Jean Oswald[1], Thomas Jues[1], Massimo Ferlin[1], Igor Girard-Carrabin[2], Fabrice Blondeau[2],
[1]CNES Space Transportation Directorate
[2]ArianeGroup SAS

Reduction of launcher costs thanks to artificial intelligence

Smart European Space Access through Modern Exploitation of data science (SESAME)

3rd ESA CNES SPACE COST ENGINEERING CONFERENCE

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Horizon2020
European Union Funding
for Research & Innovation

WHAT IS SESAME ?

Smart European Space Access through Modern Exploitation of data science

SESAME is an H2020 program

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One aim:

Demonstrate the ability of European space companies to work together and to reduce the costs using data science for predictive quality, predictive maintenance and supply chain agility.

Two use cases:

- Predictive maintenance with AI analysis for Friction Stir Welding
- Assets management with AI analysis for launcher production/exploitation and launch base operation

SESAME

WHAT MAKES SESAME A FORERUNNER?

Context:

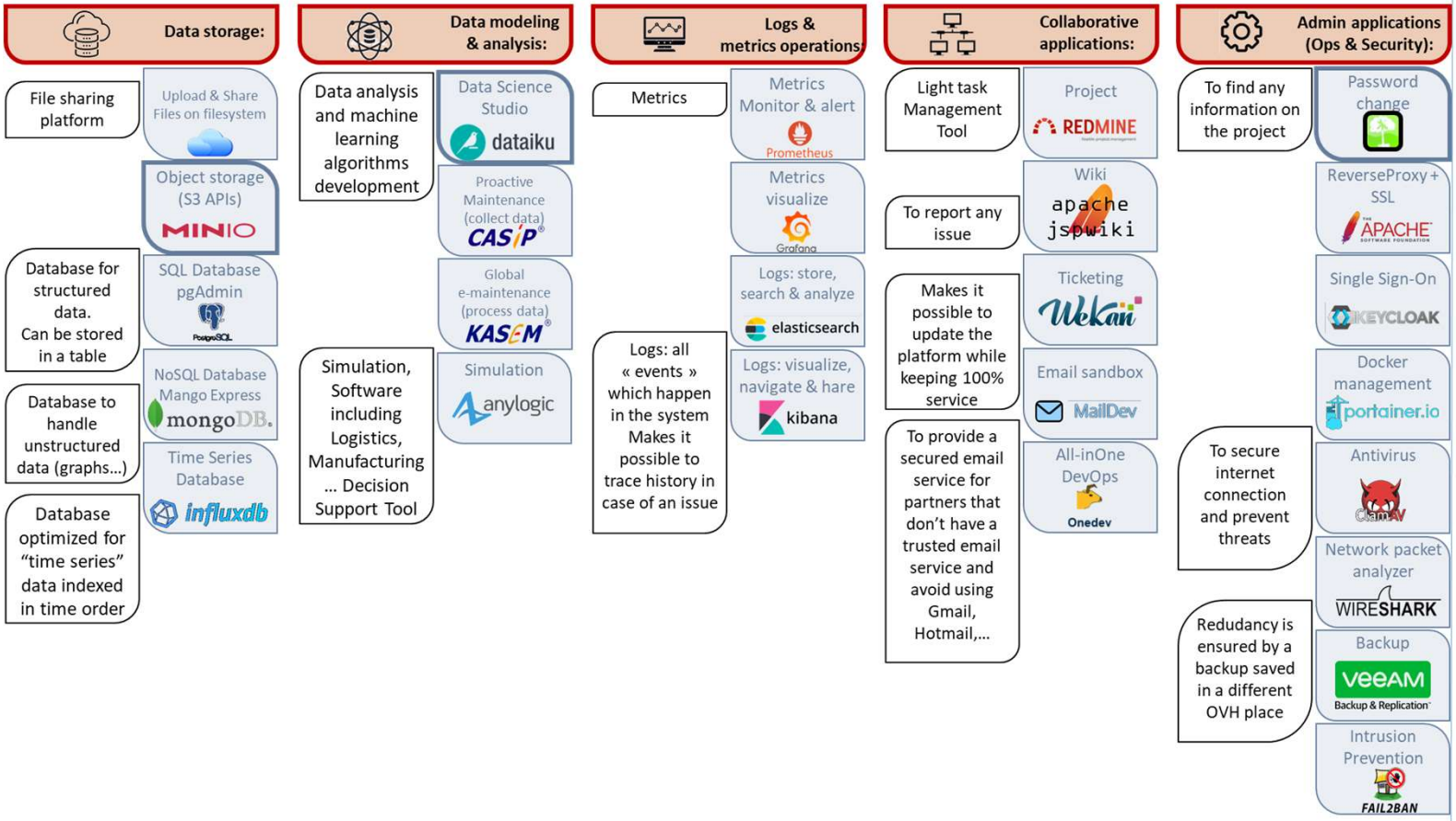
- Predictive maintenance and assets management are already used in industry

Constraint:

- Military/civilian duality makes launchers highly confidential

Solution:

- SESAME developed a **cloud** to demonstrate that data can be exchanged between partners in a secured and sovereign environment

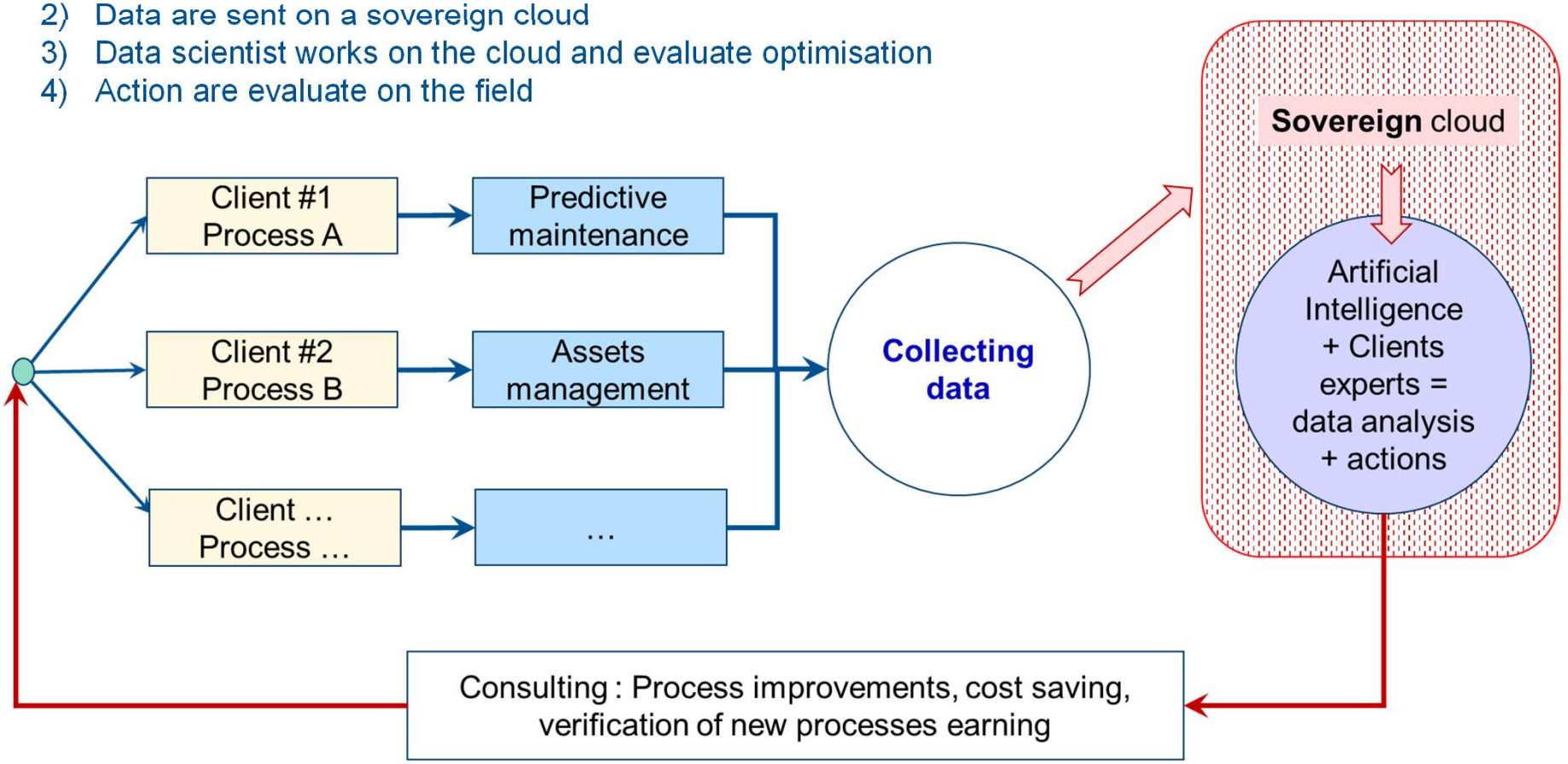


SESAME is probably the first achievement in the European space environment.

WHAT IS THE DATA PROCESS WITHIN SESAME?

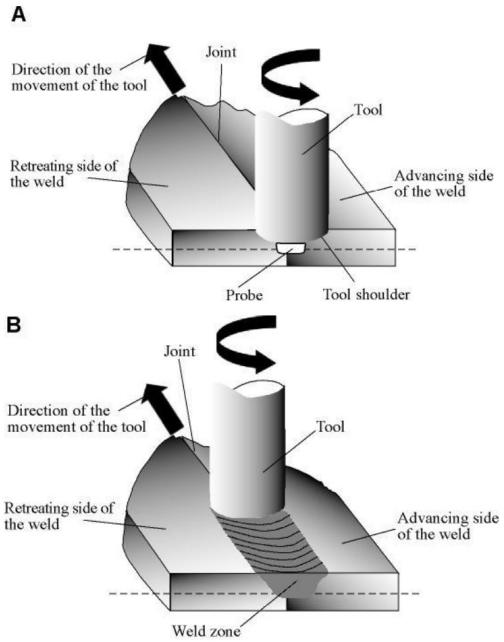
4 steps:

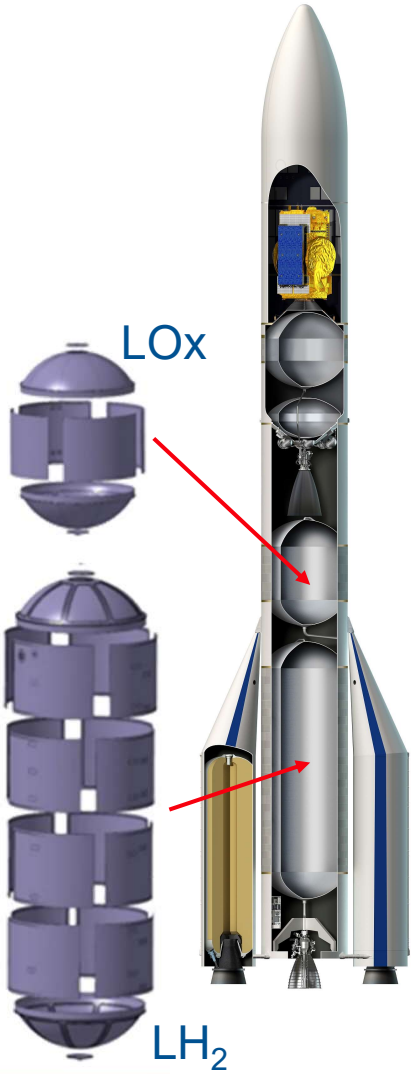
1) For each use cases, data from different sensors are collected
2) Data are sent on a sovereign cloud
3) Data scientist works on the cloud and evaluate optimisation
4) Action are evaluate on the field



USE CASE 1: Predictive Maintenance applied to FSW

Friction Stir Welding technology
A solid-state welding process





LH_2 & LOx tanks for ARIANE 6 LLPM and ULPM
FSW benches : 2 longitudinal, 2 circumferential
Located in Bremen and in Les Mureaux (N80)

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USE CASE 1: Predictive Maintenance FSW earnings modelling

Switching from **preventive** maintenance to **predictive** maintenance of the welds of LH_2 & LOx tanks for LLPM & ULPM implies :

=> Reduction of the number of probes to replace
=> Reduction of the time of control of the welds
=> Additional costs for cloud and analysis

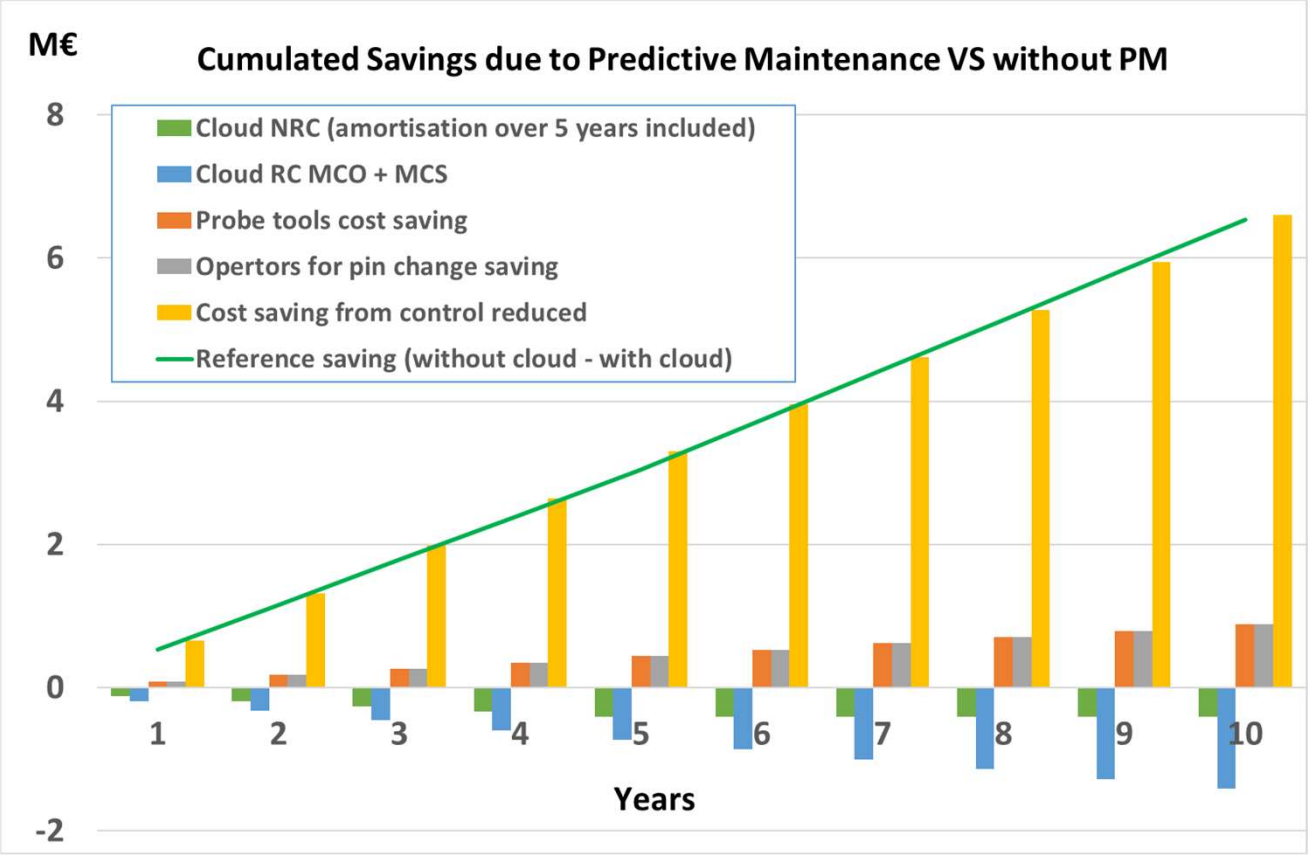
Main drivers:

Probe replacement:
- Probe cost
- Time needed to change the tool
- Labour hour rate
- Sensor cost

Control quality of the welds
- Time to control
- Control labour hour rate

Cloud and data analysis
- Platform including MCO and MCS (PenTests)
- Annual fee for cloud access, software license, soft analysis

USE CASE 1: Predictive Maintenance FSW earnings modelling



Probe change sensitivity on cumulating earnings over 10 years

Time required \ Labour rate	100€/h	150€/h
4h	100%	107%
0.5h	88%	89%

Significant cost saving, mainly due to control optimisation

USE CASE 1: Predictive Maintenance FSW earnings modelling - synthesis

Feasibility and interest of Predictive Maintenance in a complex space industry environment

- **Development of a sovereign and secured platform**
- **Data science analysis with Artificial Intelligence**
- **Reduction of manufacturing cost**
- **Improvement of quality**

Extension to include the welding of the tank bulkheads (@ AGS Partner)

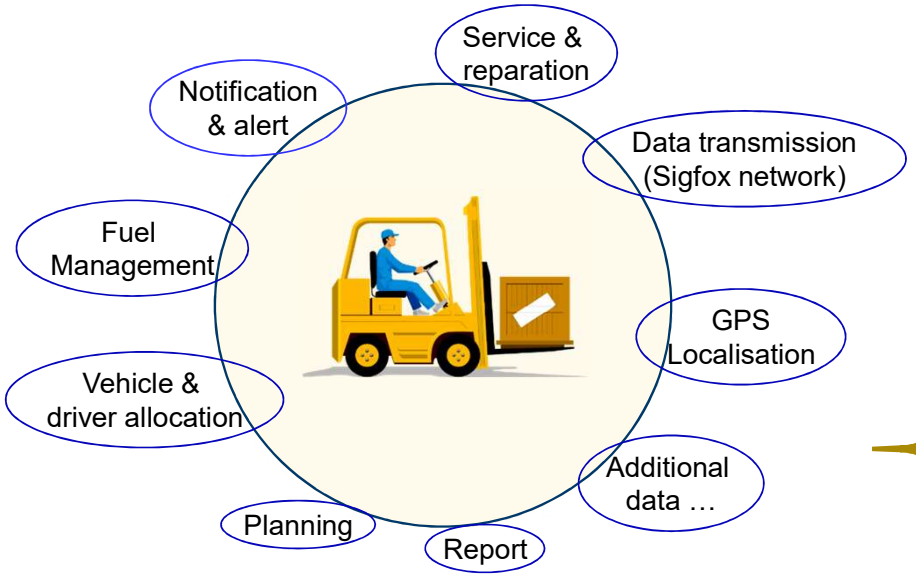
- **=> limited additional investment required for the Cloud**
- **=> double the number of FSW welds**

Higher cost reduction of launcher, faster amortisation of investment

USE CASE 2: Smart Asset Management earnings modelling

First application :

IoT trackers on a fleet of forklifts @ Arianegroup Acquitaine Issac



1st period: fleet behavior analysis

=> Analysis of collected data on the cloud

2nd period:

=> Proposition and application of new process leading to a reduction of the number of vehicles in the fleet

Main drivers:

Annual asset rental

Asset equipments
- Trackers /asset
- Datalink Sigfox subscription /year /asset

Cloud and data analysis
- Platform including MCO and MCS (PenTests)
- Annual fee for cloud access, software license, soft analysis

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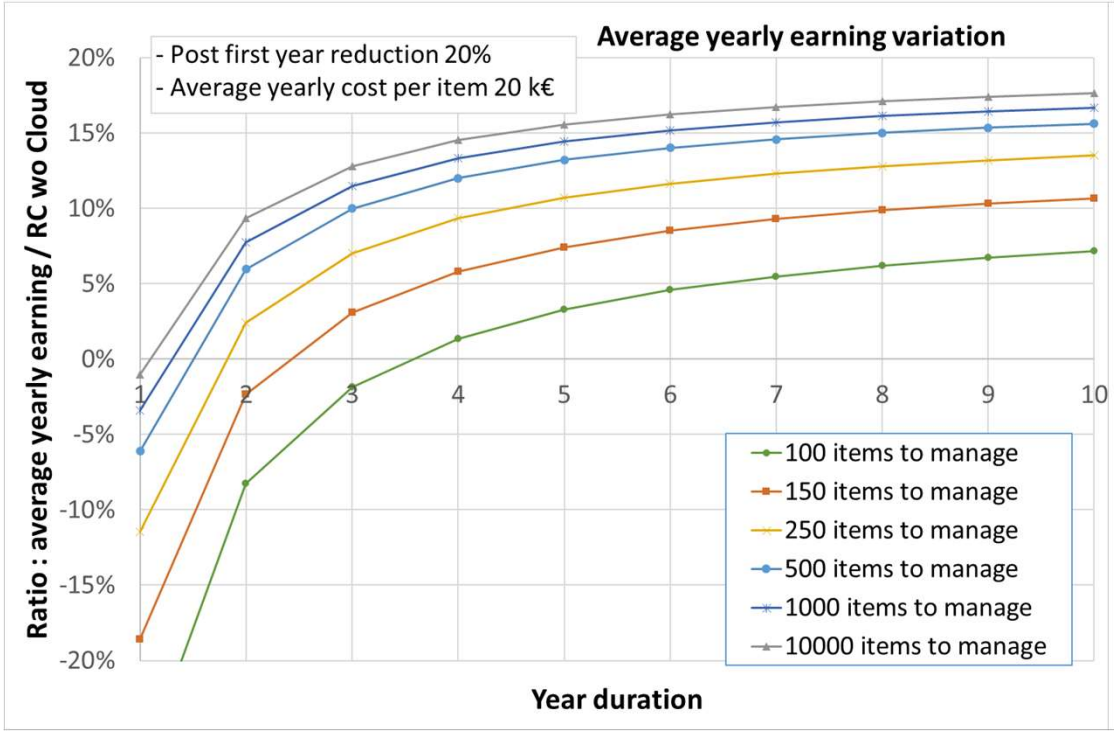
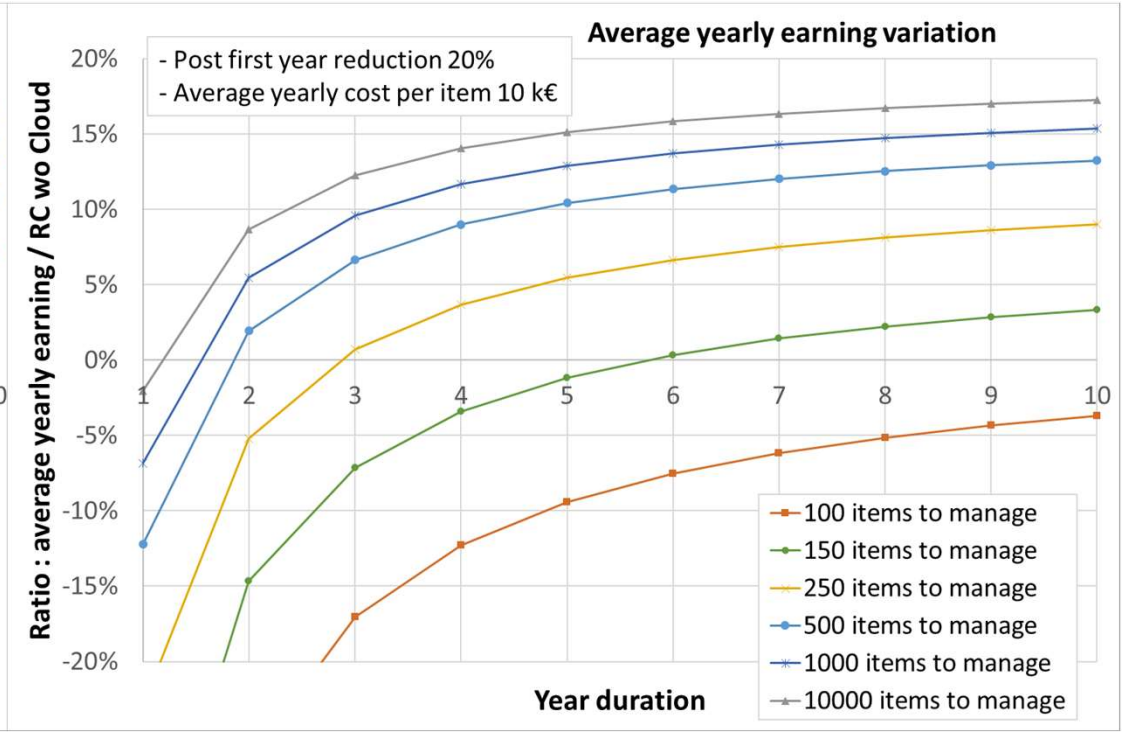
Parametric sensitivities on RC reduction depending of # of items to manage





Time and global value of assets to manage are the key parameters

USE CASE 2: Smart Asset Management earnings modelling - Synthesis (1/2)

Feasibility and interest of Asset Management in the complex space industry environment

- **Reduction of assets to rent**
- **Improvement of quality**
- **development of a sovereign and secured platform**
- **Data science analysis with Artificial Intelligence**

Scaling possibility to increase the number of items to manage

- **=> include several fleets of various asset**
- **=> limited additional investment required for the Cloud**

Higher cost reduction of launcher, faster amortisation of investment

USE CASE 2: Smart Asset Management earnings modelling - Synthesis (2/2)

The industries involved in launcher production and/or operation, can use the support of a sovereign cloud where data are stored and analysed with Artificial Intelligence driven by experts. This type of asset management can enable the analysis of lot of aspects such as:

- **Computerized Maintenance Management System (CMMS)**
- **Minimization and balancing of the input/output resource inventory;**
- **Minimization of Costs related to the storing of inventory**
- **Minimization of Penalty costs for early or delayed delivery**
- **Launch rate variations**
- **in case of perturbing events : breakdown, social events, obsolescence, Meteorology,…**
- **Reduction of pollutant emissions and respect for the environment.**

A second application is on going on AGS CSG assets on about 100 items

DOES IT GENERATE BUSINESSES ?

Strategic analysis shows that is a good opportunity

	Positive	Negative
Internal	**Strength :** • Secured & Sovereign offer • Scalable methodology from use case 2 to a larger number of assets • Incremental development depending of type of assets and companies • New job applications data scientist and cloud operators	**Weakness :** • Multiple partners involved, harder to persuade • Mainly “old space” actors reluctant to switch to new management • Depending of the position in the value chain the willingness to apply this method is not so obvious
External	**Opportunity :** • Lot of assets concern with this optimisation (In metropolis or French Guiana) • Not yet applied in space launcher industry and European spaceports • Lever to reduce cost in production and exploitation	**Threat** • Reduction of some manpower, social impact (drivers,…) • European launch site cost competition CSG with respect to new launch site in other country.

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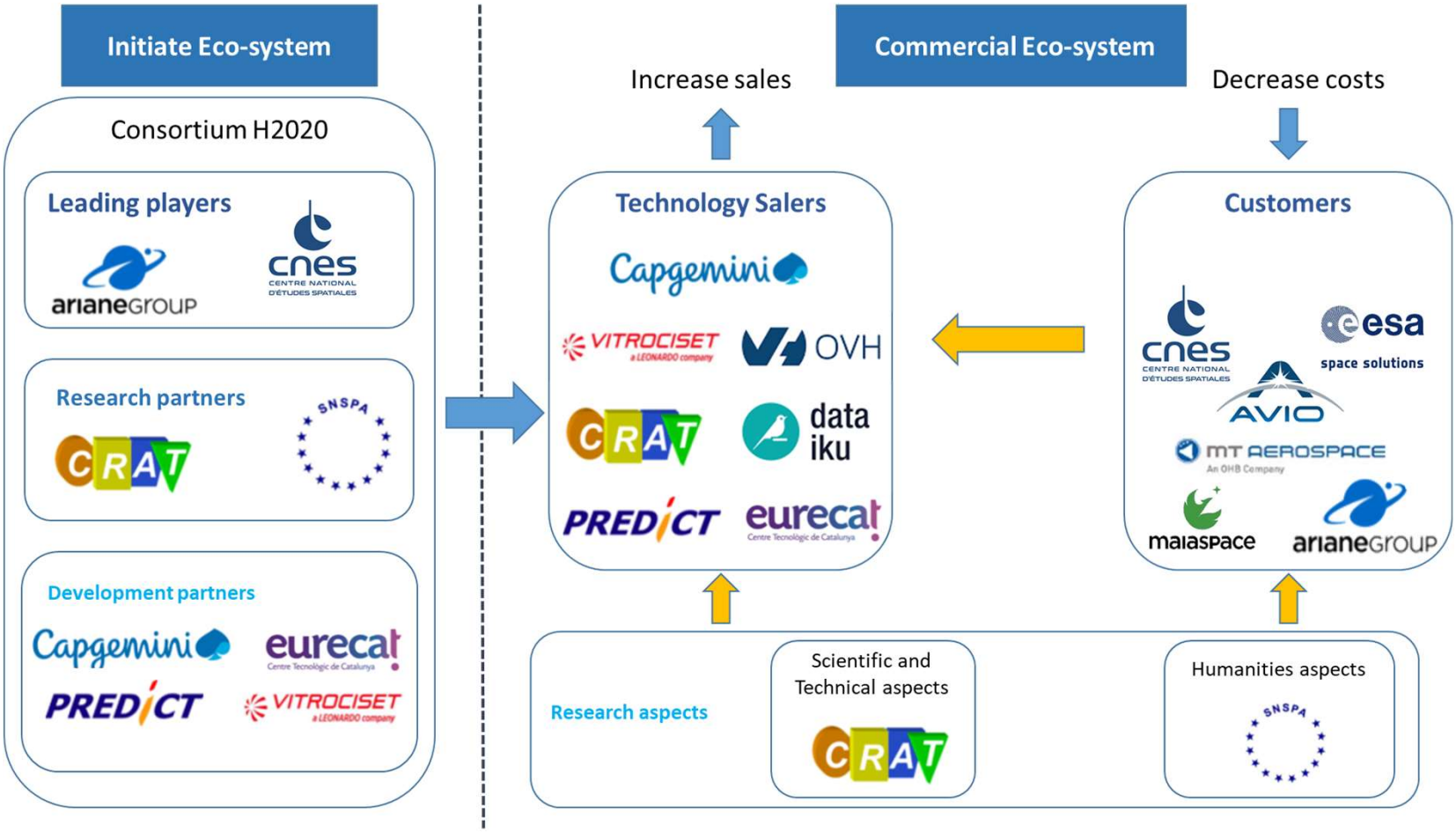
SESAME ECOSYSTEM EXTENSION

Developing an ecosystem based on Artificial Intelligence for the benefit of space industry



Conclusions

SESAME H2020 project has demonstrated that the **security constraints of space industries** can be overcome while keeping the benefit of Predictive Maintenance and Smart Asset Management performed with Artificial Intelligence

Predictive Maintenance and Smart Asset Management can be applied at a larger scale, products and entities have already been identify

Collecting additionnal data have opened the field of investigation of other optimisations :

- Adaptive Operations Module (AOM);
- Model Predictive Control (MPC)

The SESAME project concern mainly Ariane launcher production and CSG space port operations. Similar sovereign and secured cloud can be proposed to the launcher new space industries.

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Thank you for your attention

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