Capgemini engineering

SUSTAINABLE PRODUCT DESIGN

THE TIME IS NOW

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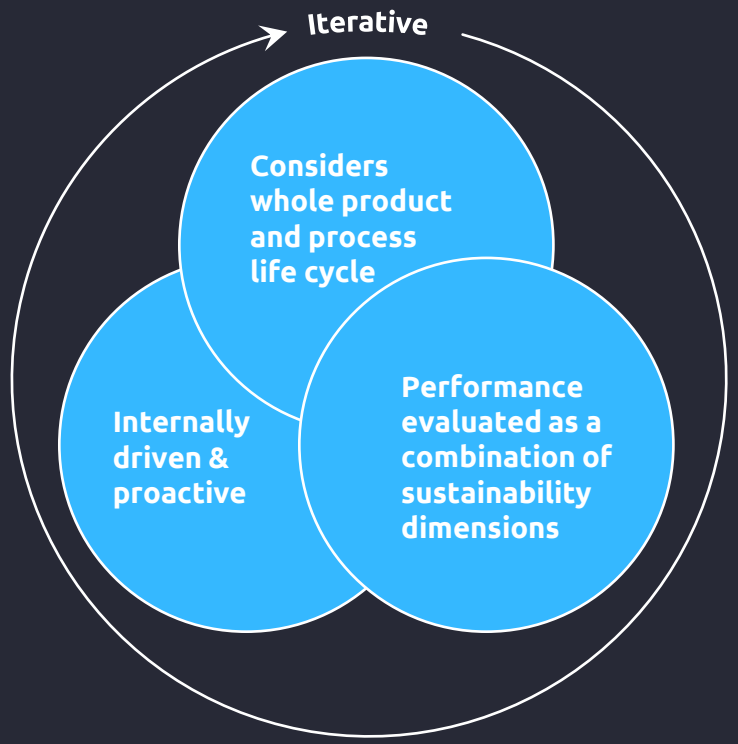
SUSTAINABLE PRODUCT DEVELOPMENT – LATEST INSIGHTS

DECISIONS MADE DURING PRODUCT DEVELOPMENT PHASE HAVE SIGNIFICANT IMPACTS TO COMPANIES' BUSINESS ACTIVITIES

Due to complexity of SPD, it is necessary to understand its basic principles

Characteristics of SPD

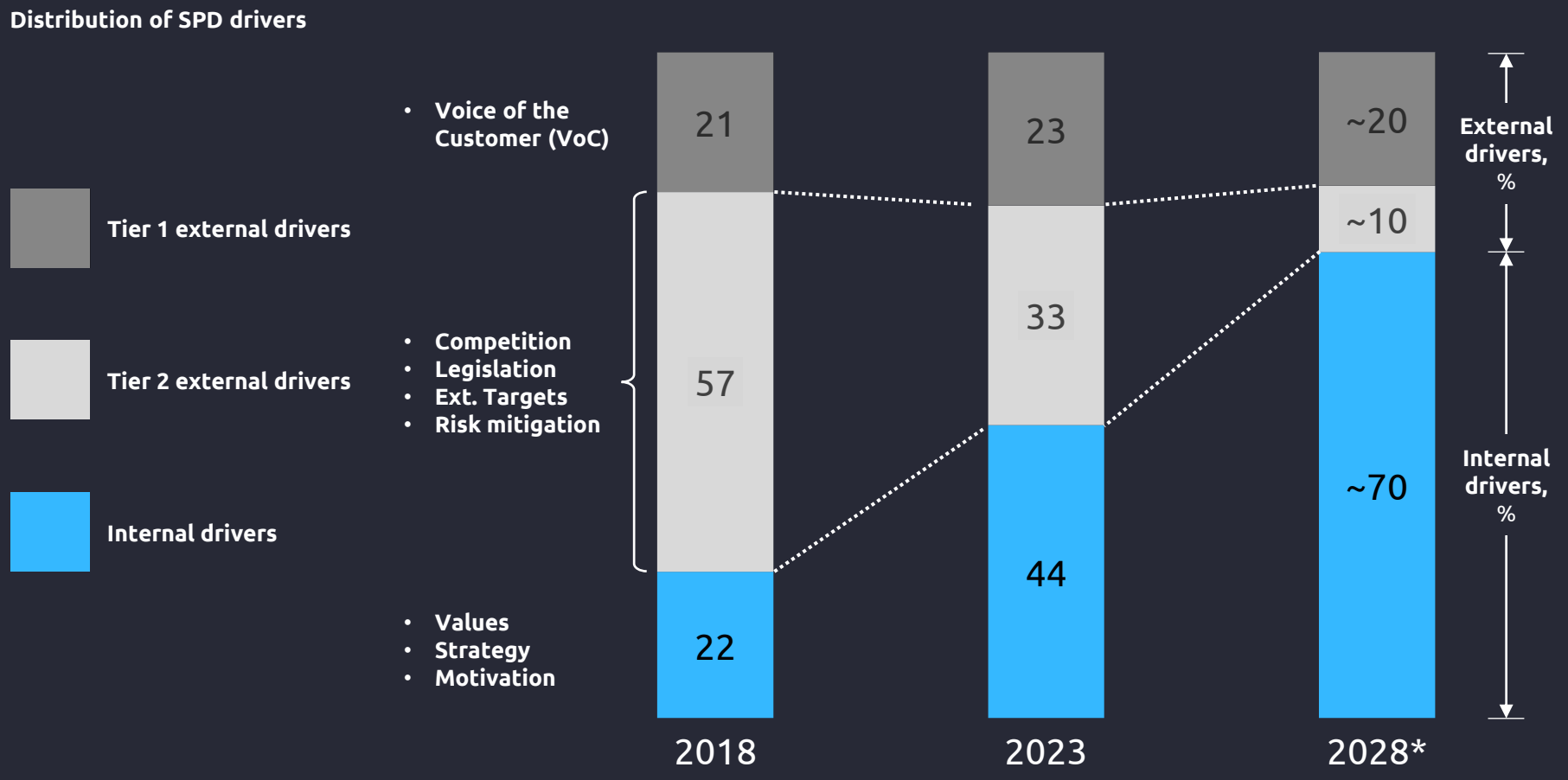


When cost concern hinders sustainable product design, sustainability is the key enabler for success now and in the future

- **TOP LINE BENEFITS**
- **BOTTOM LINE BENEFITS**
- **RISK MANAGEMENT BENEFITS**
- **PRODUCT INNOVATION BENEFITS**

EUROPEAN MANUFACTURING COMPANIES HAVE RECOGNIZED THE IMPORTANCE OF SUSTAINABILITY, BUT THEY ARE ONLY HALFWAY THERE

Externally driven sustainability approach usually leads to poor sustainability performance



SUCCEEDING IN SUSTAINABLE PRODUCT DESIGN REQUIRES COMPANIES TO STEP UP

Four domains which companies must master to achieve sustainability in product design

OBTAIN MUTUAL SUSTAINABILITY UNDERSTANDING

ENSURE COOPERATION IN LONG VALUE CHAINS

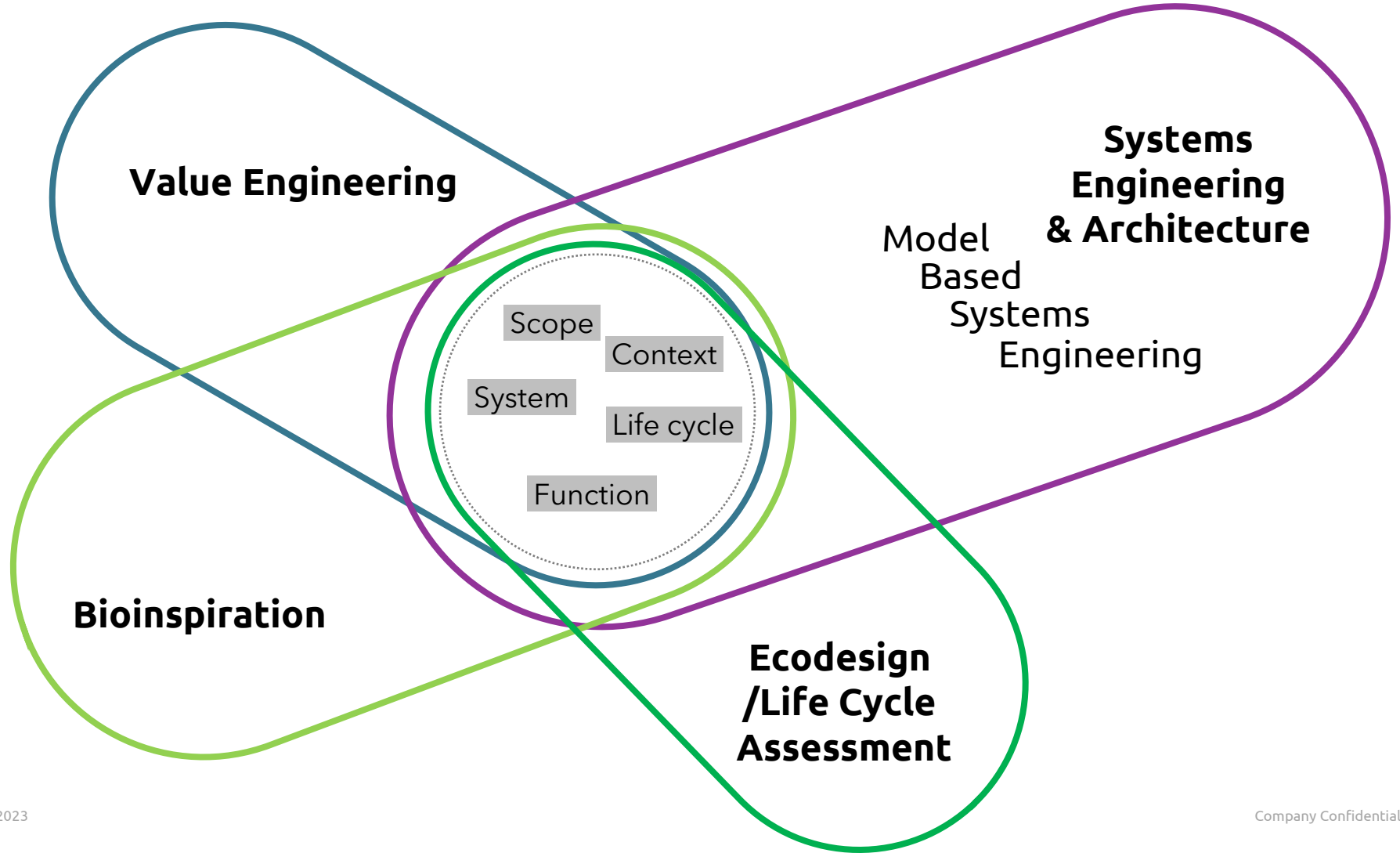
FORM A COMPREHENSIVE LIFE CYCLE APPROACH

ENABLE SUSTAINABILITY CONTINUITY

WHAT DOES SUSTAINABILITY MEAN AT CAPGEMINI?

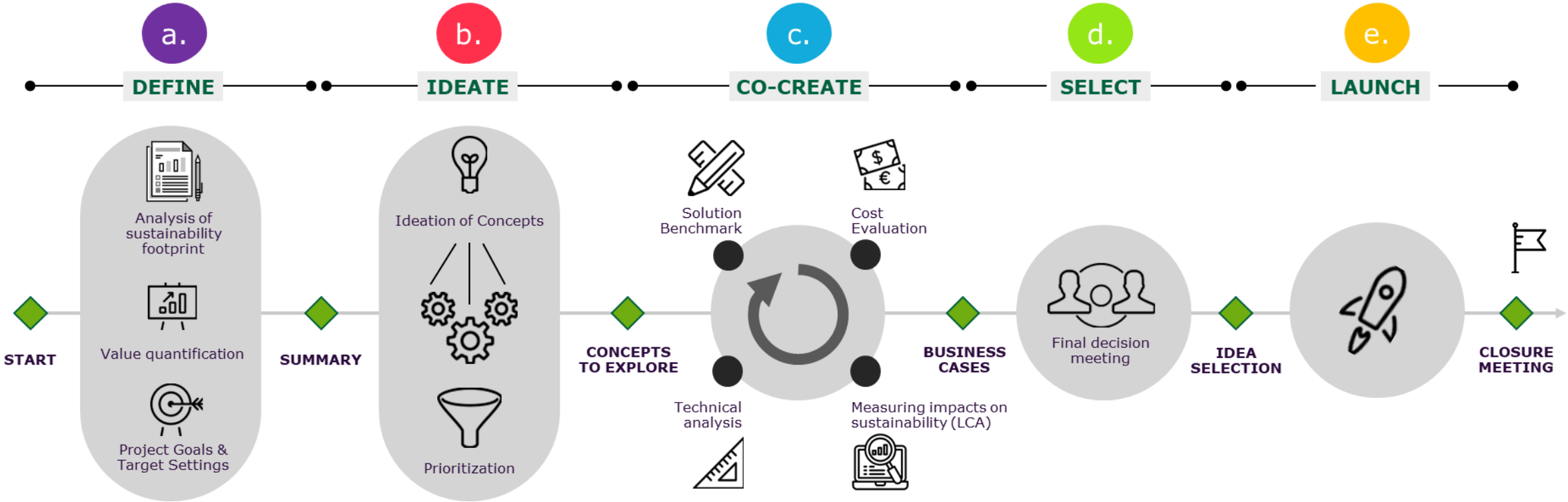
LET'S ZOOM INTO SUSTAINABILITY IN PRODUCT DEVELOPMENT

SYSTEMS ENGINEERING & ARCHITECTURE & SOME DOMAINS LINKED TO SUSTAINABILITY – FINDINGS



LET'S ZOOM INTO SUSTAINABILITY IN PRODUCT DEVELOPMENT

All along development lifecycle, some questions need to be tackled concerning **environmental concerns** (one part of Sustainable concerns)



"WHAT" – THIS MEANS TO YOU?

The ambition is to

- Propose a structured approach
- Be compliant with existing frameworks & on-going initiatives
- Answer the needs

Share the descriptions of the system in terms of Needs /Problems /solutions

Define objectives / Sustainability for taking **decisions** based on objective elements

Develop **together** System-of-Interest & some key Enabling Systems

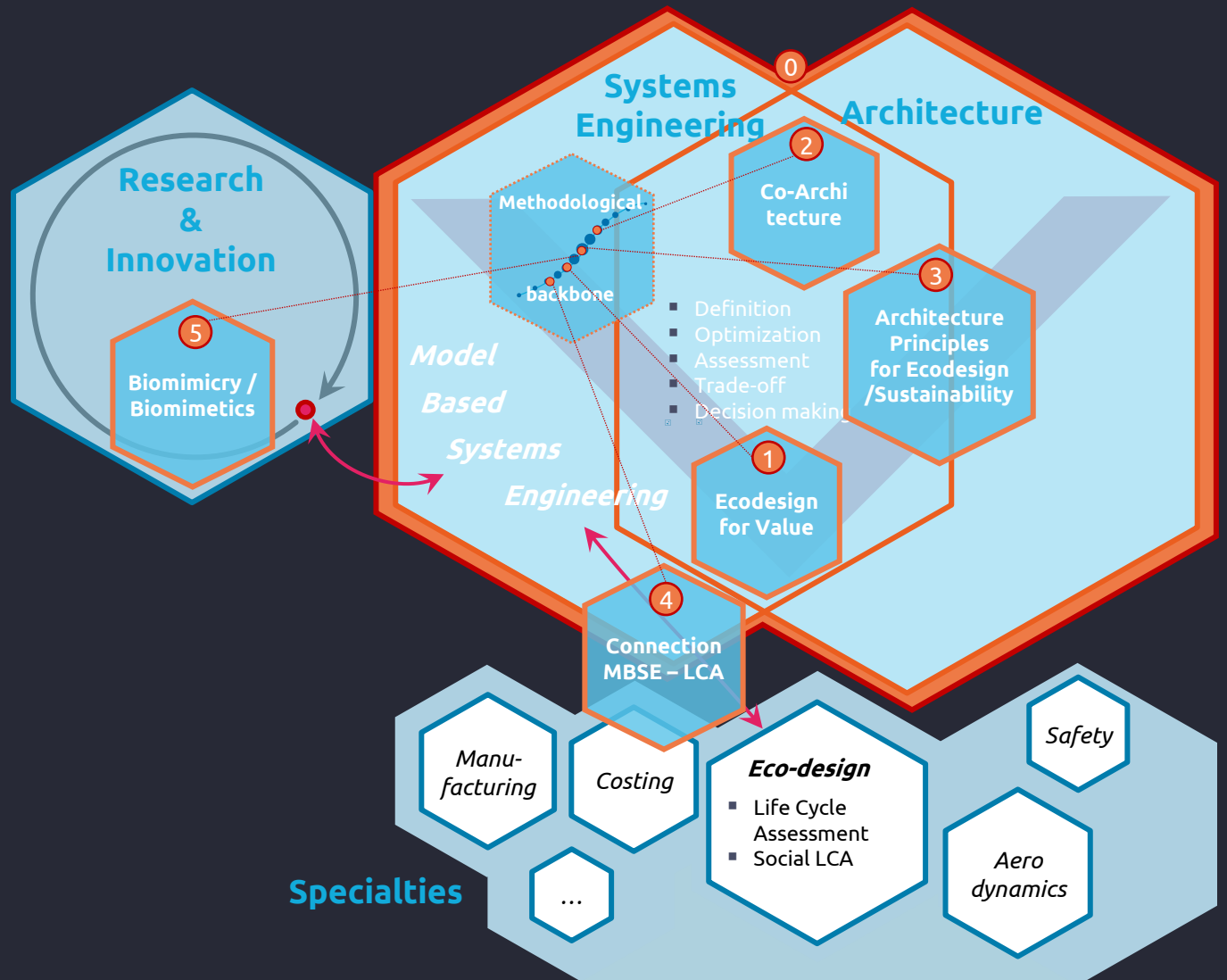
Optimize **architectures** & build ecosystemic-centric architectures

Assess Environmental impacts based on same reference data

Identify **sustainable solutions** for building more sustainable solutions

AN ANSWER

An extensive methodological framework of development with methodological bricks off-the-shelf
- Integrated via Methodological backbone
- Supported by Systems Engineering & Architecture framework



HOW DOES MBSE ENABLE SUSTAINABLE PRODUCT DEVELOPMENT?

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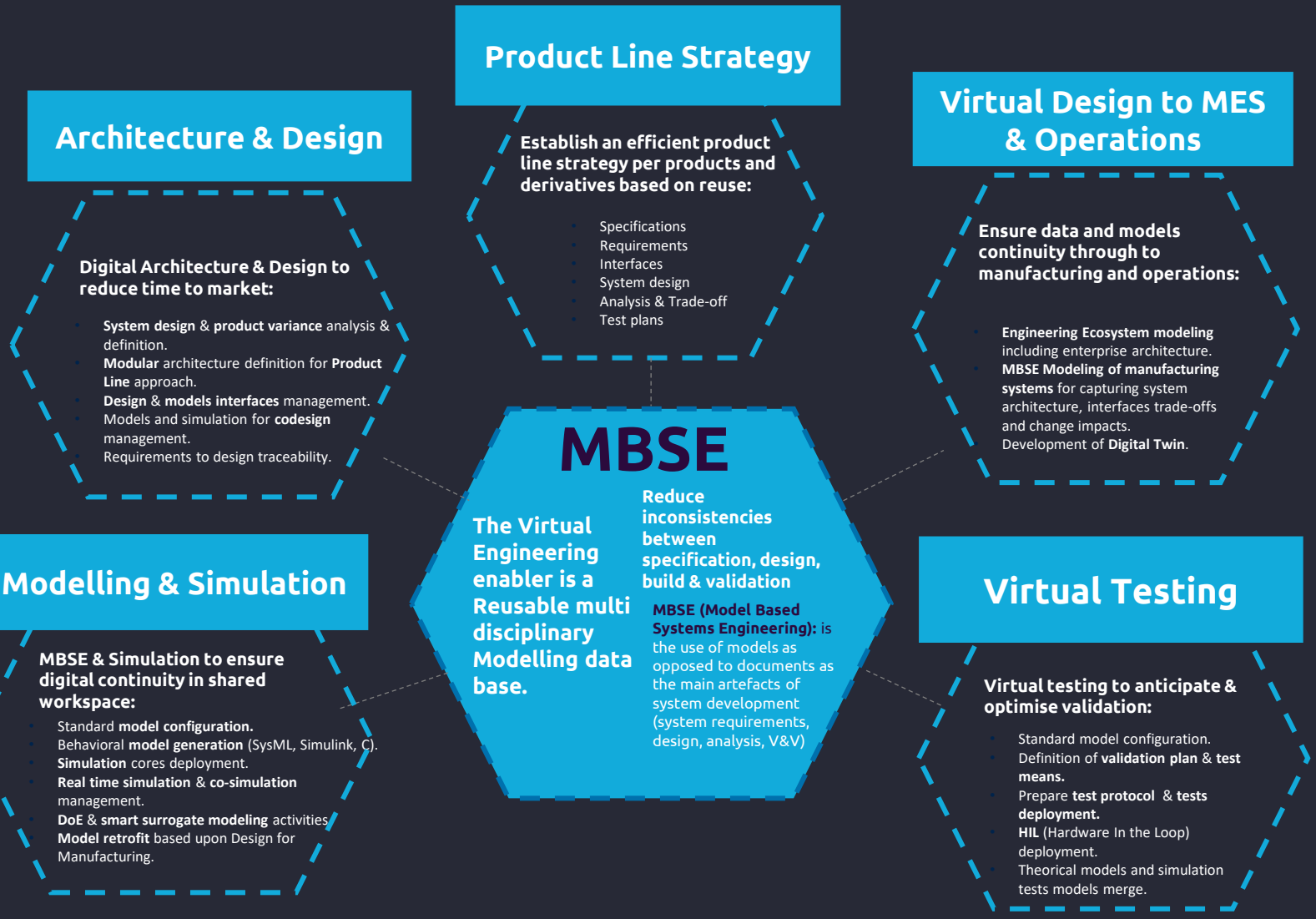
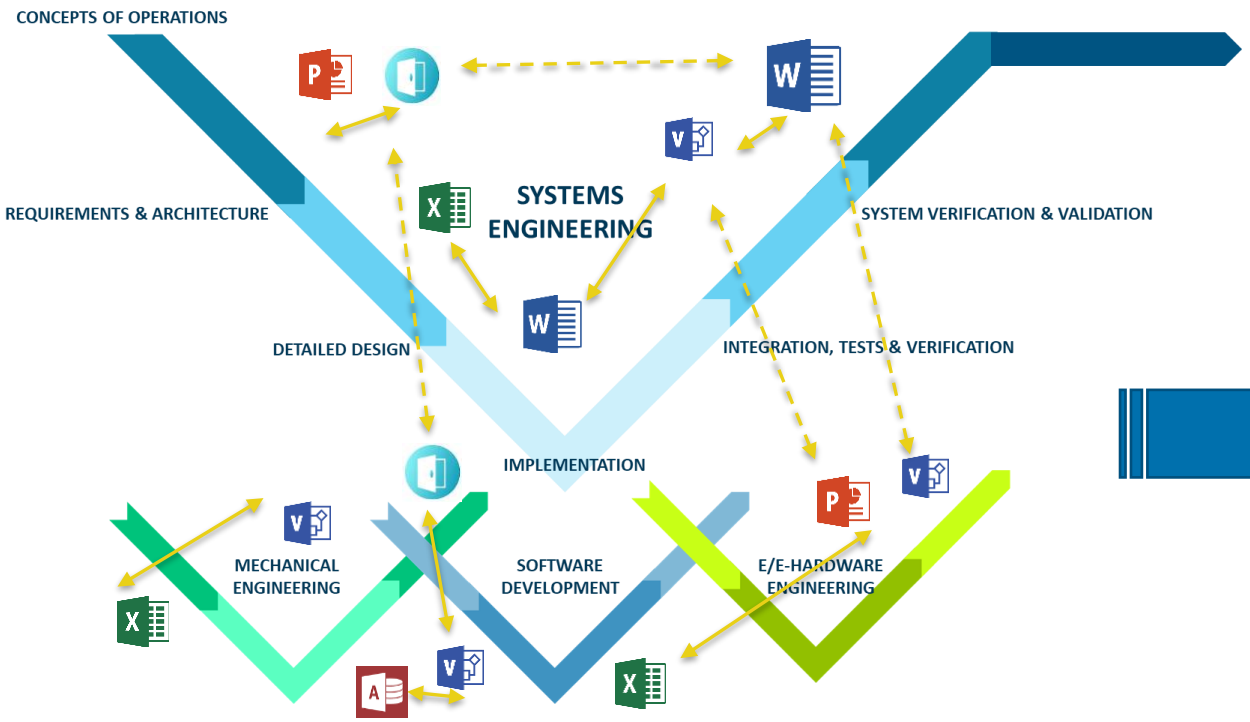
Model-based systems engineering (MBSE) is the formalized application of modelling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases

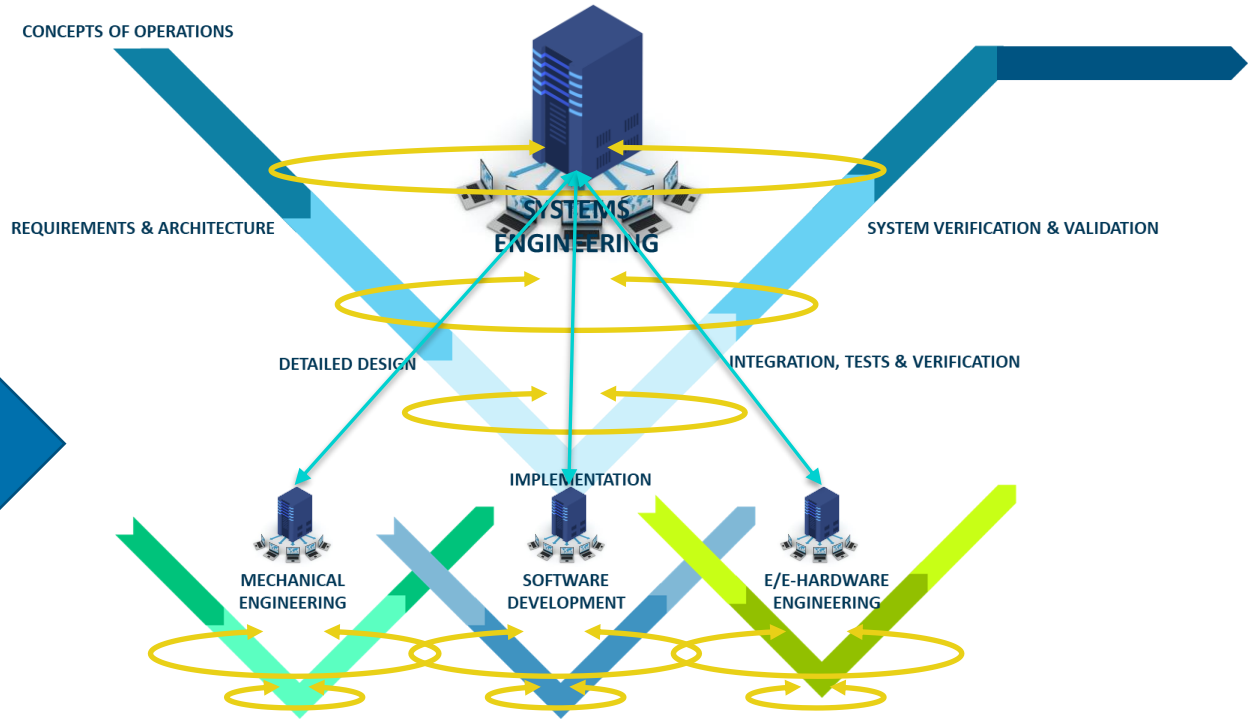
WHAT IS THE ROLE OF MBSE?



SYSTEMS ENGINEERING IMPLEMENTATION

Traditional approach vs. Model-based approach (MBSE)





Document centric **Model centric**

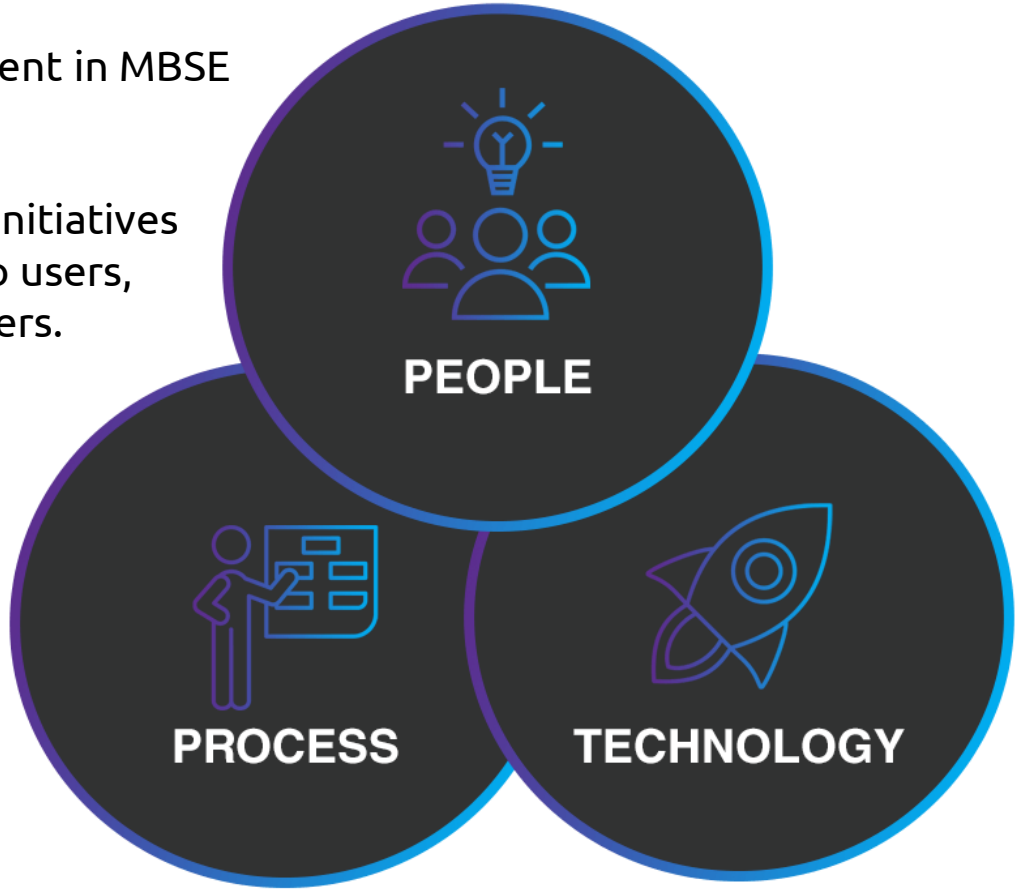
CHALLENGES OF ENTERPRISE MBSE ADOPTION

Cultural Change:

- Resistance to change
- Skilled workforce
- Continuous development in MBSE competencies
- Management buy-in
- Global MBSE training initiatives
- Continuous support to users, especially early adopters.

Global Processes:

- Common MBSE approach across the organisation
- Governance of MBSE approach
- Maintenance & updates to MBSE approach
- Reuse strategy



Tools & Infrastructure:

- Fully collaborative development environments.
- Toolset integration across lifecycle.
- Configuration management of full digital thread across toolsets.
- Maintenance & updates of tools & infrastructure.

CAPGEMINI MBSE OFFERING

What do we propose?

Bring best in class industry process and tools, raising Collaboration & Digitalization at scale, to achieve your business drivers across the lifecycle (Engineering, Manufacturing, Service):

- **Speed to Market**: Reduce Time To Market, from Lead time to Cycle time
- **Efficiency at Scale**: Improve Efficiency on local and scaled scope of your Lifecyle
- **Future-Proof**: continually innovate, manage complexity and guarantee best practice with certifications
- **Business agility**: and address market demands by delivering flexibility for your assets.
- **Improved Quality:** reduce design & manufacture defects through early validation of solutions in the model based environment.

How do we do it?

1. Systems Engineering Consulting

Supporting strategic business ambitions with an ROI-oriented enterprise transformation roadmap.

2. Transformation and Implementation

Implementing at scale best in class methods and tools to modernise your industry business

3. Engineering-as-a-Service

Industry expertise running collaborative engineering for complex products & systems across the lifecycle

Our assets

Over **4500 Experts on Systems Engineering** practice and more than **20 years** of investment and development:

MBSE Deployment Approach

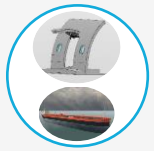
Process and maturity model for MBSE value assessment and capability growth with actionable guidance during capability development areas and approach

MBSE Eco-System

Capgemini partners with international systems engineering standards organizations such as INCOSE, sectorial organizations for Automotive, A&D, LS, and with the major platform vendors.

MBSE Academy

A coordinated training capability includes on-line and in-person training and conformance to certified higher education standards.

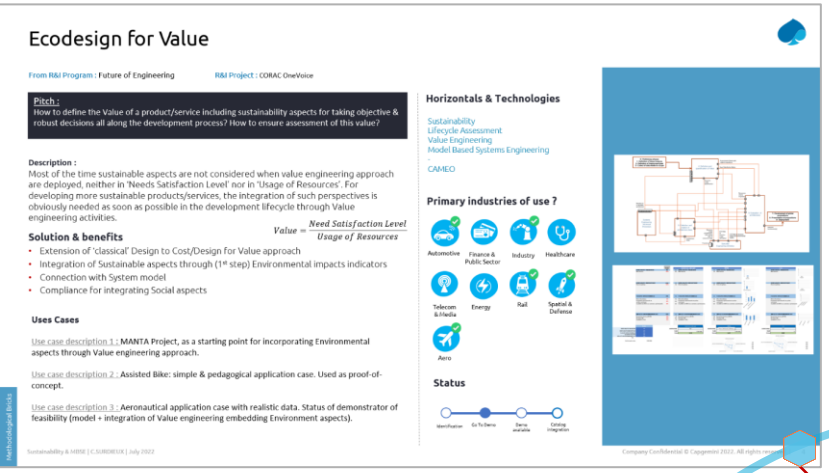


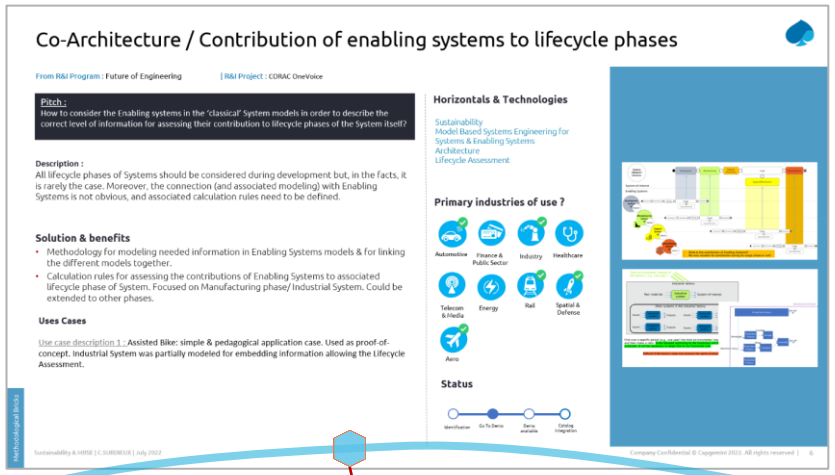
MBSE Labs

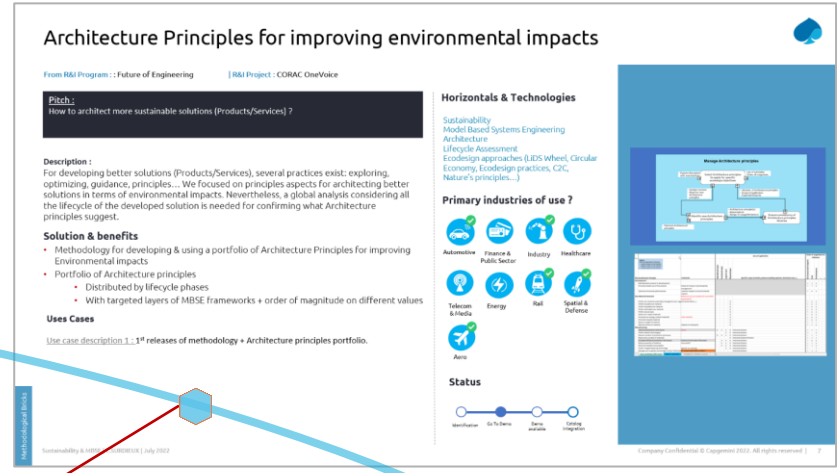
Capgemini dedicated MBSE labs focus on solution benchmarking for various industries. The labs serve as both customer experience centers and training environments.

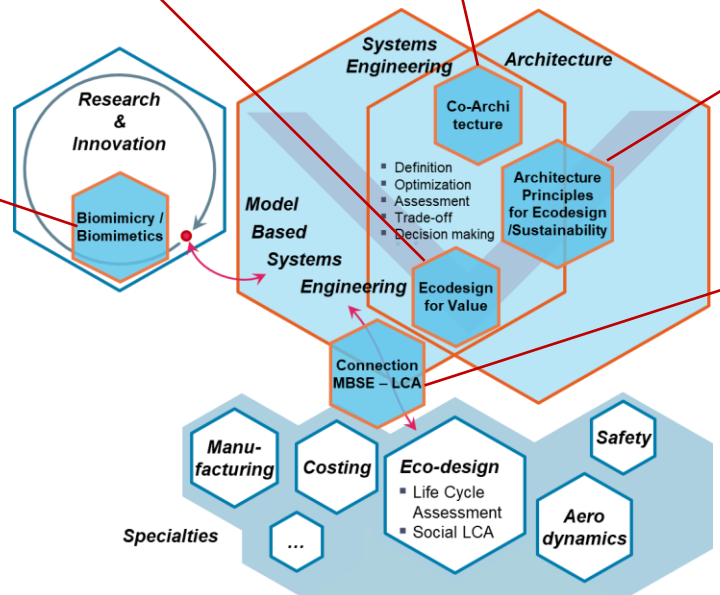
WHERE HAS CAPGEMINI DELIVERED SUCCESSFUL OUTCOMES?

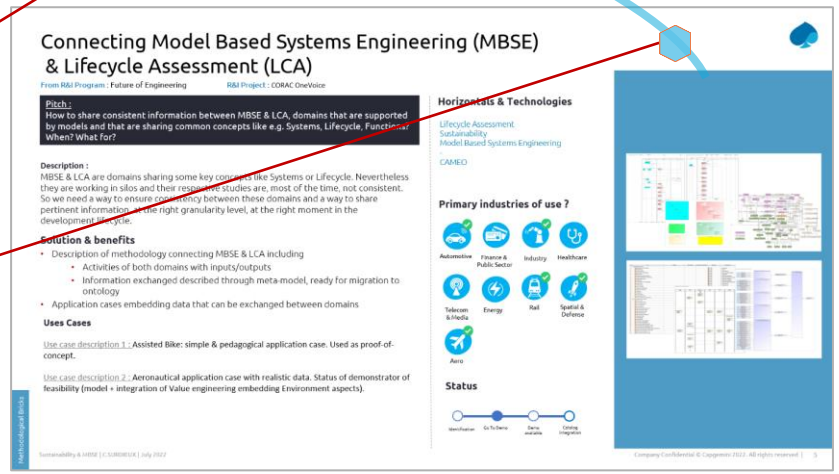
“WHERE” – HAS CAPGEMINI DELIVERED SUCCESSFUL OUTCOMES?











DESIGN FOR ENVIRONMENTAL VALUE ECO-DESIGN METHODOLOGY (VALUE & MBSE & LCA)

CONTEXT

CORAC (COnseil pour la Recherche Aéronautique Civile) is an R&I program with funding from the French state, aimed at anticipating technological changes that will make it possible to decarbonize and ensure the competitiveness of the civil aviation industry

➢ We participate to this program in the frame of **"Design to Environment"** project: eco-design methodology combining value, MBSE and LCA for aeronautical usage

OBJECTIVES

- **Definition of the Methodology**
  - Definition of the sustainability value and links with other values
  - System model embedding these values
  - Connection between MBSE & LCA models
  - Reference environmental assessment
  - Contributions of enabling systems to environmental assessment
  - Architecture Principles
  - Uncertainties management
- **Deployment with 2 cases**: Assisted bike + transposition in the aeronautic domain through realistic data

SOLUTIONS:

- **Value**
- **LCA** (Life Cycle Assessment)
- **MBSE (**Model Based Systems Engineering)
- **Eco-design methodology**

ACHIEVEMENTS

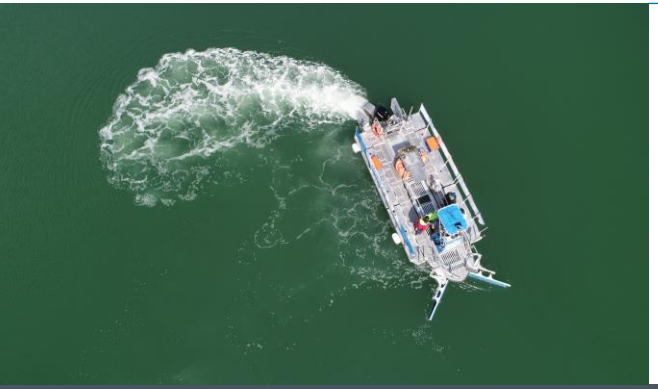
- **Different releases of methodology bricks**: Sustainable value, connection between Value – MBSE – LCA, contribution of enabling systems
- **Releases of system models,** for an Assisted bike with CAMEO tool + Aeronautical case

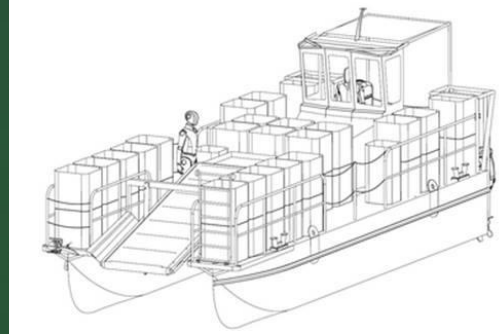
AIRBUS Capgemini engineering

CORAC Aéronautique Environnement Recherche

OneVoice
WP Design to Cost - Design for Environment

EcoPlex
Eco Design of Complex Ships





SOLUTIONS:

- **LCA** (Life Cycle Assessment)
- **MBSE** (Model Based Systems Engineering)
- **Eco-design methodology & tool**

PARTNERS :

Capgemini engineering · MANTA INNOVATION · OBEO · ÉFINOR · SDI Stirling Design International · LS2N

ECOPLEX (ECO-DESIGN OF COMPLEX SHIPS) STANDARDIZED ECO-DESIGN TOOL (MBSE & LCA)

CONTEXT

EMC2 is an European competitiveness cluster for manufacturing technologies, aiming to support companies towards better and clean production, through collaborative innovation projects.

➢ **EcoPlex project** has been qualified by this cluster & funded by Bpifrance, the Bretagne region and the CIR: Methodology & eco-design tool, with digital continuity between the MBSE and the LCA, for use in the naval domain

OBJECTIVES

- **Definition of an eco-design methodology**
  - Modular with generic parts and parts specific to naval domain
  - Digital continuity by connecting MBSE & LCA with integration of naval stakes
- **Specification dossier for software**
- **Tool development:** Capella add-on for MBSE to LCA digital continuity
- **Implementation in 3 pilot cases:** Mobula 8 & 10 + SDI boat
  - MBSE & LCA models
  - Usage of developed add-on for testing
  - Analysis results

ACHIEVEMENTS

- Analysis of the **state of the art** in all areas, with a focus on the Naval domain
- **Releases of the methodology:** macro definition of naval engineering, MBSE and LCA development processes
- **Releases of tool specifications & plug in**
- **Releases of MBSE & LCA models** for the 1st pilot cases with export-import from System model to LCA model

April 2021 – October 2022

Capgemini engineering

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