



Space OPERA: integrating the environmental performance into concurrent design

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Speaker: Augustin Chanoine, Deloitte Sustainability

Space OPERA:

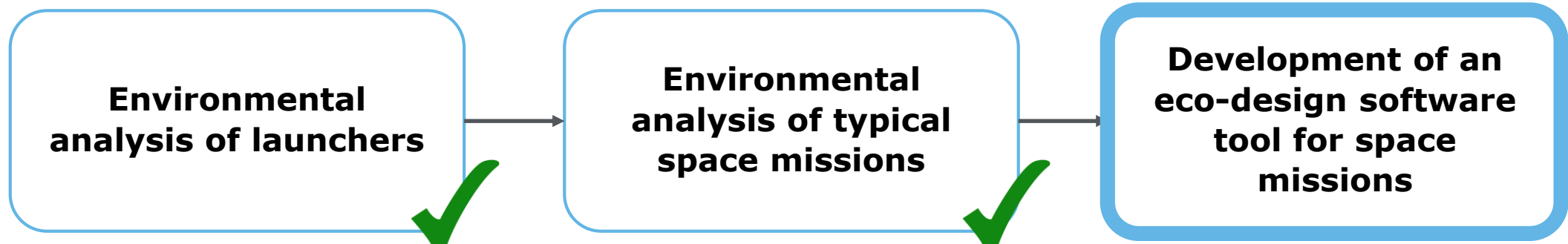
Integrating the environmental performance into concurrent design

Outline

1. Brief recap on previous steps
2. What is eco-design?
3. Space OPERA: eco-design for space
4. Conclusions and next steps

Where are we on the journey of the space sector towards eco-design?

Brief recap on previous episodes...

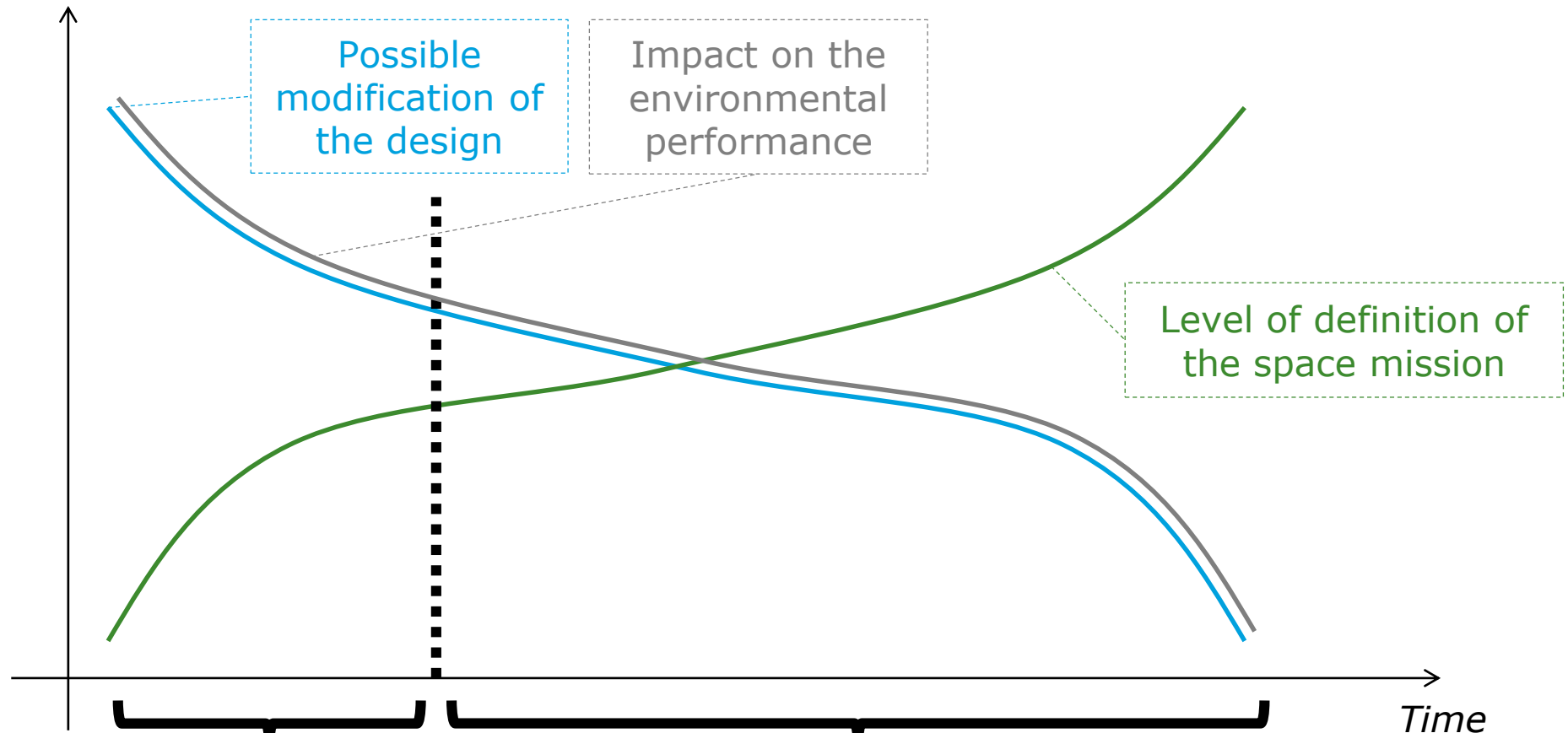


- ✓ In-depth knowledge of environmental hotspots & sources of impacts of launchers
- ✓ Validation of LCA as relevant and applicable method to study the environmental footprint of launchers
- ✓ Identification of areas for future work

- ✓ Same outcomes for space missions
- ✓ **Development of an environmental analysis model and method to be used as a basis for the eco-design tool**

What is eco-design?

Eco-design is a preventive approach to mitigate the environmental impacts of a product as early as possible in the design phase, when main technological choices are not made yet



Most of the environmental impacts are set by early design choices. **Eco-design should be initiated as early as possible in the design process.**

Environmental performance should also be assessed throughout the mission's design, in order to guide further design choices towards more environmentally friendly solutions.

What is eco-design?

Eco-design in a nutshell

Main outcomes of envir. analysis

- Identification of the environmental hotspots of a space project
- Identification of priority areas for improvement
- Environmental benchmark of design options

Key aspects...

- Multi-criteria
- Multi-step
 - ... In order to avoid burden shifting

... And key steps

1. Identification of scope and material environmental aspects
2. Constitution of a project team
3. Initial environmental analysis
4. Design
5. Decision support
6. Product development
7. Communication to stakeholders

A wide variety of project types and ambitions

- From redesign or incremental...
- To a disruptive, functional approach, questioning the business model of businesses (e.g. switching to a product-service system)

Eco-design is one of the main pillars of circular economy!

- From eco-design to eco-innovation:

Not thinking of environment as an additional constraint but as a potential area of added value

Key drivers and benefits

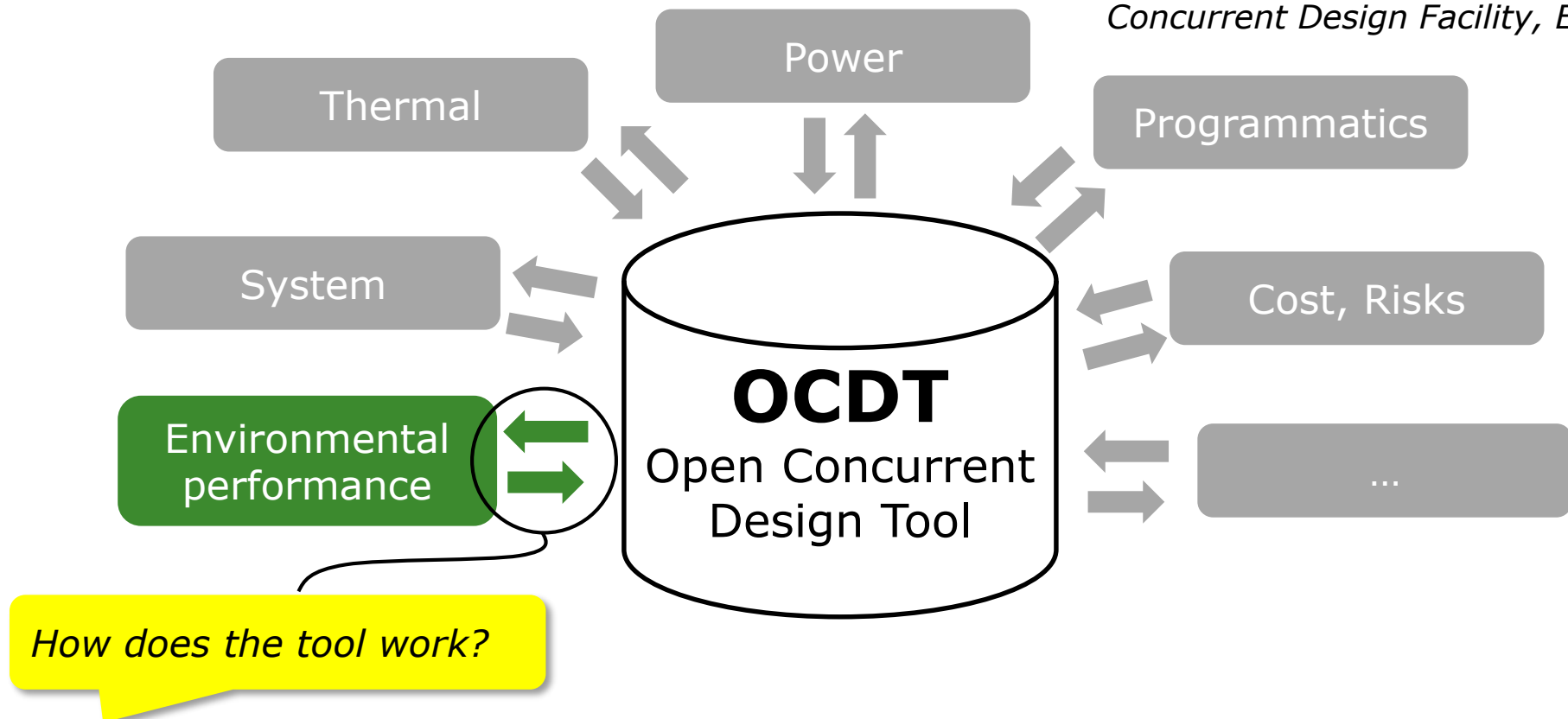
- External drivers: regulation, competition, client's and consumer's expectations
- Internal drivers: anticipate future regulations, cost reduction, new markets, reputation
- Benefits
 - Eco-design: clear asset for innovation
 - 96% of companies having initiated an eco-design strategy say it has a neutral or positive effect on profit

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Environmental performance: a new area of expertise in concurrent design

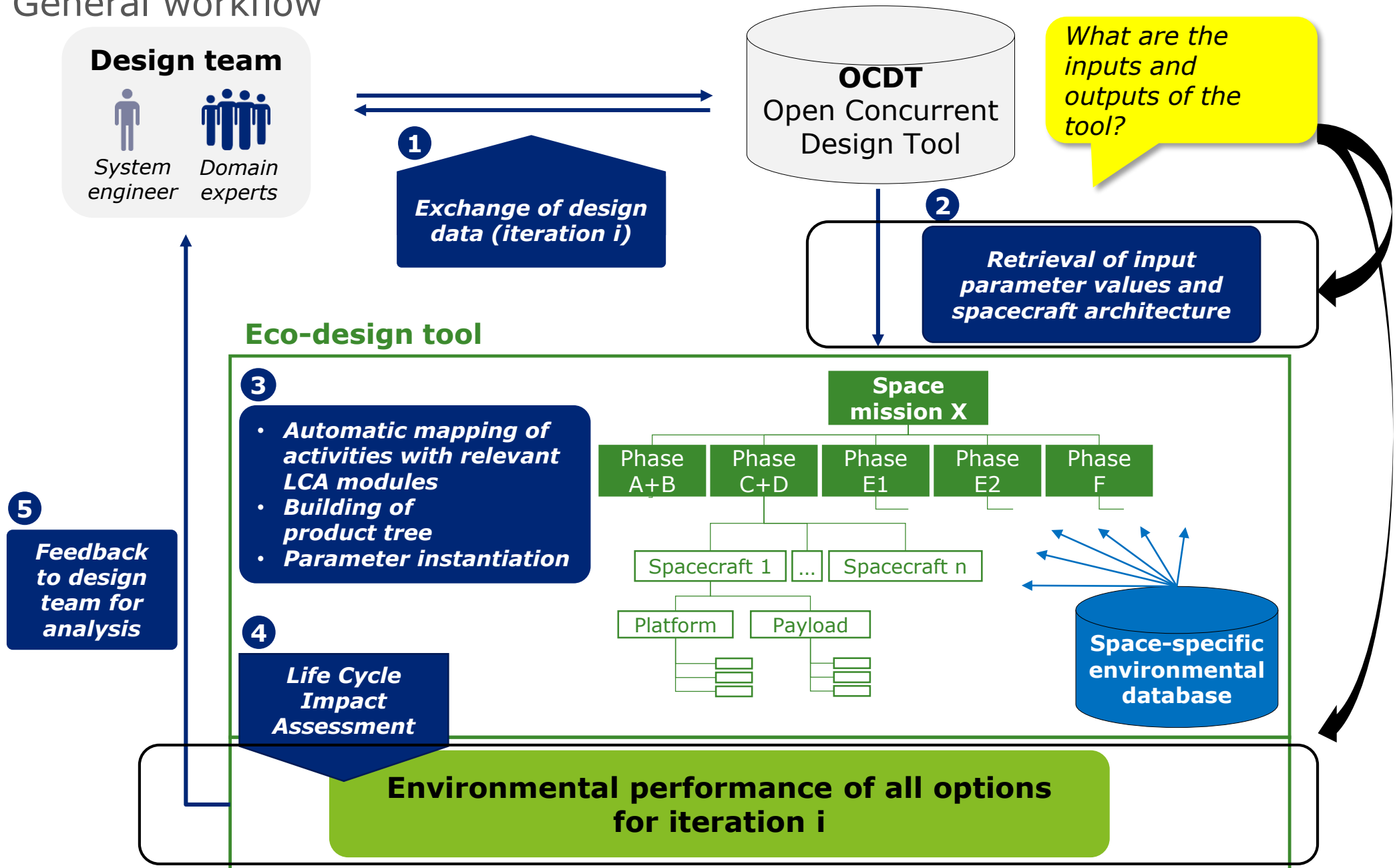


Concurrent Design Facility, ESTEC



Space OPERA: eco-design for space

General workflow



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Typical inputs and outputs

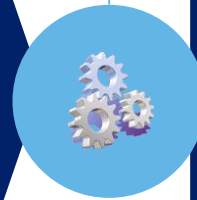
Input data

Mission-specific design data

*Man.hours for Design,
Bill of Materials,
Model Philosophy,
Type and number of tests,
Type of launcher,
Ground stations, Control Centres and
dedicated staff*

...

Eco-design tool

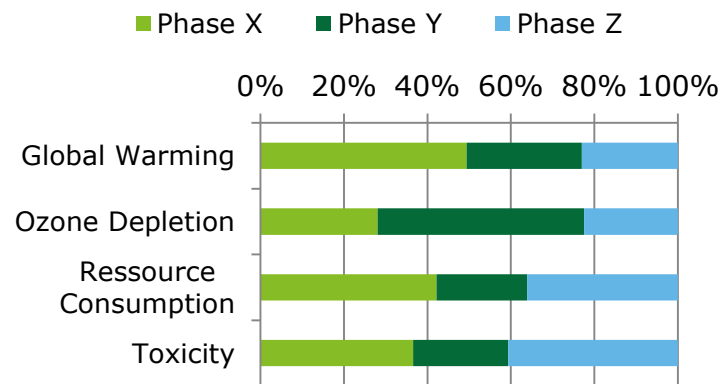


Output data

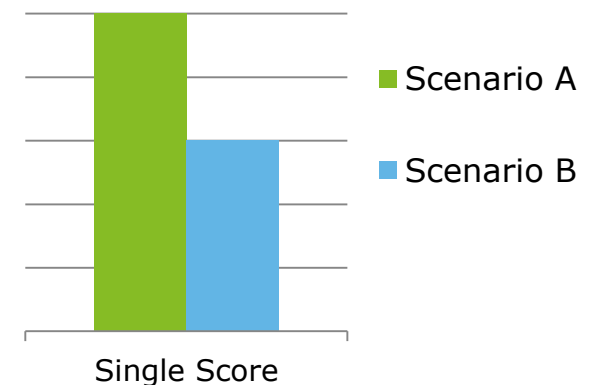
Environmental performance of the mission

Type of results (illustrative examples)

*Environmental hotspots
(multi-criteria results)*



*Trade-offs
(environmental single score)*



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Focus on the import algorithm: due to the wide variety of possible mission structures, we split the model in two main parts: static and dynamic

Create

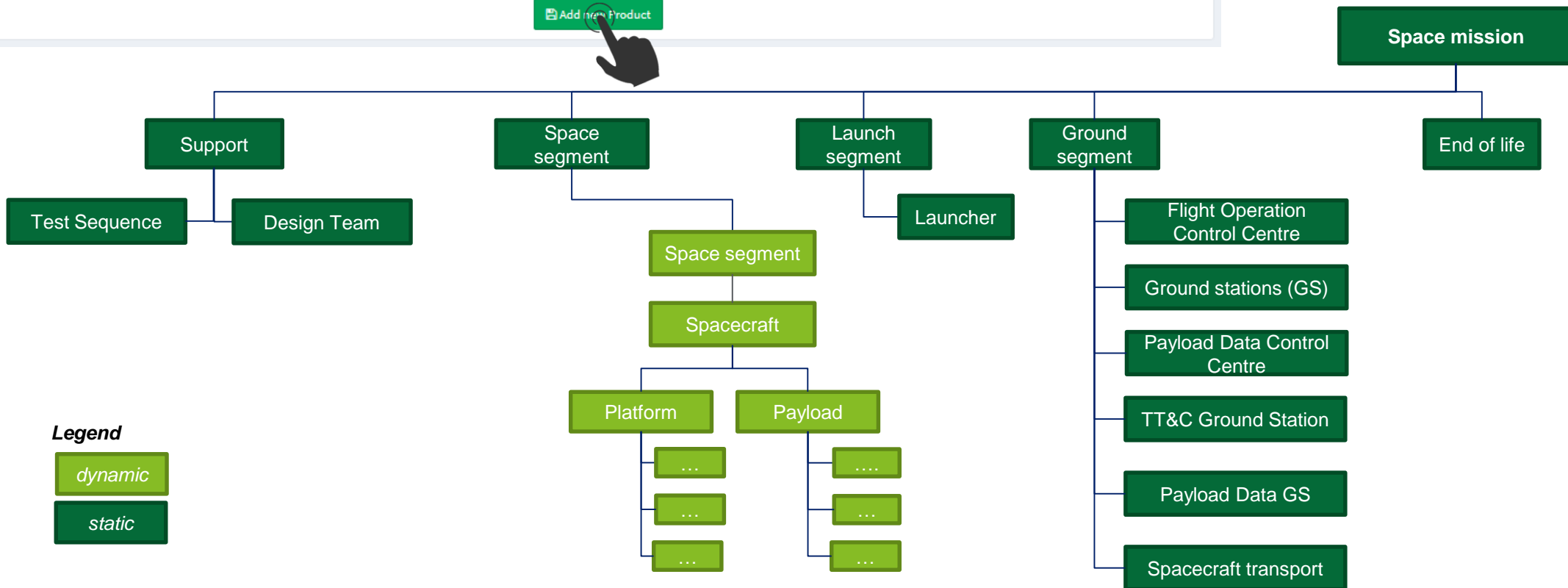
New Product

Name *

Product template *

Study

Iteration



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Focus on structure of product in Space OPERA

Description

- Main information on imported product
- Selection of the results to be calculated (*default selection available*)
- Button 'check product'

Tree

- View of the modelled LCA product
- Access to the 'building blocks' of the LCA

Values

- View questions and parameters at the hand of the system engineer
- Possible manual change of parameters
- Model philosophy

Results

- View of the results in the Graphical User Interface
- Export detailed results in Excel

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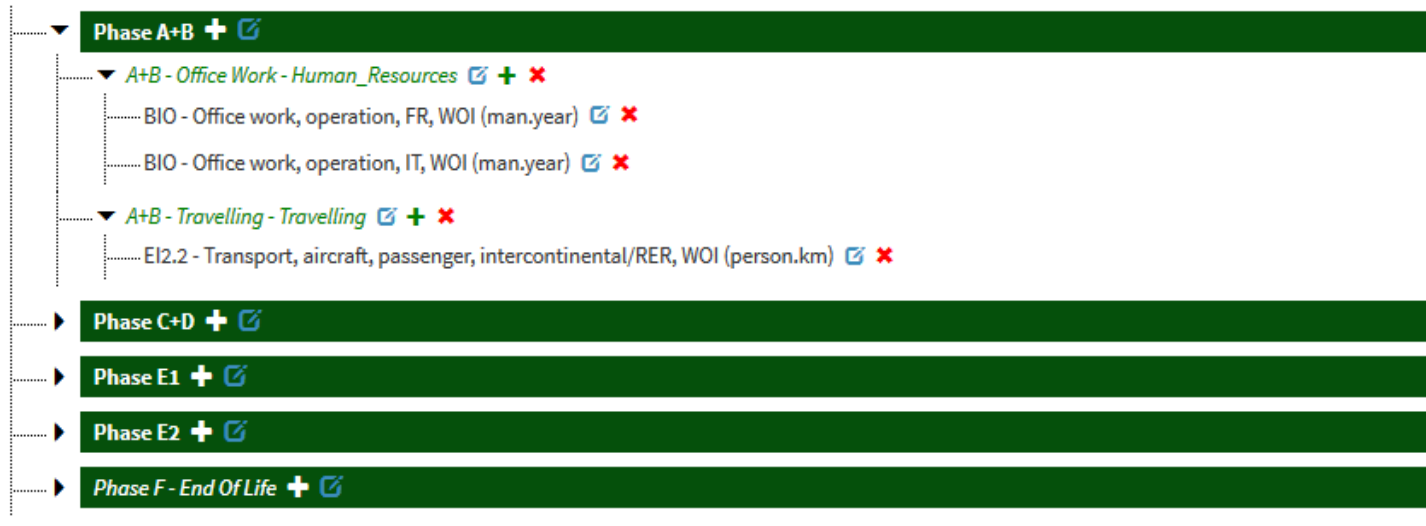
Focus on "Tree" tab

Tree



- A module in *italic* means the module is *mapped to an EU in the OCDT*

Product



- Unfold the whole tree over a level
- Add another module below
- Edit the step or module
- Delete the module from the branch

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Focus on “values” tab

Values



- Gives all parameters values: for each scenario, split per life-cycle stage and module
- **Flag** to check status of each value

low

Need for user's action

Color	Meaning
Green	the parameter value is expected, and has been retrieved from the JSON
Yellow	the parameter value is expected, a hyphen has been retrieved from the JSON, and a default value (different than "0") is available and has been set
Orange	the parameter value is expected, a hyphen has been retrieved from the JSON, and a default value equal to "0" has been set. A default value equal to "0" is used when the expected value should be defined and for which a default value is too generic
Red	the parameter value is expected, is mapped to a ParameterType, but has not been identified in the JSON
Dark Red	the parameter value is expected but is not mapped with a ParameterType, i.e. it has not been linked in the dictionary

high

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Focus on results

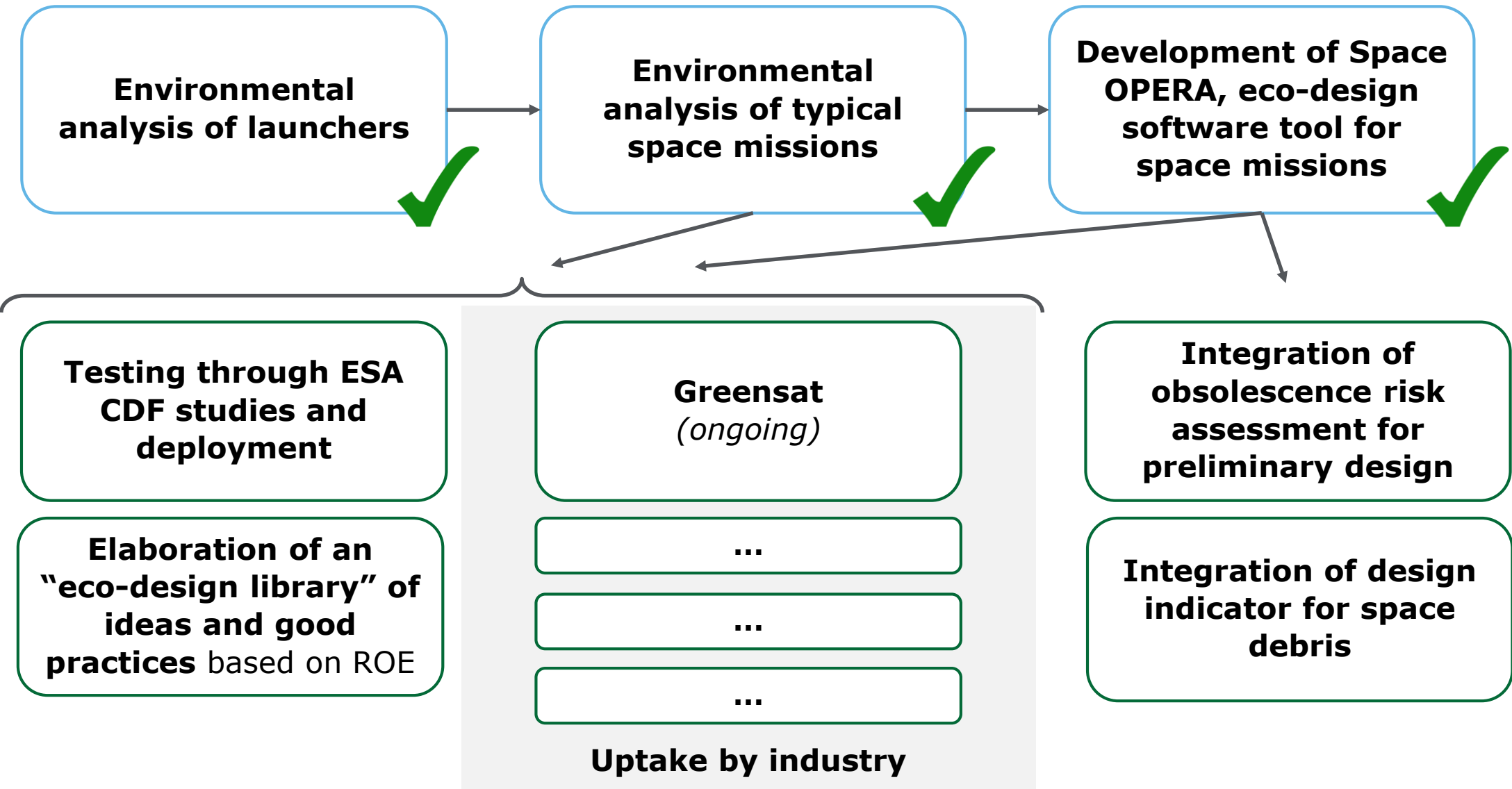
Results



- Available results:
 - **By axis:** midpoint indicators / normalised and weighted / single score
 - **By 'analysis type':**
 - 1 dimension: analysis by scenario / environmental indicator / LC step
 - *Easy comparison between two or more design options*
 - 2 dimensions: scenario & environmental indicator / **scenario & LC step**
 - *Can provide a focus on Phase C+D for instance*
 - **Graphical presentation**
 - **Table of absolute values**
 - Includes **uncertainties** associated to each indicator (information)
 - **Export of detailed results in Excel** > Further use by the design team / import in OCDDT

Conclusions and next steps

What are the next steps on the path to sustainable innovation and proactive anticipation of regulation?



Thank you for your attention!
Any questions?

Contact:

Augustin Chanoine
achanoine@deloitte.fr
+33 1 55 61 68 85



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