RATIO-SIM

Rationalisation of Simulator Tools

March 2017

European Space Agency

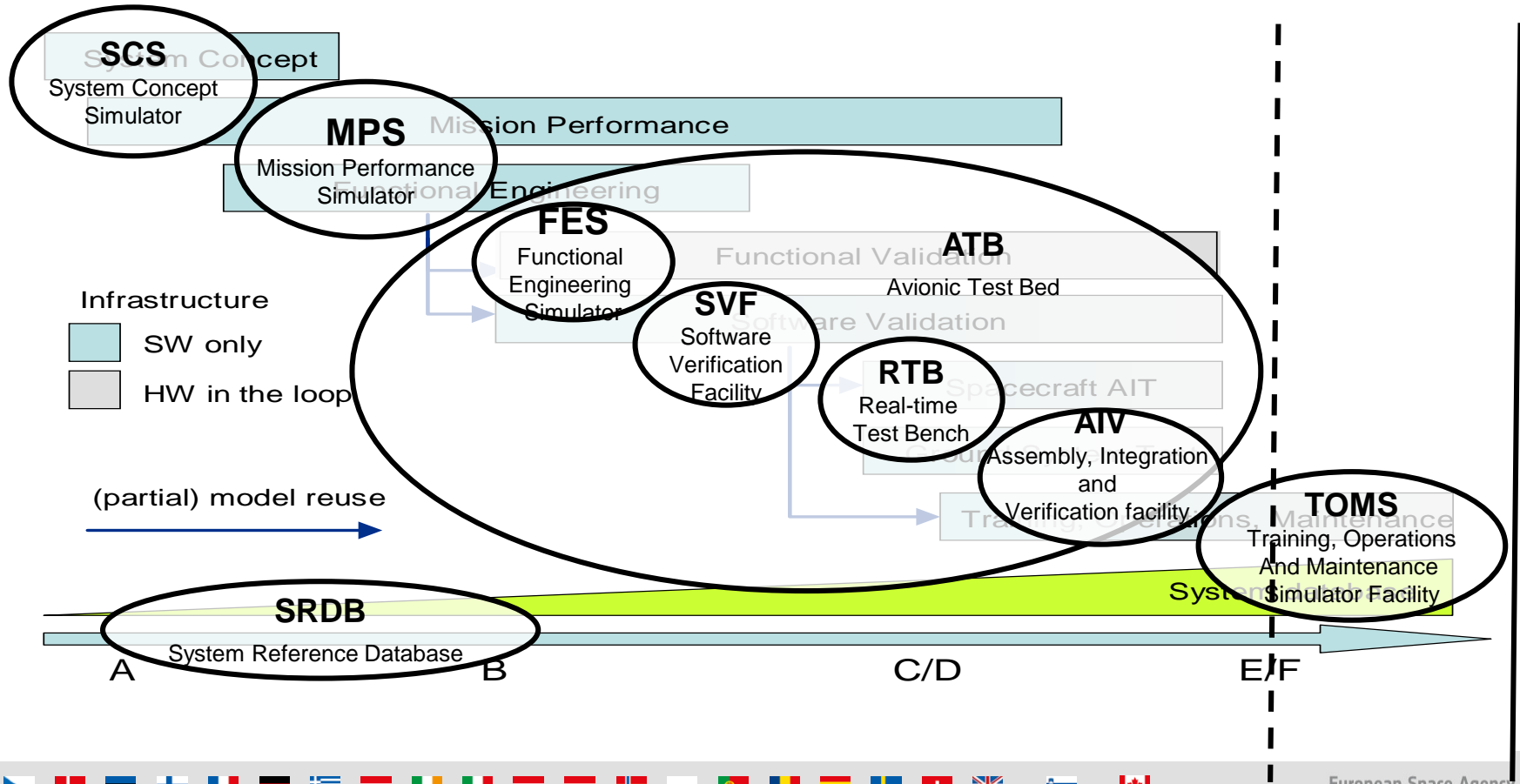# RATIO-SIM Interactive Session Content

- **Introduction**
  - Objective/General Scope
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  - Additional future needs
  - Possible options, improvements/benefits
  - Context for scoping
  - Challenges/Next steps
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- **Interactive Session**
- **Short summary**

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RATIO-SIM: Objective

Alignment of simulation tools in the European Space Domain, to allow for a **smooth model-based process** underlying the different **ETM 10-21 System Simulator Infrastructures** supporting the project life cycle (cross-tool building block exchange):

- <u>Improvement</u> of overall functionality and quality while reducing cost and development time and increase the commercial viability. Building blocks could be existing or newly developed - could be COTS or made open source - could have license that allow for adaptations or extensions.

- <u>Obsolescence</u>: current Simulation infrastructures (EuroSim, SimSat, SimTG, K2, Basiles etc.) are more than 10 years old, some technology is not first choice anymore, costly to maintain

For this activity all the **major stakeholders** need to be consulted, committed and involved. This means the Primes (Airbus, Thales, OHB, ...), Agencies (CNES, DLR, ESTEC/ESOC, ...) and some SMEs (EuroSim Consortium, ...) or Vendors.

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RATIO-SIM: General scope

Infrastructure
- SW only
- HW in the loop

(partial) model reuse

SCS — System Concept Simulator

System Concept

MPS — Mission Performance Simulator

Mission Performance

Functional Engineering

FES — Functional Engineering Simulator

Functional Validation

ATB — Avionic Test Bed

SVF — Software Verification Facility

Software Validation

RTB — Real-time Test Bench

Spacecraft AIT

AIV — Assembly, Integration and Verification facility

TOMS — Training, Operations And Maintenance Simulator Facility

Training, Operations, Maintenance

System Validation

SRDB — System Reference Database

A   B   C/D   E/F

ESA UNCL

Current status

Facility chain: due to the differences in their Use-Cases (and related specifications) and the complex Customer and Supplier Project settings in the space domain, today no single facility can exist

Tool chain: connection and alignment of different modelling and simulation tools

In house solutions: bespoke proprietary components with dedicated interfaces which are non-standardized (on European level) supporting

Heterogeneous/overlapping tools: number of partly overlapping tools and components which are either commercial, in-house built or shared tools within a small community.

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Additional future needs

- Increased onboard autonomy: AI, flexible/adaptable self-learning systems
  - requiring simulators to train and to verify a non-deterministic system

- System of Systems: relatively large, complex and connected systems

- CubeSats: low cost, more complex missions with new or non-space equipment/solutions.

- Exploration, Human Space: high cost, more complex missions
  - Mars robotic and human (orbital and surface) missions
  - Lunar missions
  - Asteroid robotic and human missions
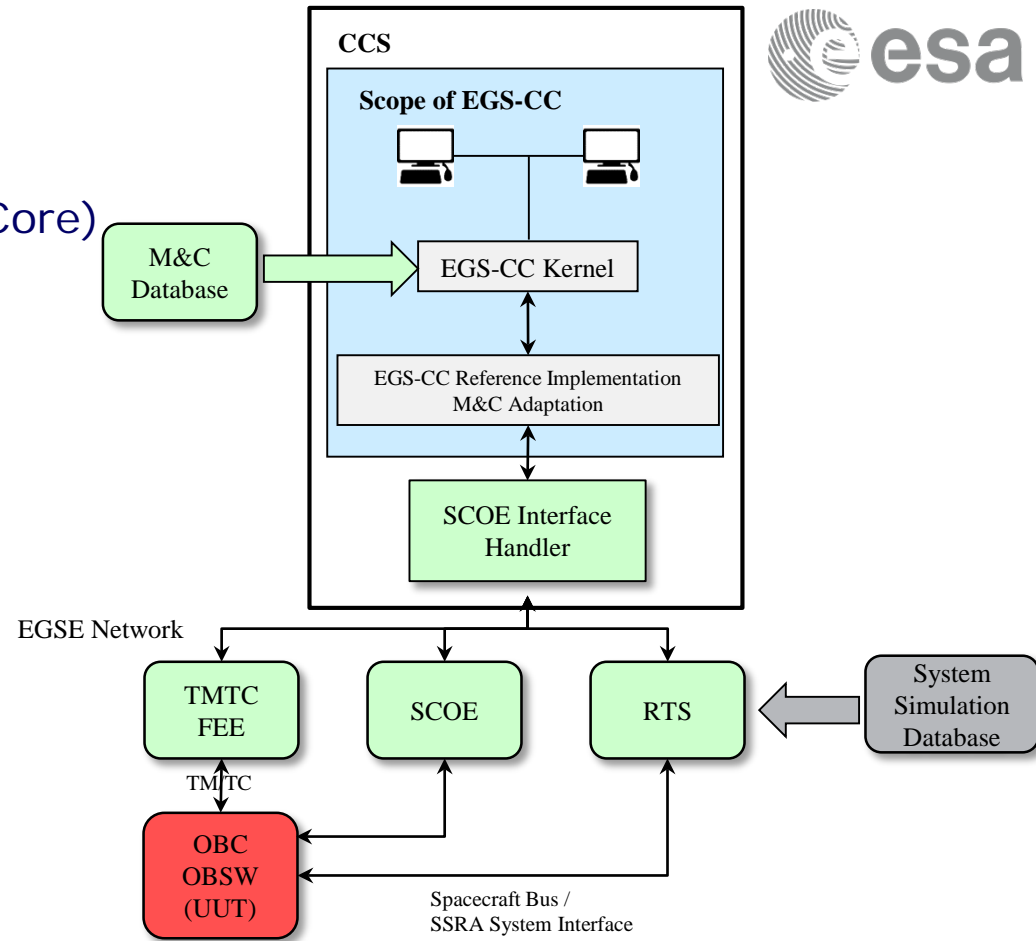
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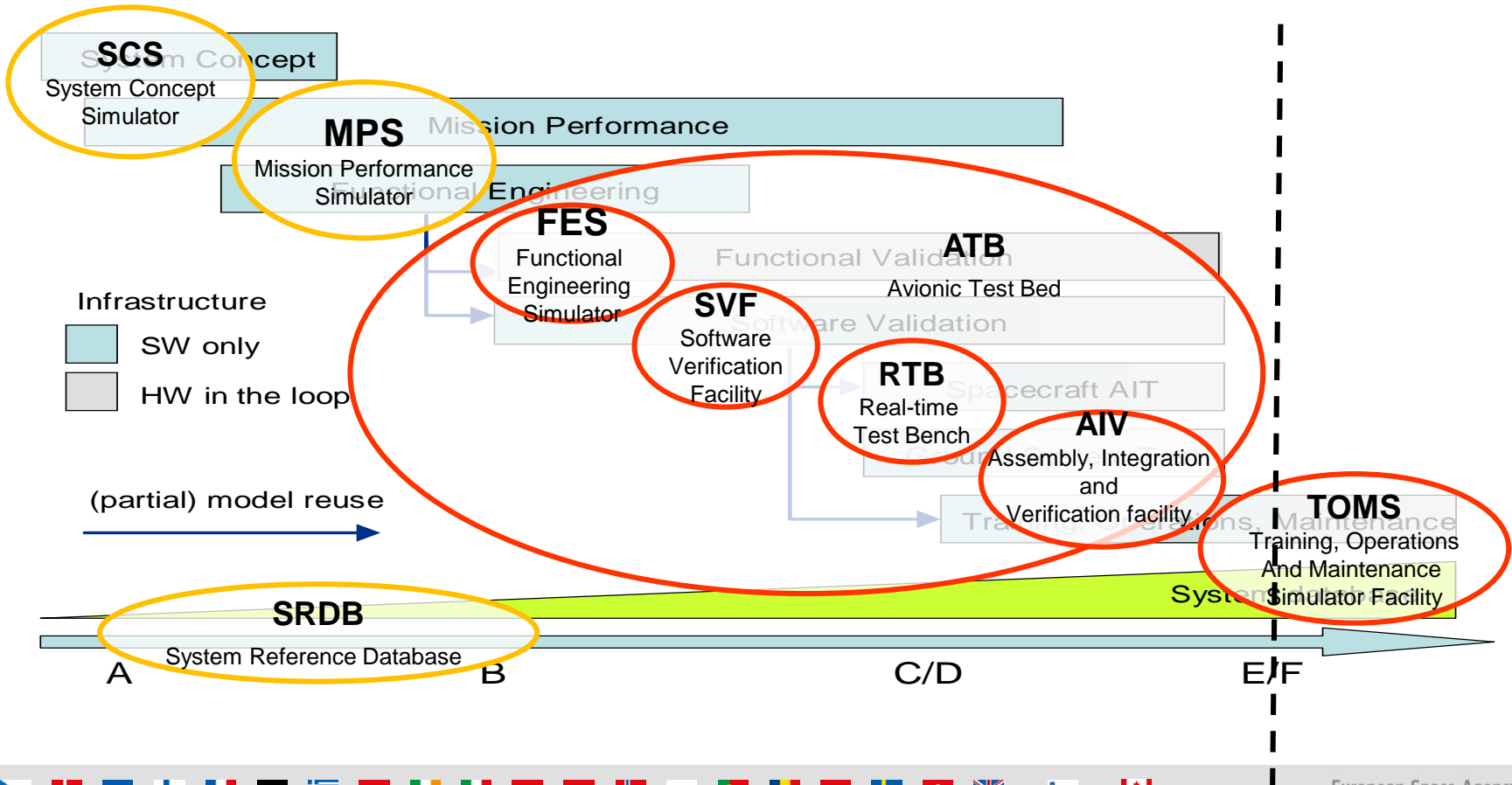
Improvements/benefits

- Migration into Digital Engineering
- Standards on:
  - Model re-use/exchange: SMP (FMI) and REFA/SSRA
  - Interfaces: EDS (Electronic Datasheets)
  - Data formats: TDE (Timeline Data Exchange)
- Bring simulators to FlatSat (simulator in the box)
- MBSE link: support of overall V&V process,
- SAVOIR execution platform
- Heterogeneous Modeling (Modelica)
- Smart GUIs, Virtual Person Assistants
- Open source?
- Cloud computing, Parallel computing and Distributed simulators (HLA/DIS)
- Collaborative and remote testing

Possible option

- Compatibility or re-use of EGS-CC
(European Ground System Common Core)

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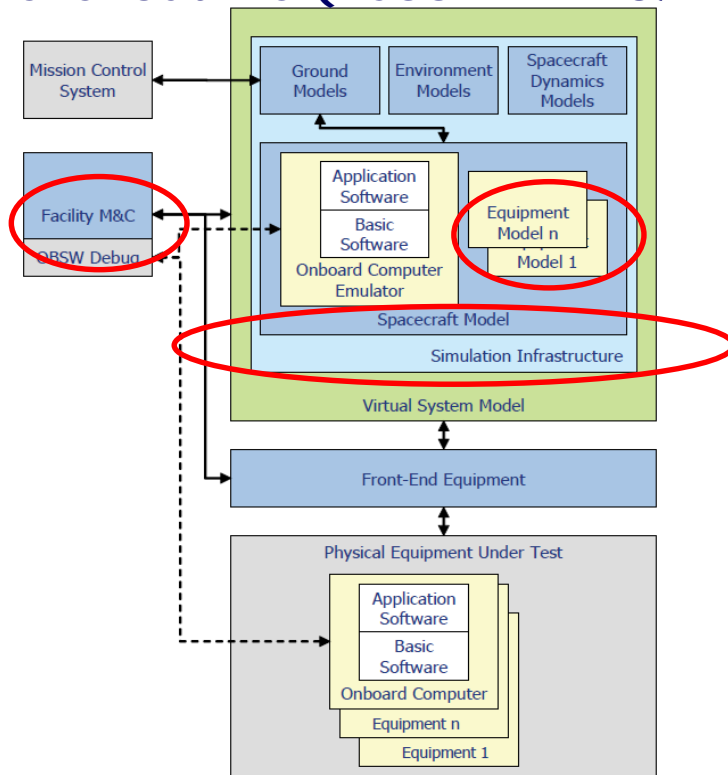# RATIO-SIM: Context for scoping project lifecycle

RATIO-SIM: Context for scoping, architecture

SVF-HIL toplevel outline (ECSS-ETM-10/21)
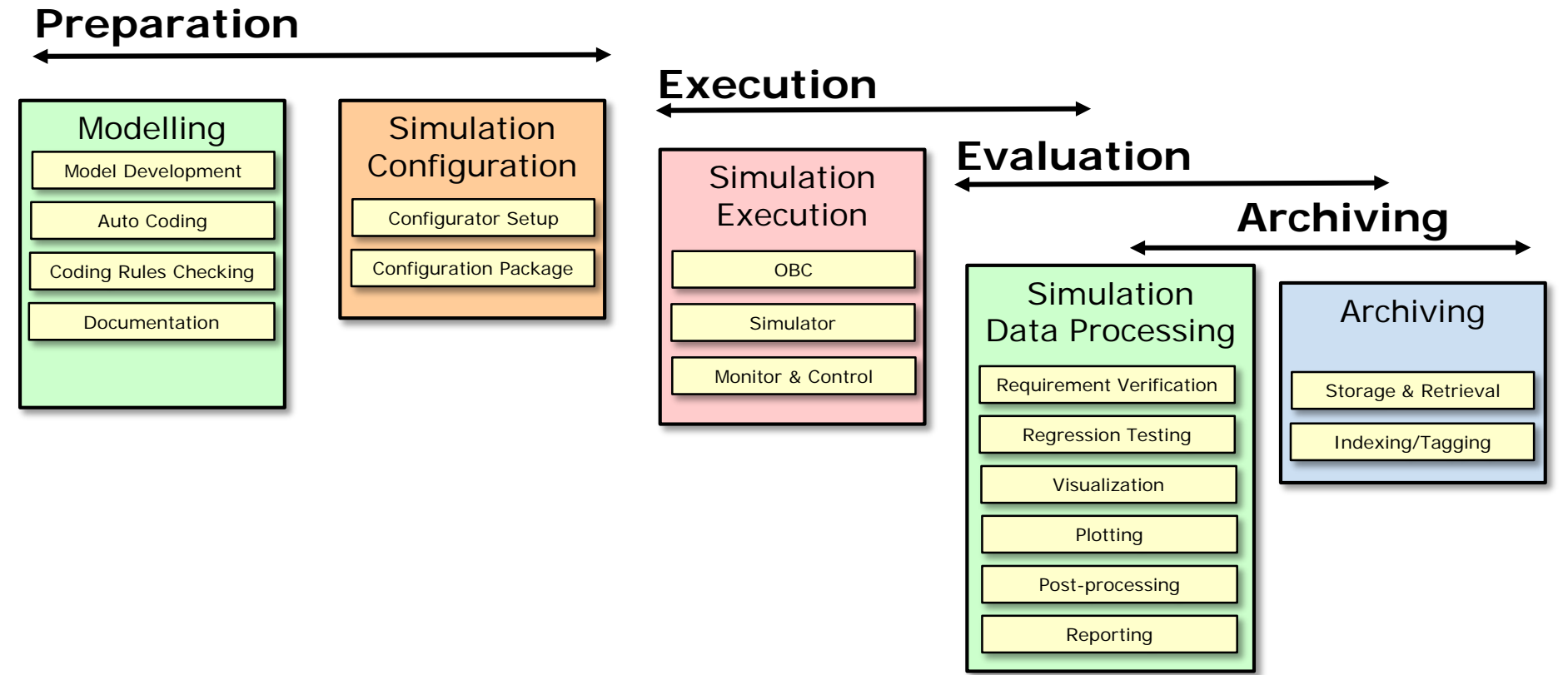

CCS/MCS infrastructure tooling
- EGS-CC
- TSC,
- SCOS-EGSE,
- ...

Simulation infrastructure tooling
- EuroSim,
- SimSat,
- Basiles,
- SimTG,
- Rufos,
- ...
- Synchronisation
- Performance

RATIO-SIM: Context for scoping, workflow stage

Preparation

Execution

Evaluation

Archiving

Modelling
- Model Development
- Auto Coding
- Coding Rules Checking
- Documentation

Simulation Configuration
- Configurator Setup
- Configuration Package

Simulation Execution
- OBC
- Simulator
- Monitor & Control

Simulation Data Processing
- Requirement Verification
- Regression Testing
- Visualization
- Plotting
- Post-processing
- Reporting

Archiving
- Storage & Retrieval
- Indexing/Tagging

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RATIO-SIM: Challenges

- Simulators are a **strategic** important technology
- Foreseen stakeholders operate in a **competitive** business environment for which large investments have been made in the past.
- New technologies have to be proven, product **maturation** takes time
- Not be easy to achieve technical as well as programmatic **consensus**, many stakeholders with different interests.
- Different organizational units (within same company) may see their **benefits** in different areas

RATIO-SIM: Next steps

- Individual workshops with stakeholders.
- **SESP Interactive Session**
- Setup of Preparation study to define scope, requirements and organization
- Development(s) activities will follow

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