

# RMIVV Presentation

Capella days

[www.thalesgroup.com](http://www.thalesgroup.com)



## What kind of product are we talking about ?

Equipments for airborne systems

Several operational capabilities

- Tactical Reconnaissance
- Advanced Targeting

High integrated technology and processing

- High resolution sensors
- High performance image processing
- Strongly constraint by Size Weight and Power (SWAP)

Multi-disciplines engineering

- Optical
- Hardware
- Mechanical
- Thermician
- Software
- Firmware



# 1. INTRODUCTION

2. THE THEORY

3. THE PROPOSED SOLUTION

3.

## Trends for Future products

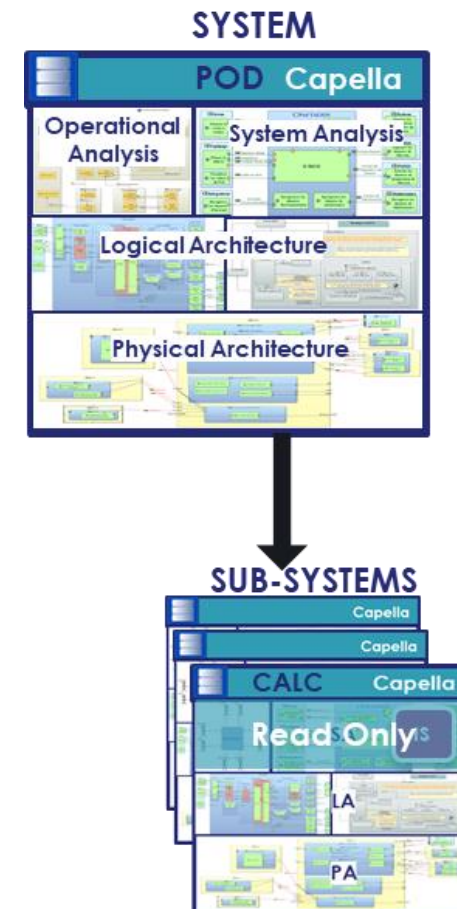
### More operational capabilities

- Detection, reconnaissance, identification, localisation
- More sensors and more imaging channels
- More functionalities and coopération
- Introduction of embedded artificial intelligence

### Several operational capabilities

- Multiple sub-systems (sensing, processing, thermal dissipation, ...)
- Highly distributed embedded systems
  - ▶ More HW boards
  - ▶ More CPUs and image co-processors
  - ▶ More algorithms to allocate
  - ▶ But in the same range of SWAP ...
  - ▶ ... and strong expectations on competitiveness

MBSE becomes essential to master complexity



1.

# INTRODUCTION

2. THE THEORY

3. THE PROPOSED SOLUTION


3.

## Engineering transformation to reach these challenges

### Promoting co-engineering activities



Based on iterative and incremental development



Based on pull-scheduling



Continuous amelioration



Collective documentary production



Search for a global optimum

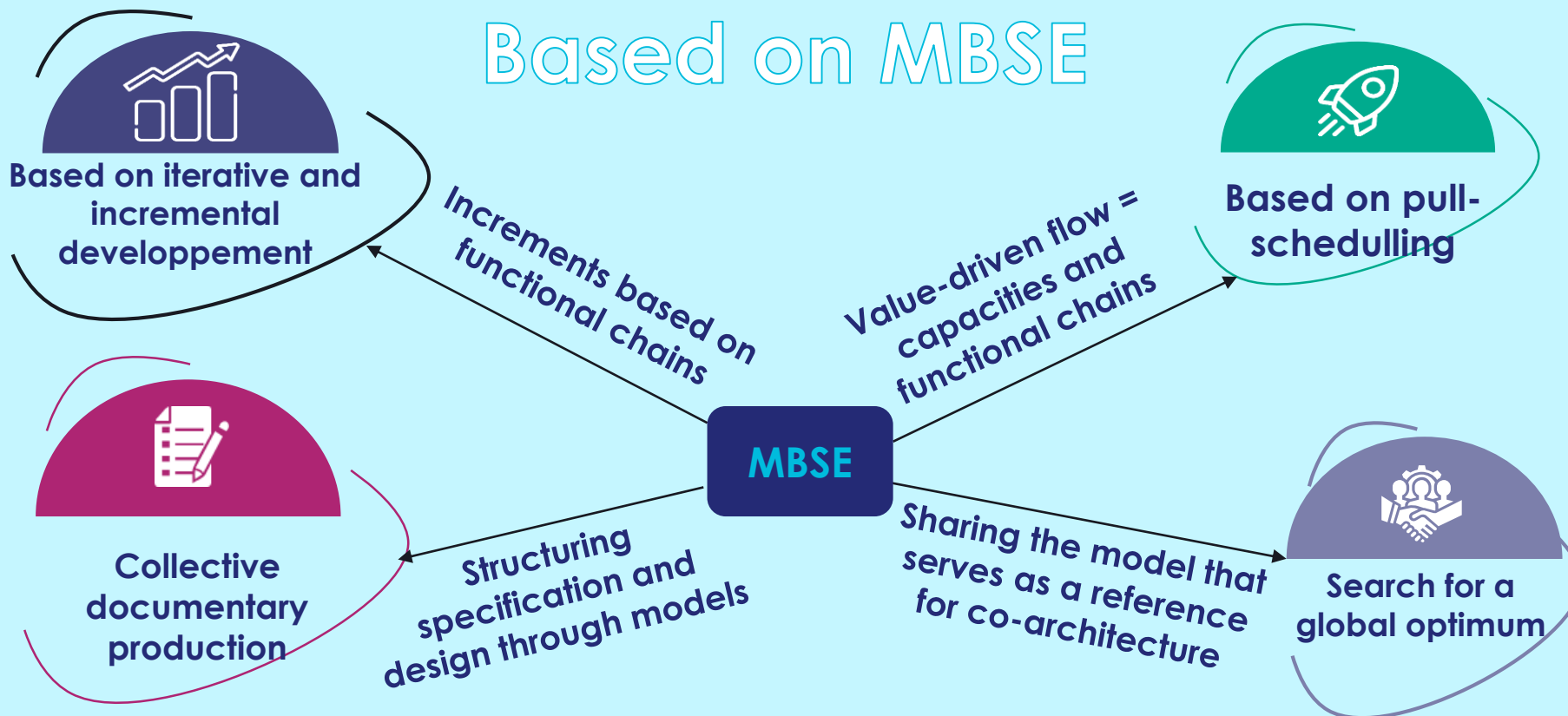


Activities synchronization

## Engineering transformation to reach these challenges

### Promoting co-engineering activities

## Based on MBSE



## IVV-Based incremental development

Capabilities and Functional chains drive the definition of the development increment content

- ▶ **An increment** is a deliverable with content that brings value to the “customer” level (in the sense of the increment's consumer). It can be applied at system, subsystems and software levels
- ▶ Its definition is driven by the value analysis of **capabilities and functional chains** from System Analysis (SA)
- ▶ The granularity of the increment can be
  - One or several functional chains end-to-end
  - A subset of functional chains

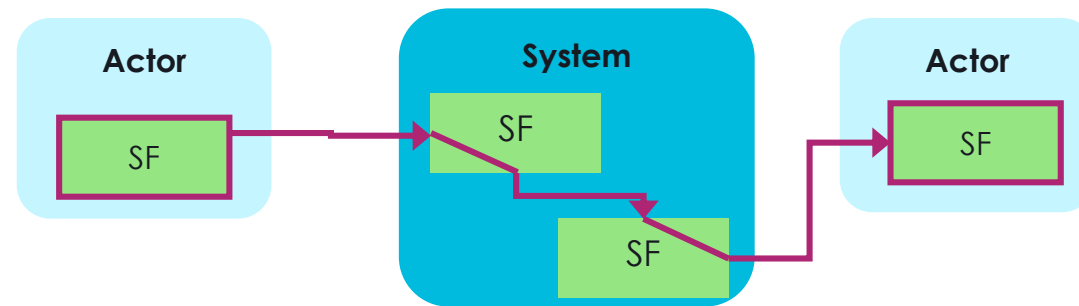
IVV shall be implied early in the functional analysis to challenge functional scenarios

- ▶ The IVV must have knowledge as soon as possible of the functional chains and associated functional scenarios
- ▶ System architect translates SA-level functional chains into logical and physical levels, and ensures traceability.
- ▶ IVV scenarios are developed by the IVV discipline on the basis of functional chains and operational scenarios.
- ▶ IVV contributes to the construction of development increments
- ▶ Functional chains and scenarios are refined at each engineering level; system and sub-system.

## Increment definition based on components

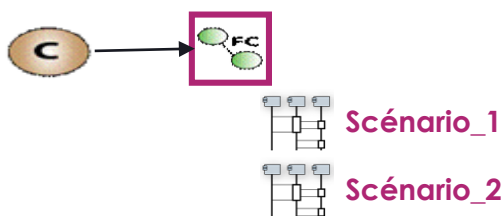


### Definition of functional chains at System Analysis level

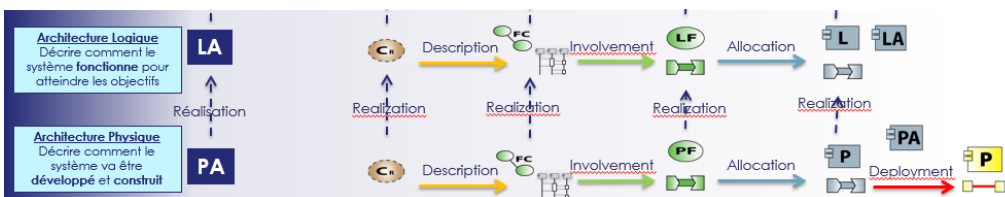


NEEDS

Identification of Capabilities and Functional chains for releases



SOLUTION



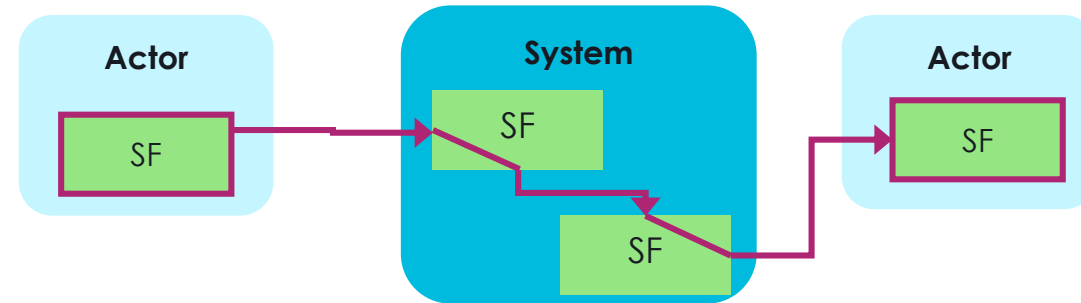
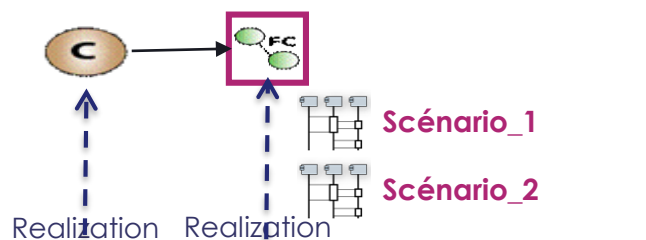
## Increment definition based on components



Definition of functional chains at System Analysis level

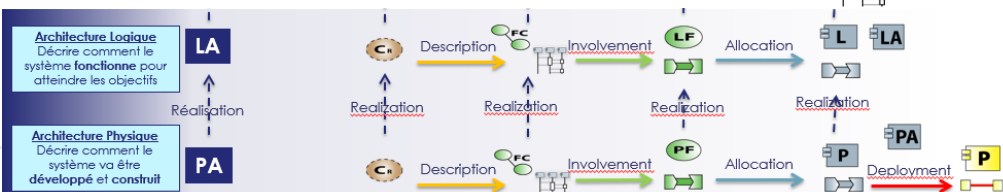
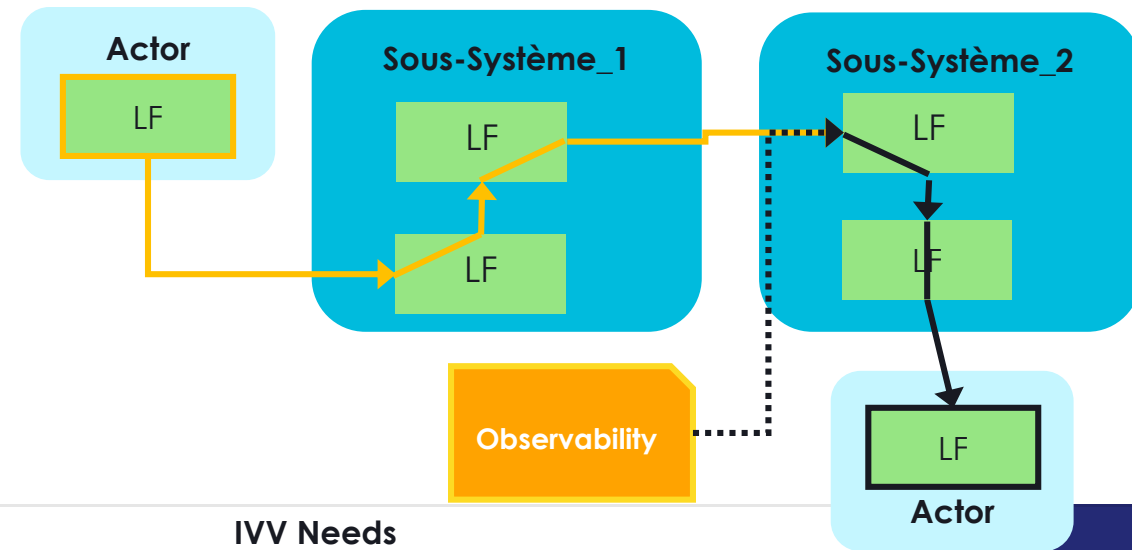
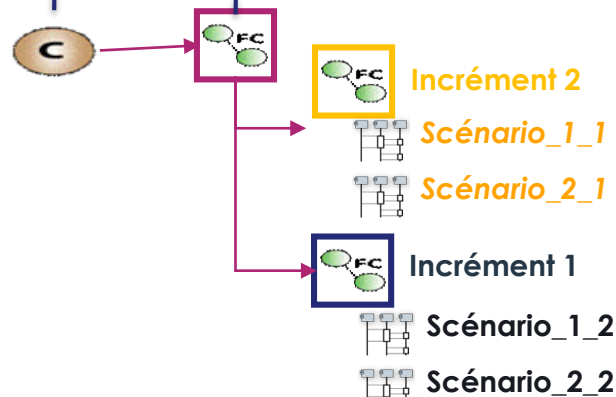
NEEDS

Identification of Capabilities and Functional chains for releases



SOLUTION

Identification of development increments to implement the releases



IVV Needs



1.

# INTRODUCTION

2. THE THEORY

3. THE PROPOSED SOLUTION

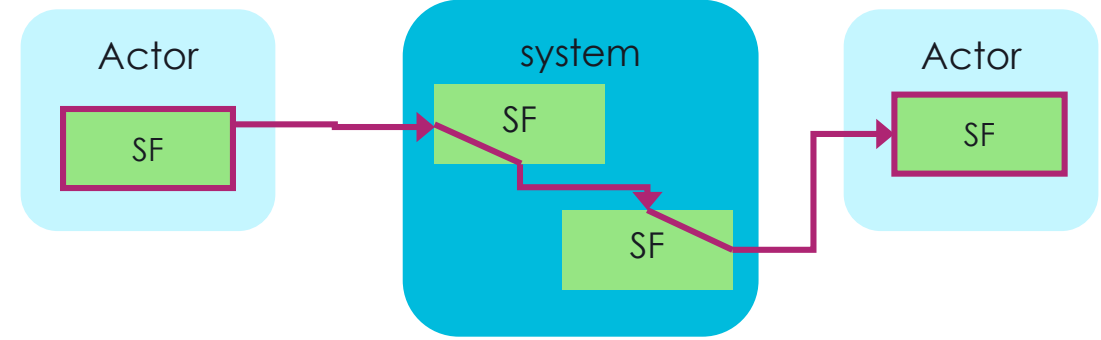
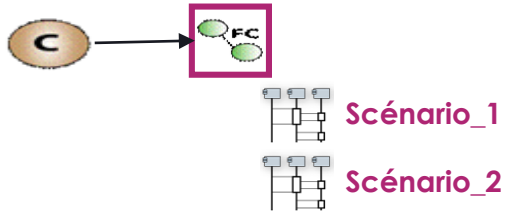
3.

## Increment definition by end-to-end FC refinement

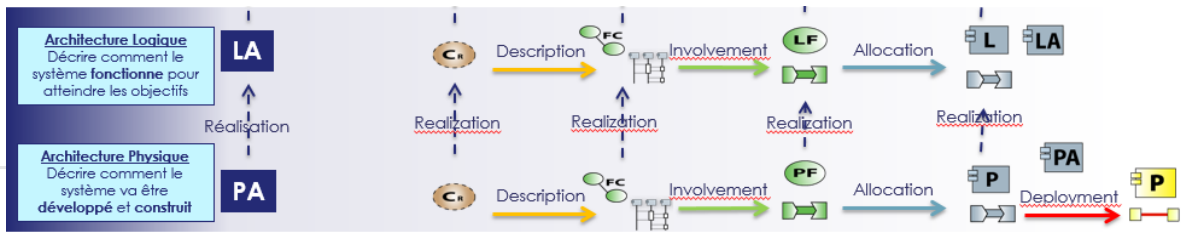
BESOIN



Identification of Capabilities and Functional chains for releases



SOLUTION



# 1. INTRODUCTION

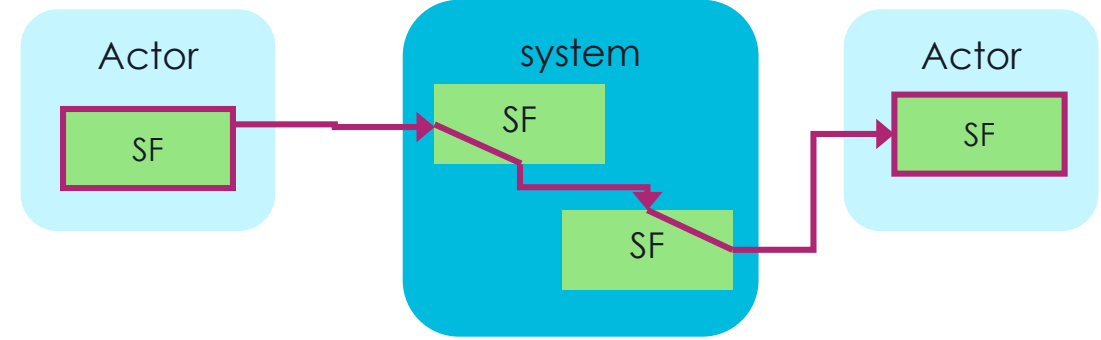
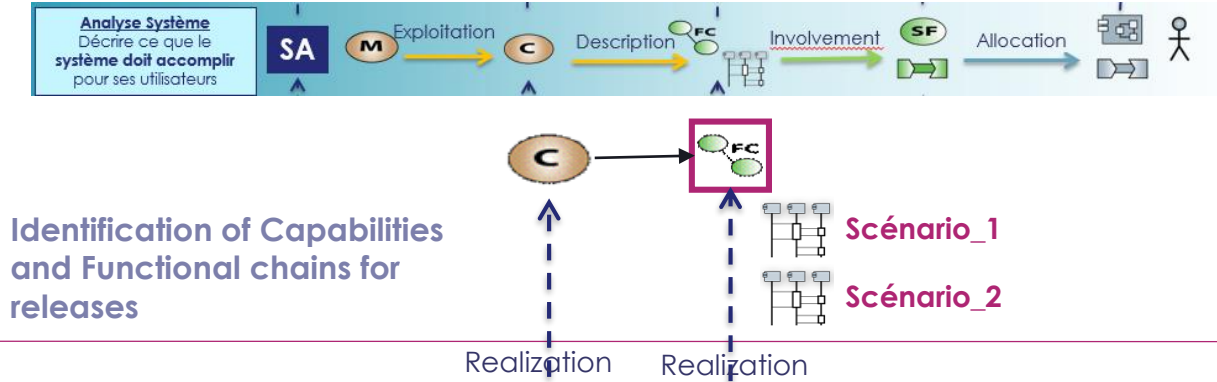
2. THE THEORY

3. THE PROPOSED SOLUTION

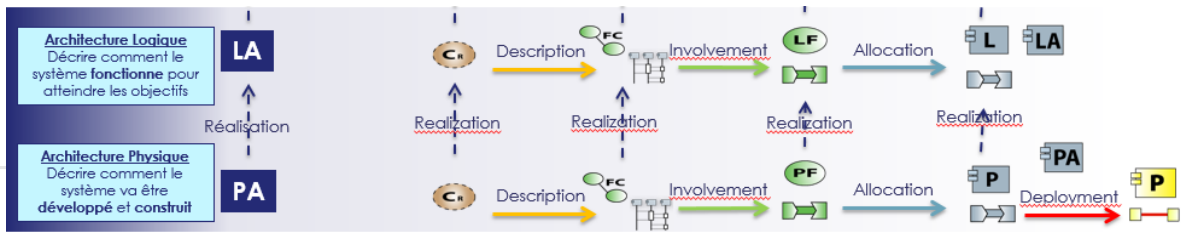
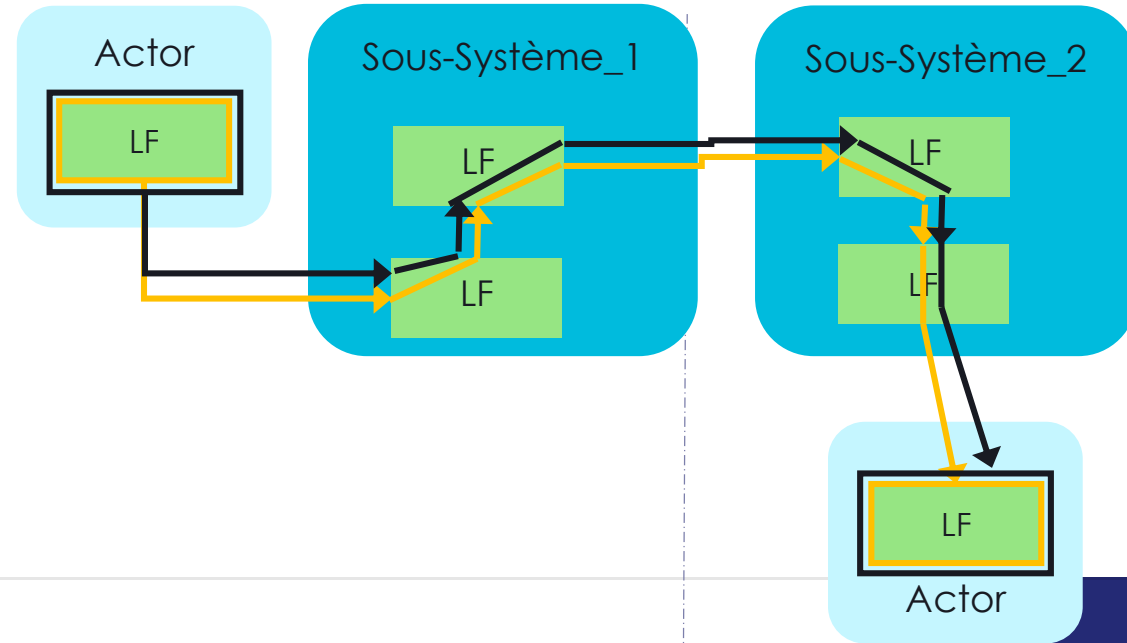
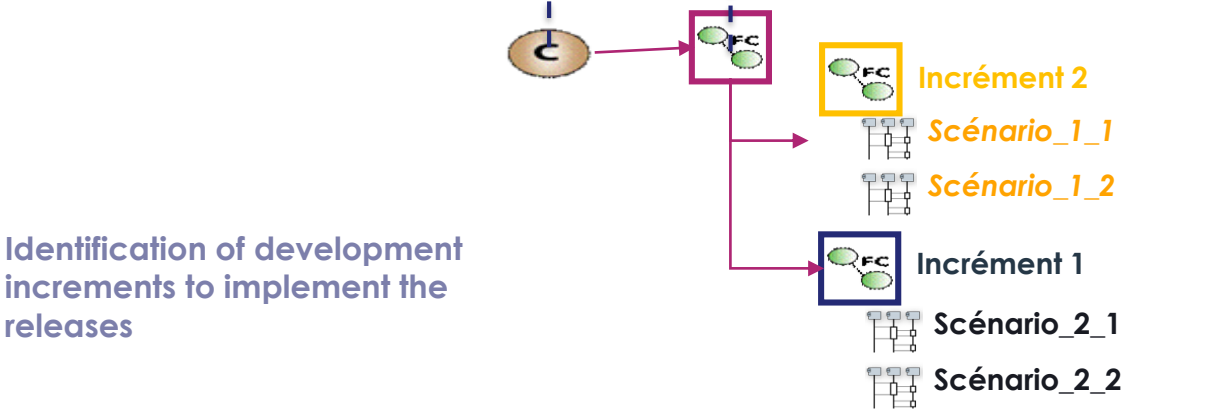
3.

## Increment definition by end-to-end FC refinement

BESOIN



SOLUTION



What is an increment?



## How to define an increment ?

### STEP 1

DEFINE WHAT IS **REQUIRED**

### STEP 2

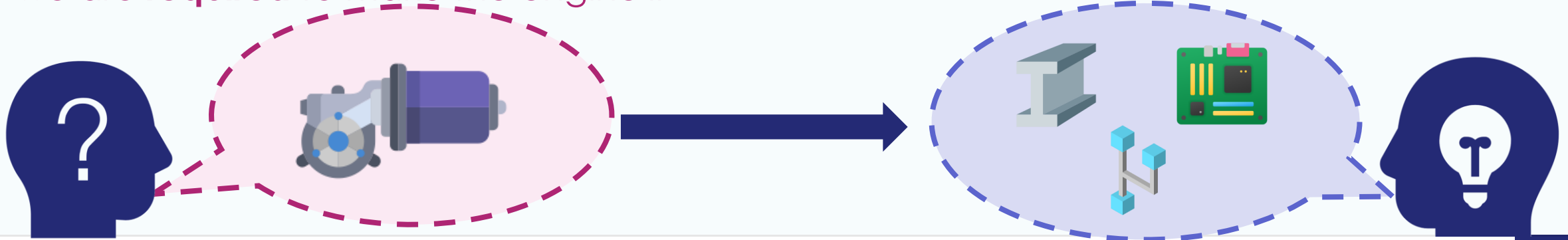
DEDUCT WHAT NEEDS TO BE **DEVELOPED**

(TO MAKE WHAT IS **REQUIRED**)

## EXEMPLE

« we want to create a car therefore we are **required** to make the engine »

« To make our car, we will **develop** these items... »



## How to define an increment?

STEP 1

**REQUIRED****=****A NEED**

STEP 2

**DEVELOPED****=****A SOLUTION**

# How to define an increment?

STEP 1

REQUIRED

=

A NEED

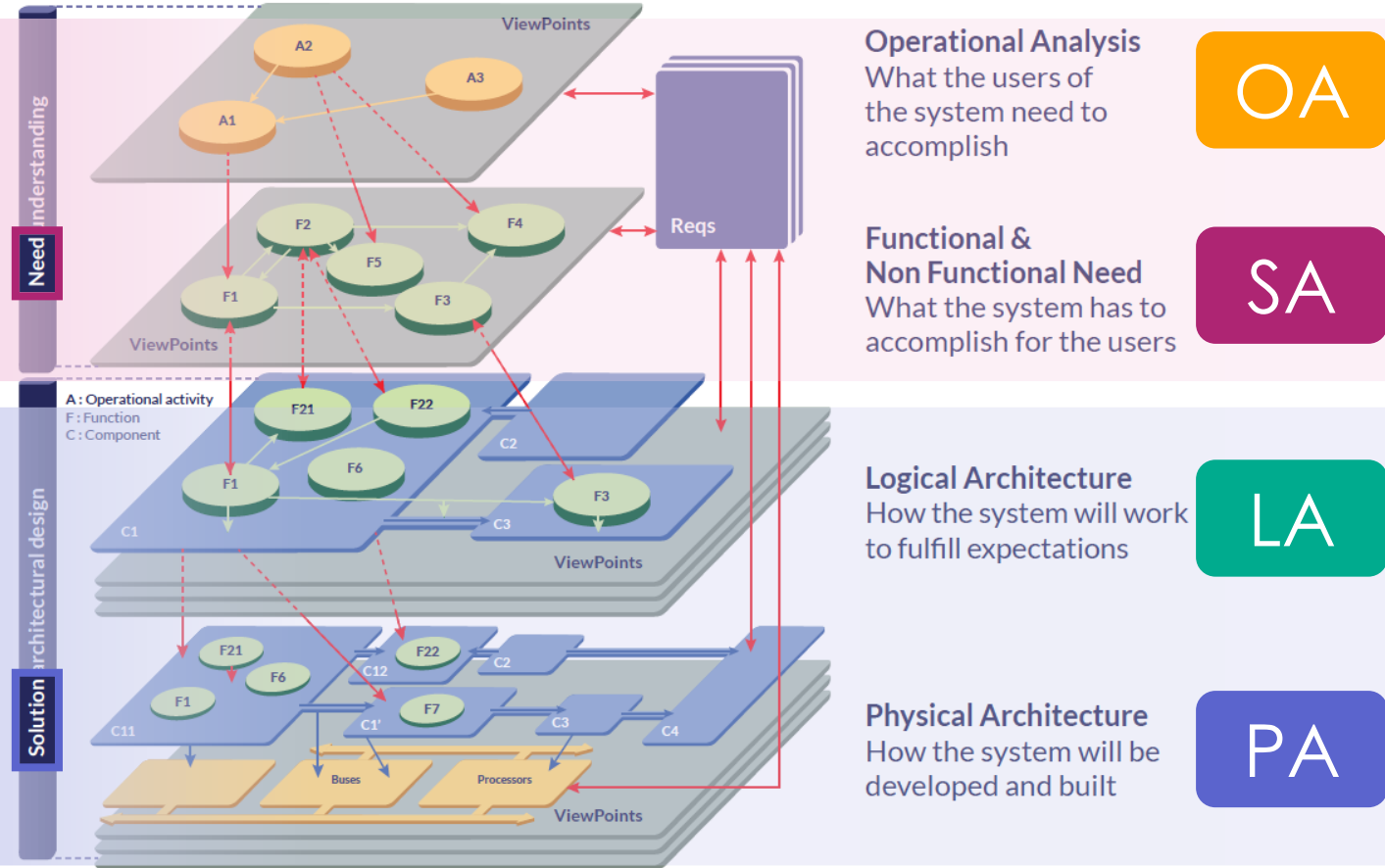


STEP 2

DEVELOPED

=

A SOLUTION



# 3. THE PROPOSED SOLUTION

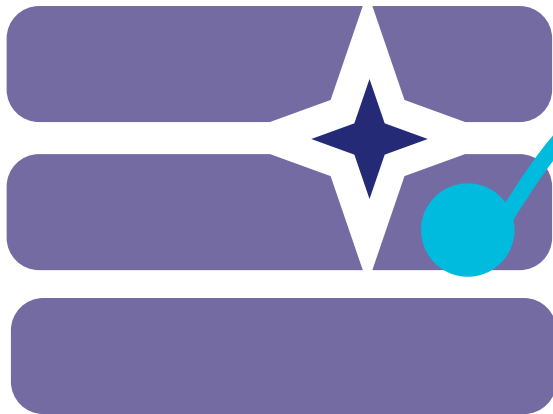
## 4. THE PLANNED PROCESS: PRACTICE



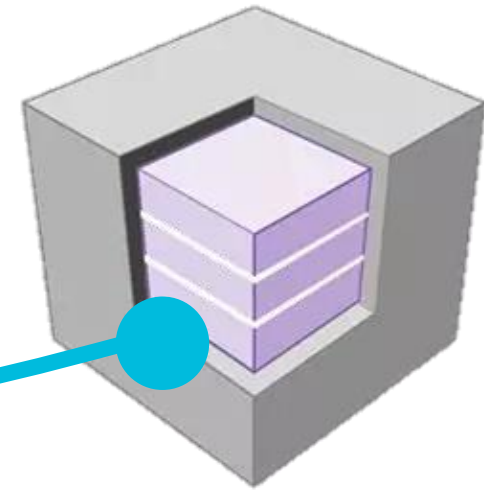
THE FACTS

→ We have 2 processes

The creation of a model  
in **Capella**



The definition of **increments**



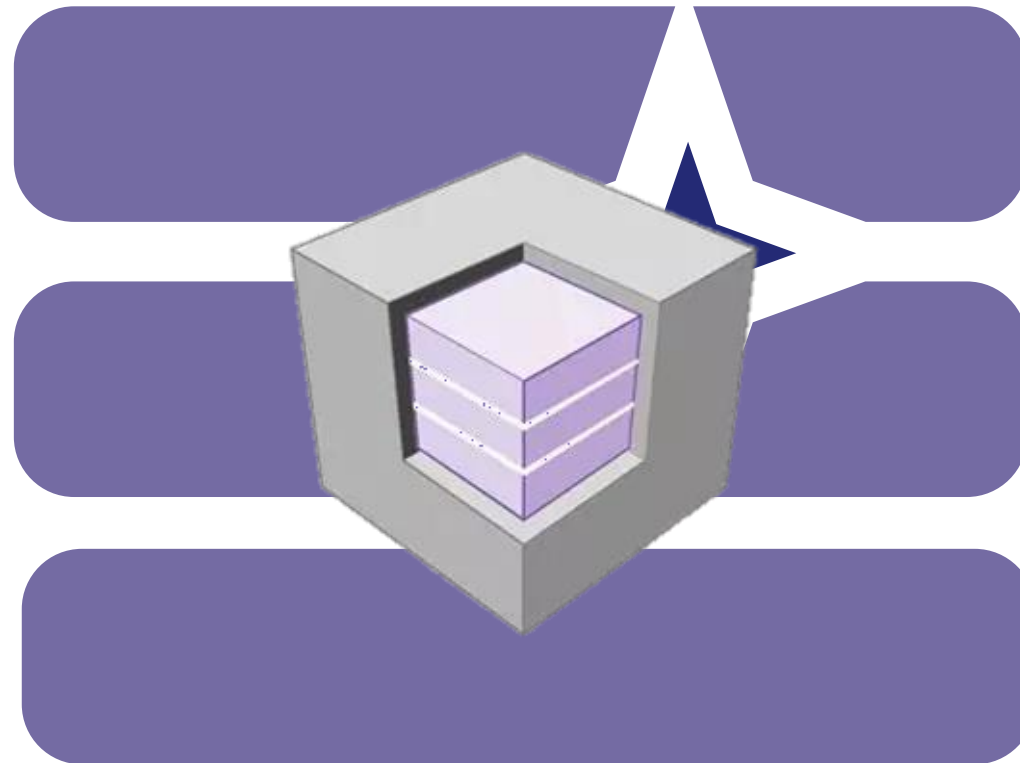
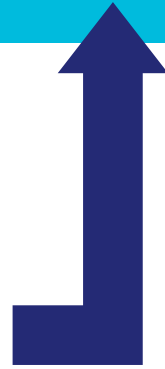
They **share** common  
concepts  
(Need/Solution)

# 3. THE PROPOSED SOLUTION

## 4. THE PLANNED PROCESS: PRACTICE

Create the increments **IN** Capella

THE IDEA



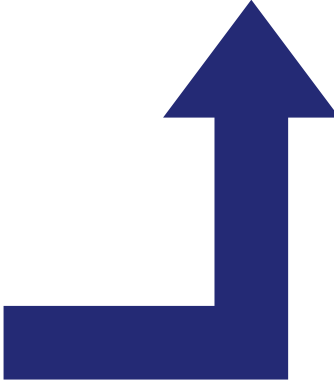


# 3. THE PROPOSED SOLUTION

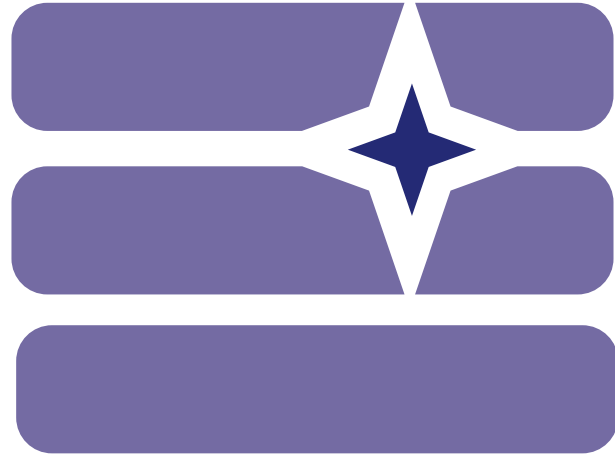
## 4. THE PLANNED PROCESS: PRACTICE

# The Add-on

# RMIVV



THE SOLUTION



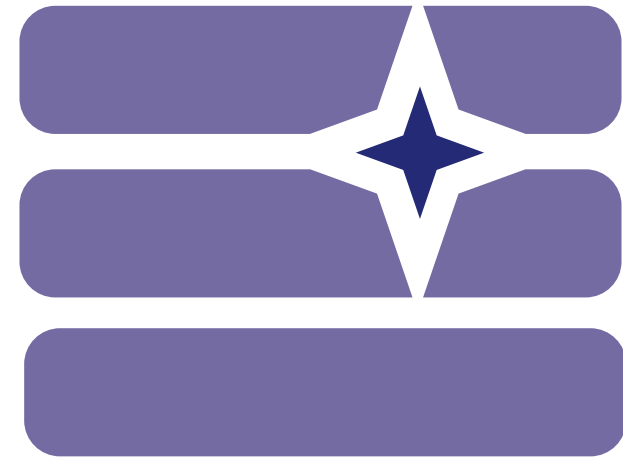
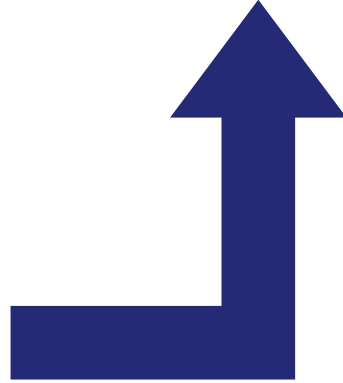
# 3. THE PROPOSED SOLUTION

## 4. THE PLANNED PROCESS: PRACTICE

### The Add-on

**R**elease **M**anagement **and** **IVV**

THE SOLUTION



# 3. THE PROPOSED SOLUTION

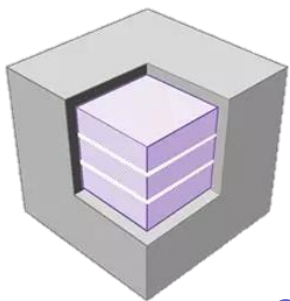
# 4. THE PLANNED PROCESS : PRACTICE

## The Add-on

### R M

Release Management

Simplifies increment creation and management



STEP 1  
REQUIRED

STEP 2  
DEVELOPED

### IVV

Provides the IVV manager with information to help him make decisions about testing

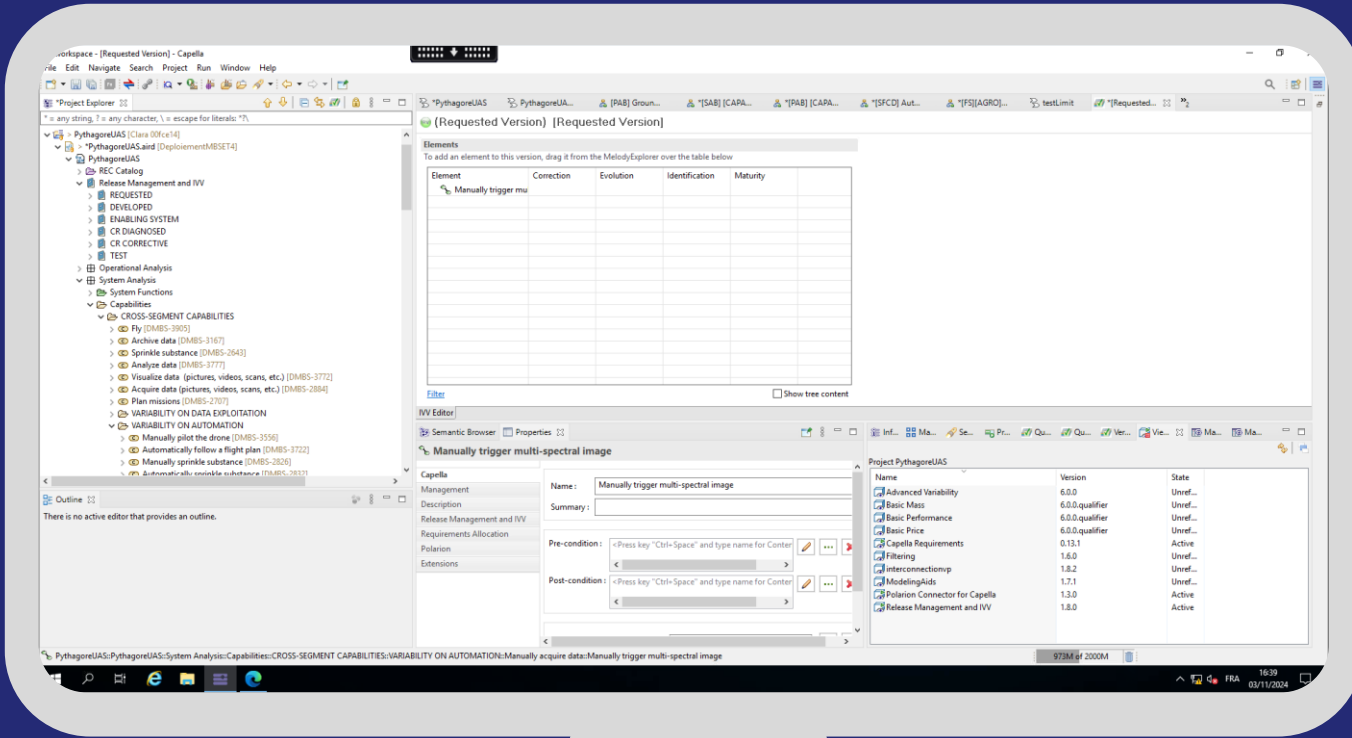


STEP 3  
TESTABILITY

and

# 4.

# THE PLANNED PROCESS : PRACTICE



We need to follow a **process** to use this add-on !

# MY RECAP

## THEORY

STEP 1

DEFINITION

Identify the  
**requested**  
elements

STEP 2

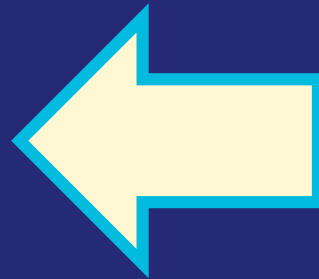
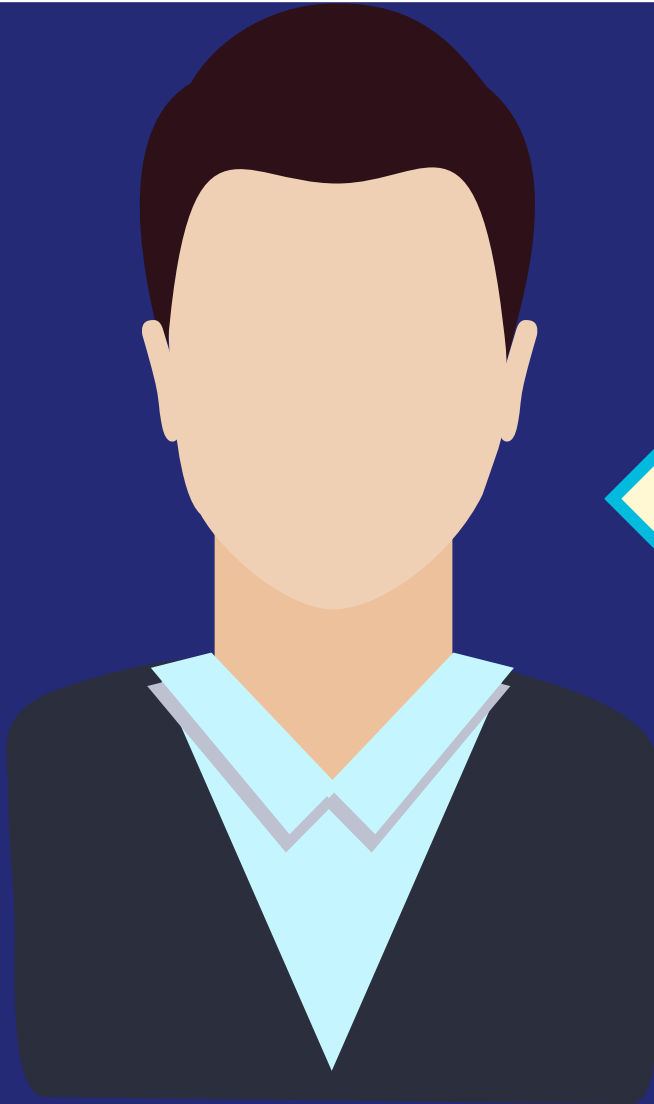
Deduce the  
**developed**  
elements

STEP 3

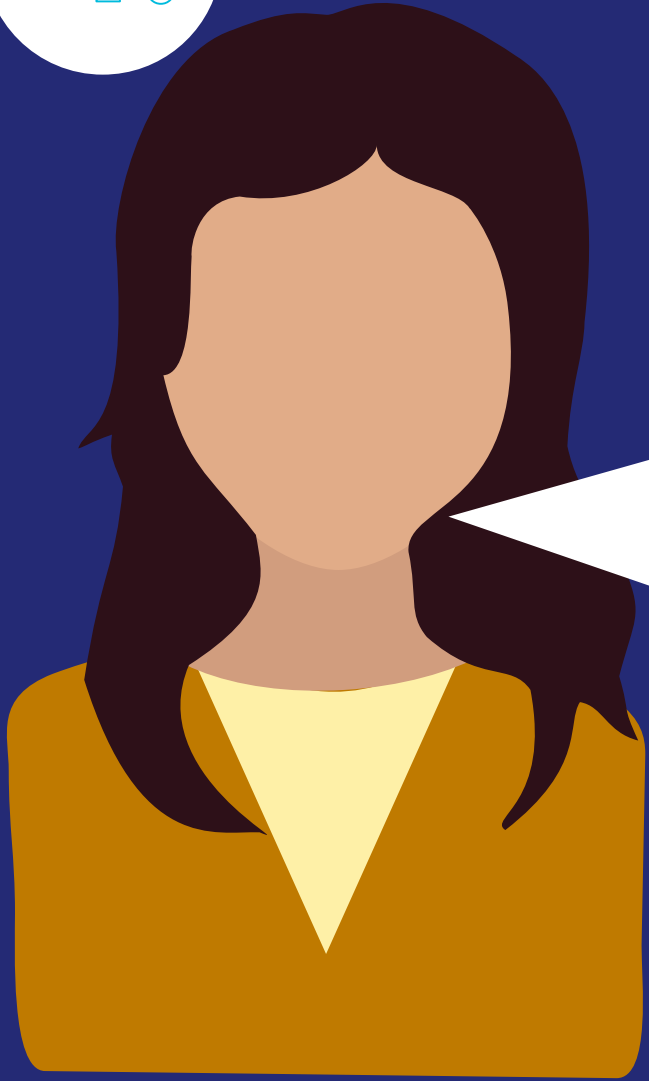
Evaluate the  
**testability**

# 4.

# THE PLANNED PROCESS : PRACTICE

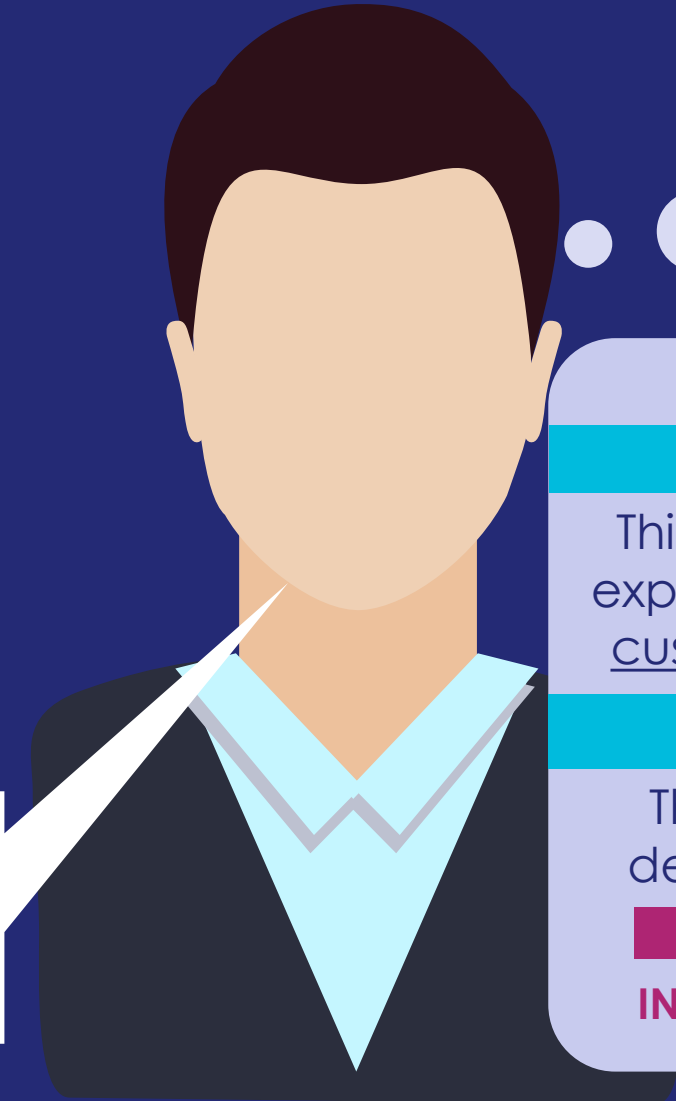


# 4. THE PLANNED PROCESS : PRACTICE



Hi!  
I'm the PDA, and I've sent you **the next release expected by the customer** we've just identified . Let's take a look at how to divide it into increments

Okay, thanks!  
I'll go and check it out right away.



**A RELEASE DEFINITION**

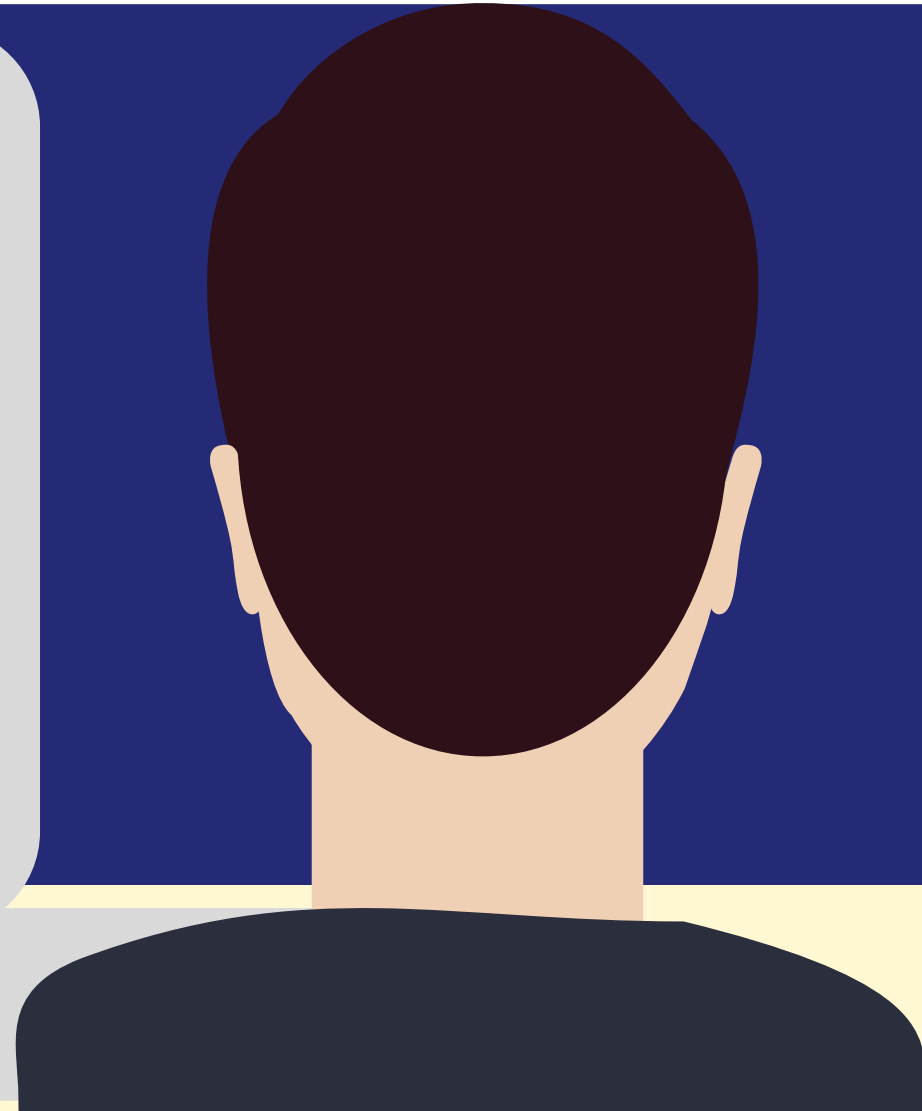
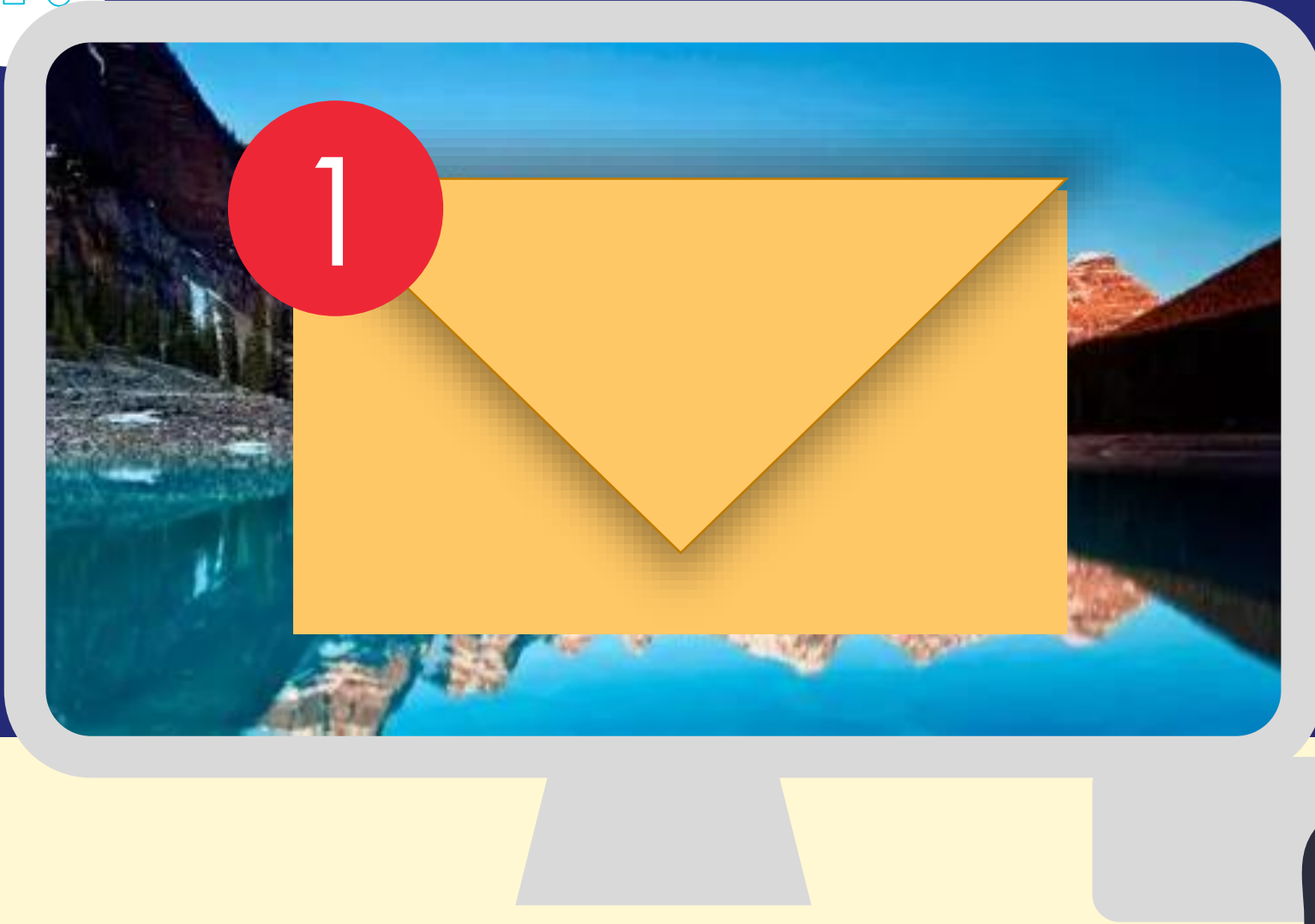
This is a major version expected either by the customer **or** internally

**ROLE**

This is the input for defining increments

RELEASE		
INC.1	INC.2	INC.3

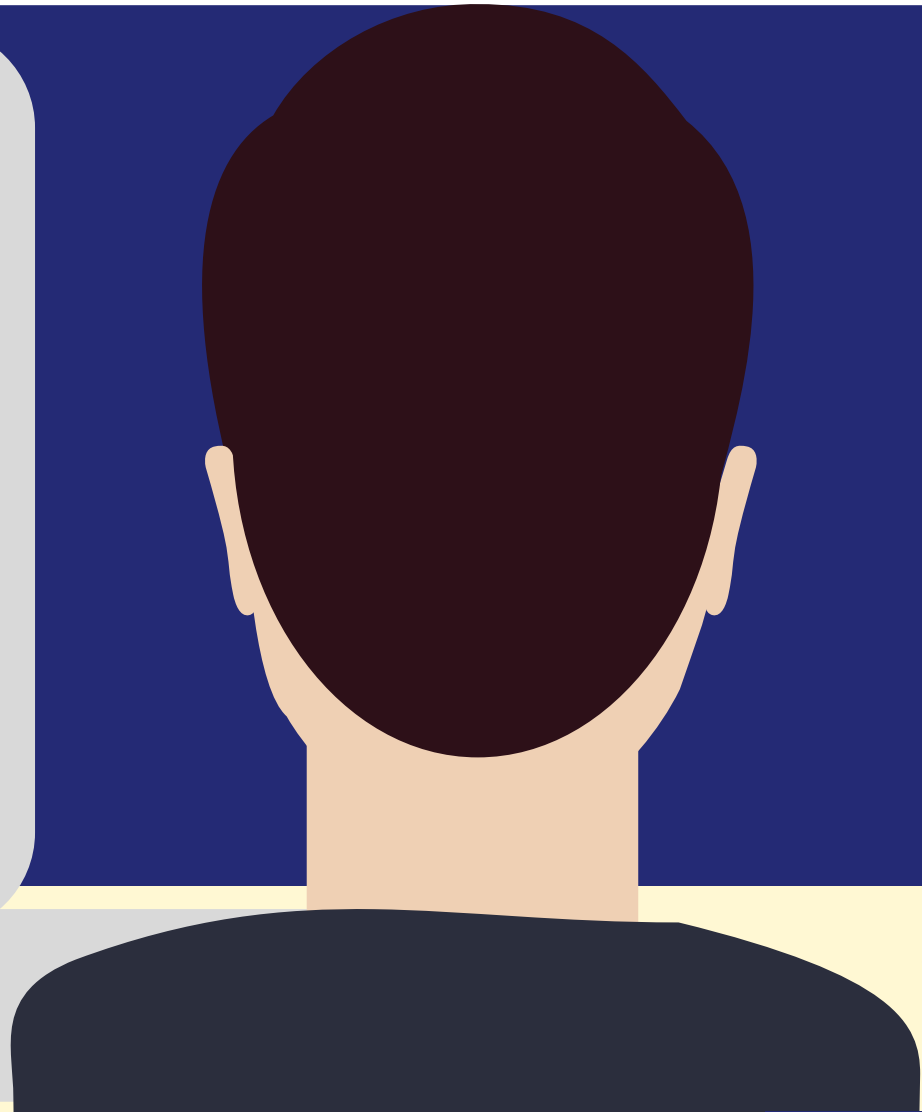
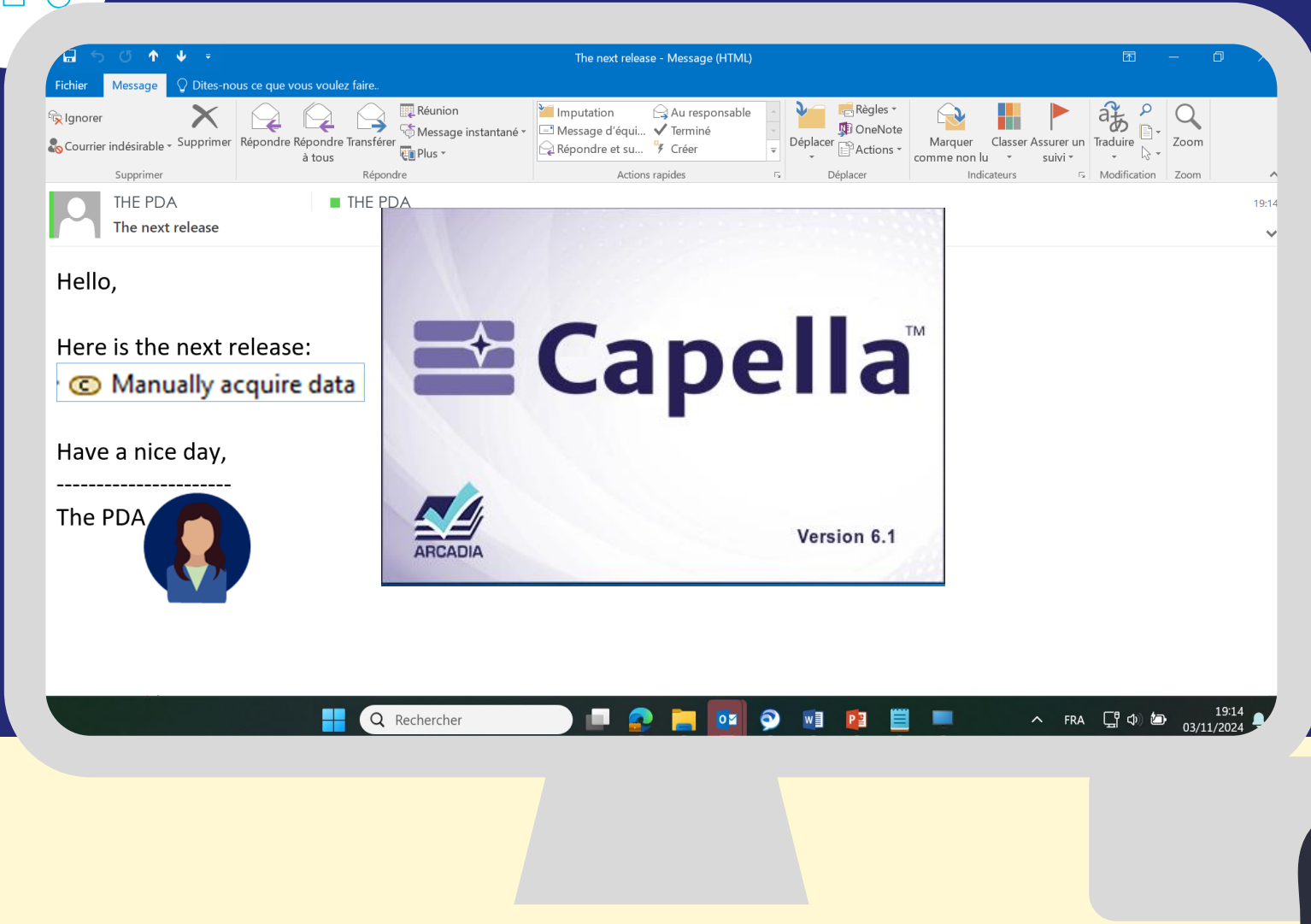
# 4. THE PLANNED PROCESS : PRACTICE





# 4.

# THE PLANNED PROCESS : PRACTICE 0.A. FIND THE RELEASE



# MY RECAP

## THEORY

## PRACTICE

STEP 0

A Identify the **release** 

DEFINITION

STEP 1

Identify the **requested** elements

STEP 2

Deduce the **developed** elements

STEP 3

Evaluate the **testability**

# 4.

# THE PLANNED PROCESS : PRACTICE 0.A. IDENTIFY THE RELEASE

**System Analysis**  
Identify the boundary of the system, consolidate requirements  
Define what the system has to accomplish for the users  
Model functional dataflows and dynamic behaviour

**Logical Architecture**  
**Develop System Logical Architecture**  
See the system as a white box  
Define how the system will work so as to fulfill expectations  
Perform a first trade-off analysis

**Physical Architecture**  
**Develop System Physical Architecture**  
How the system will be developed and built  
Software vs. hardware allocation, specification of interfaces,  
deployment configurations, trade-off analysis

**EPBS**  
**Formalize Component Requirements**  
Manage industrial criteria and integration strategy: what is  
expected from each designer/sub-contractor  
Specify requirements and interfaces of all configuration items

Okay, my capability is here.  
In the semantic browser, i can see its  
**owned functional chains**

Referencing Elements	Current Element	Referenced Elements

# MY RECAP

## THEORY

## PRACTICE

STEP 0

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

DEFINITION

STEP 1

Identify the **requested** elements

STEP 2

Deduce the **developed** elements

STEP 3

Evaluate the **testability**

# 4.

# THE PLANNED PROCESS : PRACTICE 1.A. VERIFY THE MODEL

The lines are filled, they should be empty!  
This means that some of the realization links are missing.  
I'll let the architect know and he will correct it.

**Operational Analysis**  
Define Stakeholder Needs and Environment  
Capture and consolidate operational needs from stakeholders  
Define what the users of the system have to accomplish  
Identify entities, actors, roles, activities, concepts

**System Analysis**  
Formalize System Requirements  
Identify the boundary of the system, consolidate requirements  
Define what the system has to accomplish for the users  
Model functional dataflows and dynamic behaviour

**Logical Architecture**  
Develop System Logical Architecture  
See the system as a white box  
Define how the system will work so as to fulfill expectations  
Perform a first trade-off analysis

**Physical Architecture**  
Develop System Physical Architecture  
How the system will be developed and built

FC	F	First	Occurrence	Provenance
avoidance	Manually control drone motion and orientation with obstacle avoidance	Constitute obstacles	premier 3	direct
		Implement obstacle avoidance	0 3	direct
		Manually control the drone trajectory	0 1	Manually control drone motion and orientation
		Move and orient drone	dernier 4	Manually control drone motion and orientation
		Process manual motion orders	0 1	Manually control drone motion and orientation
Manually trigger 3D image acquisition	Is the object of study	premier 5	Acquire 3D image	
	Scan	0 3	Acquire 3D image	
	Visualize, analyze and manually control the mission execution	0 11	direct	
Manually trigger HD image acquisition	Capture still images	0 5	Acquire HD image	
	Is the object of study	premier 5	Acquire HD image	
	Visualize, analyze and manually control the mission execution	0 11	direct	
Manually trigger HD video acquisition	Acquire video	0 4	Acquire HD video	

# MY RECAP

## THEORY

## PRACTICE

STEP 0

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

### DEFINITION

STEP 1

Identify the **requested** elements

A Analyze the model with : **Diagrams** + **Viatra Analysis Rules**  

STEP 2

Deduce the **developed** elements

STEP 3

Evaluate the **testability**

# 4.

# THE PLANNED PROCESS : PRACTICE 0.B. ANALYSE THE MODEL

PythagoreUAS - Capella  
Edit Navigate Search Project Run Window Help

Project Explorer  
PythagoreUAS

Workflow of PythagoreUAS

- Operational Analysis: Define Stakeholder Needs
- System Analysis: Formalize System Requirements
- Logical Architecture: Develop System Logical Architecture
- Physical Architecture: Develop System Physical Architecture

Properties Information Semantic Browser Versions

FunctionalChainAnalyzerPA Found 253

Acquire 3D image

Acquire HD image

Acquire HD video

Acquire HD video of moving element

Acquire multi-spectral image

Acquire thermal image

I notice that :

- Most of my functional chains are made up of functional **sub-chains**
- Functions are in **several functional chains**

I have already configured the rules

I want to start with the SA (System Analysis,

FC	F	Representation	0	1	direct
Acquire 3D image	Acquire 3D image	Acquire 3D image representation	0	1	direct
Acquire HD image	Acquire HD image	Is the object of study	premier	5	direct
Acquire HD video	Acquire HD video	Capture still images	0	1	direct
Acquire HD video of moving element	Acquire HD video of moving element	Is the object of study	premier	5	direct
Acquire multi-spectral image	Acquire multi-spectral image	Acquire video	0	2	direct
Acquire thermal image	Acquire thermal image	Is the object of study	premier	5	direct
		Acquire video	0	2	direct
		Is a target to follow	premier	1	direct
		Acquire multi-spectral image	0	1	direct
		Is the object of study	premier	5	direct

# MY RECAP

## THEORY

## PRACTICE

STEP 0

DEFINITION

RMIVV

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

STEP 1

Identify the **requested elements**

**RV**

=  
Requested Version

A Analyze the model with :  
**Diagrams + Viatra Analysis Rules**  

B Create and define the **RV**   
**Reminder**  
Layer: SA  
Element : FC

STEP 2

Deduce the **developed elements**

STEP 3

Evaluate the **testability**



# 4.

# THE PLANNED PROCESS : PRACTICE 1.B. CREATE THE RV

The screenshot displays a software development environment with a project explorer on the left and a main workspace. The workspace shows a 'Workflow of PythagoreUAS' diagram with four stages: Operational Analysis, System Analysis, Logical Architecture, and Physical Architecture. A blue callout box points to the first stage, stating: 'My first increment is the **Functional Chain**: Manually trigger HD video acquisition'. Below the workflow, a table lists requirements for 'liensDeRealisation\_SousChaine\_SALAPA - found 31'.

Chaine	SousChaine	ChaineNiveauSuperieur	Commentaire
Automatically control drone motion and orientation with obstacle avoidance	Compute drone attitude and altitude	Automatically control drone motion and orientation with obstacle avoidance	Lien de realisation manquant entre la SousChain
Automatically control drone motion and orientation with obstacle avoidance	Generate thrust	Automatically control drone motion and orientation with obstacle avoidance	Lien de realisation manquant entre la SousChain
Automatically trigger HD image acquisition	Acquire HD image	Automatically trigger HD image acquisition	Lien de realisation manquant entre la SousChain
Automatically trigger HD image acquisition	Acquire HD image	Automatically trigger HD image acquisition	Lien de realisation manquant entre la SousChain
Automatically trigger HD video acquisition	Acquire HD video	Automatically trigger HD video acquisition	Lien de realisation manquant entre la SousChain
Automatically trigger HD video acquisition	Acquire HD video	Automatically trigger HD video acquisition	Lien de realisation manquant entre la SousChain
Display 3D image in live	Acquire 3D image	Display 3D image in live	Lien de realisation manquant entre la SousChain
Display 3D image in live	Acquire 3D image	Display 3D image in live	Lien de realisation manquant entre la SousChain
Display acquired HD image in live	Acquire HD image	Display acquired HD image in live	Lien de realisation manquant entre la SousChain
Display acquired HD image in live	Acquire HD image	Display acquired HD image in live	Lien de realisation manquant entre la SousChain
Display acquired HD video in live	Acquire HD video	Display acquired HD video in live	Lien de realisation manquant entre la SousChain

# MY RECAP

## THEORY

## PRACTICE

STEP 0

DEFINITION

RMIVV

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

STEP 1

Identify the **requested elements**

**RV**  
= Requested Version


A Analyze the model with : **Diagrams + Viatra Analysis Rules**  

B Create and define the **RV**   
**Reminder**  
Layer: SA  
Element : FC

STEP 2

Deduce the **developed elements**

**DV**  
= Requested Version

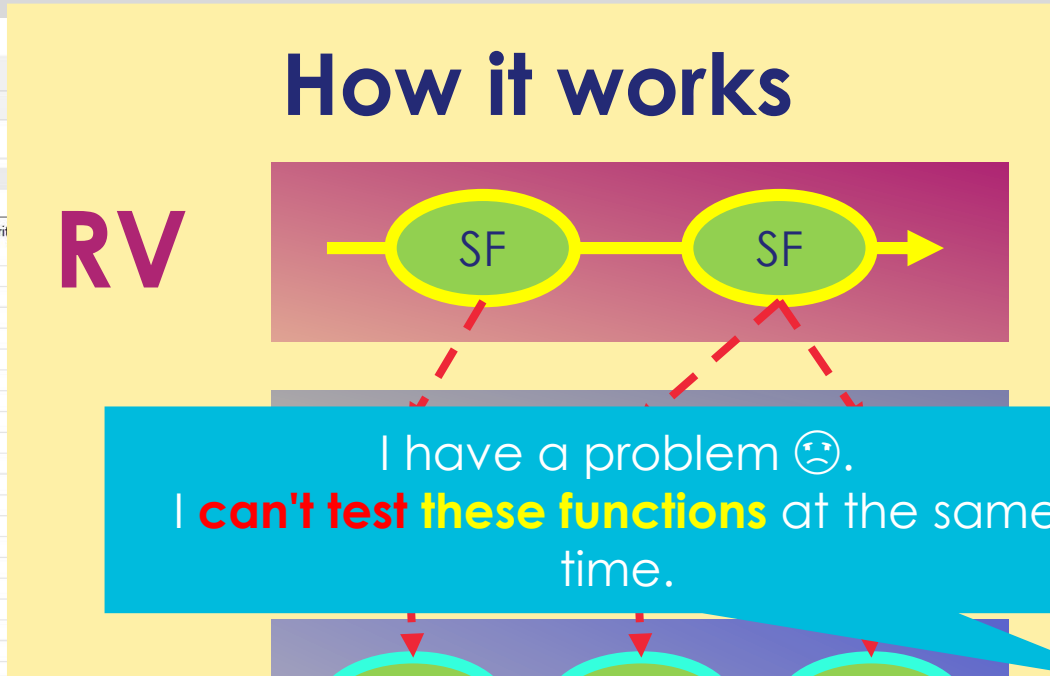
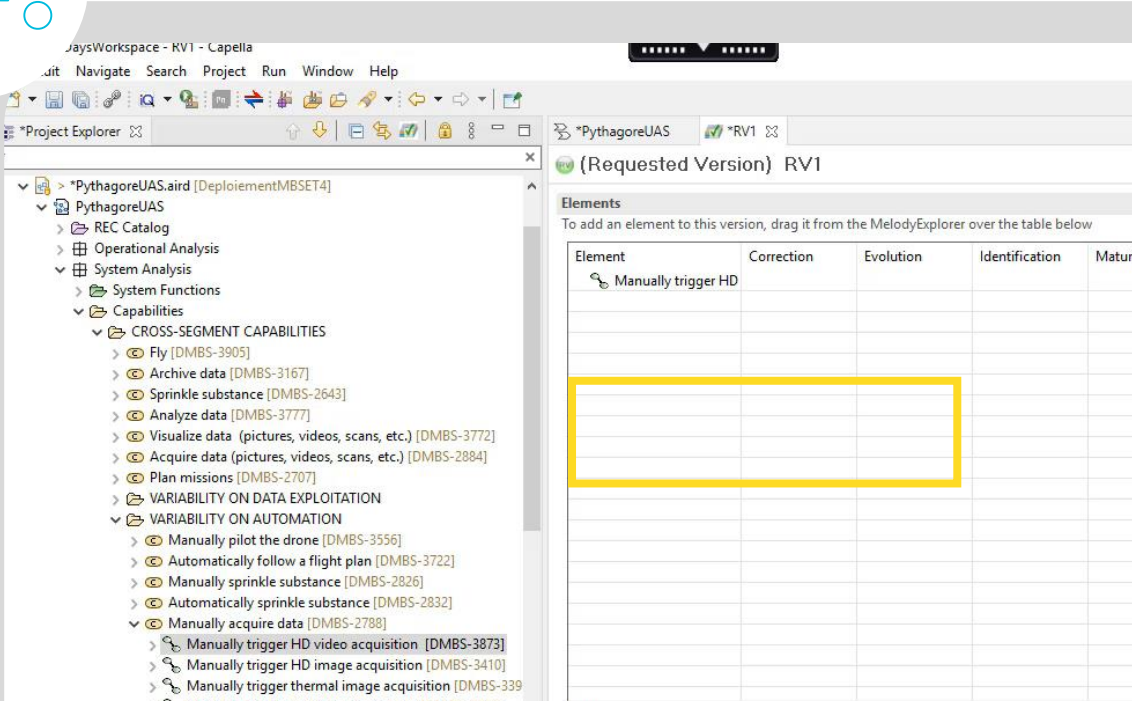
A Generate the **DV THEORIC**   
**Reminder**  
Layer: LA & PA  
Element : PC, PF, LC, LF

STEP 3

Evaluate the **testability**

# 4.

# THE PLANNED PROCESS : PRACTICE 2.A. GENERATE THE DV THEORIC



# MY RECAP

## THEORY

## PRACTICE

STEP 0

DEFINITION

RMIVV

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

STEP 1

Identify the **requested elements**

**RV**  
= Requested Version


A Analyze the model with : **Diagrams + Viatra Analysis Rules**  



B Create and define the **RV**  **Reminder**  
Layer: SA  
Element : FC

STEP 2

Deduce the **developed elements**

**DV**  
= Requested Version

A Generate the **DV THEORIC**  **Reminder**  
Layer: LA & PA  
Element : PC, PF, LC, LF

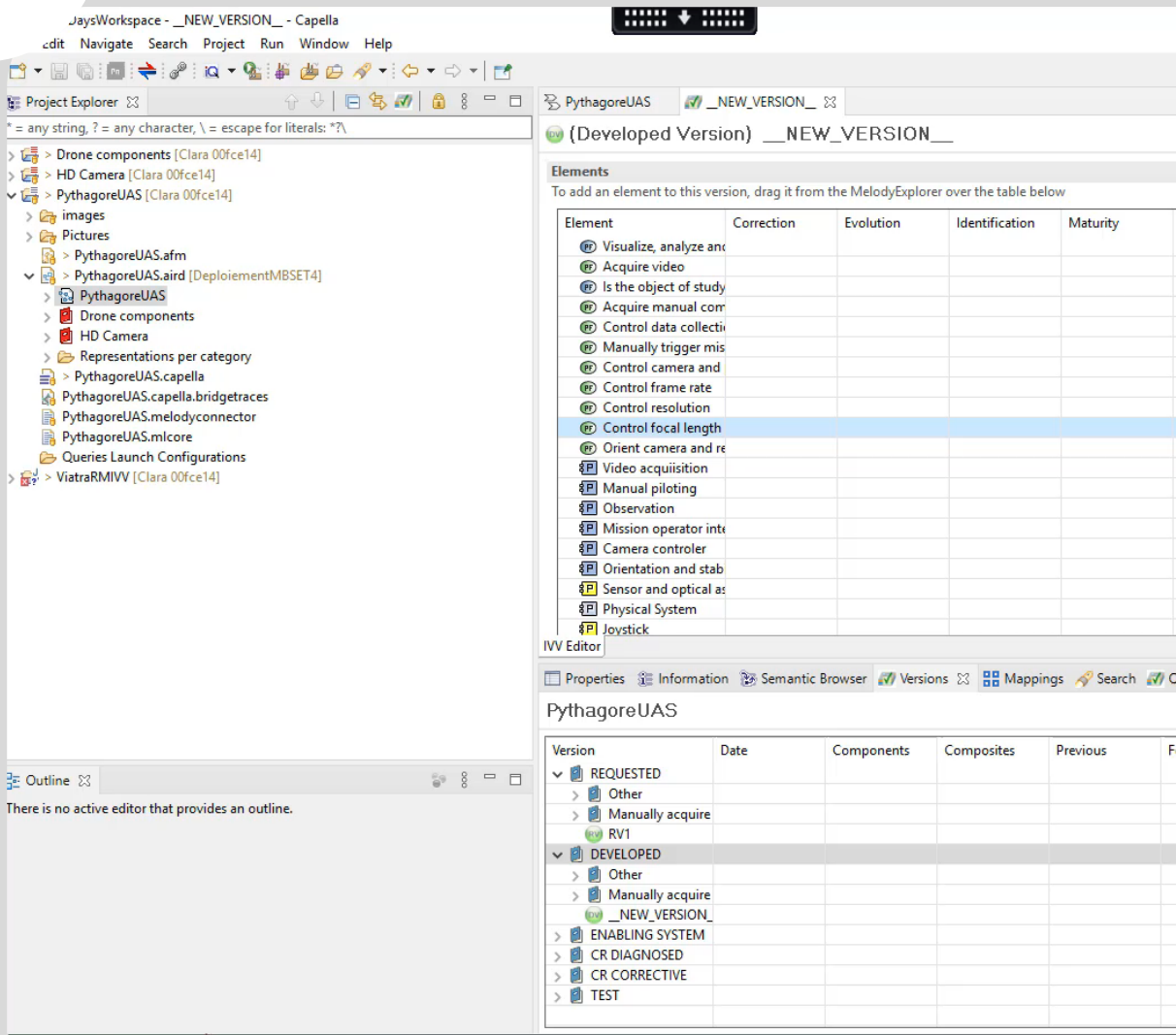
B Divide the **DV REEL**  **Reason:**  
Company constraints 

STEP 3

Evaluate the **testability**

# 4.

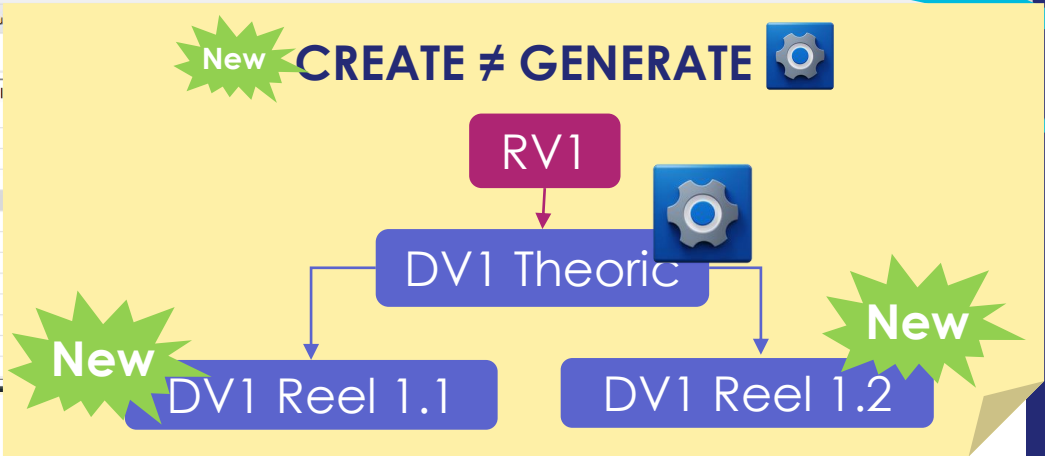
# THE PLANNED PROCESS : PRACTICE 2.B. DIVIDE THE DV REEL



I need to analyze the elements in the Developed Version (DV) with :

- Mass Visualization View
- Semantic Browser
- Diagrams

I will **create** my first Developed Version (DV) Reel (my first reel increment)



# 4.

# THE PLANNED PROCESS : PRACTICE 2.B.

**DIVIDE THE DV REEL**

For better **organization**, I need to rename my versions. It is also possible to group them

The screenshot displays the Capella software interface. On the left is the Project Explorer showing a tree structure of components like 'Drone components', 'HD Camera', and 'PythagoreUAS'. The main workspace is divided into two panes. The top pane, titled '(Developed Version) \_NEW\_VERSION', contains a table for adding elements to a version. The bottom pane, titled 'PythagoreUAS', contains a table for version management.

Element	Correction	Evolution	Identification	Maturity
Visualize, analyze and				
Acquire video				
Is the object of study				
Acquire manual com				
Control data collecti				
Manually trigger mis				
Control camera and				
Control frame rate				
Control resolution				
Control focal length				
Orient camera and re				
Video acquisition				
Manual piloting				
Observation				
Mission operator inte				
Camera controler				
Orientation and stab				
Sensor and optical as				
Physical System				
Joystick				
Drone				
Microcontroler				
Tablet				
Internal board				

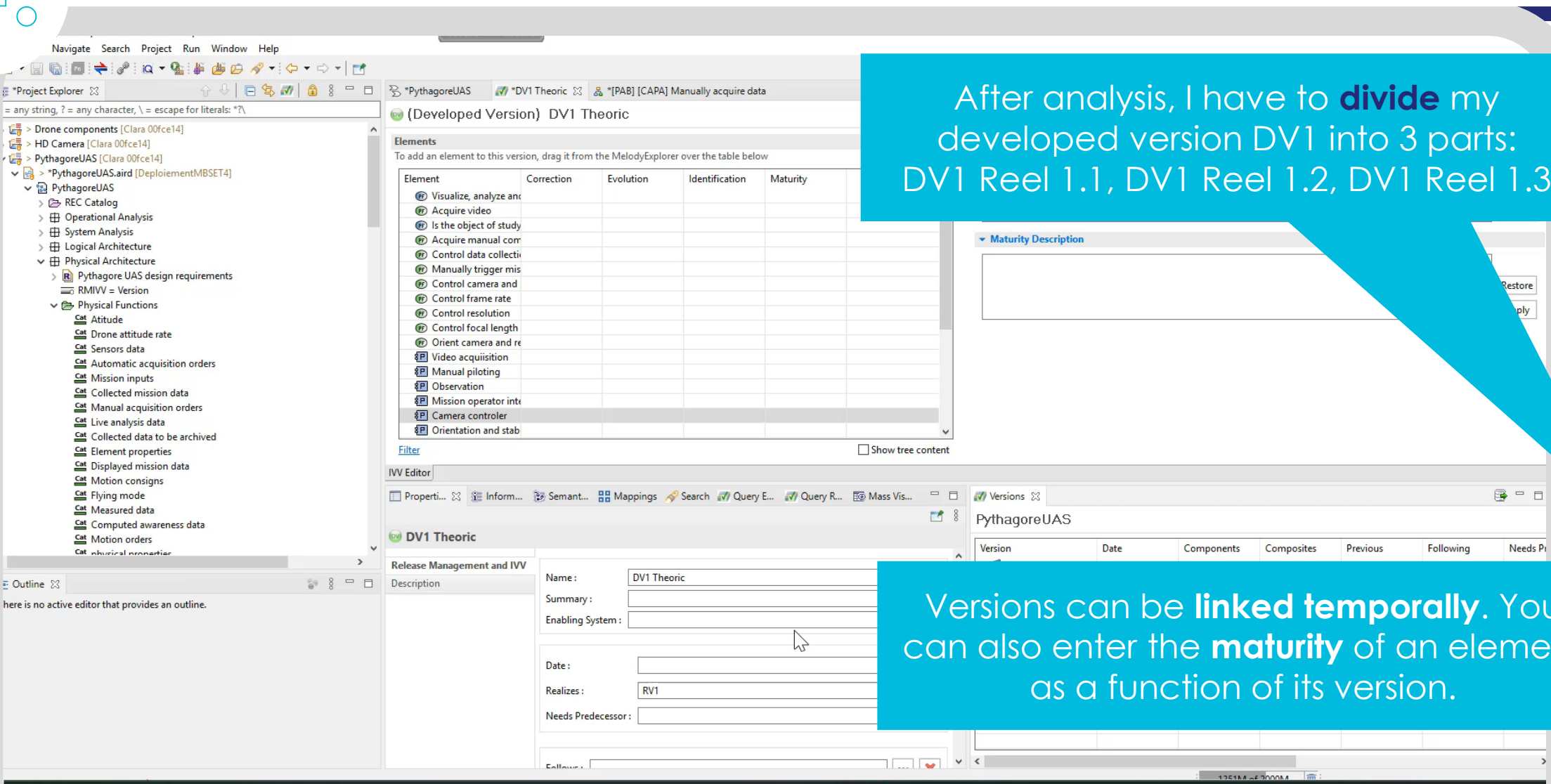
  

Version	Date	Components	Composites	Previous	Following	Needs Precede...	Realised Versio...	Raised on	CR(s) Raised	Summary	Description
REQUESTED											
DEVELOPED											
Other											
Manually acquire											
<b>_NEW_VERSION</b>							RV1				
[Developed Versio											
ENABLING SYSTEM											
CR DIAGNOSED											
CR CORRECTIVE											

# 4.

# THE PLANNED PROCESS : PRACTICE 2.B.

## DIVIDE THE DV REEL



After analysis, I have to **divide** my developed version DV1 into 3 parts: DV1 Reel 1.1, DV1 Reel 1.2, DV1 Reel 1.3.

Versions can be **linked temporally**. You can also enter the **maturity** of an element as a function of its version.

# MY RECAP

## THEORY

## PRACTICE

### STEP 0

#### DEFINITION

RMIVV

Identify the **release**



Verify that no **realization link** has been forgotten in the model



### STEP 1

Identify the **requested elements**

**RV**

=  
Requested Version

Analyze the model with :  
**Diagrams + Viatra Analysis Rules**



Create and define the **RV**



**Reminder**  
Layer: SA  
Element : FC

### STEP 2

Deduce the **developed elements**

**DV**

=  
Requested Version

Generate the **DV THEORIC**



**Reminder**  
Layer: LA & PA  
Element : PC, PF, LC, LF

Divide the **DV REEL**



**Reason:**  
Company constraints

### STEP 3

Evaluate the **testability**

**ES**

=  
Enabling System

Generate the **ES**



**Reminder:**  
need to **simulate, plug or already developed** to test this increment

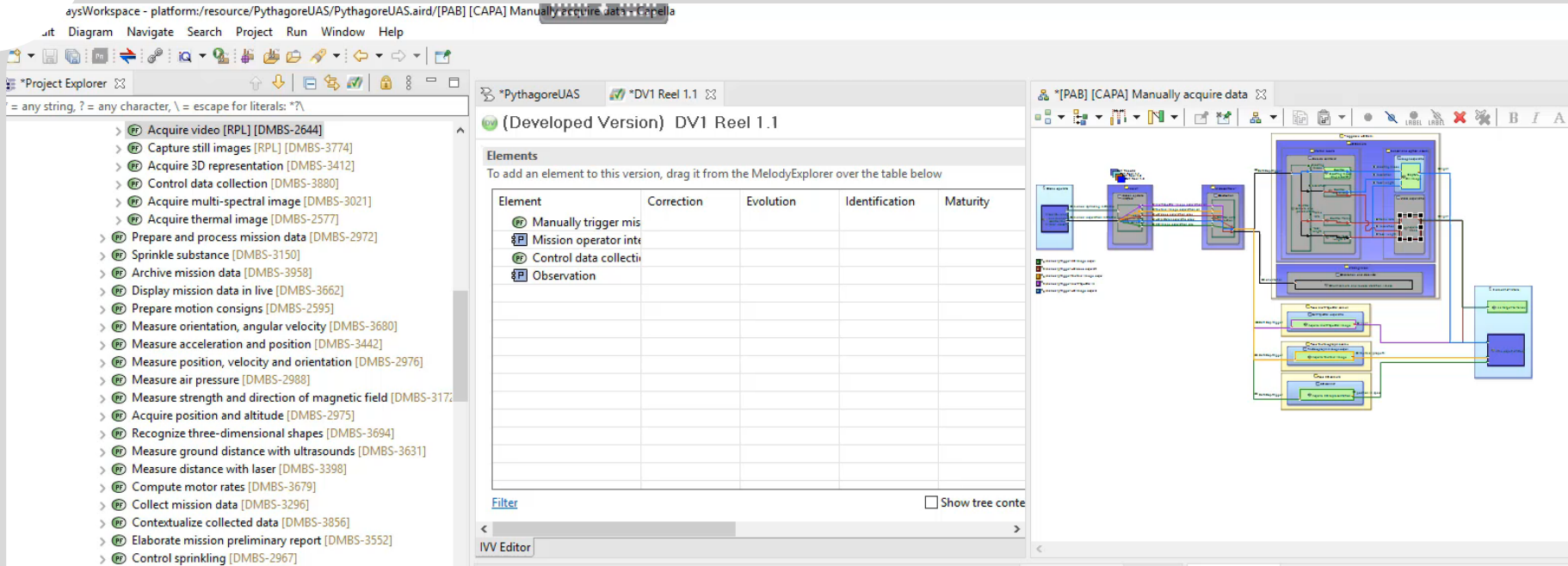


# 4.

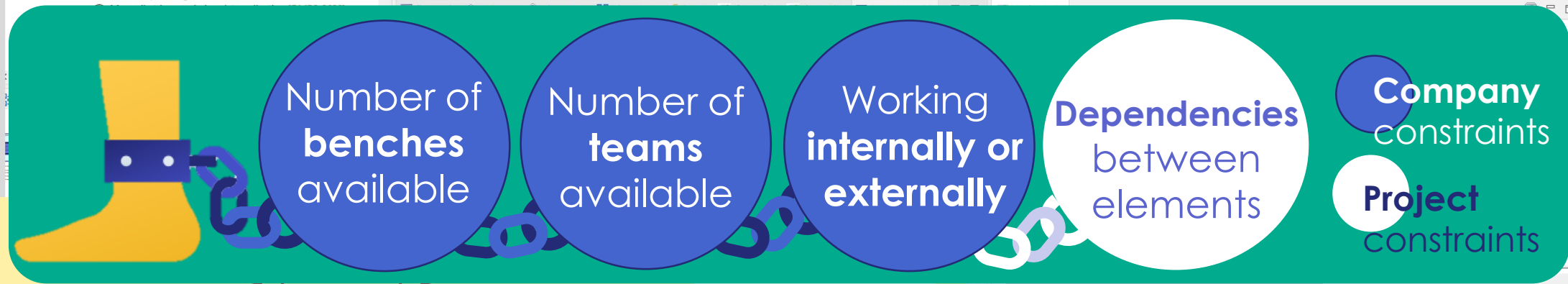
# THE PLANNED PROCESS : PRACTICE

## 3.A.

## GENERATE THE ES

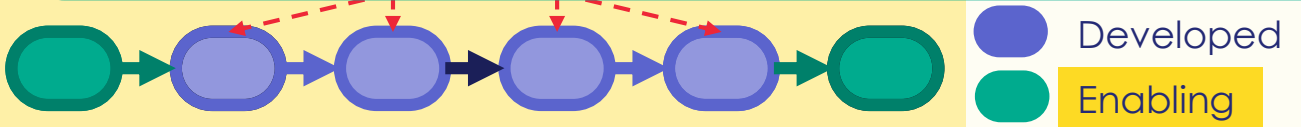


I need to generate an Enabling System (ES) per DV Reel. In the ES, we'll find the elements which have links with the elements in the DV Reel, and we'll need to simulate, plug or already developed to test this increment.



SA

PA



# MY RECAP

## THEORY

## PRACTICE

### STEP 0

A Identify the **release** 

B Verify that no **realization link** has been forgotten in the model 

### DEFINITION


RMIVV

### STEP 1

Identify the **requested elements**

**RV**  
= Requested Version


A Analyze the model with : **Diagrams + Viatra Analysis Rules**  



B Create and define the **RV**   
**Reminder Layer: SA**  
**Element : FC**


### STEP 2

Deduce the **developed elements**

**DV**  
= Requested Version

A Generate the **DV THEORIC**   
**Reminder Layer: LA & PA**  
**Element : PC, PF, LC, LF**




B Divide the **DV REEL**   
**Reason: Company constraints** 

C **Modify DV Reel** (if it's necessary)    
**Reason: Project constraints**

### STEP 3

Evaluate the **testability**

**ES**  
= Enabling System

A Generate the **ES**     
**Reminder: need to simulate, plug or already developed to test this increment**

B Analyze the model with **tools**  
**Tolls: Mass Visualization View, Diagrams, Semantic Browser, ...**

# 5. CONCLUSION

**Feedback** from an IVV manager who tested the RMIVV add-on along with his process

## **Task Simplification:**

- Information extracted from the model (time-saving)

## **Visualization:**

- Diagram colorization (better visibility)
- Visual management, and temporal aspect

## **Definition and Sharing:**

- Interest in co-engineering
- V-cycle integration

## **Export:**

- Useful for data import into other tools