



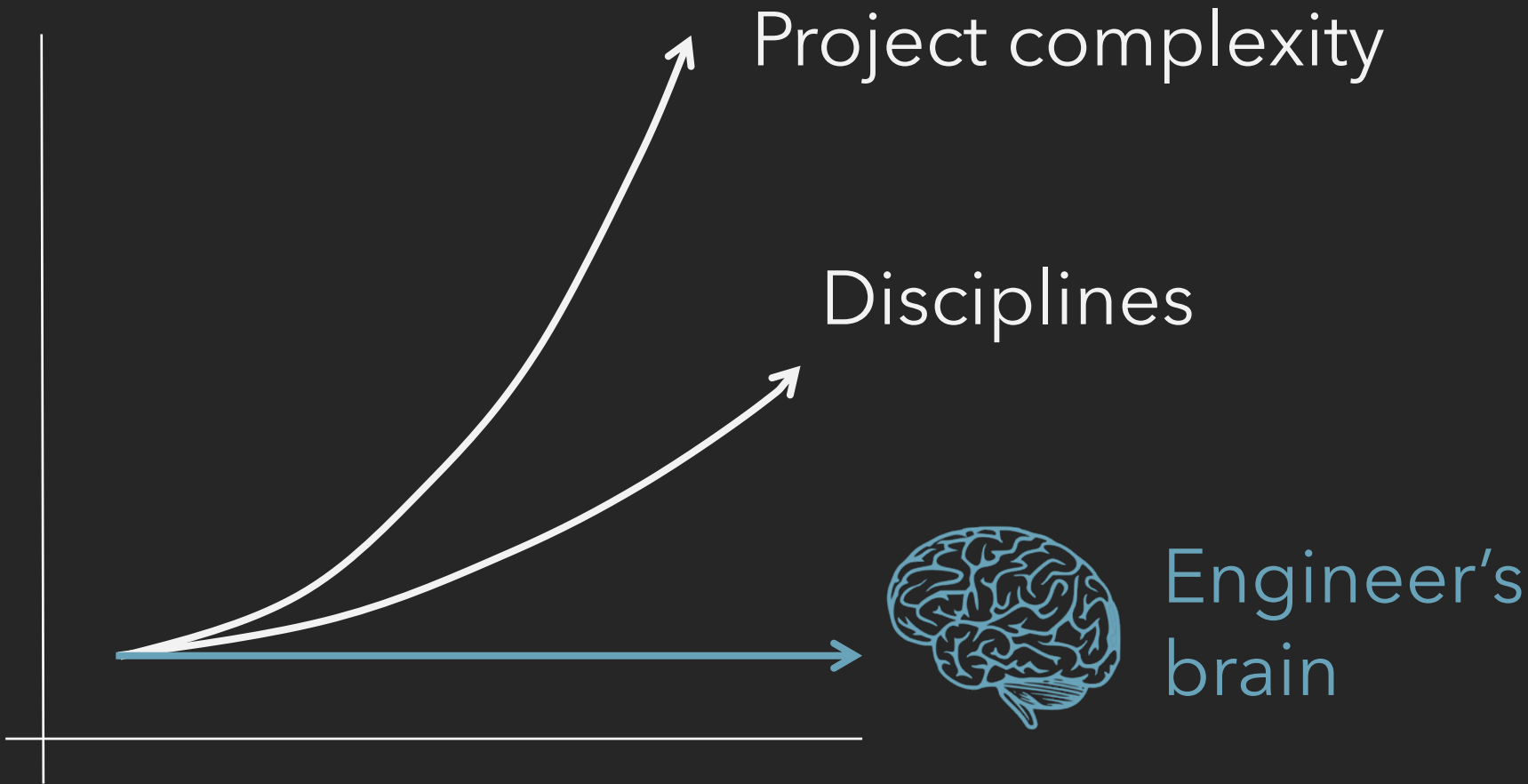
# Fostering MBSE in engineering culture

INCOSE INTERNATIONAL WORKSHOP 2020

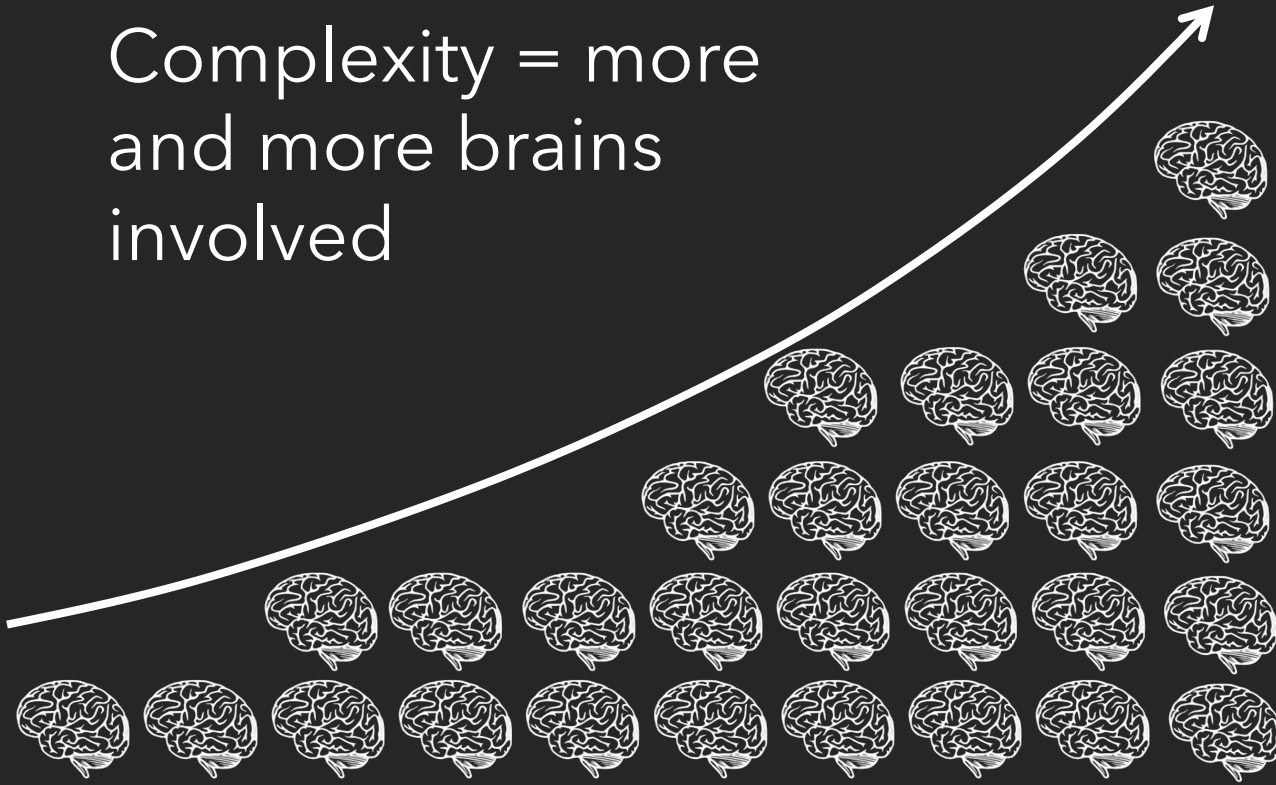
Stéphane Bonnet

Thales Corporate MBSE Coaching

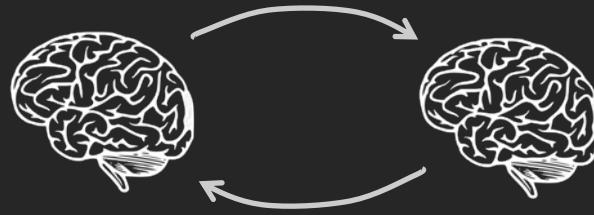
*With contributions of Jean-Luc Voirin, Juan Navas, Eric Lepicier, Guillaume Journaux, Karin Pellen, and others*



Complexity = more  
and more brains  
involved

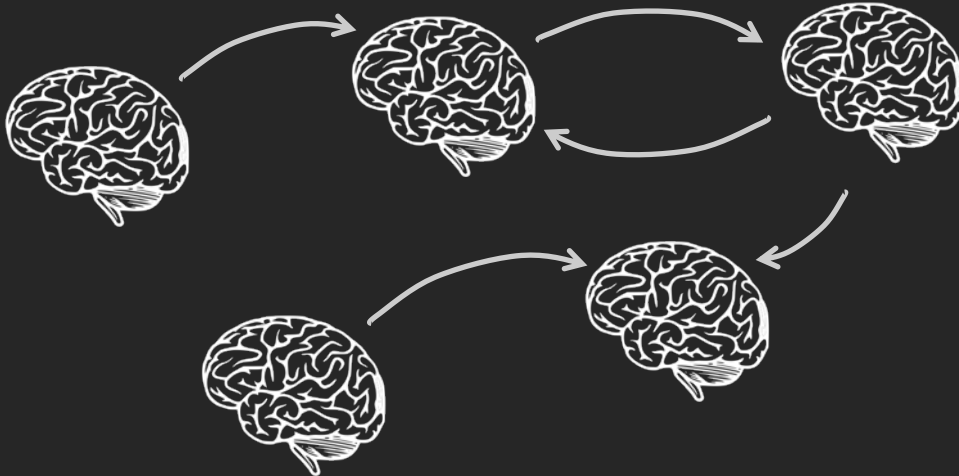


Doing more, with more constraints and less time



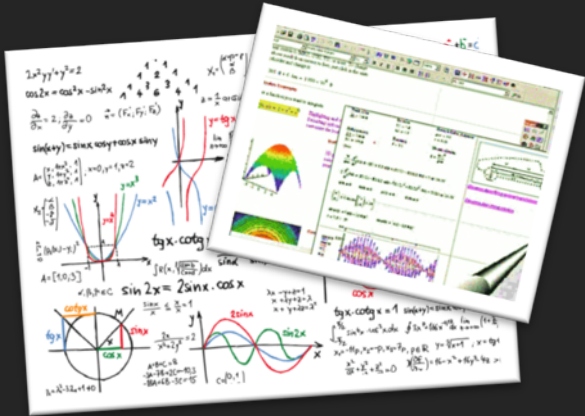
Coping with very demanding customers

Interacting with more peers

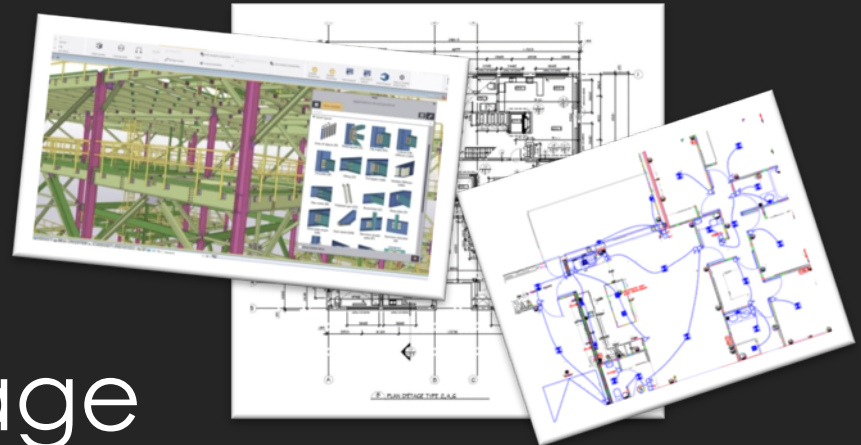


Communication and information management problem

# Mathematics



# Construction

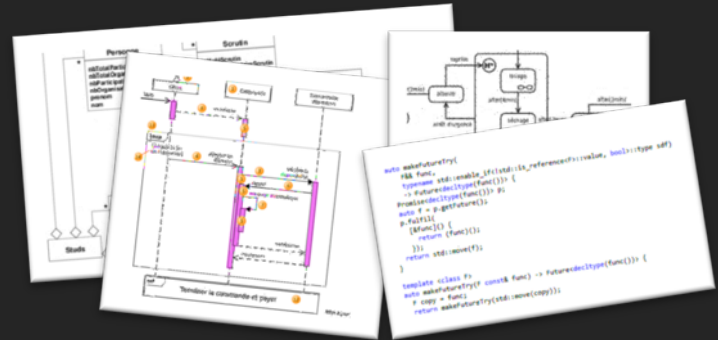


# Language

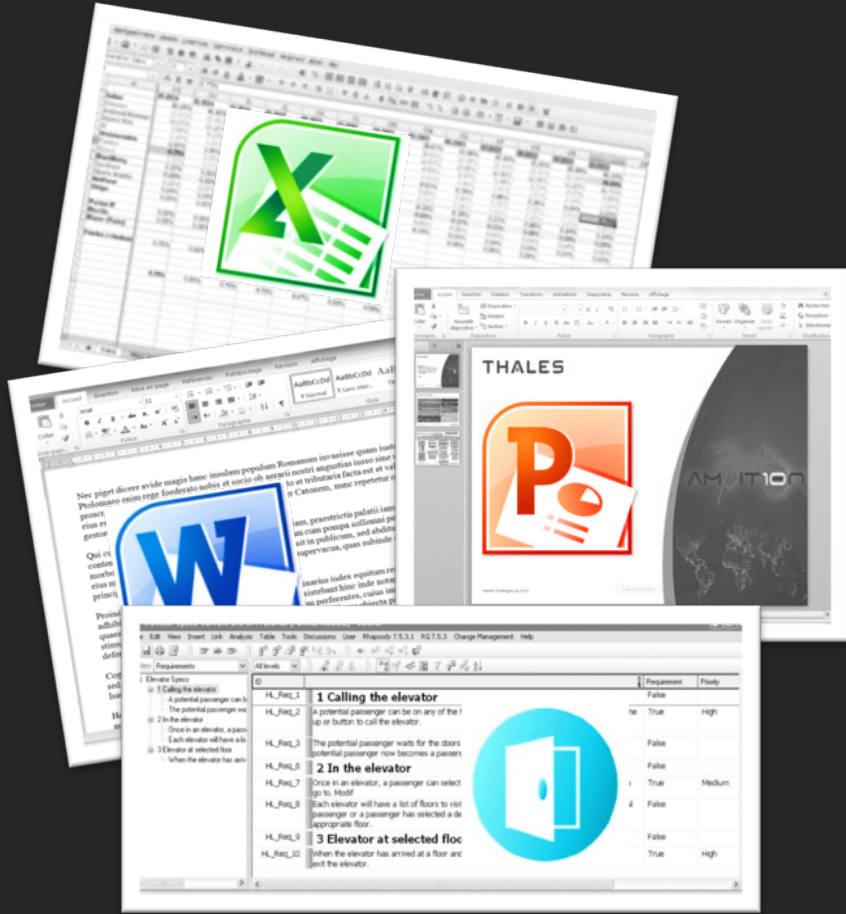
# Electronics



# Software



# Systems Engineering

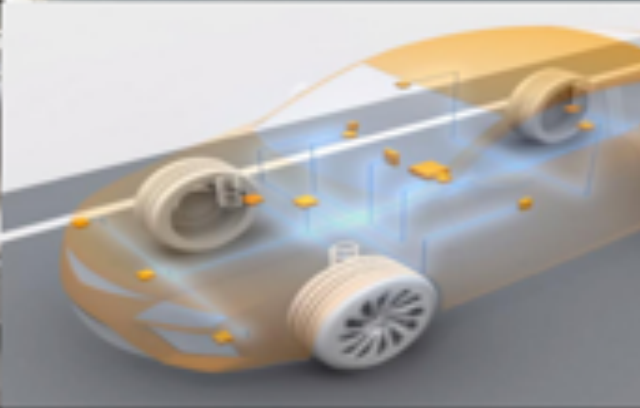
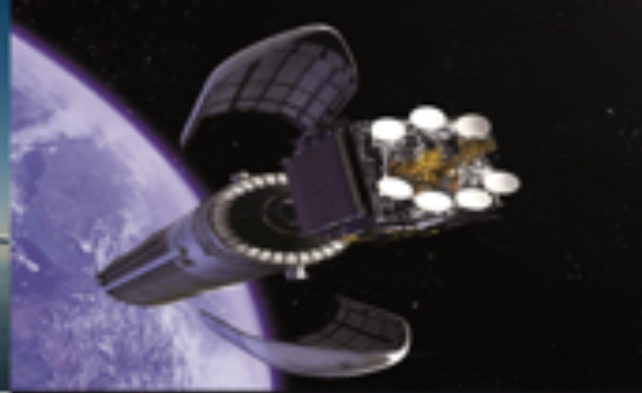


Model-based systems engineering is the formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.”

Vision 2020 (INCOSE-TP-2004-004-02, Sep 2007)

1. Fundamentals: method and concepts
2. Engineering practices
3. Framework of (model-based) engineering objectives
4. Organizational aspects of deployment





# 1. Fundamentals

Methodology and high level  
concepts and viewpoints



Purpose-built to provide the  
notation and diagrams fitting  
the Arcadia approach



## Need model

helps formalize and consolidate customer and system requirements

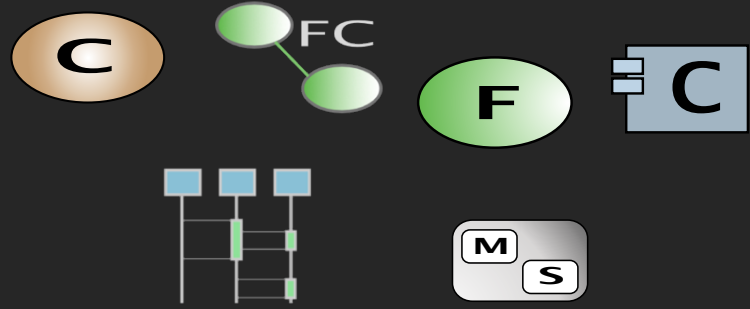
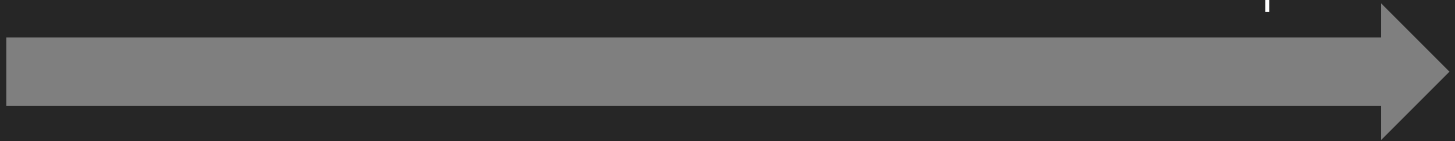
## Requirements

are at the heart of the current engineering practices

## Solution model

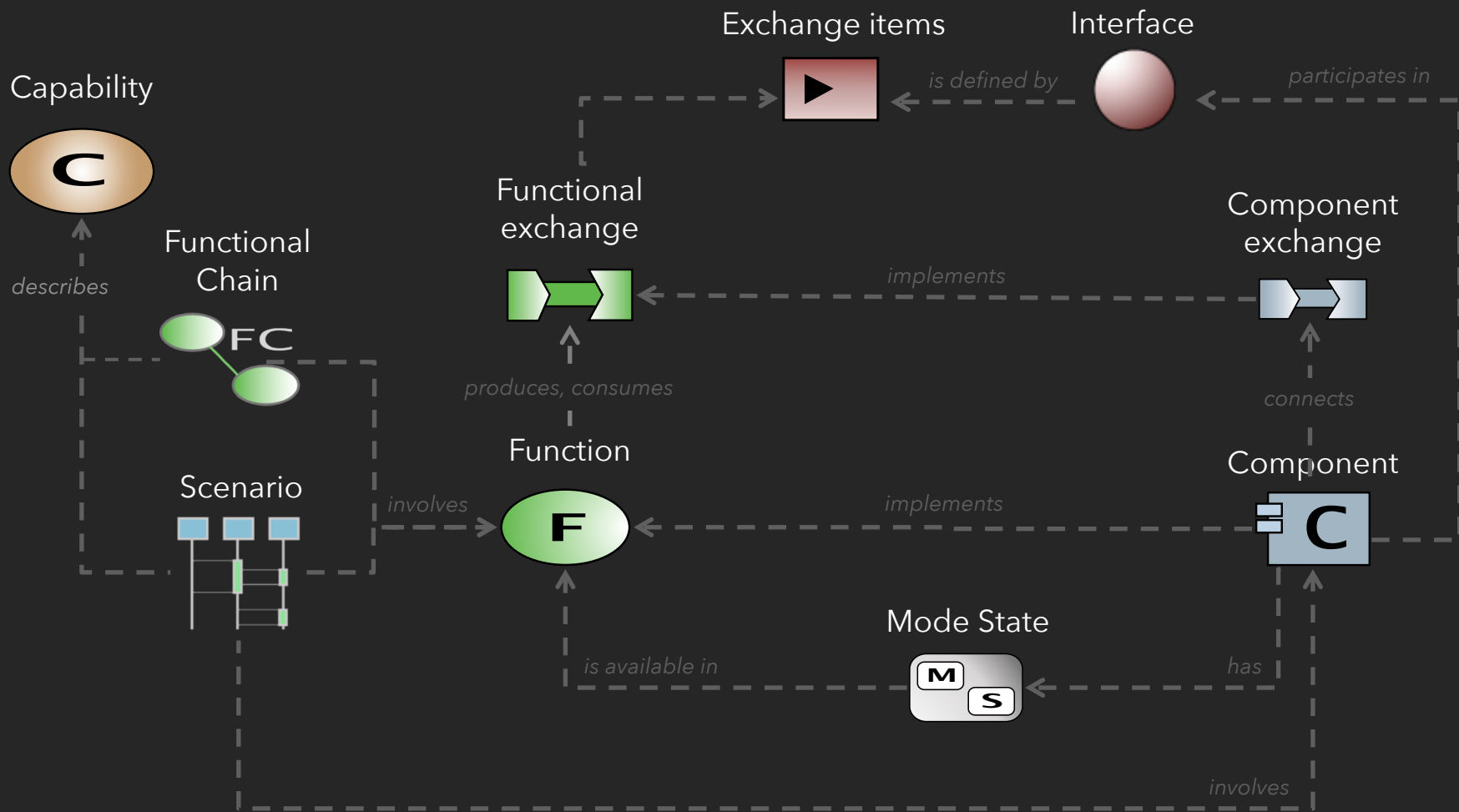
helps validate feasibility, elicit/justify new requirements for system/subsystems

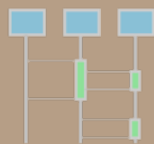
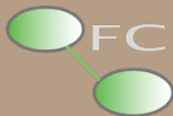
Model concepts



Engineering  
Perspectives  
(need + solution)







Capability  
analysis



Interface description



Functional  
analysis

Textual  
requirements

Behavioral  
description



Structural  
description



# Visualize live data during flight

- FC
- FC
- FC
- FC
- FC

Display live acquired HD video



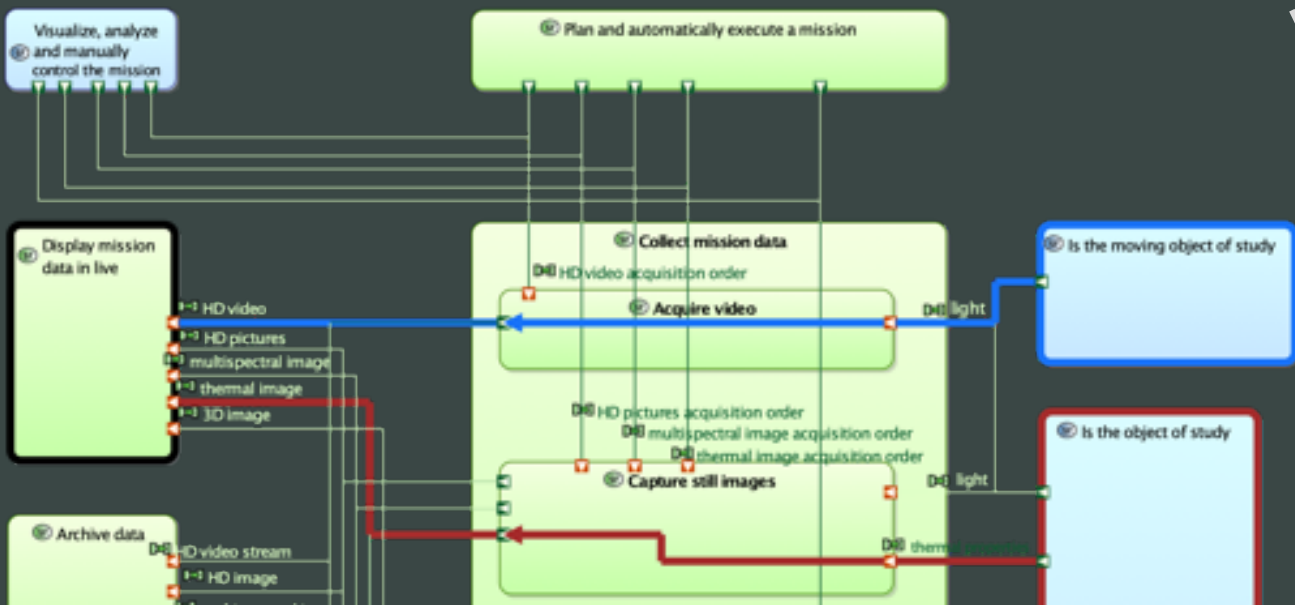
Display live multi-spectral image

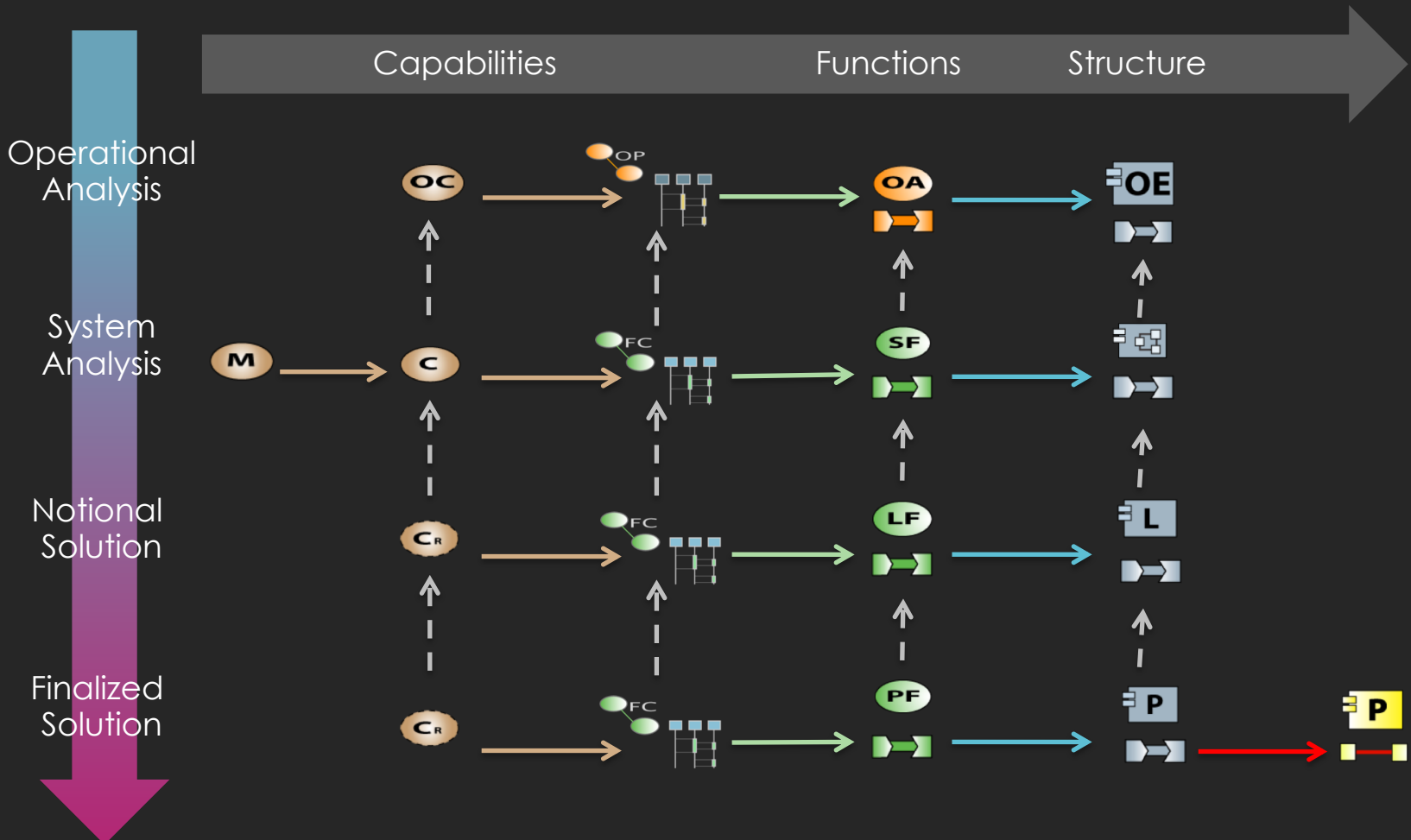
Display live thermal image



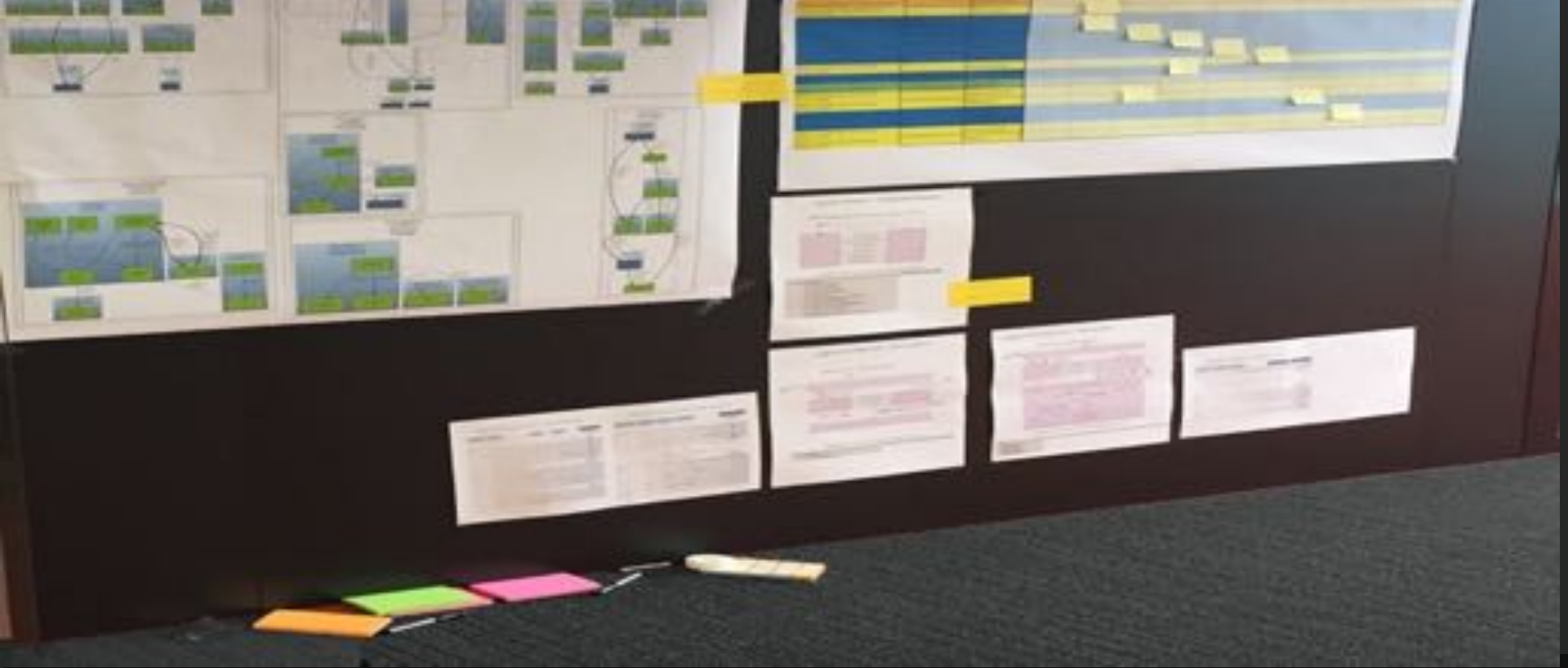
Visualize all collected mission data

Visualize substance levels in real time





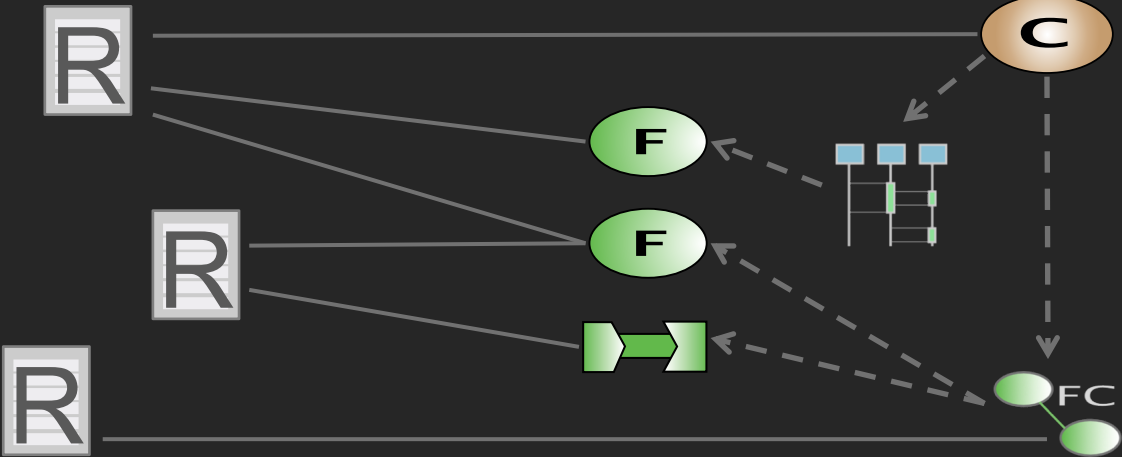




## 2. Engineering practices

# Requirements

# Model elements

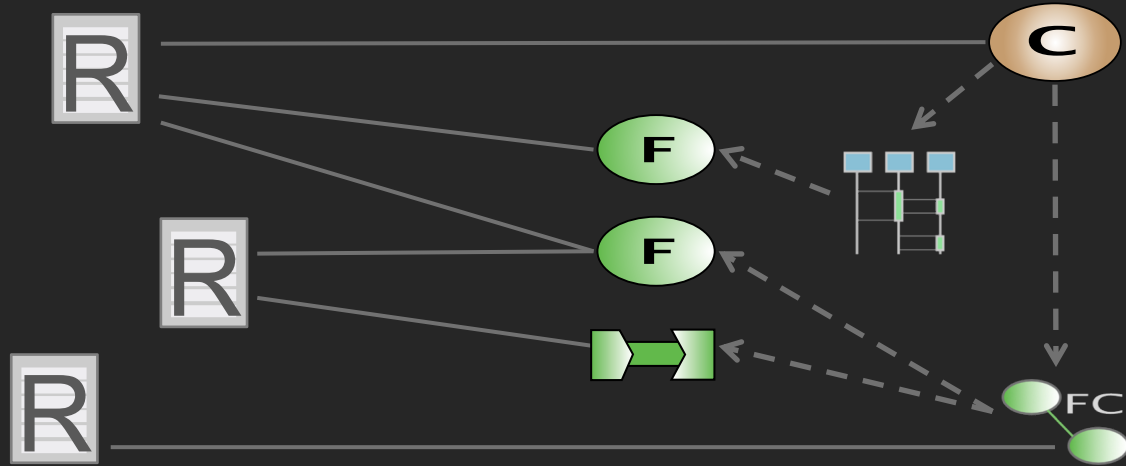


Models add **rigor** to need expression / solution description

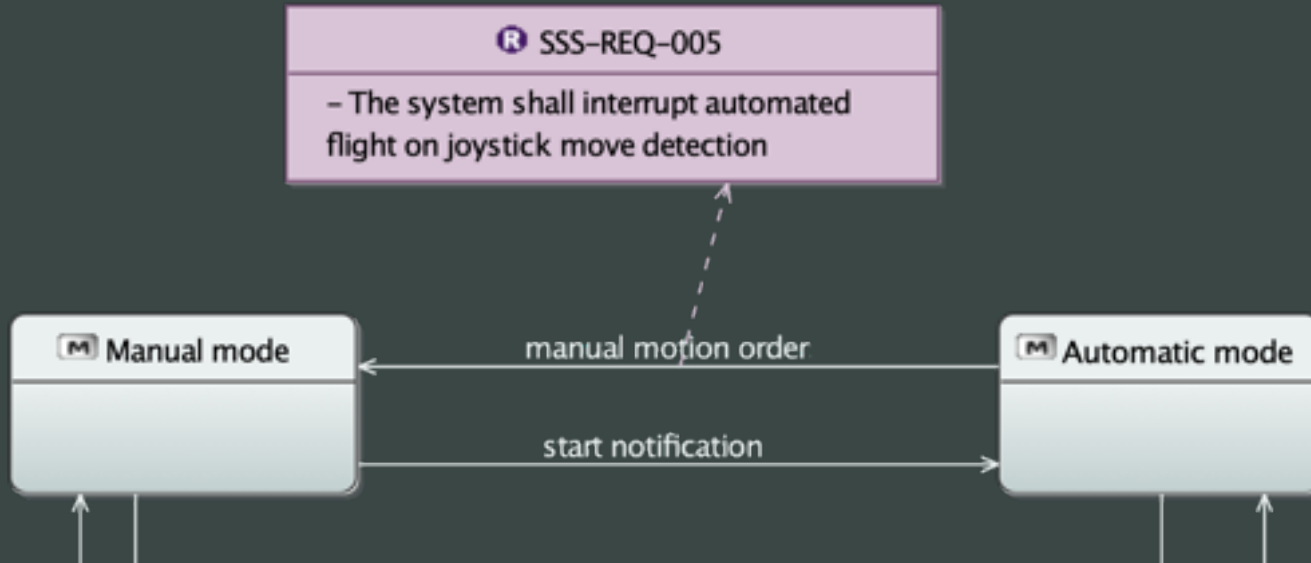
Models enable **automated processing**

Textual  
Requirements

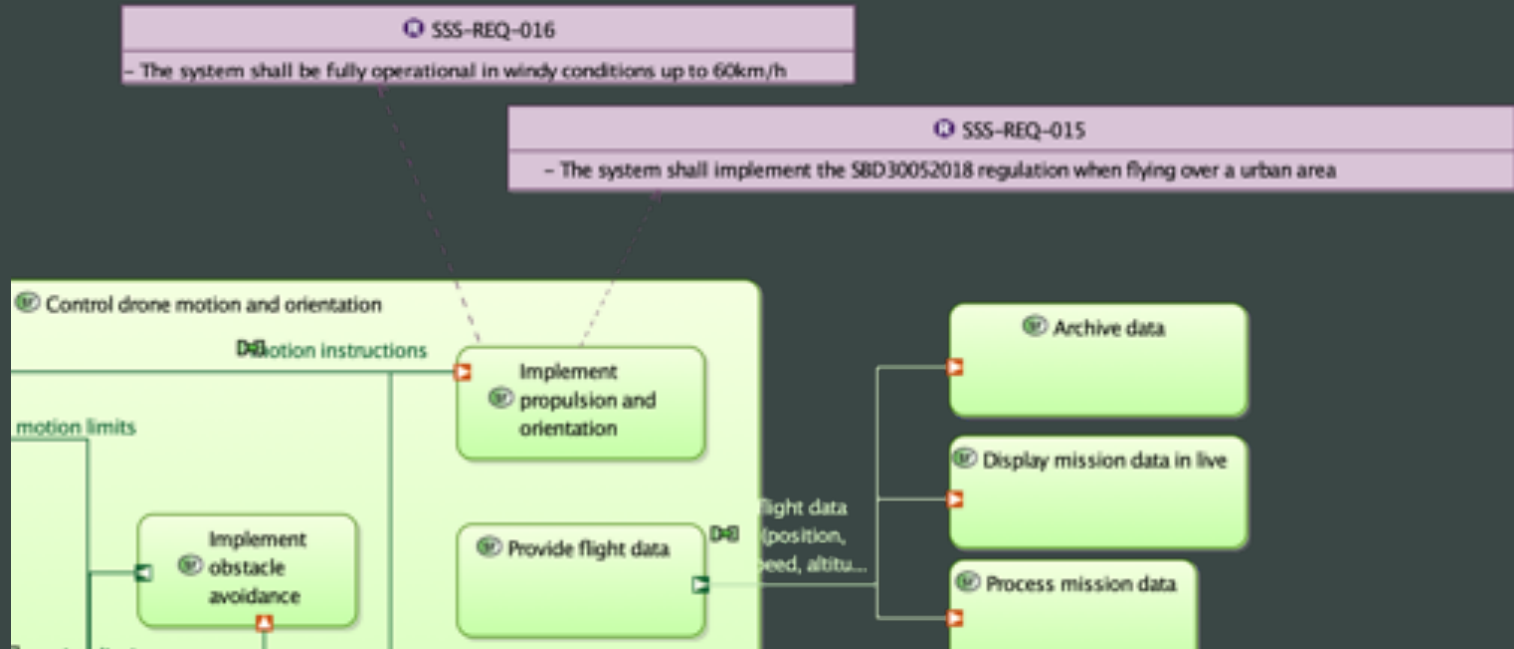
Model elements  
~~Requirements~~



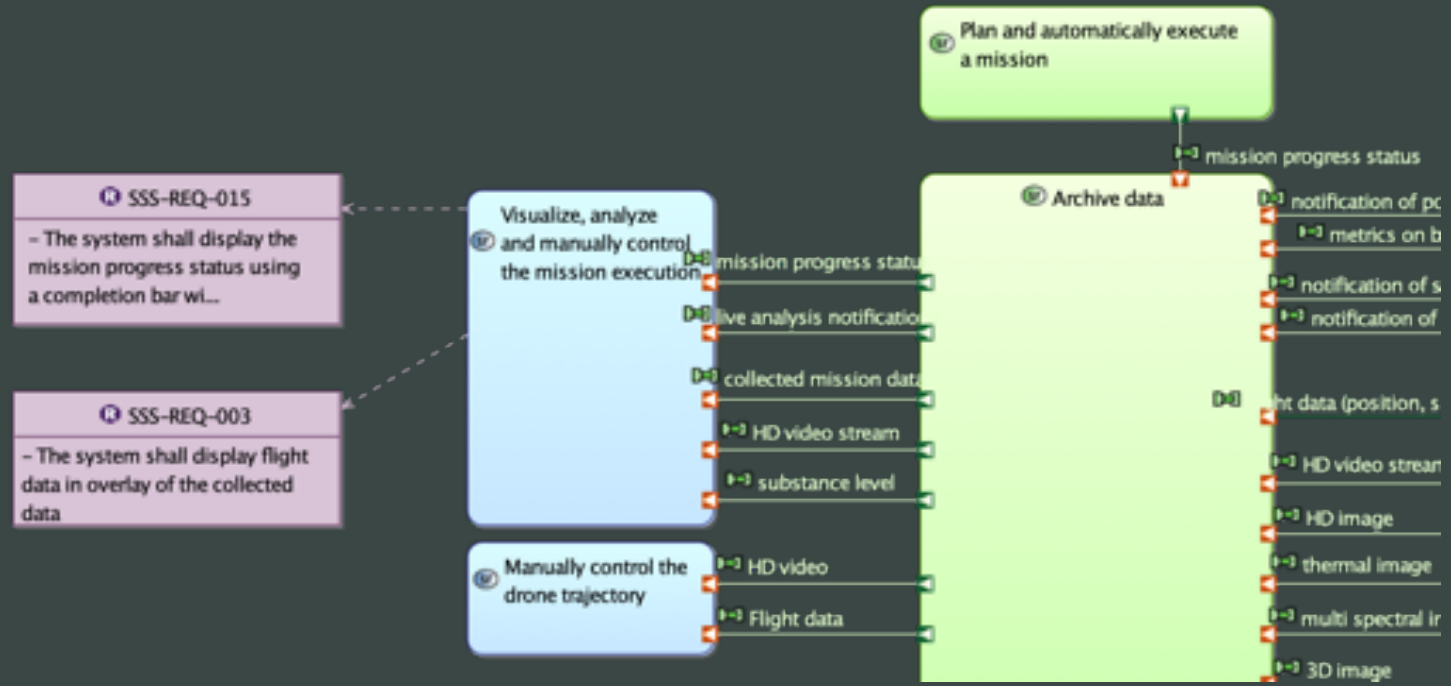
A model requirement can formalize a textual requirement and explicit its effects and ramifications



Some expectations (environmental, regulations, etc.)  
are easier to express with textual descriptions.



Some expectations on a model element at a given engineering level do not require a formal modeling (which is left to subsystem design)



# Happy consequences

Contracts  
between  
engineering  
levels

Verification  
and validation

Incremental  
(agile)  
development  
strategy



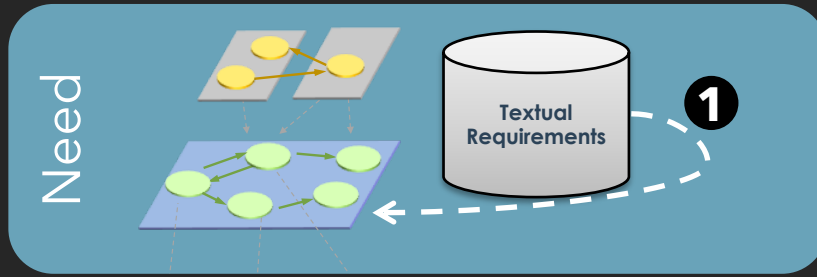
# Happy consequences

Contracts  
between  
engineering  
levels

Verification  
and validation

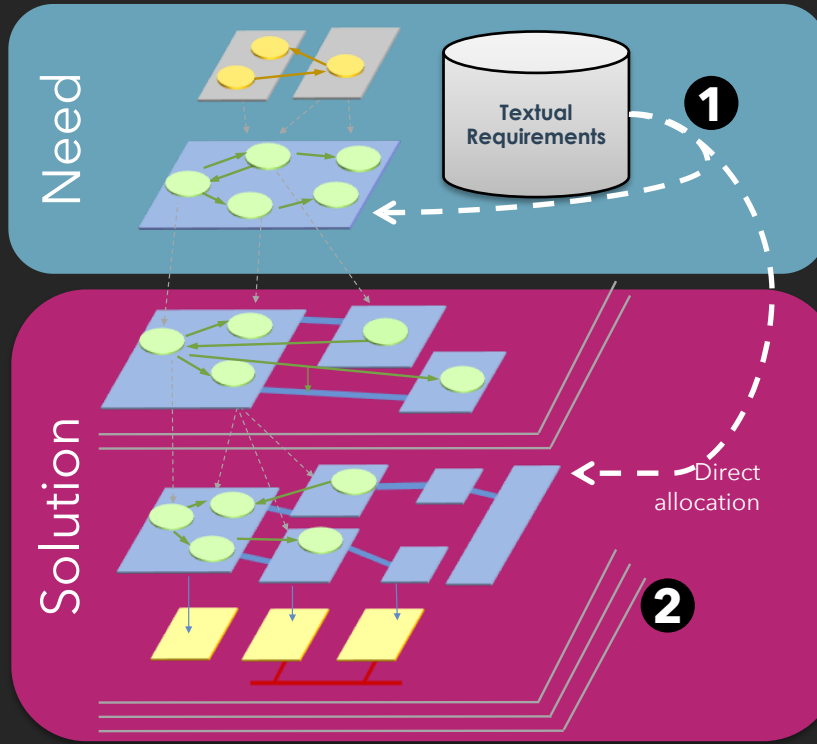
Incremental  
(agile)  
development  
strategy

Level N



- 1.**  
Elicitation of  
model and textual  
requirements  
on the system

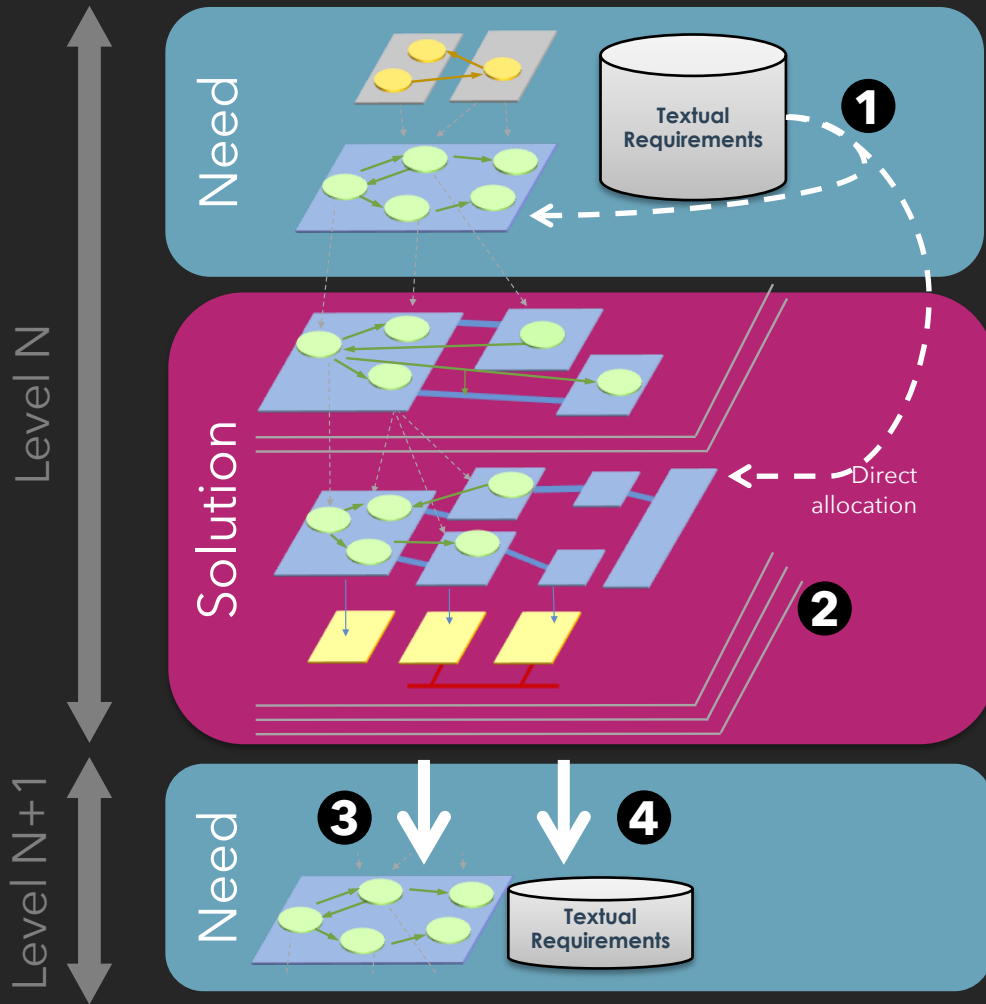
Level N



**2.**

Architecture description specifies with the adequate level of detail how the system works and what is expected from each constituent

Objective: Prepare the contracts for all subsystems and guarantee their proper integration.



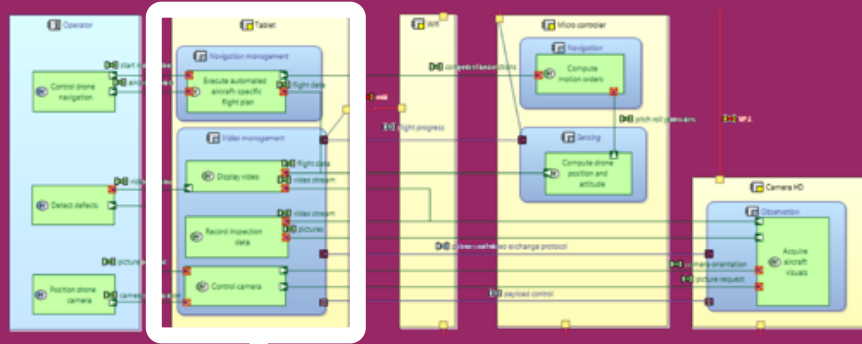
**3.**

The context of a given system constituent is entirely computed (anything contributing to the definition of this constituent including allocated Functions, interfacing Components, etc.)

**4.**

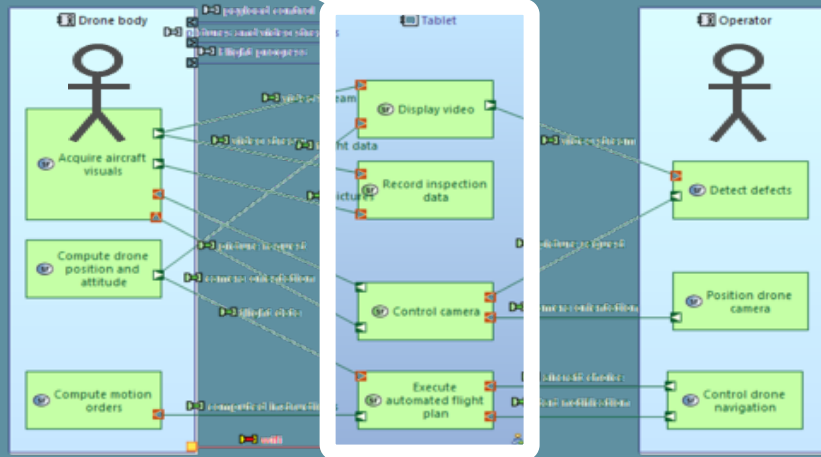
Textual requirements are created when needed, in addition to the model requirements: legal, non-functional, additional specification of internal expected behavior

Tablet is a constituent of a drone-based system



3

Tablet is the (sub)system of interest





Model-based workflow favors co-engineering over the traditional differentiation between "customer" requirements and "system" requirements

# Happy consequences

Contracts  
between  
engineering  
levels

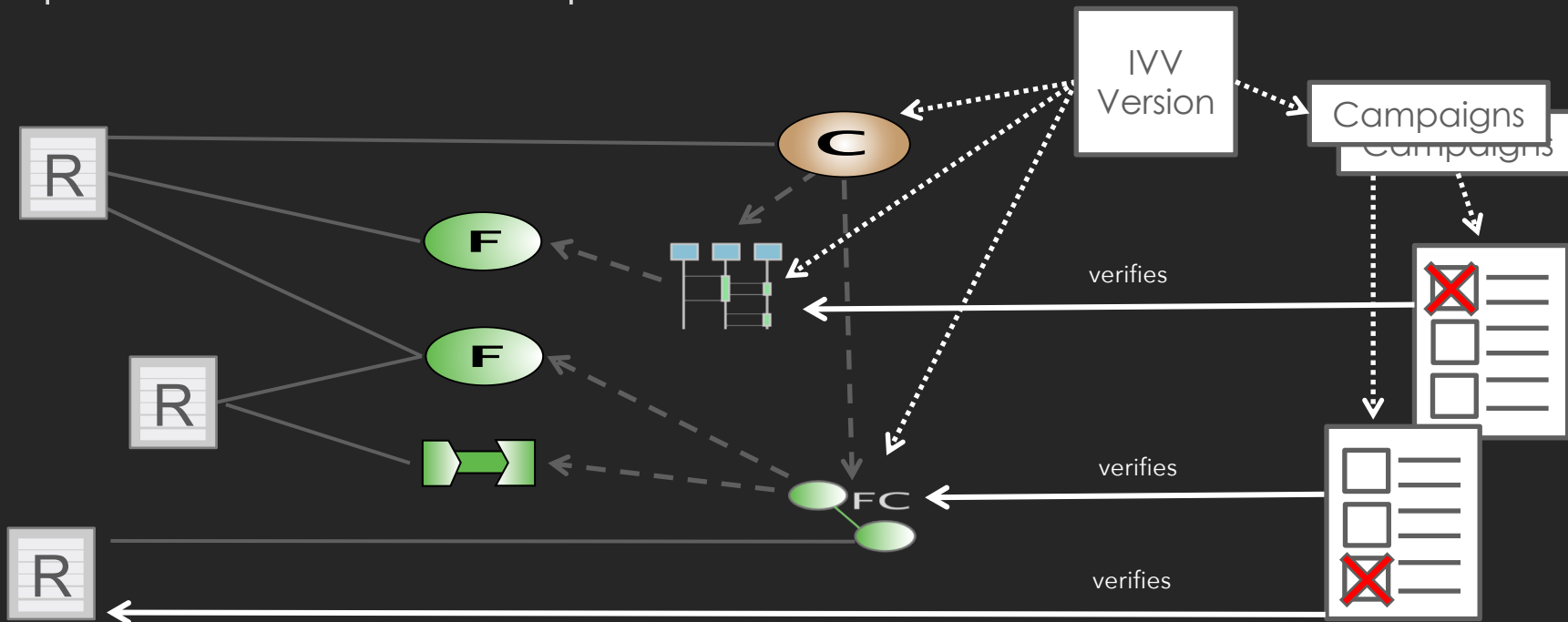
Verification  
and validation

Incremental  
(agile)  
development  
strategy

Textual requirements

Model requirements

Verification and validation







2 years  
30 persons  
8 subsystems  
9 engineering data packages

### Functional Chains list

- CF-SMG-0201 - Alerter l'opérateur d'une panne de liaison SSR1-SSCT
- CF-SMG-0202 - Alerter l'opérateur d'une panne équipement CVI
- CF-SMG-0203 - Alerter l'opérateur d'une panne équipement IFF
- CF-SMG-0204 - Alerter l'opérateur d'une panne équipement radar
- CF-SMG-0205 - Réagir à une panne générale Radar

### Functional Chains release definition

Version	Date	Components	Composites	Previous	Following	Needs this
ATL2 - SSR1						
Other						
SSRI_V0			SSRI_ABE	SSRI_V1		
SSRI_V1			SSRI_V0	SSRI_V2		
SSRI_V2			SSRI_V1	SSRI_V3		
SSRI_V3			SSRI_V2			
SSRI_V4			SSRI_V3			
SSRI_V5			SSRI_V4			

### Functional chain



### Requirements

- 4.5.5.1 Gestion de l'alerte SSR1
  - 4.5.5.2 Gestion de l'alerte et navigation
  - 4.5.5.3 Gestion des états
  - 4.5.5.4 Transmission de état SSR1
- TH\_20\_555-REQ-000471  
Fonction émet à la fréquence de 314 le message [SSRI\_LOTTI\_ETA] (Transmission de état SSR1)
- TH\_20\_555-REQ-000474  
Fonction émet à la fréquence de 314 le message [SSRI\_LOTTI\_ETA] (Transmission de état SSR1)



### IVV Test Suite Repository

Allocate webres in TSR

Refresh from TSR

Orchestra  
Test Suite Repository Dashboard  
Version 1.0.0

Legend:  
Automatically filled  
Imported data from DOORS  
To be filled  
Imported data from TSE

ID	Title	Associated Campaigns
TH_20_555-REQ-000001	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000002	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000003	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000004	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000005	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000006	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000007	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000008	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100
TH_20_555-REQ-000009	Configurer et activer des secteurs d'inhibition d'émission radar (radar seul et radar IFF)	SSRI_V0,SSRI_V1,SSRI_ABE,SSRI_V2,SSRI_V3,SSRI_V4,SSRI_V5,SSRI_V6,SSRI_V7,SSRI_V8,SSRI_V9,SSRI_V10,SSRI_V11,SSRI_V12,SSRI_V13,SSRI_V14,SSRI_V15,SSRI_V16,SSRI_V17,SSRI_V18,SSRI_V19,SSRI_V20,SSRI_V21,SSRI_V22,SSRI_V23,SSRI_V24,SSRI_V25,SSRI_V26,SSRI_V27,SSRI_V28,SSRI_V29,SSRI_V30,SSRI_V31,SSRI_V32,SSRI_V33,SSRI_V34,SSRI_V35,SSRI_V36,SSRI_V37,SSRI_V38,SSRI_V39,SSRI_V40,SSRI_V41,SSRI_V42,SSRI_V43,SSRI_V44,SSRI_V45,SSRI_V46,SSRI_V47,SSRI_V48,SSRI_V49,SSRI_V50,SSRI_V51,SSRI_V52,SSRI_V53,SSRI_V54,SSRI_V55,SSRI_V56,SSRI_V57,SSRI_V58,SSRI_V59,SSRI_V60,SSRI_V61,SSRI_V62,SSRI_V63,SSRI_V64,SSRI_V65,SSRI_V66,SSRI_V67,SSRI_V68,SSRI_V69,SSRI_V70,SSRI_V71,SSRI_V72,SSRI_V73,SSRI_V74,SSRI_V75,SSRI_V76,SSRI_V77,SSRI_V78,SSRI_V79,SSRI_V80,SSRI_V81,SSRI_V82,SSRI_V83,SSRI_V84,SSRI_V85,SSRI_V86,SSRI_V87,SSRI_V88,SSRI_V89,SSRI_V90,SSRI_V91,SSRI_V92,SSRI_V93,SSRI_V94,SSRI_V95,SSRI_V96,SSRI_V97,SSRI_V98,SSRI_V99,SSRI_V100

### IVV procedure

Back to summary

Legend: To be filled, Automatically filled, Imported data from DOORS, To be filled, Imported data from TSE

Append test case(s)

Step	Description	Requirement ID
3	Positionner l'axe de fin du même secteur à 13°	TH_20_555-REQ-000397 (3-3)
4	Vérifier que le secteur de blanking est affiché dans la vidéo radar-FF en mode édition	TH_20_555-REQ-000397 (3-3)
5	Appliquer le secteur de blanking défini	TH_20_555-REQ-000397 (3-3)
6	Activer le secteur de blanking n°1	TH_20_555-REQ-000397 (3-3)
7	Vérifier que le secteur de blanking n°1 est affiché dans la vidéo radar-FF	TH_20_555-REQ-000397 (3-3)



2 years  
30 persons  
8 subsystems  
9 engineering data packages

Check of consistency with specification

### Test suites

Test Suite	Test Case	Test Result	Test Date
TS001	TC001	Pass	2023-01-01
TS002	TC002	Fail	2023-01-02
TS003	TC003	Pass	2023-01-03
TS004	TC004	Pass	2023-01-04
TS005	TC005	Pass	2023-01-05

### Requirements

- 4.5.5 Assurer interface SSCIT
- 4.5.5.1 Gestion données et navigation
- 4.5.5.2 Gestion des états

[RH\_20\_505-#E0-000417] La fonction émet à la fréquence de 300 le message [SSRL\_LOTS\_Etat\_Systeme\_SSR].

[RH\_20\_505-#E0-000418] Elaboration de l'état système SSR.

[RH\_20\_505-#E0-000419] La fonction élabore [SSRL\_LOTS\_Etat\_Systeme\_SSR] à partir de [Etat système SSR].

### LA functions & exchanges



Impact analysis

### Specification Defects

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

Capacité (free_field_choice_03)	EPPO-Acquies et exploiter les images radar
Sous-Capacité (free_field_choice_04)	EPPO-04 Lancer et afficher une acquisition D400
Chaîne Fonctionnelle	EPPO-0102 Lancer l'acquisition d'une image DSA

### Component Defects

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

Capacité (free_field_choice_03)	EPPO-Acquies et exploiter les images radar
Sous-Capacité (free_field_choice_04)	EPPO-04 Lancer et afficher une acquisition D400
Chaîne Fonctionnelle	EPPO-0102 Lancer l'acquisition d'une image DSA

### Component Evolution

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

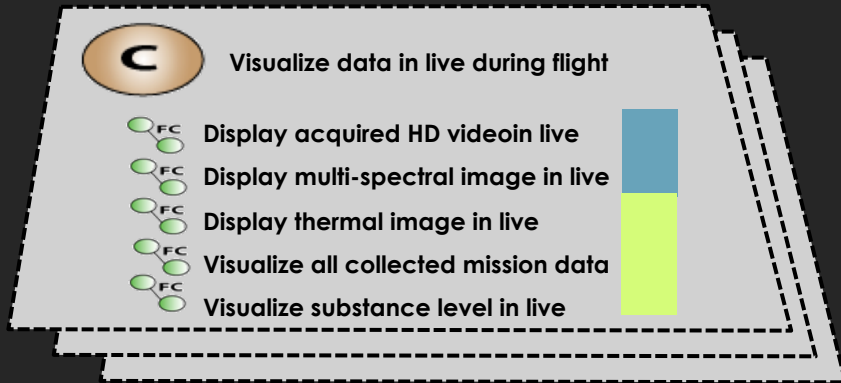
Capacité (free_field_choice_03)	EPPO-Acquies et exploiter les images radar
Sous-Capacité (free_field_choice_04)	EPPO-04 Lancer et afficher une acquisition D400
Chaîne Fonctionnelle	EPPO-0102 Lancer l'acquisition d'une image DSA

# Happy consequences

Contracts  
between  
engineering  
levels

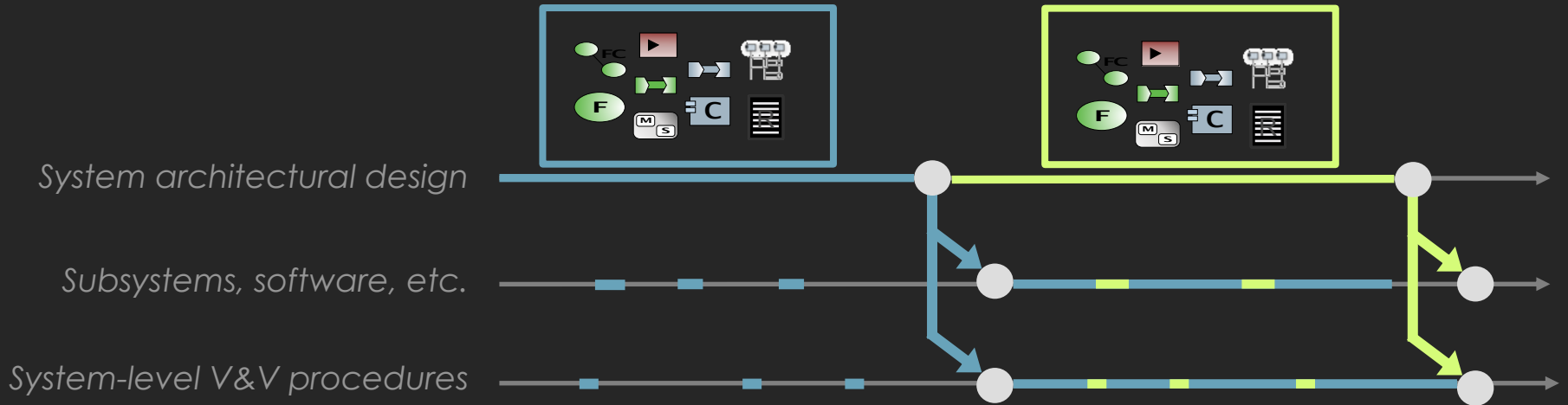
Verification  
and validation

Incremental  
(agile)  
development  
strategy



Definition of increments with expected functional chains

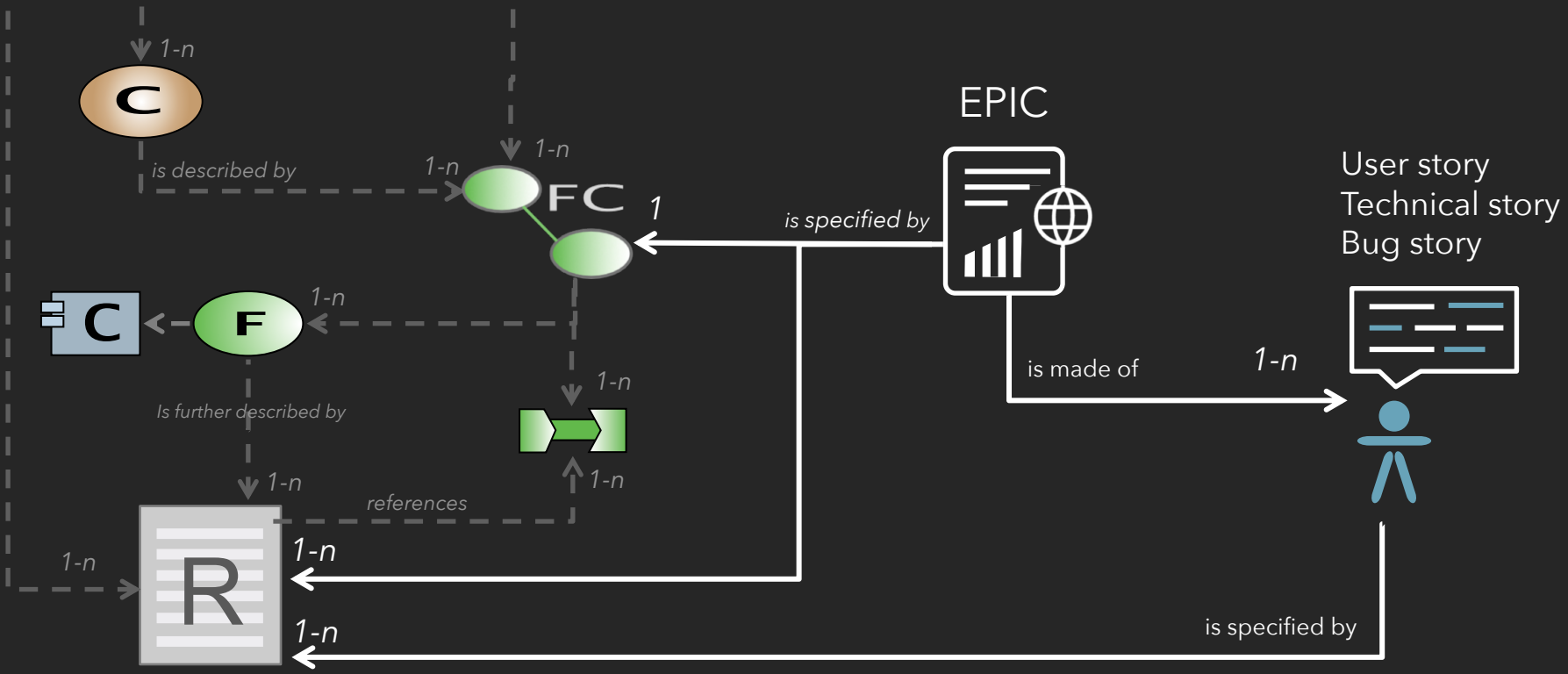
Vertical slices of architectural design across need and solution models

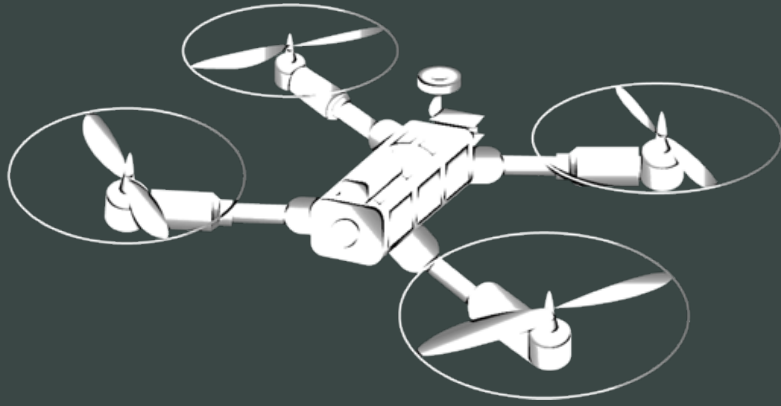


# System increment

# Agile release

# Agile sprint





Systems team



V&V team



Software team

System iteration: 3 months  
SW sprint: 3 weeks

Vision of the high-level capabilities of the product is known and shared, functional chains have been dispatched in several system expected increments

*FC « Manually control the drone motion »*

Architectural design



Systems team

End of Iteration n

End of Iteration n+1

*GUI, mode supervision, development of joystick driver, etc.*

Co-engineering and reviews

Refinement of EPICs/FCs in User Stories



Control SW team

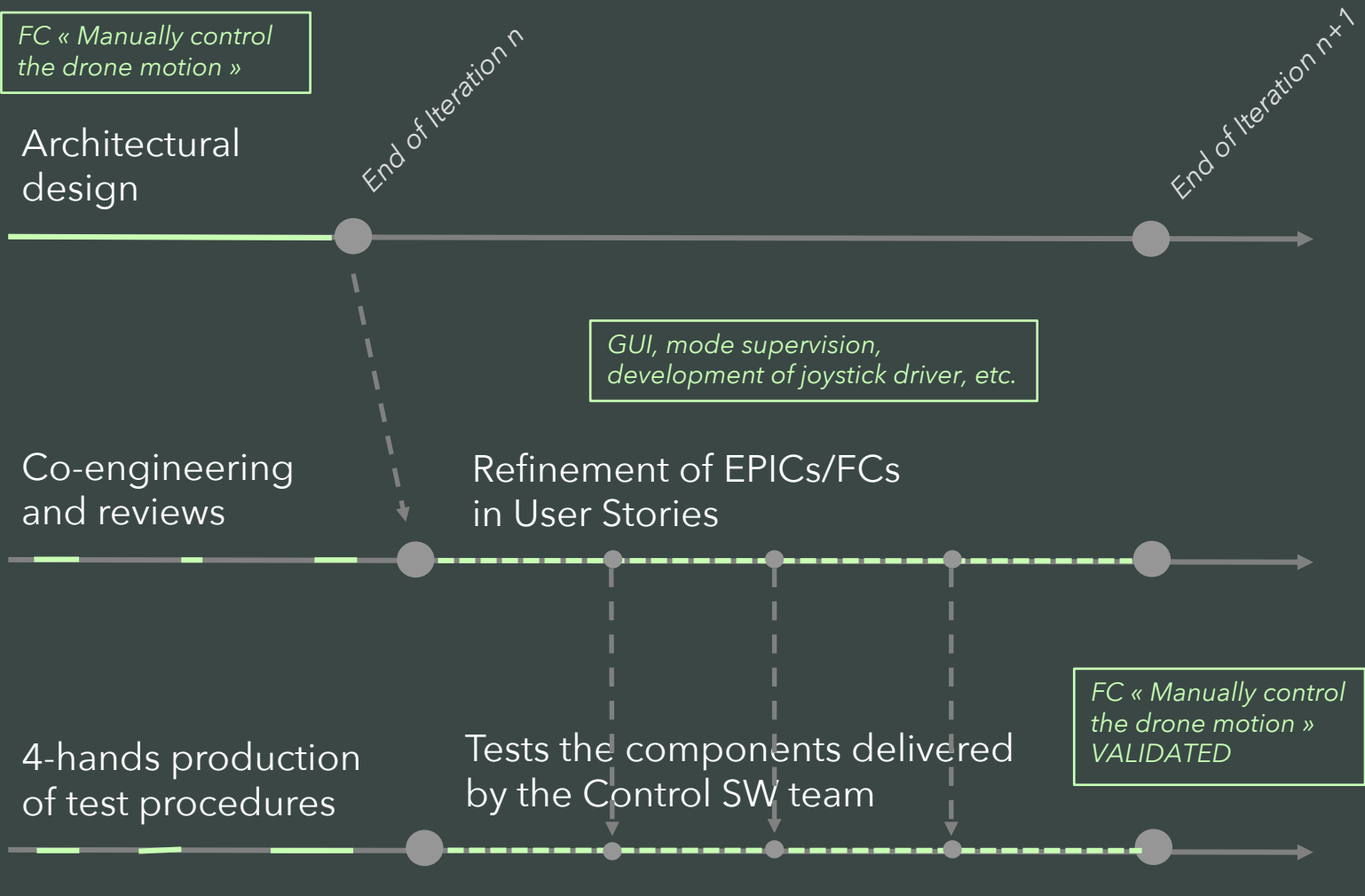
4-hands production of test procedures

Tests the components delivered by the Control SW team

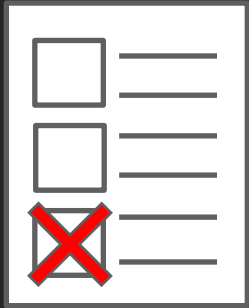
*FC « Manually control the drone motion »  
VALIDATED*



V&V team



# Functional chains are the new backbone



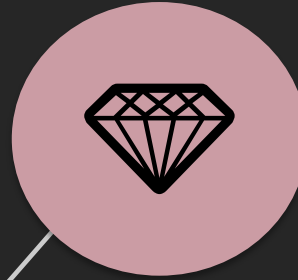
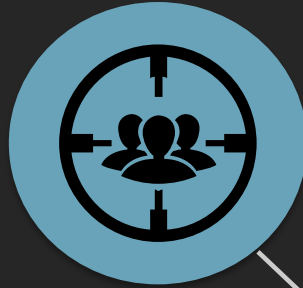




### 3. (MB) Engineering objectives

## SHARE

Improve communication  
and reduce ambiguities



## SECURE

Analyze and evaluate  
to master complexity,  
drive engineering  
activities

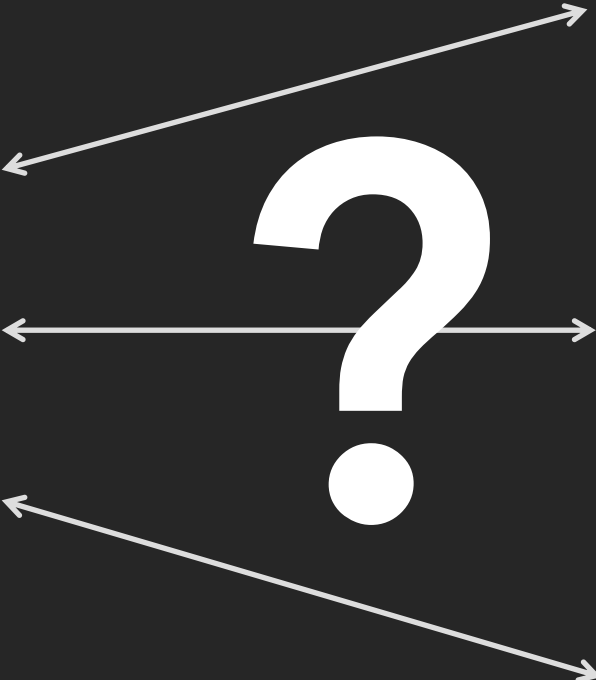



## AUTOMATE

Generate  
documentation, code,  
models, etc.

Three different kinds  
of purposes for models.  
More is not necessarily better.

11  
Engineering  
Activities



		 <b>SHARE</b>	 <b>SECURE</b>	 <b>AUTOMATE</b>	
UN	Arca arc				
	Arca arc				
B DEV S		<b>3. DESIGN THE ARCHITECTURE</b>	<p>Arcadia LA/PA models describe the architectural design: <b>functional expectations</b> from each solution constituent, interfaces, functional chains. They provide a <b>common understanding of the chosen solution</b>, are known by all stakeholders, and are used in documentation on ad hoc basis.</p>	<p>Arcadia LA/PA models describing the architecture are exploited to <b>guarantee the consistence and completeness of the design</b>. They are used to consider <b>alternatives</b> and support <b>early evaluation</b> (sizing assumptions, performance, cost, etc.). Model and textual requirements are rigorously articulated (derivation, justification, etc.).</p>	<p><b>SSDD/ICD are (at least partially) generated</b> from the Arcadia LA/PA models.</p> <p>Engineering data is extracted from the model to feed engineering specialties models and vice versa. Early design validation is performed with <b>simulation techniques</b>.</p>
FO REQ					
CO CON		<b>4. MANAGE VARIABILITY AND REUSE</b>	<p>Models of reusable assets and of product architecture exist and are known. They are mainly <b>used for documentation purpose</b>. Feature models describe the product variability and standard configurations</p>	<p><b>Models of reusable assets are rigorously governed</b> and managed in configuration, they are assembled in solution architecture models. <b>Architecture models are mapped to feature models</b>, they help <b>capture, strengthen, and optimize</b> product variability and configurations.</p>	<p>Project models are <b>automatically initialized or derived</b> from feature models and architecture models</p>

# Orientation and assessment



10 000 feet



1 000 feet



10 feet

# Orientation and assessment

1. Analyze context, identify relevant activities

2. Answer orientation/assessment questions (10 000/1000/10)

3. Get a quick and visual overview/progress status of the MBSE footprint in engineering practices

S  
S  
A



4. Define concrete improvement actions: how can MBSE help solved specific engineering problems

1. UNDERSTAND NEED AND CONTEXT			
2. TRANSLATE NEEDS INTO REQUIREMENTS			
3. DESIGN THE ARCHITECTURE			
4. DEFINE THE APPROPRIATE BASE			
5. MAKE YOUR PRODUCT MAINTAINABLE AND MANUFACTURABLE			
6. ANTICIPATE AND PERFORM HV			
7. SAFE AND CYBER SECURED SOLUTION			
8. MASTER HW DEVELOPMENT			
9. MASTER SW DEVELOPMENT			
10. BUILD THE DEVELOPMENT STRATEGY			
11. MASTER CO- & SUB-CONTRACTING			



## 4. Organizational aspects of deployment

# Core enablers

Constant and renewed commitment from the management

Strong motivation and resilience of a network of highly skilled individuals who work together on a common goal

Sizable mentoring/coaching force



# Mantras

1. Delivering  $\neq$  Being competitive
2. Visio diagrams are not enough: You need more rigor
3. Don't seek the big bang, focus on specifics © David Long
4. Manage/monitor your modeling activities
5. Get help

# MSBE Community

**Welcome!**

Model and simulation based engineering (MSBE) is the application of rigorous, near-formal techniques to support requirements, design, analysis, verification and validation activities.

Architectural design   Detailed design, SW   Simulation   Digital Twin

What is it? What for? For who?   Getting started, getting help   Supporting tools

Newsletters   Discussions FAQ   Recent/ongoing work

Experience feedback, testimonies   Need capture, tool evolutions   Capella outside Thales

**Capella PVMT Webinar**  
Easily enrich Capella models with your own domain extensions.

**Latest news**

- Stephane BONNET: "Engineering and modeling" day @ SIX updated Oct 13, 2019 - view change
- Pierre NOWODZIENSKI: Kicking off the Simulink modeling practices workshop updated Oct 04, 2019 - view change
- Simulation and Early IVV talks @JRAL IVVQ updated Oct 04, 2019 - view change
- Stephane BONNET: Straight from China: Capella model execution and systems simulation updated Sep 27, 2019 - view change
- The spirit of Arcadia and Capella in 7 minutes created Sep 27, 2019

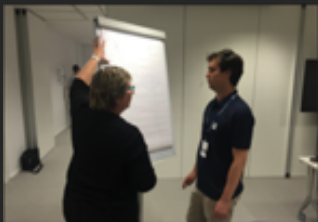
Show More

**Latest contributions**

Latest pages   Latest comments



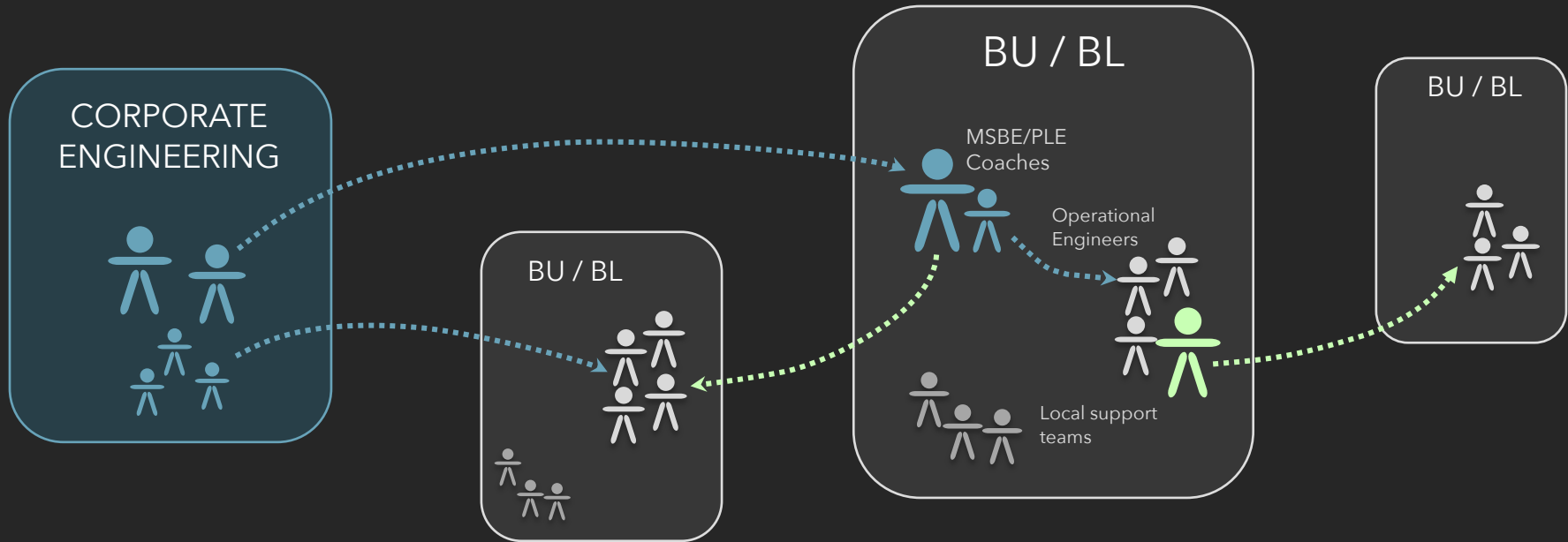
# Capella Users Days



# MSBE Services



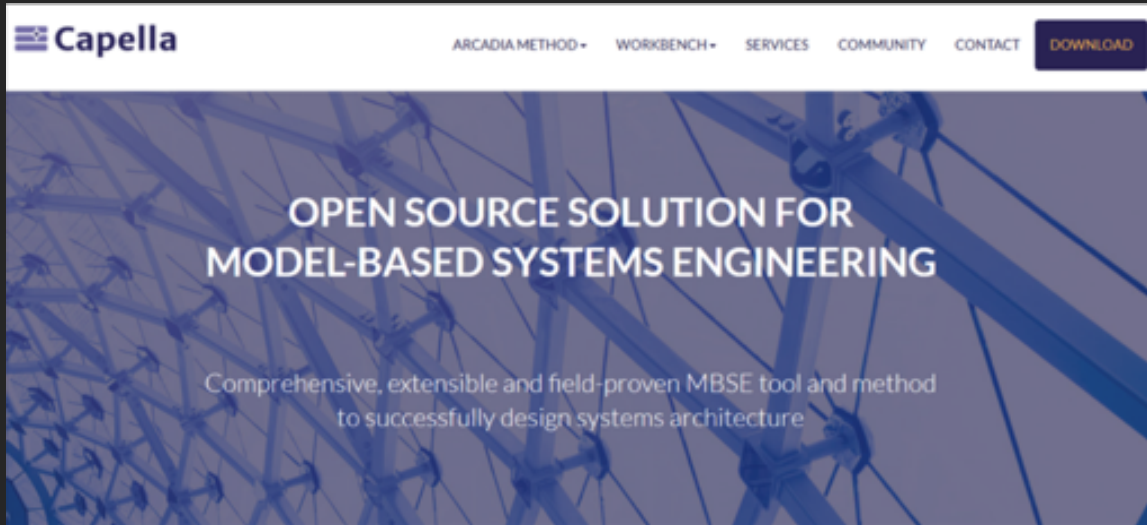
# Network of coaches





Resources

# <https://eclipse.org/capella>



Learning material

Industrial case studies

Public forum

Youtube channel  
(webinars)

Free download

# Thank you! Questions?

Capella website:

<http://www.polarsys.org/capella/>

LinkedIn 

<https://www.linkedin.com/in/capella-mbse-tool>

<https://www.linkedin.com/groups/8605600>

Twitter 

[https://twitter.com/capella\\_arcadia](https://twitter.com/capella_arcadia)