System Architecture Framework (SAF) Architecture I

GfSE Arbeitsgruppe SAF

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INCOSE EMEA WORKSHOP 2019, Utrecht

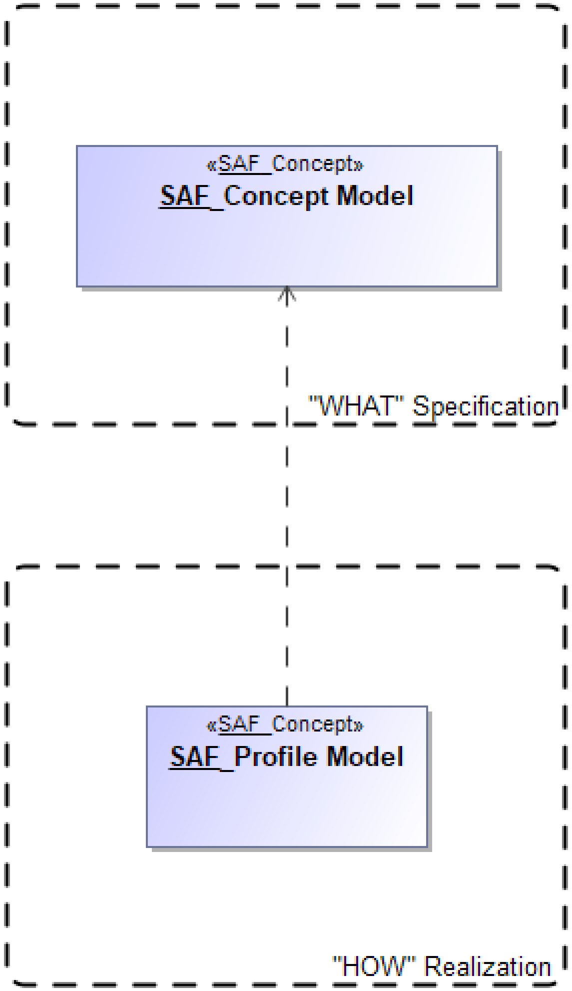
SAF Workshop Presenters

- Alex
  - Systems Engineer @ Atlas Elektronik GmbH
  - 15+ experience in Systems Modeling
  - SAF WG founding member
- Klaus
  - Consultant @ invenio Systems Engineering GmbH
  - 10+ experience in Modeling Systems and Software Architectures
  - Joined SAF in 01/2019
- Christian
  - System Architect @ ZF Friedrichshafen
  - 2 years of experience in Modeling Systems
  - Joined SAF in 08/2018

SAF Goals

- Offering an architecture framework dedicated to technical system development
- Providing an architecture framework description as concept model, profile and guidance documentation
- Fostering the creation of architecture repositories allowing reuse
- Interface to enterprise frameworks to improve collaboration

SAF Concept and Profile Model



Concept Model defines

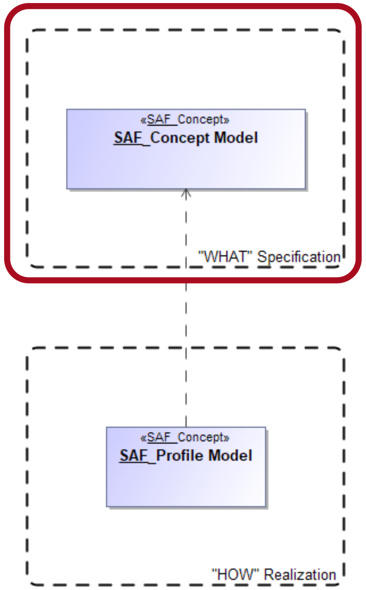
- What items are captured in an architectural model
- How items are interrelated
- Which viewpoints are available
- Which items are present in a viewpoint

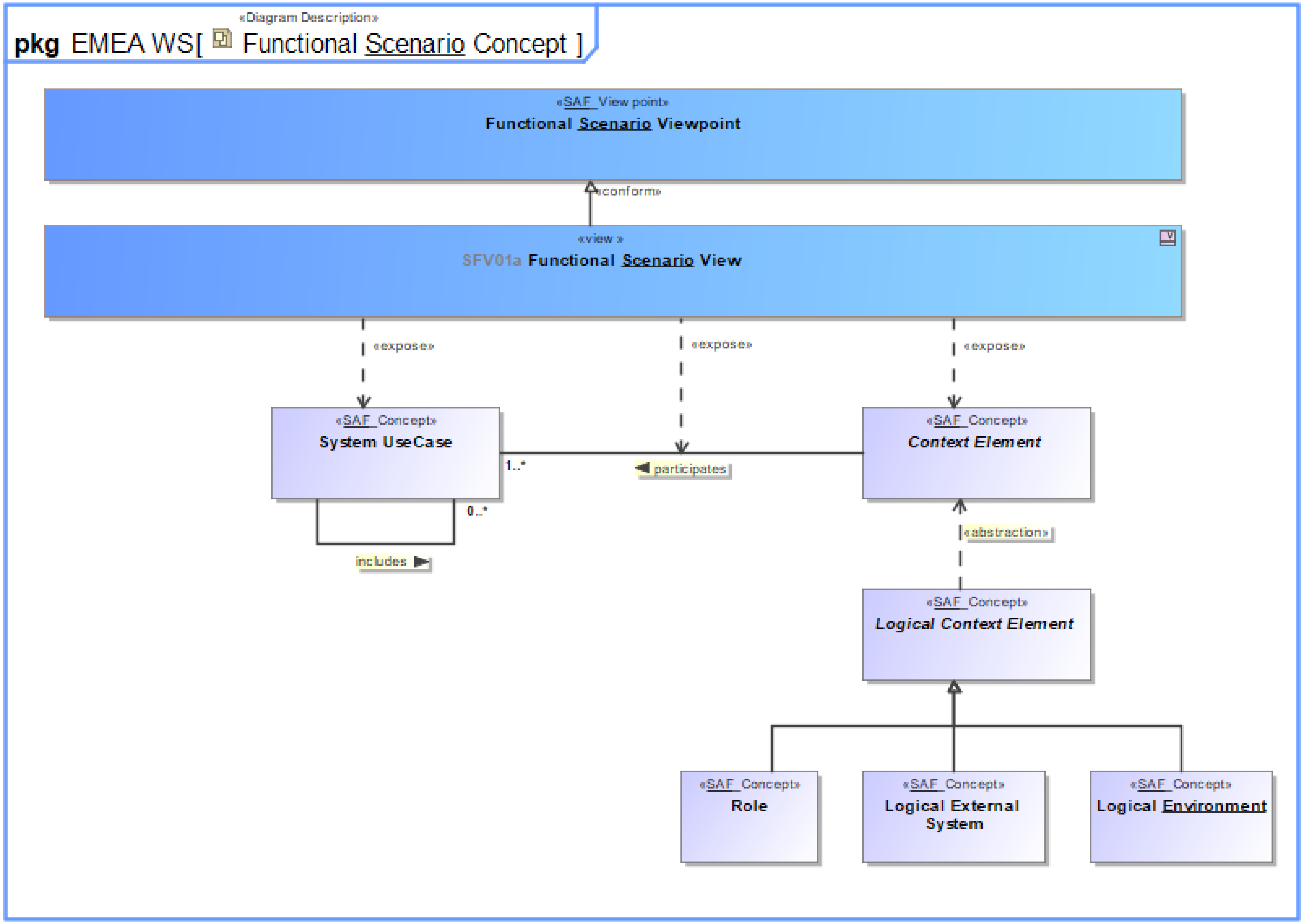
It is agnostic to the implementation

Profile Model

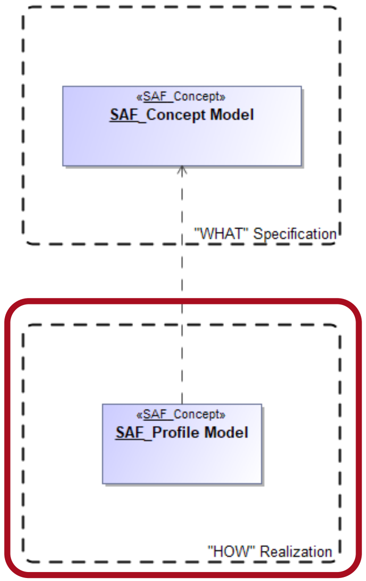
- Defines how the items and relations are modeled
- Is based on SysML and UML
- Provides additional stereotypes
- Is traced to concept model

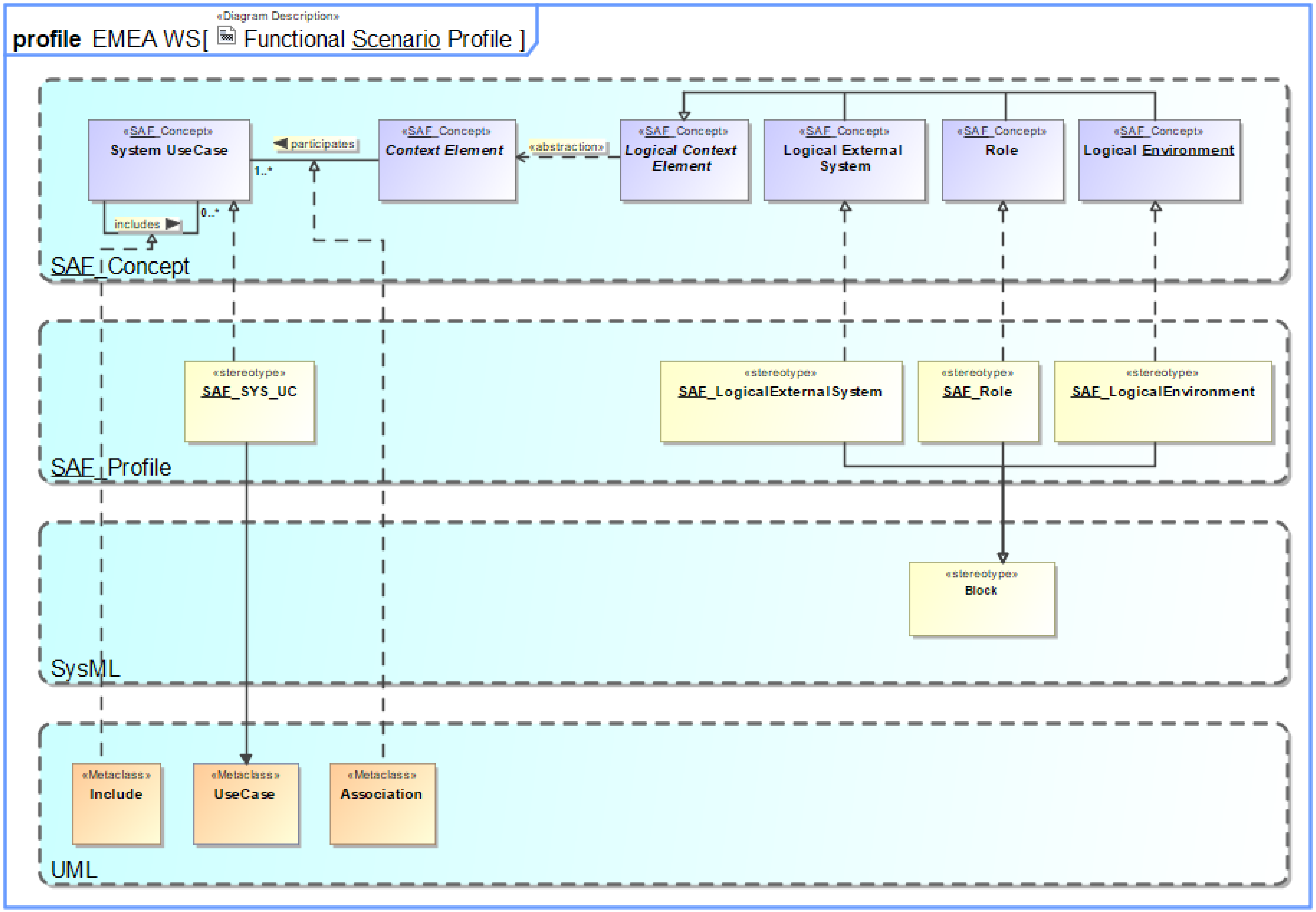
SAF Concept Model example



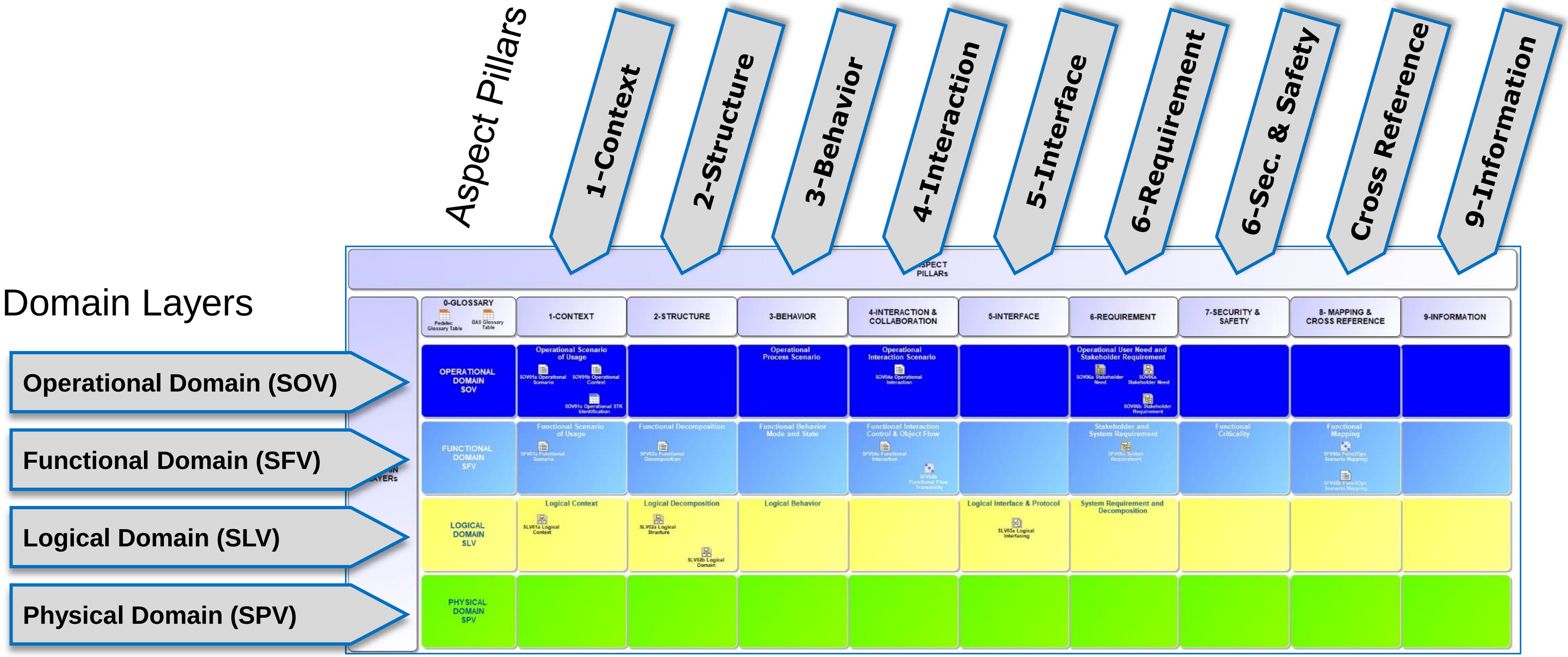


SAF Profile Model example





SAF Grid



Aspect Pillars
1-Context
2-Structure
3-Behavior
4-Interaction
5-Interface
6-Requirement
6-Sec. & Safety
Cross Reference
9-Information
Domain Layers
Operational Domain (SOV)
Functional Domain (SFV)
Logical Domain (SLV)
Physical Domain (SPV)
ASPECT PILLARs
0-GLOSSARY
1-CONTEXT
2-STRUCTURE
3-BEHAVIOR
4-INTERACTION & COLLABORATION
5-INTERFACE
6-REQUIREMENT
7-SECURITY & SAFETY
8- MAPPING & CROSS REFERENCE
9-INFORMATION
OPERATIONAL DOMAIN SOV
Operational Scenario of Usage
Operational Process Scenario
Operational Interaction Scenario
Operational User Need and Stakeholder Requirement
FUNCTIONAL DOMAIN SFV
Functional Scenario of Usage
Functional Decomposition
Functional Behavior Mode and State
Functional Interaction Control & Object Flow
Stakeholder and System Requirement
Functional Criticality
Functional Mapping
LOGICAL DOMAIN SLV
Logical Context
Logical Decomposition
Logical Behavior
Logical Interface & Protocol
System Requirement and Decomposition
PHYSICAL DOMAIN SPV

SAF Grid and ISO 15288 Lifecycle / Processes

Concept stage	Development stage	Production stage	Utilization stage / Support stage	Retirement stage

- Business / Mission Analysis
- Stakeholder Needs and Requirements definition

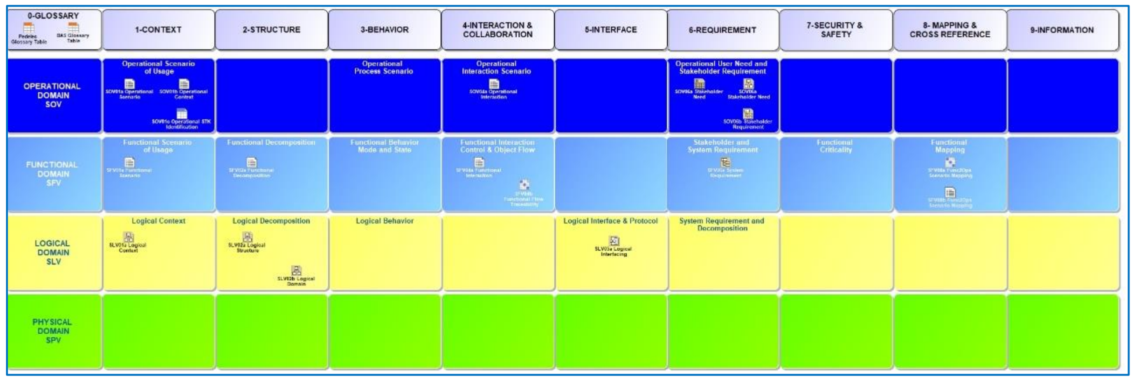
- System Requirements definition
- Architecture Definition
- Design Definition

Operational Domain (SOV)

Functional Domain (SFV)

Logical Domain (SLV)

Physical Domain (SPV)



SAF Example

- Technology is our friend
- E-Bike startup
- Tim, one of the startup founders, his eBike has been stolen

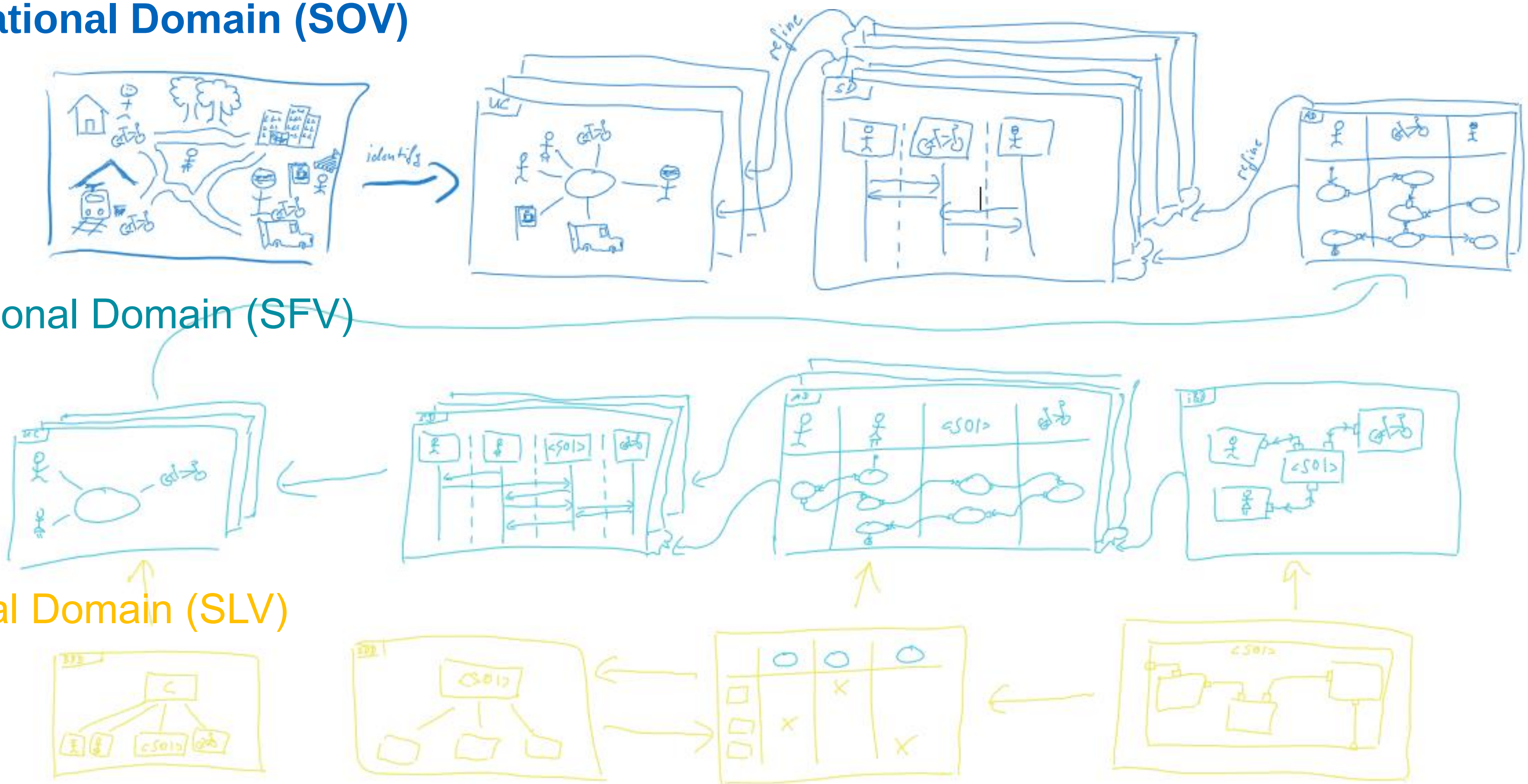
Quelle: https://www.berlin.de/senuvk/verkehr/mobil/fahrrad/hinweise/de/schutz.shtml

SAF Workshop Script

Operational Domain (SOV)

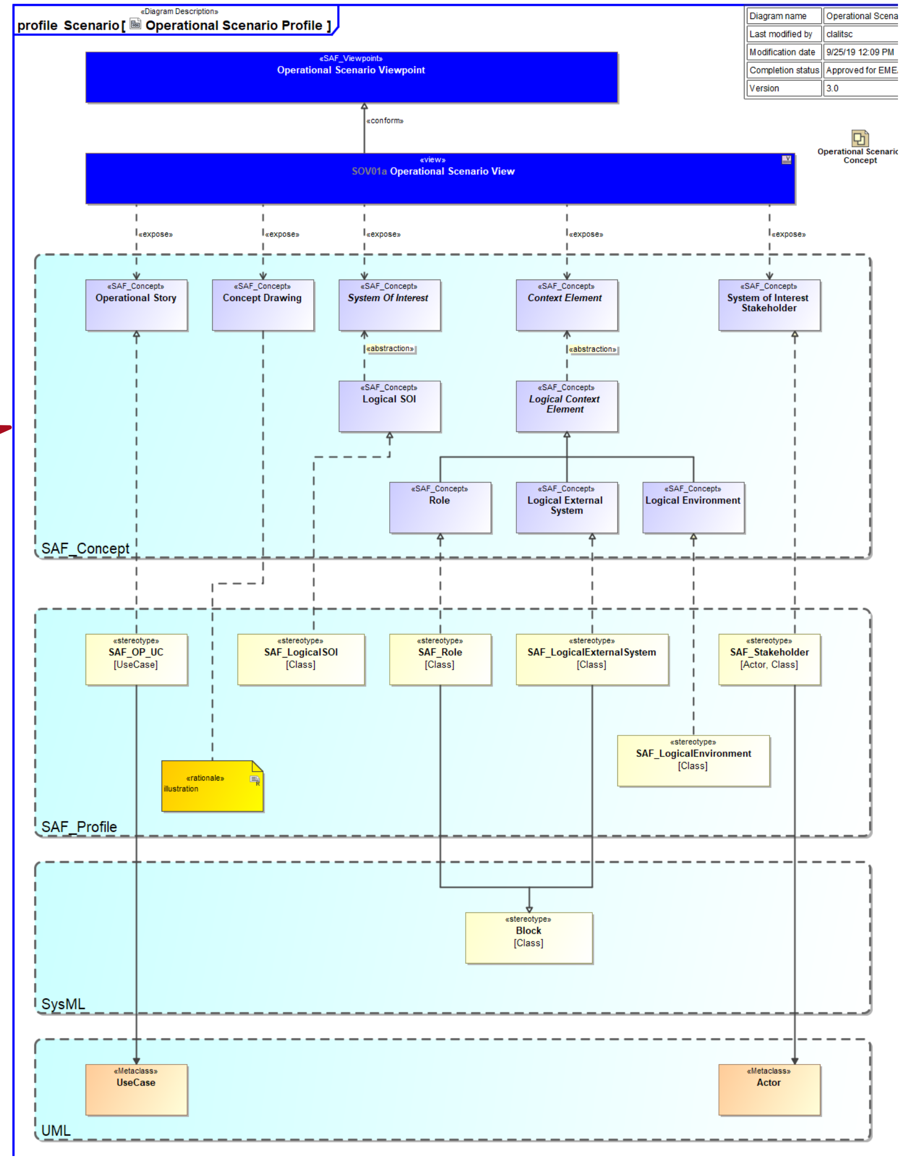
Functional Domain (SFV)

Logical Domain (SLV)

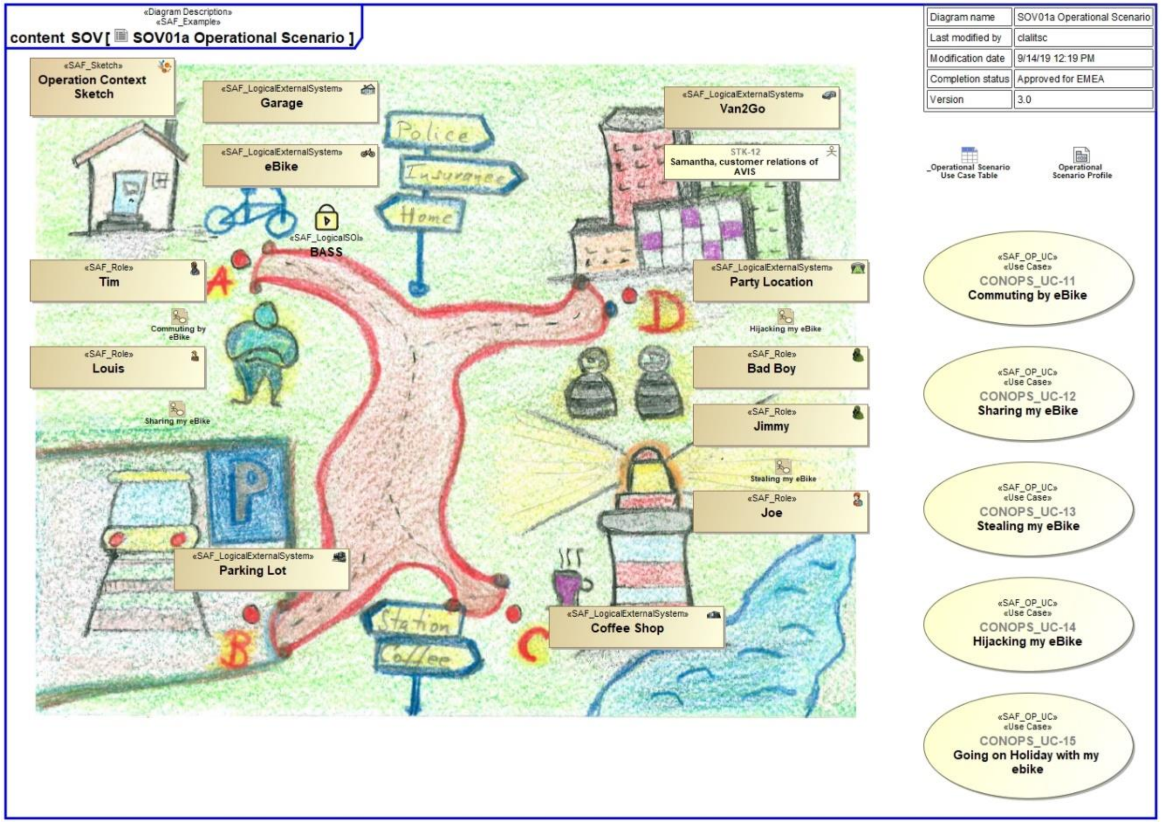


SOV01 Operational Scenario View

Show in model tool

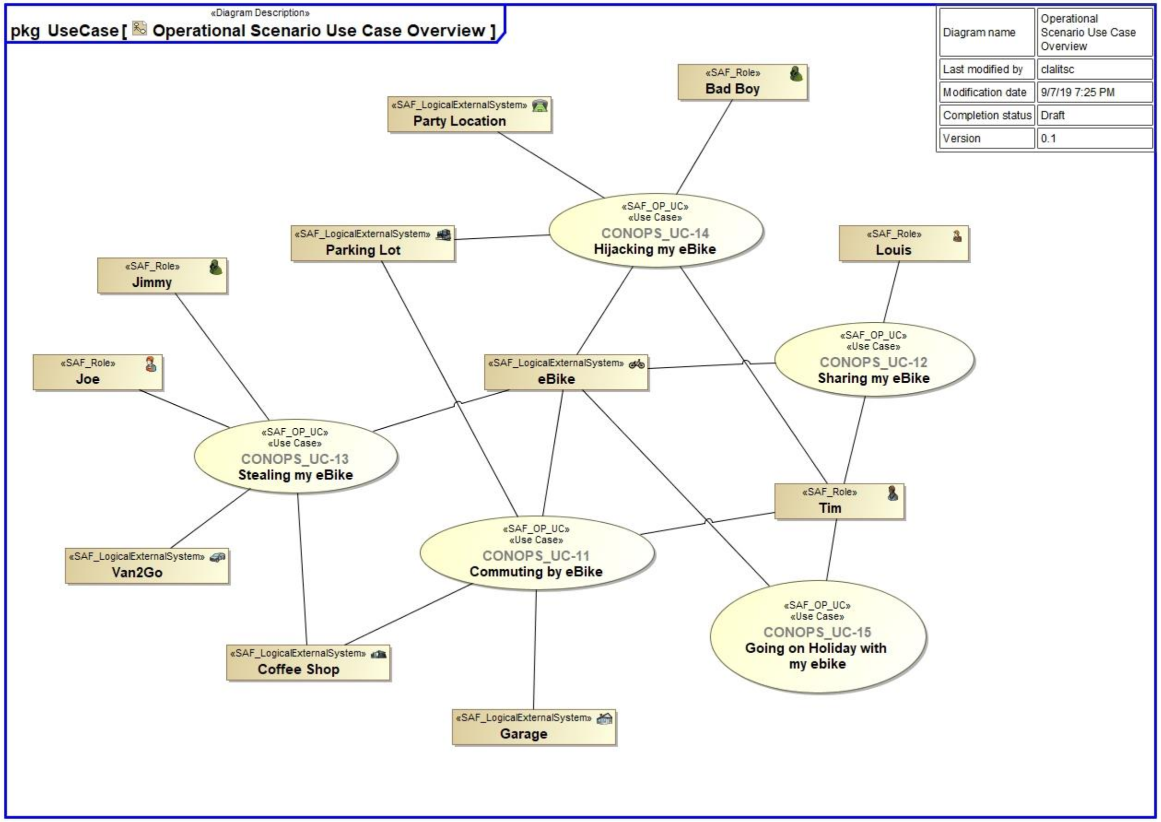


SOV01 Operational Scenario



Illustrates the operational background. An illustration fosters the communication between (non-engineering) stakeholders.

SOV01 A Day in the Life of a System



Operational Use Cases describe the background of the system features in the customer language (story telling).

SOV01 A Day in the Life of the System

UC Name	Description
Commuting by bike	'Tiny Tim' is a 31 year old IT consultant. He commutes 4 days a week from home to work and back again. He leaves home at 7:00 AM in the morning, takes his 'Cannondale Synapse Neo 1' bike from his garage and cycles to the near-by train stain, Bloomington-Normal, IL. He parks his bike in the station bike parking, a safe parking lot monitored by cameras, and gets on the Lincoln Service train 300 to Chicago at 7:31 AM. Returning from work in Chicago downtown late in the evening Tim picks-up his bike at the station parking and drives home. On his way home he stops by at the coffee shop 'CoffeeHouse & Deli' to grab a cup of his favorite coffee.
Sharing a bike	Louis, a dear friend of Tiny Tim, is planning an ebike weekend-tour with Tiny Tim's "Cannondale Synapse Neo 1". Louis calls Tim to check with Tim the "Cannondale Synapse Neo 1" availability for the coming weekend and to settle the pickup and return time of Tim's eBike. Tim reviews the "Cannondale Synapse Neo 1" reservations for the coming weekend using this iPhone "mYeBike" App. "mYeBike" App calendar summaries the "Cannondale Synapse Neo 1" free / busy status; status of "Cannondale Synapse Neo 1" is free. Tim places a reservation order, "mYeBike" creates an authorized ebike usage voucher, the "Cannondale Synapse Neo 1" calendar changes from free to busy status for the coming weekend.
Stealing a bike	'Jimmy Sticky Fingers' is watching the coffee shop 'CoffeeHouse & Deli'. 'Fat Joe', a bike dealer, commissioned him to steal a 'Cannondale Synapse Neo 1' bike for one of his clients. Jimmy has been following Tim for days waiting for the right moment to steal Tim's bike. While Tim orders his favorite coffee at 'CoffeeHouse & Deli', Jimmy grabs the bike Tim left outside the coffee shop leaning against the shop window and drops it in waiting van. Jimmy finally drives off and the delivers the stolen bike to 'Fat Joe'. Will Tim's bike insurance cover the theft?

SOV01 Operational Stakeholder Identification

- Why?
- It is decisive for the success of the project that the concerns of stakeholders are addressed.

- What?
- Identify all individuals and organizations that may have requirements to or an interest in the system.

- How?
- The list of stakeholders is initially elaborated in a workshop and continually reviewed during the project life time.

Jackies Missionen in Kalifornien, dargestellt als Sketchnote-Map

© Das Sketchnote Arbeitsbuch, Mike Rohde, Verlag mitp, 2015

SOV01 Operational Stakeholder Identification

#	Client	Documentation	relevar	involver	life cycle phase
1	STK-16 Donald, senior vice pres...	The interests of stakeholder(s) are manifold: both bike manufacturers and insurance companies may tolerate a certain threshold on the number of stolen bikes. Beyond this threshold, insurance companies may react just by adjusting their loss risk; insurance companies may decide to increase the bike insurance fees.	High	Low	Development, Acceptance
2	STK-15 Bill, chief engineer of Ca...	The interests of stakeholder(s) are manifold: both bike manufacturers and insurance companies may tolerate a certain threshold on the number of stolen bikes. Beyond this threshold, bike manufacturers may decide to invest in a development of an electronic BASS to decrease the costs of bike insurance or for publicity reasons.	Critical	High	Development, Operation, Disposal
3	STK-17 Hagen, control authorit...	Regulation Authorities can have impact by imposing stakeholder requirements against the system and by their involvement in the development and acceptance phases (e.g. safety or IT security acceptance audits). The term "authorities" also refers to current applicable regulations and laws.	Medium	Medium	Development, Acceptance
4	STK-22 *Mrs. MARKETING+SALES*	The User is the individual, organization or group that benefits from the operation of the system. The User provides the usage scenarios, the User needs and finally the user requirements representing most of the functional requirements but also non-functional requirements.	Critical	High	Development, Operation, Disposal

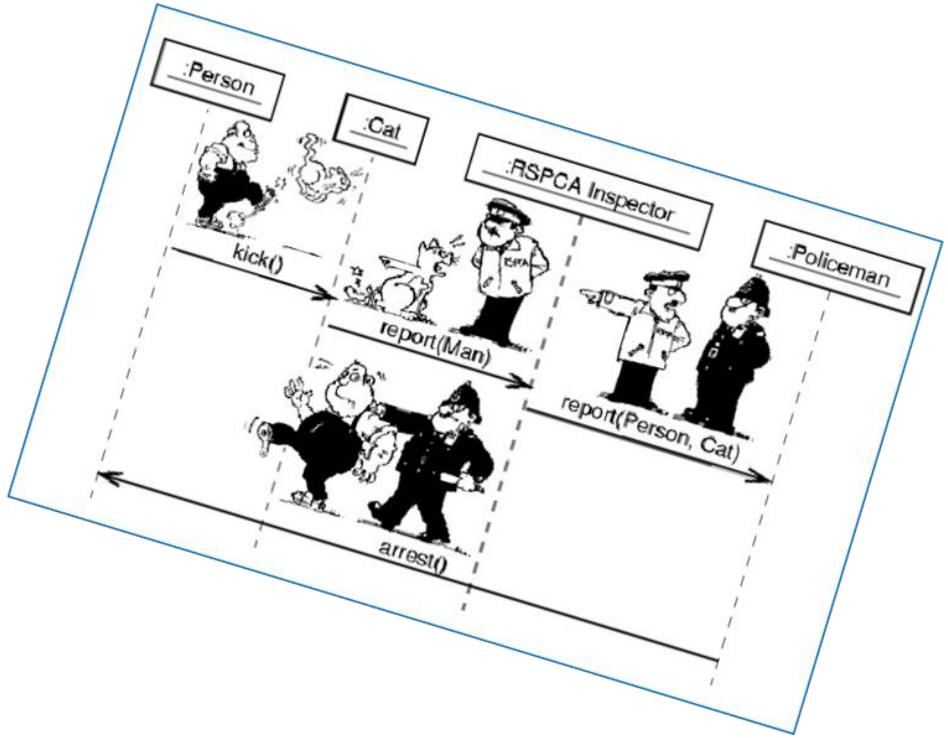
Identify all individuals and organizations that have a legitimate interest in the operational usage.

SOV04 Operational Interaction

- Why?
- Essential for understanding the functions of the system in its context.

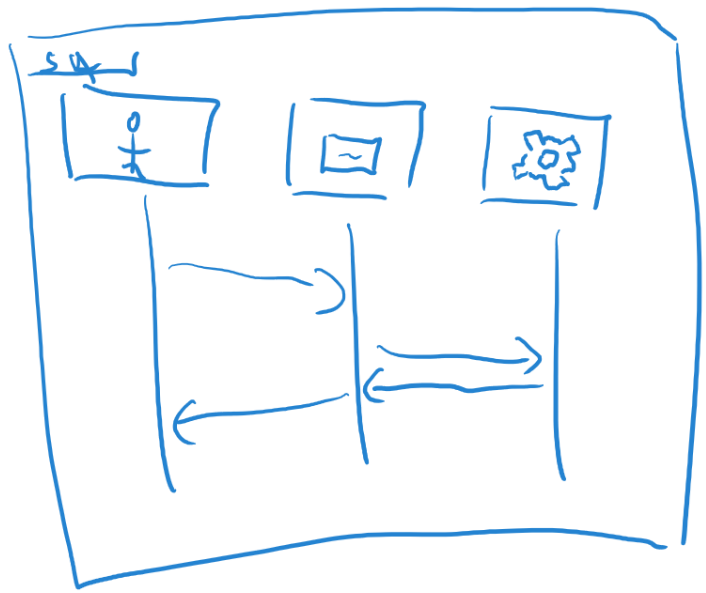
- What?
- The functionality identified during a ConOps use case analysis is elaborated using interactions.

- How?
- A sequence diagram depicts the sequence of exchanges between the participating parties needed to carry out the functionality of the scenario.



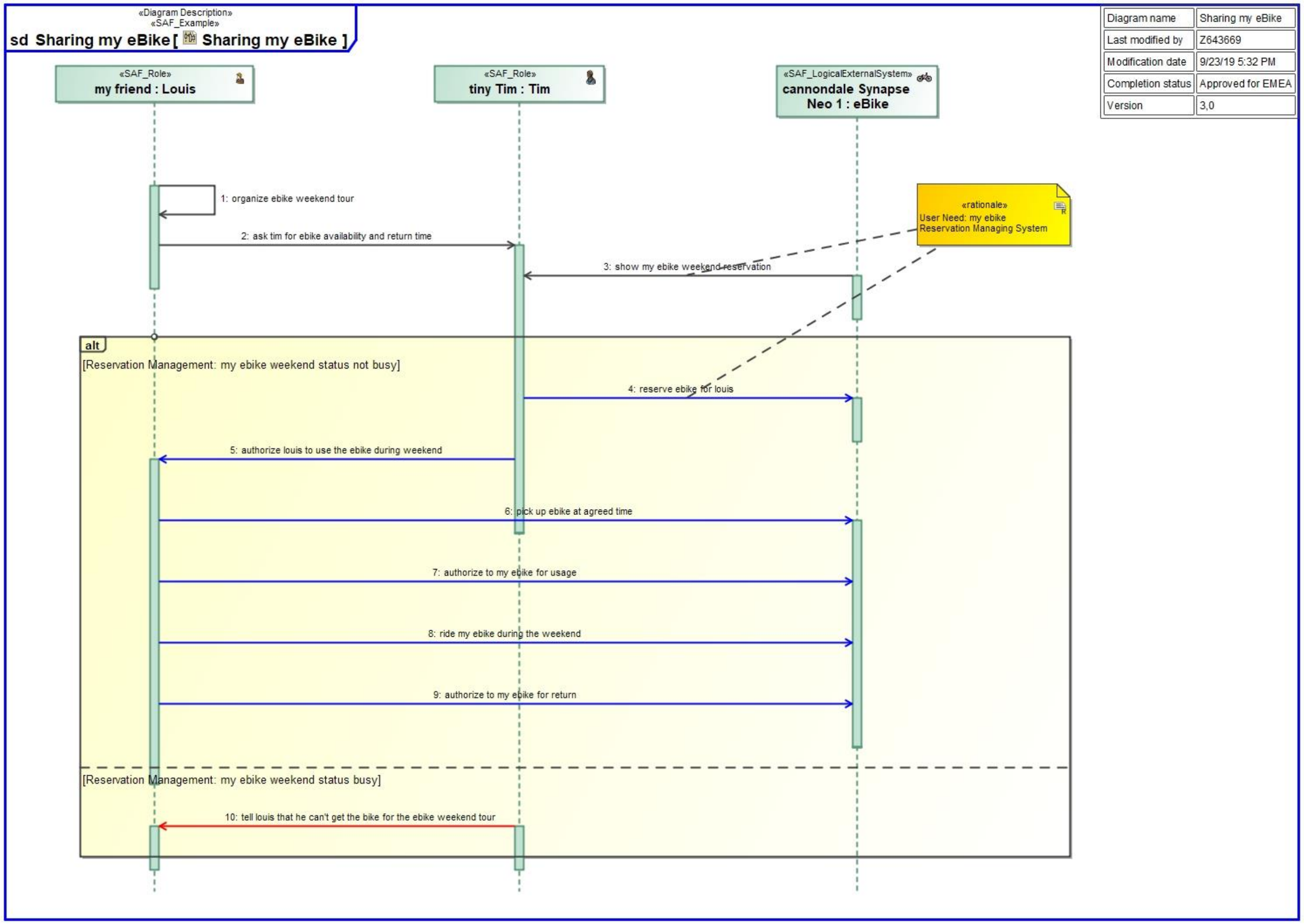
SOV04 Operational Interaction

- **Exercise**: Please do your own sequence diagram for one of the ConOps use cases, e. g. **Sharing a bike or Stealing a bike**

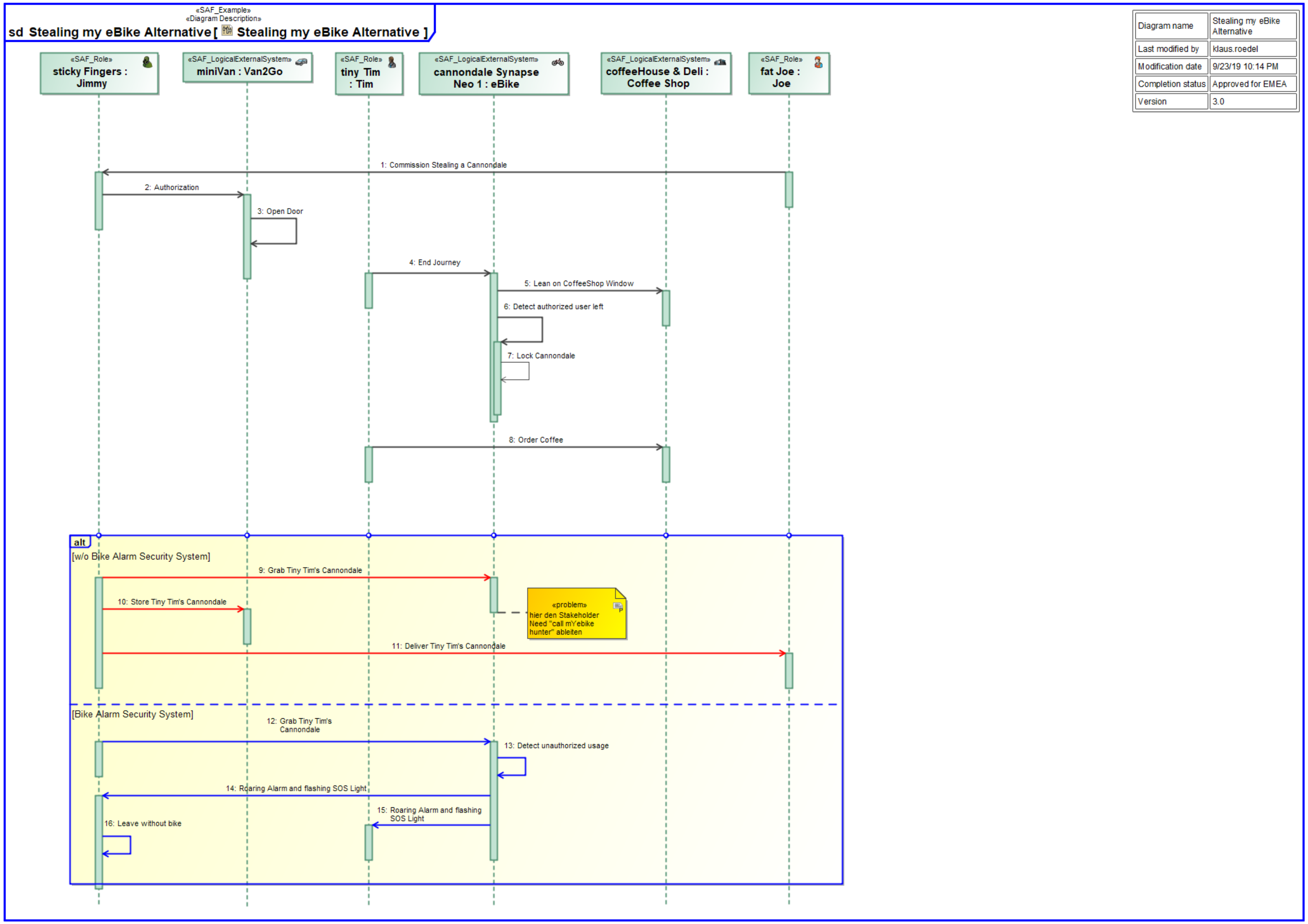


Operational Interaction fosters the identification of system use cases.

SOV04 Operational Interaction > Sharing a bike



SOV04 Operational Interaction > Stealing a bike

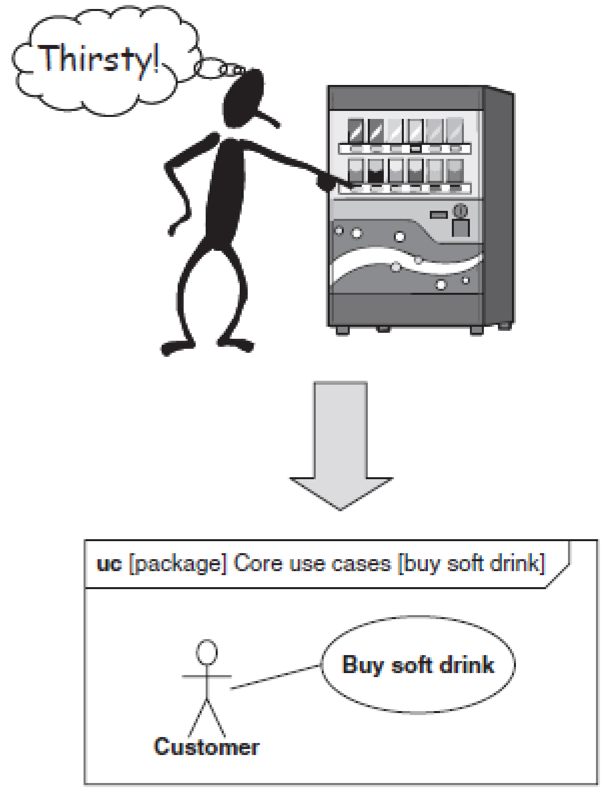


SFV01 System Use Case

- Why?
- Use cases tell stories how the system will be used.

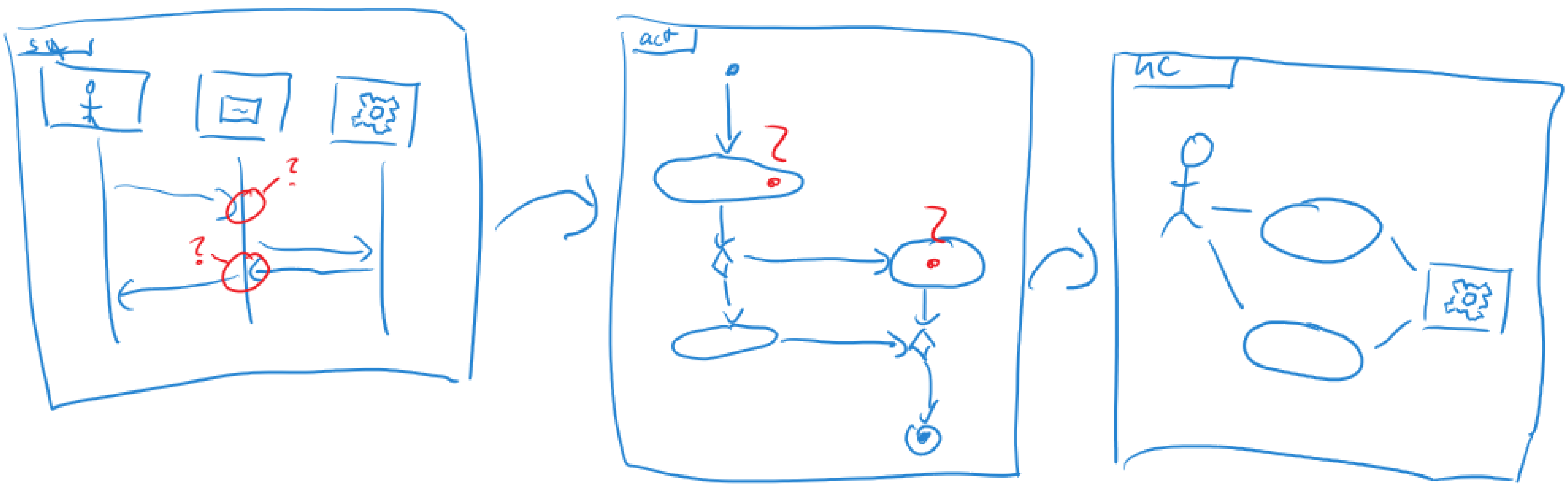
- What?
- Use cases are identified and associated to the participating external systems, users and environment

- How?
- Use cases are elaborated systematically based on requirements and system context



SFV01 System Use Case

- **Exercise**: Please identify the system use cases based on your Operational Interaction diagrams



System Use Cases represent essential functionality. The system of interest is developed and operated to support these use cases.

SFV01 System Use Case

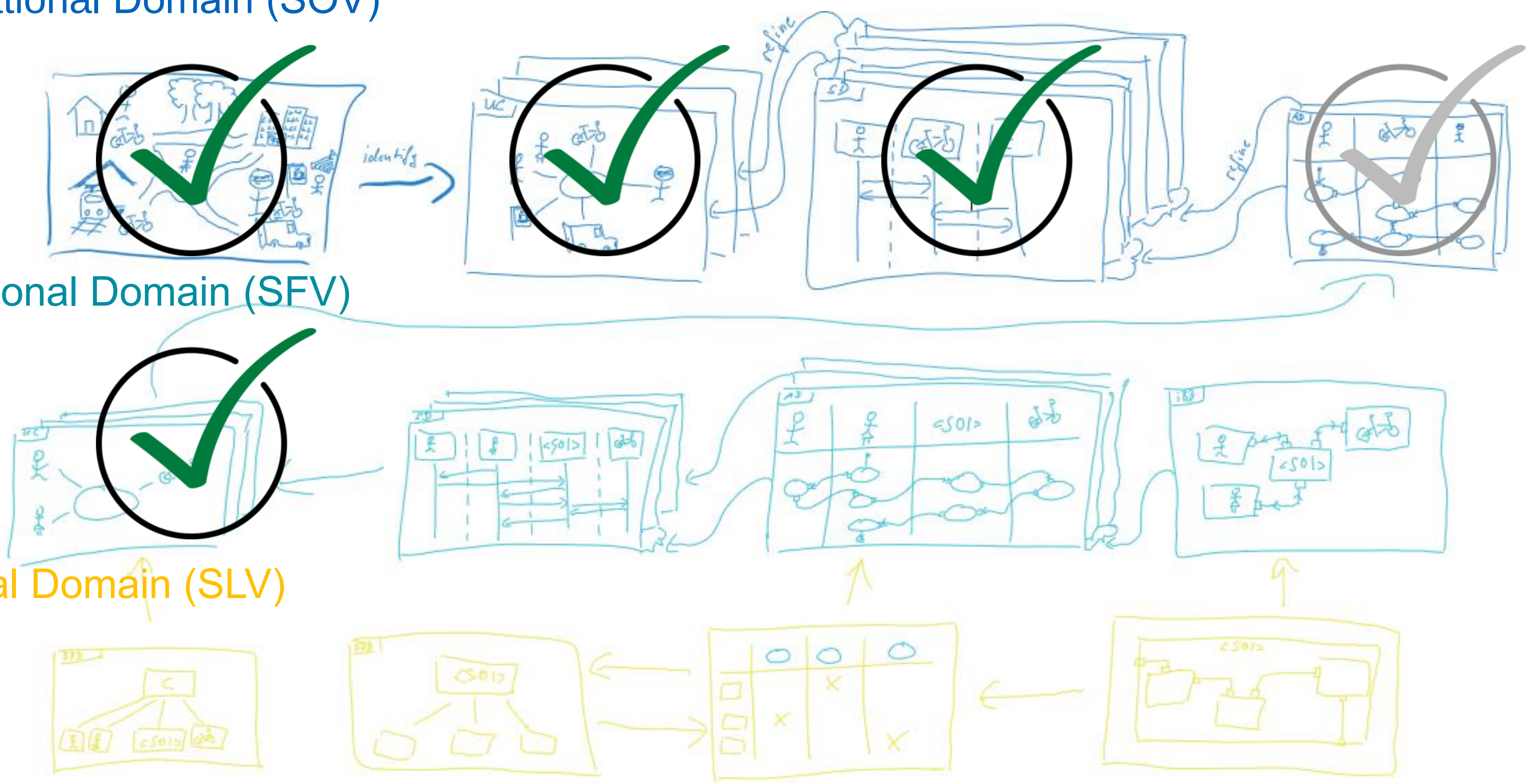
UC Name	Description
Book authorized ebike usage	Louis, a dear friend of Tiny Tim, is going to pick-up Tiny Tim's "Cannondale Synapse Neo 1" for a weekend ebike tour on Saturday morning. Tiny Tim had alread declared Louis as "authorized user" last month using his iPhone. Tiny Tim checks for any "Cannondale Synapse Neo 1" week-end reservation, and reserves his "Cannondale Synapse Neo 1" for Louis creating an authorized ebike usage voucher for Louis' week-end ebike tour. Tiny Tim's iPhone is going to send a notification about the reservation to Louis.
Start authorized ebike usage	Louis, a dear friend of Tiny Tim, picks-up Tiny Tim's "Cannondale Synapse Neo 1" for a weekend ebike tour on Saturday morning as agreed. To be able ride Tim's "Cannondale Synapse Neo 1" Louis has to disarm the anti-theft alarm system. Tiny Tim created an authorized ebike usage voucher for Louis the night before, so Louis simply has to identify himself as "authorized user" via iPhone. Once successfully authenticated by the mYeBIke access system, Louis can start using Tiny Tim's "Cannondale Synapse Neo 1" during the weekend. Louis' iPhone is going to send a notification about the start of ebike usage to Tiny Tim.
Call my ebike hunter	'Jimmy Sticky Fingers' is watching the coffee shop 'CoffeeHouse & Deli'. Jimmy has been following Tim for days waiting for the right moment to steal Tim's 'Cannondale Synapse Neo 1' ebike. While Tim orders his favorite coffee at 'CoffeeHouse & Deli', Jimmy grabs the ebike Tim left outside the coffee shop leaning against the shop window. But Tim's 'Cannondale Synapse Neo 1' takes care of itself featuring a tamper detection and an earsplitting alarm. Tim's ebike responds with a loud warning sound when a 'Jimmy Sticky Fingers' touches it, followed by an urgent roaring alarm if the Jimmy doesn't back down. Finally, Tim's 'Cannondale Synapse Neo 1" disables its own eMotor and smart convenience functionality to save energy and starts flashing SOS with its lights. When Jimmy drops Tim's ebike in the loading area of the waiting van, Tim's ebike is finally reported stolen in the mYebike app, Tim's ebike sends out a tracking signal until the mYebike hunter Nick finds and recovers it. Nick, the silent hunter, is armed with a super soaker, type CPS500.

SAF Workshop Wrap Up

Operational Domain (SOV)

Functional Domain (SFV)

Logical Domain (SLV)



System Architecture Framework (SAF) Architecture II

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- Alex
  - Systems Engineer @ Atlas Elektronik GmbH
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- Klaus
  - Consultant @ invenio Systems Engineering GmbH
  - 10+ experience in Modeling Systems and Software Architectures
  - Joined SAF in 01/2019

- Christian
  - System Architect @ ZF Friedrichshafen
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Operational Domain (SOV)

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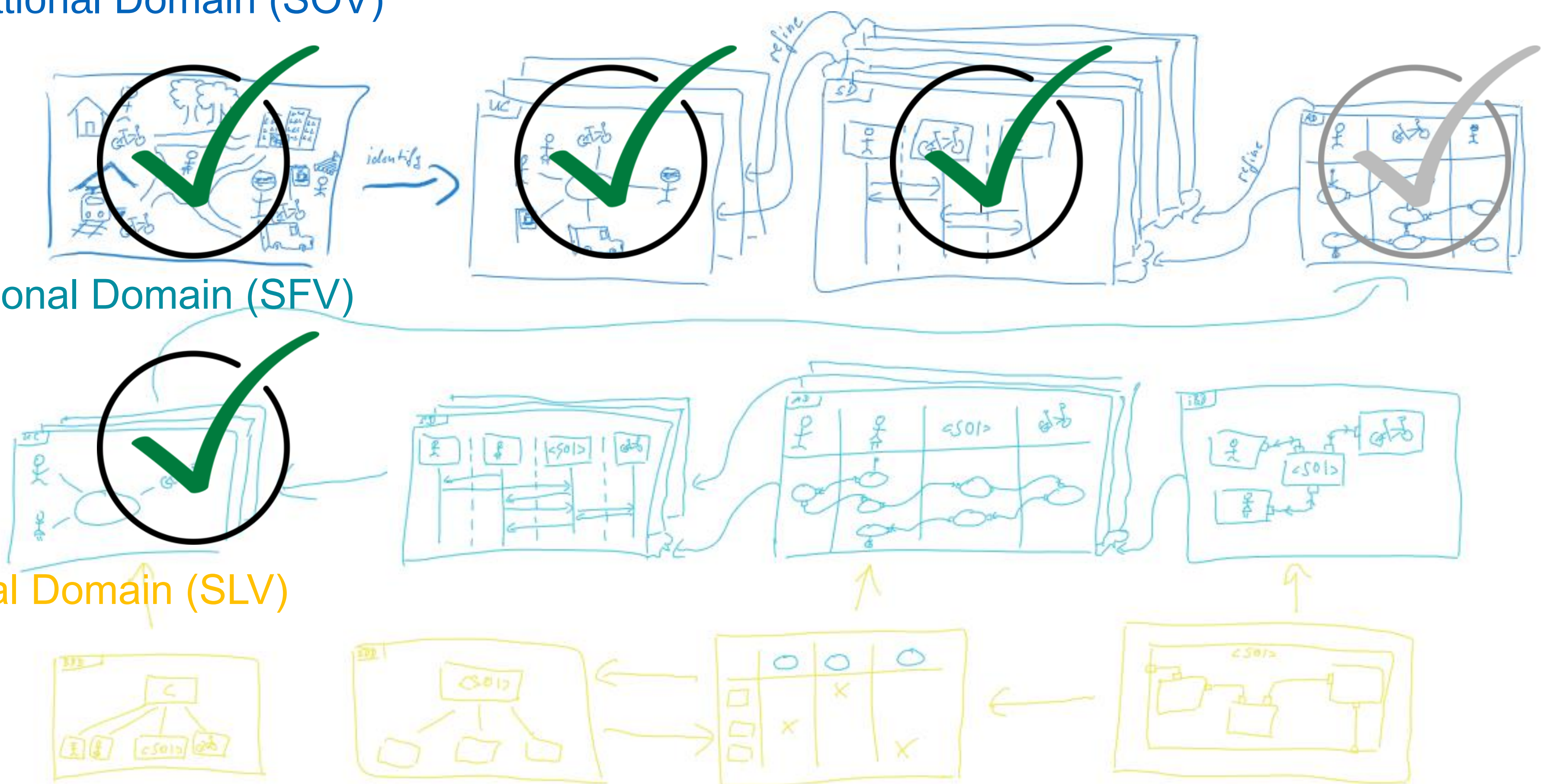
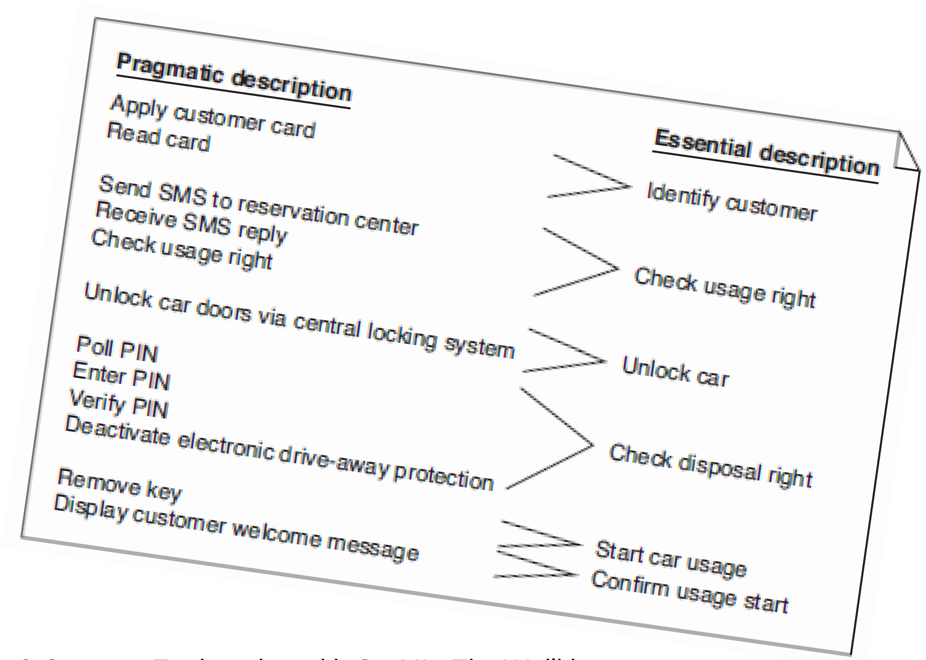


SFV04 Functional Interaction

- Why?
- An overview of the system's functions is needed.

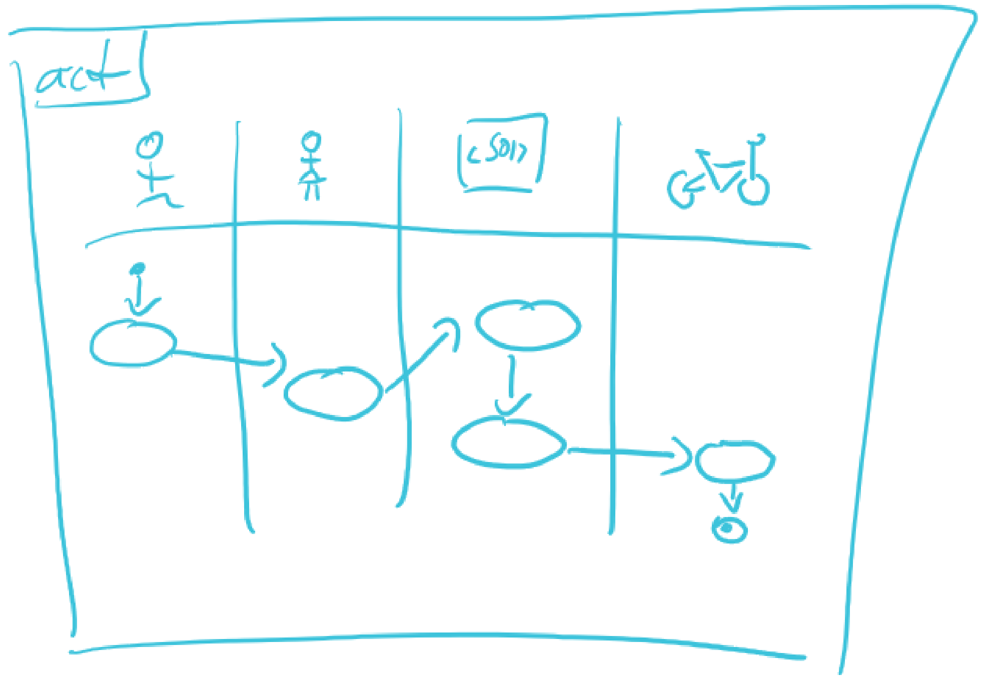
- What?
- Describe essential steps of each UC. Please do not consider technical details.

- How?
- Think of the steps involved in the standard sequence of a UC.



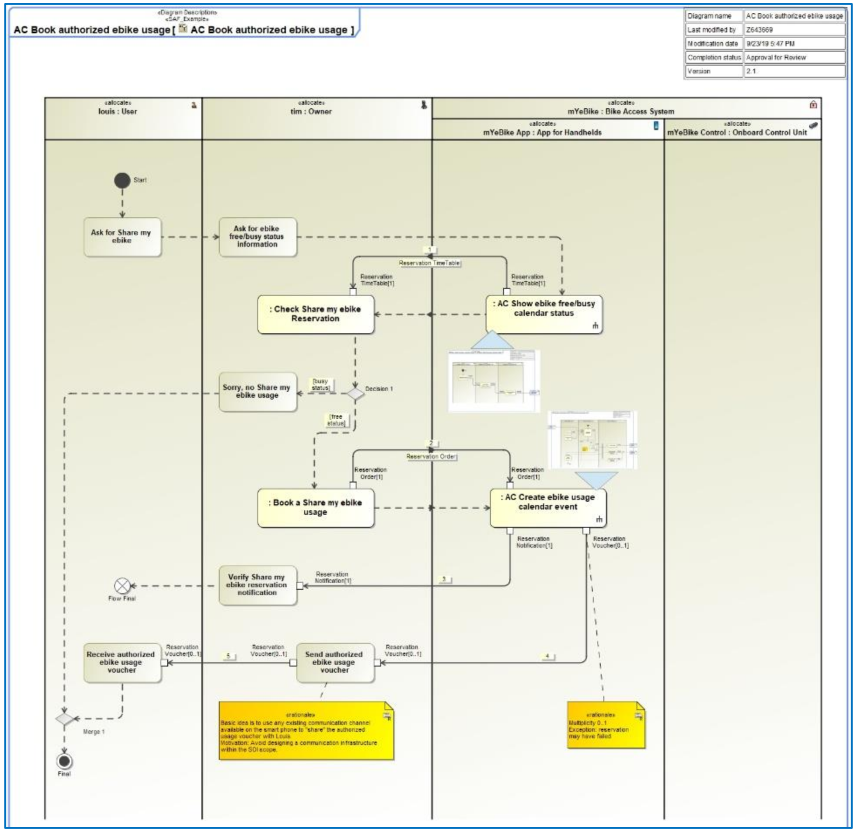
© Systems Engineering with SysML, Tim Weilkiens, Verlag Elsevier, 2007

- **Exercise**: Please describe the essential steps of system use case. Please do not consider technical details.



Functional Interaction compiles the functions the system of interest (SoI) has to perform, the interactions on identified interfaces with external systems (incl. actors)

SFV04 Functional Interaction



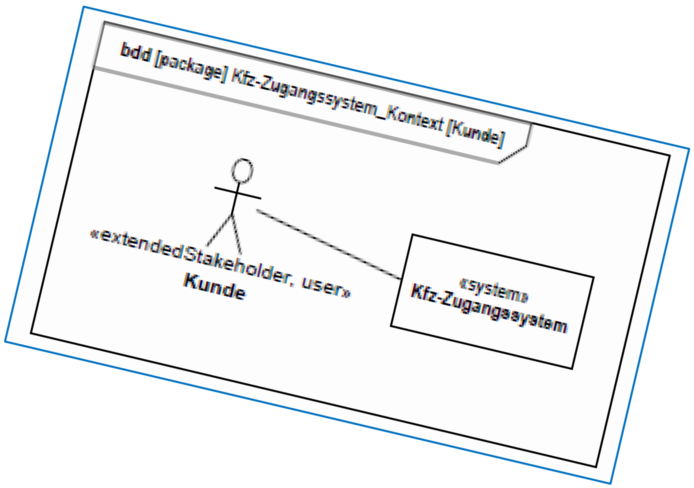
Activity diagrams are commonly used to decompose the top-level system function into lower level functions, which can be allocated to the items of the logical architecture

SLV01 System Context

- Why?
- An overview of the external systems interacting with the system.

- What?
- Define external systems and logical interfaces.

- How?
- In parallel to Functional Interaction.
- Think of external entities.



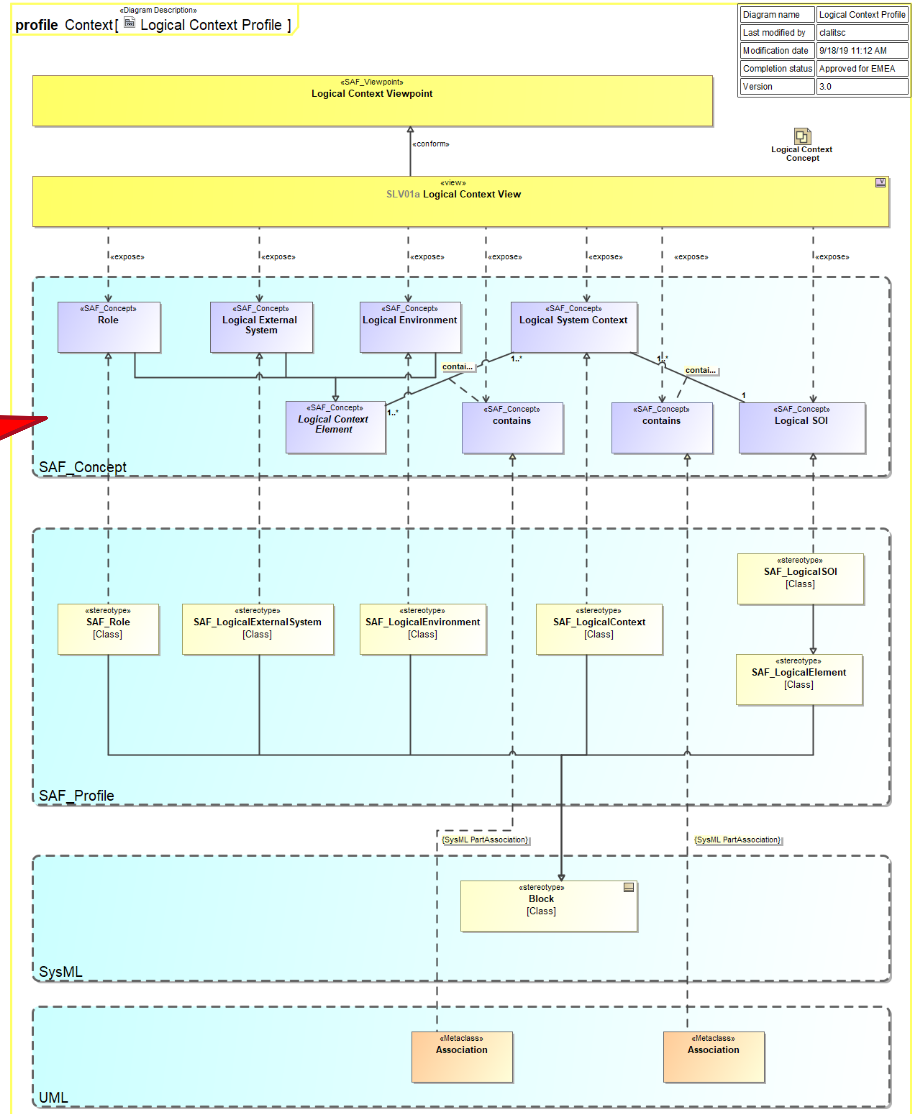
SLV01 System Context

- **Exercise**: Please define your own system context for the **Bike Access System**

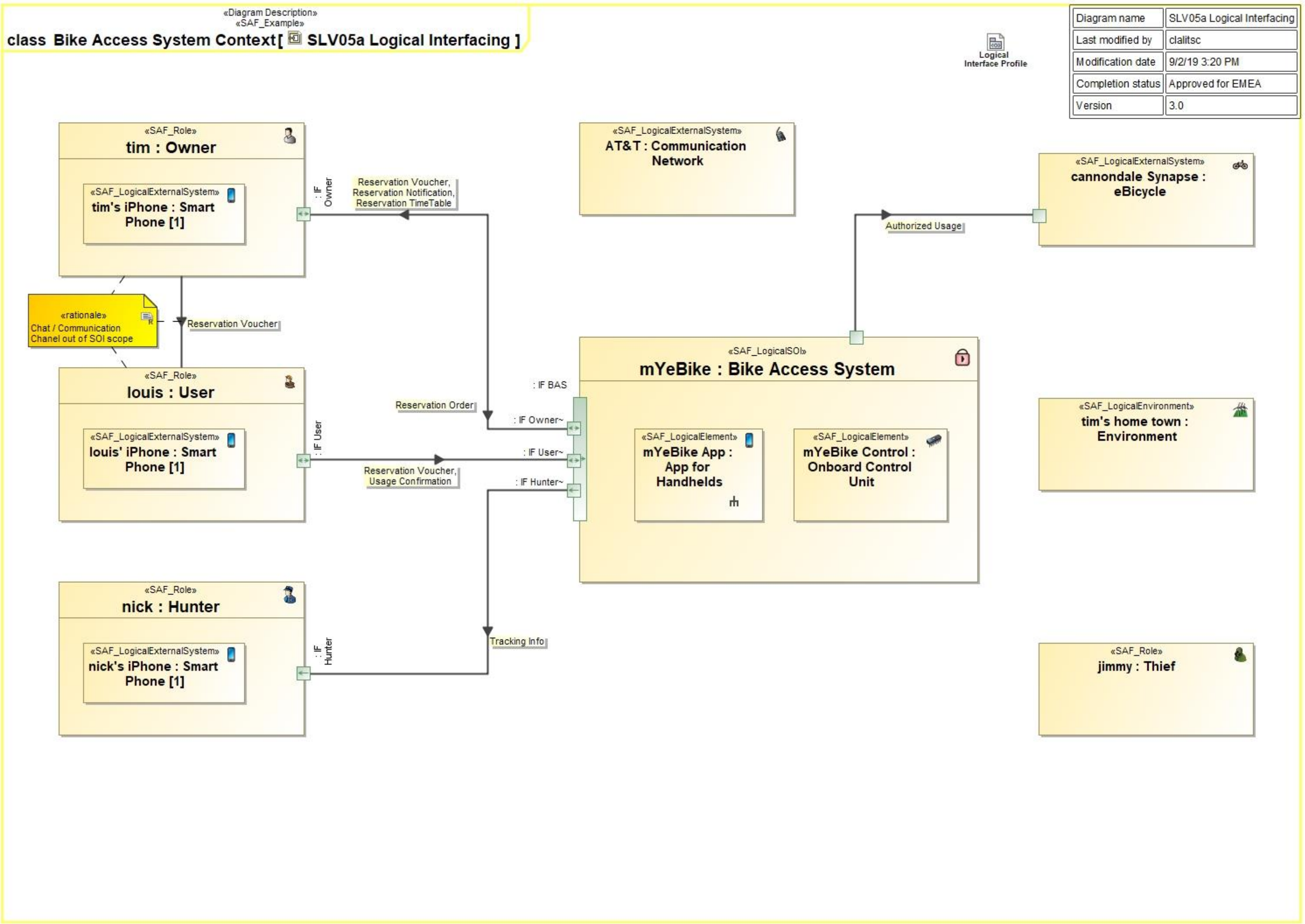
System Context depicts how the system is embedded in its environment, i.e. the system actors, interfaces, and communication links between the actors and the system.

System Context

Show in model tool

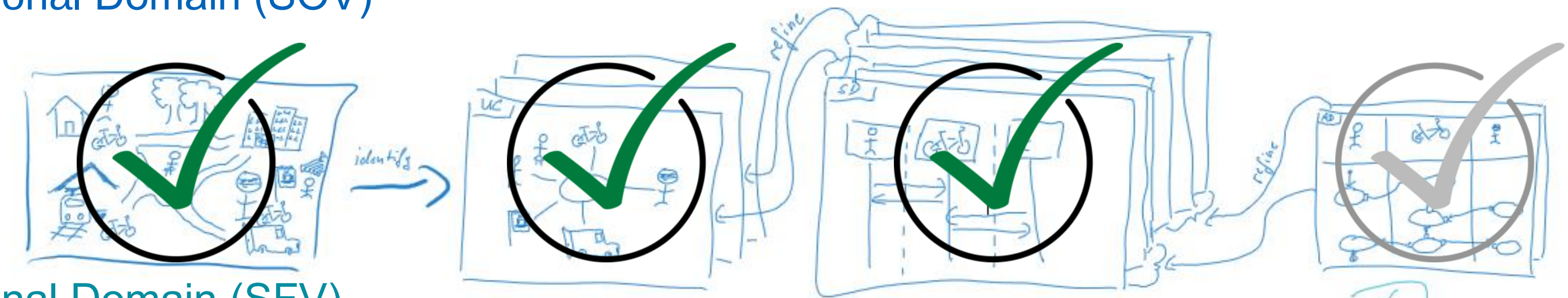


SLV01 System Context

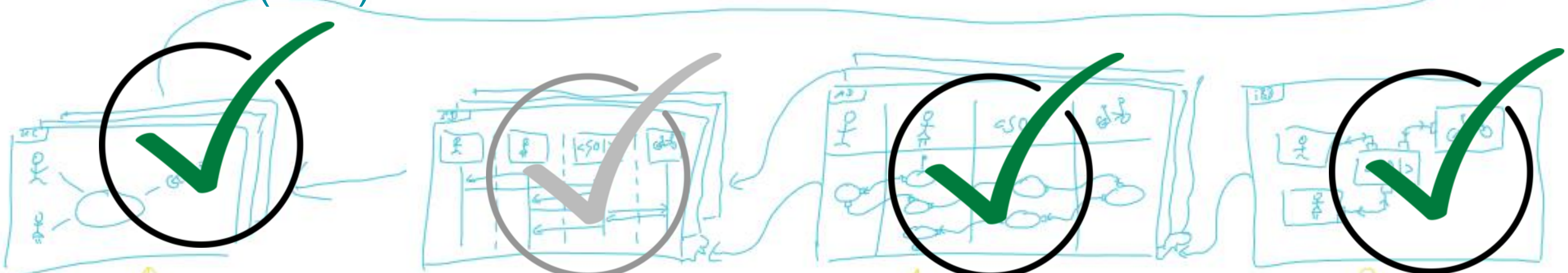


SAF Workshop Wrap Up

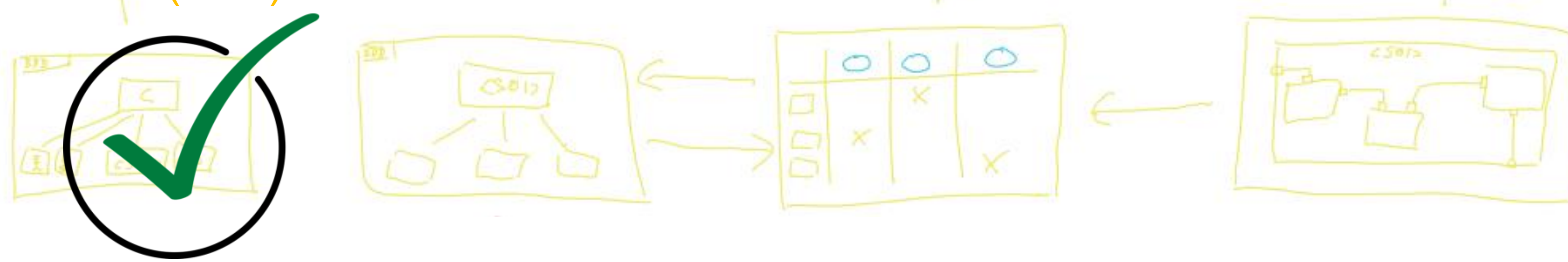
Operational Domain (SOV)



Functional Domain (SFV)



Logical Domain (SLV)



Thank you for your attention!

Discussion / Feedback

GfSE Arbeitsgruppe SAF
Gesellschaft für Systems Engineering e.V.