SYSTEMS'S ARTIFACTS AND CONTEXT ANALYSIS

Prepared by Prof. Dr. Christopher Shneider Cerqueira

Session 09

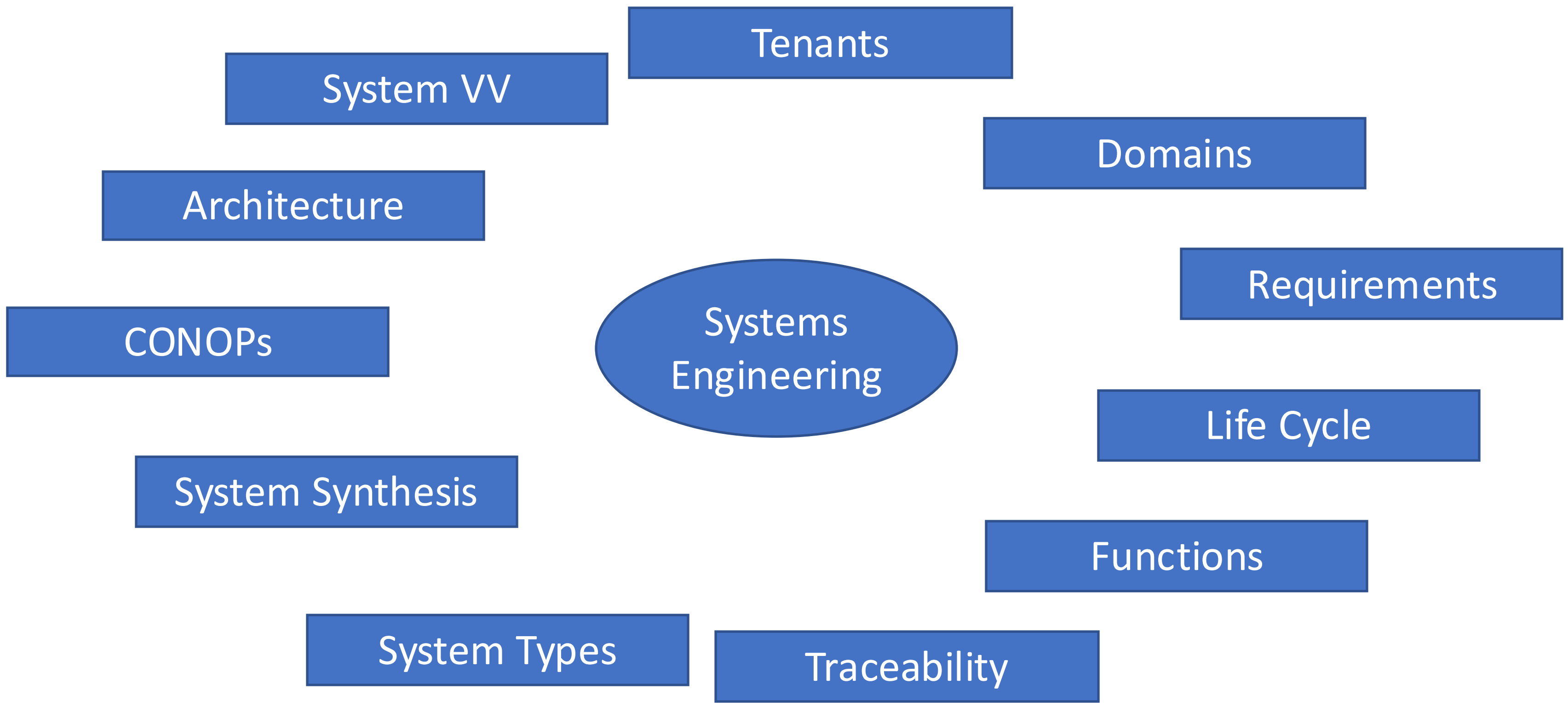
SEMANA		TEORIA	INDIVIDUAL	PESO	GRUPO	PESO
1	1	Estrutura e Filosofia do Curso	AI-01 - Resumo Cap 1 - HB INCOSE	10%		
05-Aug	1	O que é Engenharia de Sistemas? INCOSE				
	1	Elementos da Eng Sis.				
	1	Introdução aos diagrams clássicos.				
2		* (Viagem ao EUA)	AI-02 - Leitura/Resumo paper sobre representações clássicas.	10%		
12-Aug						
3		* (Viagem ao EUA)	AI-03 - Exercício sobre arquitetura e escrita de requisitos.	10%		
19-Aug						
4	1	Metodologias de MBSE e uso de modelos.	AI-04 - Resumo Artigo de Metodologias	10%		
26-Aug	1	Revisão de UML-SysML.				
	1	OPM				
	1	Arcadia				
5	1	OPM	AI-05 - Lista de exercícios	10%		
02-Sep	1					
	1					
	1					
6	1	Blocos e Classes	AI-06 - Lista de Exercícios	20%		
09-Sep	1					
	1	Máquina de Estados				
	1					
7	1	Casos de Uso	AI-07 - Lista de Exercícios	20%		
16-Sep	1					
	1	Sequência				
	1					
8	1	Integração dos pontos de vistas em um	AI-08 - Resumo sobre Ciclo de Vida de Modelos	10%	AI-08 - Descrição e Contorno do Problema.	100%
23-Sep	1	Associação dos artefatos de SE com modelos				
	1	Análise Operacional				
	1					
				100%		**100%**
SEM						
30-Sep						

SEMANA		TEORIA	INDIVIDUAL	PESO	GRUPO	PESO
9	1	Apresentação das necessidades			AG-09 - Apresentação Necessidades	20%
07-Oct	1	Intervenção Sistêmica				
	1	Associação com Requisitos				
	1					
10	1	Apresentação da Arq e Req de sistema	AI-10 - Exercícios de Arquitetura Funcional	20%	AG-10- Apresentação Arq / Caixa Preta	20%
14-Oct	1	Conceitos de Arquitetura Funcional				
	1	Arquitetura Conceitual				
	1					
11	1	Utilização de modelos para outros processos			AG-11 - Geração de documentos	10%
21-Oct	1					
	1	Exportação automática de documentos				
	1					
12	1	Apresentação da arquitetura Conceitual	AI-12 - Explorar RCE lendo arquivo do Capella	20%	AG-12 - Apresentação Arq. Conceitual e Proposta de VV	20%
28-Oct	1	Co-Engineering / CDF / RCE				
	1	Arquitetura Concreta				
	1					
13		* (ADS-HLG)	AG.13 - Explorar Plugin M2DOC (extra)	20%		
04-Nov						
14		* (ADS-HLG)	AG-14 - Explorar Plug in P4C (extra)	20%		
11-Nov						
15	1	Metamodelo	AG=5 - Figura do Metamodelo	20%	AG-15 = Relatório de Proposta de plugin	20%
18-Nov	1	Capella Studio - Criação de plugins				
	1					
	1					
16	1	Apresentação final			AG-16 - Apresentação do Projeto Completo	20%
25-Nov	1					
	1					
	1	Encerramento do Curso				
				100%		**110%**
EXAME 02-Dec 13-Dec		**Grupo: Apresentação / Relatório / Gravação / Código de um: plugin ou doc**				**100%**

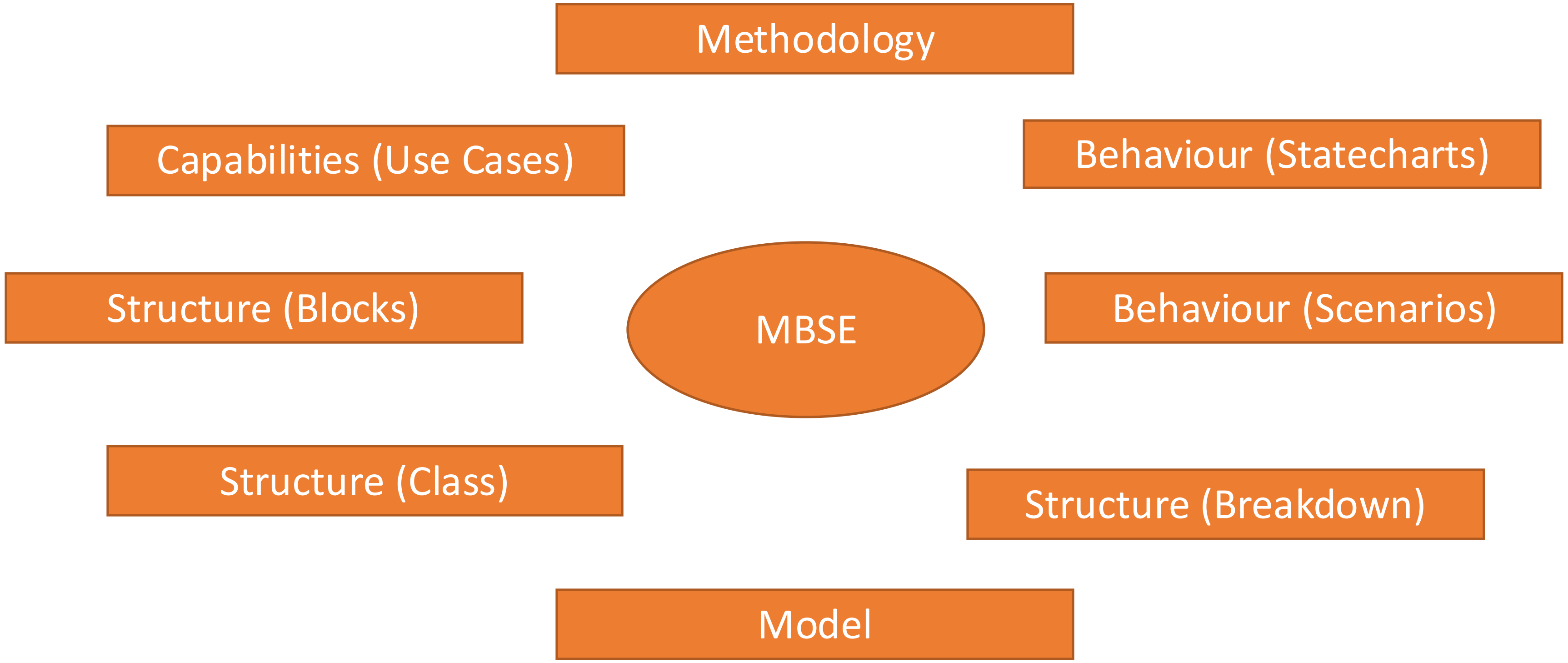
Summary

Systems Engineering Artifacts

Systems Engineering Helm



MBSE HELM


Methodology
Capabilities (Use Cases)
Behaviour (Statecharts)
Structure (Blocks)
MBSE
Behaviour (Scenarios)
Structure (Class)
Structure (Breakdown)
Model

This course

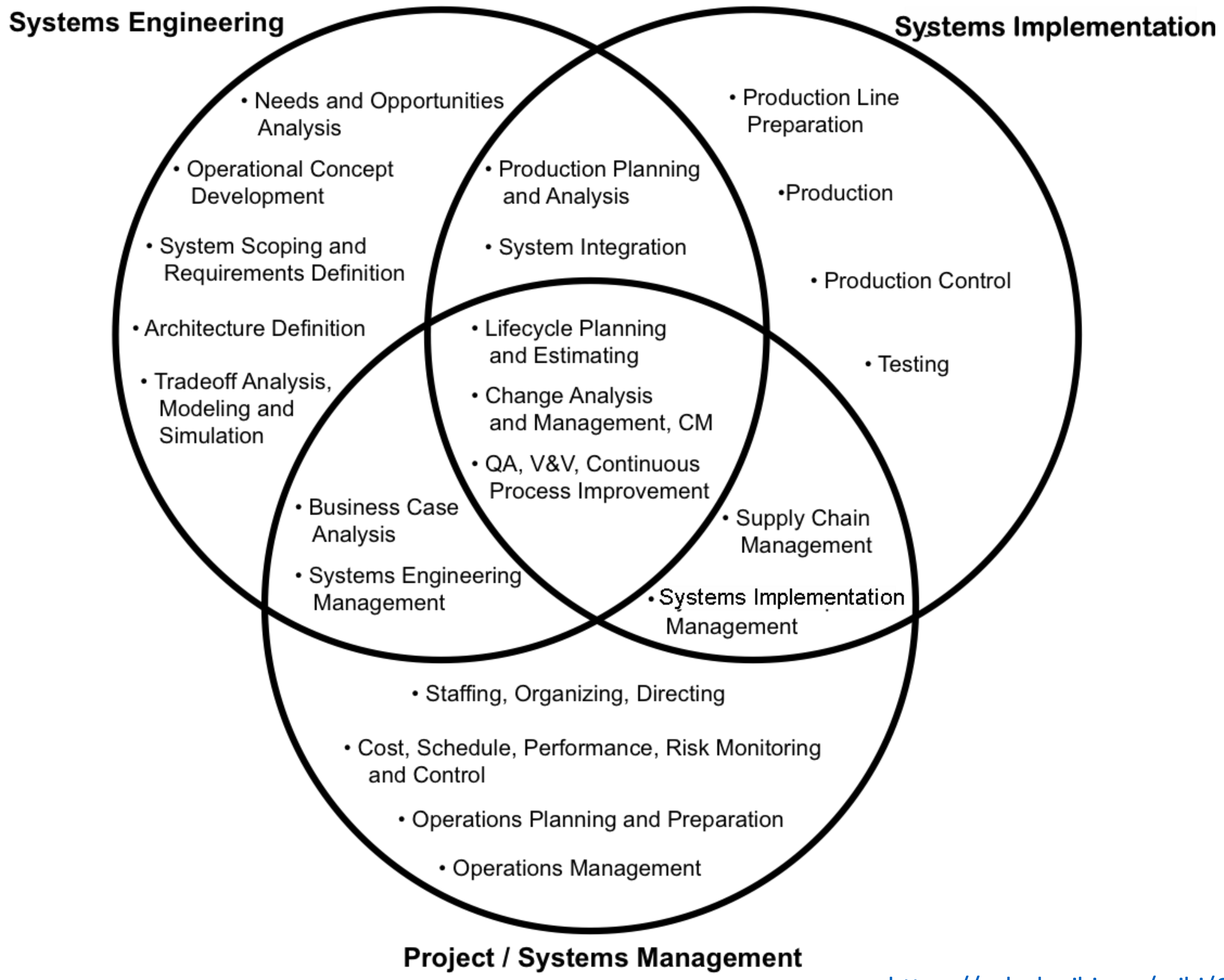
Systems Engineering

- Tenants
- Domains
- Requirements
- Life Cycle
- Functions
- System Synthesis
- Traceability
- System Types
- CONOPs
- Architecture
- System VV

MBSE

- Model
- Capabilities (Use Cases)
- Behaviour (Statemachine)
- Structure (Blocks)
- Behaviour (Scenarios)
- Structure (Breakdown)
- Structure (Class)
- Methodology

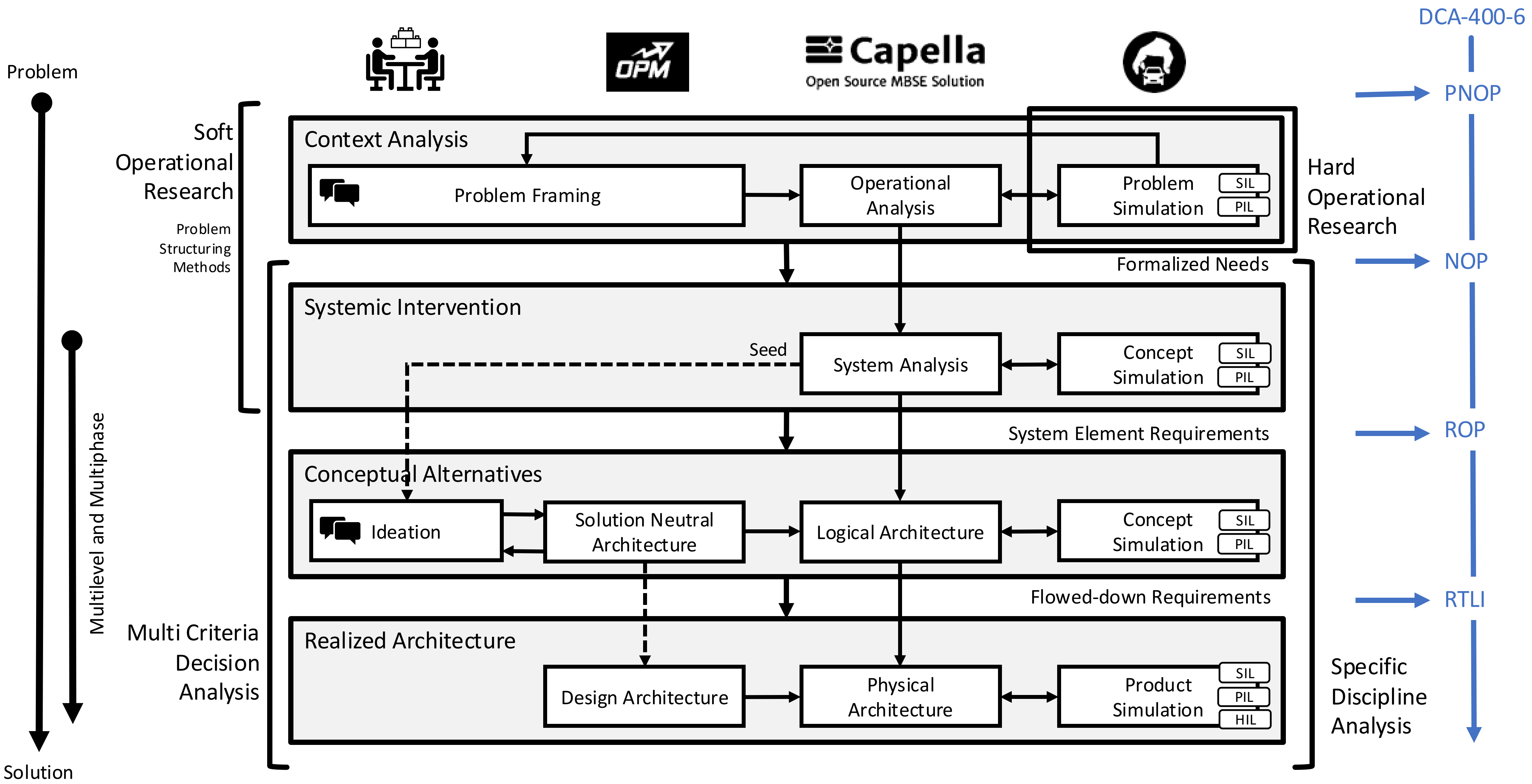
Relationship with Other Disciplines



https://sebokwiki.org/wiki/Systems_Engineering_Overview

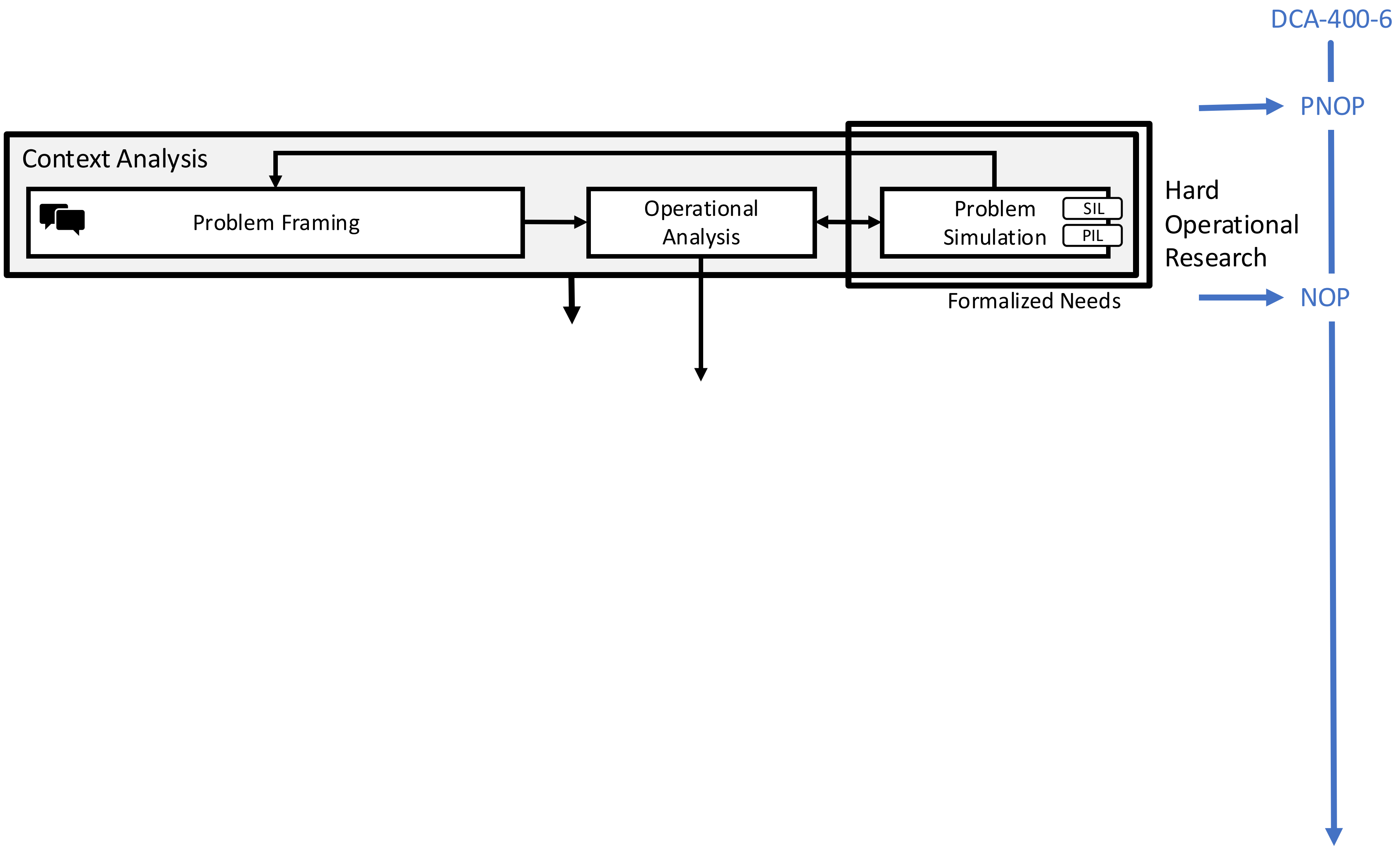
UP Example

MMMF



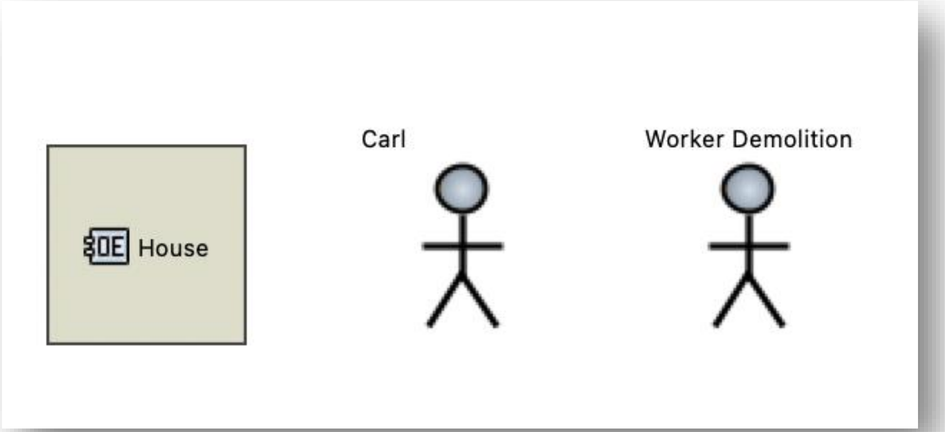
DCA-400-6
Problem
Soft Operational Research
Problem Structuring Methods
OPM
Capella
Open Source MBSE Solution
Context Analysis
Problem Framing
Operational Analysis
Problem Simulation
SIL
PIL
Hard Operational Research
PNOP
Formalized Needs
NOP
Systemic Intervention
Seed
System Analysis
Concept Simulation
SIL
PIL
System Element Requirements
ROP
Multilevel and Multiphase
Conceptual Alternatives
Ideation
Solution Neutral Architecture
Logical Architecture
Concept Simulation
SIL
PIL
Flowed-down Requirements
RTLI
Multi Criteria Decision Analysis
Realized Architecture
Design Architecture
Physical Architecture
Product Simulation
SIL
PIL
HIL
Specific Discipline Analysis
Solution

Context analysis



DCA-400-6
PNOP
NOP
Context Analysis
Problem Framing
Operational
Analysis
Problem
Simulation
SIL
PIL
Hard
Operational
Research
Formalized Needs

Modelling the Actors/Entities of what is happening now (as is)



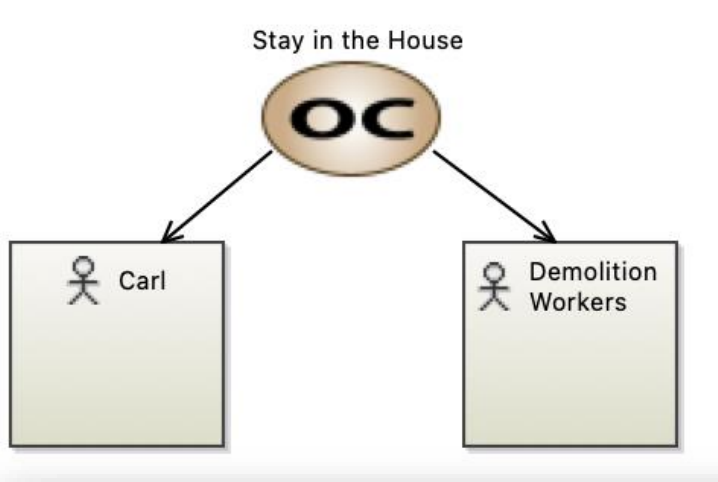
Symbols

Use context images

Capella>>Operational Analysis>>Operational Entity Breakdown Diagrams

Map what is happening

1.



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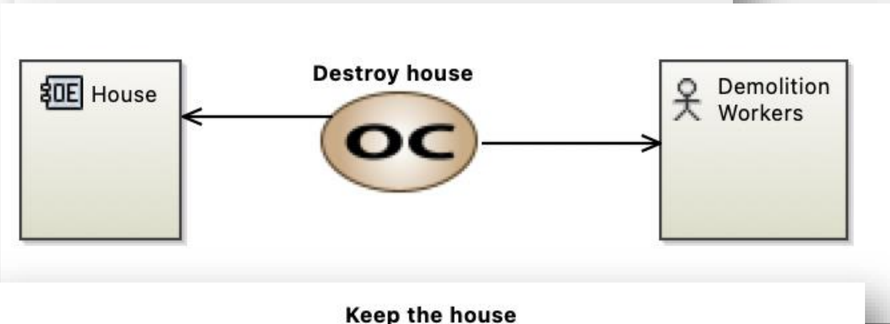

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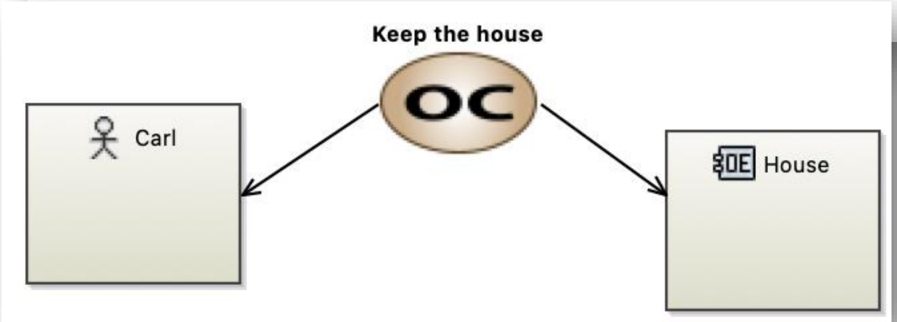
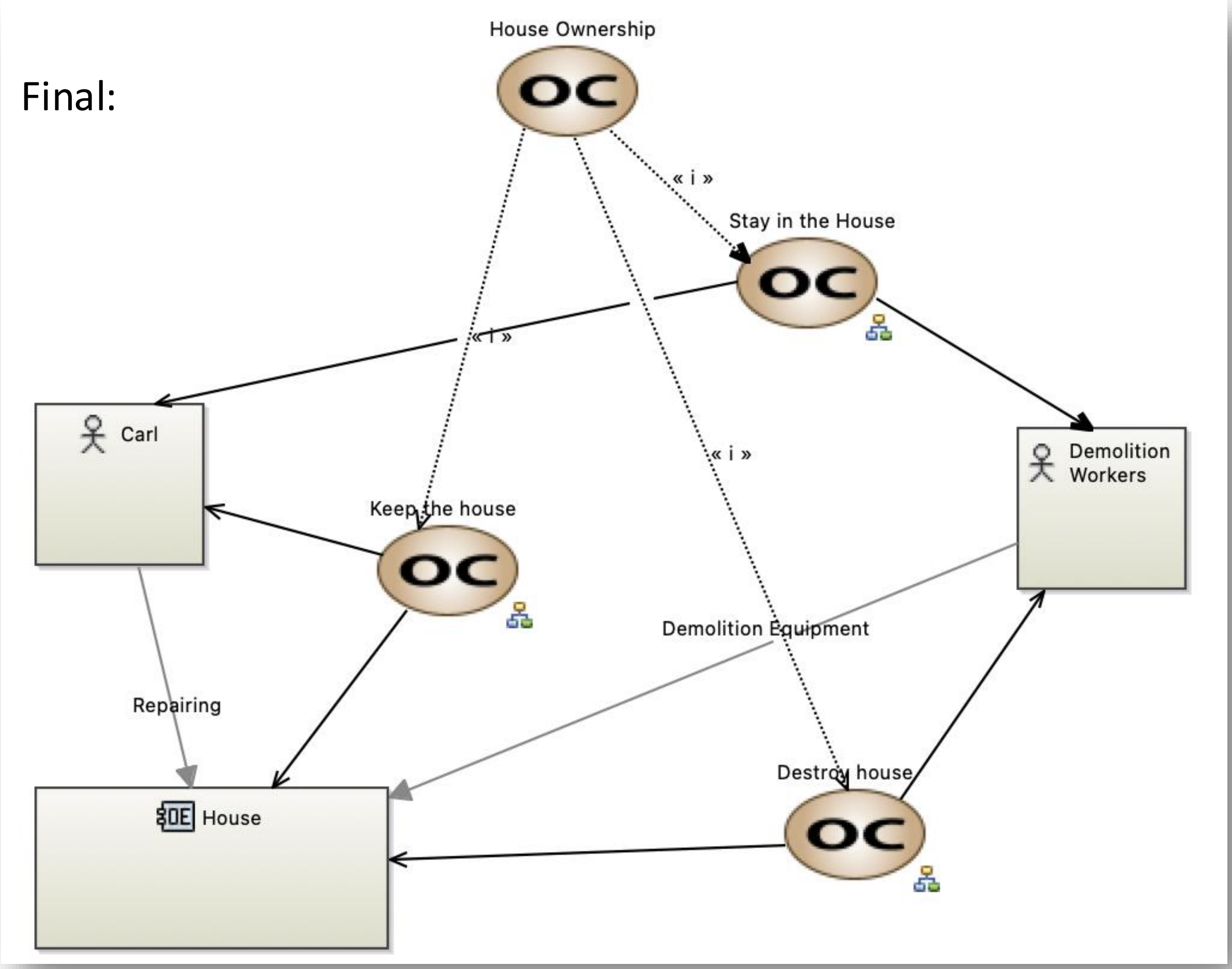
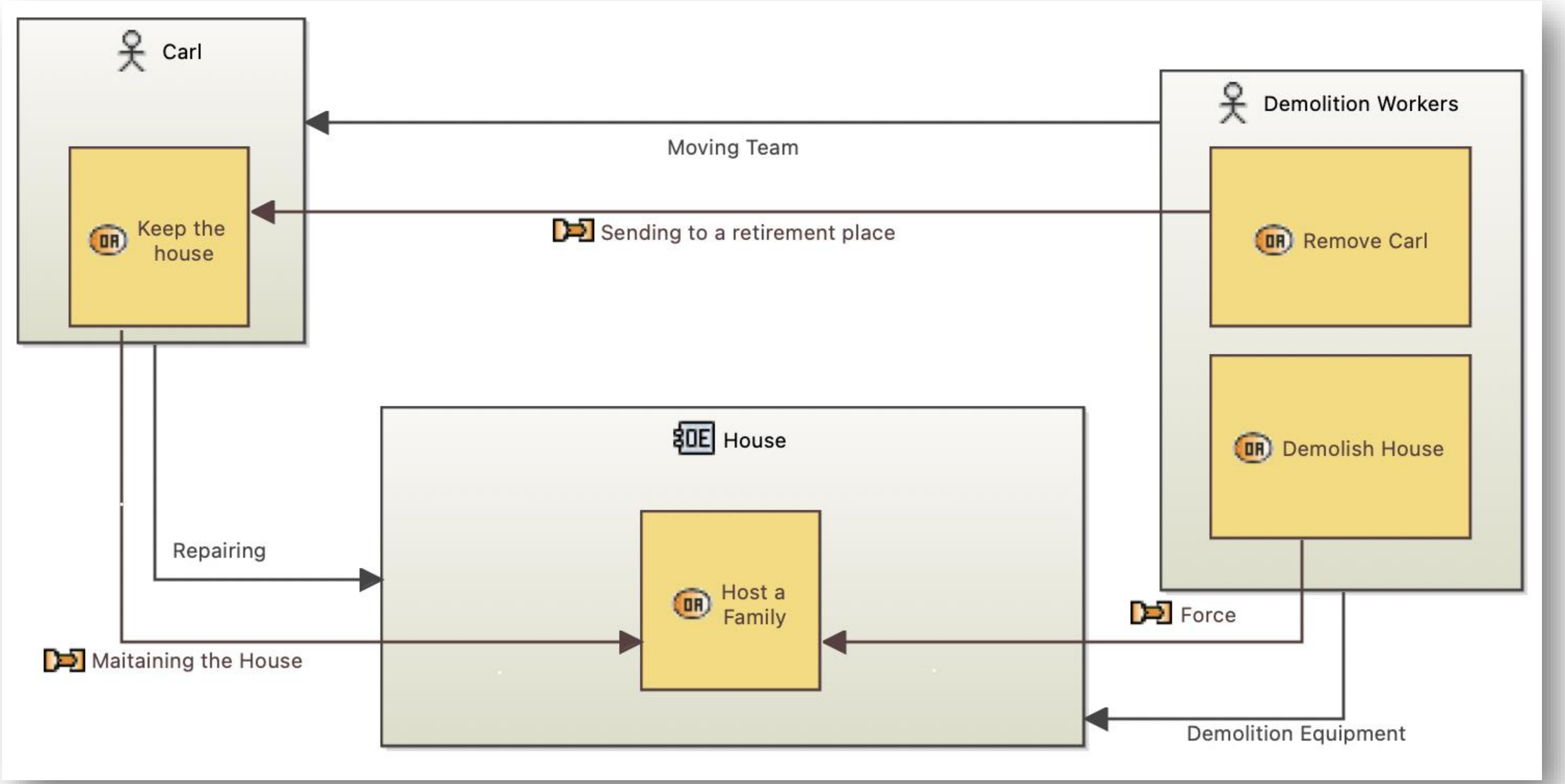




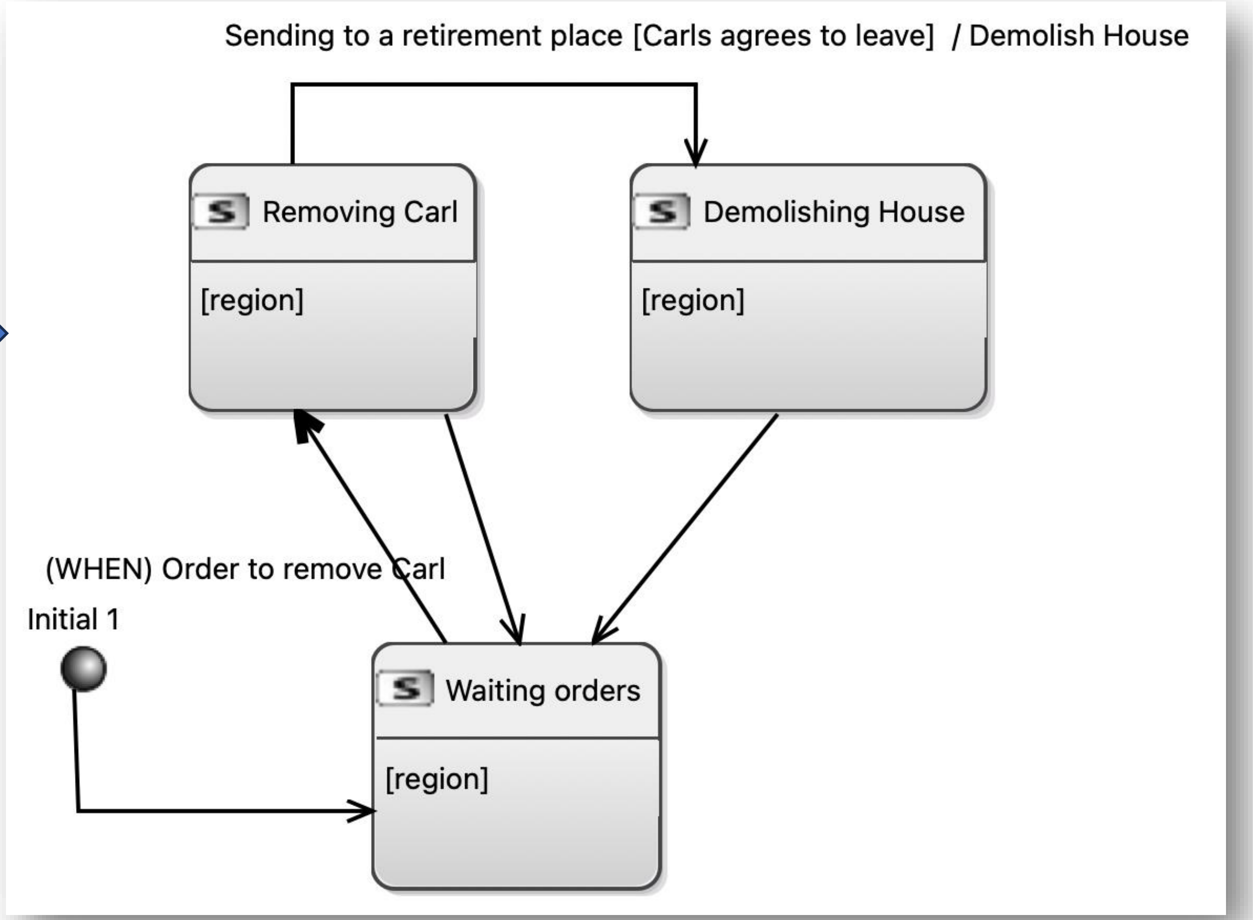
Capella>>Operational Analysis>>Operational Capabilities Diagrams

Each Stakeholder (Actor/Entity) do something (activity) and relates to each Other (interaction)



Capella>>Operational Analysis>>Operational Architecture Diagram

Describe the stakeholders' behaviors



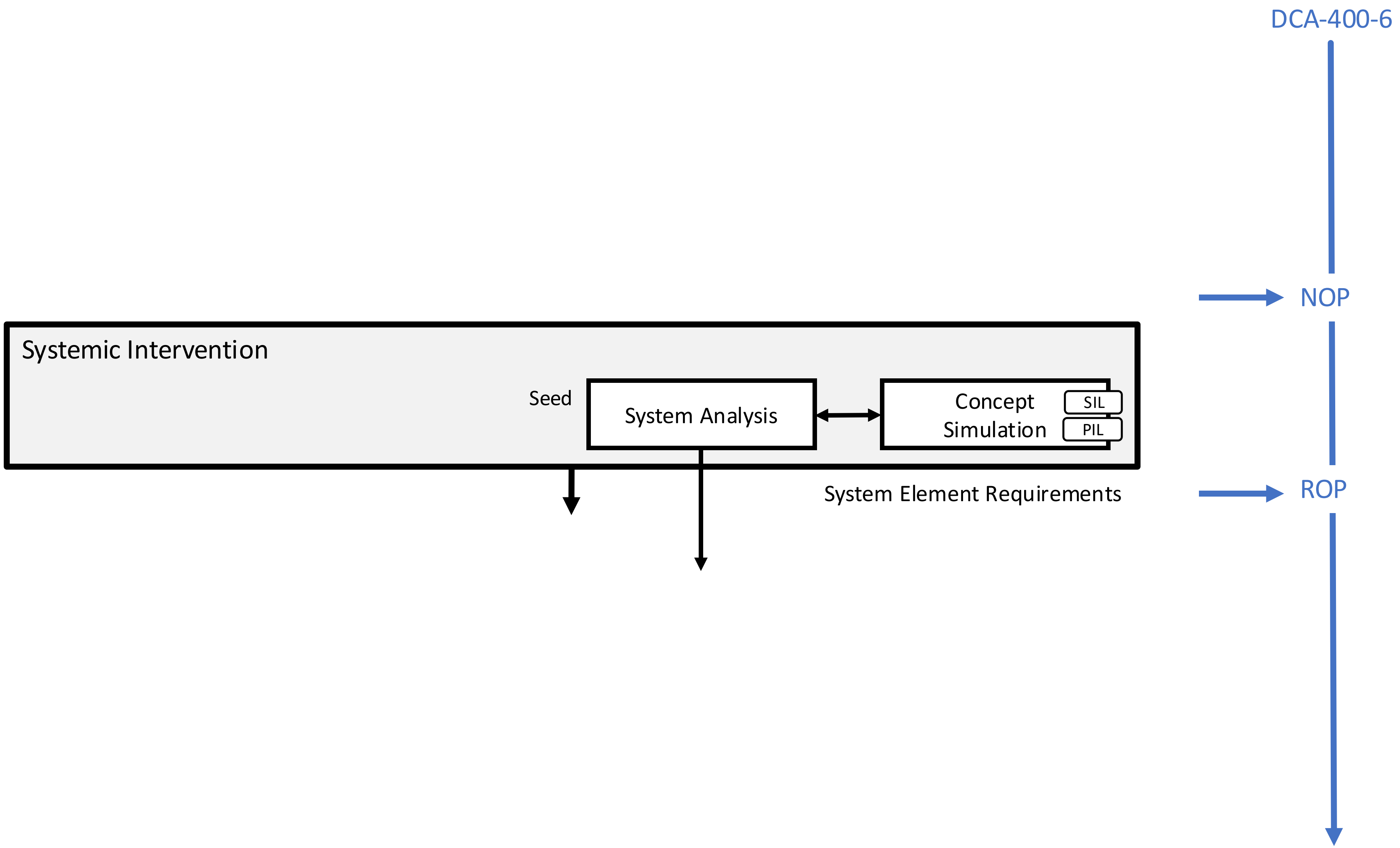
Capella>>Operational Analysis>>StateMachine Diagram

What do we need to finish with it?

- Needs mapped: What the users of the system need to accomplish
  - Mission Requirements
  - User Requirements
- Maybe not all the stakeholders opinion/needs are going to be “relevant”. It is a matter of analysis and priorization of the organization.
- One thing: this is the problem domain..... So your systems ***DOES NOT EXIST.***

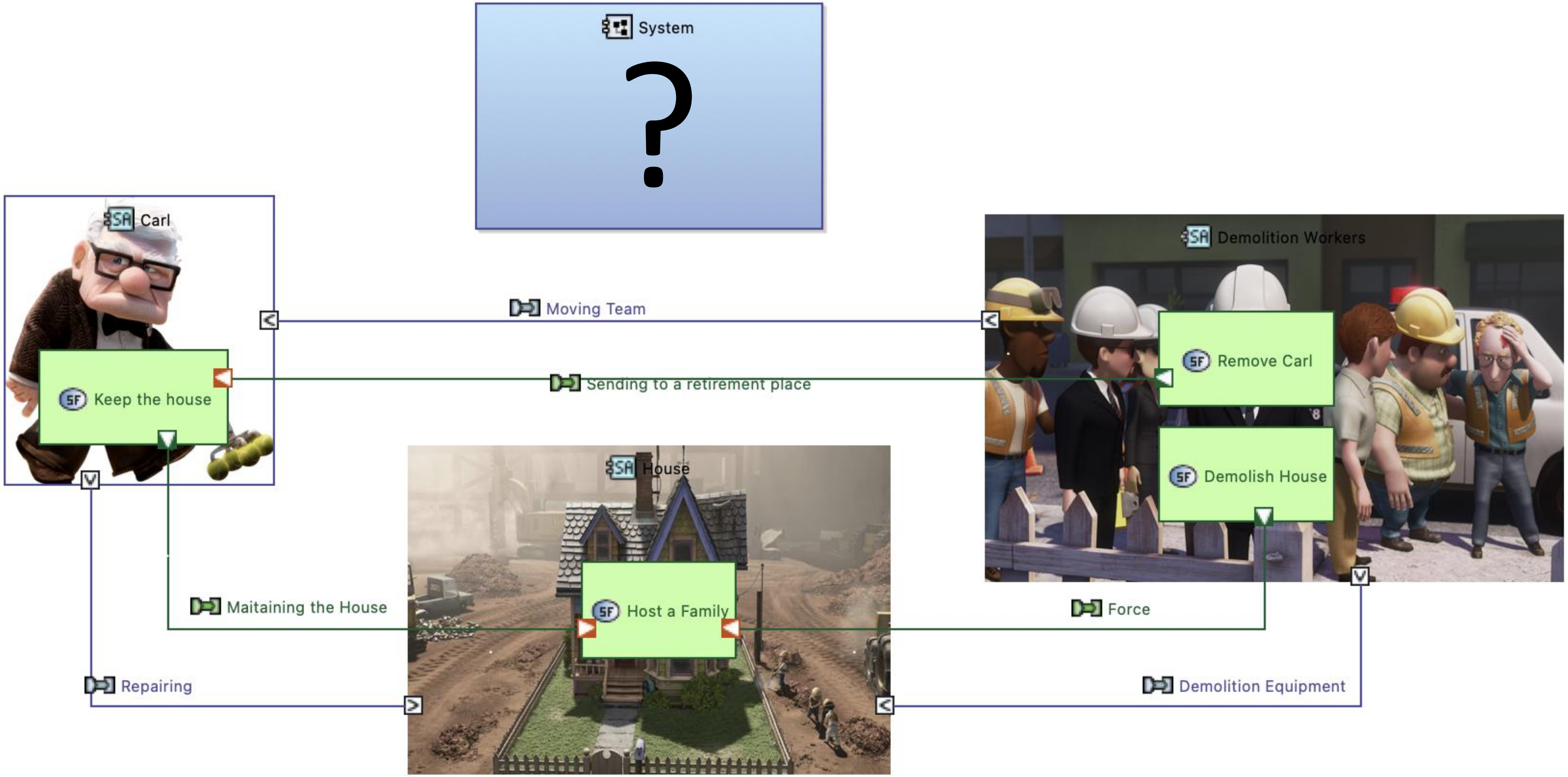
System intervention

What the system has to accomplish for the users


DCA-400-6
NOP
ROP
Systemic Intervention
Seed
System Analysis
Concept
Simulation
SIL
PIL
System Element Requirements

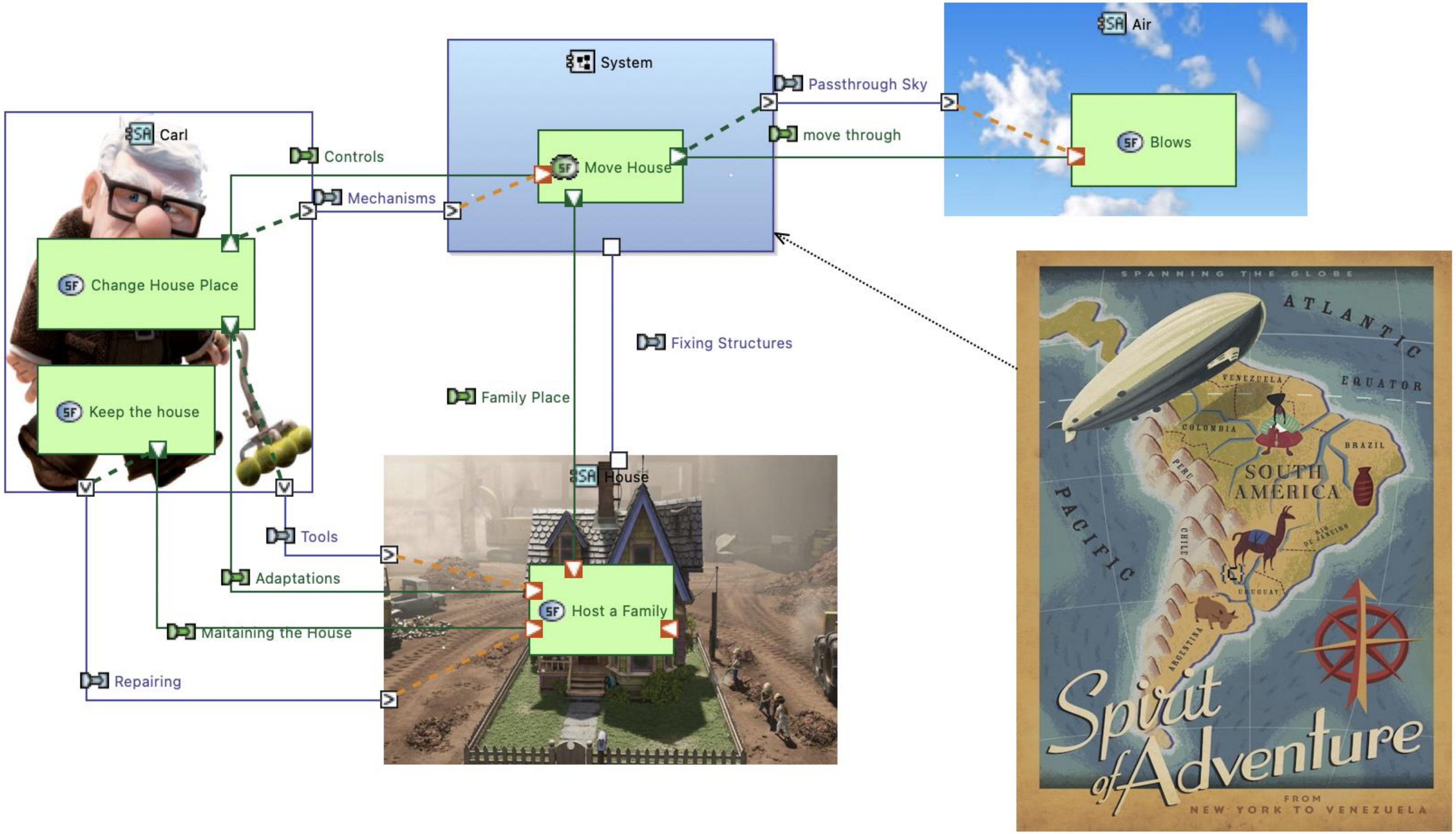

SPANNING THE GLOBE
ATLANTIC
EQUATOR
VENEZUELA
COLOMBIA
BRAZIL
PERU
SOUTH AMERICA
PACIFIC
CHILE
RIO DE JANEIRO
URUGUAY
ARGENTINA
Spirit of Adventure
FROM
NEW YORK TO VENEZUELA

Well.. What do the system must do?!



Capella>>System Analysis>>System Architecture Diagram

Well... Carl wants to move the house



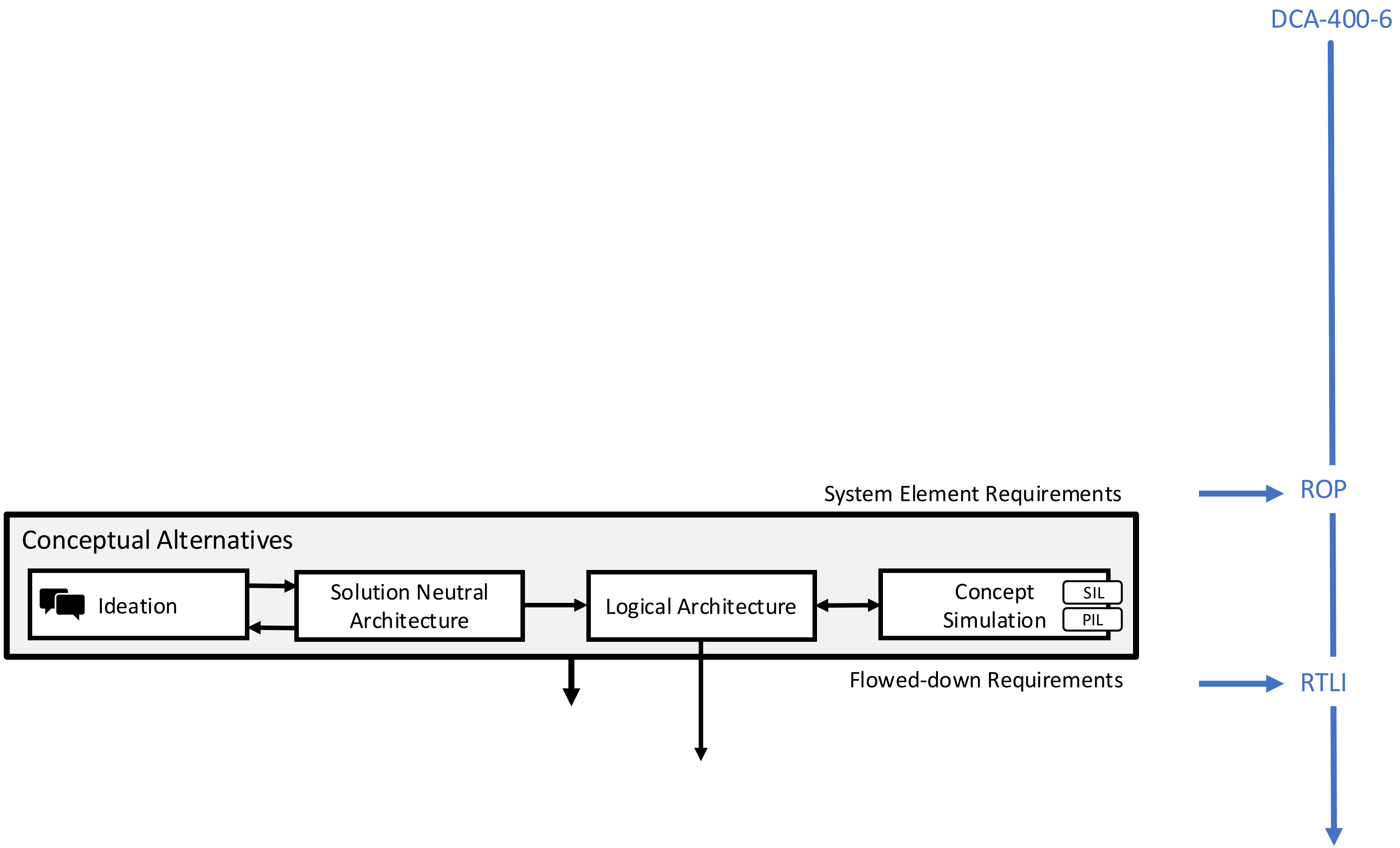
Capella>>System Analysis>>System Architecture Diagram

What do we need to finish with it?

- Requirements mapped: What the system has to accomplish for the users
  - System Requirements
- Remember that requirements are on the problem domain → does not carry solution on it.
  - The system must receive 24V /// and not /// The Li-Po Battery must provide 24V to the System.
- One thing: The System is a black box... We can not see inside only the frontier functions (interface/external functions) – such functions are what emerges!!! (emergent properties)

Conceptual Architecture

How the system will work to fulfill the expectations


DCA-400-6
System Element Requirements
ROP
Conceptual Alternatives
Ideation
Solution Neutral Architecture
Logical Architecture
Concept Simulation
SIL
PIL
Flowed-down Requirements
RTLI


ZEPPELIN


ZEPPELIN



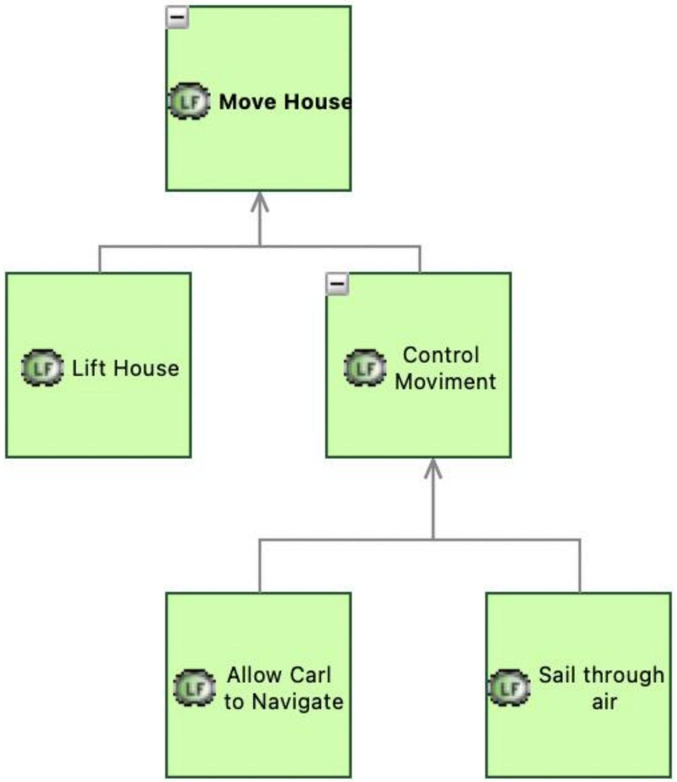
LED-ZEPPELIN

hummm

- Even though the joke with Led Zeppelin is a good one... And I could not avoid to make it... ☺

- It is more a balloon than a zeppelin.

Well.. The main function was: Move House

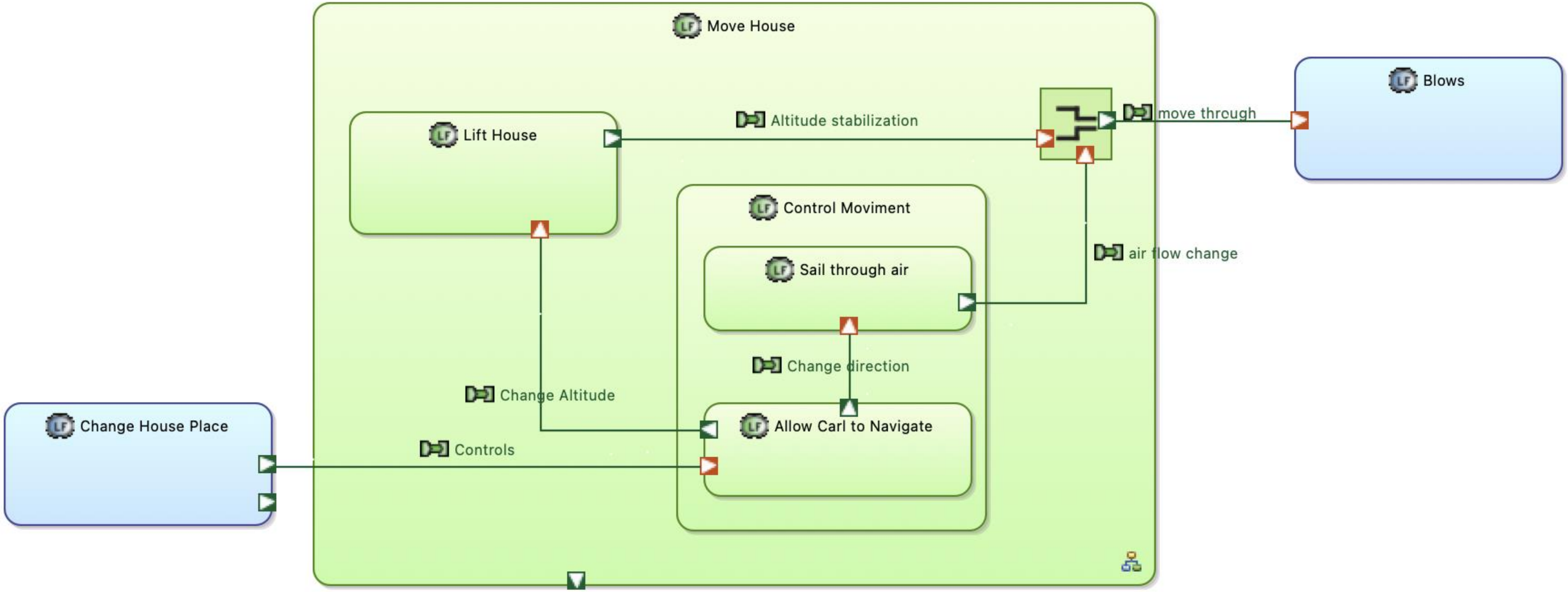


We can decompose the functions in subfunctions.

Only leaf functions must be used.

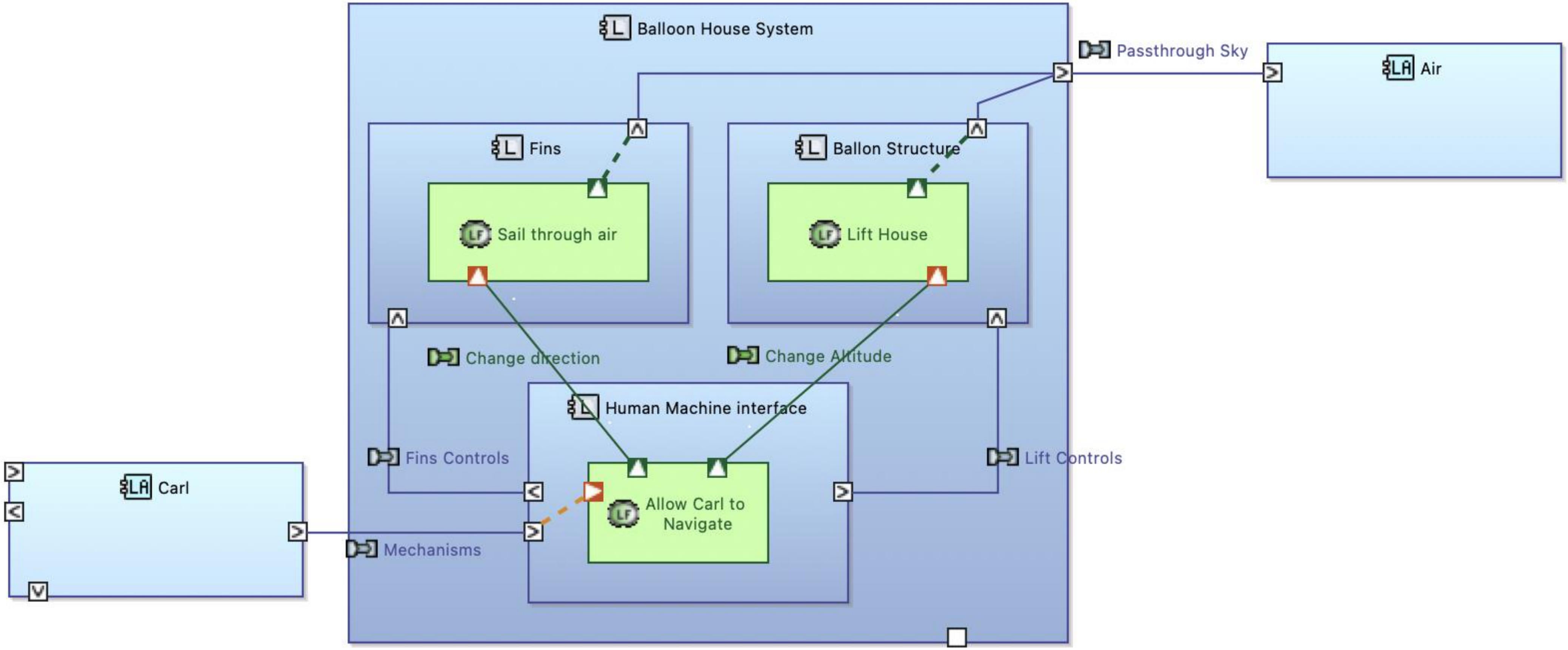
Capella>>Logical Architecture>>Logical Function Breakdown Diagram

The functions might have its own architecture: Functional Architecture



Capella>>Logical Architecture>>Logical Function Data Flow Diagram

We can conceptually split functions into a reference architecture of the aiming solution



Capella>>Logical Architecture>>Logical Architecture Diagram

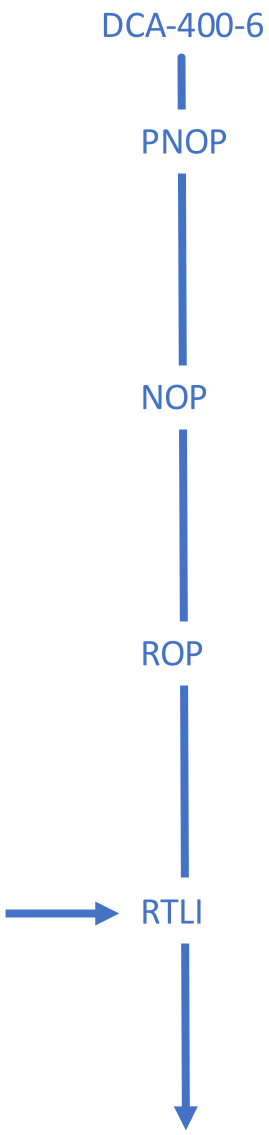
We could have decided a CONOPs to this solution concept

What do we need to finish with it?

- Requirements mapped: How the system will work to fulfill the expectations
  - Subsystem Requirements (or any decomposition part of it)
- We have a functional architecture spread through a desired architecture.
  - We can plan verifications, transitions, integrations, operations, and everything.
  - Here is the place to ask for functions that will have a technological solution on the next step.
- One thing: The System is now a white box... We can see inside and design the desired (at least requested) architecture.

Concrete Architecture

How the system will be built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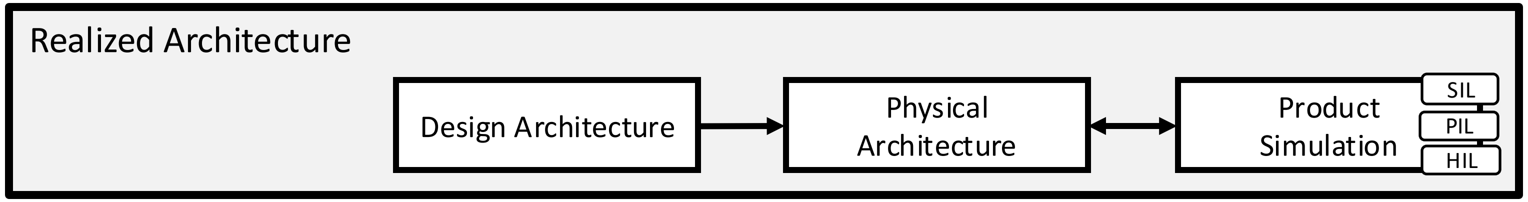
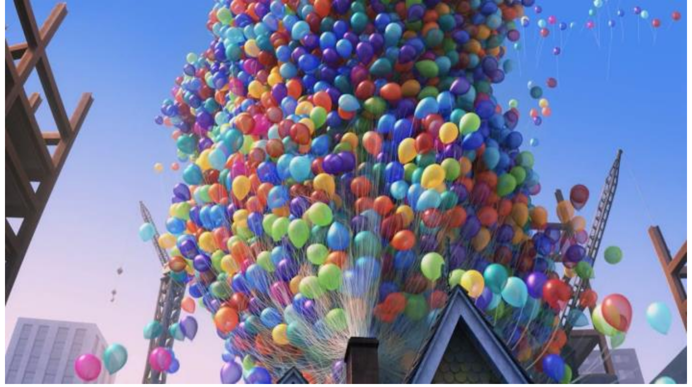

Realized Architecture
Design Architecture
Physical Architecture
Product Simulation
SIL
PIL
HIL

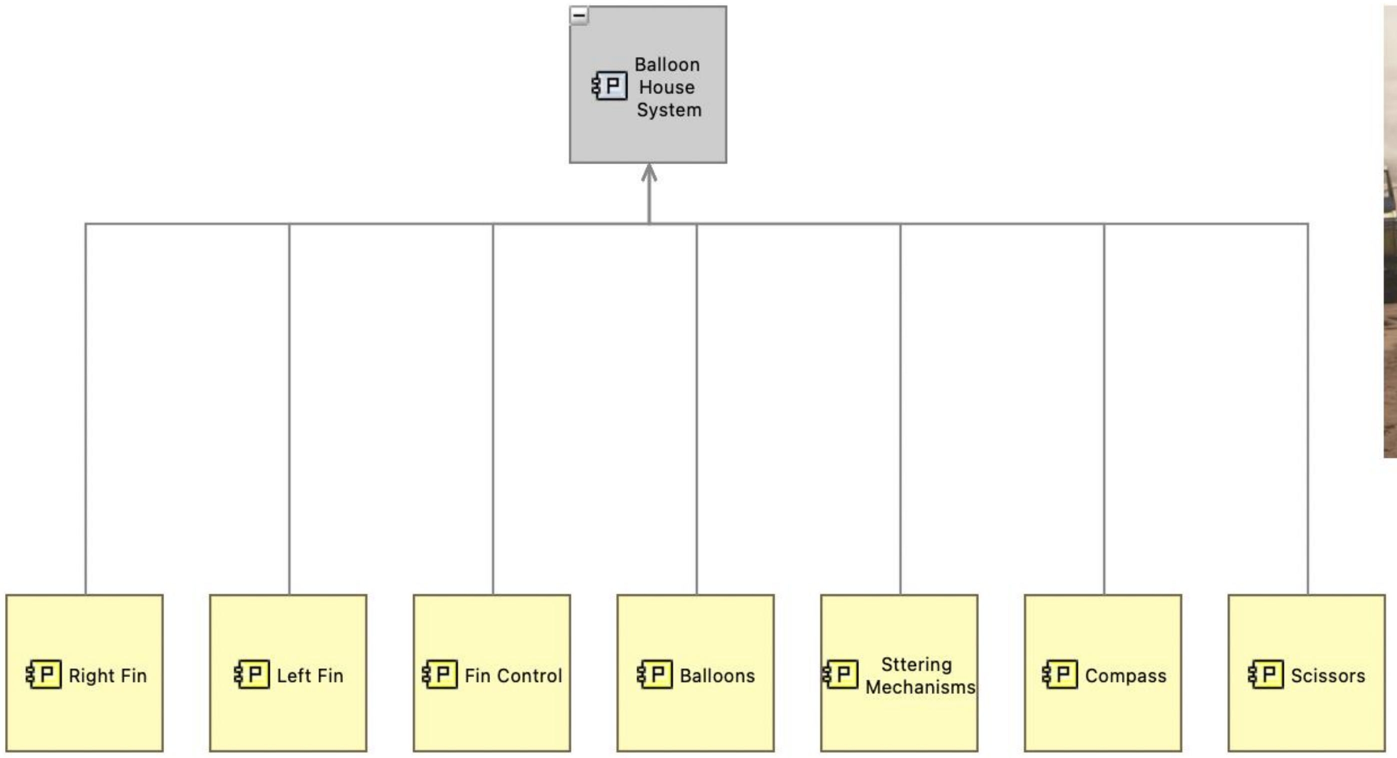
So ok... Final step is specify what is going to be built

- He had the “things” that were feasible, pre-existing in the house and easily acquirable.
  - To lift: balloons
  - To steer: some house tools
  - To sail: towels, blankets
  - To navigate: compass
  - To adjust altitude: cut the balloon strings

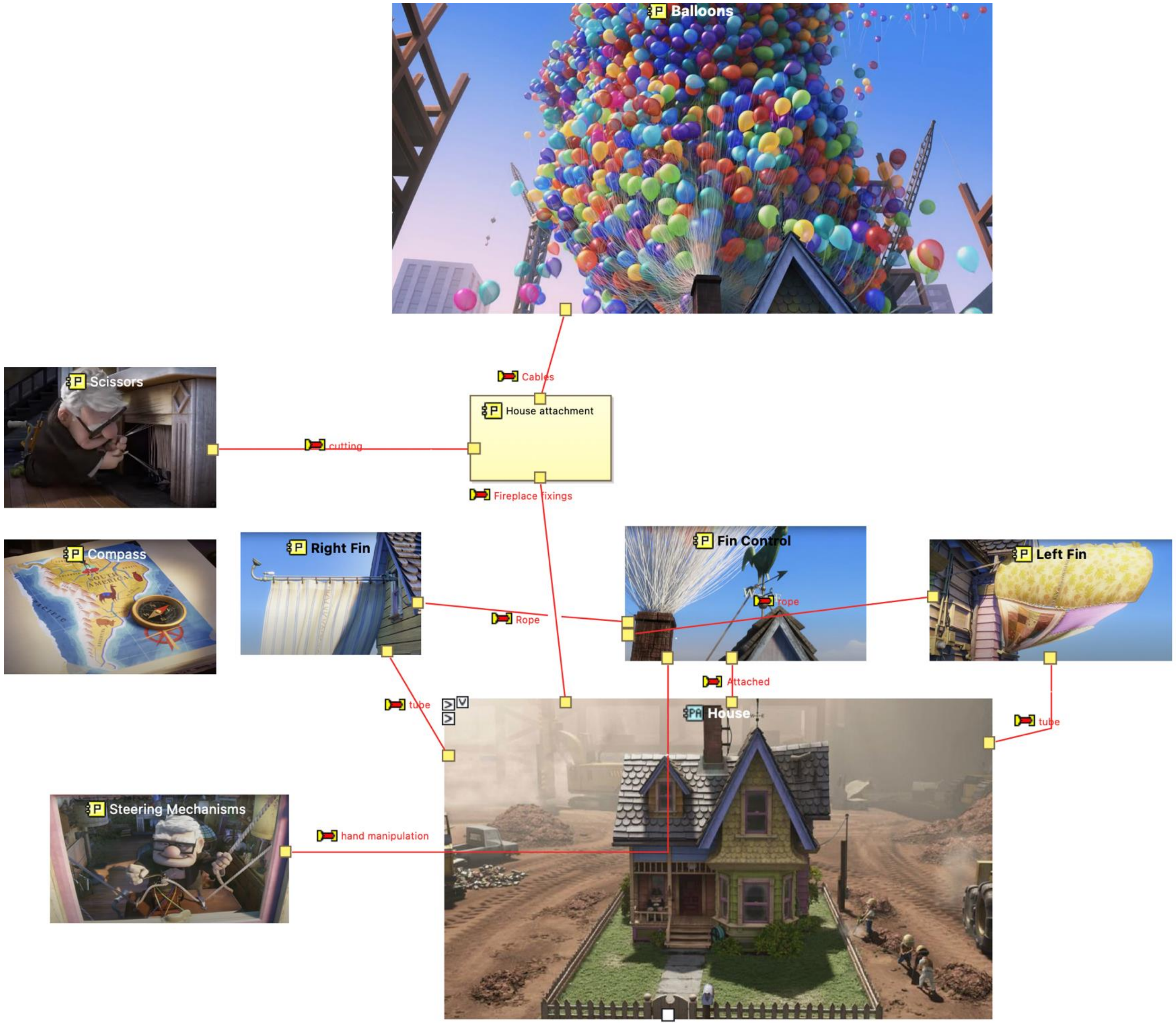



SOUTH
AMERICA

Point out the technological choices to built the Balloon House System



Capella>>Physical Architecture>>Physical Component Breakdown Diagram



To be built model

Capella>>Physical Architecture>>Physical Architecture Diagram

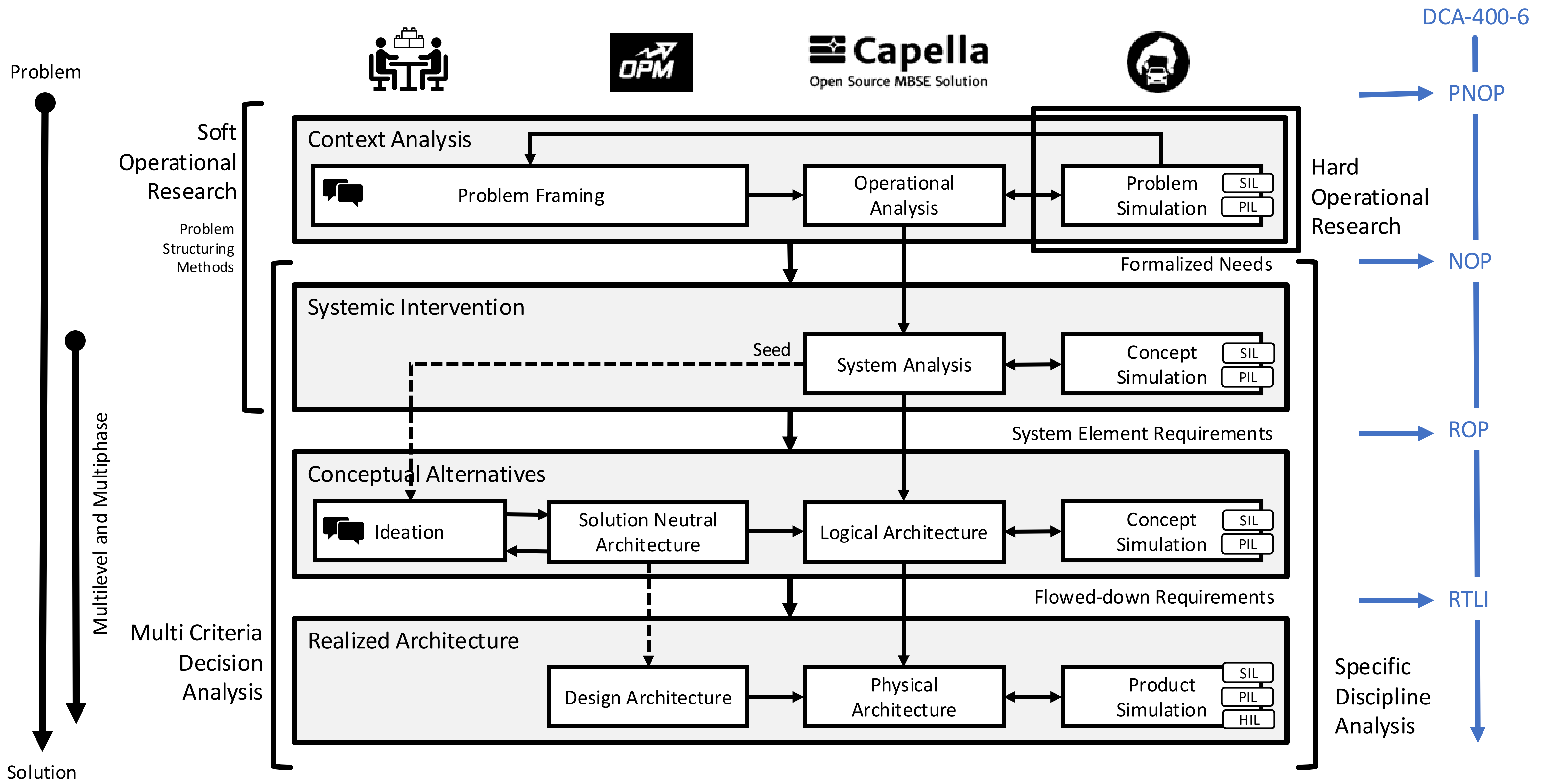
What do we need to finish with it?

- Specifications to the development/acquisition/building process
  - Would go to every details necessary to build the system.
- We have a concrete architecture (do not be confused by the word physical – does not need to be “physical”… can be a process, software, information, so on)
- Usually in the Phase 0 / Pre-A of the Space System Lifecycle it is designed a feasibility architecture with co-engineering (in Concurrent Engineering Labs). This Architecture would be born in this phase and iterated/adapted through the next life cycle phases.

System Delivered:

FireSAT Example

MMMF



DCA-400-6
Problem
Soft
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Structuring
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Multi Criteria
Decision
Analysis
Realized Architecture
Design Architecture
Physical
Architecture
Product
Simulation
SIL
PIL
HIL
Specific
Discipline
Analysis
Solution

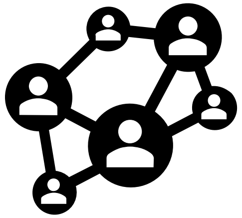
Context Analysis

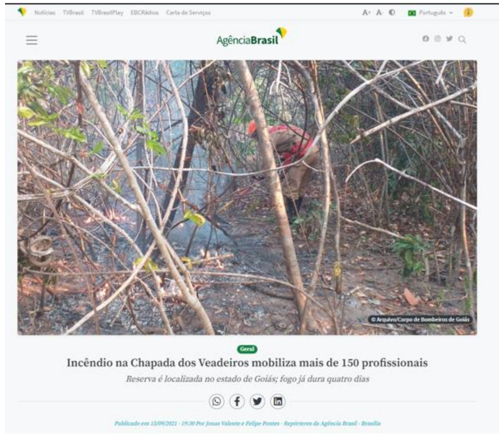
Research before engineer

Initial understanding: free explorations of the problem.

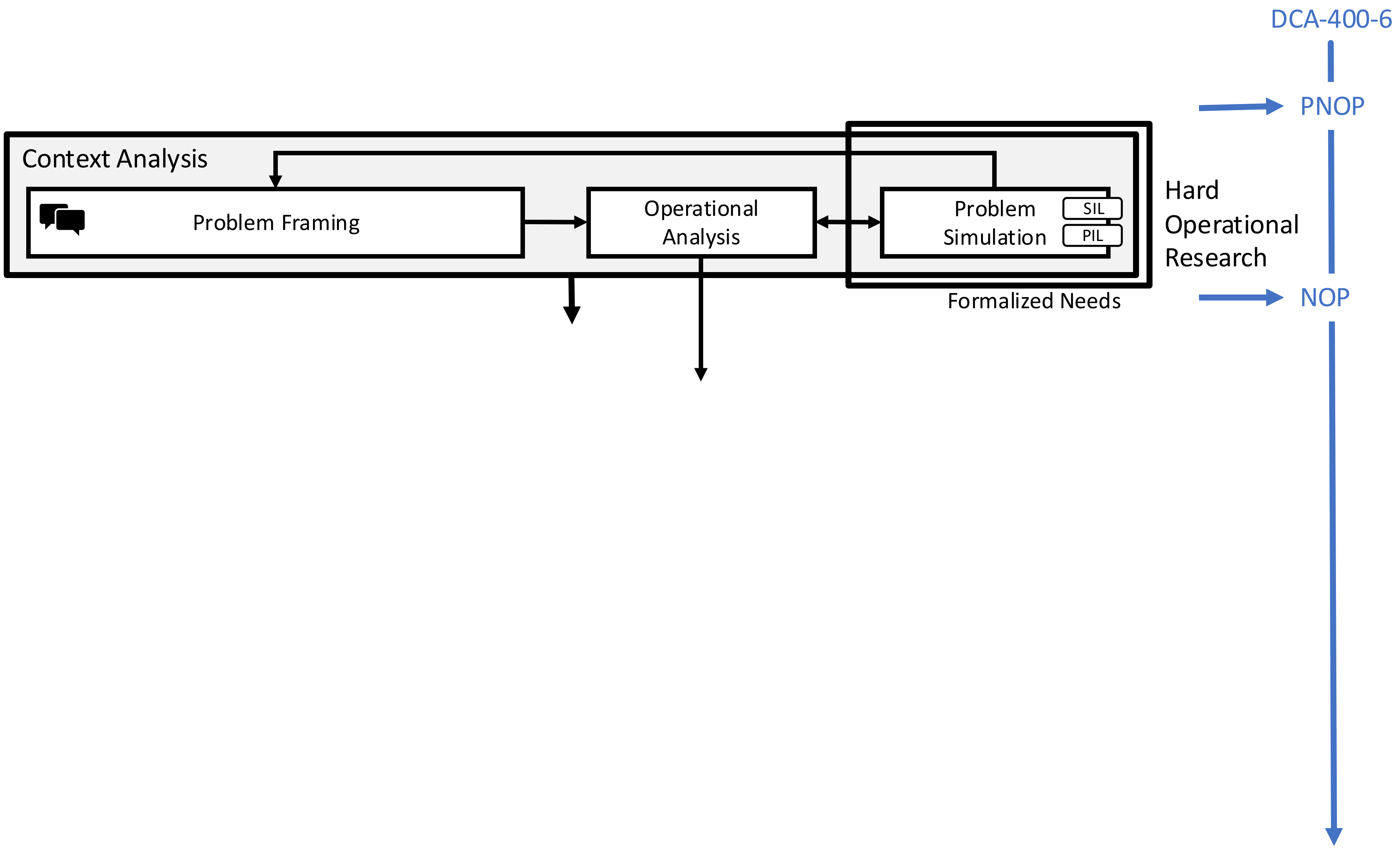
Learning the domain to improve knowledge

Find stakeholders!

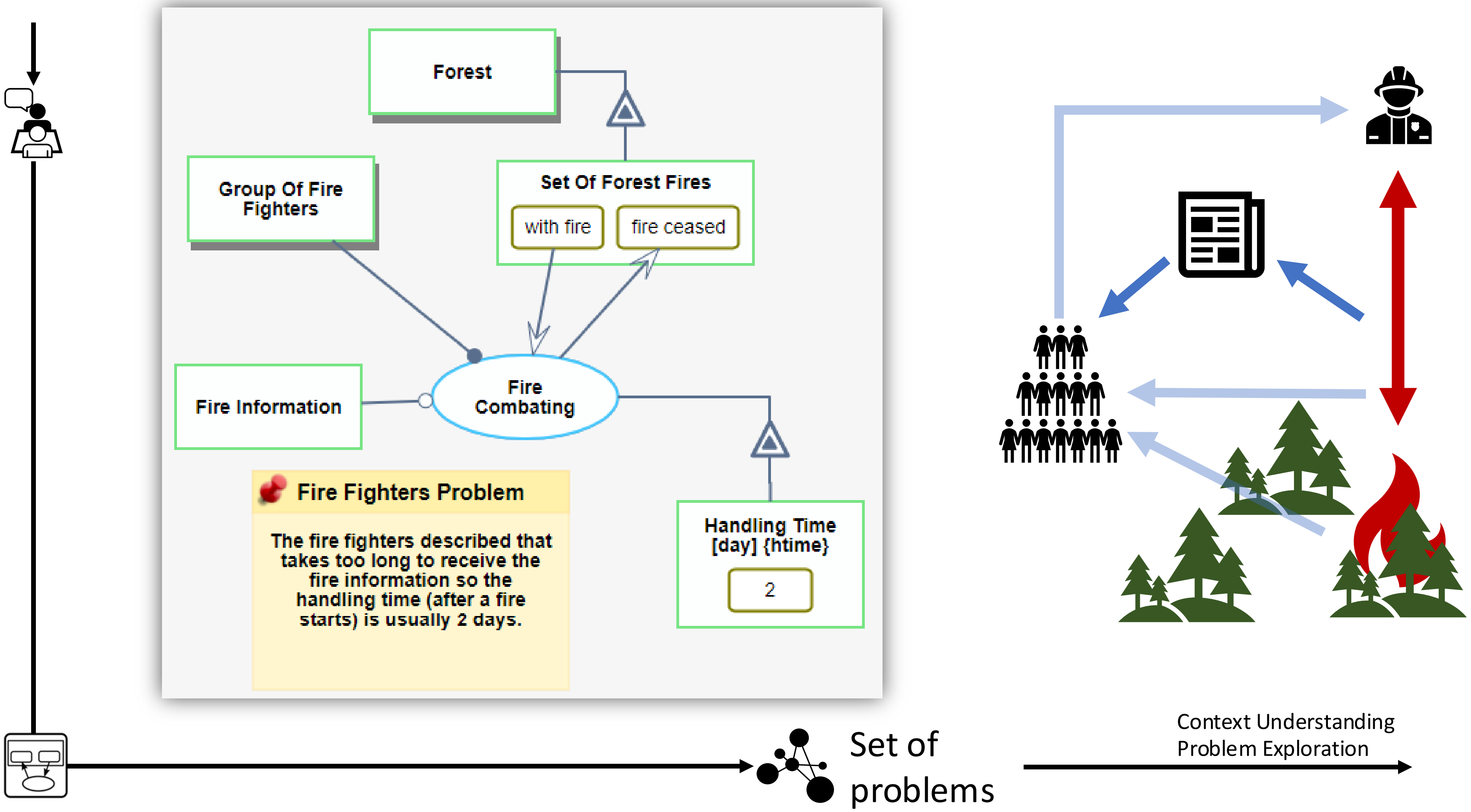




Framework Activities



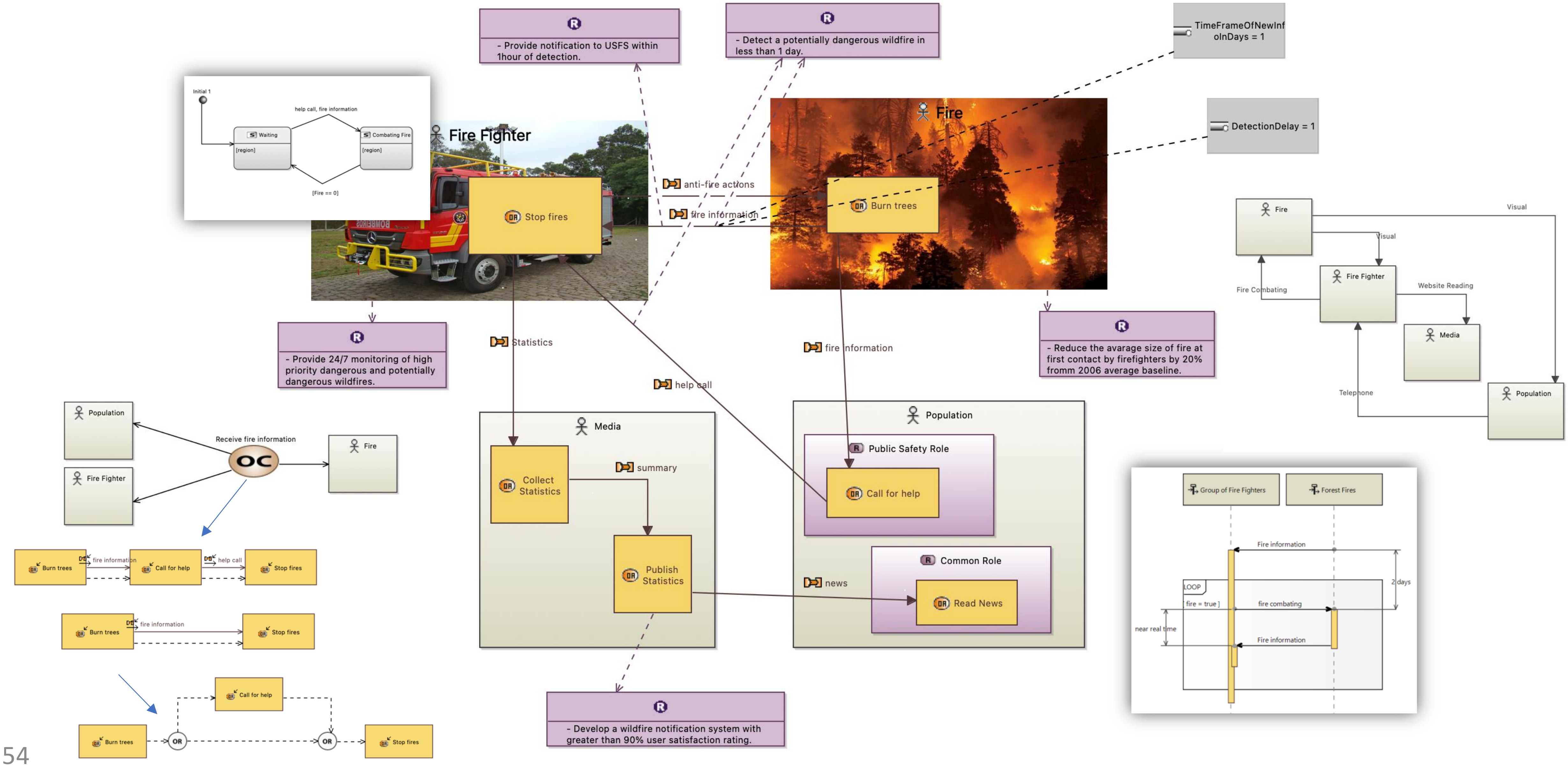
Structuring the problem (infinite ways of doing)



Identification of stakeholders

- Raising who they are
- What they want
- What changes are desired in the current situation
- Capture Success Metrics (MoEs)
- Lift

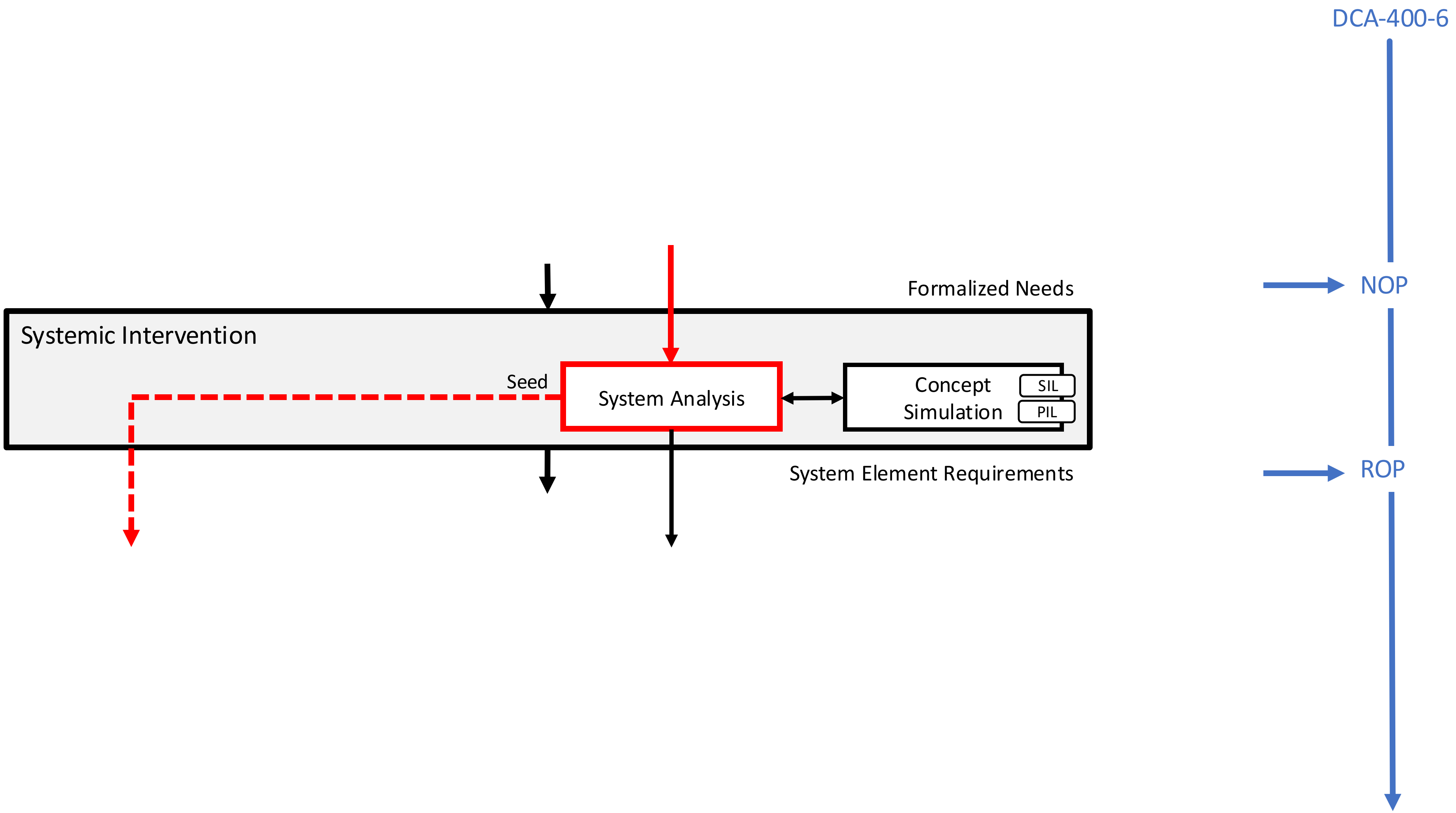
Operational analysis



FAB: Publicação do NOP

- Descrever os stakeholders (OMs)
- Descrever o conjunto de documentos originadores
- Estruturar as propostas de necessidades
- Descreve a situação atual com a mudança que precisa existir.
- Rastrear o desejo de mudança com a arquitetura da situação atual
- Justificar conjunto de necessidades.
  - Isento de solução

Systemic intervention


Formalized Needs
Systemic Intervention
Seed
System Analysis
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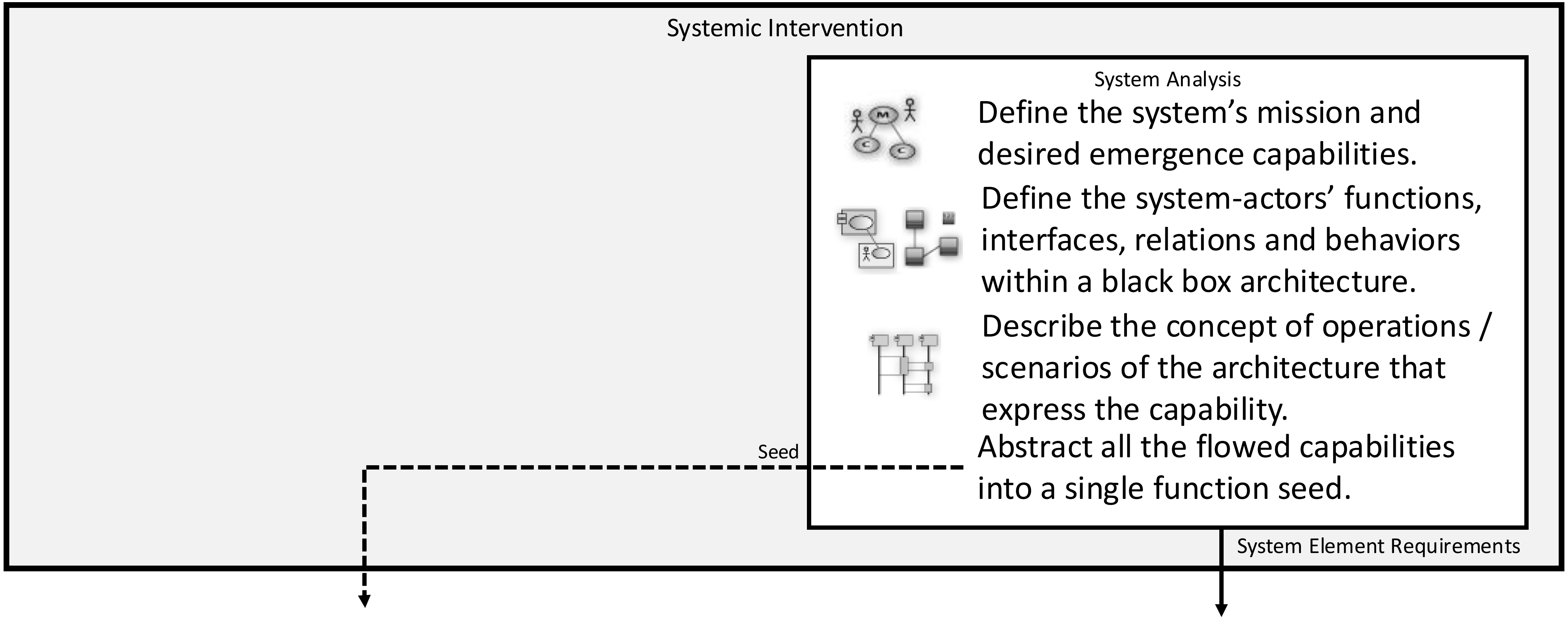
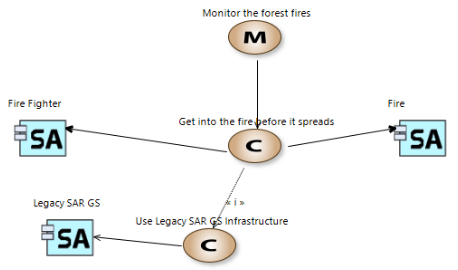
System Element Requirements
DCA-400-6
NOP
ROP

Systemic intervention

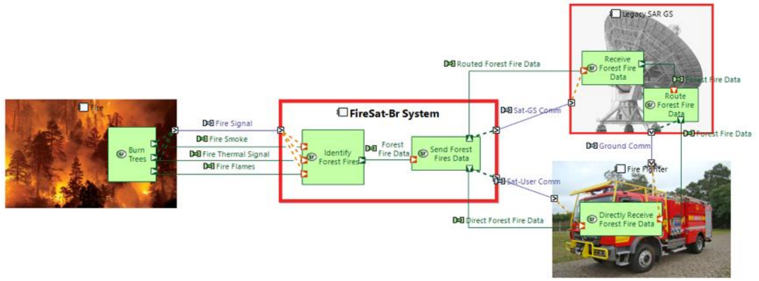


Systemic Intervention Analysis



Define the system's mission and desired emergence capabilities.

Define the system-actors' functions, interfaces, relations and behaviors within a black box architecture.

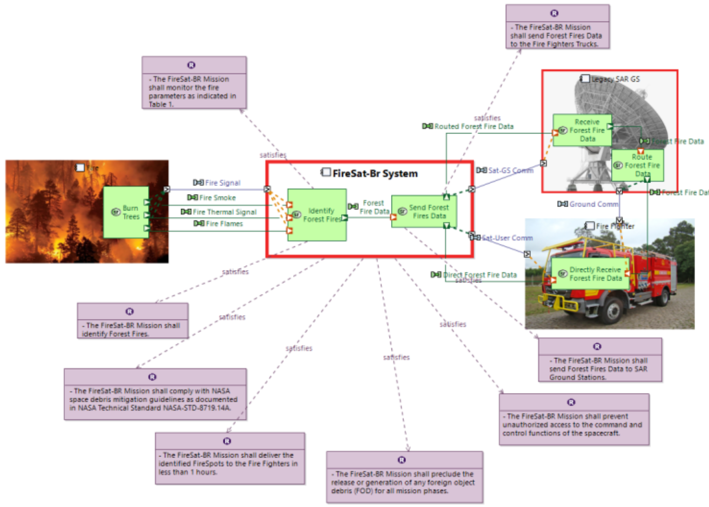


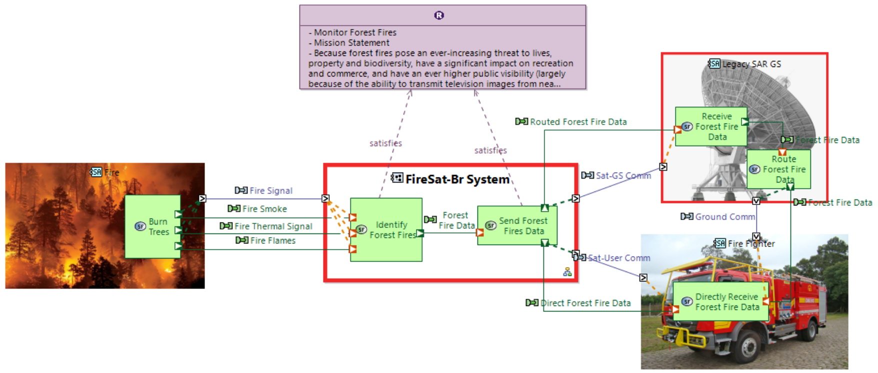
Describe the concept of operations / scenarios of the architecture that express the capability.

Seed

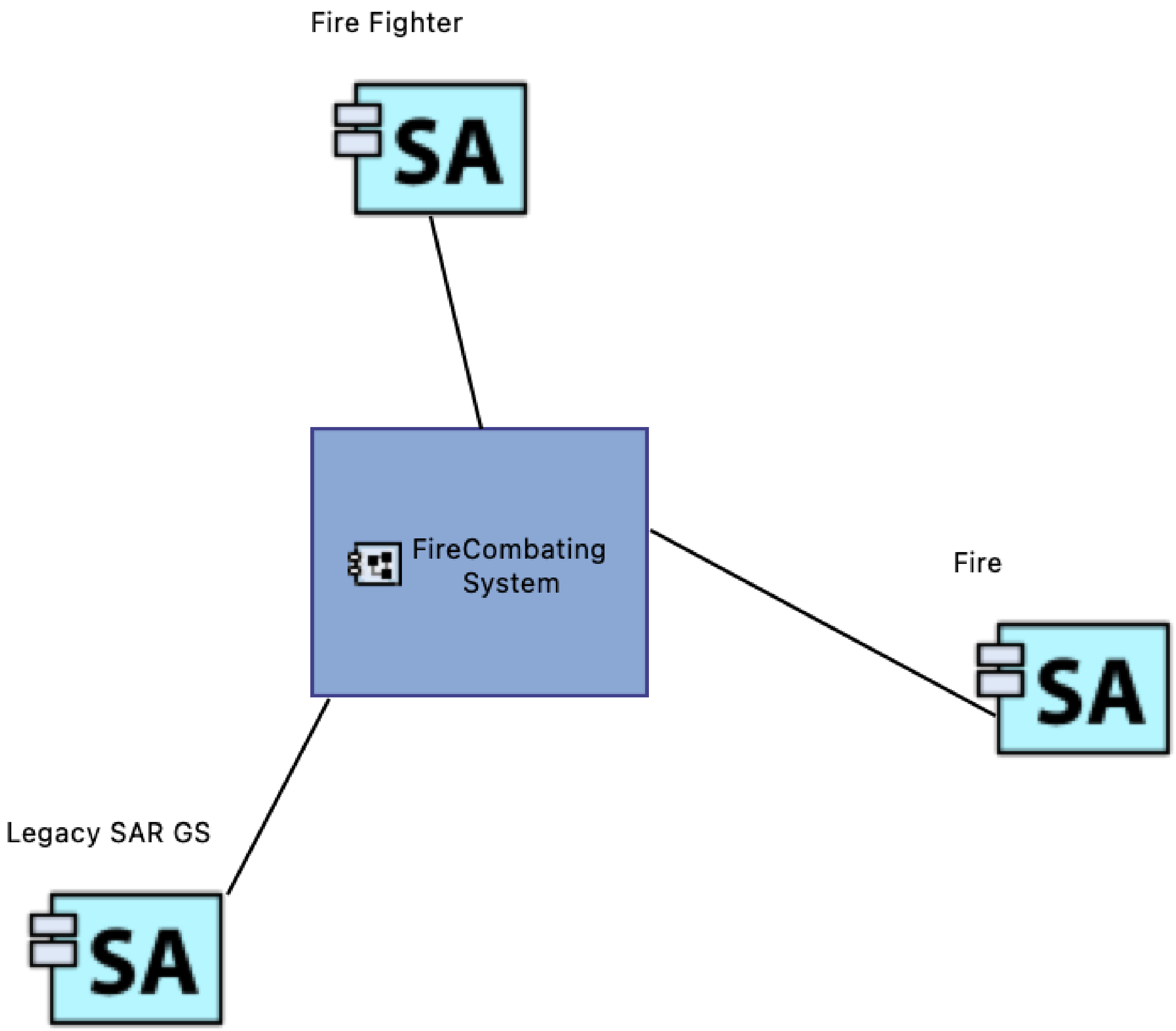
Abstract all the flowed capabilities into a single function seed.

System Element Requirements





Context

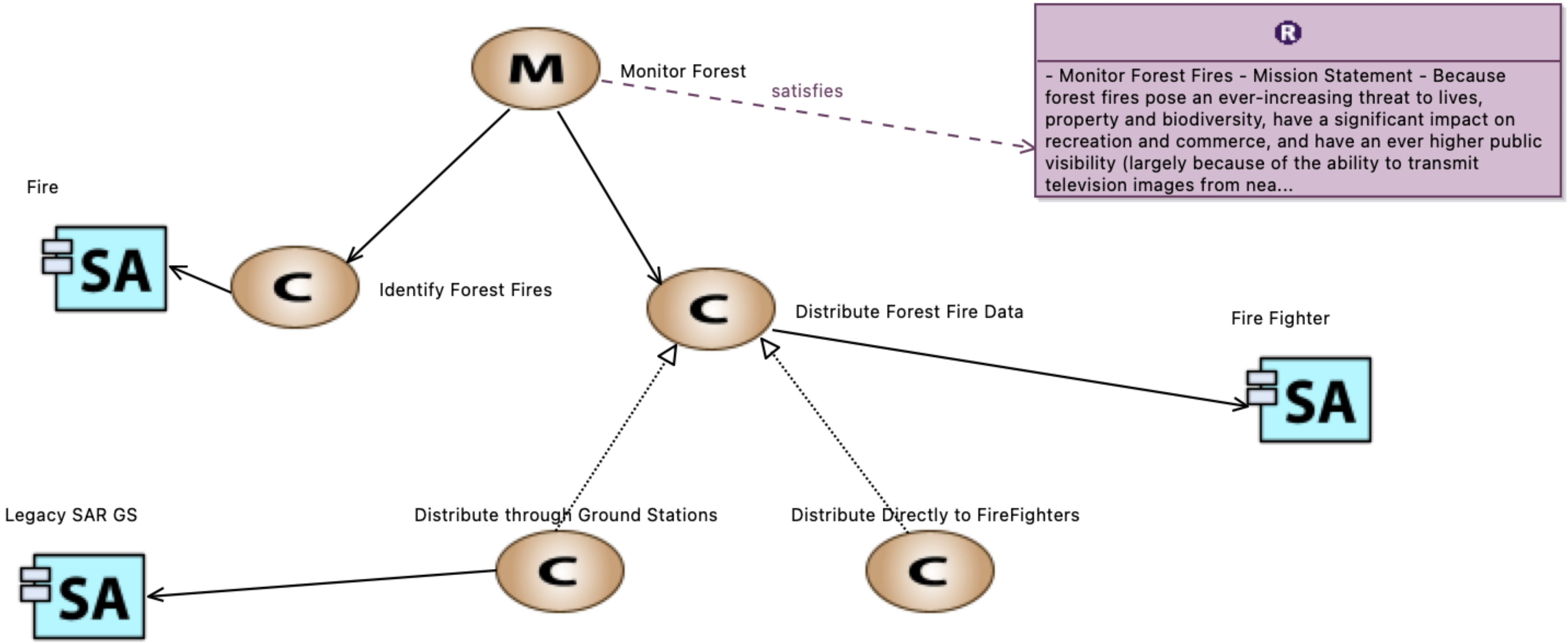

Fire Fighter
SA
FireCombating
System
Fire
SA
Legacy SAR GS
SA

MISSION STATEMENT

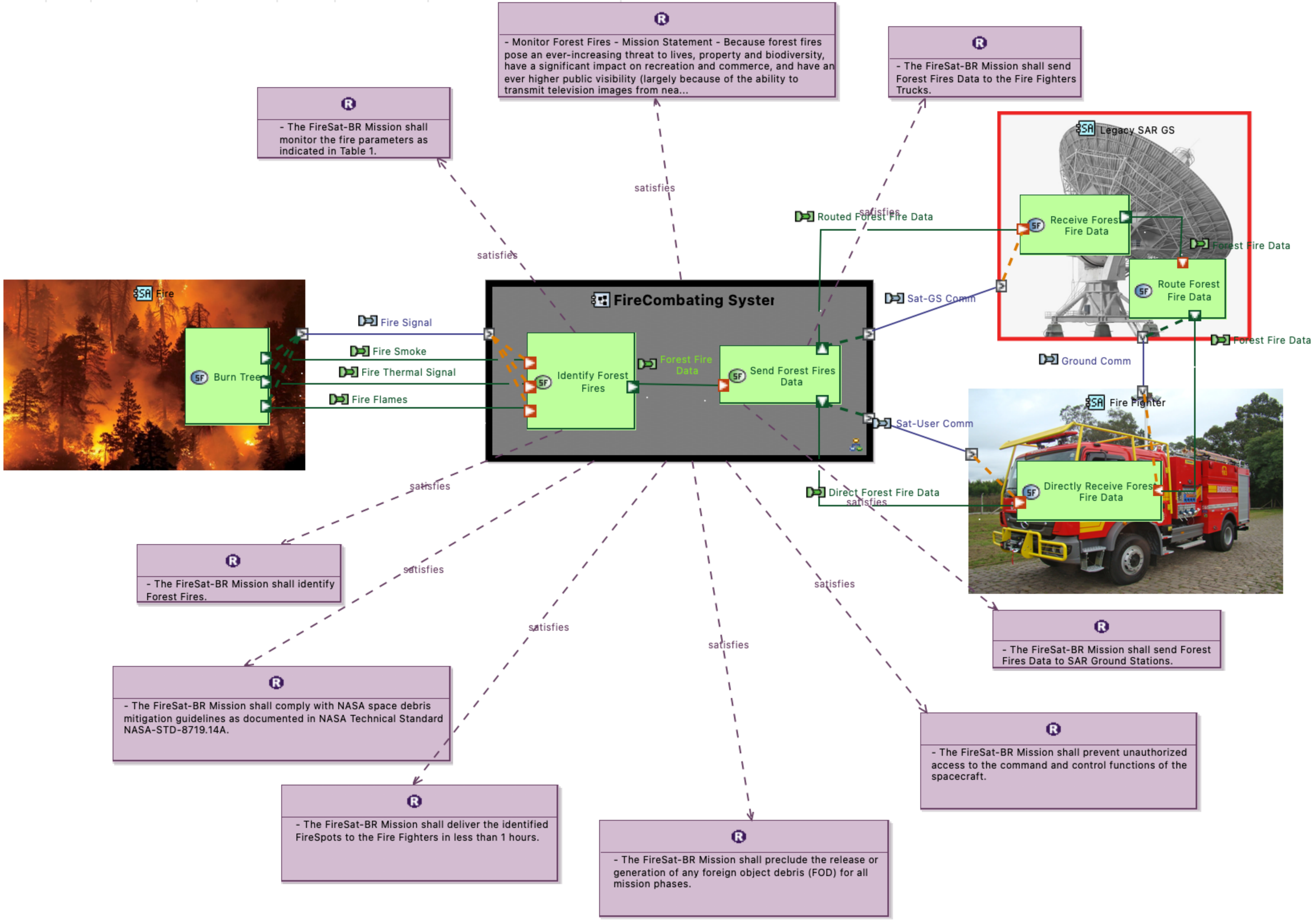
Because forest fires pose an ever-increasing threat to lives, property and biodiversity, have a significant impact on recreation and commerce, and have an ever higher public visibility (largely because of the ability to transmit television images from nearly anywhere in real time), the USFS needs a more effective system to identify and monitor them. In addition, it would be desired (but not required) to monitor forest fires for other nations; collect statistical data on fire outbreaks, spread, speed and duration, and provide other forest management data. This must be done at low cost to make the system affordable to the Forest Service and not give the perception of wasting money that could be better spent on fire-fighting equipment or personnel.

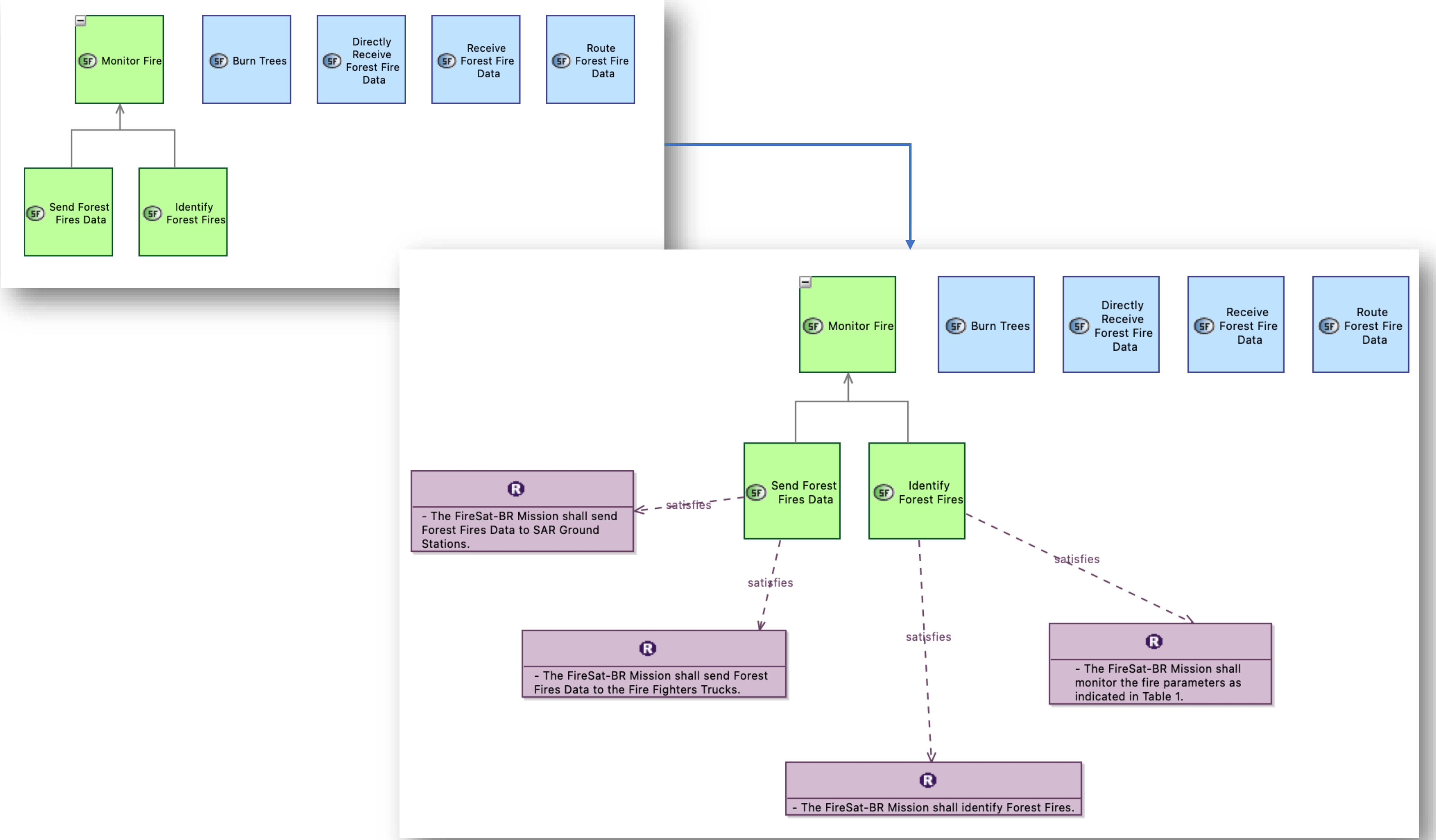
Ultimately, the Forest Service's fire monitoring office, fire management officers in the field, and individual firefighters and rangers fighting the fire will use the data. Data flow and formats must meet the needs of all the groups without specialized training and must allow them to respond promptly and efficiently to changing conditions.

(adapted from "Space Mission Engineering: the new SMAD, 2011")

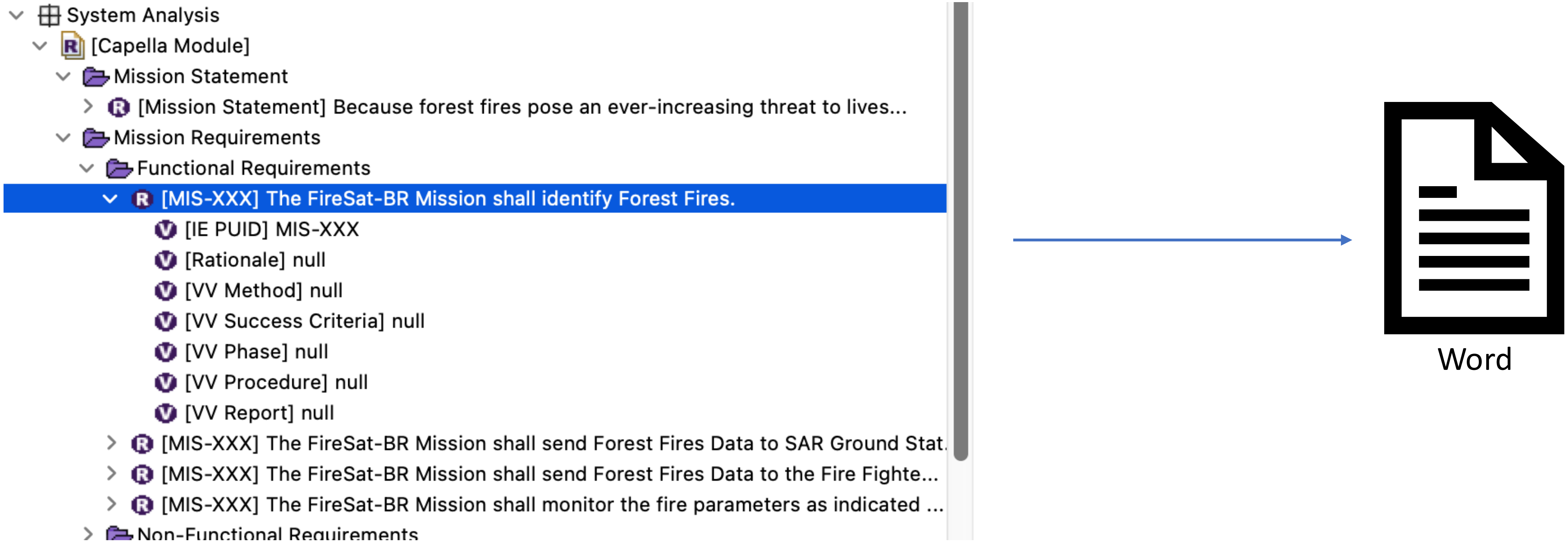


Monitor Forest
satisfies
- Monitor Forest Fires - Mission Statement - Because forest fires pose an ever-increasing threat to lives, property and biodiversity, have a significant impact on recreation and commerce, and have an ever higher public visibility (largely because of the ability to transmit television images from nea...
Fire
SA
Identify Forest Fires
Distribute Forest Fire Data
Fire Fighter
SA
Legacy SAR GS
Distribute through Ground Stations
Distribute Directly to FireFighters
SA

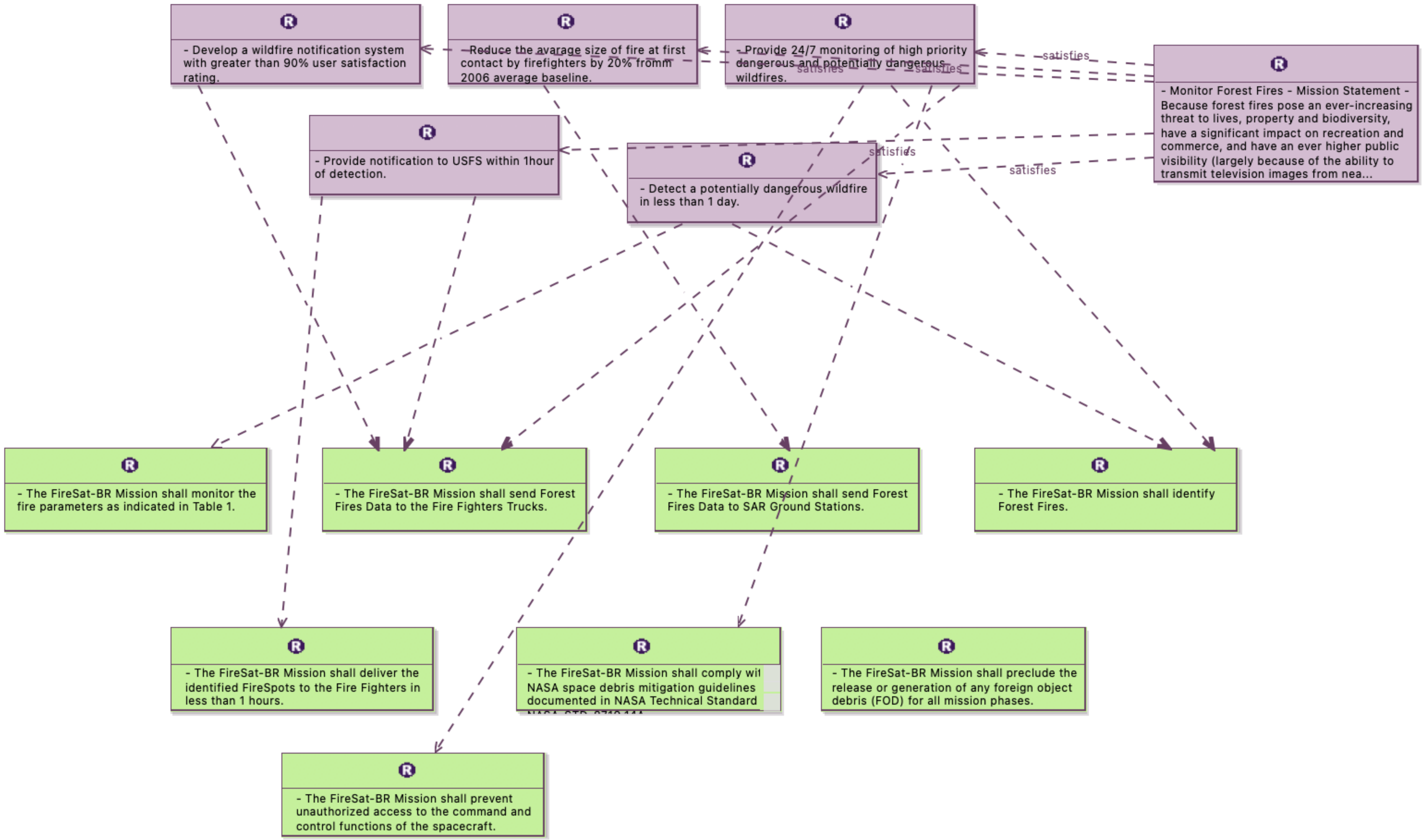

- Monitor Forest Fires - Mission Statement - Because forest fires pose an ever-increasing threat to lives, property and biodiversity, have a significant impact on recreation and commerce, and have an ever higher public visibility (largely because of the ability to transmit television images from nea...
- The FireSat-BR Mission shall send Forest Fires Data to the Fire Fighters Trucks.
- The FireSat-BR Mission shall monitor the fire parameters as indicated in Table 1.
satisfies
Legacy SAR GS
Receive Forest Fire Data
Route Forest Fire Data
Routed Forest Fire Data
Forest Fire Data
Fire
Burn Tree
Fire Signal
Fire Smoke
Fire Thermal Signal
Fire Flames
FireCombating System
Identify Forest Fires
Forest Fire Data
Send Forest Fires Data
Sat-GS Comm
Ground Comm
Fire Fighter
Sat-User Comm
Directly Receive Forest Fire Data
Direct Forest Fire Data
- The FireSat-BR Mission shall identify Forest Fires.
- The FireSat-BR Mission shall send Forest Fires Data to SAR Ground Stations.
- The FireSat-BR Mission shall comply with NASA space debris mitigation guidelines as documented in NASA Technical Standard NASA-STD-8719.14A.
- The FireSat-BR Mission shall prevent unauthorized access to the command and control functions of the spacecraft.
- The FireSat-BR Mission shall deliver the identified FireSpots to the Fire Fighters in less than 1 hours.
- The FireSat-BR Mission shall preclude the release or generation of any foreign object debris (FOD) for all mission phases.


Monitor Fire
Burn Trees
Directly Receive Forest Fire Data
Receive Forest Fire Data
Route Forest Fire Data
Send Forest Fires Data
Identify Forest Fires
Monitor Fire
Burn Trees
Directly Receive Forest Fire Data
Receive Forest Fire Data
Route Forest Fire Data
Send Forest Fires Data
Identify Forest Fires
satisfies
- The FireSat-BR Mission shall send Forest Fires Data to SAR Ground Stations.
satisfies
- The FireSat-BR Mission shall send Forest Fires Data to the Fire Fighters Trucks.
satisfies
- The FireSat-BR Mission shall identify Forest Fires.
satisfies
- The FireSat-BR Mission shall monitor the fire parameters as indicated in Table 1.

Requirements...



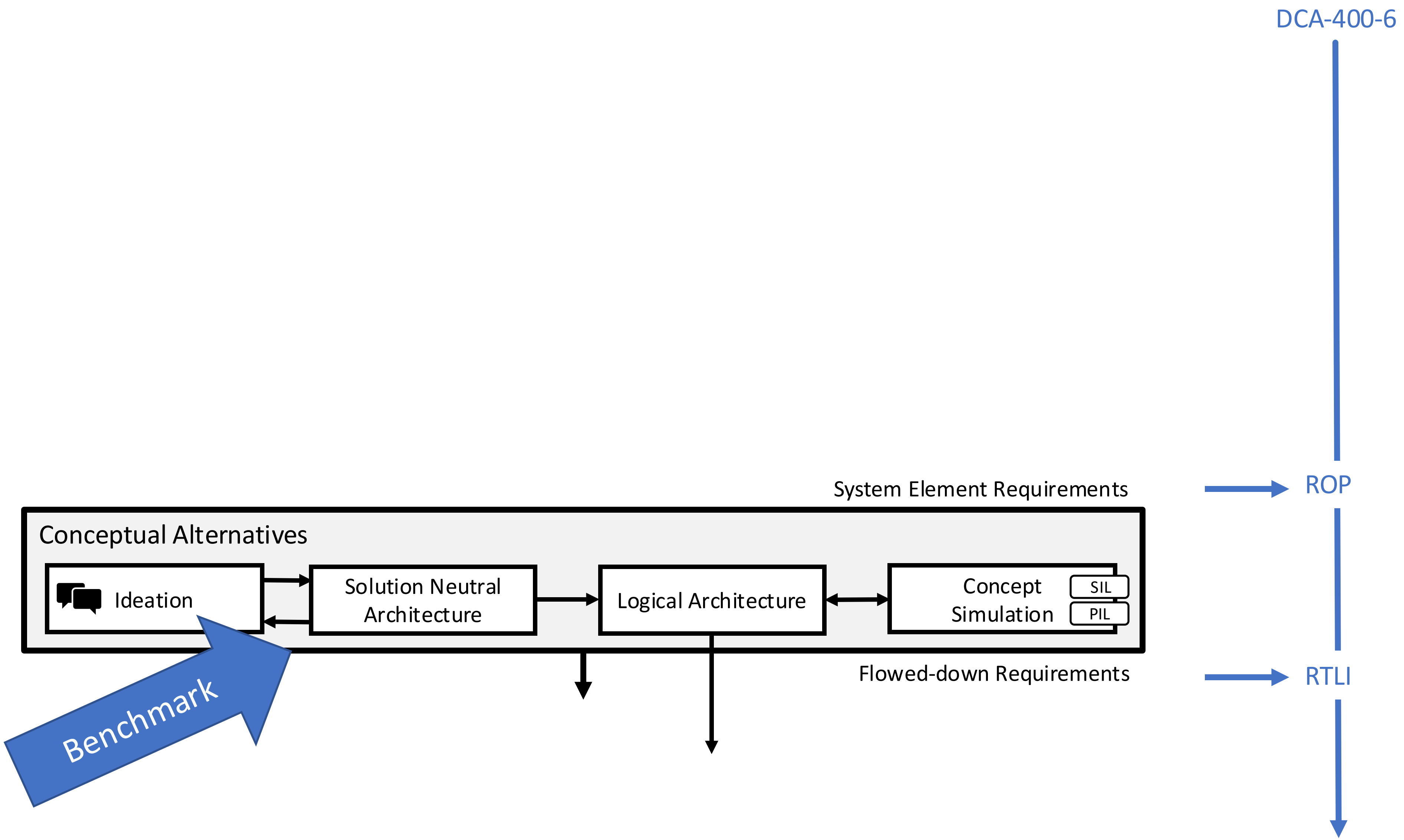
Traceability req_user – req_sys (nop-rop)



FAB: publicação do ROP

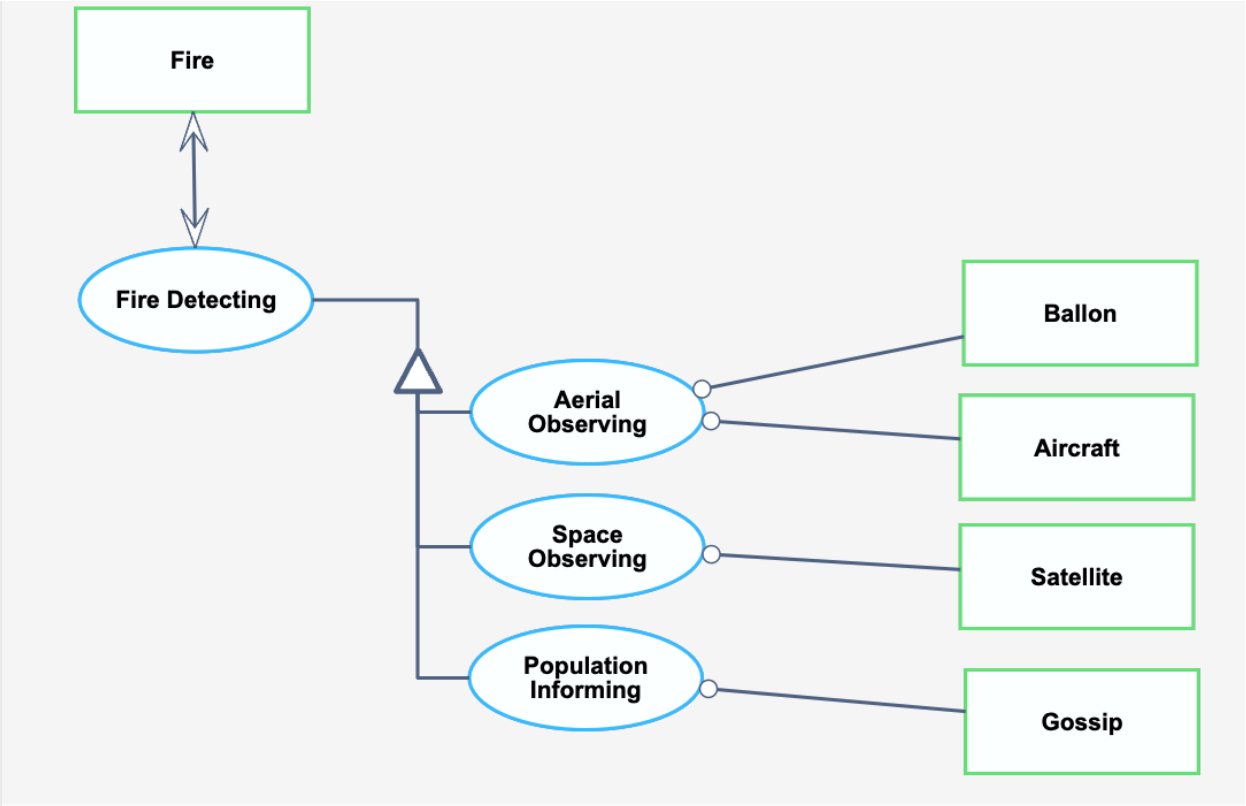
- Descrever o que o sistema tem que fazer para os stakeholders (OMs)
- Descrever o conceito de operação geral desse sistema com os stakeholders.
- Rastrear as necessidades aos requisitos.
- Justificar as interfaces e funções.
- Formaliza o que o sistema tem que prover sem explicar como e dar margem para os fornecedores.

Conceptual Alternatives



DCA-400-6
System Element Requirements
ROP
Conceptual Alternatives
Ideation
Solution Neutral Architecture
Logical Architecture
Concept Simulation
SIL
PIL
Flowed-down Requirements
RTLI
Benchmark

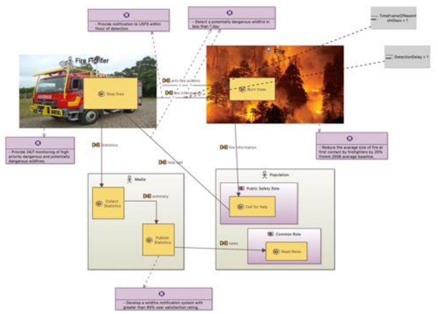
Intention exploration



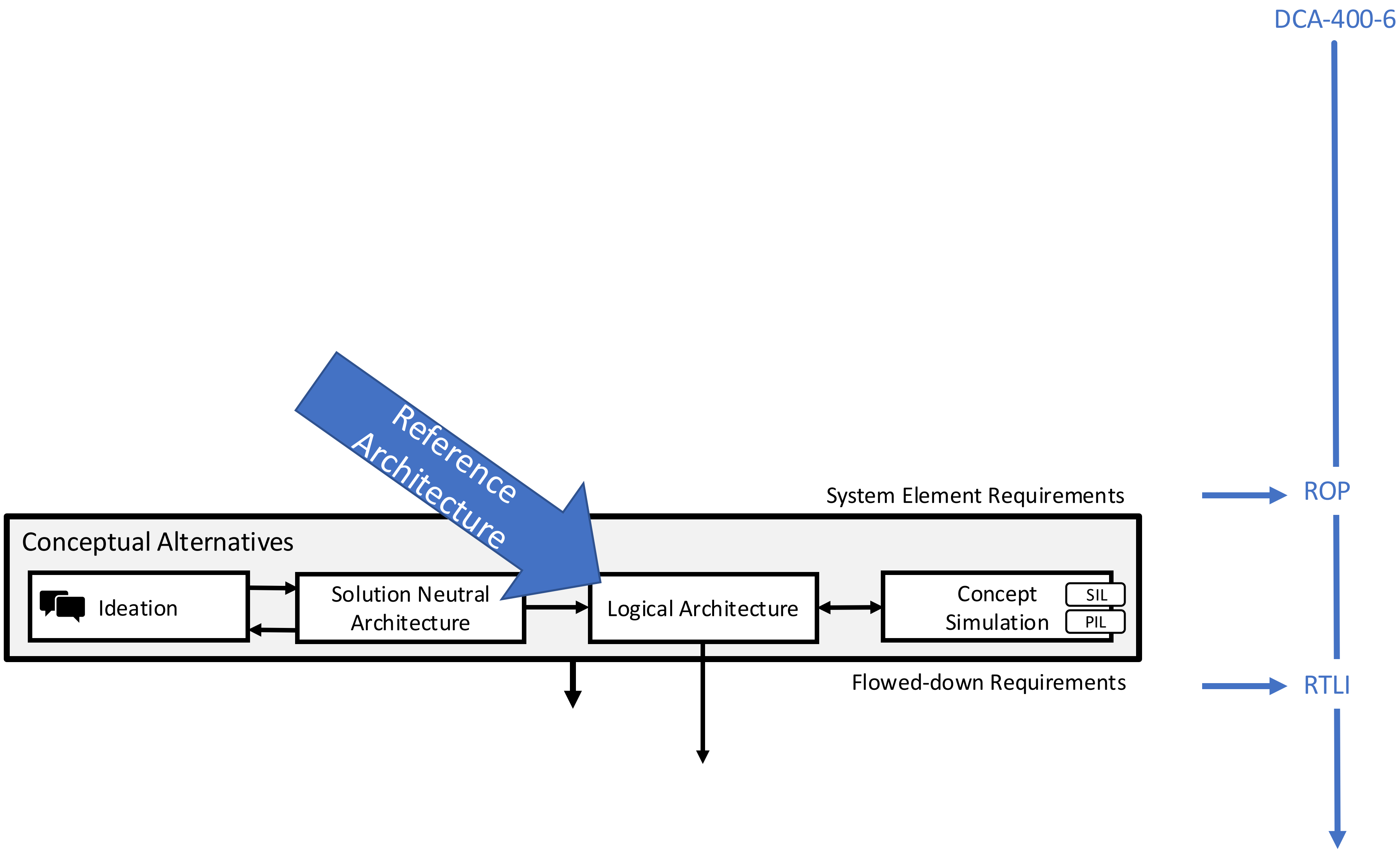
OPL

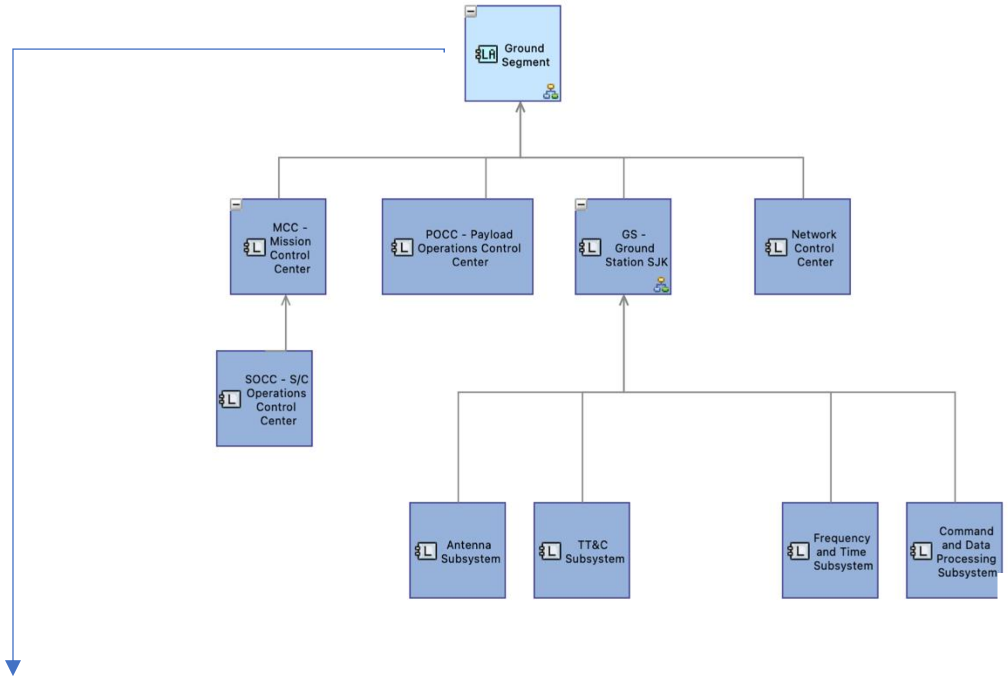
1. Aerial Observing, Population Informing and Space Observing are Fire Detecting.
2. Fire Detecting affects Fire.
3. Aerial Observing requires Aircraft and Ballon.
4. Space Observing requires Satellite.
5. Population Informing requires Gossip.

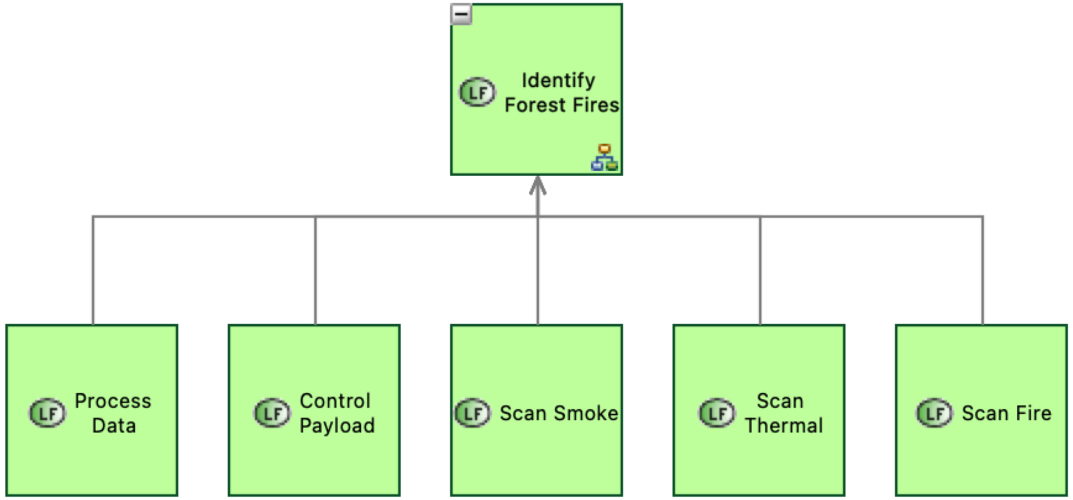
Trading

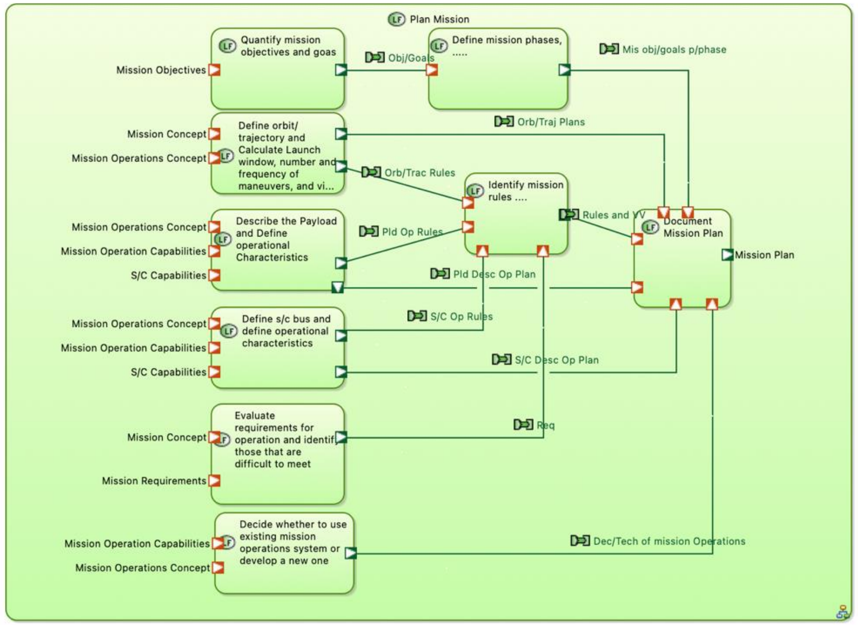


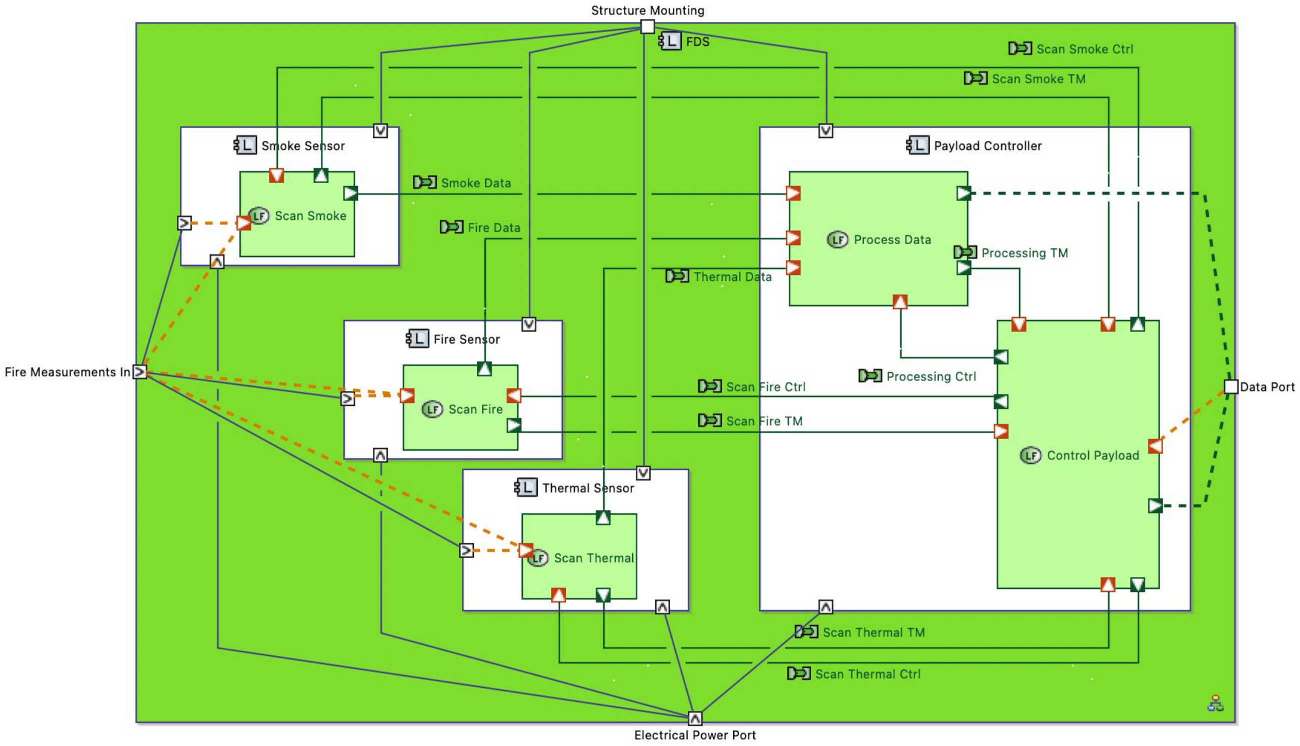
		Ballon	Aircraft	Satellite	Gossip
TimeFrameOfNewInformation	.4	-	+	+	0
DetectionDelay	.6	+	-	+	0
	Total	0	0	2	
	Weighted	.6	.4	1	

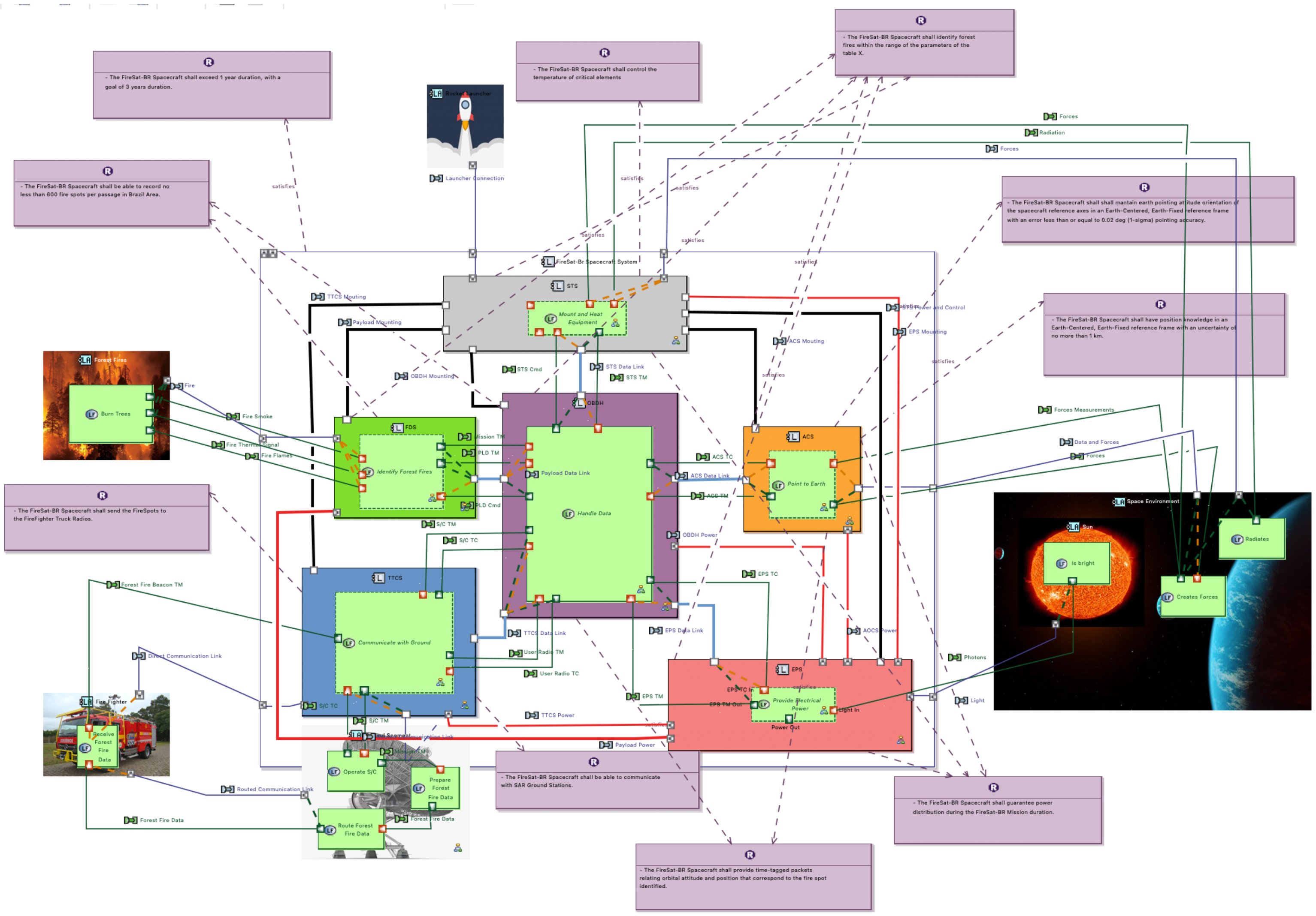

DCA-400-6
Reference Architecture
System Element Requirements
ROP
Conceptual Alternatives
Ideation
Solution Neutral Architecture
Logical Architecture
Concept Simulation
SIL
PIL
Flowed-down Requirements
RTLI


Ground Segment
MCC - Mission Control Center
POCC - Payload Operations Control Center
GS - Ground Station SJK
Network Control Center
SOCC - S/C Operations Control Center
Antenna Subsystem
TT&C Subsystem
Frequency and Time Subsystem
Command and Data Processing Subsystem


Identify Forest Fires
Process Data
Control Payload
Scan Smoke
Scan Thermal
Scan Fire

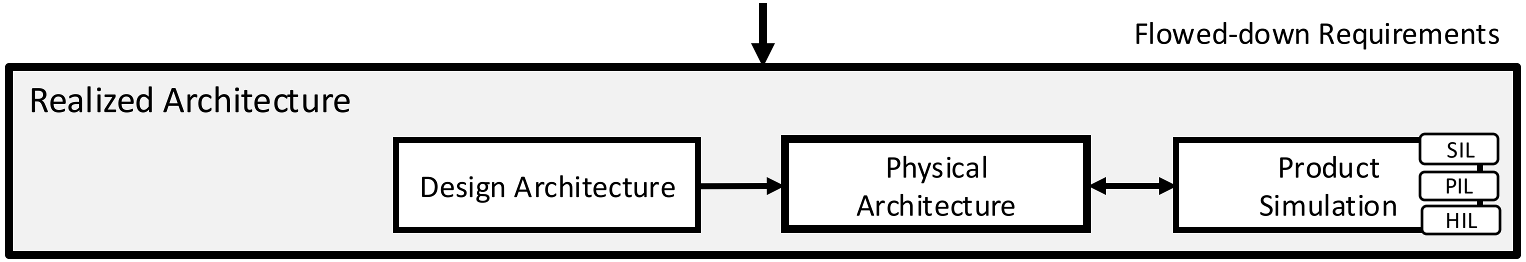

Plan Mission
Quantify mission objectives and goas
Define mission phases, ...
Mission Objectives
Obj/Goals
Mis obj/goals p/phase
Orb/Traj Plans
Mission Concept
Mission Operations Concept
Define orbit/ trajectory and Calculate Launch window, number and frequency of maneuvers, and vi...
Orb/Trac Rules
Identify mission rules ....
Rules and VV
Document Mission Plan
Mission Plan
Describe the Payload and Define operational Characteristics
Mission Operation Capabilities
S/C Capabilities
Pld Op Rules
Pld Desc Op Plan
Define s/c bus and define operational characteristics
S/C Op Rules
S/C Desc Op Plan
Evaluate requirements for operation and identify those that are difficult to meet
Req
Mission Requirements
Decide whether to use existing mission operations system or develop a new one
Dec/Tech of mission Operations


Structure Mounting
FDS
Scan Smoke Ctrl
Scan Smoke TM
Smoke Sensor
Scan Smoke
Smoke Data
Fire Data
Payload Controller
Process Data
Processing TM
Thermal Data
Fire Sensor
Scan Fire
Fire Measurements In
Scan Fire Ctrl
Scan Fire TM
Processing Ctrl
Control Payload
Data Port
Thermal Sensor
Scan Thermal
Scan Thermal TM
Scan Thermal Ctrl
Electrical Power Port



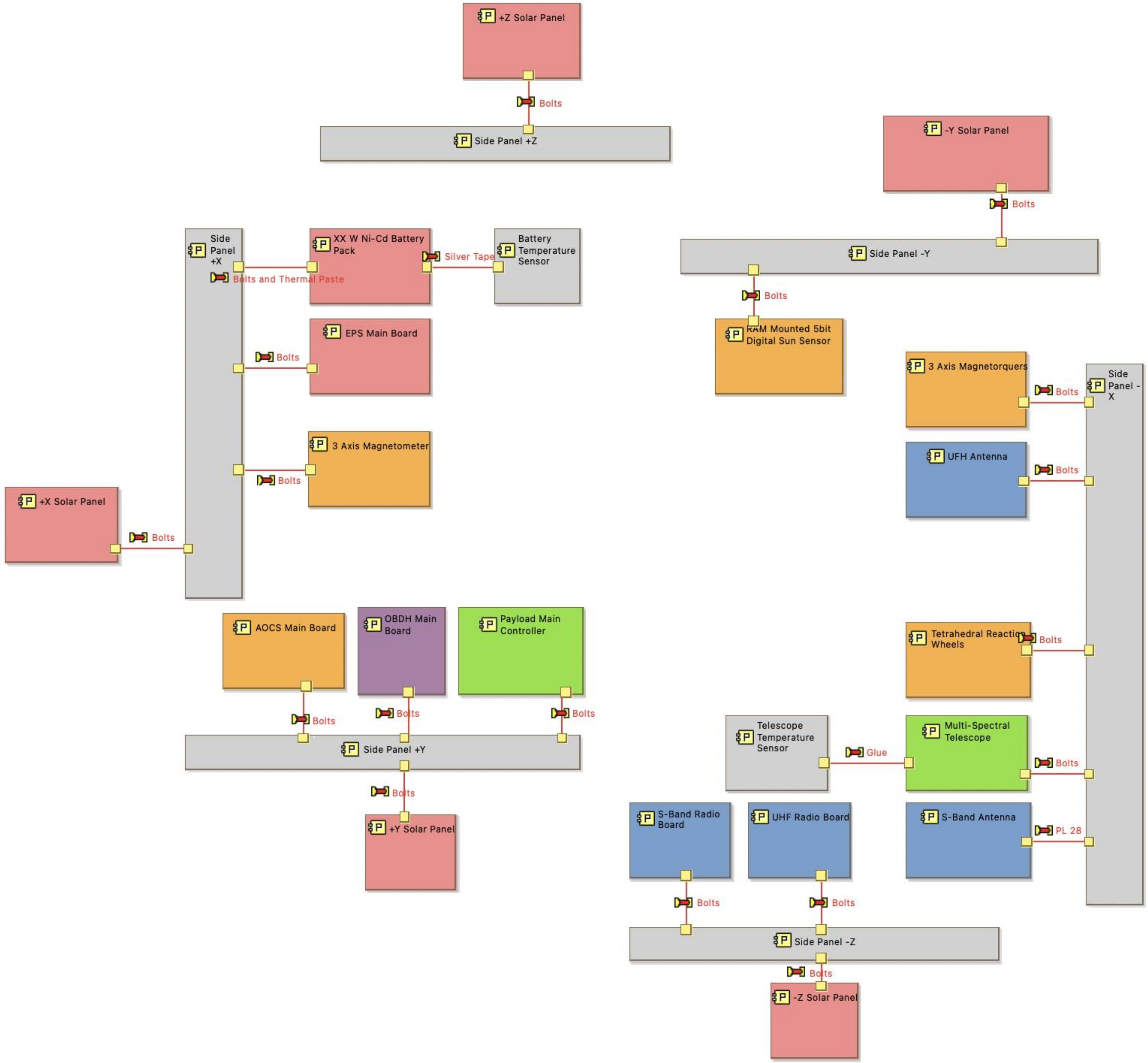
- Logical Architecture
  - [Capella Module]
    - System Requirements
      - [SYS-XXX] The FireSat-BR Spacecraft shall guarantee powe
        - [IE PUID] SYS-XXX
        - [Rationale] null
        - [VV Method] null
        - [VV Success Criteria] null
        - [VV Phase] null
        - [VV Procedure] null
        - [VV Report] null
      - [SYS-XXX] The FireSat-BR Spacecraft shall shall mantain ea
      - [SYS-XXX] The FireSat-BR Spacecraft shall be able to recor
      - [SYS-XXX] The FireSat-BR Spacecraft shall be able to comm
      - [SYS-XXX] The FireSat-BR Spacecraft shall exceed 1 year d
      - [SYS-XXX] The FireSat-BR Spacecraft shall control the tem
      - [SYS-XXX] The FireSat-BR Spacecraft shall send the FireSp
      - [SYS-XXX] The FireSat-BR Spacecraft shall identify forest f
      - [SYS-XXX] The FireSat-BR Spacecraft shall provide time-ta
      - [SYS-XXX] The FireSat-BR Spacecraft shall have position k
    - []

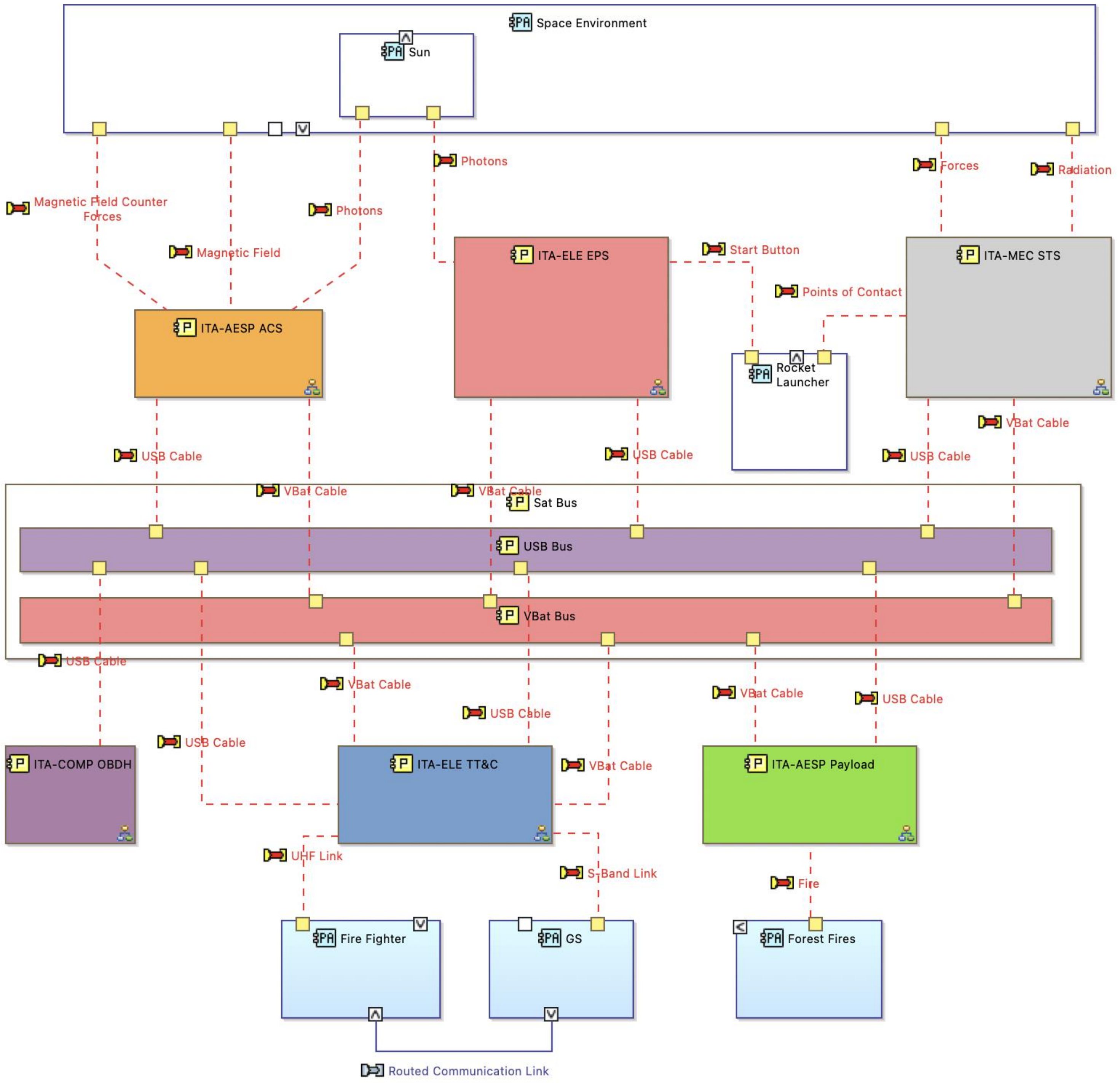
Realized Architecture

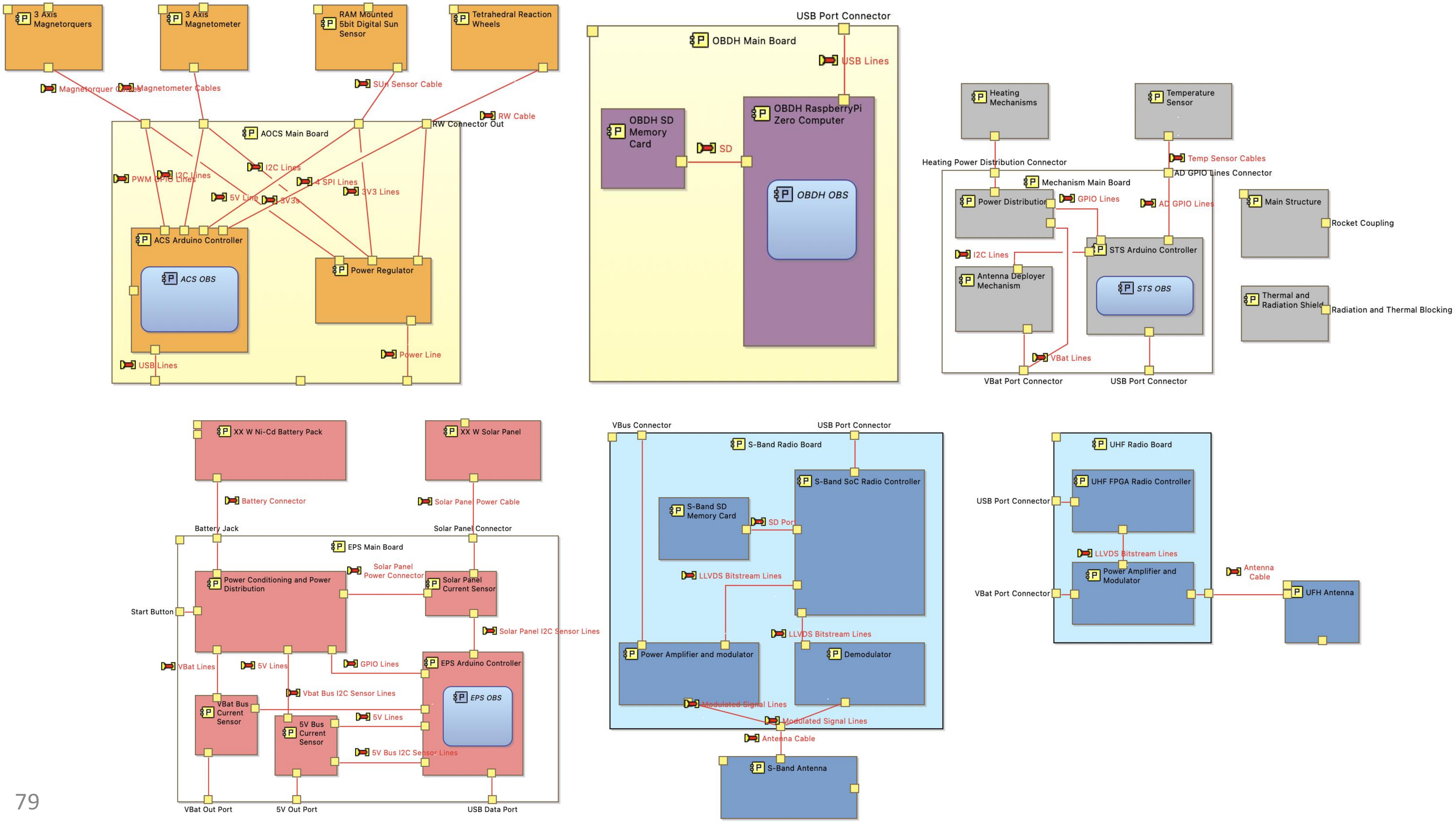


RTLI

Specific Discipline Analysis


+Z Solar Panel
Bolts
Side Panel +Z
-Y Solar Panel
Bolts
Side Panel -Y
Bolts
RAM Mounted 5bit Digital Sun Sensor
Side Panel +X
XX W Ni-Cd Battery Pack
Silver Tape
Battery Temperature Sensor
Bolts and Thermal Paste
EPS Main Board
Bolts
3 Axis Magnetometer
Bolts
+X Solar Panel
Bolts
3 Axis Magnetorquers
Bolts
Side Panel -X
UFH Antenna
Bolts
Tetrahedral Reaction Wheels
Bolts
AOCS Main Board
OBDH Main Board
Payload Main Controller
Bolts
Bolts
Bolts
Side Panel +Y
Bolts
+Y Solar Panel
Telescope Temperature Sensor
Glue
Multi-Spectral Telescope
Bolts
S-Band Radio Board
UHF Radio Board
S-Band Antenna
PL 28
Bolts
Bolts
Side Panel -Z
Bolts
-Z Solar Panel


Space Environment
Sun
Photons
Forces
Radiation
Magnetic Field Counter Forces
Photons
Magnetic Field
Start Button
Points of Contact
ITA-AESP ACS
ITA-ELE EPS
Rocket Launcher
ITA-MEC STS
USB Cable
USB Cable
VBat Cable
USB Cable
VBat Cable
VBat Cable
Sat Bus
USB Bus
VBat Bus
USB Cable
VBat Cable
USB Cable
VBat Cable
USB Cable
USB Cable
VBat Cable
ITA-COMP OBDH
ITA-ELE TT&C
ITA-AESP Payload
UHF Link
S-Band Link
Fire
Fire Fighter
GS
Forest Fires
Routed Communication Link

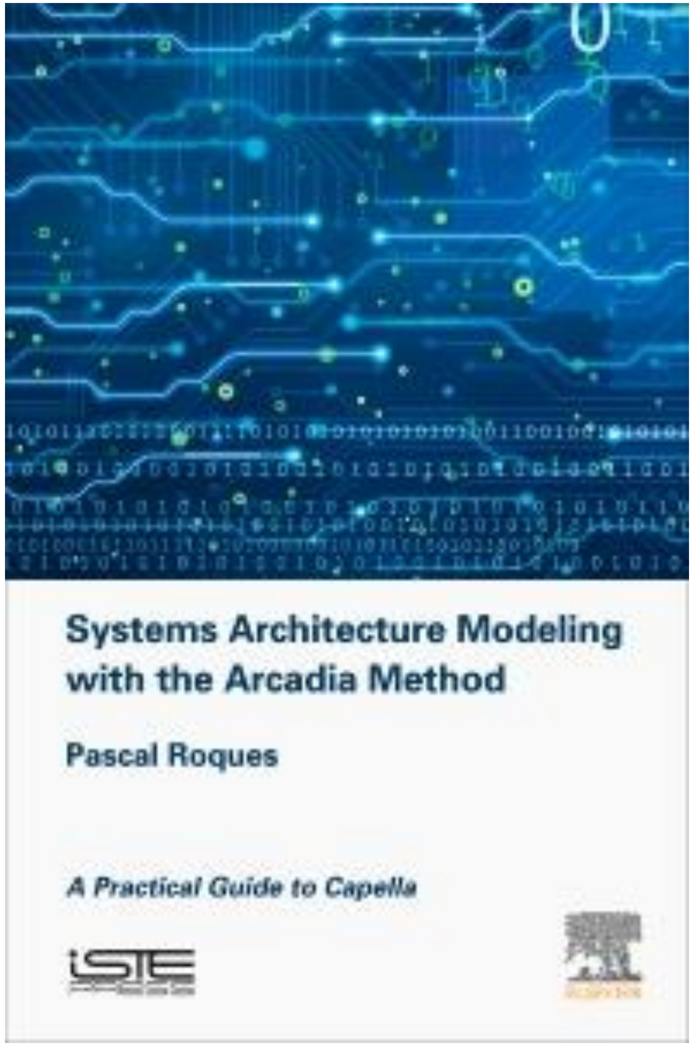

3 Axis Magnetorquers
3 Axis Magnetometer
RAM Mounted 5bit Digital Sun Sensor
Tetrahedral Reaction Wheels
Magnetorquer Cables
Magnetometer Cables
SUn Sensor Cable
RW Cable
RW Connector Out
AOCS Main Board
PWM GPIO Lines
I2C Lines
I2C Lines
4 SPI Lines
3V3 Lines
5V Line
3V3s
ACS Arduino Controller
ACS OBS
Power Regulator
Power Line
USB Lines
USB Port Connector
OBDH Main Board
USB Lines
OBDH SD Memory Card
SD
OBDH RaspberryPi Zero Computer
OBDH OBS
Heating Mechanisms
Temperature Sensor
Temp Sensor Cables
Heating Power Distribution Connector
AD GPIO Lines Connector
Mechanism Main Board
Power Distribution
GPIO Lines
AD GPIO Lines
I2C Lines
STS Arduino Controller
Antenna Deployer Mechanism
STS OBS
VBat Lines
VBat Port Connector
USB Port Connector
Main Structure
Rocket Coupling
Thermal and Radiation Shield
Radiation and Thermal Blocking
XX W Ni-Cd Battery Pack
XX W Solar Panel
Battery Connector
Solar Panel Power Cable
Battery Jack
Solar Panel Connector
EPS Main Board
Solar Panel Power Connector
Power Conditioning and Power Distribution
Solar Panel Current Sensor
Start Button
Solar Panel I2C Sensor Lines
VBat Lines
5V Lines
GPIO Lines
EPS Arduino Controller
Vbat Bus I2C Sensor Lines
VBat Bus Current Sensor
5V Lines
5V Bus Current Sensor
EPS OBS
5V Bus I2C Sensor Lines
VBat Out Port
5V Out Port
USB Data Port
VBus Connector
USB Port Connector
S-Band Radio Board
S-Band SoC Radio Controller
S-Band SD Memory Card
SD Port
LLVDS Bitstream Lines
LLVDS Bitstream Lines
Power Amplifier and modulator
Demodulator
Modulated Signal Lines
Modulated Signal Lines
Antenna Cable
S-Band Antenna
UHF Radio Board
UHF FPGA Radio Controller
USB Port Connector
LLVDS Bitstream Lines
Power Amplifier and Modulator
VBat Port Connector
Antenna Cable
UFH Antenna

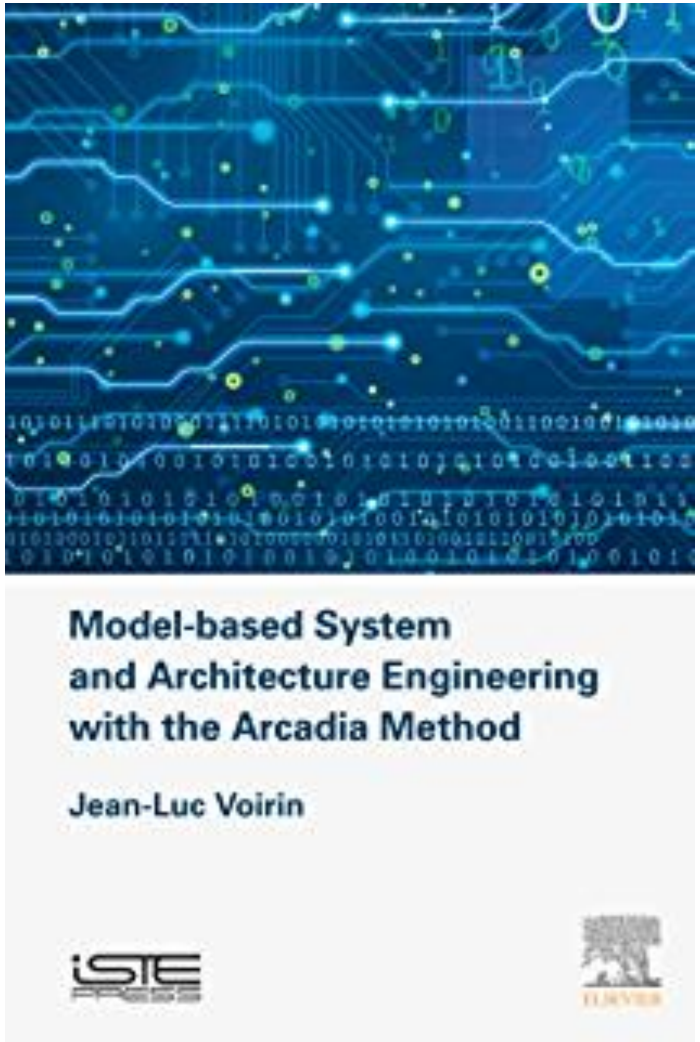
Arcadia Methodology

REF-006: VOIRIN, J.L. Model-based System and Architecture Engineering with the Arcadia Method. Elsevier, 2017. ISBN 978-0-0810-1794-4.

REF-007: ROQUES, P. Systems Architecture Modeling with the Arcadia Method – A Practical Guide to Capella. Elsevier, 2017. ISBN: 978-0-0810-1792-0

Key References





- Systems engineers have been making use of modeling techniques for a long time.
- **The technique of structured analysis and design (SADT) and structured real-time analytics (Structured Analysis for Real Time SA/RT) are some of the best known and date back to the 1980s**.
- There are many other approaches based on Petri nets or finite state machines.
- However, they are also limited by their comprehensiveness and expressiveness, as well as by the difficulty in integrating them with other formalisms and requirements.

- **Unfortunately, in practice, it has been shown that the affiliation of the SysML language to UML often leads to difficulties in terms of understanding and use for systems engineers who are not also computer scientists.**

- This is the reason that led Thales to define the ARCADIA method, structured by Jean-Luc Voirin, along with its underlying formalism, for his own needs.

https://www.linkedin.com/in/jean-luc-voirin-8087a9155/

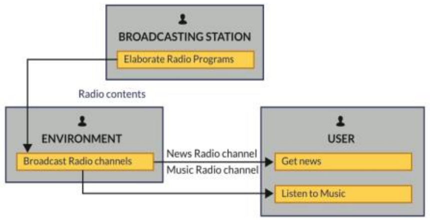
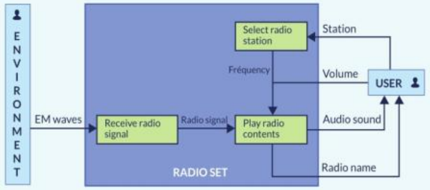
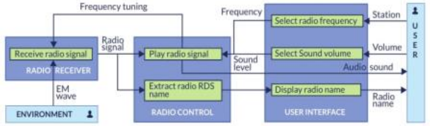
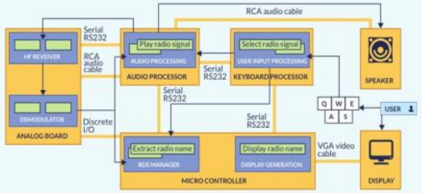
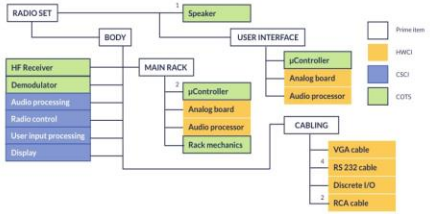
https://www.youtube.com/watch?v=NIFayQAueso

https://www.youtube.com/watch?v=2fveJ7nwiuU

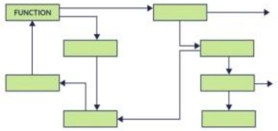

Architect
Specialty engineering: safety, perf, security, ...
Functions
Safety
Performance
Human Factors
Security
IVVQ, Product Line, Cost...
ViewPoints
Evaluation Rules
Product Line Manager, Etc.
Sub-contractors
Solution Architecture

Founding principles

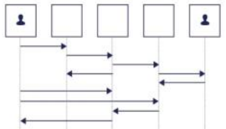
- All engineering **stakeholders share the same methodology, the same information, the same description** of the need and the product in the form of a shared model;
- Each specialized type of engineering (e.g., safety, performance, cost, and mass) is formalized as a **"point of view"** against the requirements from which the proposed architecture is then verified;
- The **rules for early verification of the architecture are established** in order to verify the architecture as quickly as possible;
- **Co-engineering** between the different levels of engineering is supported by the joint elaboration of models, with the models of the different levels and specialties being deduced/validated/linked to each other.

METHOD STEPS	TASKS	SAMPLE MODEL	CONCEPTS
NEED — **Customer Operational Need Analysis** What the users of the system need to accomplish	✓ Define operational capabilities ✓ Perform an operational need analysis		- Operational capabilities - Actors, operational entities - Actor activities - Interactions between activities & actors - Information used in activities & interactions - Operational processes chaining activities - Scenarios for dynamic behaviour
System/ SW/HW Need Analysis What the system has to accomplish for the Users	✓ Perform a capability trade-off analysis ✓ Perform a functional and non-functional analysis ✓ Formalise and consolidate requirements		- Actors and system, capabilities - Functions of system & actors - Dataflow exchanges between functions - Functional chains traversing dataflow - Information used in functions & exchanges, data model - Scenarios for dynamic behaviour - Modes & states
SOLUTIONS — **Logical Architecture Design** How the system will work so as to fulfil expectations	✓ Define architecture drivers and viewpoints ✓ Build candidate architectural breakdowns in components ✓ Select best compromise architecture		*SAME CONCEPTS, PLUS :* - Components - Component ports and interfaces - Exchanges between components - Function allocation to components - Component interface justification by functional exchanges allocation
Physical Architecture Design How the system will be developed & built	✓ Define architectural patterns ✓ Consider reuse of existing assets design a physical ✓ Design a physical reference architecture ✓ Validate and check it		*SAME CONCEPTS, PLUS :* - Behavioural components refining logical ones, and implementing functional behaviour - Implementation components supplying resources for behavioural components - Physical links between implementation components
Development Contracts What is expected from each designer/ sub-contractor	✓ Define a components IVVQ strategy ✓ Define & enforce a PBS and component integration contract		- Configuration items tree - Parts numbers, quantities - Development contract (expected behaviour, interfaces, scenarios, resource consumption, non-functional properties...)

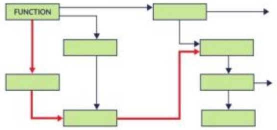
DESCRIPTION MEANS



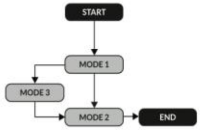
Dataflow: functions, op. activities interactions & exchanges



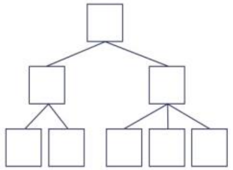
Scenarios: actors, system, components interactions & exchanges



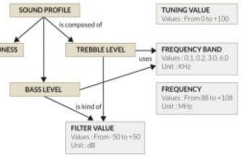
Functional chains, operational processes through functions & op. activities



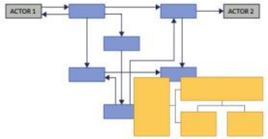
Modes & states of actors, system, components



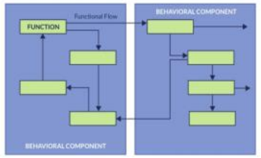
Breakdown of functions & components



Data model: dataflow & scenario contents, definition & justification of interfaces



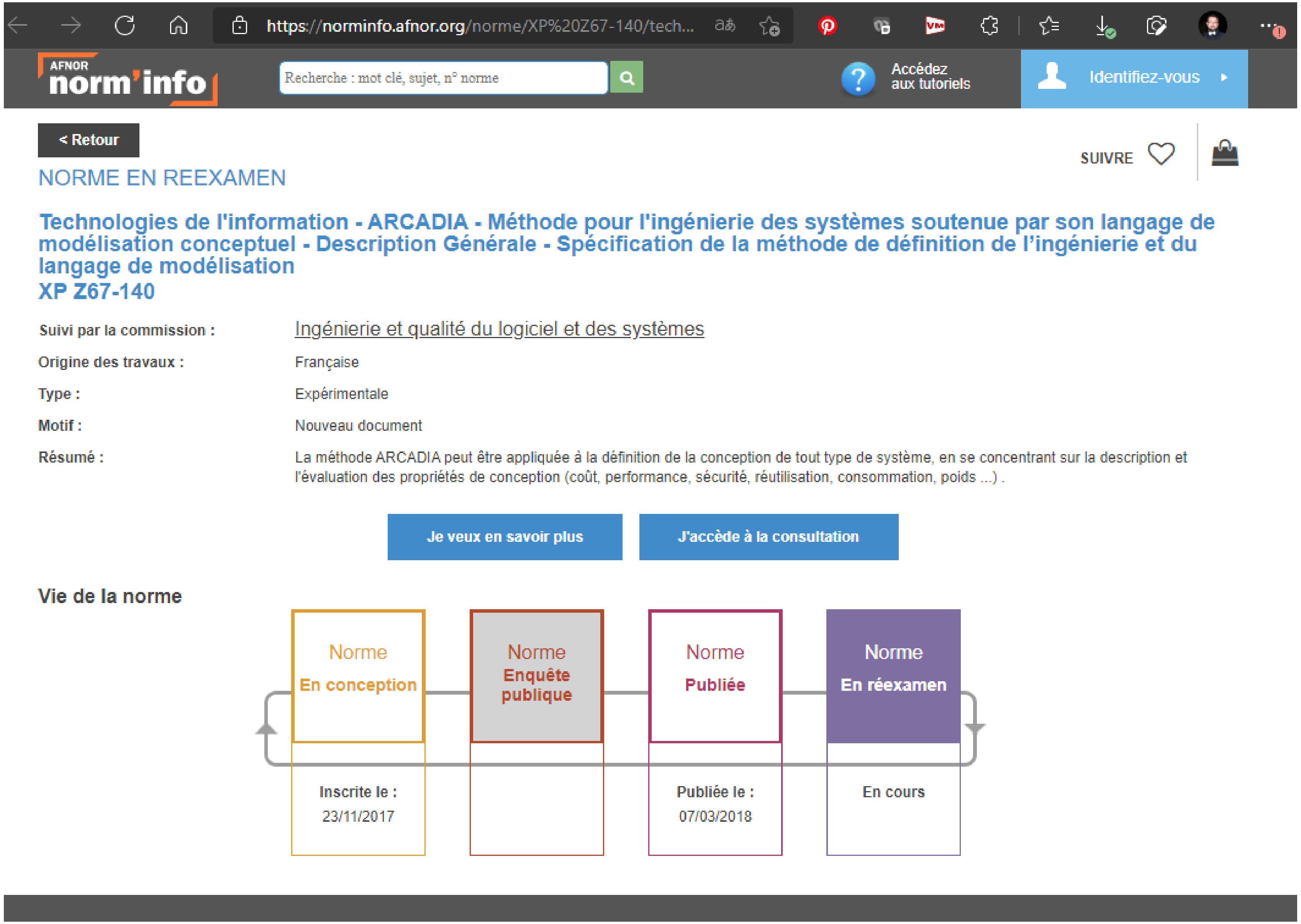
Component wiring: all kinds of components



Allocation of op.activities to actors, of functions to components, of behav.components to impl.components, of dataflows to interfaces, of elements to configuration items

XP Z67-140 - ARCADIA

Norme XP Z67-140 (afnor.org)



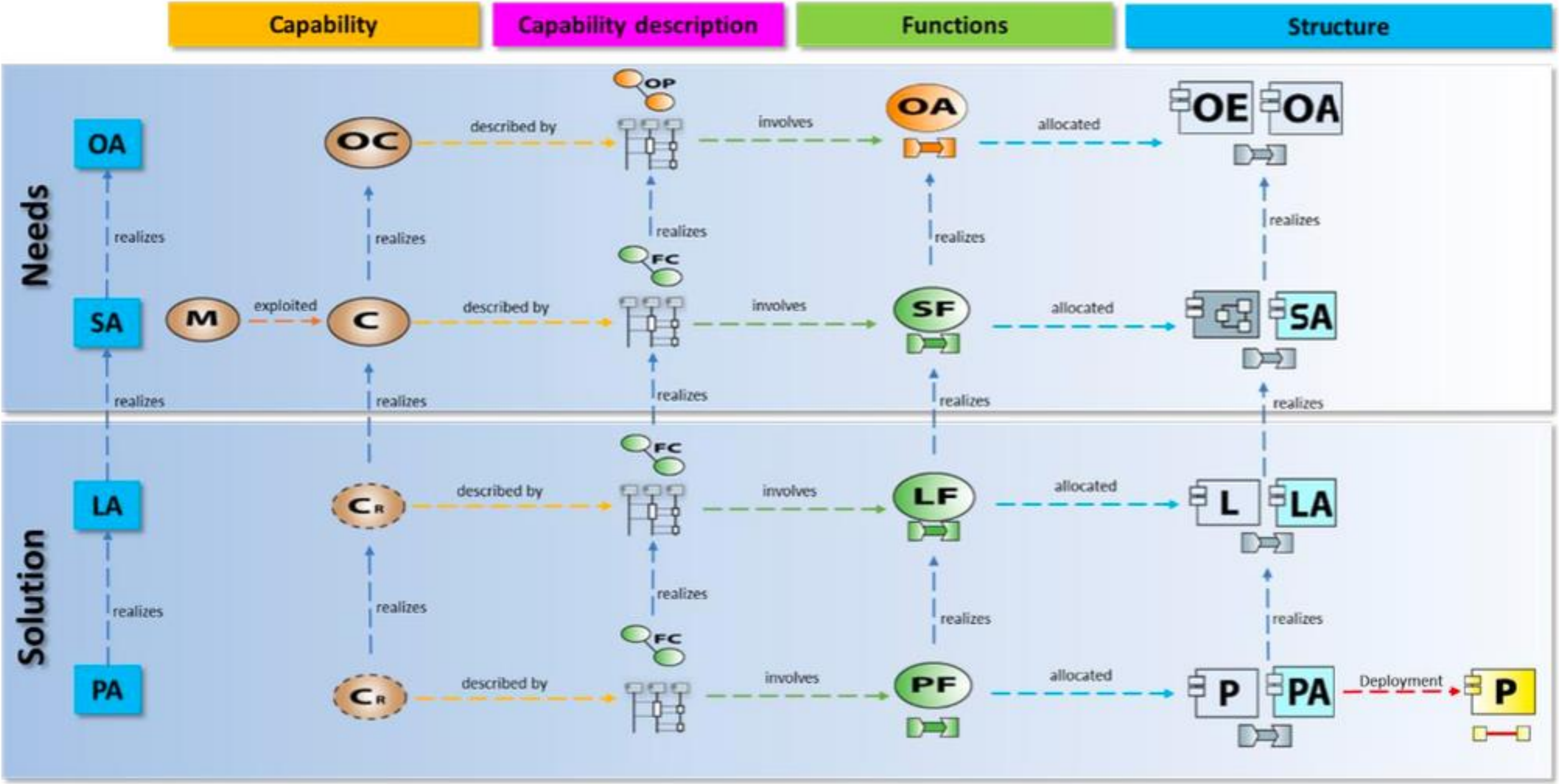


Figure 2.3: Arcadia ontology traceability

https://www.slideshare.net/HelderCastro3/mbse-with-arcadia-methodpdf-256664096

Arcadia layer	Requirements	Capability	Capability description	Functional	Structure	Modes and States	Data	Interfaces
Operational Analysis	**R-OA** Capture stakeholder requirements	**OA1** Define Operational Capabilities	**OA2** Define processes and scenarios	**OA3** Define Operational Activities and interactions	**OA4** Capture Operational Entities and Actors. Allocate Operational Activities to Operational Actors, Entities	**M&S-OA5** Define operational modes and states	**D-OA6** Define operational data model	**I-OA7** Define interfaces and describe interfaces scenarios
System Analysis	**R-SA** Derive Stakeholder requirements and capture System requirements	**SA1** Define System Missions and System Capabilities	**SA2** Define Functional Chains and Scenarios.	**SA3** Define System Functions. Define Functional Exchanges and components	**SA4** Allocate System Functions to System and Actors	**M&S-SA5** Define system modes and states	**D-SA6** Define system data model	**I-SA7** Define interfaces and describe interfaces scenarios Enrich Logical Scenarios.
Logical Architecture	**R-LA** Derive system requirements and Capture components requirements	**LA1** Transition Capabilities Realization from system layer	**LA2** Define Functional Chains and scenarios	**LA3** Derive System Functions and define Logical Functions. Define Functional Exchanges and components.	**LA4** Allocate Logical Functions to Logical Components	**M&S-LA5** Define logical components modes and states	**D-LA6** Define logical data model	**I-LA7** Delegate System Interfaces and create Logical Interfaces. Enrich Logical Scenarios.
Physical Architecture	**R-PA** Derive logical requirements and capture physical requirements	**PA1** Transition Capabilities Realization from logical layer	**PA2** Define Functional Chains, Scenarios, and Physical Path	**PA3** Derive Logical Functions and define Physical Functions. Define Functional Exchanges and components.	**PA4** Define Physical Nodes and refine Behavioural Physical Components. Allocate Behavioural Components.	**M&S-PA5** Define physical nodes modes and states	**D-PA6** Define physical data model	**I-PA7** Delegate Logical Interfaces and create Physical Interface. Enrich Physical Scenarios.

Table 3.2: Arcadia matrix activities

https://www.slideshare.net/HelderCastro3/mbse-with-arcadia-methodpdf-256664096

Arcadia layer	Requirements	Capability	Capability description	Functional	Structural	Modes and States	Data	Interfaces
Operational Analysis	**R-OA** No dedicated diagram	**OA1** [OCB] Operational Capabilities	**OA2** [OAS] Operational Activity Scenario [OPD] Operational Process Scenario [OES] Operational Entity Scenario	**OA3** [OABD] Operational Activity Breakdown Diagram [OAIB] Operational Activity Interaction Blank	**OA4** [OEBD] Operational Entities Blank Diagram [ORB] Operational Roles Blank [OAB] Operational Architecture Blank	**M&S-OA5** [MSM] Modes and States	**D-OA6** [CDB] Class Diagram	**I-OA7** [IDB] Interface Definition Blank [CEI] Component External Interfaces [IS] Interface Scenario [CDI] Component Detailed Interface
System Analysis	**R-SA** No dedicated diagram	**SA1** [MCB] Mission and Capabilities Blank [CC] Contextual Capability	**SA2** [FS] System Functional Scenario [ES] System Entity Scenario [SFCD] System Functional Chain Description	**SA3** [SFBD] System Functional Breakdown Diagram [SDFB] System Data Flow Blank	**SA4** [CSA] Contextual System Actor [SAB] System Architecture Blank	**M&S-SA5** [MSM] Modes and States	**D-SA6** [CDB] Class Diagram	**I-SA7** [IDB] Interface Definition Blank [CEI] Component External Interfaces [IS] Interface Scenario [CDI] Component Detailed Interface
Logical Architecture	**R-LA** No dedicated diagram	**LA1** [CRB] Capabilities Realization Blank [CRI] Contextual Capability Realization Involvement	**LA2** [FS] Logical Functional Scenario [ES] Logical Entity Scenario [LFCD] Logical Functional Chain Description	**LA3** [LFBD] Logical Functional Breakdown Diagram [LDFB] Logical Data Flow Blank	**LA4** [LCBD] Logical Component Breakdown Diagram [LAB] Logical Architecture Blank	**M&S-LA5** [MSM] Modes and States	**D-LA6** [CDB] Class Diagram	**I-LA7** [IDB] Interface Definition Blank [CEI] Component External Interfaces [IS] Interface Scenario [CDI] Component Detailed Interface
Physical Architecture	**R-PA** No dedicated diagram	**PA1** [CRB] Capabilities Realization Blank [CRI] Contextual Capability Realization Involvement	**PA2** [FS] Physical Functional Scenario [ES] Physical Entity Scenario [PFCD] Physical Functional Chain Description	**PA3** [PFBD] Physical Functional Breakdown Diagram [PDFB] Physical Data Flow Blank	**PA4** [PCBD] Physical Component Breakdown Diagram [PAB] Physical Architecture Blank	**M&S-PA5** [MSM] Modes and States	**D-PA6** [CDB] Class Diagram	**I-PA7** [IDB] Interface Definition Blank [CEI] Component External Interfaces [IS] Interface Scenario [CDI] Component Detailed Interface

Table 3.3: Arcadia diagrams matrix

https://www.slideshare.net/HelderCastro3/mbse-with-arcadia-methodpdf-256664096

https://www.eclipse.org/capella/adopters.html

ADOPTERS

Eclipse Capella is a MBSE solution adopted worldwide in various industrial domains.
Discover some of the many organizations using Capella.

ALL4TEC
axone
CNXMOTION — A CONTINENTAL + NEXTEER MOTION CONTROL VENTURE
CT ENGINEERING DRIVEN PEOPLE
EMBRAER
gmv
Grus
ISAE ENSMA
ITA
Maplesoft
MARQUETTE UNIVERSITY — BE THE DIFFERENCE.
Mentor — A Siemens Business
NEXTRAIL
OBEO
PRFC
SAMARES ENGINEERING — Accelerate Systems Design
SIEMENS
Solutions Thinking
SUTD — SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN
THALES
The Reuse Company
UNIVERSITY OF INDIANAPOLIS
UNIVERSITÉ TOULOUSE Jean Jaurès
Virgin Hyperloop one
VISION:EER
vitesco TECHNOLOGIES
wsp

https://youtu.be/nv8IOg_xVMs

Context Analysis

T2 – Consider the whole problem, the whole solution and the full lifecycle

- Systems Engineering is concerned with the **whole problem and the whole solution**, including how the "**intervention system**" will interact with its environment as part of a larger system when it is deployed, and all the enabling systems and services required to establish and maintain system effectiveness throughout its lifecycle until eventual satisfactory disposal.
- We need to consider the **full lifecycle of the entire solution, including all the enabling systems that go along with the system of interest**

PROBLEM SPACE

Table 4: Applying SE Tenets to the Problem Domain

Tenet	Problem Domain application
Understand what success means	Establish a clear definition of purpose and success criteria. Understand what success means for each stakeholder, and establish shared vision, purpose and success criteria among all stakeholders.
Whole problem whole system whole lifecycle	View the problem as a system. Recognise that introducing a new system that solves or suppresses the existing problem may create new ones. Situation may include technical, societal and naturally occurring systems.
Understand and manage interdependencies	Understand how the elements of the problem interact, and how the new system will interact with and change the environment. Understand the relationships and interdependencies between stakeholders, and how that affects their views of purpose and success criteria. Understand how different success criteria interact to constrain or expand the solution space.
Adapt the parts to serve the purpose of the whole	It may be possible to solve the problem by changing the existing operational practices rather than adding a new system.
Systems Engineering at multiple levels	Each layer of the solution provides the problem for the layers below.
Base decisions on evidence and reasoned judgement	Maintain clear line of sight from all decisions to purpose and success criteria. Characterise the problem – e.g. is it simple, chaotic, complicated or complex? – and use an appropriate approach (e.g. for complex – "probe sense respond"). Where "evidence" is not available or inconclusive, use reasoned judgement to make the best decisions possible at the time.
Uncertainty, change, risks, opportunities and expectations	Understand dynamics of change in problem space. Accept we don't know everything, we can't know some things, and almost everything changes. Realise that sometimes we can't fully understand the problem until we start work. Manage stakeholder expectations to be realistic.
Structure and behaviour	Look for structures in the problem space that cause the problematic behaviours. Look for leverage points that will allow an intervention system to alleviate the problem while minimising adverse consequences.
Feedback	Look for the feedback mechanisms that keep the problem going in spite of attempts to solve it. Understand how the feedback mechanisms in the problem space might be exploited to amplify the effects of a successful intervention.
Value	Understand stakeholders' perceptions of value. Seek opportunities to manage and maximise value.
Systemic and Systematic	Use appropriate shared model-building methods and tools to enable the transdisciplinary group to frame the problem, for example Soft Systems Methodology (SSM), Interpretive Structural Modelling (ISM), Causal Loop and System Dynamic Modelling (CLM/SDM).
Respect the people	Ensure you understand who is affected by the problem and possibly who is benefiting from it. Bring those people together and facilitate in such a way that they all have equal opportunity to express those opinions, and that those opinions are valued and considered.

- viewing the **problem as a system**,
- understanding how the **interdependencies between the elements in the problem space create the "problem symptoms"**, and how the "intervention system" might alleviate the problem symptoms
- **understanding stakeholder interactions** and interdependencies and establishing **overall agreed purpose** and success criteria
- anticipating and aiming to minimize potential adverse or unintended consequences of the intervention system
- scanning for and early detection of anomalous behavior and unintended consequences – not all can be anticipated beforehand

TYPES OF PROBLEMS

- Problems can be “tame,” “regular,” or “wicked”:
  - **Tame problems**: are those that the solution may be well-defined and obvious.
  - **Regular problems:** are those that are encountered on a regular basis. Their solutions may not be obvious, thus serious attention should be given to every aspect of them.
  - **Wicked problems**: are those that cannot be fully solved, or perhaps even fully defined.

CHARACTERISTICS OF A "*WICKED PROBLEM*"

Many stakeholders involved

Complex context

Poorly Defined

Solutions require design and analysis

Decisions require weighing value trade-offs

Long time horizons

For every complex problem there is an answer that is clear, simple, and wrong

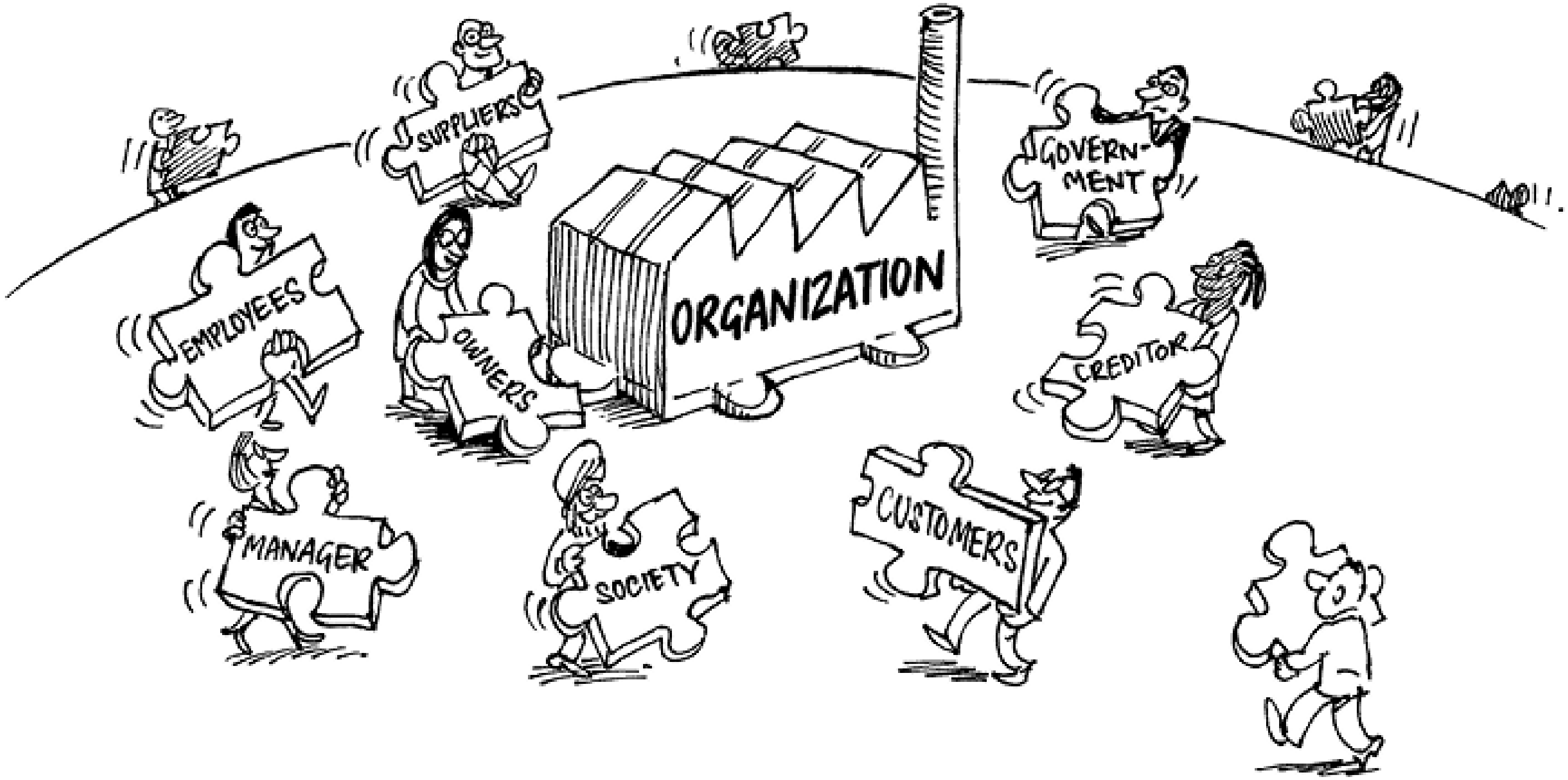
[H.L. Mencken]

STAKEHOLDERS

1h

Stakeholders

- A stakeholder is any individual, group or organization that can affect, be affected by a project.

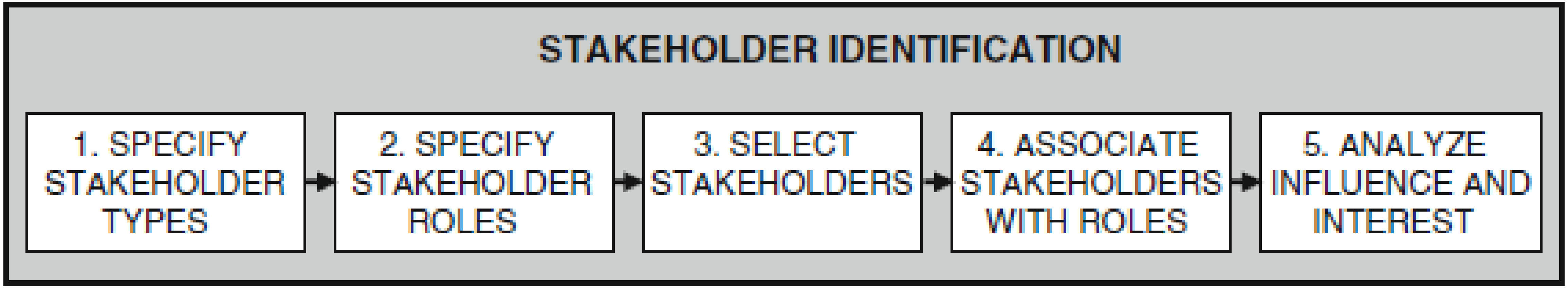


STAKEHOLDER DEFINITION

One of many stakeholder identification process:

Method for stakeholder identification in interorganizational environments

Luciana C. Ballejos · Jorge M. Montagna



By executing the first step, diverse stakeholders' attributes are analyzed, such as: performed functions, hierarchical levels, abilities or knowledge, and geographical location. The roles that stakeholders may play along the project lifecycle are determined. The third step is devoted to selecting the concrete stakeholders that will represent the diverse interests in the project. The identified stakeholders are associated to the roles specified in Step 2. Tools for analyzing the influence and interest each of them may have in relation to the project and its success.

Table 1 Stakeholder Roles

Beneficiaries: Those that benefit from the system implementation

Functional: They benefit directly from the functions performed by the system and its products or results. Other information systems that interact with the new one can be included in this role, since the functionalities to be implemented would be beneficial to this exchange

Financial: They benefit indirectly from the system, obtaining financial rewards

Political: They benefit indirectly from the system, obtaining political gains in terms of power, influence and/or prestige

Sponsors: Those in charge of the project and of starting the system development, collecting funds and protecting them against political pressures and budget reductions, for example

Negatives: Those that undergo some kind of damage as a consequence of the system implementation or are adversely impacted by its development (for example, losing their jobs, losing power for decision making, physical damage, financial damages, etc.)

Responsibles: They are in charge of the system throughout all lifecycle phases. This role includes people working with budgets and schedules (for example, project manager, those responsible for selecting suppliers, etc.)

Decision-makers: Those that control the process and make decisions to reach agreements. They define the way in which consensus is attained throughout the project

Regulators: They are also called legislators. They are generally appointed by government or industry to act as regulators of quality, security, costs or other aspects of the system. They generate guidelines and outlines that will affect the system development and/or operation. For instance, health organisms that control standards, organisms that defend rights, organisms related to legal and tax controls, etc.

Operators: They are also called "users" by many authors, since they operate the system to be developed. They interact with the system and use its results (information, products, etc.). They are different from functional beneficiaries, even though their roles may overlap. An operator can benefit from the system or not

Experts: They are familiar with functionalities and consequences of the system implementation. They widely know the implementation domain and can collaborate in requirements elicitation to a great extent

Consultants: These include any role dealing with providing support for any aspect of the system development. They are generally external to the organization and have specific knowledge on a particular area

Developers: They are directly involved in IOS development (requirements engineer, analyst, designer, programmer, tester, safety engineer, security engineer, project manager, etc.)

Table 8 Facilitator Role Table

Name: Facilitator

Brief description: This role represents collaborators who interact directly with the project team. They help in the resolution of problems regarding specific questions related to the entity to which they pertain

Responsibilities: They are the nexus between the external project team and the organization. They must collaborate in the normal executions of interviews and solving problems in order to achieve synergy with personnel, making easier to arrive to consensus

Participation: It will take part in different stages of the project:

Initial contact

Meetings moderator

Documentation of processes and "as-is" situation

Stakeholder selection

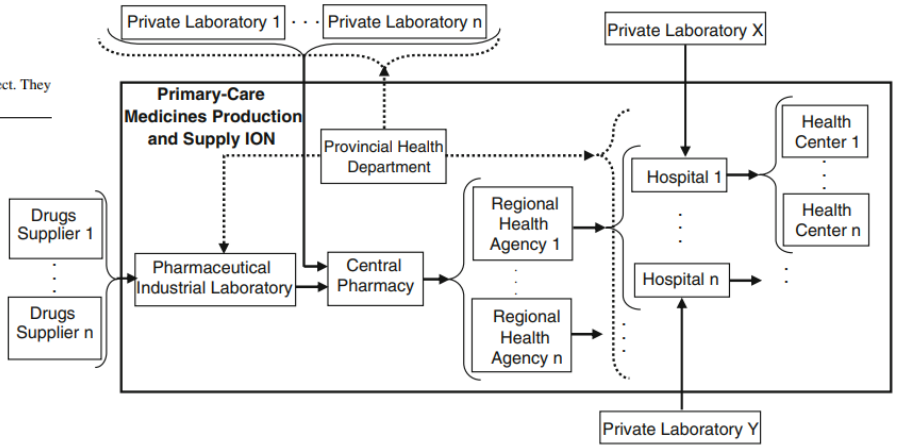
Requirements validation

Table 9 Stakeholders Table for the example

ID	Stakeholder	Description	Stakeholder type: Criterion	Stakeholder type: Dimension
S1	Physicians organization X	They perform their activities in Organization X (e.g., hospital X)	Functional	Organiz. (Hospital X)
S2	Private laboratory A	Organizations which supply drugs and medicines to Central Pharmacy	Functional Geographical location	External
S3	RHA coordinator (region B)	Pursues political goals and regional interests in health area (Region B)	Geographical location Hierarchial	ION
S4	Specialist in process redesign	Defends strategic issues for processes performance improvement	Knowledge/ability	External
S5	Information systems administrator organiz. Y, dependency 1	Looks after computer systems in Dependency 1 of organization Y	Geographical location Knowledge/ability	Organiz. (Organizat. Y)
S6	Pharmacist region C	Controls medicines quality, security, storage conditions, etc. in hospitals of Region C	Functional Knowledge/ability	ION
S7	PIL agent	Collects information about medicines real consumption in Hospitals	Functional	Organiz. (PIL)

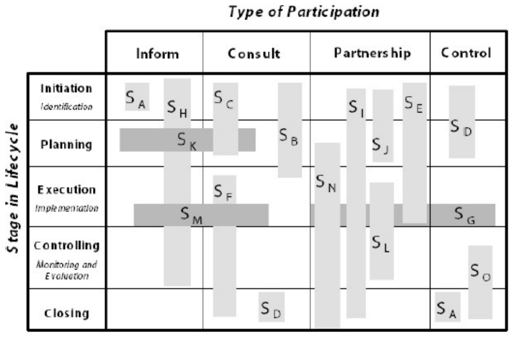
Table 6 Stakeholders influence and interest matrix

		Influence: Low	Influence: High
Interest	High	**B** These stakeholders will need special initiatives	**A** These stakeholders constitute the supporting base of the project
	Low	**D** They are the least important stakeholders for the project	**C** They can influence results, but their priorities are not the same as those of the project. They may constitute a risk or an obstacle for the project

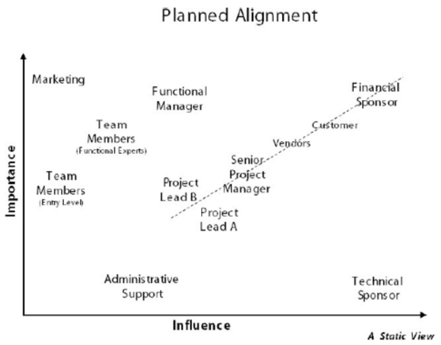


	Stakeholder	Interests	Estimated Project Impact	Estimated Priority
Primary	Owner	Achieve targets Liability (avoid at all costs) Increase sales margin	Med + High - Med +	1
	Sponsor	Successfully addresses needs of adjunct customer Appears competent among peers Provides new market to expand ventures	Low + Low - Med +	3
	Team Memebers	New product excitement Demand end-of-year bonus Retain and expand skill level Strike (if basic demands aren't met with new process)	Med + ? Med + High -	2
	Project Manager			
Secondary				

DIMENSION		CRITERION	STAKEHOLDER	FUNCTIONAL	FINANCIAL	POLITICAL	SPONSORS	NEGATIVES	RESPONSIBLES	DECISION-MAKERS	REGULATORS	OPERATORS	EXPERRTS	CONSULTANTS
				BENEFICIARIES										
INTERNAL	ORG	Functional	Physicians organization X	√										
			PIL agent					√						
			...											
		Geog. Locat.	Information systems administrator organis. Y, dependency 1	√								√	√	
			...											
		Knowl/Ability	Information systems administrator organis. Y, dependency 1	√								√	√	
			...											
		Hierar. Level	...											
	ION	Functional	Pharmacist region C	√								√		
			...											
		Geog. Locat.	RHA coordinator (region B)				√		√					
			...											
		Knowl/Ability	Pharmacist region C	√										
			...											
		Hierar. Level	Health department director			√			√	√				
			RHA coordinator (region B)			√			√	√				
EXTERNAL		Functional	Private laboratory A	√								√		
			...											
		Geog. Locat.	Private laboratory A	√										
			...											
		Knowl/Ability	Specialist in process redesign										√	√
			...											
		Hierar. Level	...											

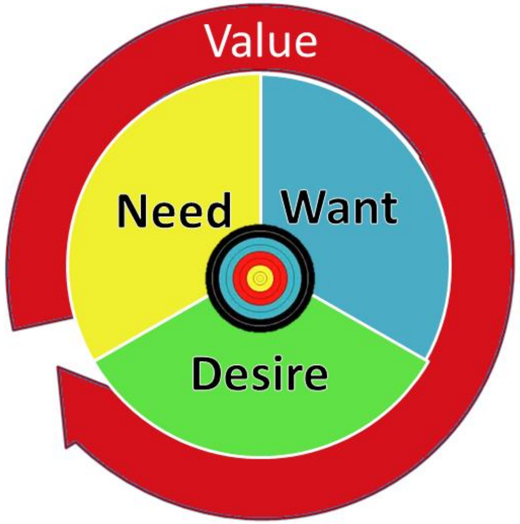


S_x = Stakeholder X



At the end: Stakeholder "Requirements"

- Stakeholder ***requirements*** describe the needs, wants, desires, expectations and constraints of stakeholders
  - Defines value to be created for stakeholders



ID	Need	Stakeholder
N1	"Need to notify support manager when a 'support request' is initiated."	Support manager
N2	"Need to assign support request to appropriate support engineer."	Support manager
N3	"Need to keep customer informed of the progress of a support request."	Customer (user)

WHAT IS IN THE OPERATIONAL ANALYSIS (OA)

Operational Analysis

"What system users must achieve"

"What the users of the system need to accomplish"

- This perspective analyses the issue of operational users, by identifying actors that have to interact with the system, their **goals, activities, constraints and the interaction conditions between them**.
- Analysis of the issues of operational users by identifying the actors that must interact with the system, their activities and their interactions with each other.

00:09

- Trying to best satisfy a customer need, without having an imposed system scope.

- OA **should not mention the system**, *so as not to bar itself from potentially interesting alternatives for achieving the satisfaction of customer needs*: it aims at understanding this need without any *a priori* assumptions about how the system will contribute thereto; this is to not restrict the scope of possibilities too quickly.

00:09

- EXAMPLE.– Suppose that the customer need is to be able to hang a mirror on a wall.

If this need is translated too quickly into "how to attach a dowel to the wall with a drill?"

- this prematurely excludes other possibilities (**such as using glue, for example**),
- And, also, criteria that would help guiding the process toward the right solution (**such as the need or not to be able to disassemble the mirror later**).

00:09

Arcadia method – operational analysis summary

Define missions and required operational capabilities	determining future system and environment users' missions – or more generally their motivations, expectations, goals, objectives, intentions, etc., as well as the capabilities required to assume these missions.
Perform operational needs analysis	capture the conditions for the completion of a mission previously identified, and those for the implementation of associated capabilities, mainly through the activities and interactions of the key players that contribute thereto.

OA ELEMENTS VOCABULARY

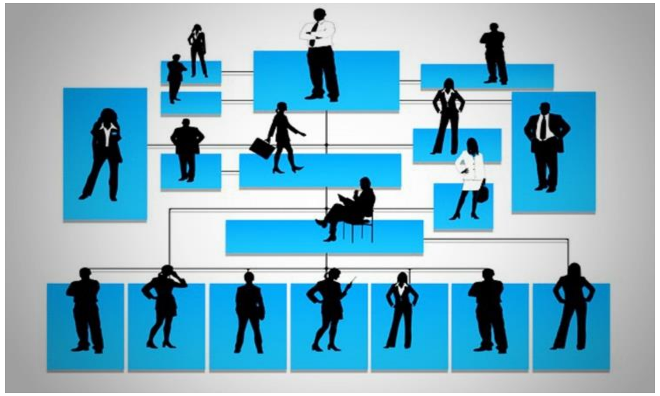
00:09

• **Operational Capability**: capab**ility** of an organization to provide a high-level service leading to an **operational objective** being reached (*for example Provide weather forecasts, etc.*); - high-level objectives

OA CONCEPTS

00:09

- **Operational Entity**: entity belonging to the real world (*organization, existing system, etc*.) whose role is to **interact with the system** being studied or **with its users** (*for example Crew, Ship, etc.*);



00:09

- **Operational Actor**: particular case of a (*human*) **non-decomposable operational entity** (*for example Pilot, etc.*);

00:09

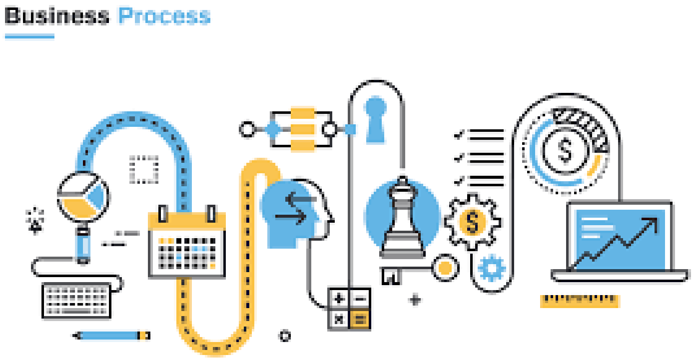
- **Operational Activity**: process step carried out in order to **reach a precise objective** by an operational entity, which might need to use the future system in order to do so (*for example Detect a threat, Collect meteorological data, etc.*);

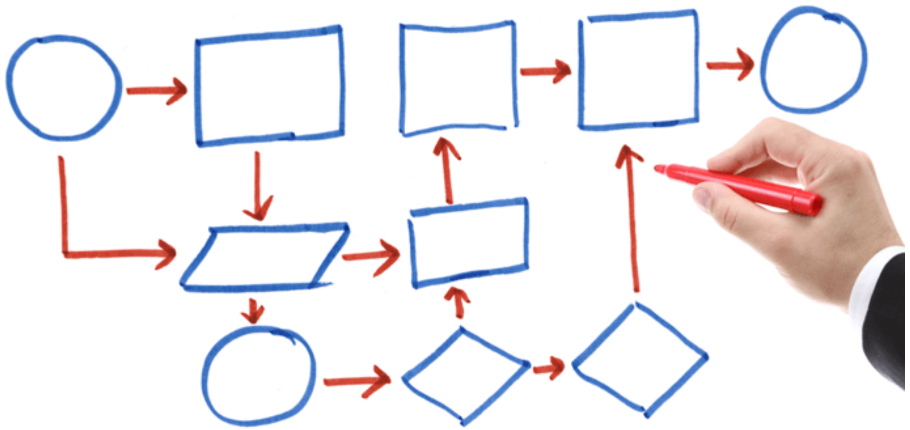
- **Operational Interaction**: **exchange of information** or of unidirectional matter **between operational activities** (for example meteorological data, etc.);

OA CONCEPTS

00:09

- **Operational Process:** series of **activities** and of **interactions** that contribute toward an operational capability.





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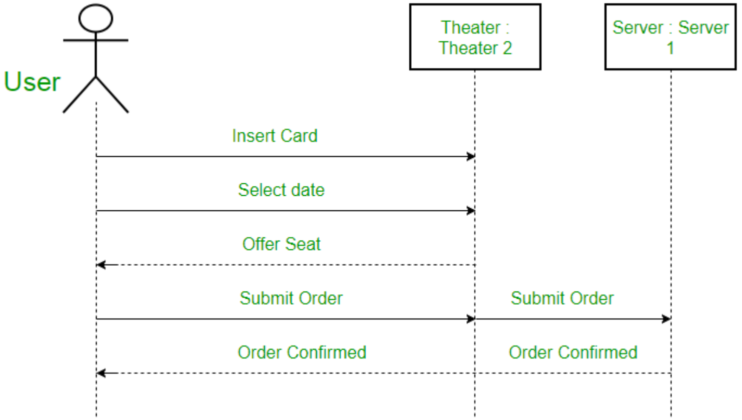
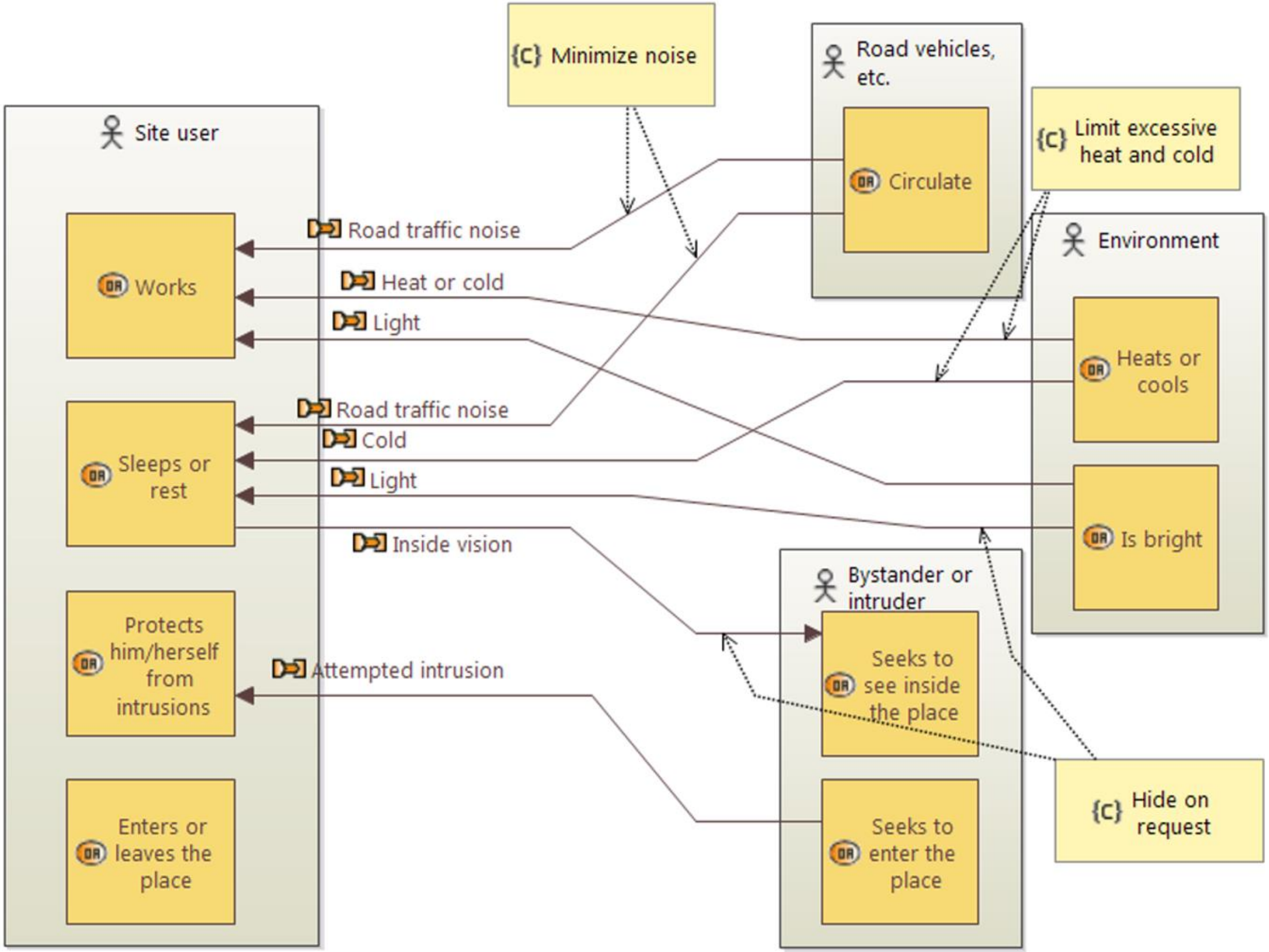
- **Operational Scenario**: scenario that **describes the behavior** of entities and and/or operational activities in the **context of an operational capability**. *It is commonly represented as a sequence diagram, with the vertical axis representing time.*




{C} Minimize noise
Road vehicles, etc.
Circulate
{C} Limit excessive heat and cold
Site user
Works
Road traffic noise
Heat or cold
Light
Environment
Heats or cools
Sleeps or rest
Road traffic noise
Cold
Light
Is bright
Inside vision
Bystander or intruder
Protects him/herself from intrusions
Attempted intrusion
Seeks to see inside the place
Enters or leaves the place
Seeks to enter the place
{C} Hide on request

00:09

Diagrams

Operational Analysis
Define Stakeholders Needs

System Analysis

Define Operational Entities and Capabilities

[OEBD] Create a new Operational Entity Breakdown diagram

[OCB] Create a new Operational Capabilities diagram

Identify the operational domain: who are the actors and entities, what are their purposes? The activities give a global view of the operational objectives of the business.

Define Operational Activities and describe Interactions

[OABD] Create a new Operational Activity Breakdown diagram

[OAIB] Create a new Operational Activity Interaction diagram

[OAS] Create a new Operational Activity Scenario

Detail the breakdown of operational activities, describe the interactions between entities, and model the processes.

Allocate Operational Activities to Operational Actors, Entities or Roles

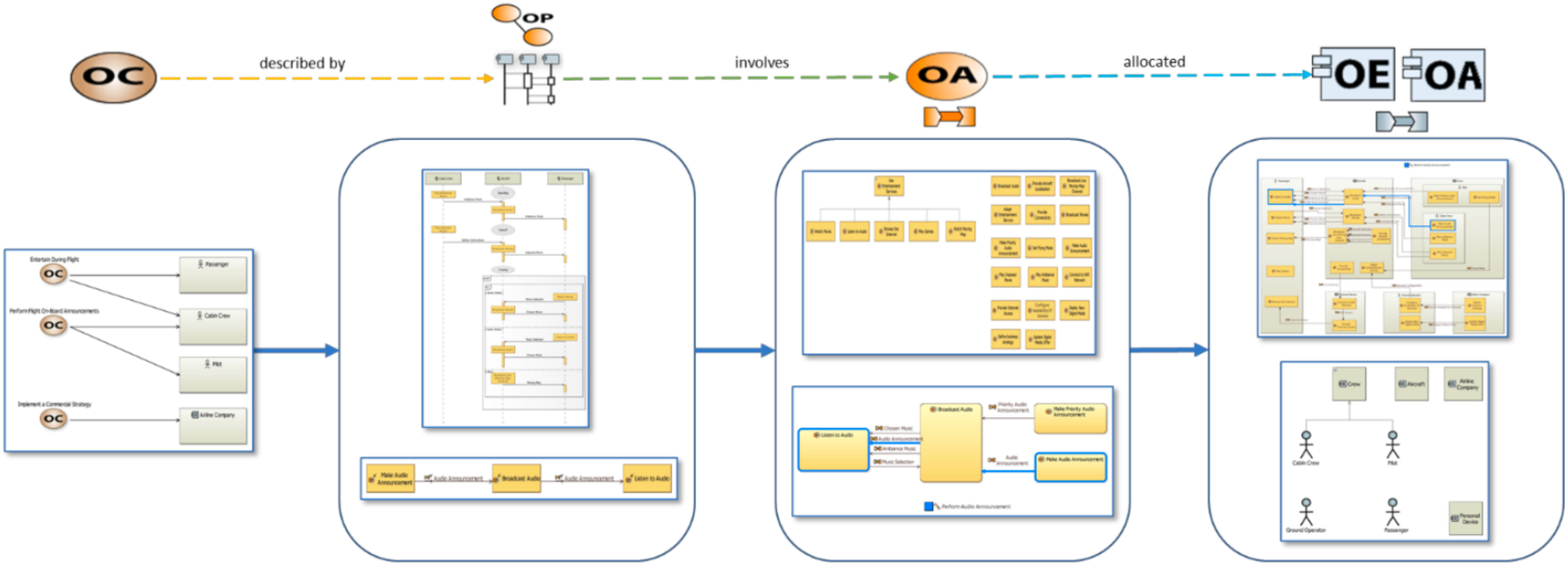
[OAB] Create a new Operational Architecture diagram

[ORB] Create a new Operational Role diagram

[OES] Create a new Operational Entity Scenario

The actors and operational entities are responsible for the execution of operational activities. Manage allocations and deduce means of communication between entities.
Create scenarios to illustrate interactions between operational actors and entities

Transverse Modeling



Capability diagram	Capability description diagrams	Functional diagrams	Structural diagrams
[OCB] Operational Capabilities	[OAS] Operational Activity Scenario [OPD] Operational Process Scenario [OES] Operational Entity Scenario	[OABD] Operational Activity Breakdown Diagram [OAIB] Operational Activity Interaction Blank	[OEBD] Operational Entities Blank Diagram [ORB] Operational Roles Blank [OAB] Operational Architecture Blank

Figure 4.10: Operational Analysis model elements and diagrams traceability

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Final Considerations

SOME THOUGHTS

- OPERATIONAL ANALYSIS ANSWERS:
  - ***What the users of the system need to accomplish***
- There is ***NO SYSTEM*** IN the operational analysis.
- Focus in the problem and in the “as-is”.
- Map the **stakeholders’** interactions with the **subject domain**.

Atividades para a próxima aula

- Fazer a etapa de Análise de Contexto
- Apresentar o entendimento do problema na sua maneira (pode usar o método que achar interessante)
- Apresentar o modelo da análise operacional
  - Características mínimas: 3 stakeholders – um deles negativo, 2 capacidades desejadas, 1 diagrama de capacidades, 2 cenários que acontecem no sistema problema, 6 atividades distribuídas pelos stakeholders, 1 diagrama de fluxo funcional, 1 diagrama de arquitetura do problema, 2 processos – 1 deles relacionado com um cenário, 1 classe que indique o que é trafegado em 1a interação, 5 necessidades apontadas, 4 medidas de efetividade e 3 restrições.