



ESA-ESTECH AR/VR for Space Programs 2023

*Sim4Sys, an agile MBSE process and
tooling, to accelerate AR/VR scenarios
preparation time*

- 1. CIL4Sys Engineering overview.**
- 2. The use of Virtual Reality in design processes today**
- 3. Words from ESA on Model Based Systems Engineering (MBSE)**
- 4. Sim4Sys, an agile MBSE process and tooling**
- 5. From MBSE to Virtual Reality**
- 6. Examples of applications**
- 7. Conclusion**

CIL4Sys has created Sim4Sys, a method and toolchain proposing agile systems engineering to accelerate the development of products, services and production lines.

Skills

System
Architecture

Design with
executable
models

Simulation &
Visualization

Validation in
short loops

Automatic
generation of
documents

Model-based
systems
engineering
(MBSE)

Offers

Systems design services
Software Licenses
Premium users support
Trainings

Team

≈ 25
employees

Turnover

2 M€
2023

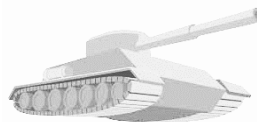
Localization

Paris
Tunis

Partners



Industries



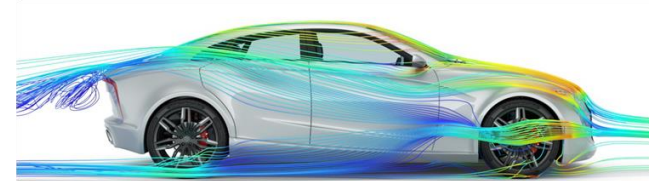
FUNCTIONAL DESIGN

Hundreds of thousands of requirements to describe and architecture the functional behaviour. The design hidden in documents, unverifiable for months. Debugging takes place late, during the integration phase



PHYSICAL DESIGN

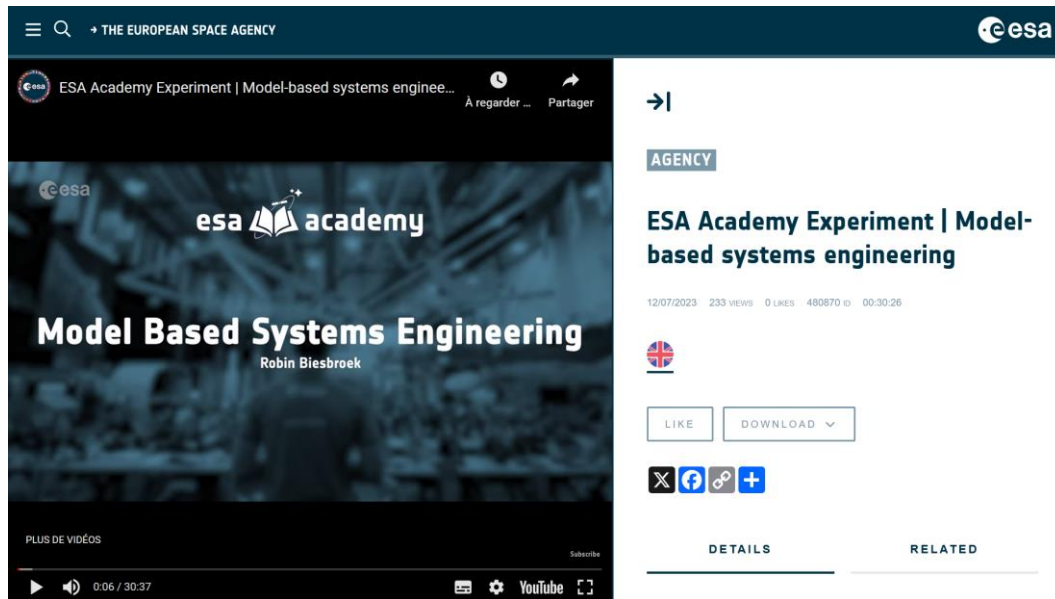
The design team can immerse themselves in the digital definition of the product and collaborate with powerful tools to verify and validate early their design choices.



The state of the art is to use virtual reality on a detailed design. VR is often used on the physical definition of a product and digital twins that reproduce the systems behavior are specific projects that come late in the programs, only when the need for trainings or operations justifies the investment.

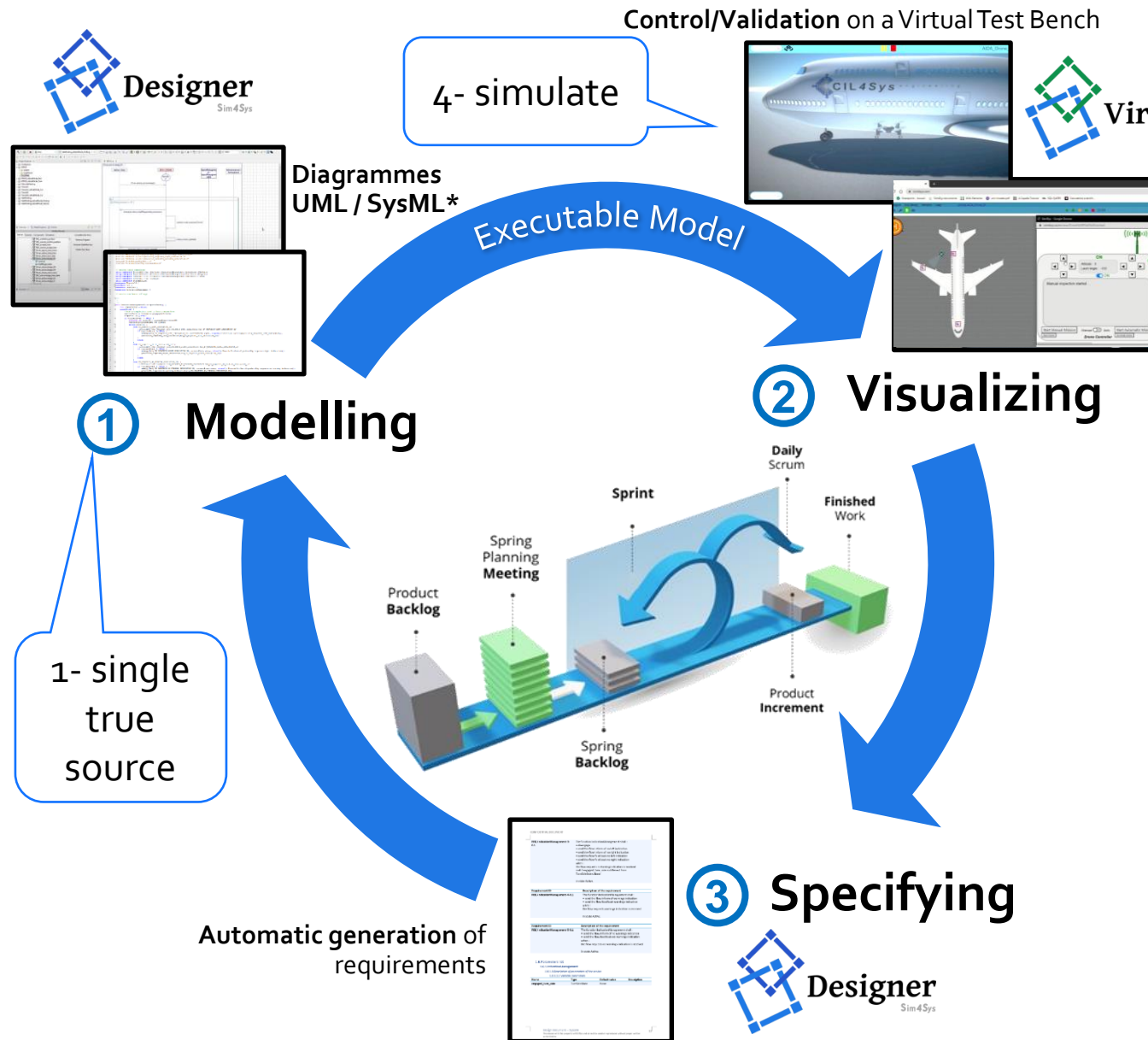
What if a Functional Digital Mockup could be executed in VR as early as the project starts ?

How can Model Based Systems Engineering allow a such goal ?



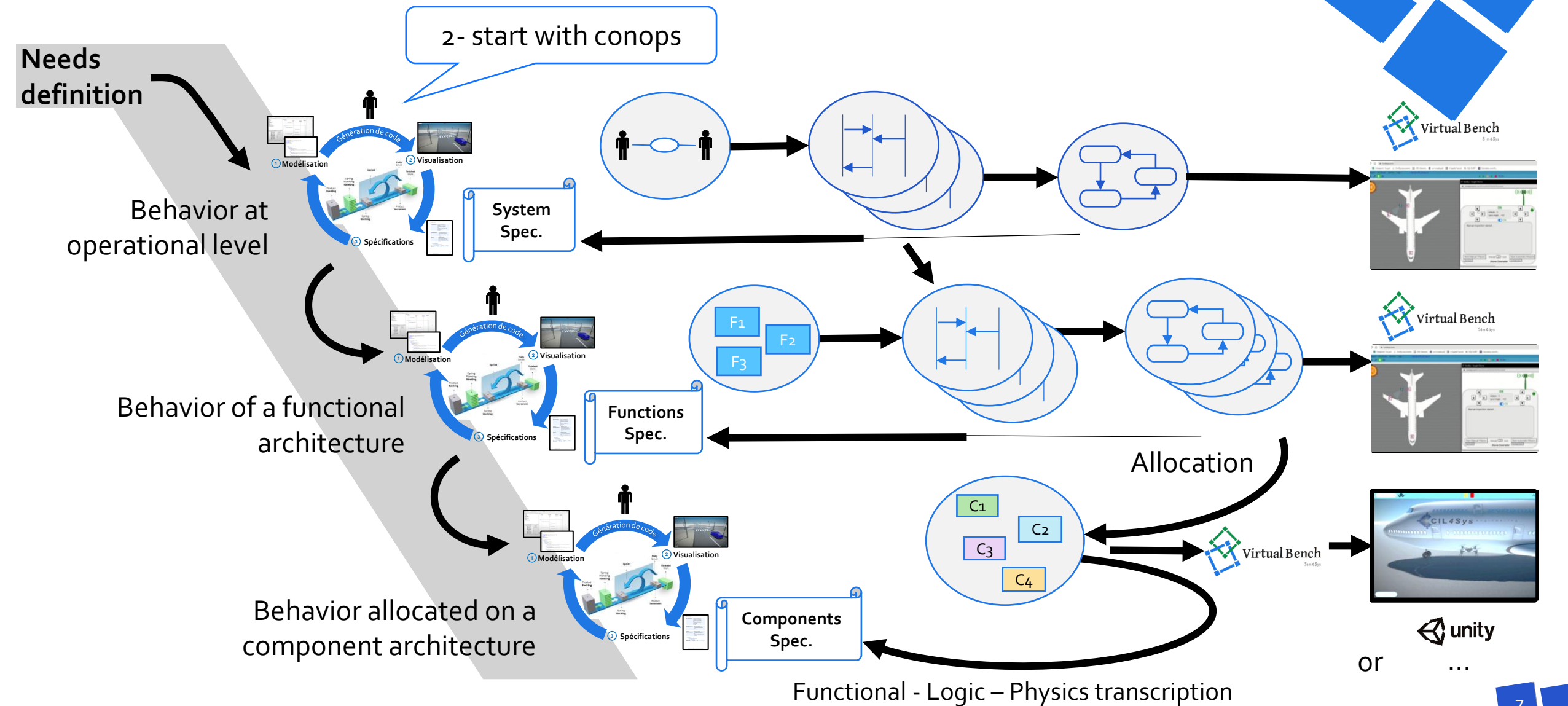
Robin Biesbroek

1. “The model should be the true source of your design, therefore not the document.”
2. “How can we start MBSE design ? [...] What we need to do is define CONOPS, a short for concept of operations.”
3. “One nice thing also about MBSE is when you define an interface [...] you can indicate what format this interface needs to be.”
4. “Another thing MBSE can do for you is to simulate.”
5. “When I look a bit ahead, possibly we would like to make things more visual.”
6. “In the future we will also see that integration could even be led by MBSE tools and we are investigating use of virtual reality [...]. It is now a bit unclear if it brings an advantage.”
7. “No matter what tool you use, they all have a steep learning curve.”



- The behavioral logic and the interactions are designed with UML / SysML diagrams *
- The use of natural language is limited to expressing the performance and the non-functional (in the "non-executable" sense) characteristics of the system.
- The behavioral requirements and the specification documents are generated automatically from the diagrams.
- After each design iteration that lasts from one to two weeks, the engineers present consistent results including:
 - ✓ A set of diagrams of the studied perimeter
 - ✓ An executable code generated with these diagrams
 - ✓ Operational scenarios in a virtual world that allow to see the behavior achieved by the executable code
 - ✓ Specification documents generated

* UML = Unified Modeling Language / SysML = System Modeling Language



CIL4Sys has developed an **overlay** on modelers of the market :

- to lower the learning curve of MBSE.
- to accelerate the work with automatization.
- to secure the model quality (ex : engineers are forced to define data types in interfaces)
- to ease code generation and execution in a virtual world

3- Interfaces format

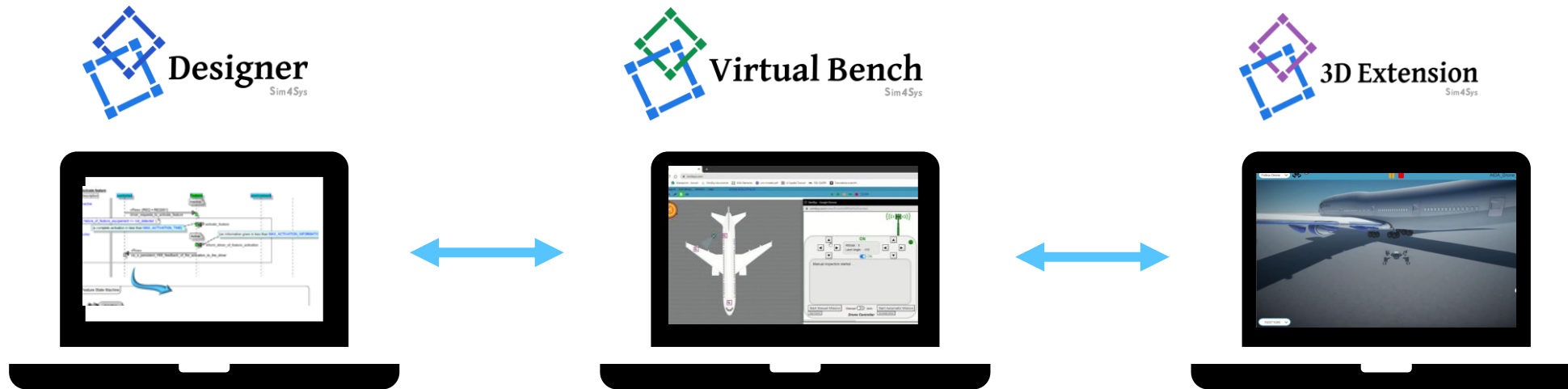


To be developed



Implement UML/SysML standards

7- No matter what tool you use, they all have a steep learning curve



The Sim4Sys toolset allows to :

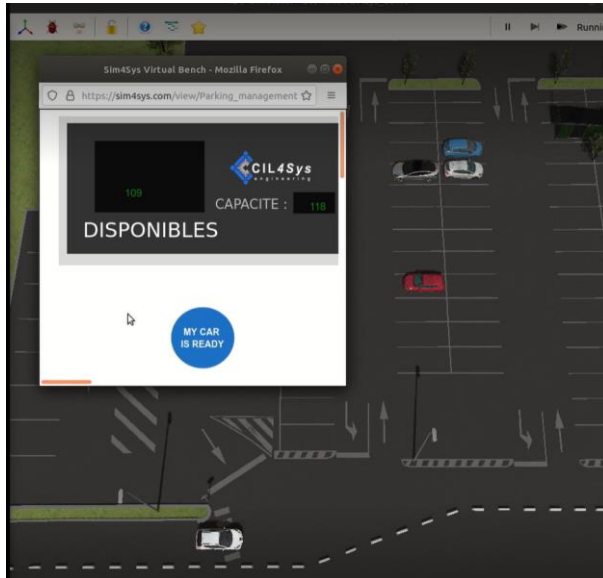
- define complex behaviors with models and code libraries integration (no code to write).
- draft scenarios in 2D and prepare test plans.
- play in a VR environment.

(it is available with Unity and can easily be developed with any simulator with a documented API).

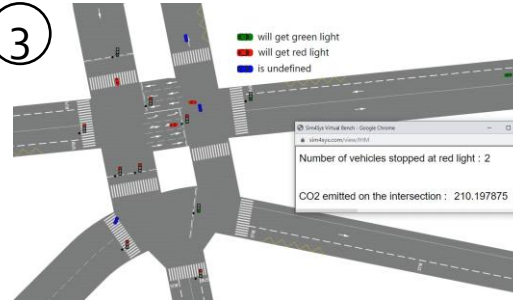
To play CONOPS in VR along the project development, to verify and validate functional design, becomes easy and cheap.

6- In the future we will also see that integration could even be led by MBSE tools and we are investigating use of virtual reality [...]. It is now a bit unclear if it brings an advantage

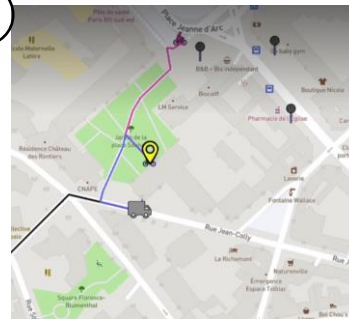
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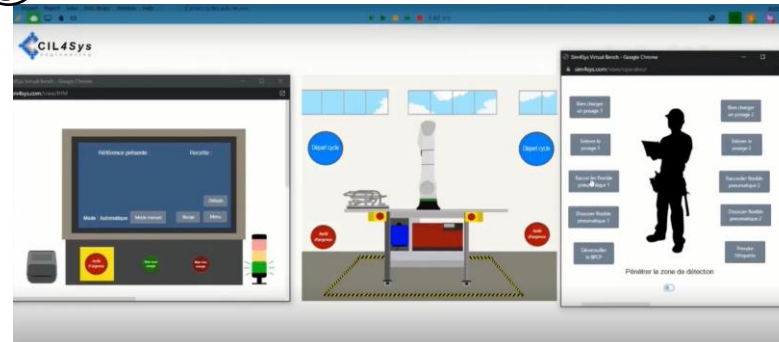
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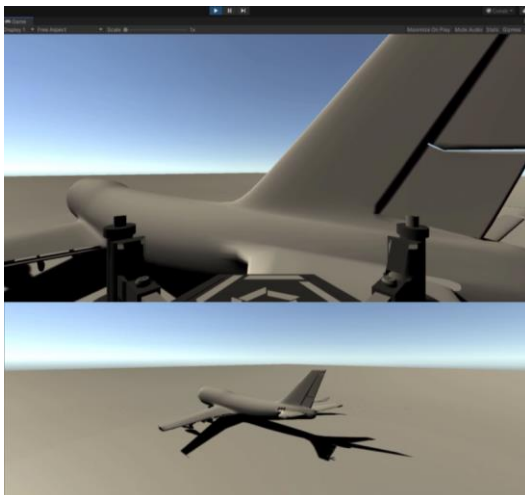


- 1 – Autonomous valet parking
- 2 – Inspection drone
- 3 – Intelligent Traffic management
- 4 – Multimodal deliveries
- 5 – A cobotic process
- 6 – Many examples in Automotive, Railway, Defense, Energy, ...

6



2





- Do not take for given that MBSE requires a steep learning curve : it can be much simplified for common users if the goals are well defined and the tools customized.
- The document-based systems engineering has reached its limits with the complexity that modern systems reach.
- Using models in a proper way to write the specification makes Virtual Reality an easy-to-use test bench to continuously verify and validate the design down the V cycle.
- CONOPS in Virtual Reality, that are defined at the very beginning of a project, can become the sound of the digital twins in operations at the end of the project.

ANY QUESTION ?

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