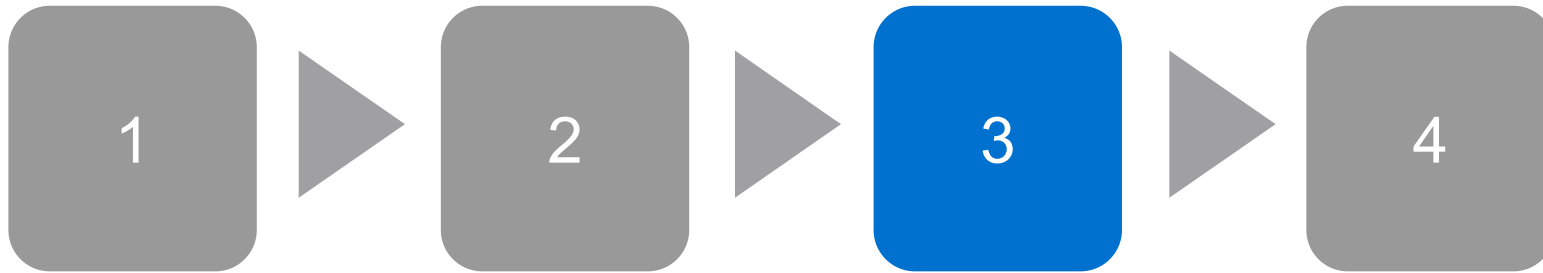
Make decisions using models

Conclusions & Perspectives

- Strengths

- Intended use

- Gaps

- Potential extensions

Strengths

- Address both system and software engineering activities towards "collaborative engineering" practices.
- Standardize the use of models right from the early stages of system development
- Forces to identify the value of models
- It covers, not only building models to describe systems architecture, but also all the other aspects as configuration management, maintenance, interoperability, etc.
- Gives a comprehensive view on the relations to other standards

Intended uses in Enterprises

- Considering as the entry point while applying MBSSE
- Models as the deliverable work products (as other HW/SW components)
- Reference in (contractual) documents as the source of good practices.
- Basis to define the MBSE governance
- Bringing extra rigor to the current MBSE practices

Gaps

- As the MBSSE processes are covered at a higher level, future projects are needed to cover the gaps

- Physical or hardware modelling aspects are not enough addressed (e.g. size, habitability, etc.)

- Relationship between Models and Textual requirements are not well covered

- Need to have a tailoring approach to adapt to different industries (translating common vocabulary, acronyms, etc. into company-specific)

System Model dimensions
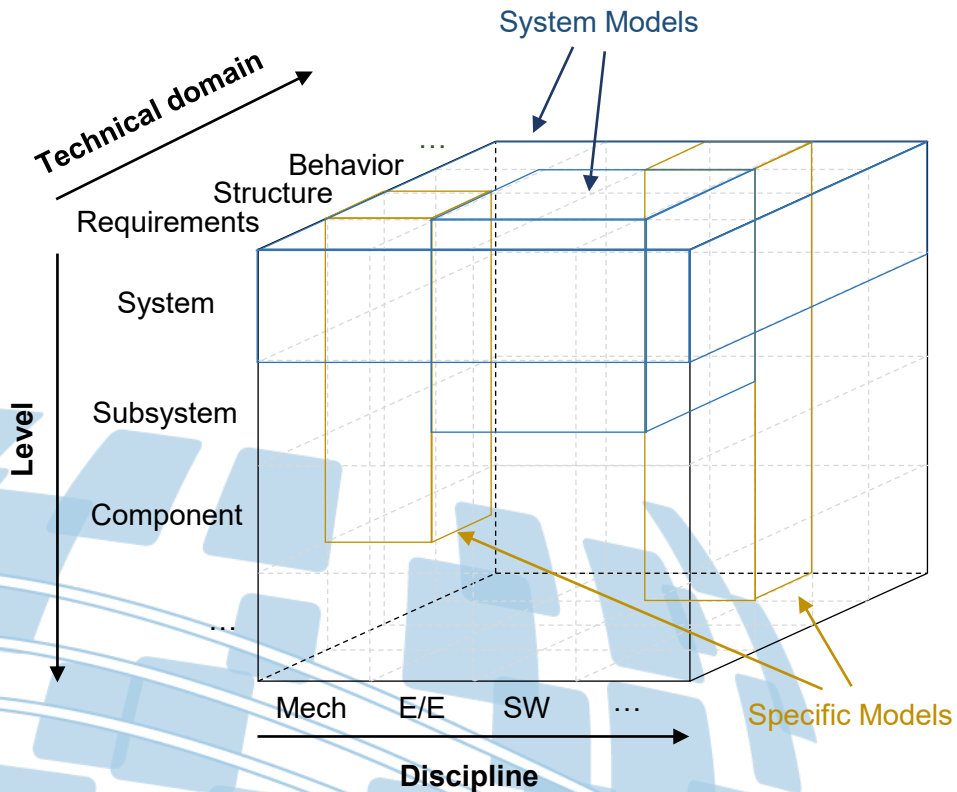
- Breadth: The disciplines involved in the development of a system (e.g., mechanics, electrics/ electronics, software, etc.)

- Width: Technical domains considered in the system development (e.g., requirement, structure, behavior, verification and validation, etc.).

- Depth: The degrees of detail of above dimensions on several levels through the system hierarchy.
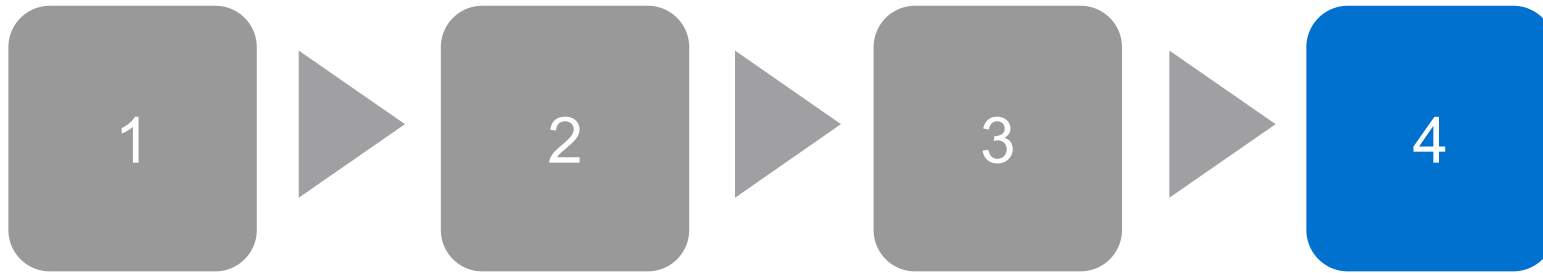
Source : Annex B.1

Potential future projects

- Model-Based digital continuity between System architecture and software design
- Model-Based digital continuity between System architecture and hardware design
- Model-Based system analysis, verification and validation by simulation
- MBSSE Model Evaluation Framework
- MBSSE Certification
- A Guide to ISO/IEC/IEEE 24641 (MBSSE)

Future project proposal

- Methods and tools for model-based system analysis by simulation

- Rationale:
  - Many standards exist to address a particular aspect of MBSSE as processes, methods, modeling languages …
  - ISO/IEC/IEEE 24641 standard covers overall processes at a higher level. The extensions are required to dig in to deeper in some MBSSE processes especially when we consider discipline specific models and the models related to common activities in perform MBSSE process area.
  - System analysis, verification and validation by simulation is one of the cross cutting area which needs further development.
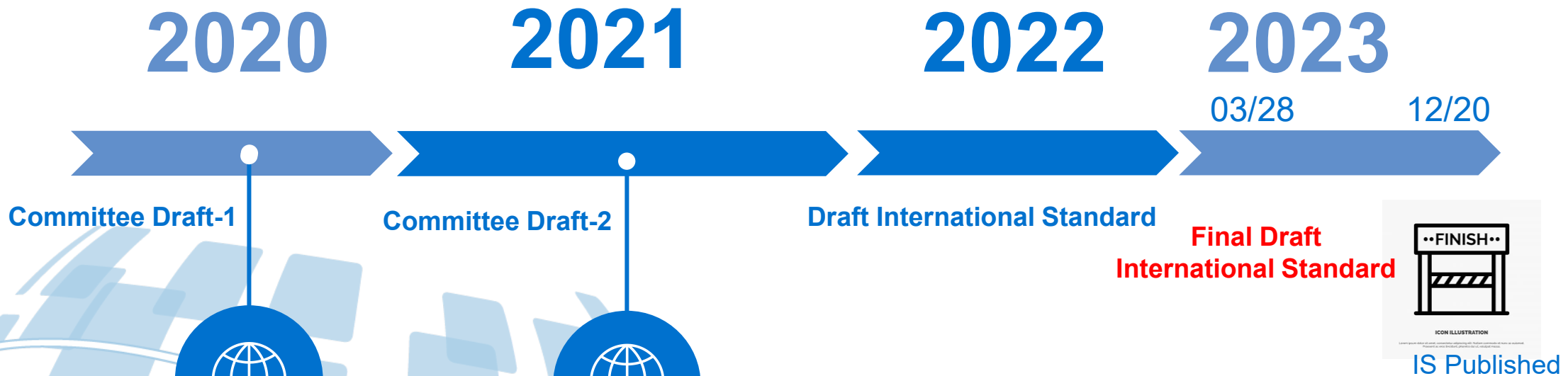
1 Introduction ▶ 2 Content Summary ▶ 3 Conclusion & perspectives ▶ 4 Status

ISO Draft Review Process

2020
Committee Draft-1

INCOSE WG

2021
Committee Draft-2

INCOSE WG

2022
Draft International Standard

2023
03/28   12/20

Final Draft International Standard

FINISH

ICON ILLUSTRATION

IS Published

Editors
Lalitha Abhaya
Eric Gauthier
Andrew Banks
Mark Henley

INCOSE WG
Jim Armstrong	Shelley Higgins
Barclay Brown	David Kaslow
John Brtis	Tony Komar
Steve Dam	Howard Lykins
Hyman Duan	Mark Malinoski
Brittany Friedland	Robert Malone
Robert Halligan	Kate Trase
David Hetherington	James Wetzex

28-janv.-23   www.incose.org/IW2023

Next Steps

- Prepare and circulate draft CRR of FDIS ballot results by the end of April, 2023.

- Feedback on draft CRR by the end of May, 2023.

- Review and discuss during 2023 Plenary meeting (4th to 9th of June – Okayama Japan).

- Prepare IS document by September 15, 2023.

2023
Annual **INCOSE**
international workshop
HYBRID EVENT
Torrance, CA, USA
January 28 - 31, 2023

www.incose.org/IW2023