31st Annual INCOSE international symposium
virtual event
July 17 - 22, 2021

UAF (Unified Architecture Framework) Based MBSE (UBM) Method to build a System of Systems Model

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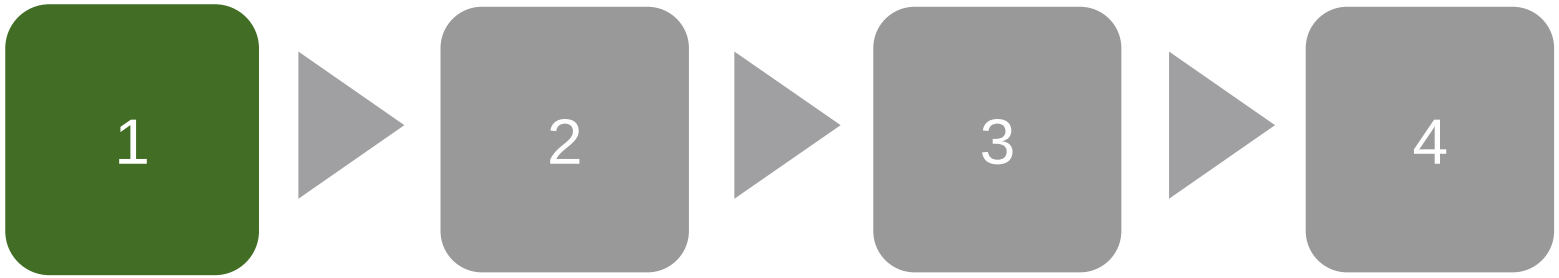
Agenda

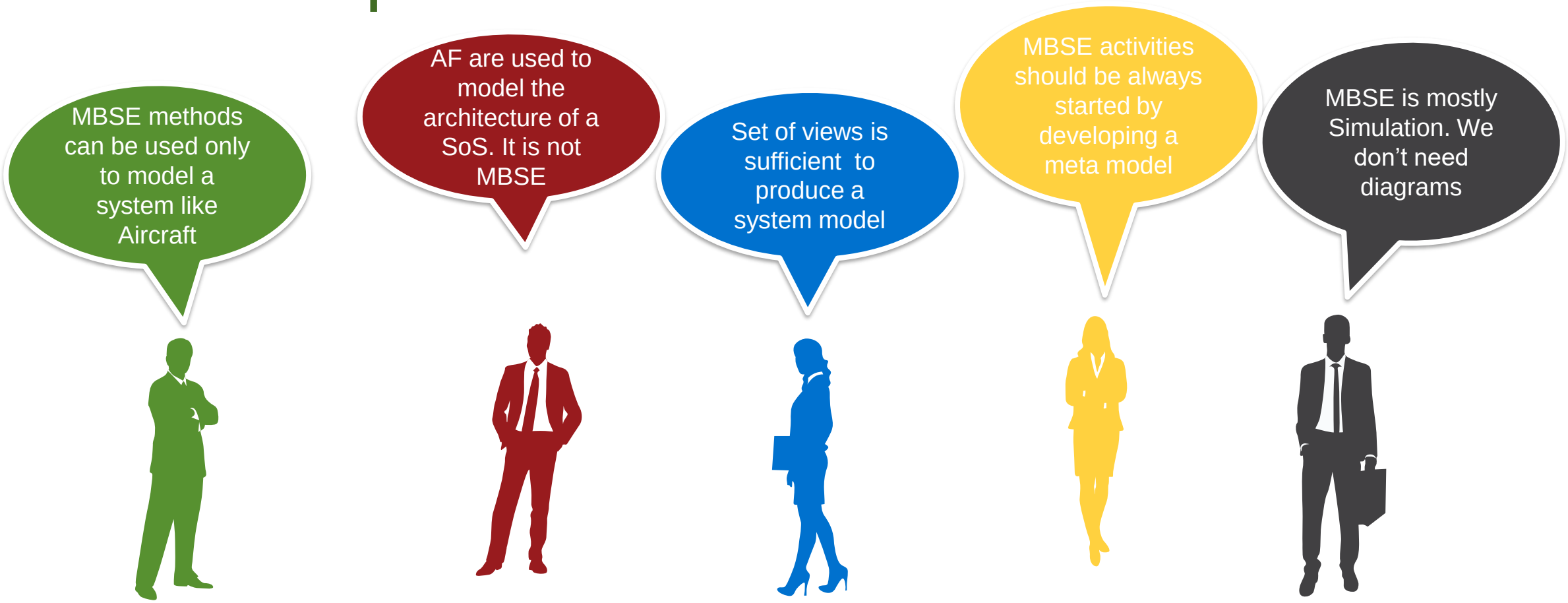


Why? What? How? Conclusion

Why?

- Clarify misconceptions
- Answer the questions
- Address needs

Misconceptions

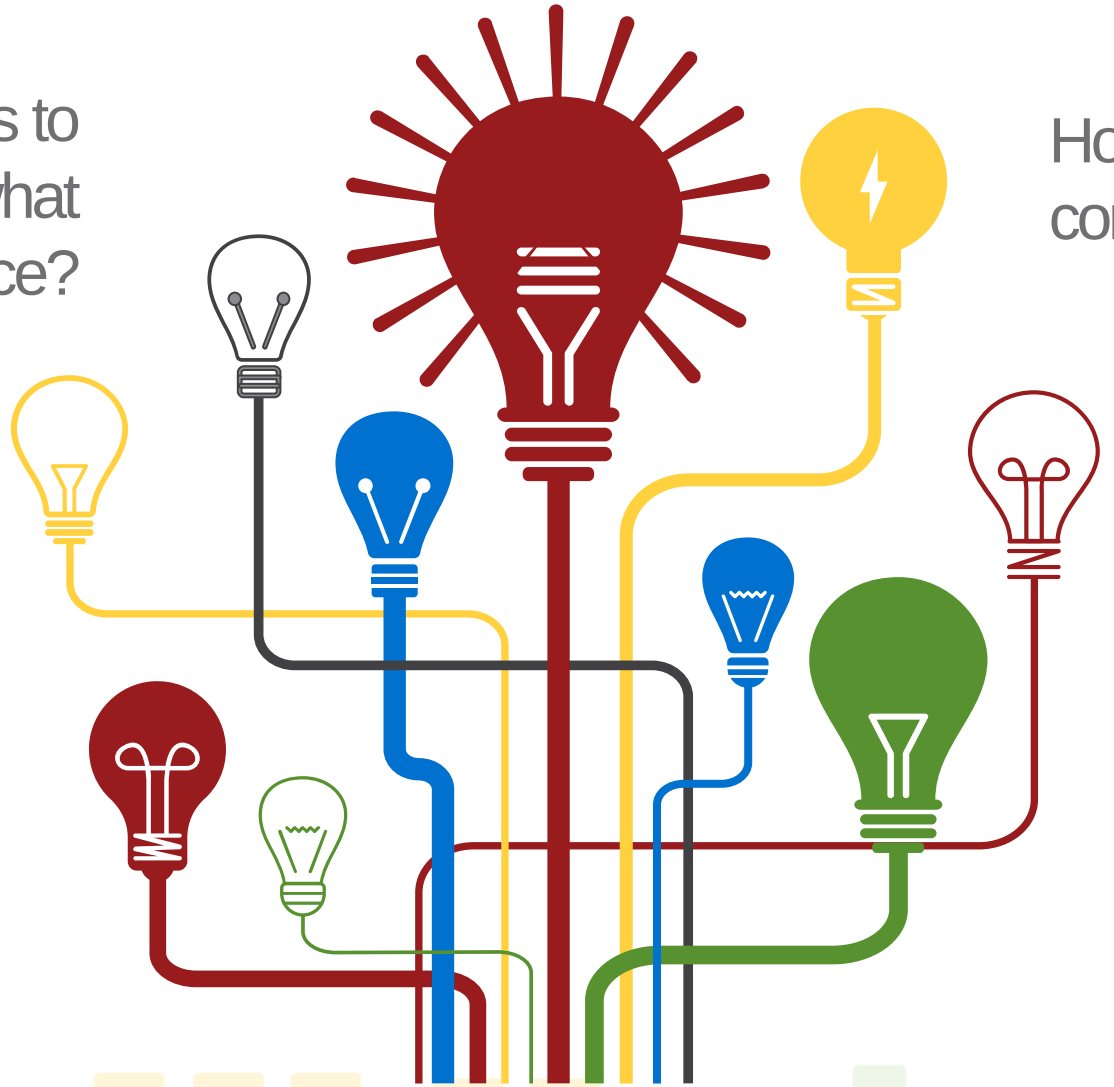


Questions

Which activities to be done in what sequence?

How to structure the model?

Which artifacts to deliver?



How to ensure consistency?

How to manage models?

How to communicate & collaborate?

Needs

Deliverables

Customer requests NAF Views within deliverables

SoS

Organization wants to design a complex SoS, on time, on quality.

Meta-Model

Partners understand models which conform to standard military AF/Domain models

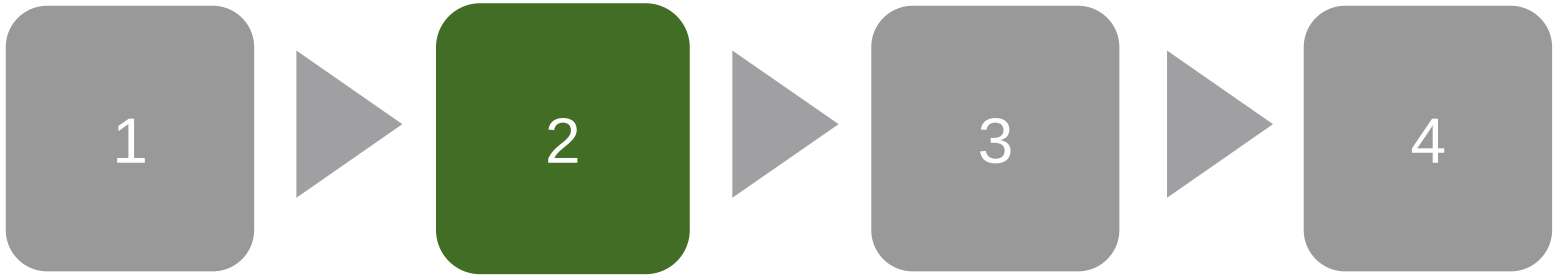
Tools

IM team needs to increment tool versions with less constraints

Tailoring

SE requires guidance to select model elements/Views

Agenda



Why? **What?** How? Conclusion

UBM Method Overview

Mission Analysis & Design

Operational Analysis & Design

Iterative & Recursive

Functional Analysis & Design

Logical Structure Design

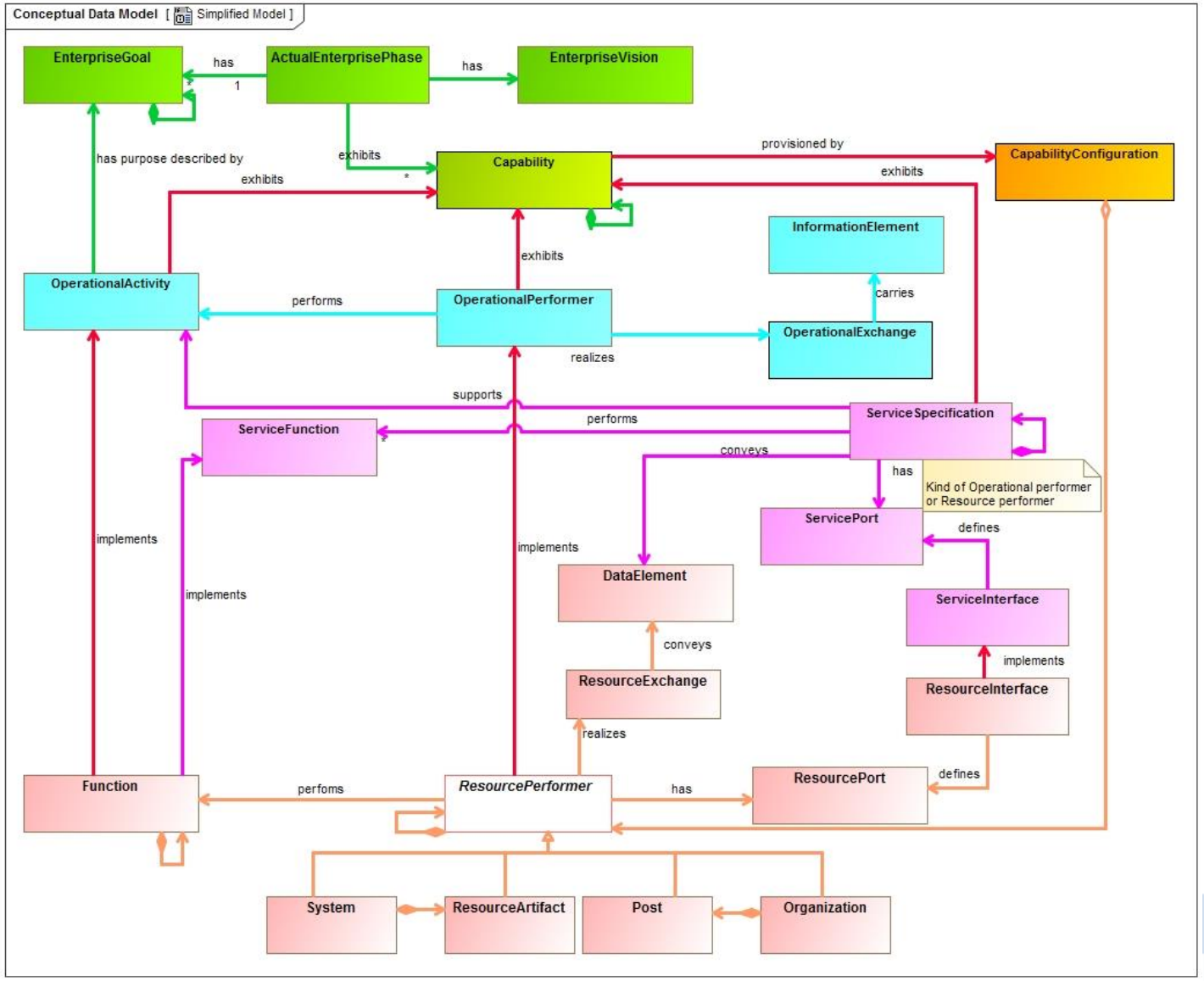
System Physical Design

Which activities to be done in what sequence?

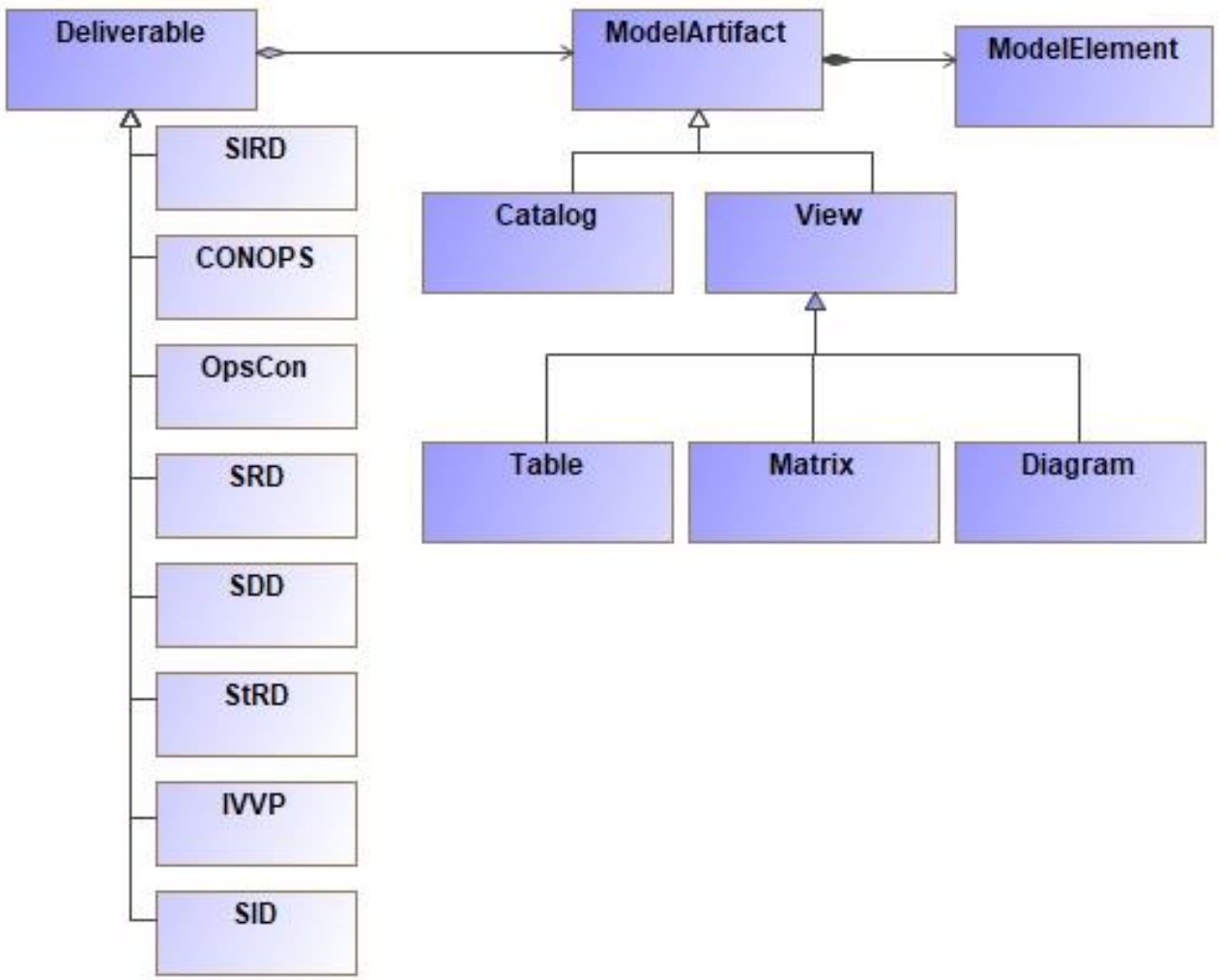
Selected elements from UAF domain model

How to structure the model?

How to ensure consistency?

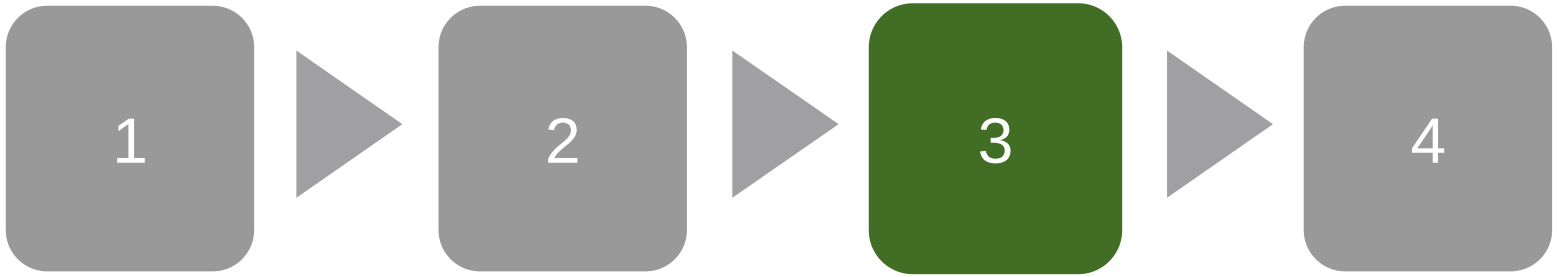


Deliverable Model



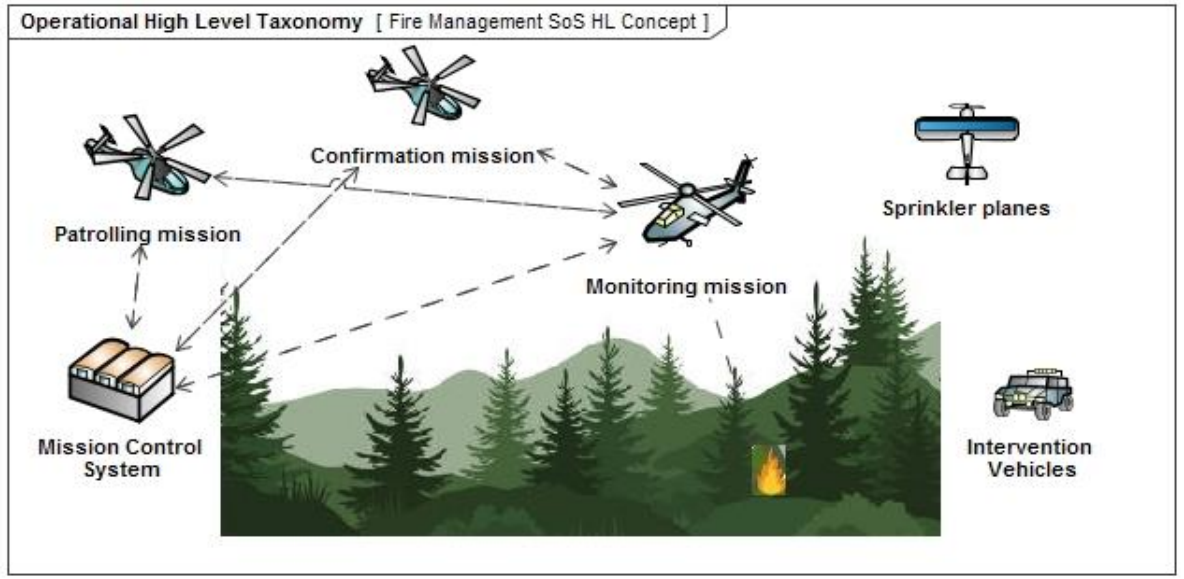
Which artifacts to deliver?

Agenda



Why? What? How? Conclusion

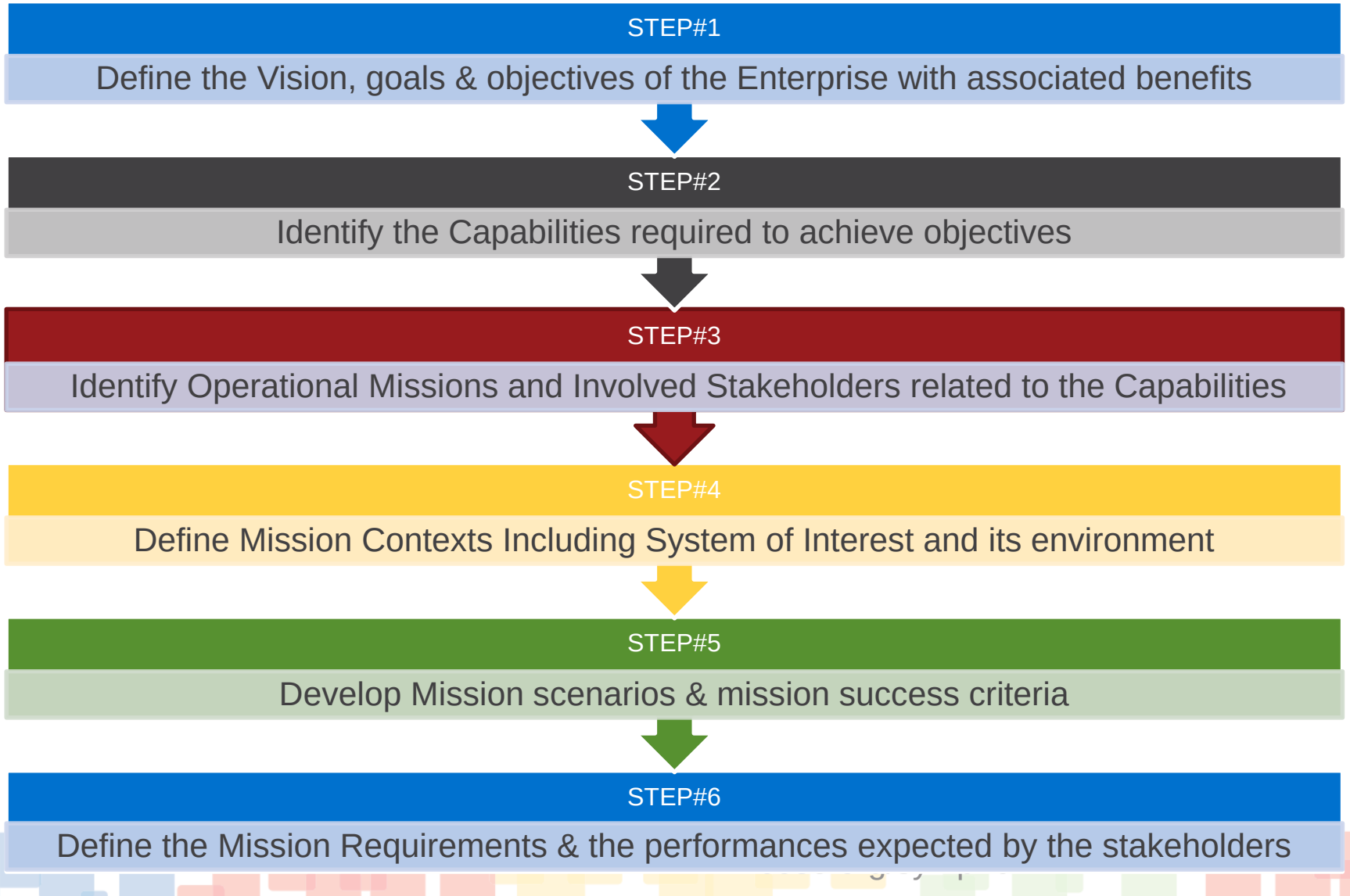
Example



Multi-UAV Forrest Fire Management SoS

When patrolling, a UAV suspects or detects a fire.
Then the mission of the UAV is modified to a confirmation mission or it is assigned to another UAV.
One UAV with sufficient loitering capabilities monitors the fire.
Mission control system coordinates missions, forecast fire evolution and order intervention

Mission Analysis & Design

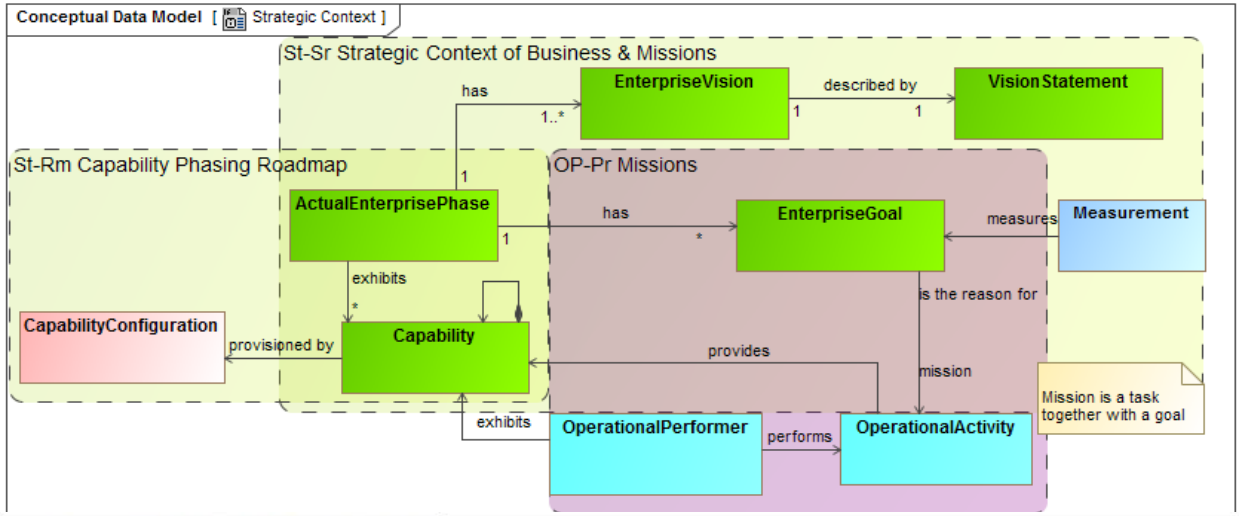


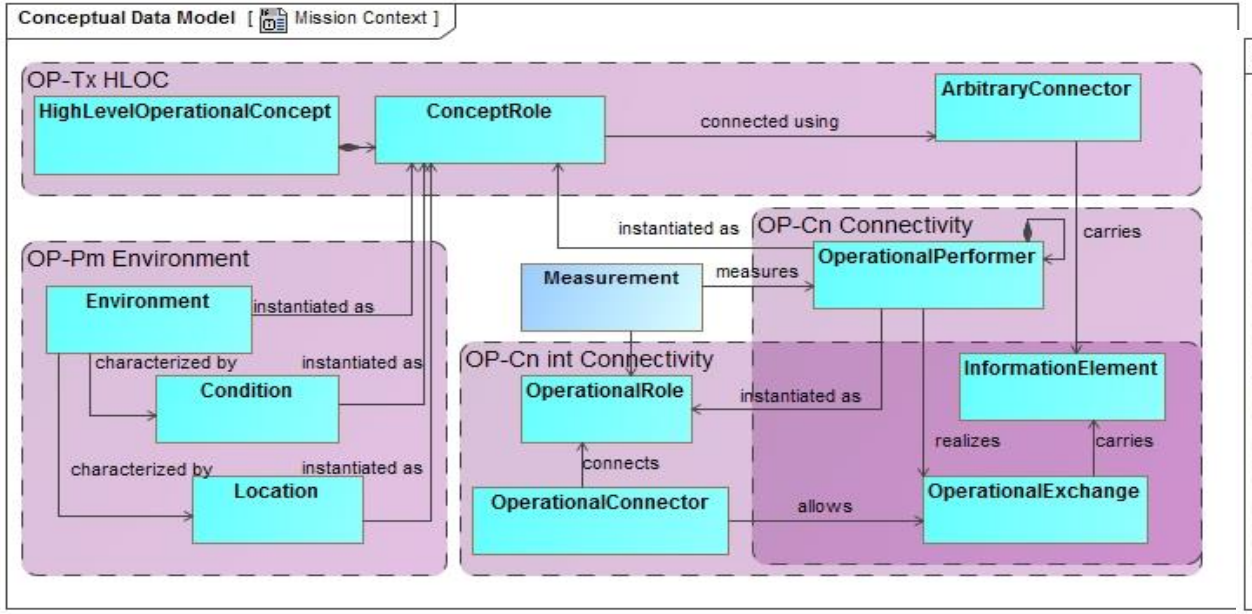
Strategic View point

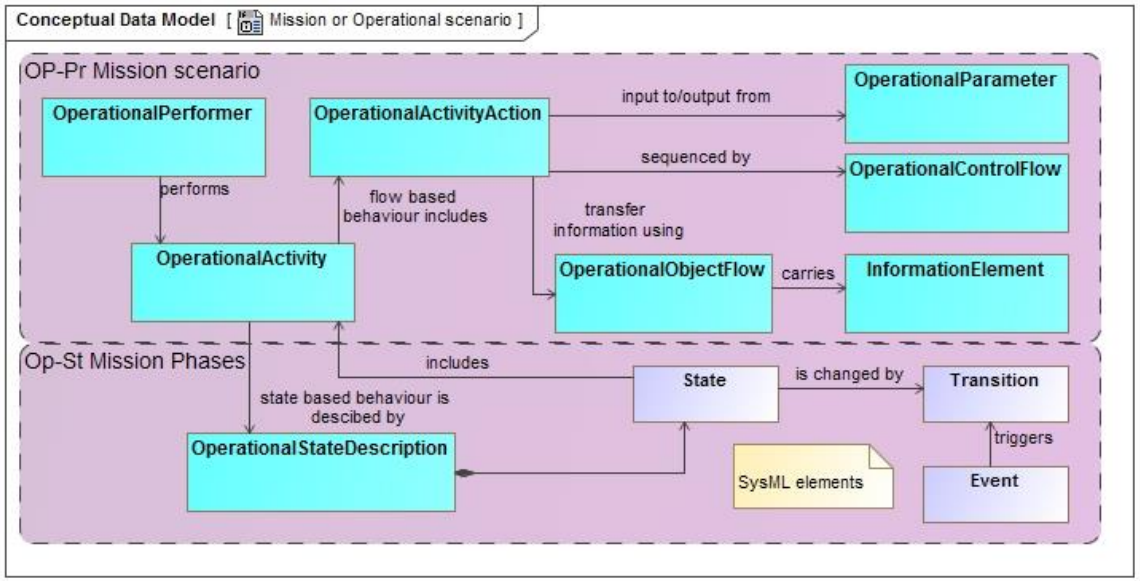
Focus : Mission

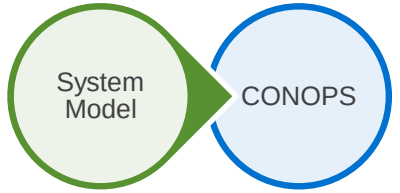
Operational View point

Mission Analysis & Design







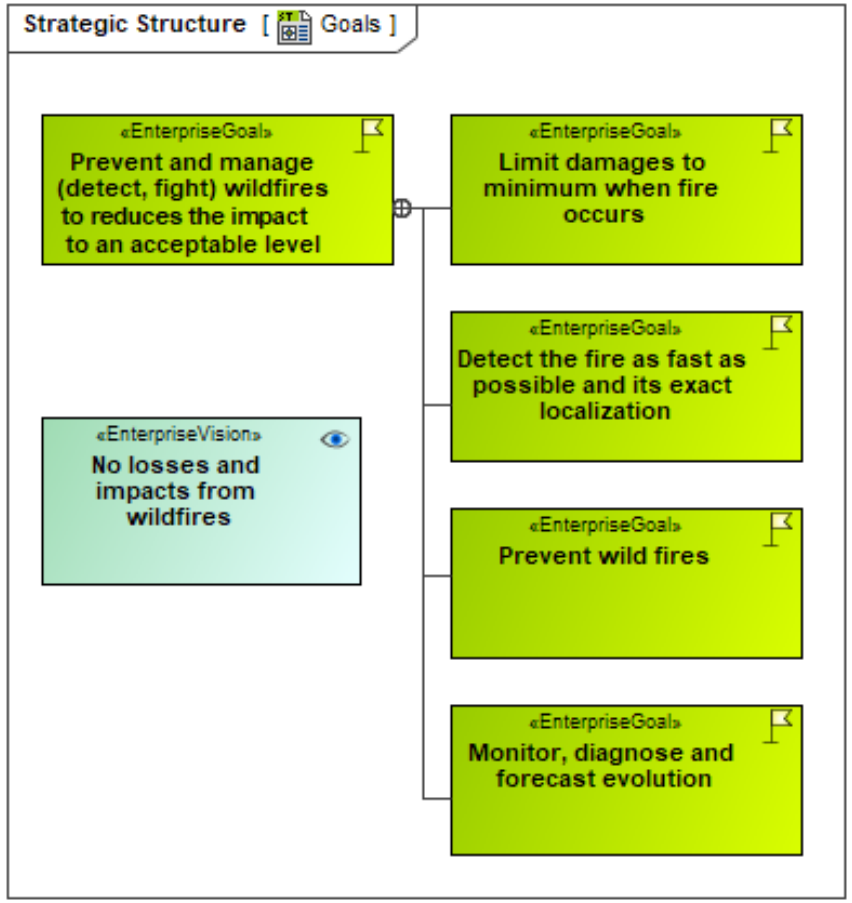


- Goals
- Capabilities
- Capability Gaps
- Stakeholders
- Missions & mission success criteria
- Requirements

- St-Sr
- St-Rm
- OP-Pr
- Traceability matrixes

Mission Analysis & Design

Goals & Capabilites

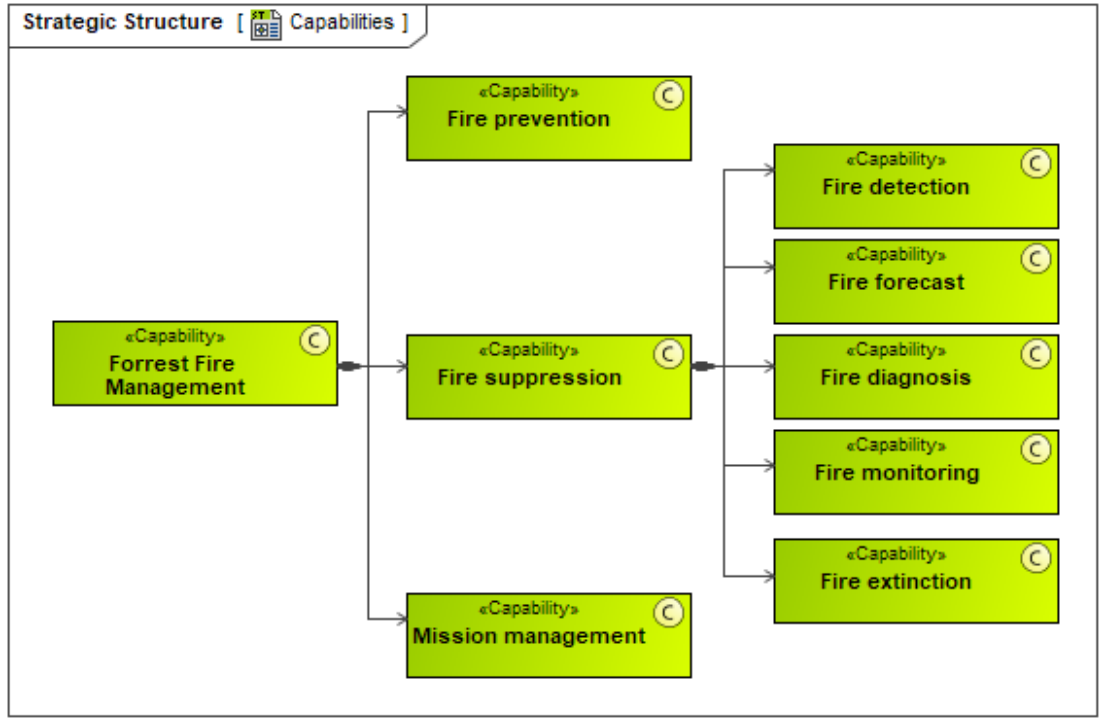


STEP#1

Define the Vision, goals & objectives of the Enterprise with associated benefits

STEP#2

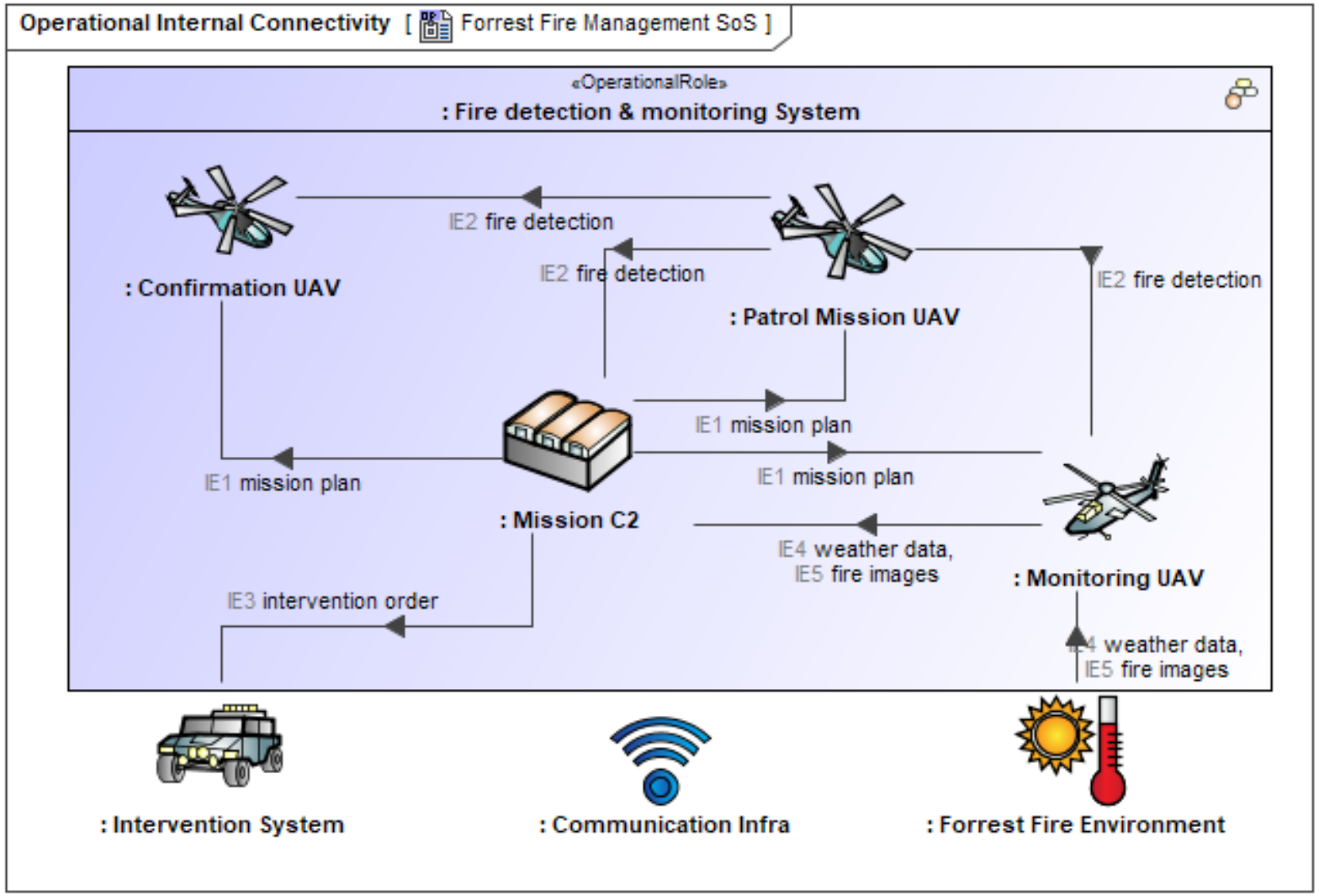
Identify the Capabilities required to achieve objectives



- Goals
- Capabilities
- Capability Gaps

Mission Analysis & Design

Mission Context



STEP#3

Identify Operational Missions and Involved Stakeholders related to the Capabilities

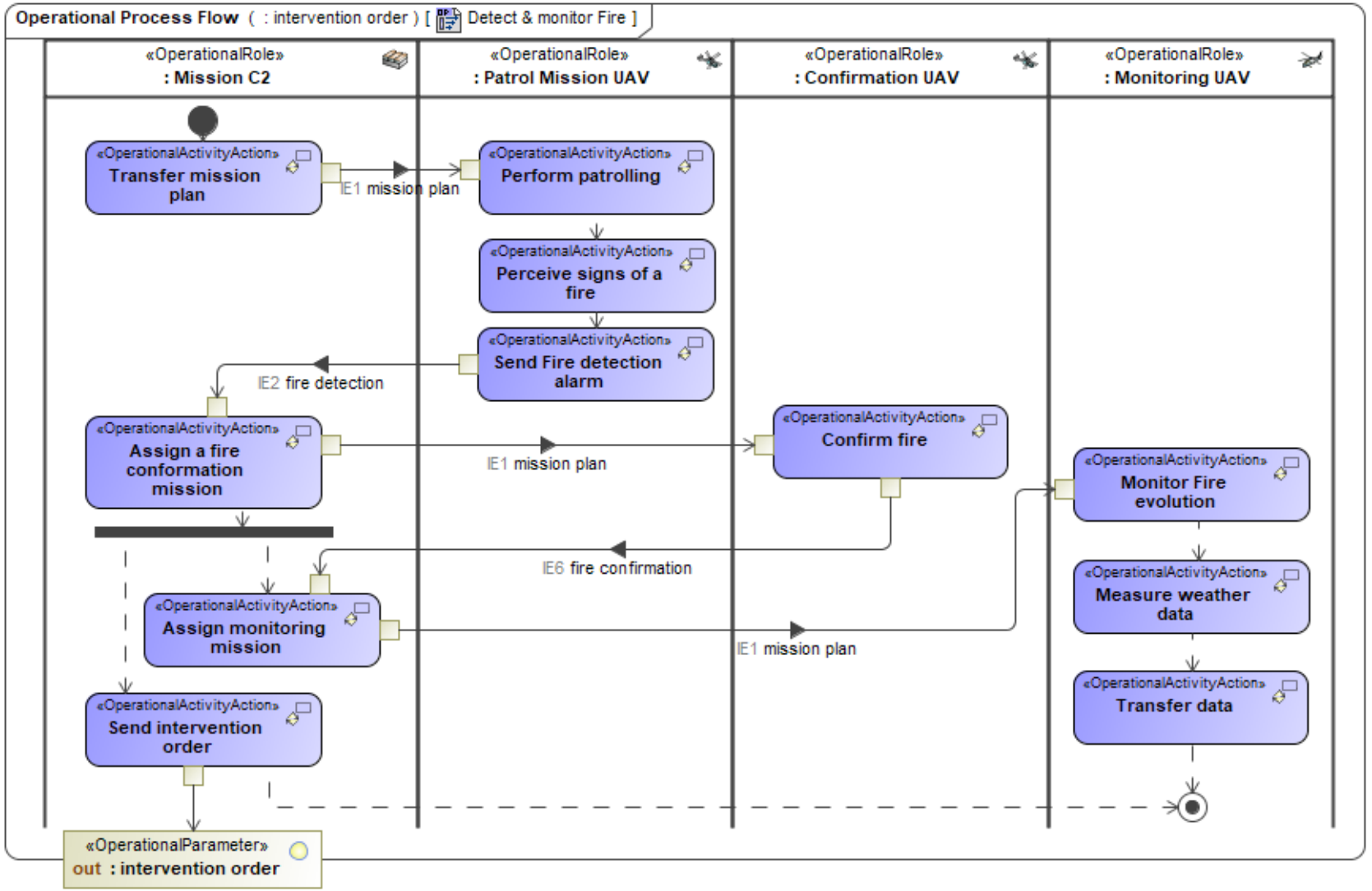
STEP#4

Define Mission Contexts Including System of Interest and its environment

- Stakeholders
- Missions

Mission Analysis & Design

Mission scenarios



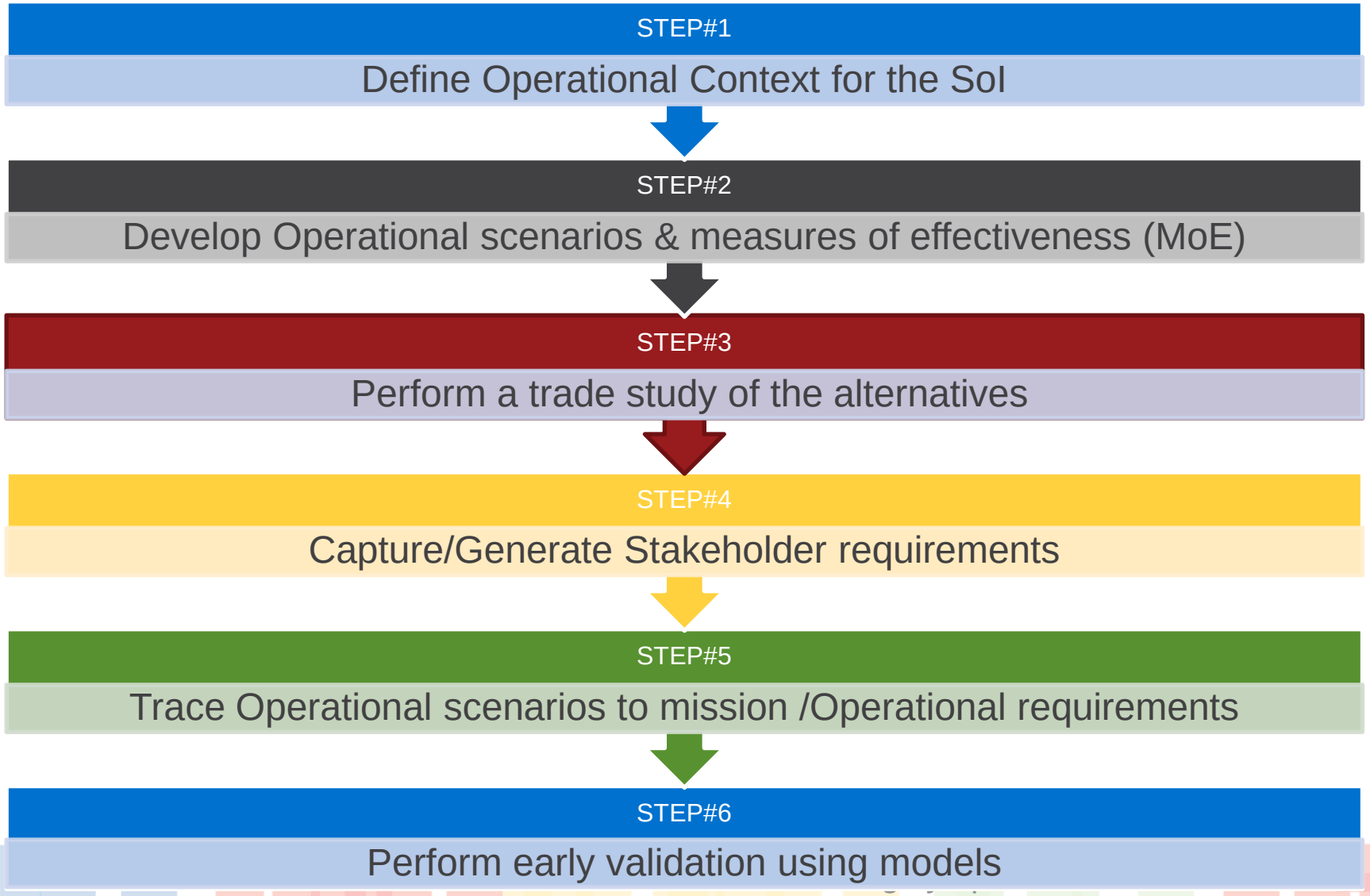
STEP#5

Develop Mission scenarios & mission success criteria

STEP#6

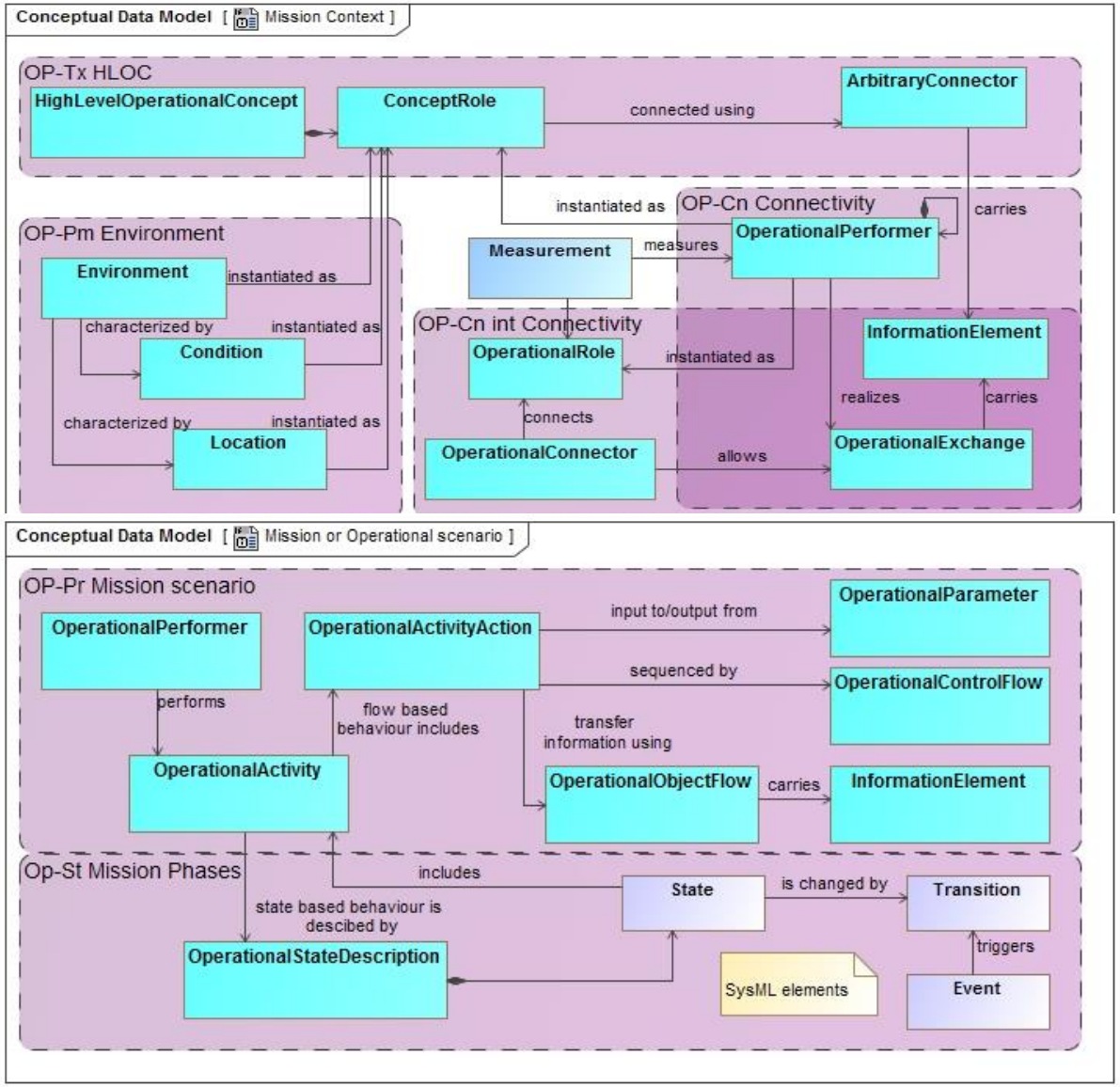
Define the Mission Requirements & the performances expected by the stakeholders

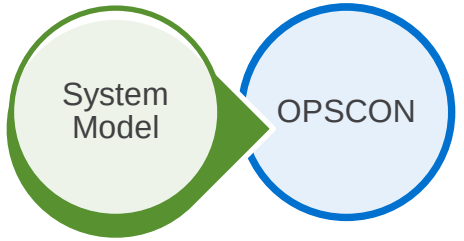
Operational Analysis & Design



Focus : System throughout the Life Cycle

Operational Analysis & Design





- Goals
- Capabilities
- Capability Gaps

- Stakeholders
- Missions & mission success criteria
- Requirements

- Use cases
- Operational activities
- Operational scenarios

- OP-Cn
- OP-Pr
- Traceability matrixes

Operational Analysis & Design

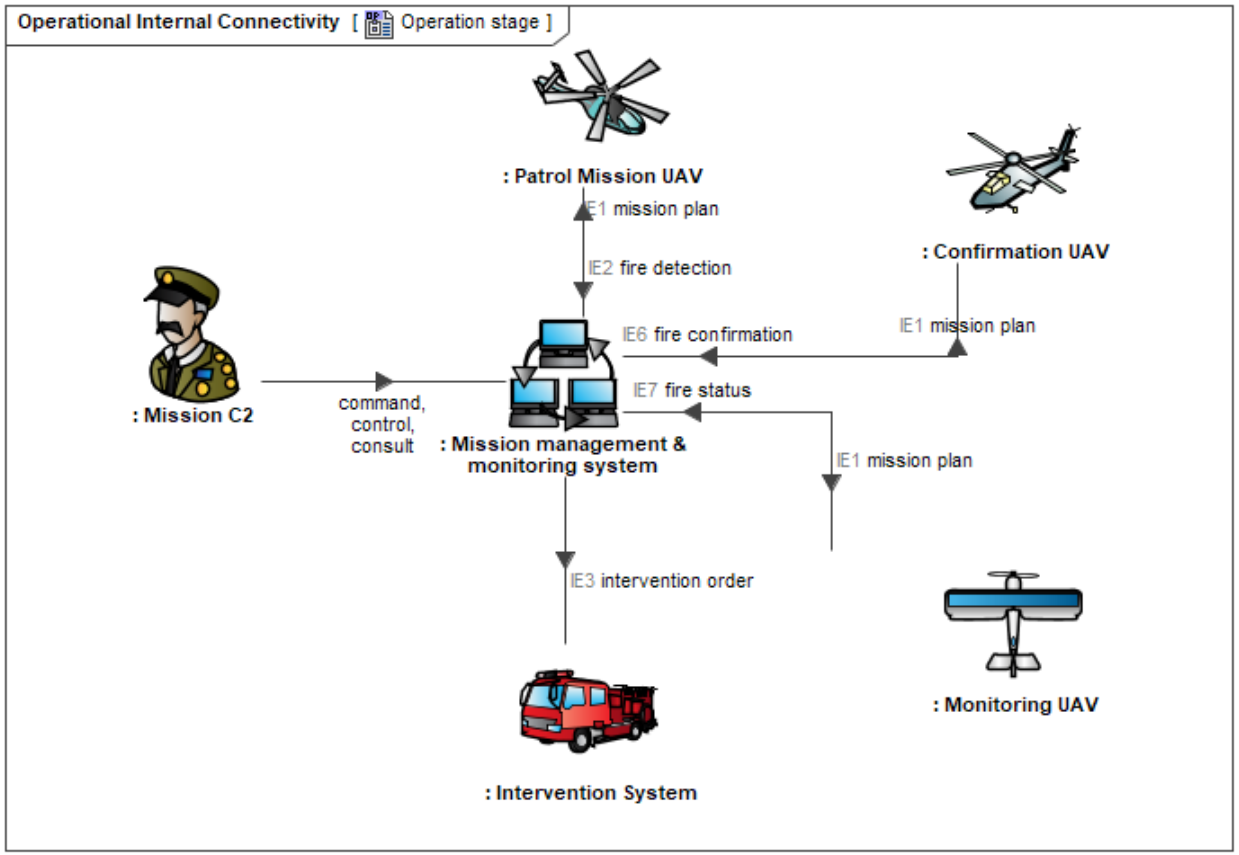
Operational Context

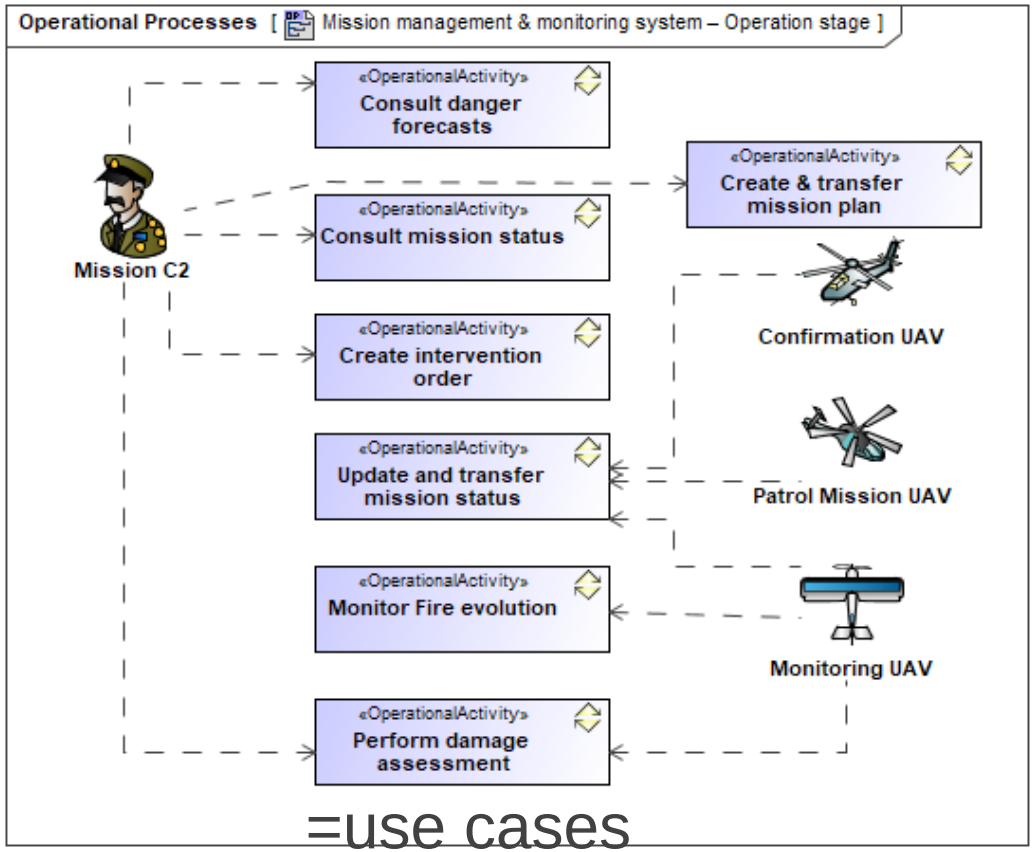
STEP#1

Define Operational Context for the SoI

STEP#2

Develop Operational scenarios & measures of effectiveness (MoE)

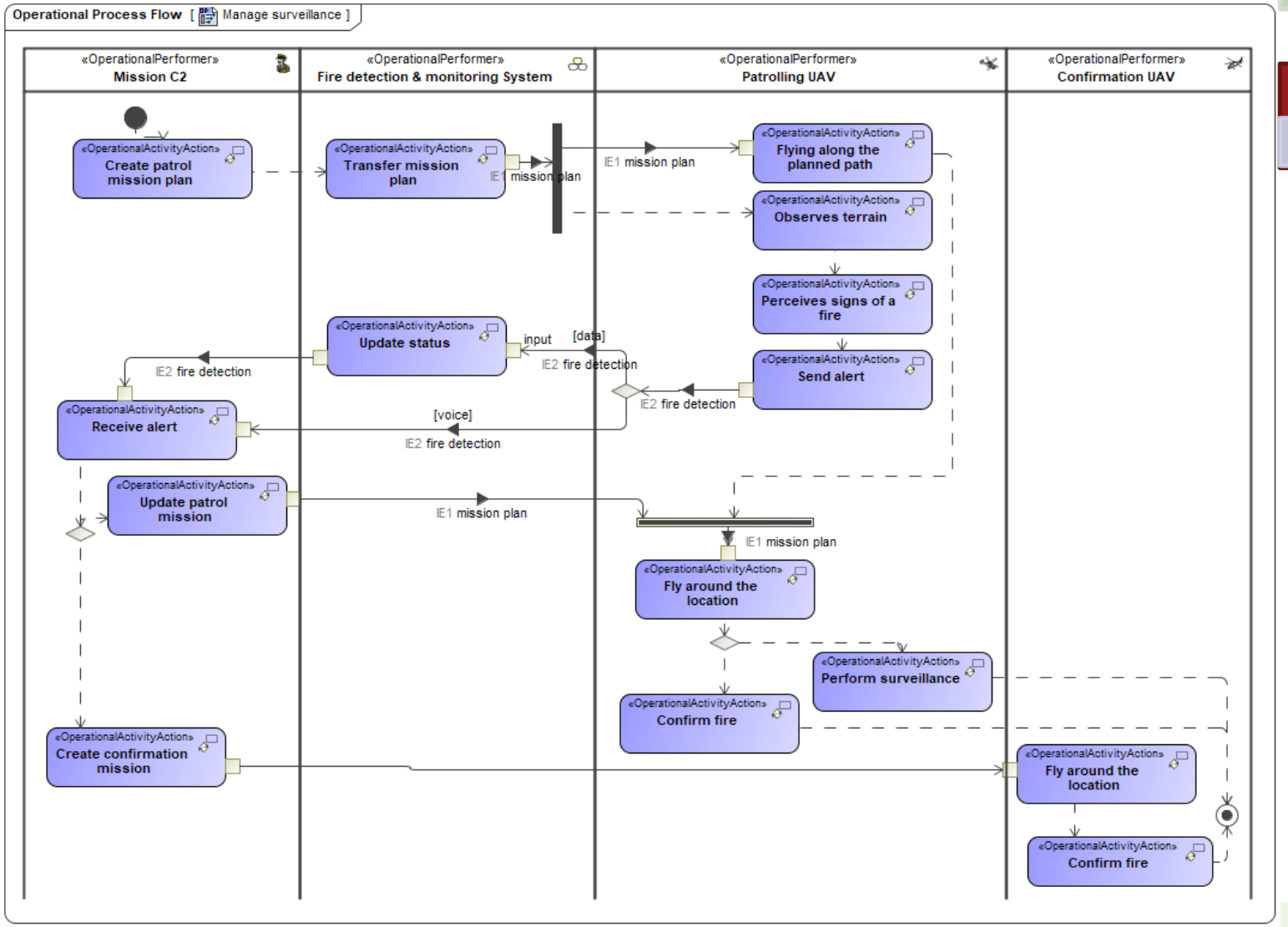




=use cases

Operational Analysis & Design

Operational scenarios



STEP#2

Develop Operational scenarios & measures of effectiveness (MoE)

STEP#3

Perform a trade study of the alternatives

Operational Analysis & Design

Trade-studies

A- Establish the Study/problem Statement;

B - Review inputs, requirements, constraints and assumptions;

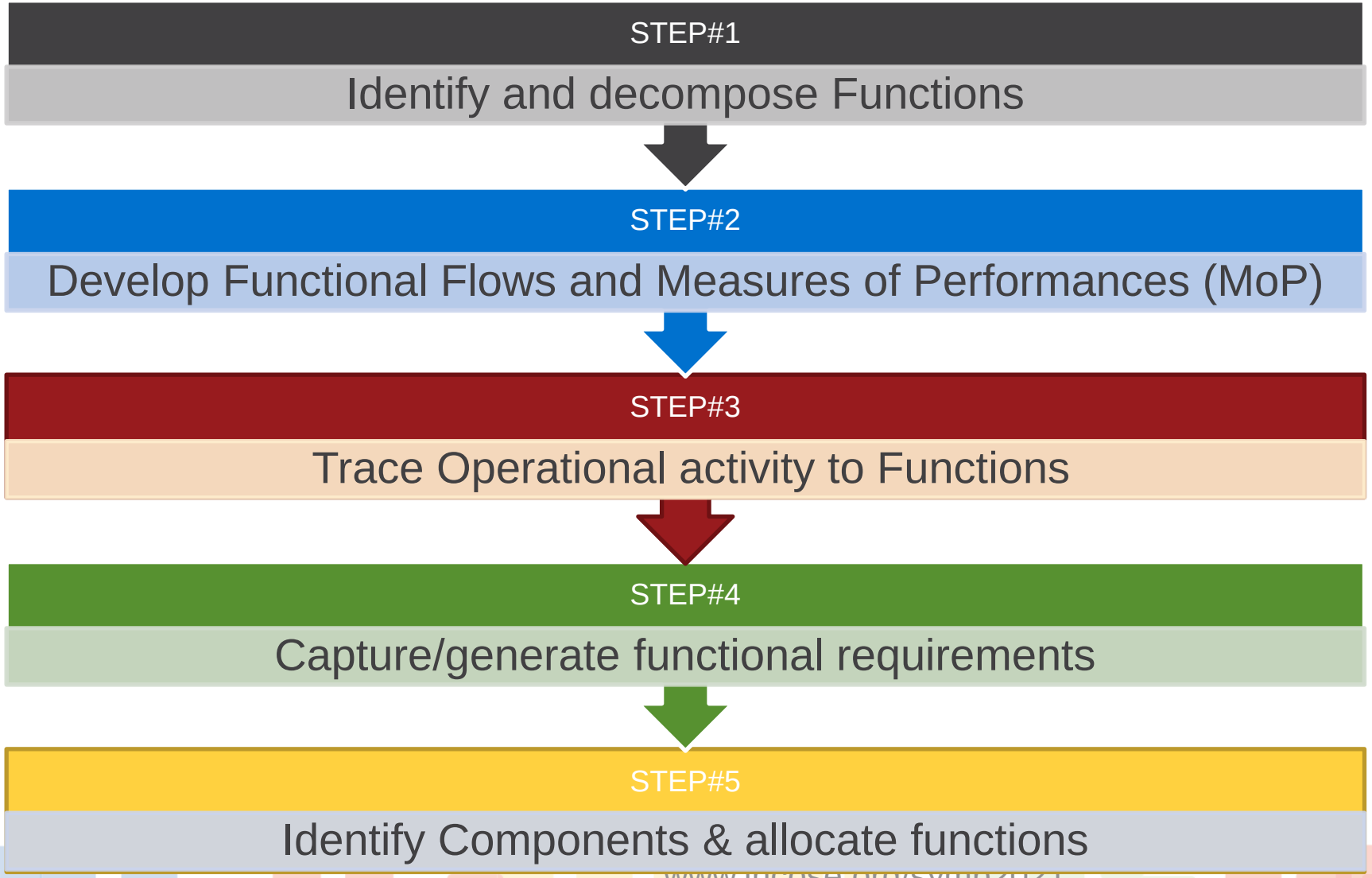
C - Develop and quantify criteria including weights (relative importance);

D - Develop/refine alternative models and measurements of merit;

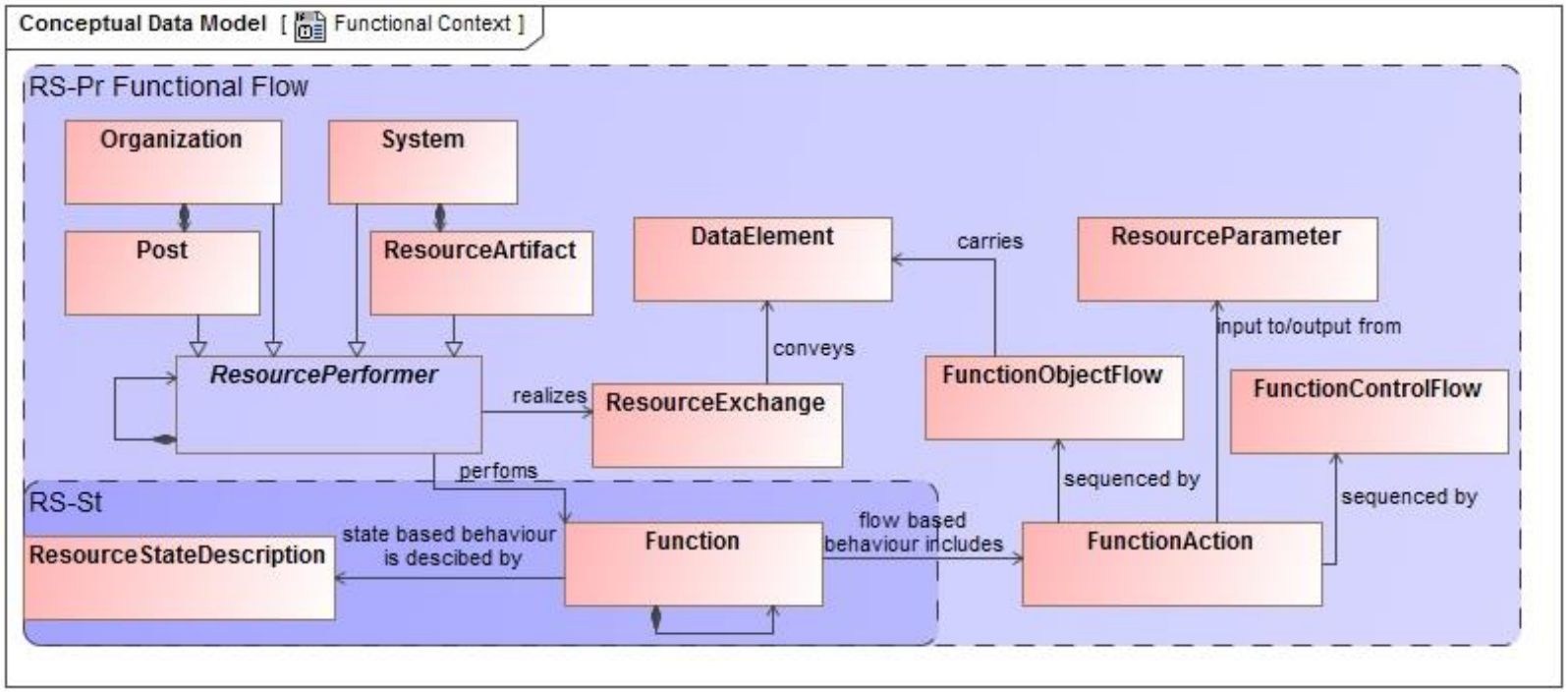
E - Evaluate alternatives and analyze results;

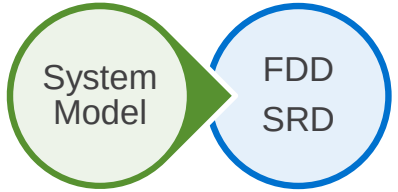
F - Document process and results.

Functional Analysis & Design



Functional Analysis & Design





Goals
Capabilities
Capability Gaps

Stakeholders
Missions
St Requirements
MoE

Use cases
Operational activities
Operational scenarios

Functions
Functional Flows
MoP
Sys Requirements

- RS-Pr
- RS-St
- Traceability matrices
- System Requirements

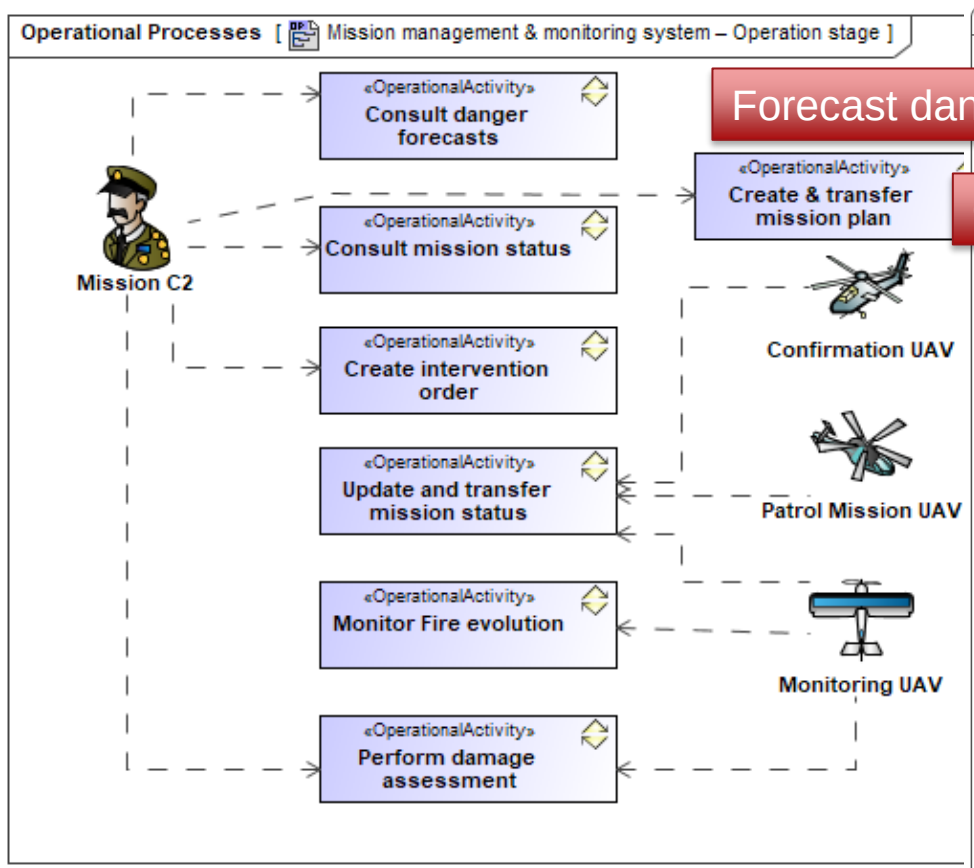
Functional Analysis & Design

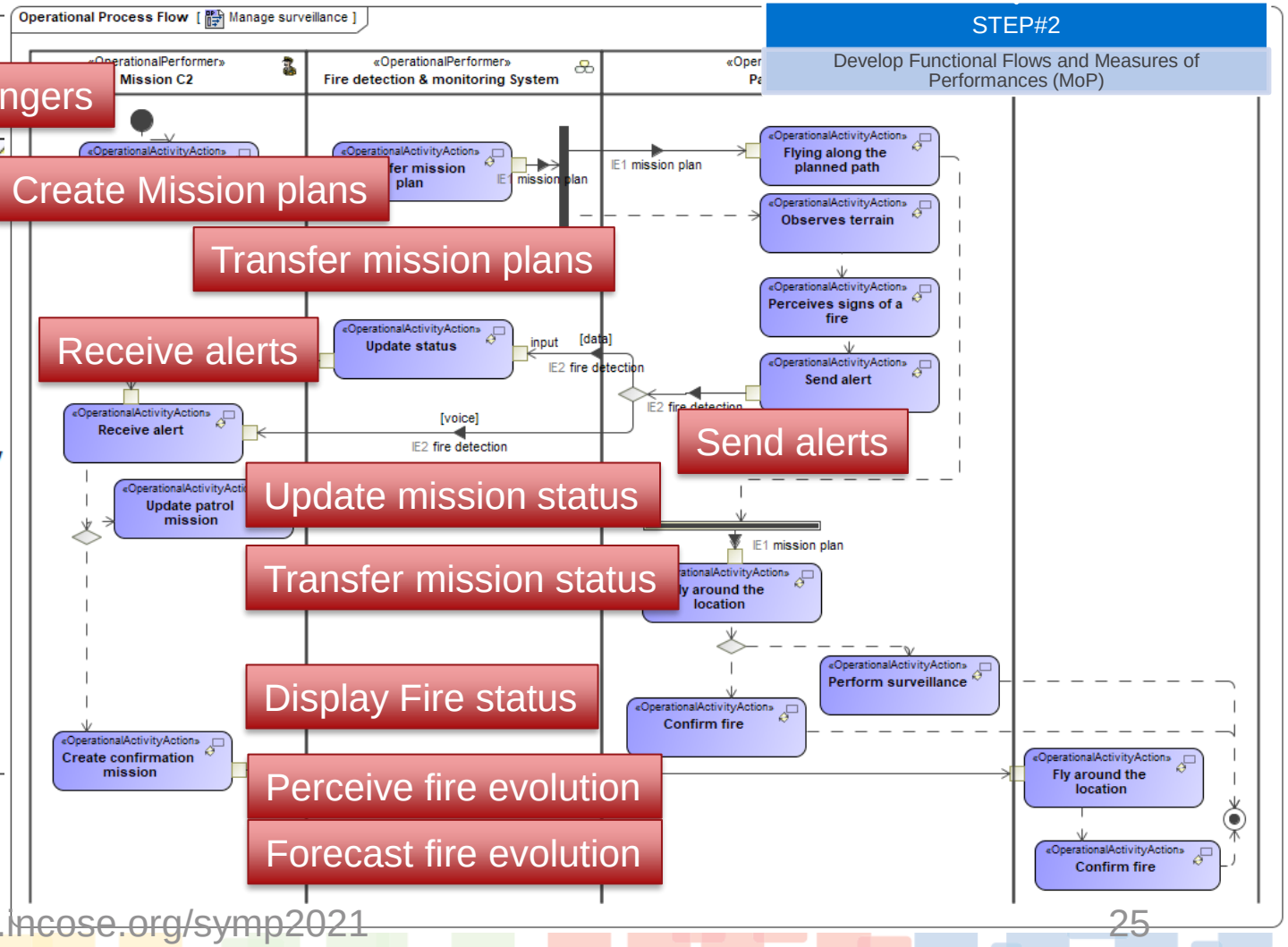
STEP#1

Identify and decompose Functions

STEP#2

Develop Functional Flows and Measures of Performances (MoP)





Forecast dangers

Create Mission plans

Transfer mission plans

Receive alerts

Send alerts

Update mission status

Transfer mission status

Display Fire status

Perceive fire evolution

Forecast fire evolution

Functional Analysis & Design

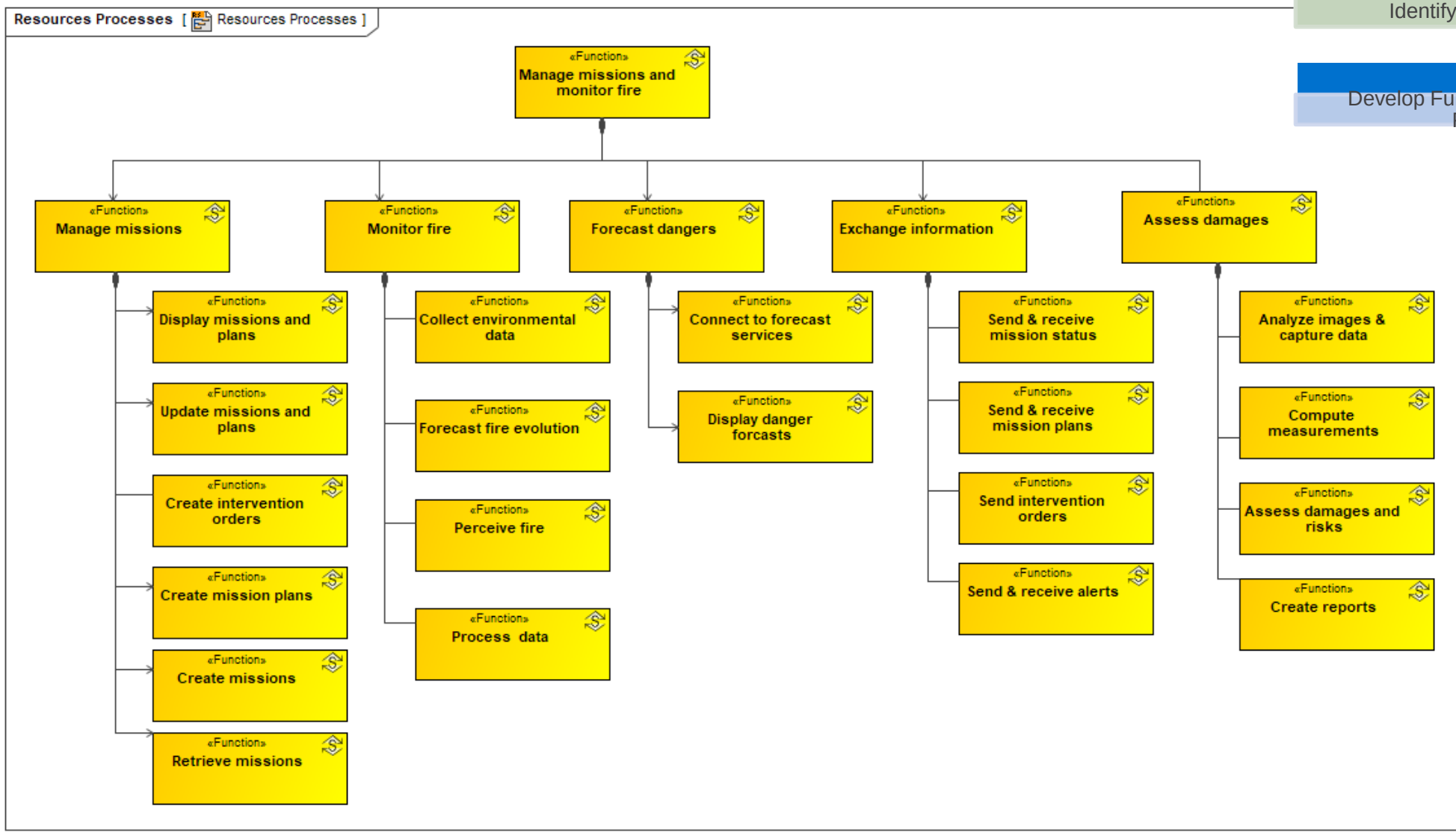
Functional trees

STEP#1

Identify and decompose Functions

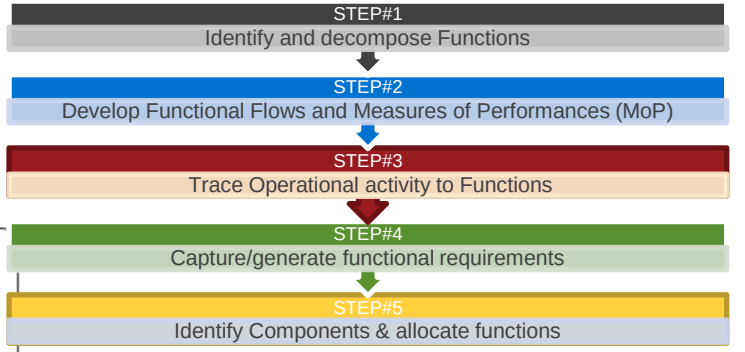
STEP#2

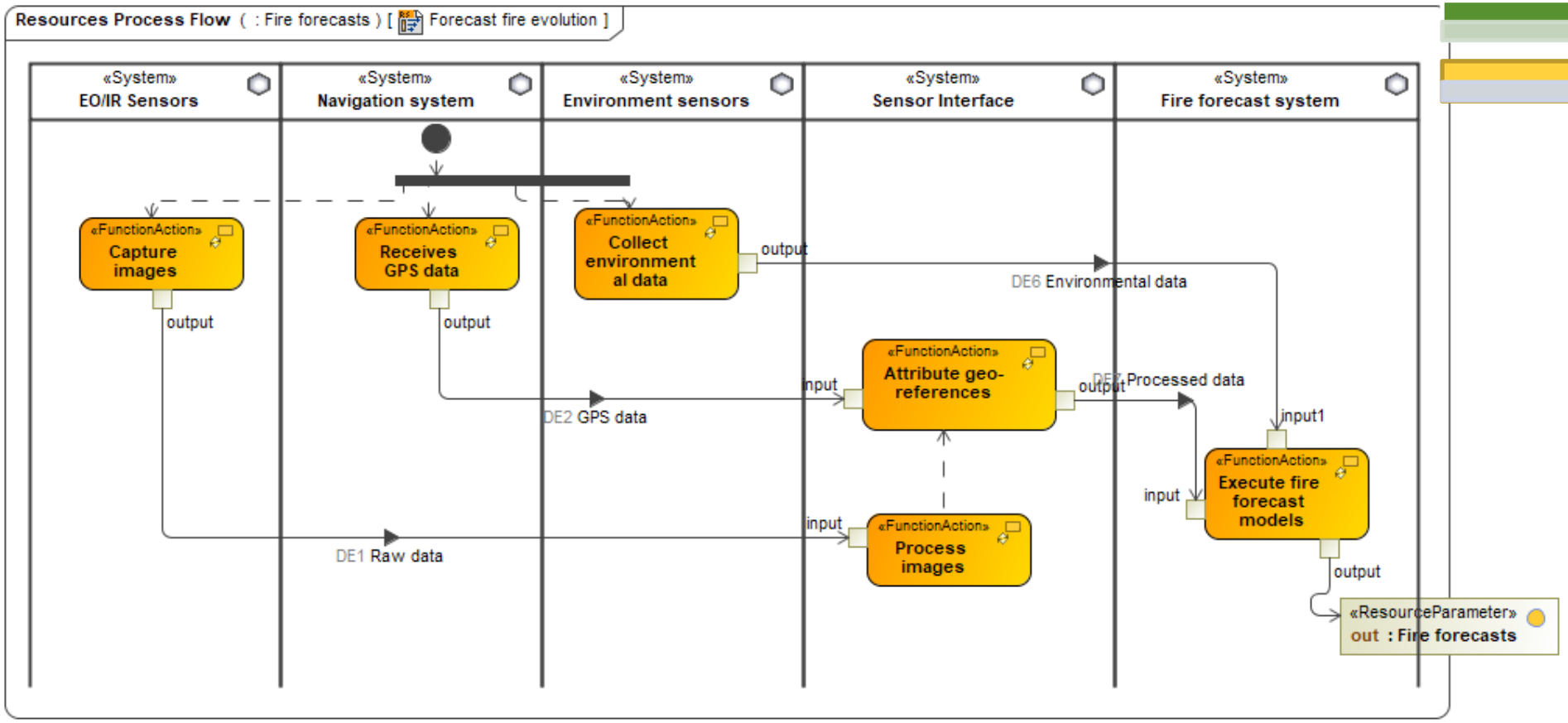
Develop Functional Flows and Measures of Performances (MoP)



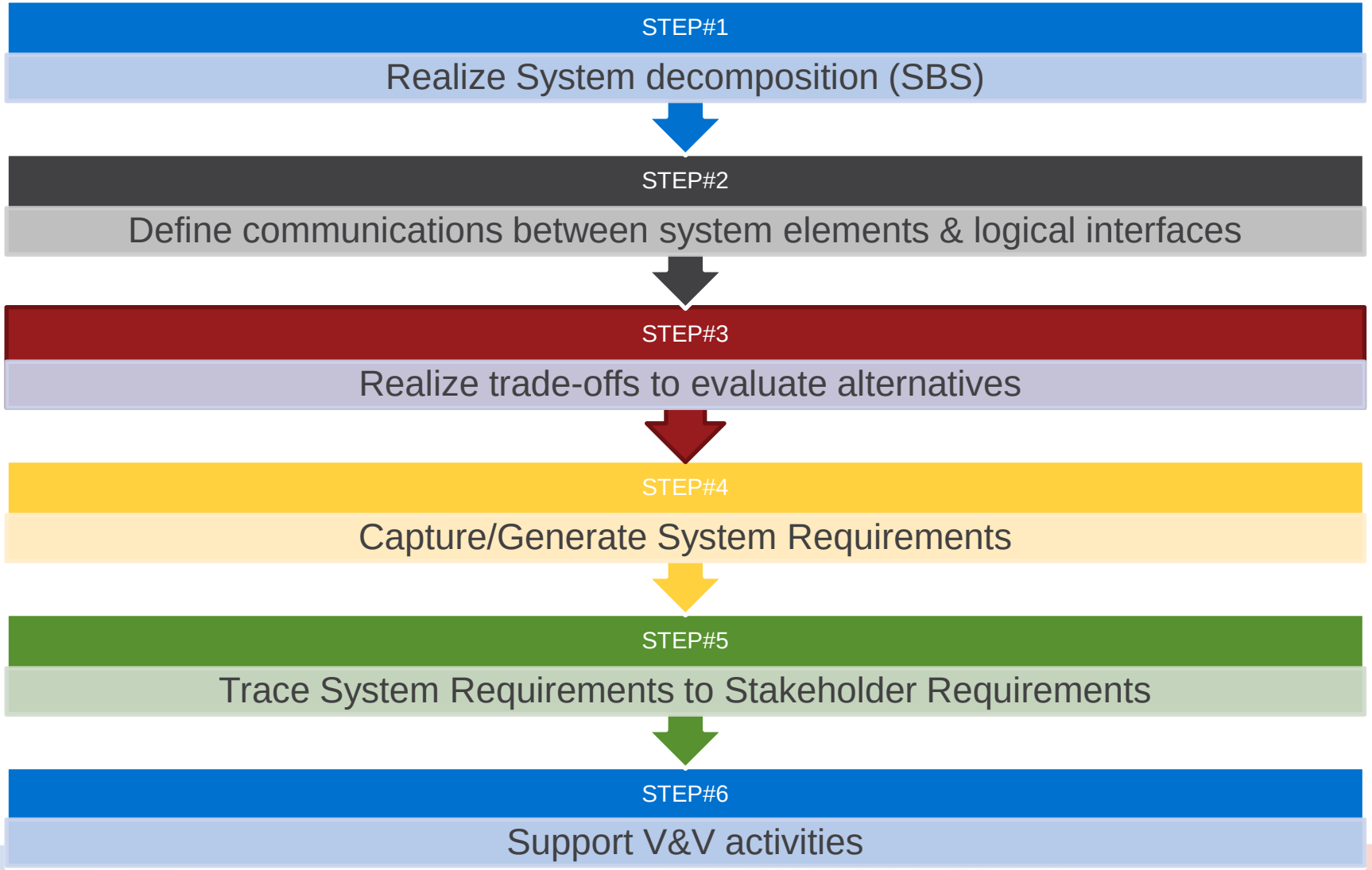
Functional Analysis & Design

Functional flows

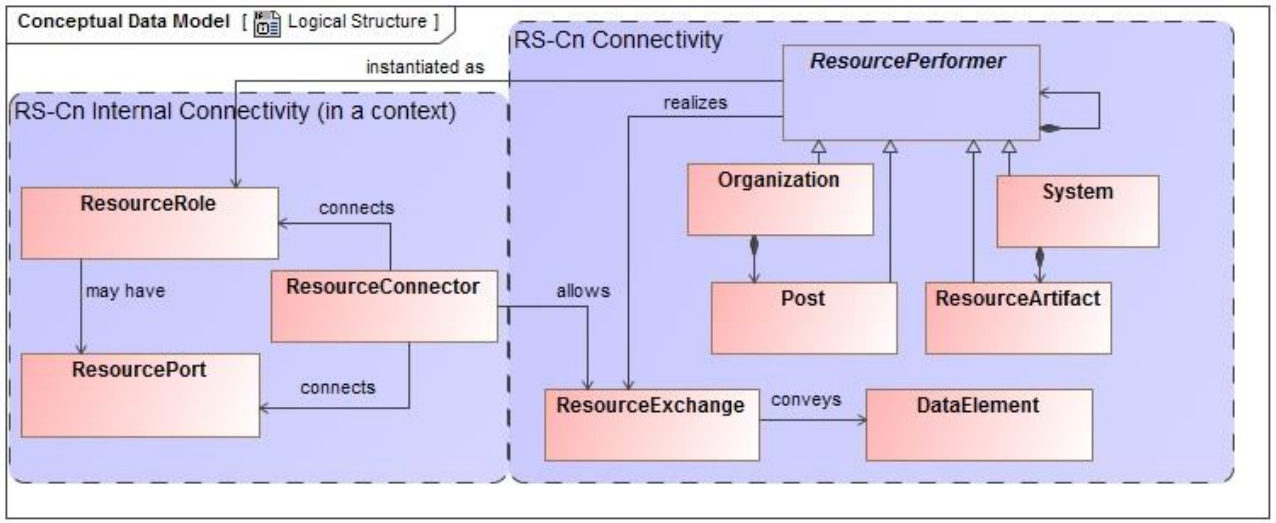


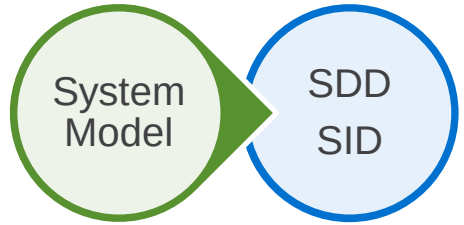


Logical Structure Design



Logical Structure Design





Goals
Capabilities
Capability Gaps

Stakeholders
Missions
St Requirements
MoE

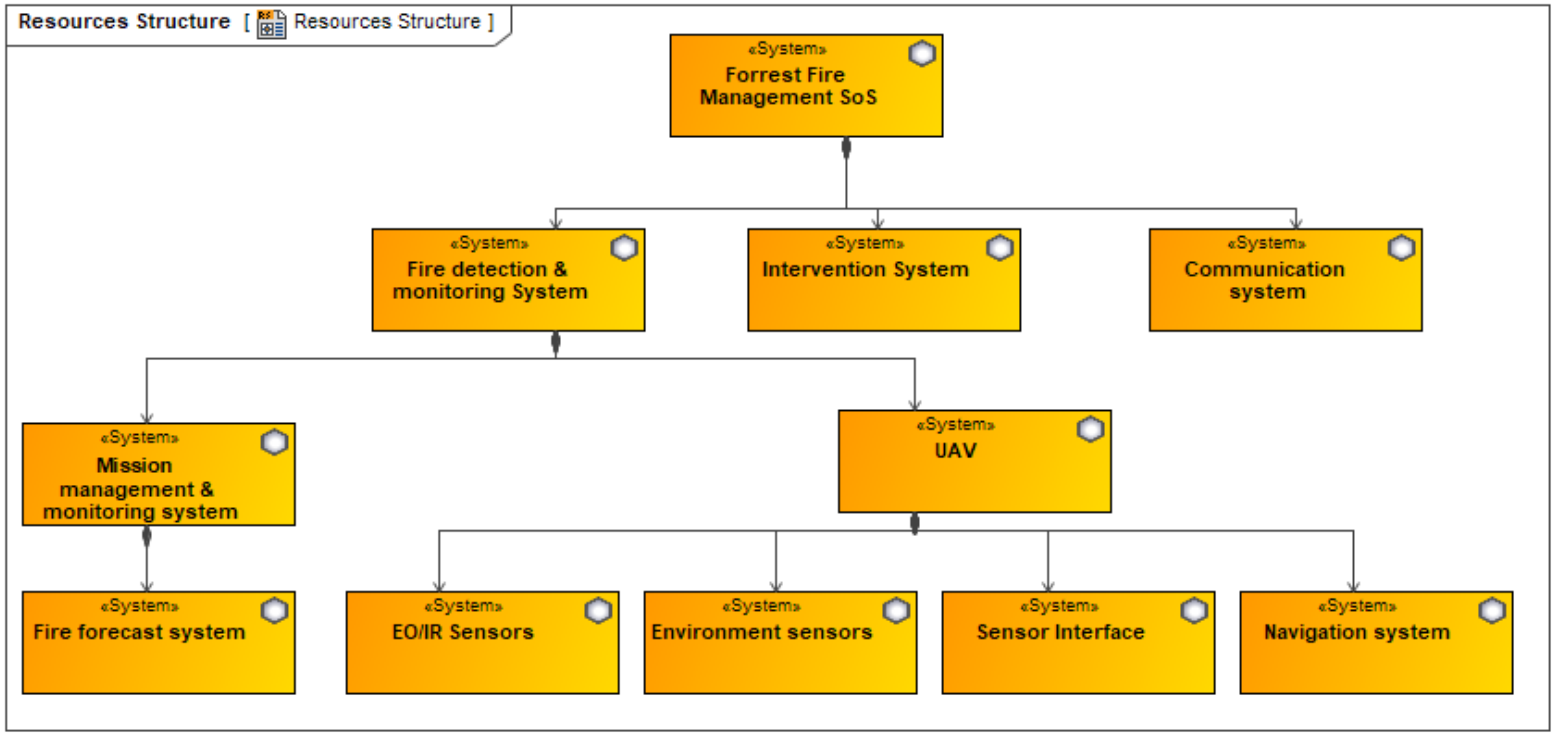
Use cases
Operational activities
Operational scenarios

Functions
Functional Flows
MoP
Sys Requirements

Systems/System Elements
Resource exchanges

- RS-Sr
- RS-Cn
- Traceability matrices

Logical Structure Design
SBS



STEP#1
Realize System decomposition (SBS)

STEP#2
Define communications between system elements & logical interfaces

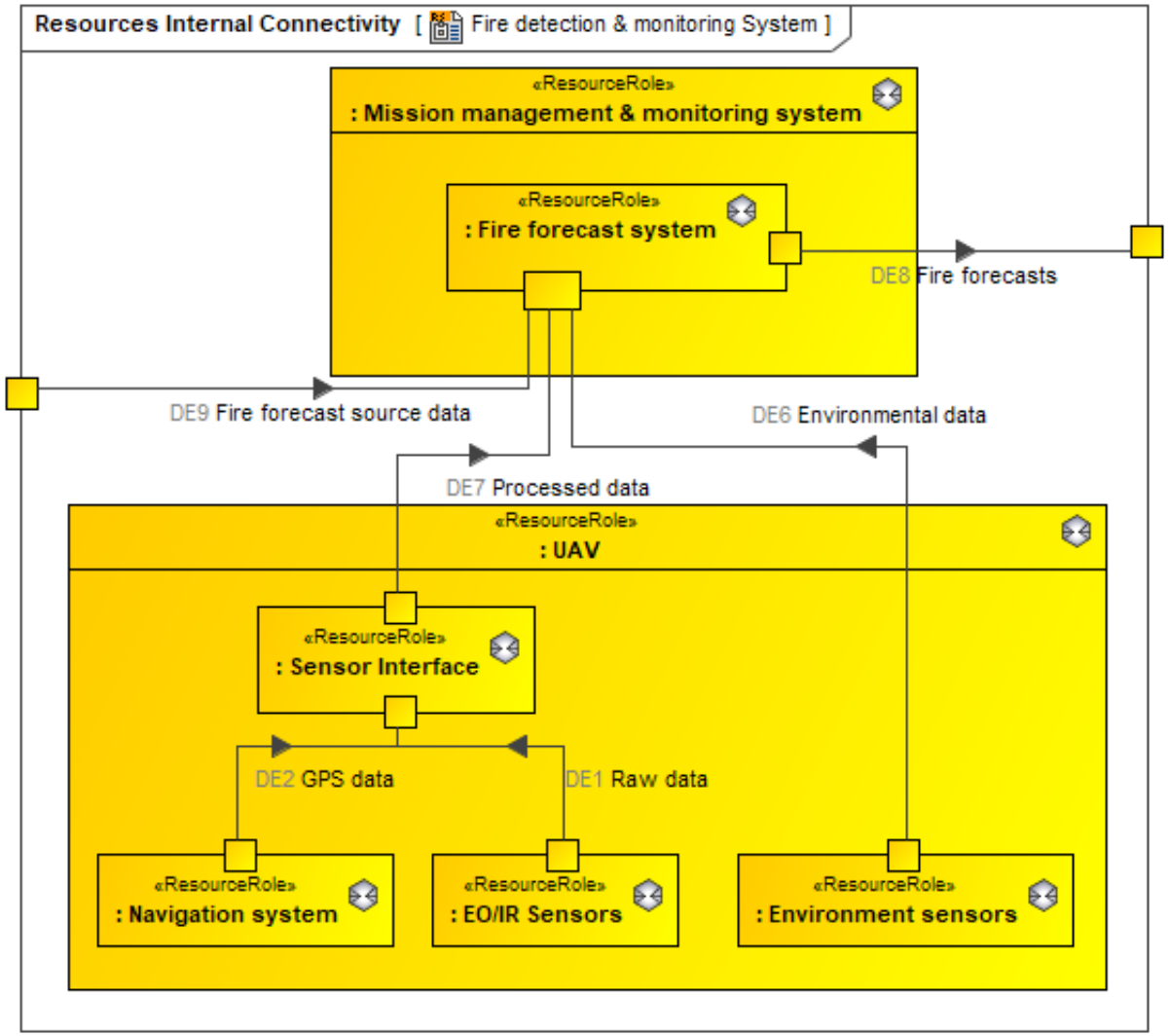
STEP#3
Realize trade-offs to evaluate alternatives

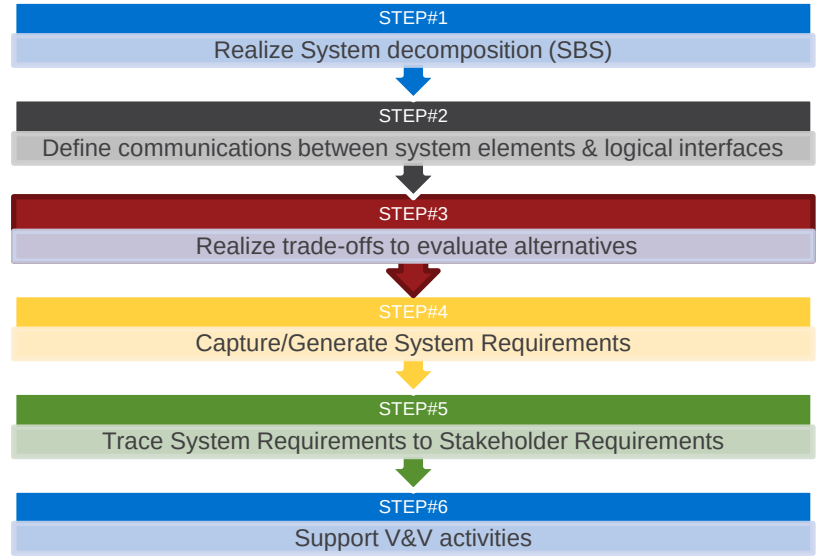
STEP#4
Capture/Generate System Requirements

STEP#5
Trace System Requirements to Stakeholder Requirements

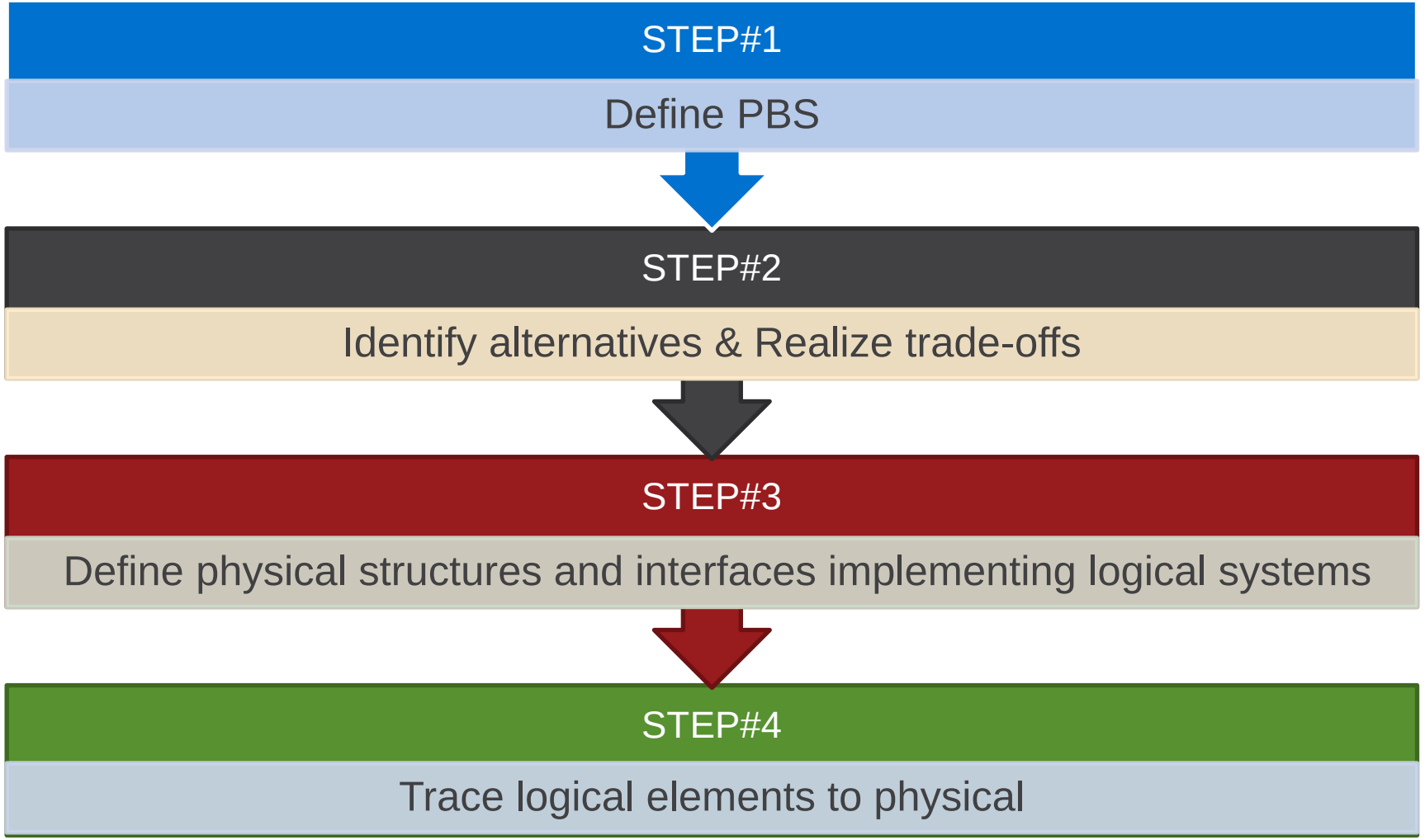
STEP#6
Support V&V activities

Logical Structure Design
logical interfaces





System Physical Design



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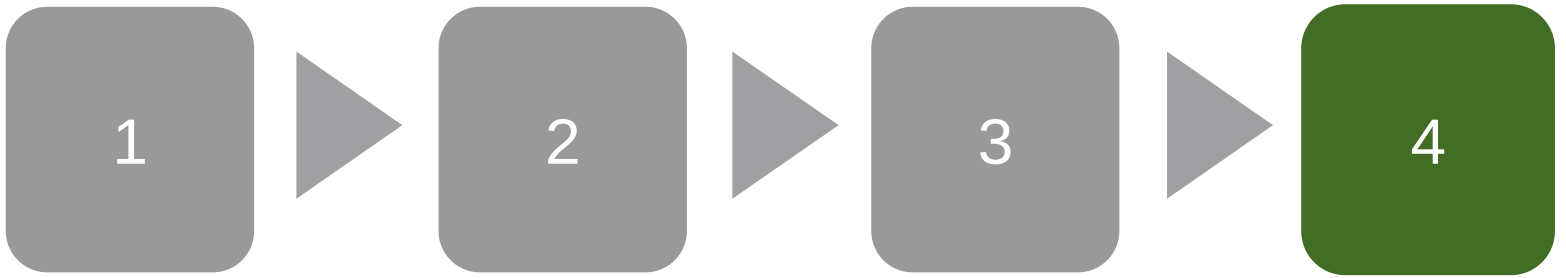

Why? What? How? **Conclusion**

Conclusion

- The proposed method is applicable to any type of system within the system hierarchy and to the system elements at any level.
- It is based on the standard so it provides the benefits brought by standards
- Architecture Framework tailoring is already performed
- Conversion to different view formats (UAF, NAF V3 & 4) is available
- Finally, these advantages lead to the increase in the productivity of the system engineering effort.
- Some issues related to the UAF are identified and addressed during methodology development.

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