THALES

# Model-based System Engineering #3

## ENSTA CSC_5RO08_TA

# Session #3 : System needs analysis

# Methodological Overview

1

Operational Analysis

2

System Needs Analysis

3

System Logical Architecture

4

System Physical Architecture

# System Needs Analysis (SA)

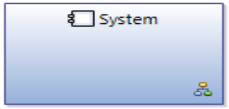
## Objectives

- Define the contribution expected from the system to the needs of the users, either coming from the Operational Analysis or in the form of requirements expressed by the client
- Clearly define the system boundaries

## Main activities

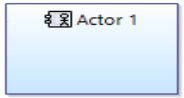
- Perform a functional and non-functional need analysis
- Perform a capability trade-off analysis (taking into consideration more than functional aspects: client organization, operating principles, infrastructure, human factors, etc.)
- Formalize and consolidate the expression of system needs

# Main concepts




## System

- Set of elements functioning as a whole, responding to customer and user demand and needs




## Actor

- Entity (human or not) that is external to the System (in term of responsibility), interacting with it, via its interfaces

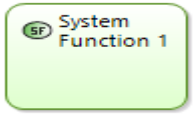

## System Mission

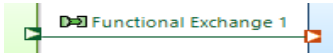
- High-level goal to which the System should contribute. To be fulfilled, a Mission should use a number of system Functions regrouped within one or more system Capabilities

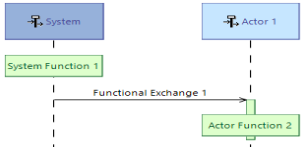

## System Capability

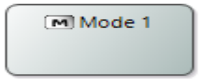
- The ability of the system to supply a service contributing to fulfilling one or more Missions. A system Capability represents a system usage context. It is characterized by a set of Functional Chains and Scenarios it references.

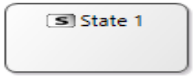
# Main concepts




## Function

- Action performed by the System or by an Actor, in order to realize a system Capability.

## Functional Exchange

- A functional exchange represents a dependency between a source function and a target one. Exchanges connect Function Ports, which specify what a Function is capable of producing or is requiring.

## Exchange Scenario / Functional Chain

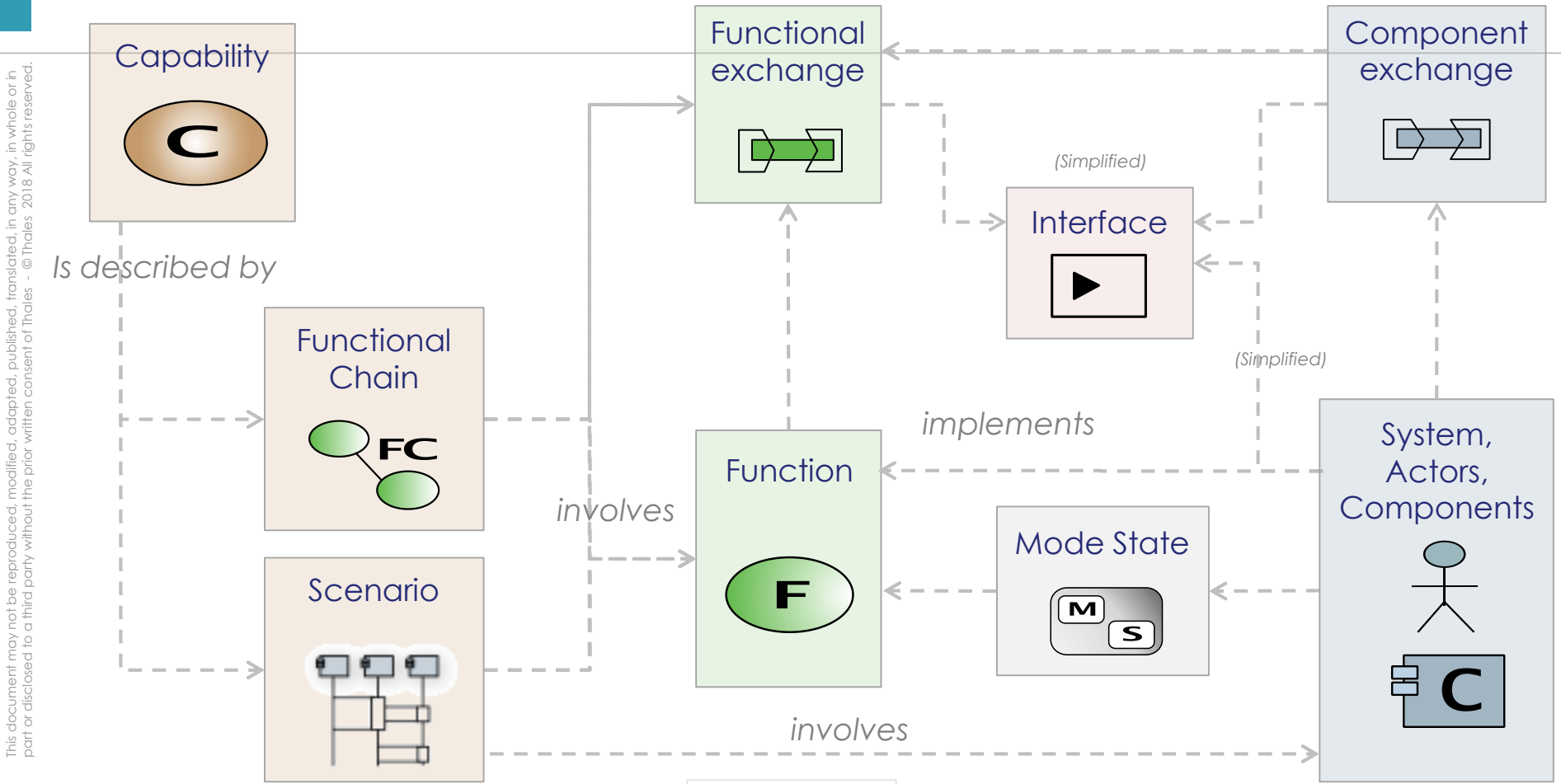
- Describe the system behaviour in a particular usage context with references towards Functions and Functional Exchanges

## Mode

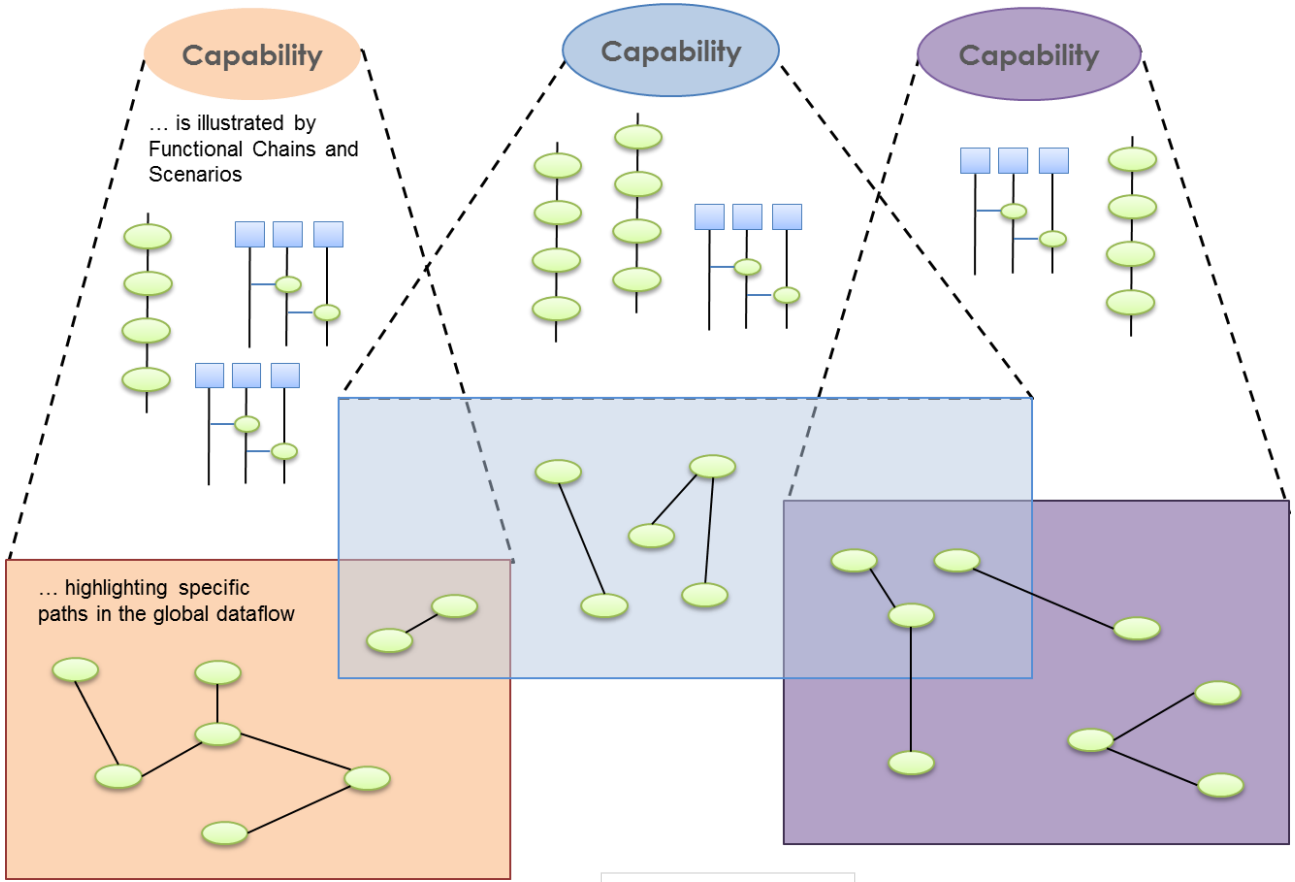
- A Mode is a behavior expected from the system or from an Actor in chosen conditions

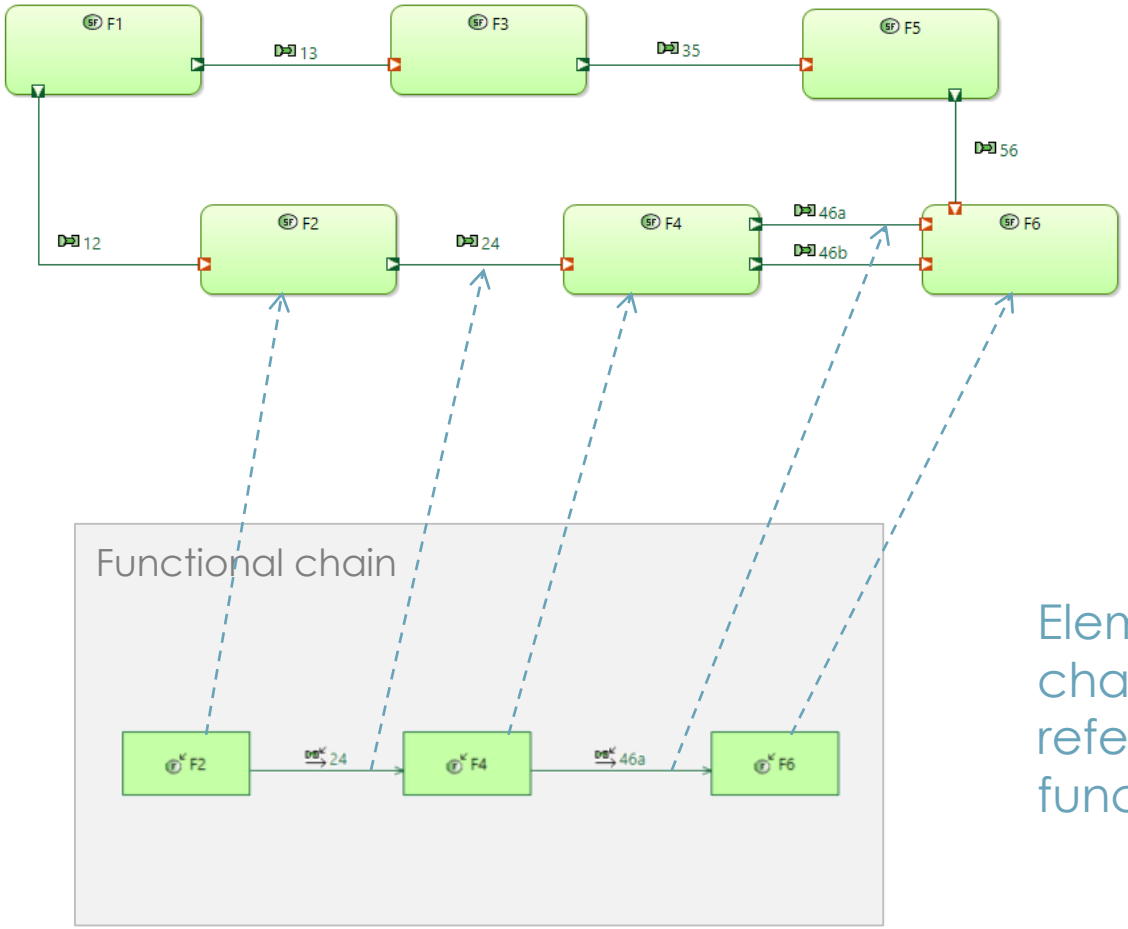
## State

- A State is a context undergone by the system or a component in specific circumstances (for example imposed by the environment)

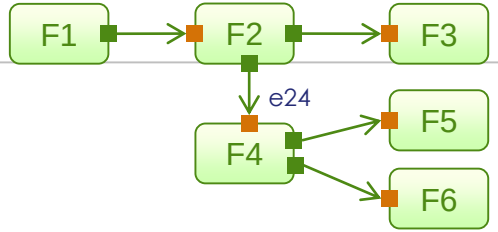


# Capabilities – functions – functional chains and scenarios






# Elements of a functional chain: involvements reference functions and functional exchanges



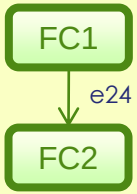
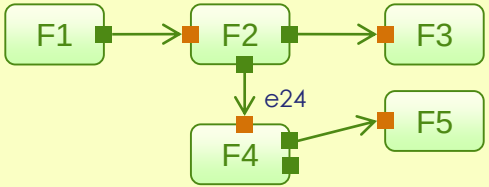
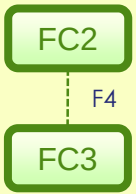
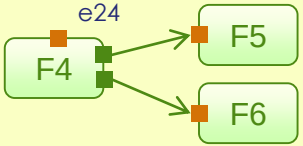

*Compete dataflow*

*FC1*


*FC2*


*FC3*


What Arcadia says…

| Kind of assembly | Folded | Content of the assembled chain |
|---|---|---|
| *By compatible exchange* |   |   |
| *By common function* |   |   |





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## QUESTION 1

# What are the external interfaces of the system?

PYTHAGORE

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## QUESTION 2

# What are the system’s main capabilities?

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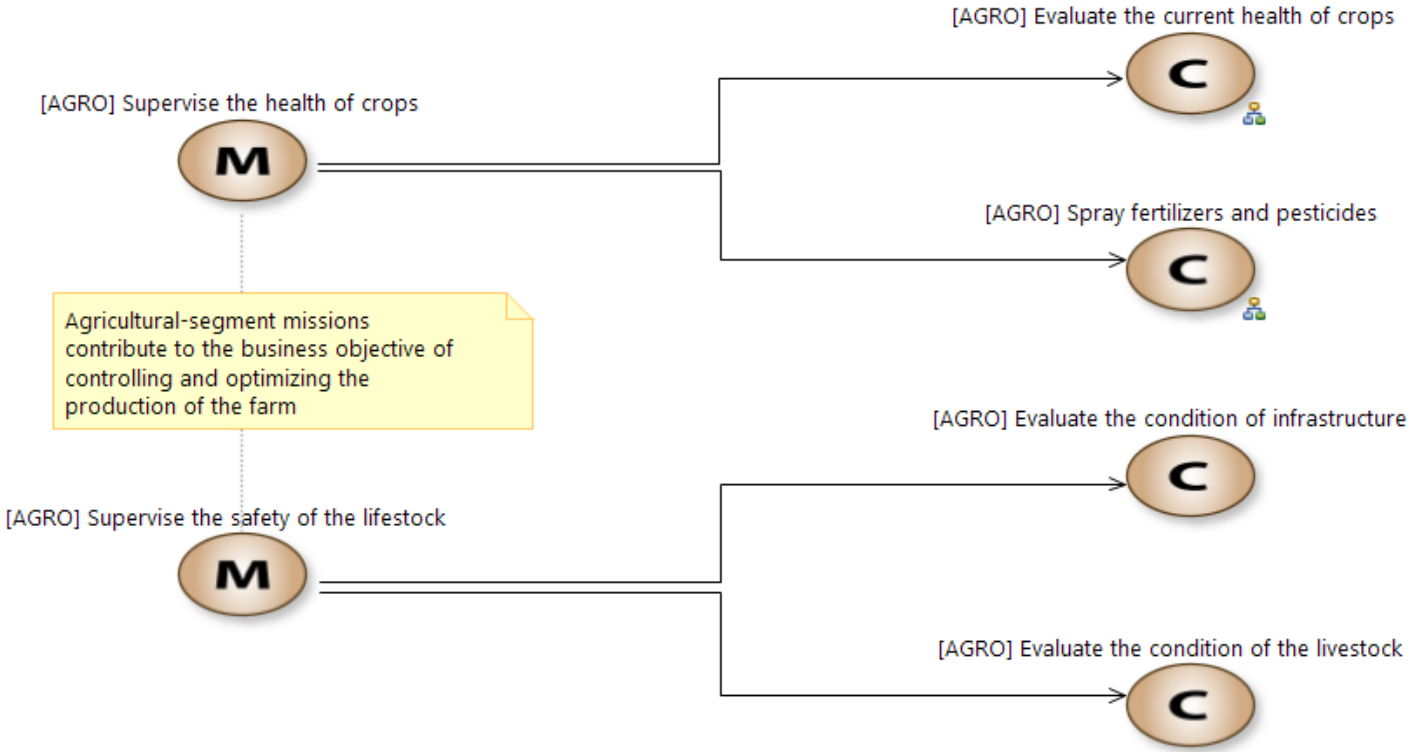
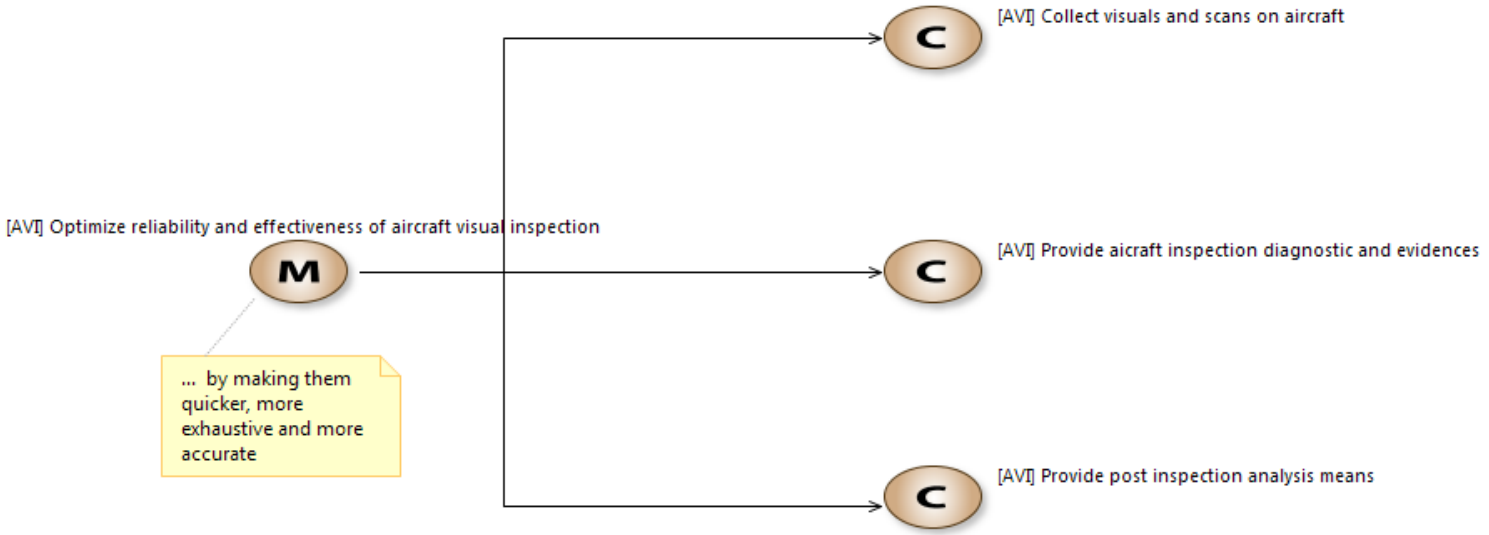
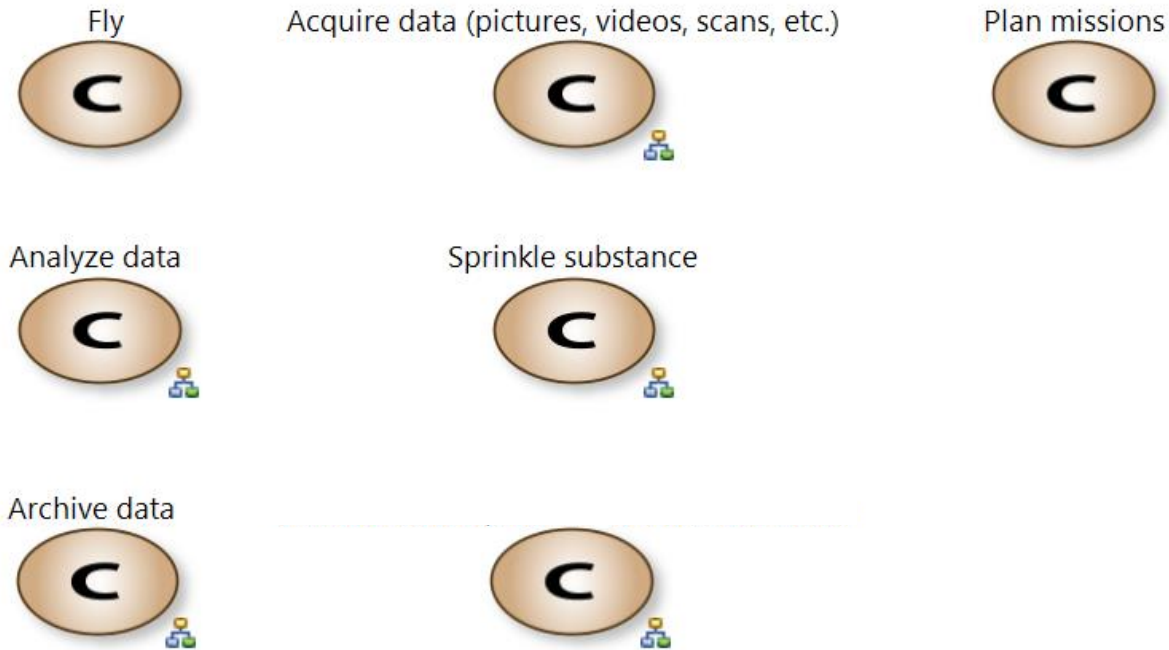
# Market-segment specific Missions and Capabilities



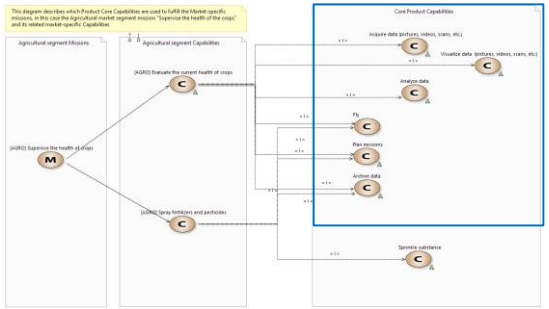
# Market-segment specific Missions and Capabilities



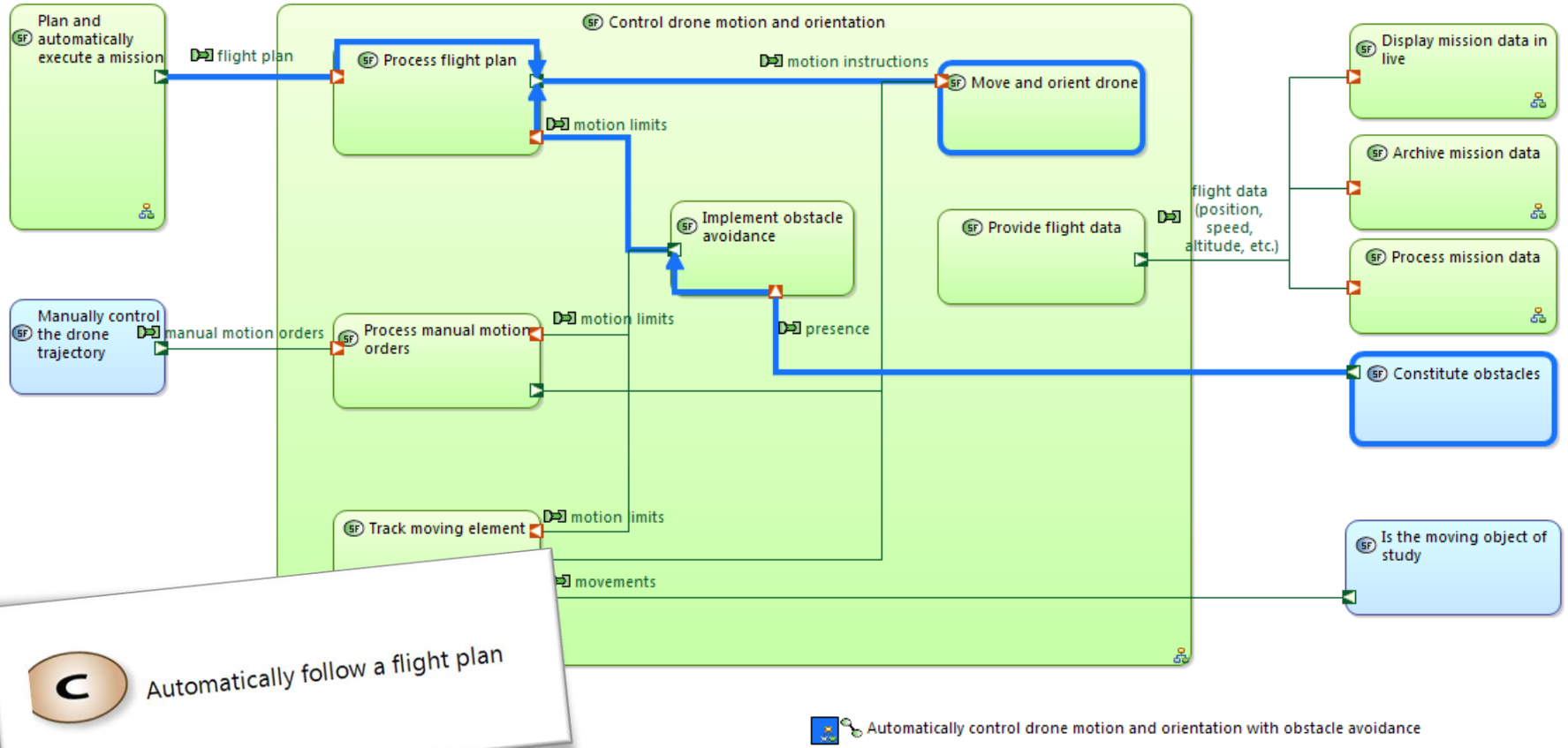
# Product capabilities for all market segments (commonalities)



# Market capabilities – Core capabilities



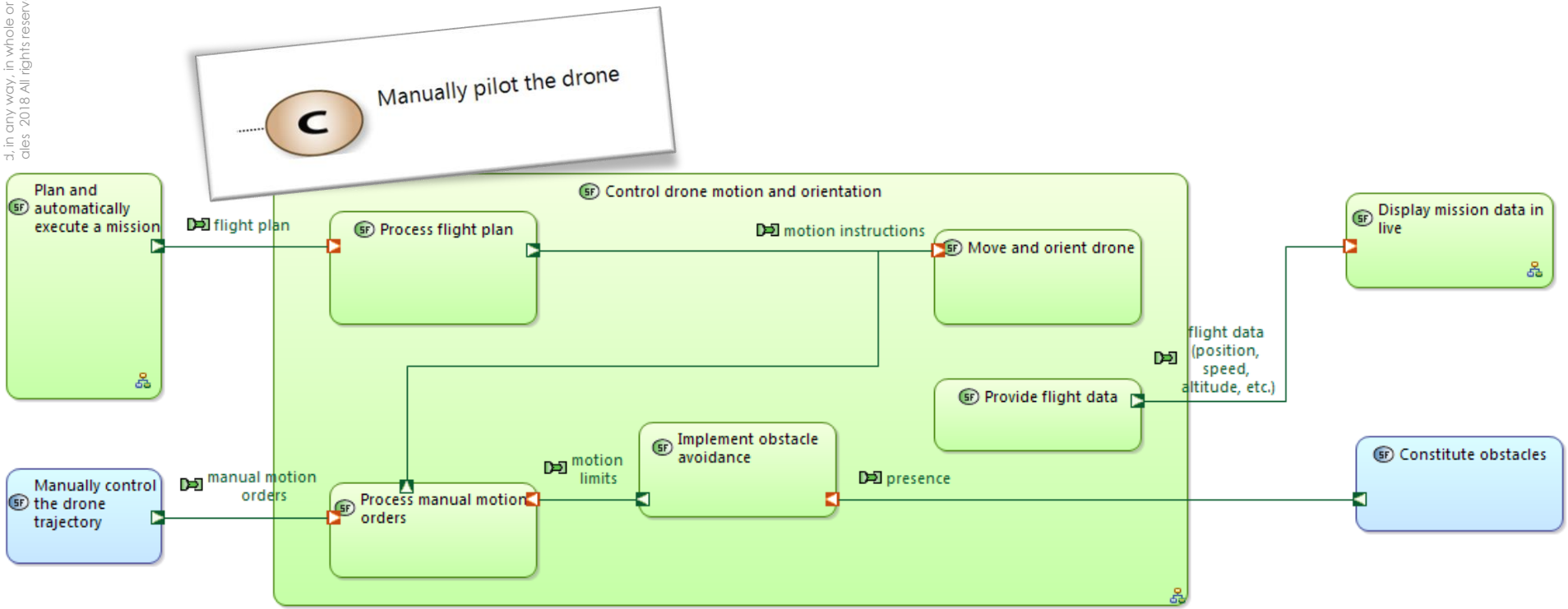
# Focus on the capability « Fly » : Automated



# Focus on the capability « Fly » : Automated

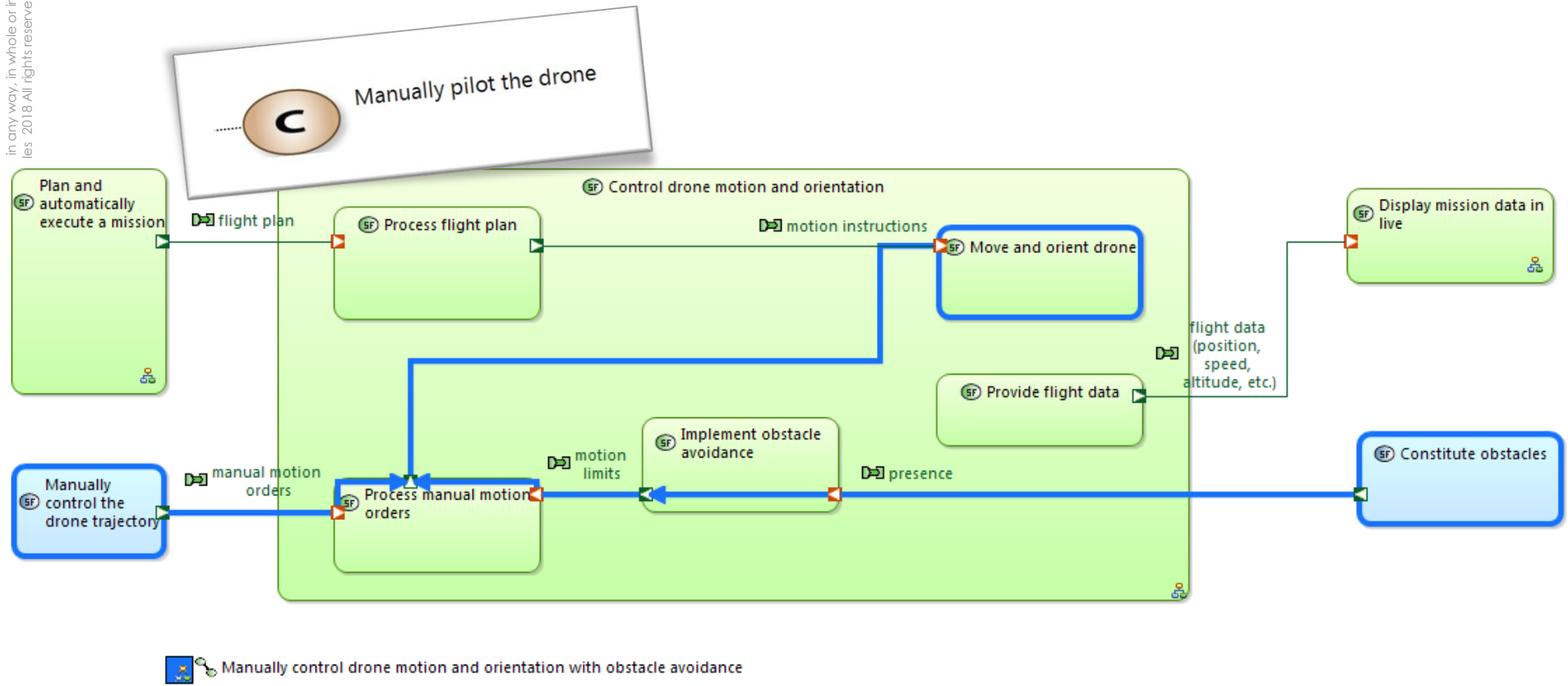
- Automatically follow a flight plan
  - Automatically control drone motion and orientation
  - Automatically follow a moving target
  - Automatically control drone motion and orientation with obstacle avoidance
  - Automatically follow a moving target with obstacle avoidance
  - Visualize mission progress status

# Focus on the capability « Fly » : Manual



# Focus on the capability « Fly » : Manual









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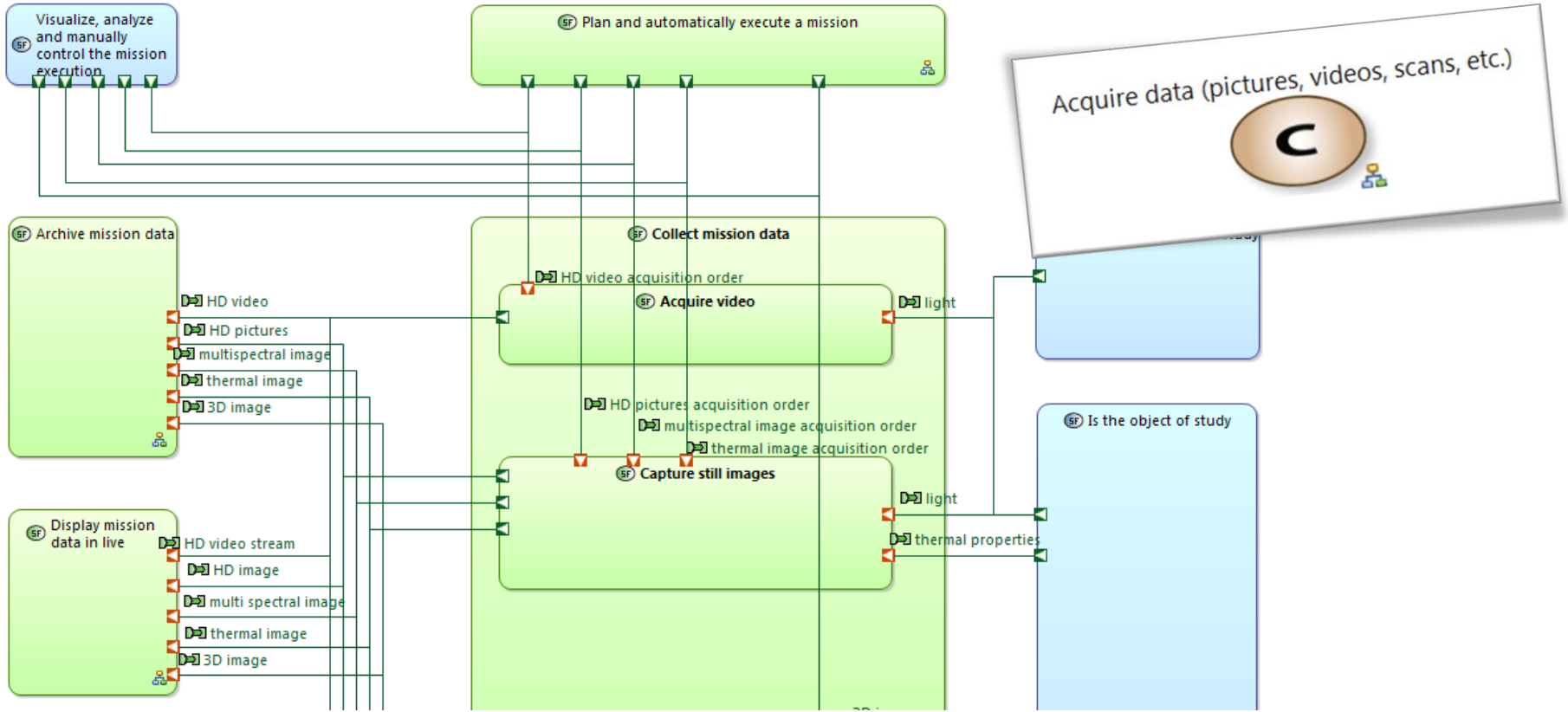
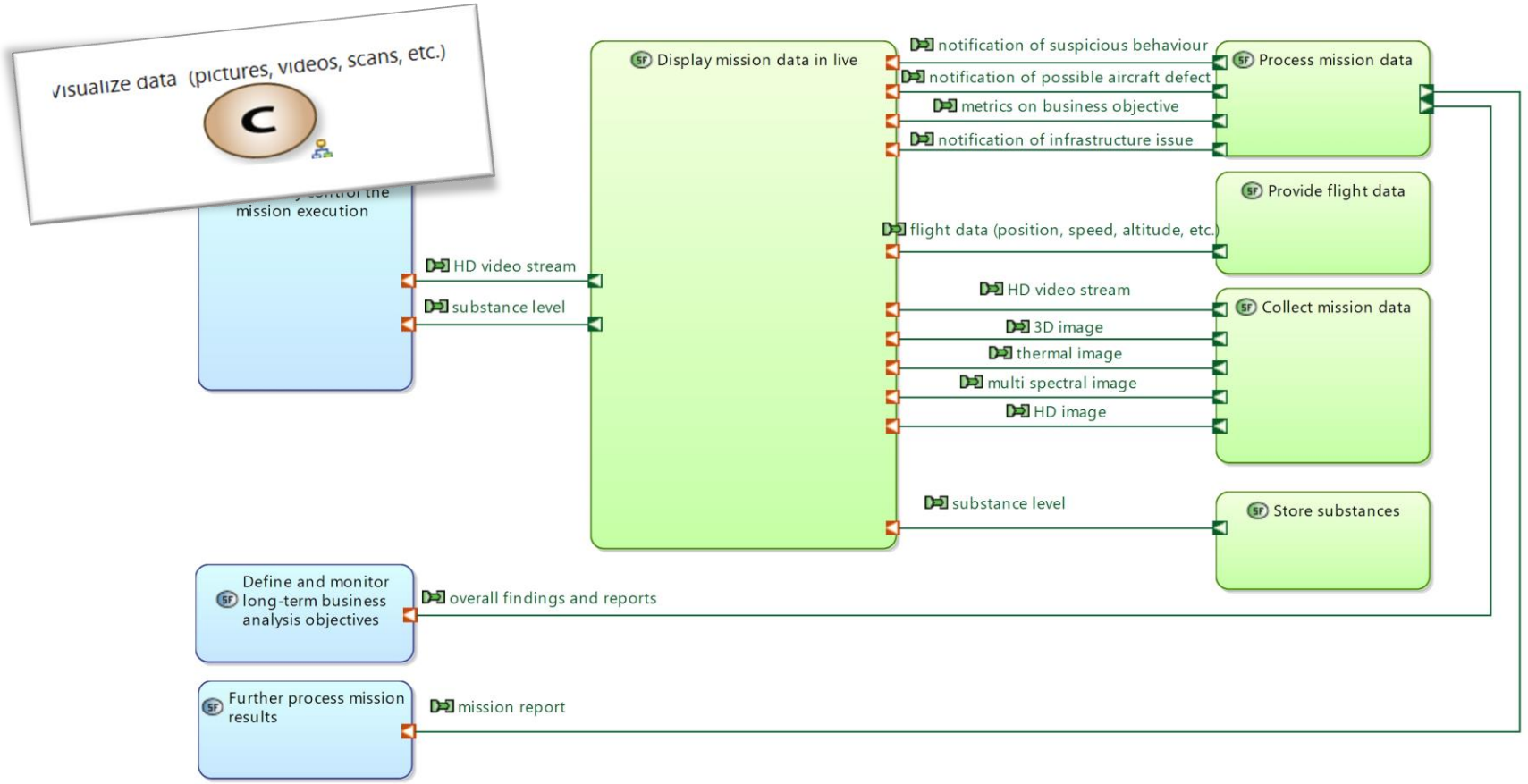
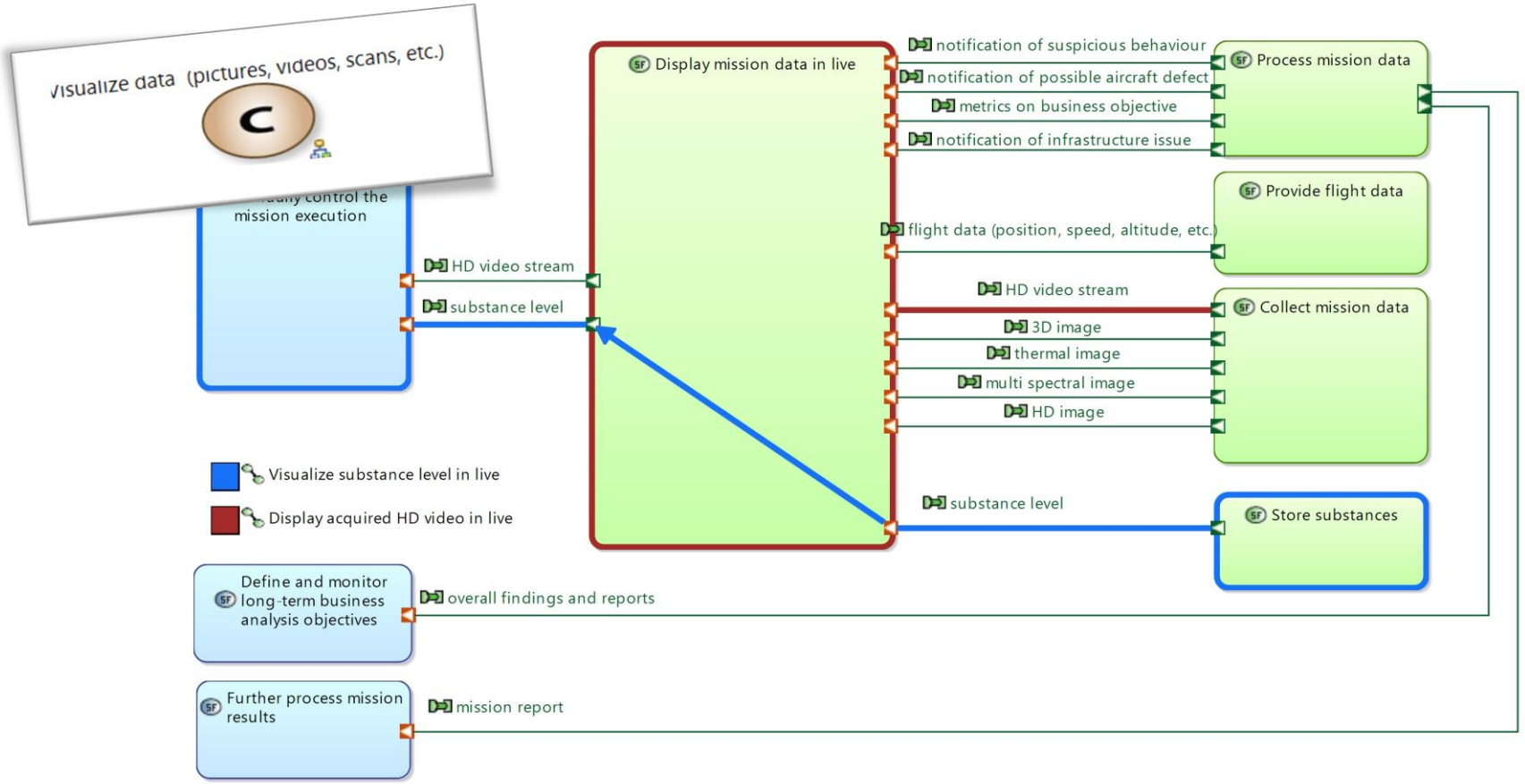
# Focus on the capability « Acquire data »



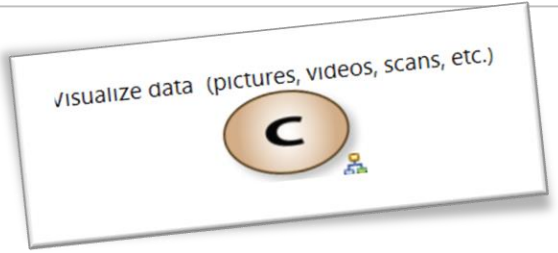
# Focus on the capability « Visualize data »

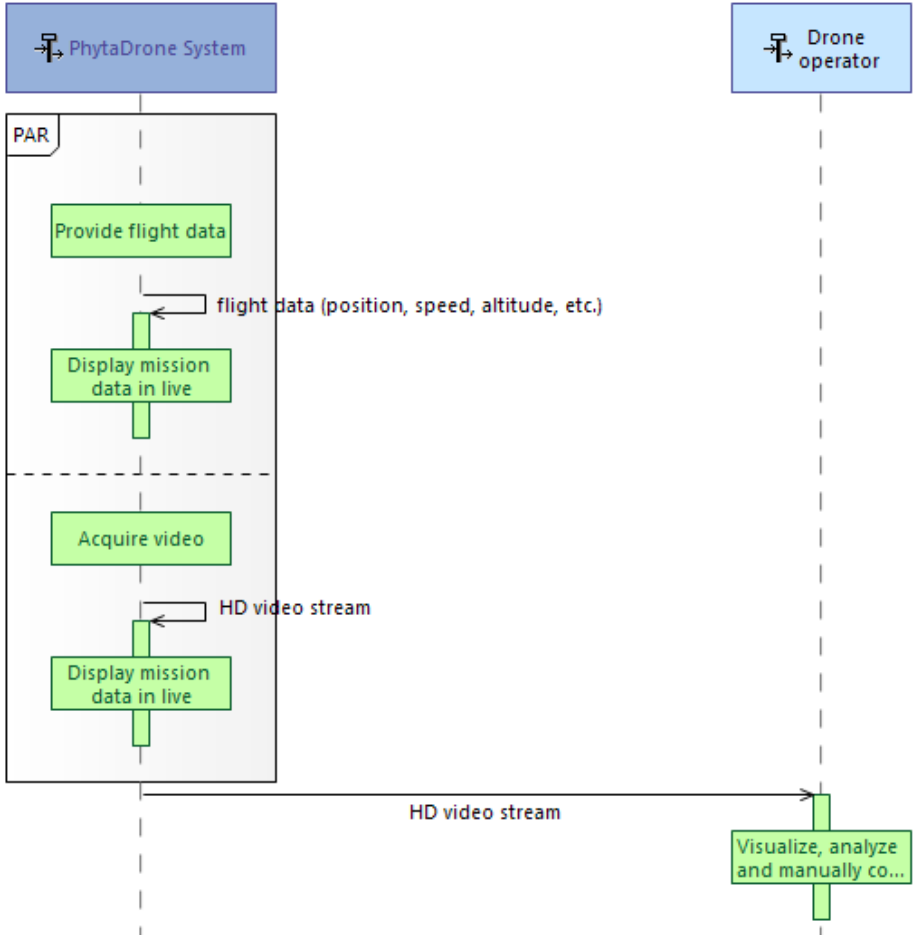


# Focus on the capability « Visualize data » – Functional Chains



# Focus on the capability « Visualize data » – Scenarios



# Product Need Analysis

model



**Farmer**
- Take decisions based on information about the field

**Service provider**
- Provide business intelligence

**Drone operator**
- Manually control the drone trajectory
- Visualize, analyze and manually control the...

**Mission manager**
- Prepare mission
- Configure drone operating environm...
- Define and monitor long-term business ...
- Further process mission results

**PythaDrone Product**

| | | | | |
|---|---|---|---|---|
| Automatically perform business-specific analysis of collected data | Provide guidance to the definition of business objectives | Store substances | Provide guidance to the creation of a mission | Track moving element |
| Consolidate collected mission data | Elaborate mission report | Measure business objective | Process manual motion orders | Provide flight data |
| Present mission data with guidance and suggestions | Automatically execute a mission | Acquire video | Move and orient drone | |
| Capture still images | Process flight plan | Scan | Display mission data in live | |
| Implement obstacle avoidance | Elaborate findings and reports on business objectives evolution | Release substance | Archive mission data | |

**Airline company database**
- Provide aircraft history

**Moving element of interest**
- Is the moving object of study

**Environment**
- Constitute obstacles

**AESEA certified inspector**
- Decide on aircraft possible defects

**Element of interest**
- Is a target
- Is the object of study

OPEN



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