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Towards an approach to co-execute system models at the enterprise level

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- ASEP, OCSMP, OCEB, OCUP certified professional
- Originator of MagicGrid

Agenda

1. Introduction
2. Suggested Approach
3. Case Study
4. Conclusions
5. Q&A

Introduction

Motivation

- MBSE practices are widely applied to enterprise (including system of systems and mission) architectures, which become a crucial part of successful digital transformation.

- Today's primary challenge encompasses not only the establishment of digital continuity by interconnecting different model layers but also the successful execution of detailed analysis and simulation within the enterprise-level model.

Purpose

- Our paper proposes guidelines for **co-executing** system models defined in Systems Modeling Language (**SysML)** in the integrated model of Unified Architecture Framework (**UAF)** resource configuration.

- The approach covers **end-to-end co-execution** of the integrated enterprise model.

- A thorough SoS case study on **urban transportation** is presented to prove the usefulness of the proposed approach in the overall lifecycle of system engineering.

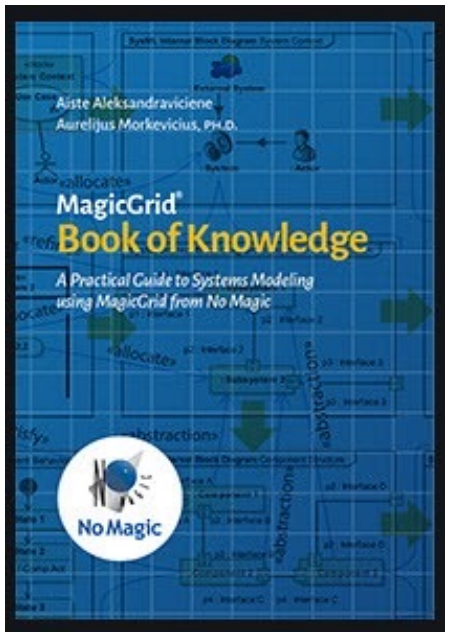
Core of the proposed approach

UAF®
OMG UNIFIED ARCHITECTURE FRAMEWORK®

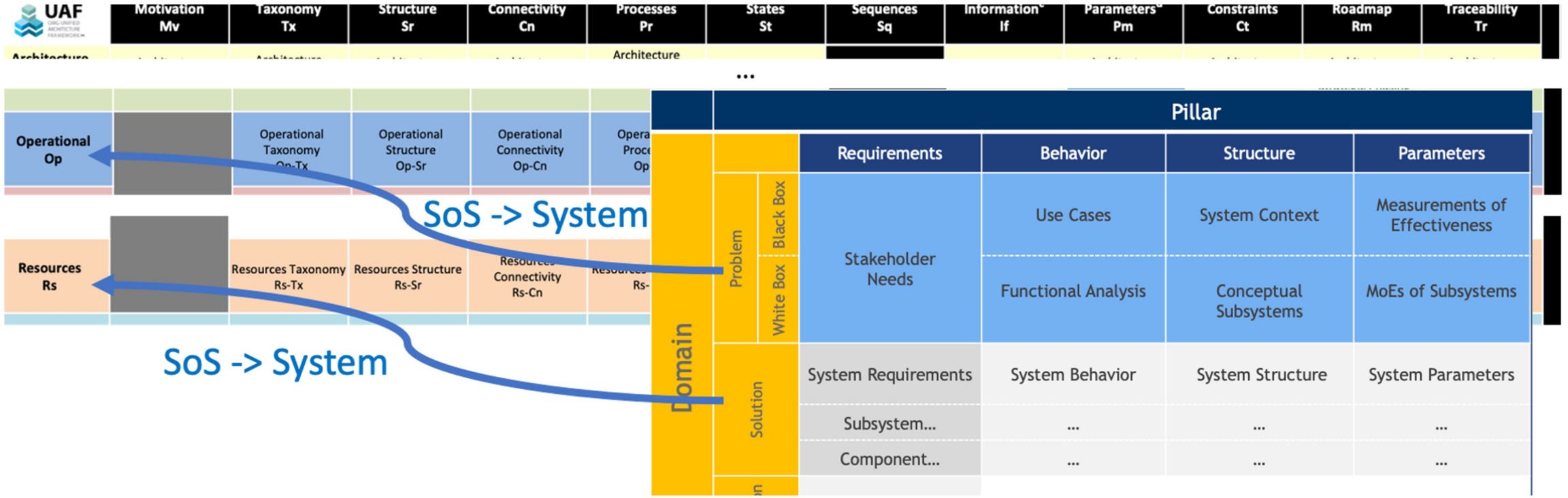
+

OMG SYSTEMS MODELING LANGUAGE
SysML™

+

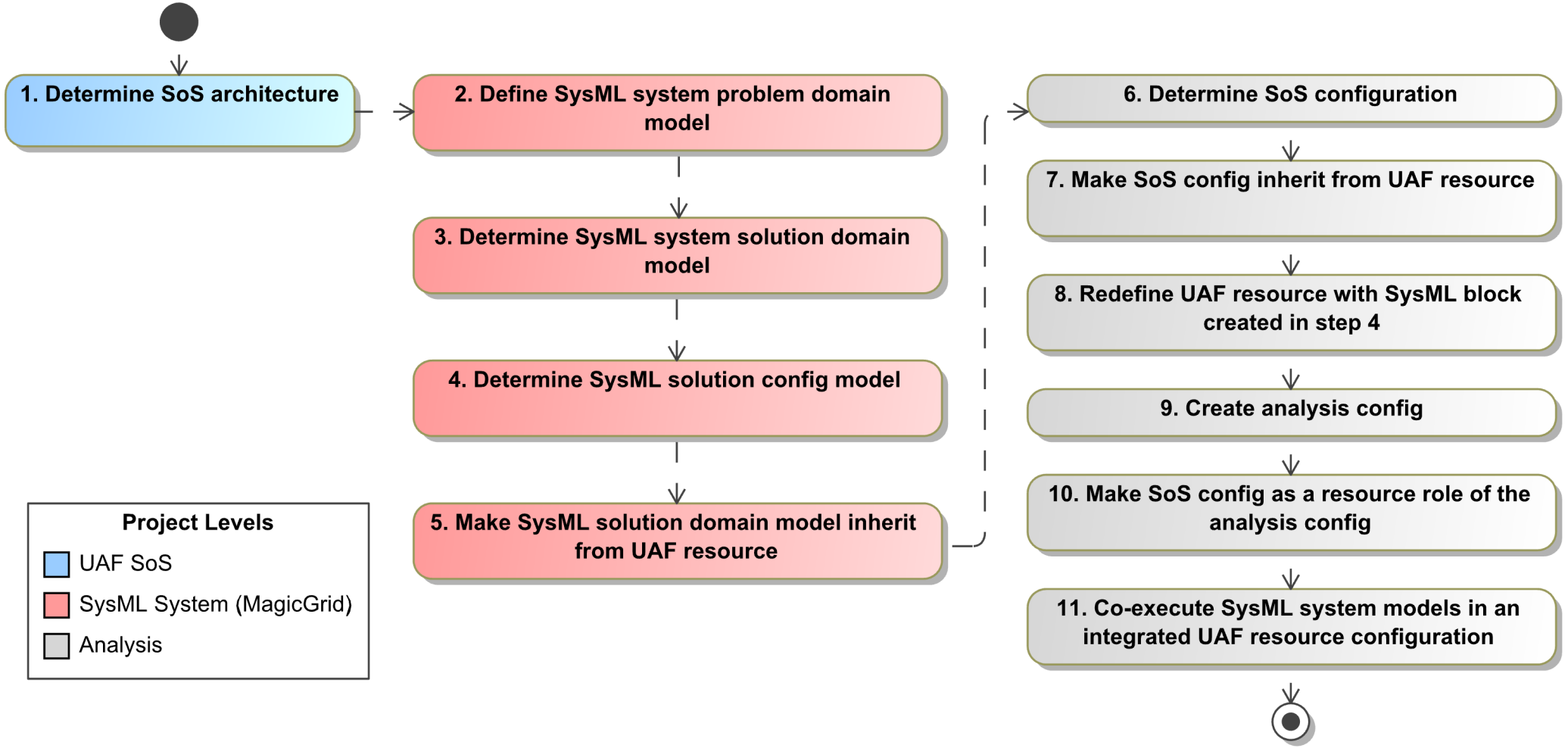


Alignment between levels of abstraction of **UAF** and **MagicGrid**

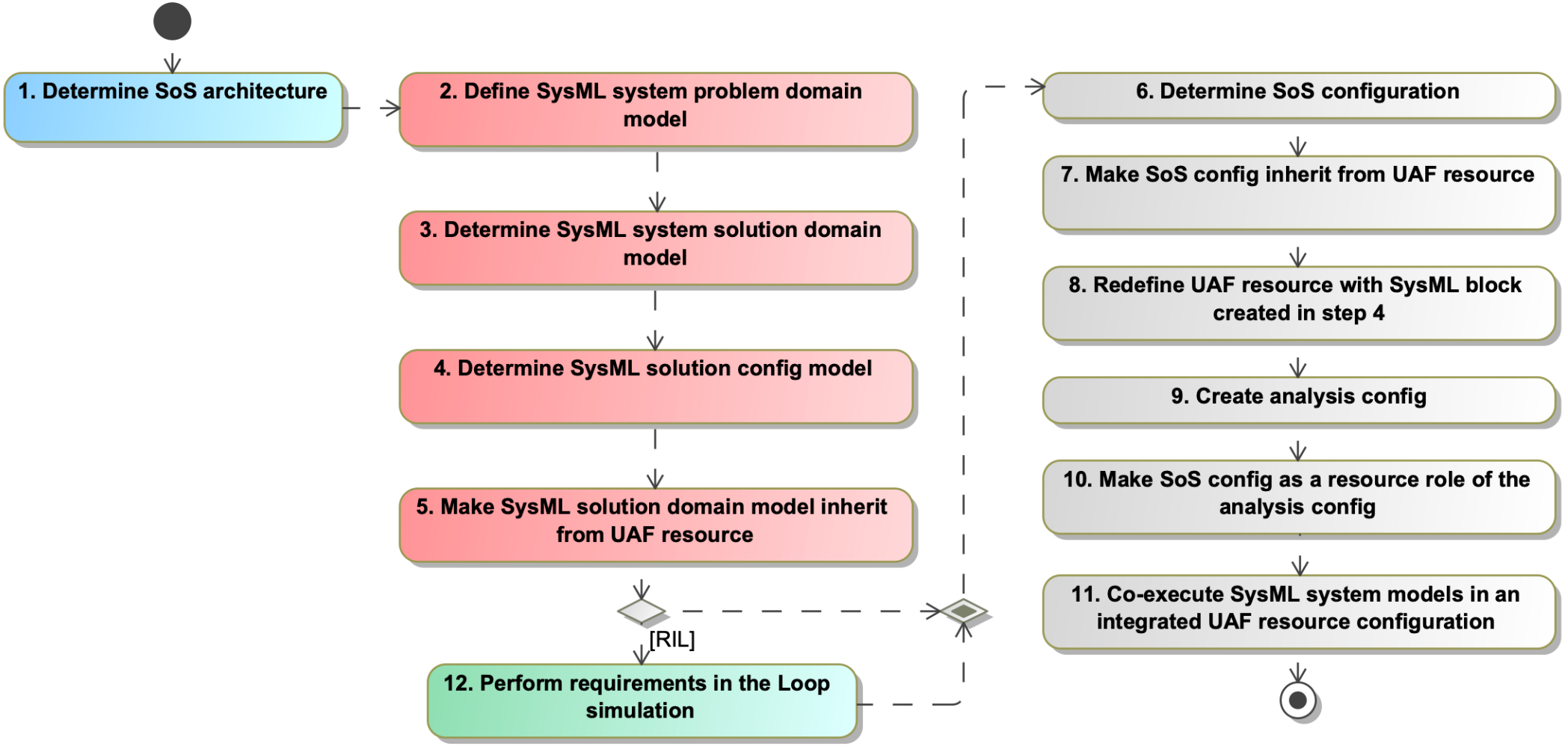


An approach to co-execute SysML system models in an integrated UAF resource configuration

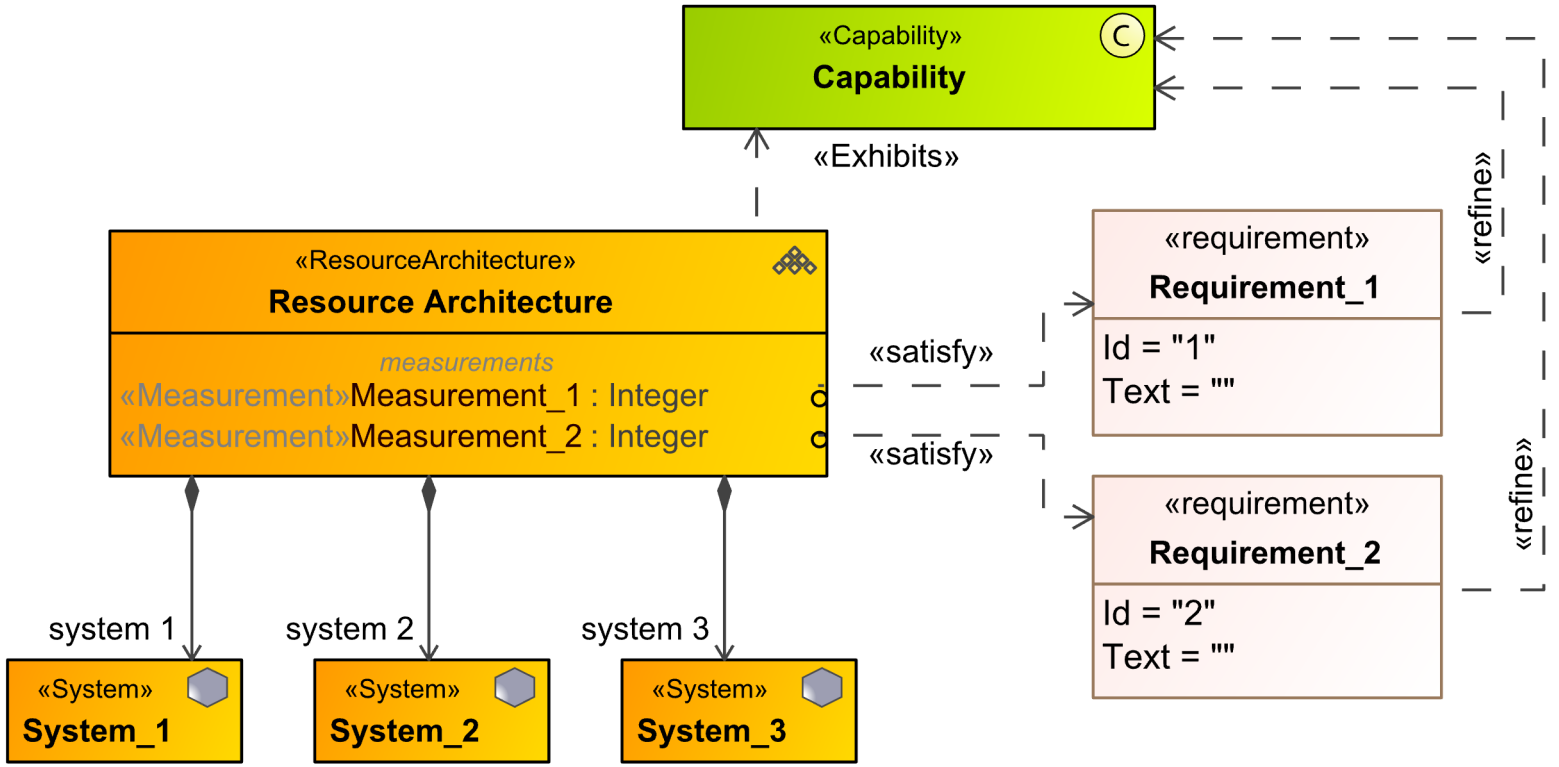
Workflow of co-executing SysML system models within UAF resource configuration approach



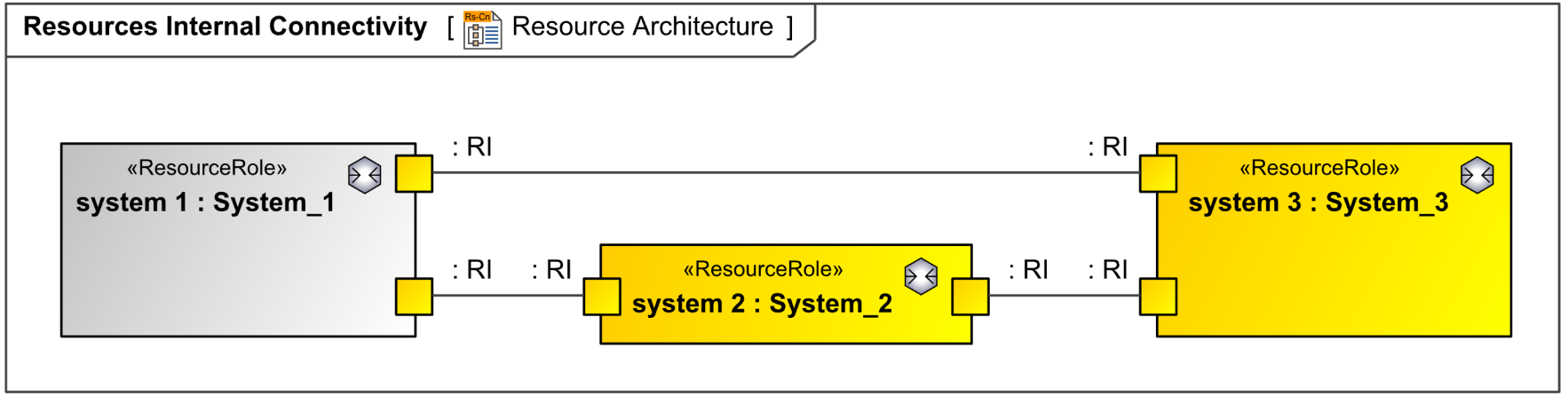
Workflow of approach within Requirements in the Loop



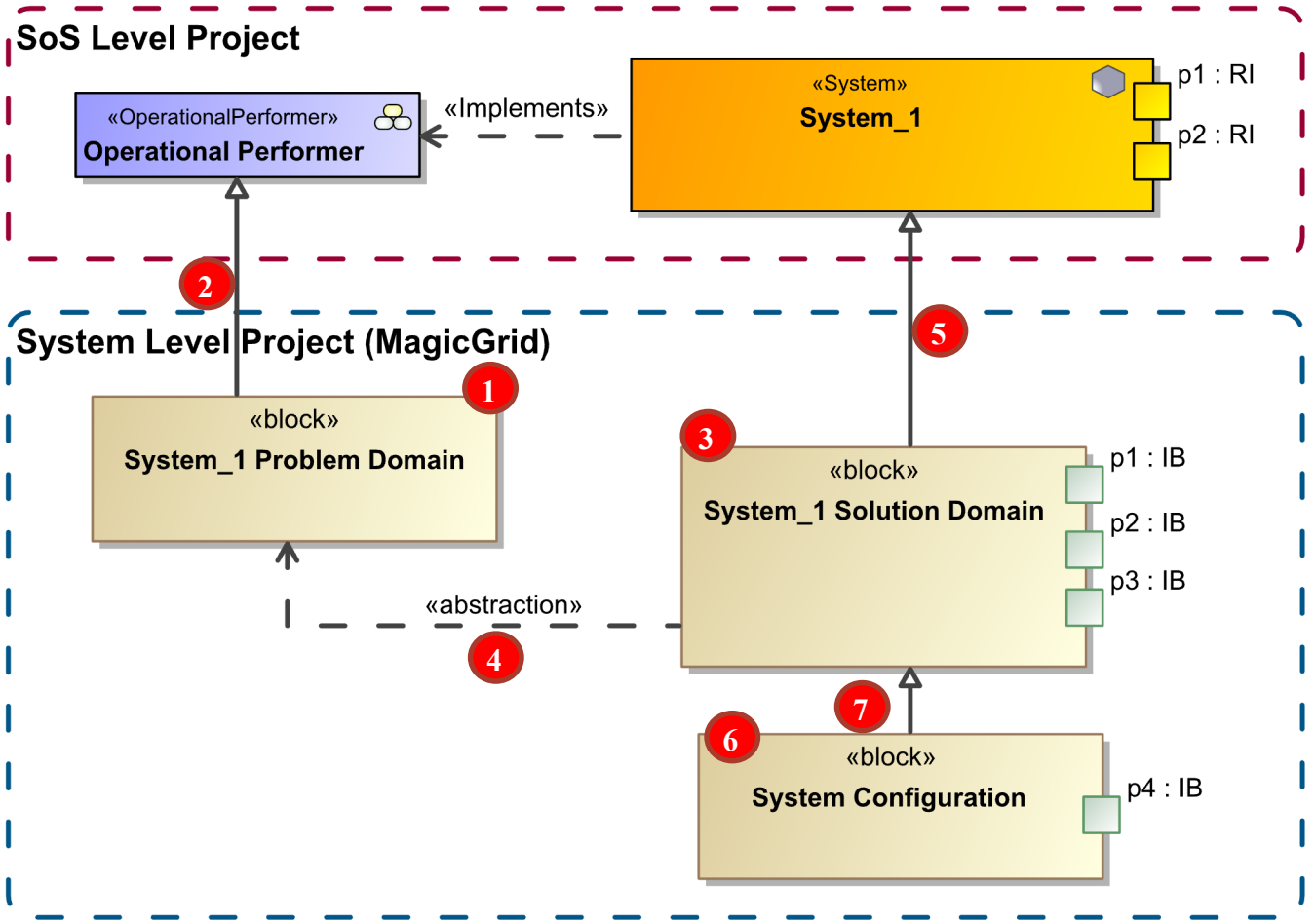
Approach: SoS level project / UAF Resource Configuration (1)



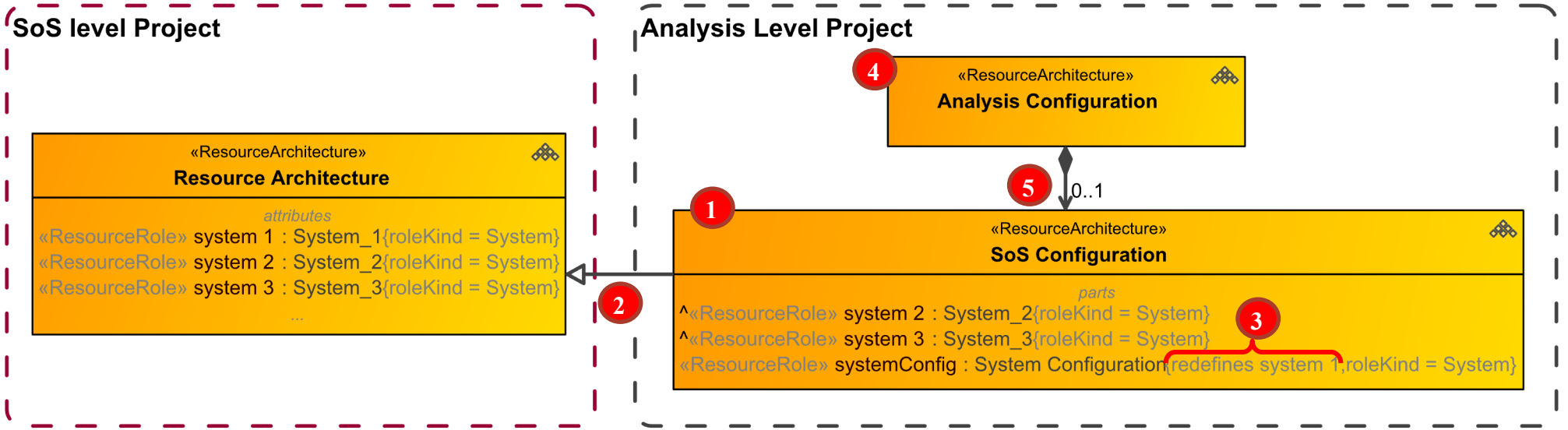
Approach: SoS level project / UAF Resource Configuration (2)



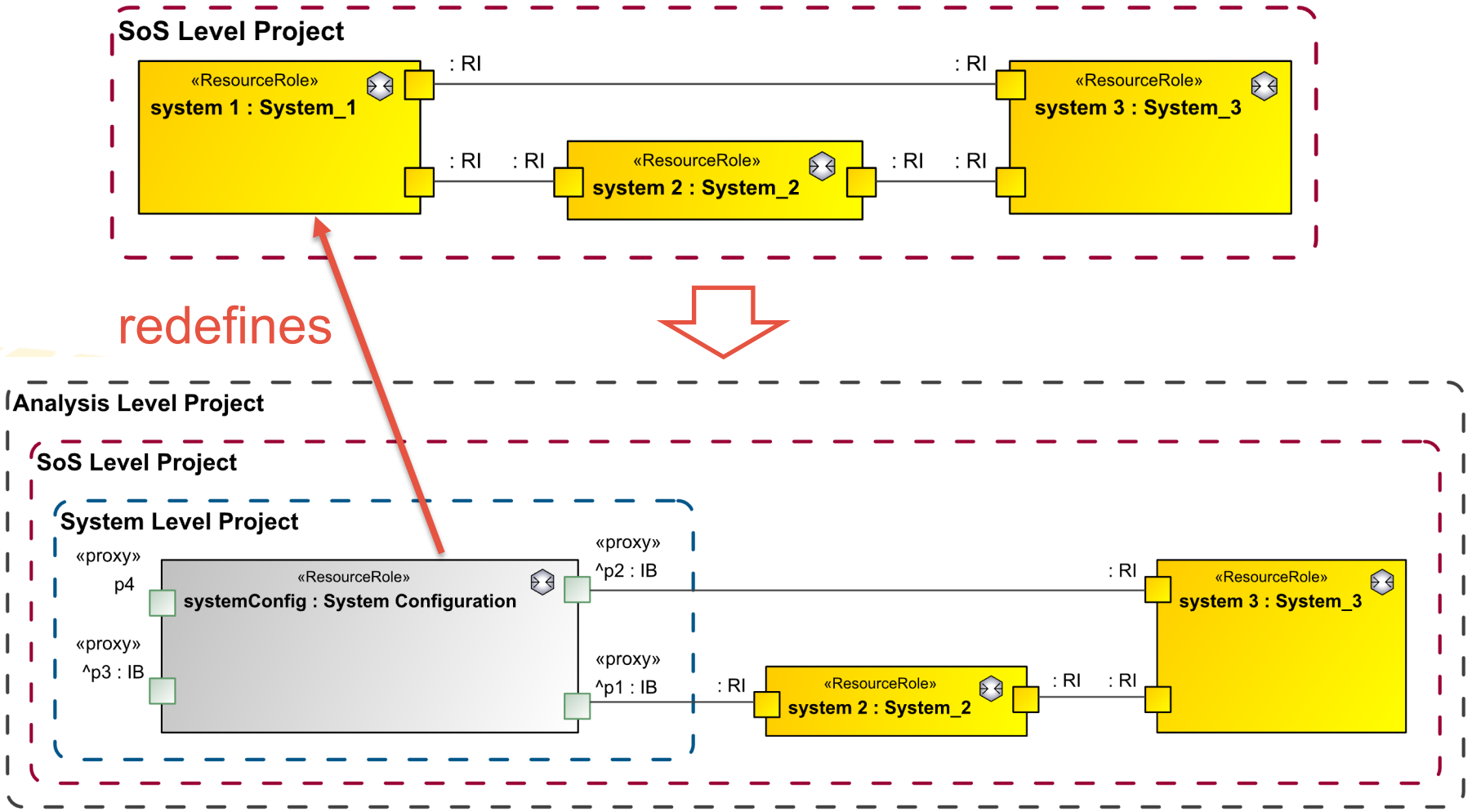
Approach: System level project (MagicGrid) / SysML system model



Approach: Analysis level (1)



Approach: Analysis level (2)



Case Study

Case Study – System Of Interest (1)

- The City Transportation System was chosen as the subject for the case study
- Using the proposed approach, our objective was to analyze and compare the performance of different Electric Bus fleets configurations

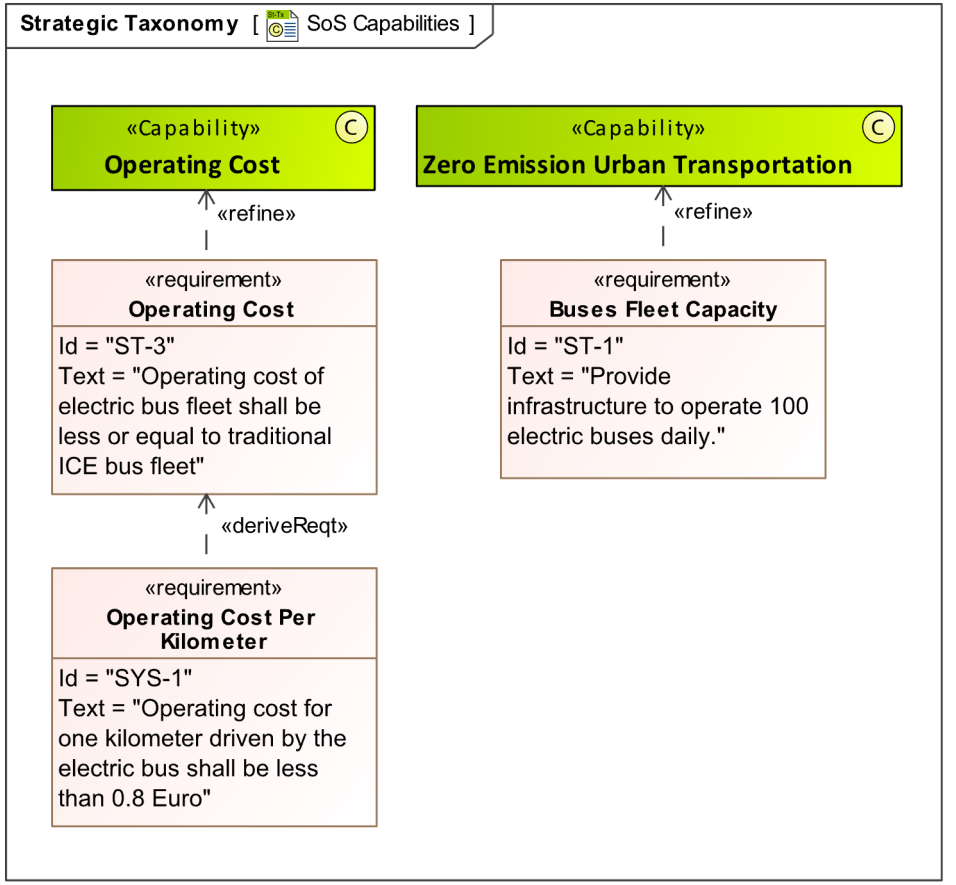
vs.

Case Study – System of Interest (2)

- This selection was made because this is understandable system and has SoS characteristics
- The question at hand is how to transition from executable SysML models to executable UAF models

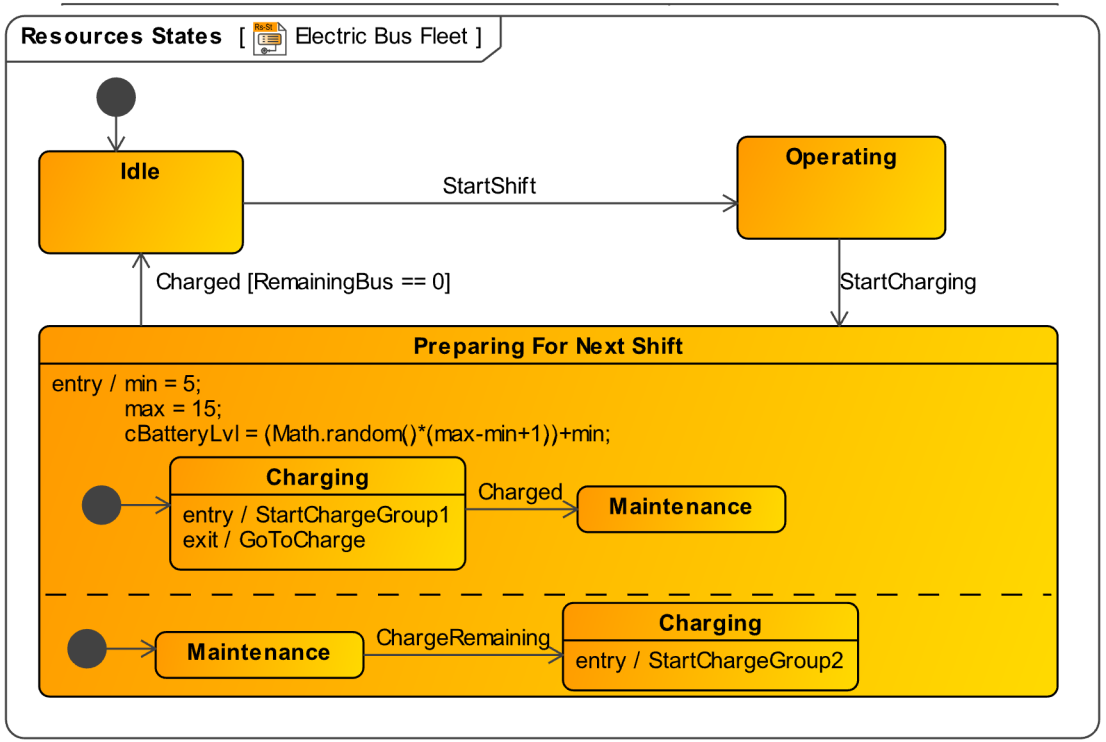
Focus of the Case Study

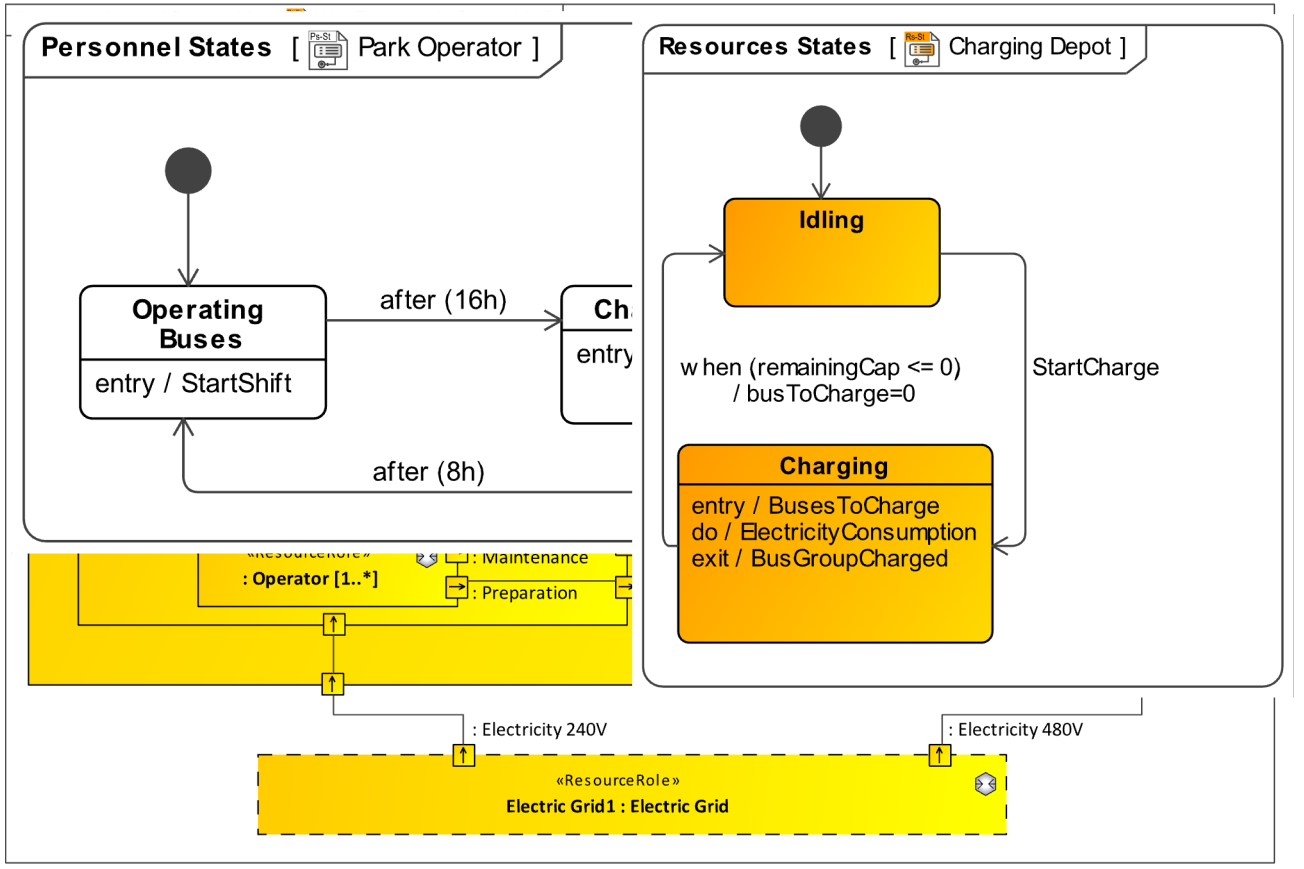
- Given the immense size of the SoS and its associated systems, we have focused our primary attention on a specific criterion for the analysis of the case study
- The primary criterion considered for the case study was the operating cost



Definition of Model

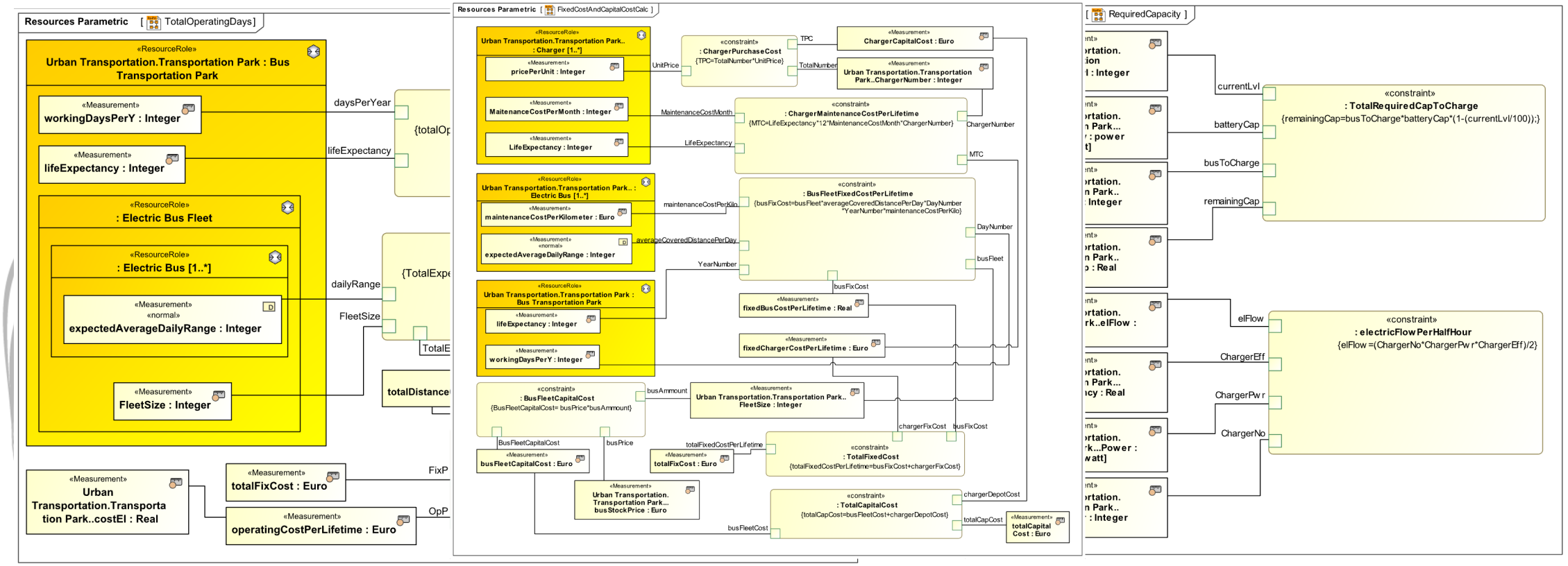
- We start at SoS and define structural and behavioral views





Model-based Analysis

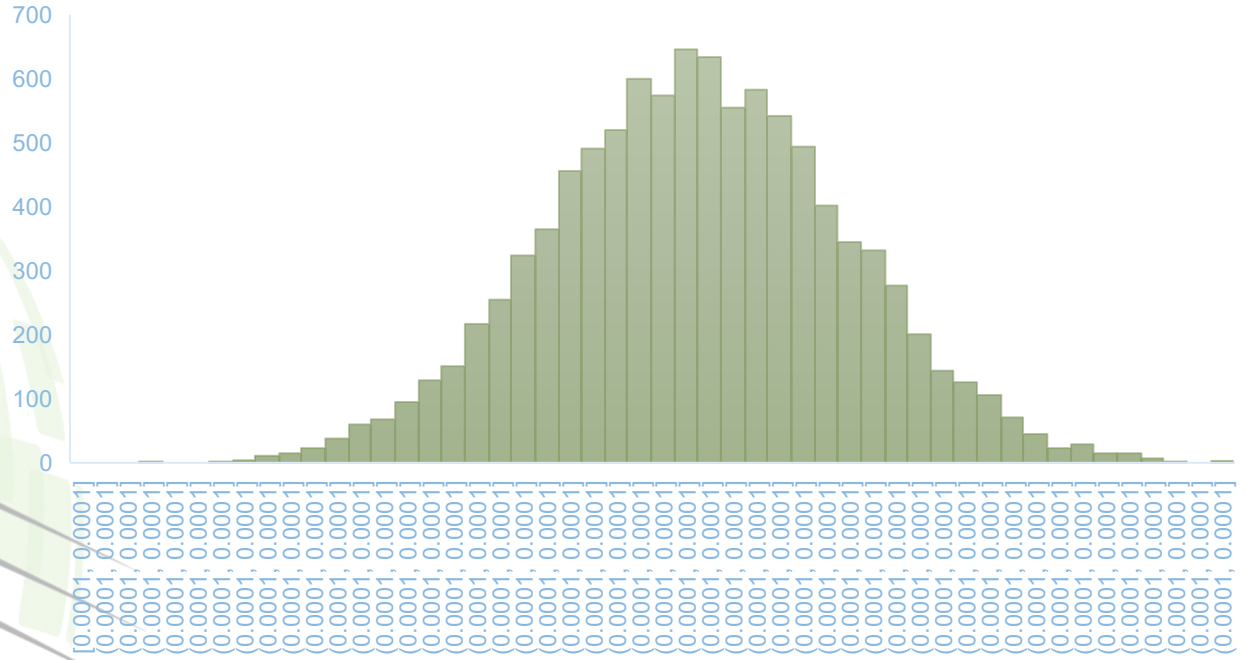
- Next step involved the definition of analysis model responsible for calculating the



Inherent Probabilistic Characteristics of SoS

- SoS model had few stochastic features
- Therefore Monte-Carlo analysis was applied

	Mean Value Euro	Standard Deviation Euro	Runs No
Operating Cost per Kilometer, Euro	0.7940	0.0643	10000

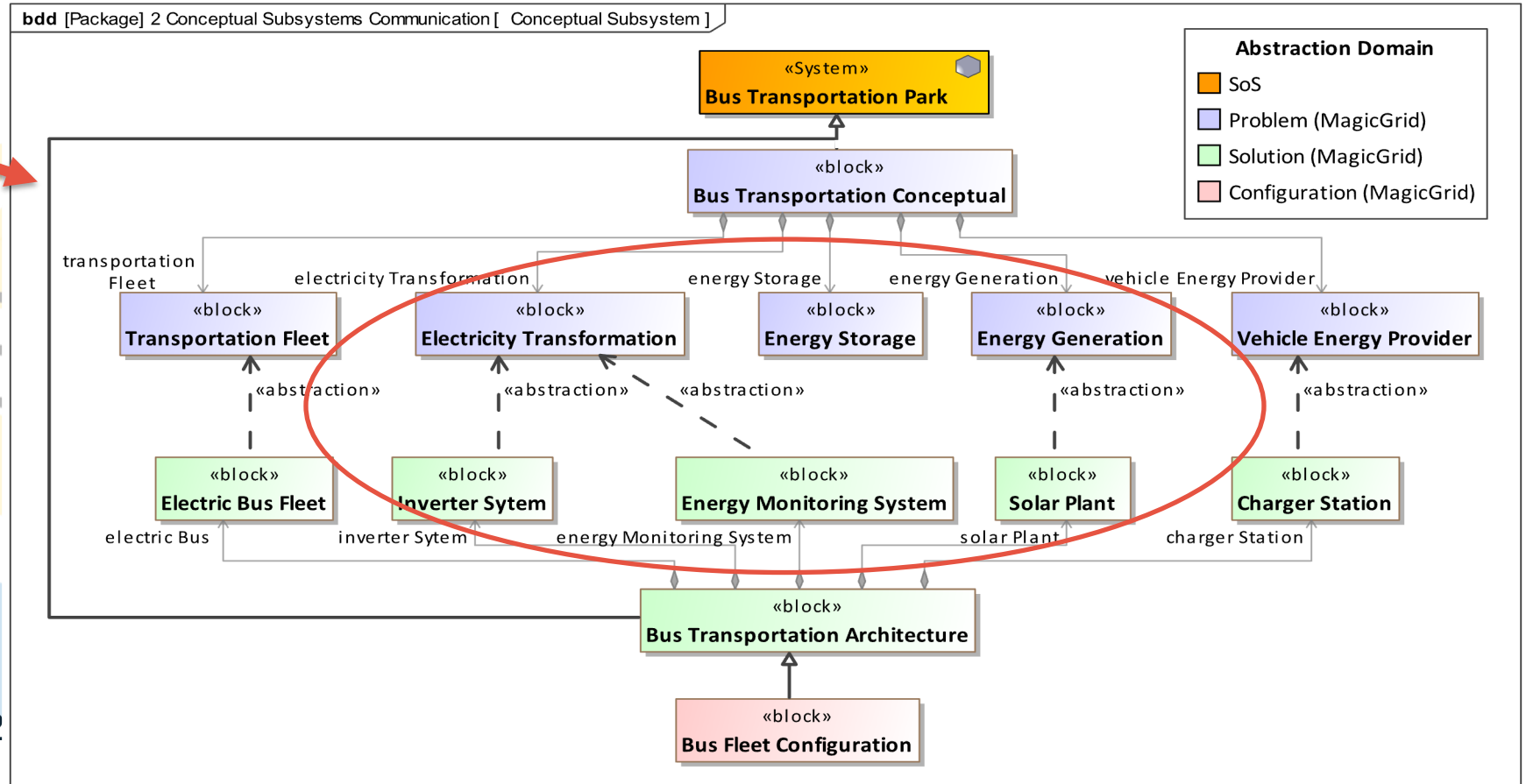


SoS Individual System Analysis

- This was initial analysis of SoS
- In systems engineering processes this could categorized as Business/Mission Analysis and Stakeholder Needs Definition
- After these steps the SoS is then subjected to analysis by each individual system
- Since SE processes are not linear and sequential, it should be anticipated that information from lower-level processes will be fed back to higher-level processes
- Need to integrate executable SysML models to UAF models

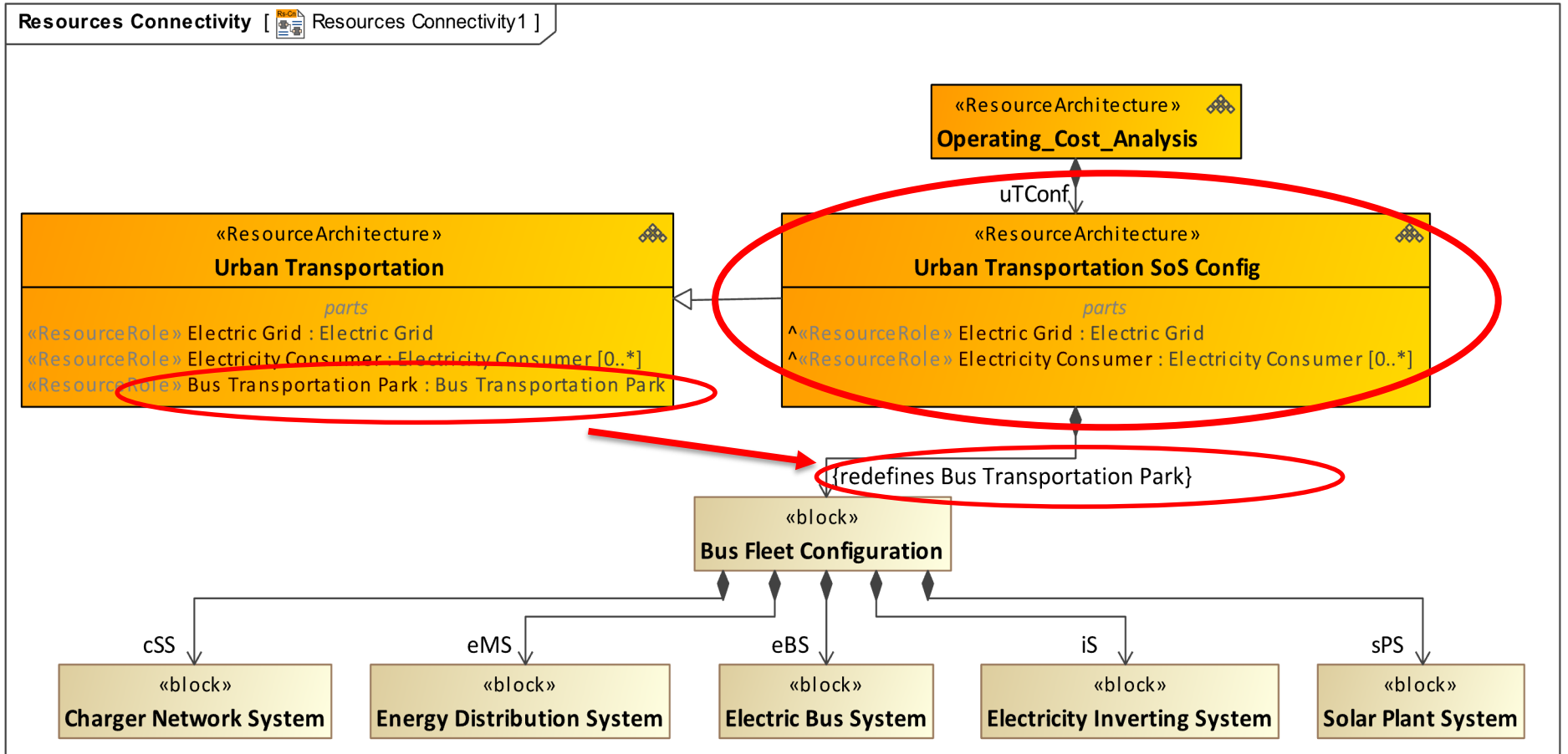
Transportation Park Analysis

- During the analysis at the system level, the potential for incorporating a solar energy generation system is identified

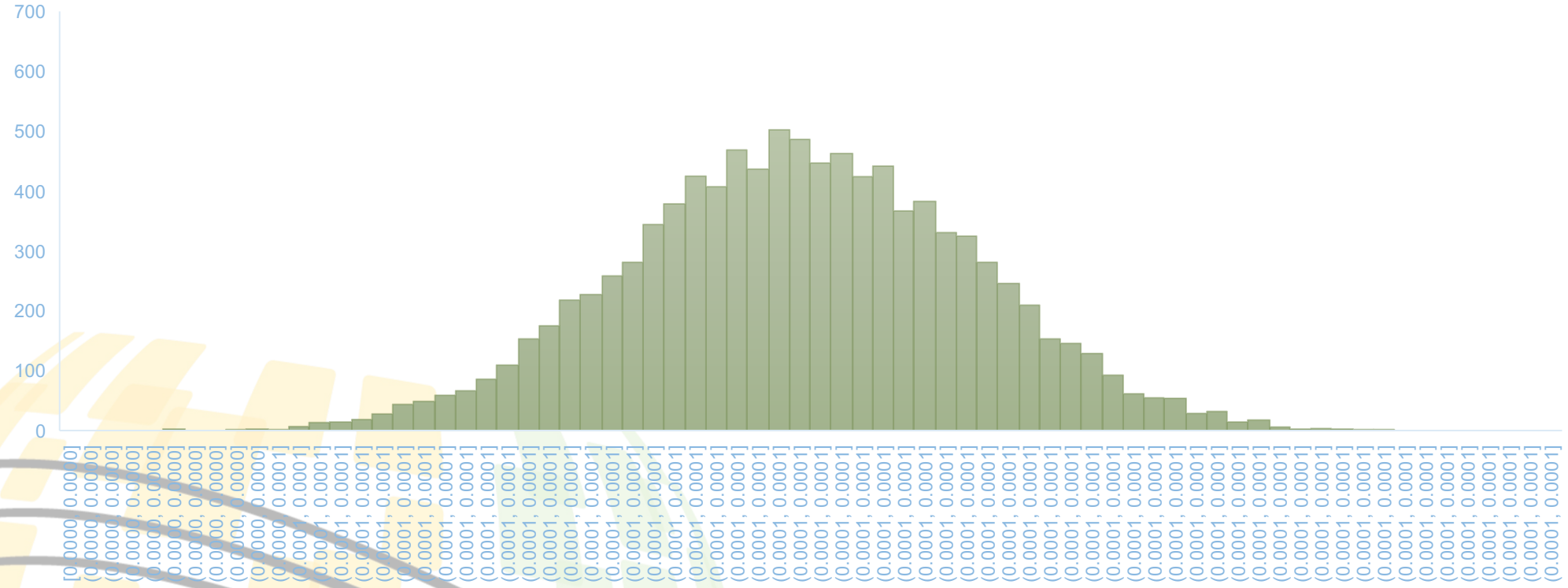


Configuration of SoS Model

- Inheritance is not enough. SoS components need to be redefined with updated system description from System models



Rinse and Repeat



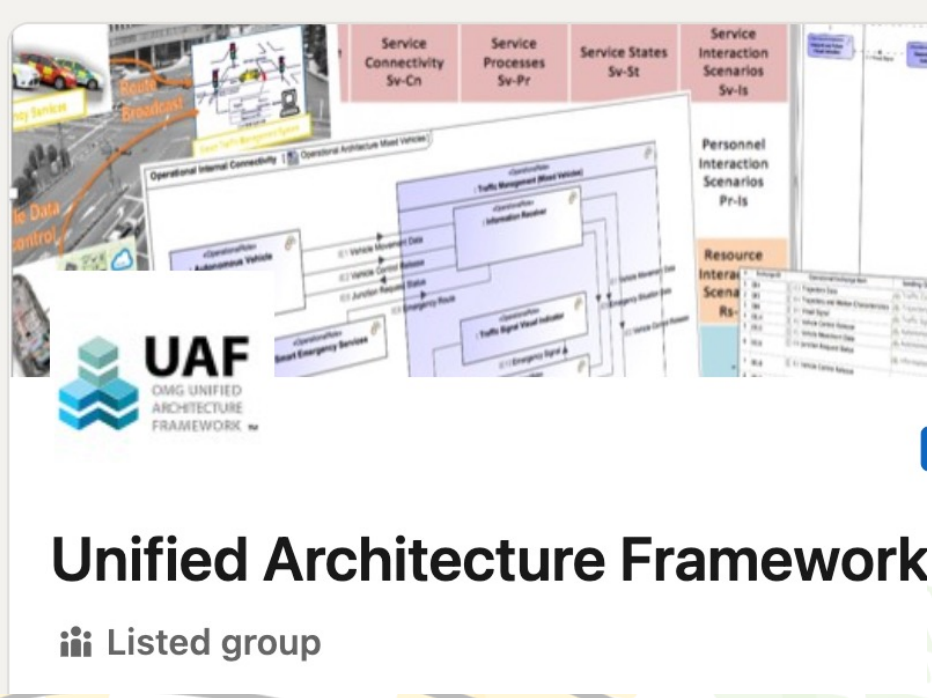
	Mean Value, Euro	Standard Deviation, Euro	Runs No
Operating Cost per Kilometer, Euro	0.7509	0.0831	10000
Difference	-5.4 %	+29.2 %	

Conclusions

Summary and Conclusions

- The industry is exploring ways to transition from SoS models to Systems models in their modeling approach
- This paper presents a potential method for connecting and co-executing SoS and System models
- This proposal is based on the concepts of UAF, SysML and the MagicGrid framework
- The proposed approach necessitates inheriting System Level models into SoS Level models in order to redefine an updated system
- From case study we understood that the most sensible approach is to redefine the atomic systems of SoS, since this allows the most straightforward system model integration into a SoS model

More on UAF



Unified Architecture Framework
https://www.linkedin.com/groups/8878655/

MagicGrid
https://www.linkedin.com/groups/9016086/

Q&A

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