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Implementing Product Line Engineering for Railway Rolling Stock

Where the big bucks (will) come from

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Acuity Solutions

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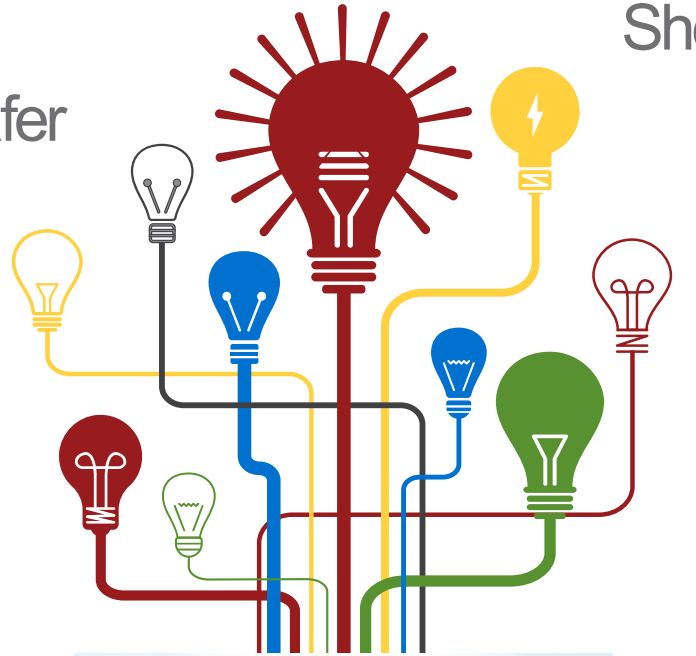
A too familiar picture

Shorter time-to-market

Safer



Higher profits

More reliable

Highly competitive markets

More attractive

Global marketplace

More cost-effective

An example: railway rolling stock industry

- Significant changes over the past few years
  - New players – operators and rolling stock providers
  - Market growth spread world-wide
  - European railway operations market now formally open to competition

➢ Key factor: delivering the appropriate product with ever shorter times-to-market and at competitive costs

How to face this challenge?

Push products to the market? ✗

Leverage previously developed assets for their reuse into a new product?

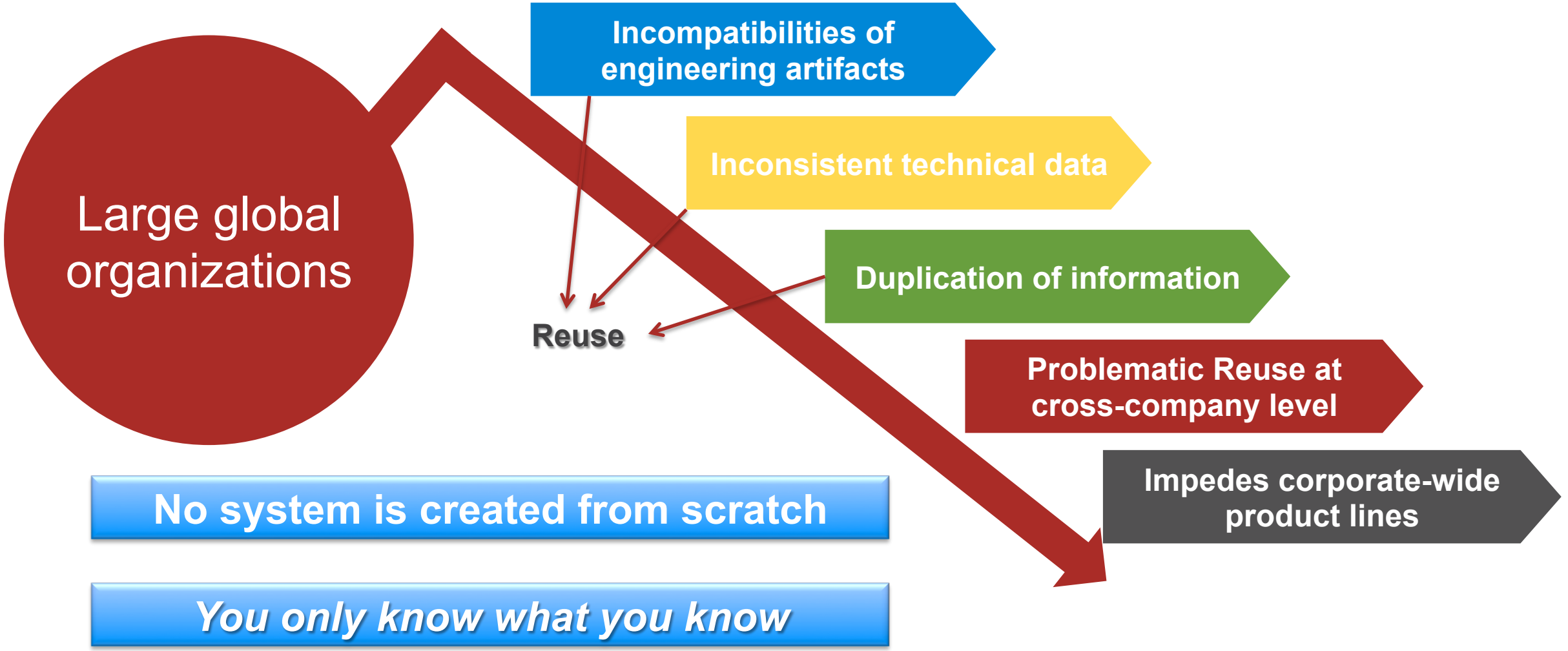
About reuse

- A known concept – *Use again what you have done before to produce the same thing or something similar*
- But an unclear understanding of its ***purpose*** – *Produce the same thing or something similar… only faster and better*"

Product Line: "A family of similar products with variations in features and functions"

Product Line Engineering: "The engineering of a product line using a shared set of engineering assets and an efficient means of production, taking advantage of the commonality shared across the family, while efficiently and systematically managing the variation among the products"

About real life



No system is created from scratch

You only know what you know

Problem statement

How can a large, global organization transition from a widespread, careless practice on reuse to an **effective** and **profitable** implementation of PLE?

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Where to start?

Reuse: a well documented practice in SW and manufacturing

01

References for a reuse ***practice*** for engineering complex systems is scarce and relatively new

02

Let common sense be the guide: Apply a little systems thinking & start with your own needs

03

04

Understand where you are (identify current practices) & Decide where you want to go (how would we like to go about your business)

What are the barriers?

Enterprise transformation

- Acceptance and application of PLE principles: difficult in areas where reuse is performed "unintentionally"
- PLE calls for a more rigorous formalization: It is seen as burdensome, rigid & process-oriented
  "*I don't have time to do this!*"
- PLE requires upfront investment and forethought
  "*… and you also want me to pay **and** think?!*"

Keywords: Step-by-step & Flexibility
➔ Best approach: a balance between your problem and your maturity

The top challenges

3 *"Reuse concerns only final tangible products"*

2 *"I want my product line, too!"*

4 Careless reuse
(Copy-paste **is not** engineering)

1 *"Not with my money, you won't!"*
(Power to the Projects…
a.k.a. Quick wins, long-term losses)

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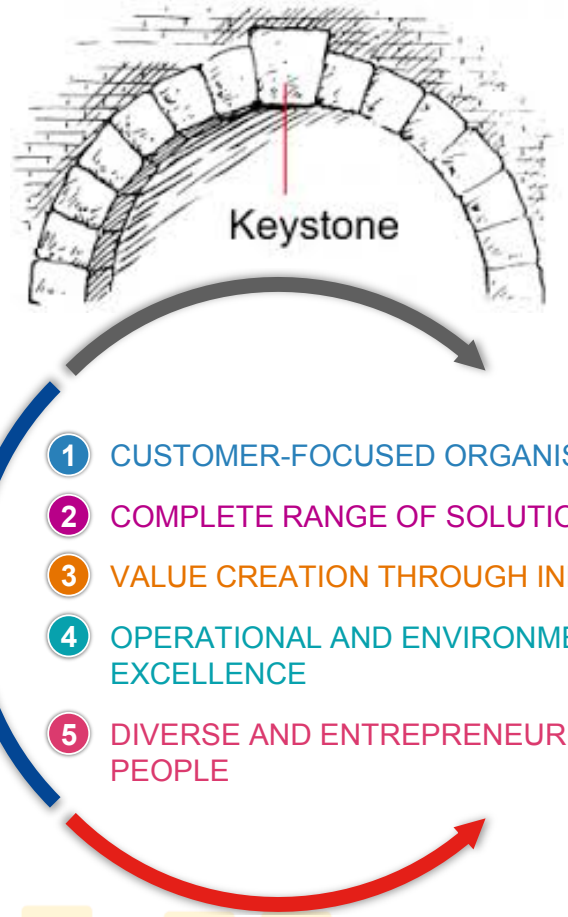
Sowing the seeds of PLE

Anchor PLE as or in the strategy of the Organization

PLE must be understood correctly

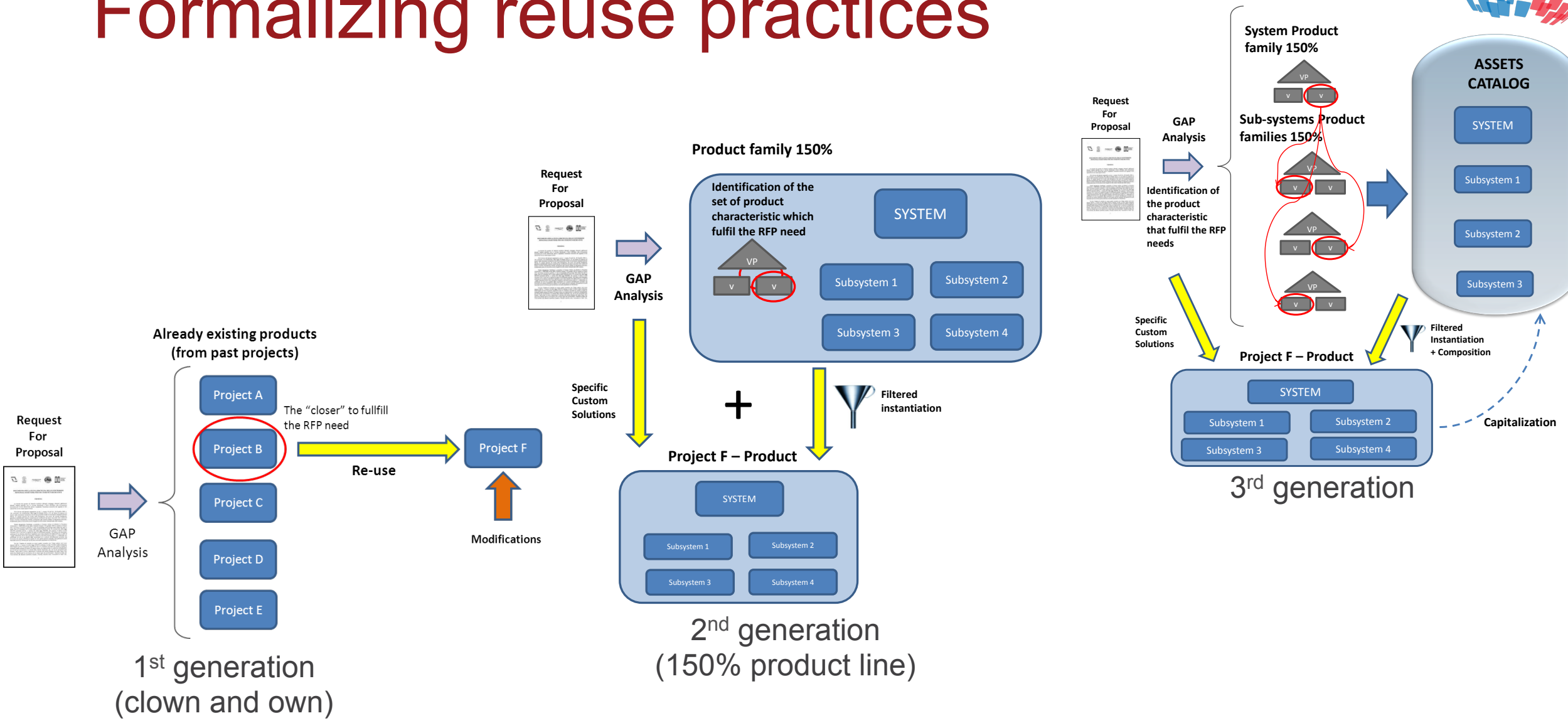
- Required investments
- Expected benefits



Formalize and share the purpose of PLE

- Keep focused
- Reorient initiatives

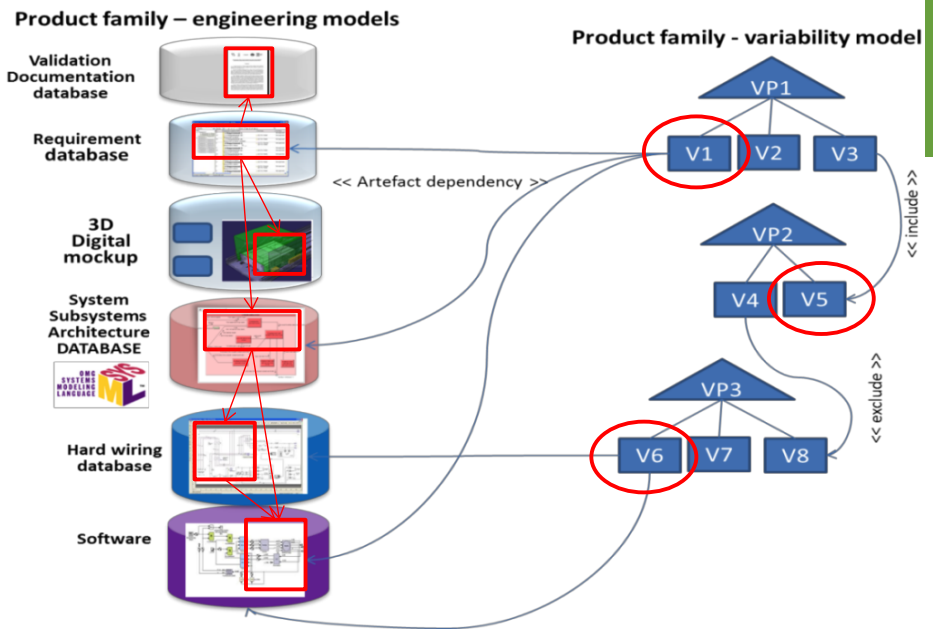
Formalizing reuse practices



Pre-requisites & enabling factors

Implement configuration mechanisms

Chose applicable variants and instantiate asset repositories



Explicit dependencies

What engineering artifacts are affected and how

Describe product variability

Issue: identifying **core** assets

Stop gambling

1. Use Systems Engineering
2. Perform **good SE**

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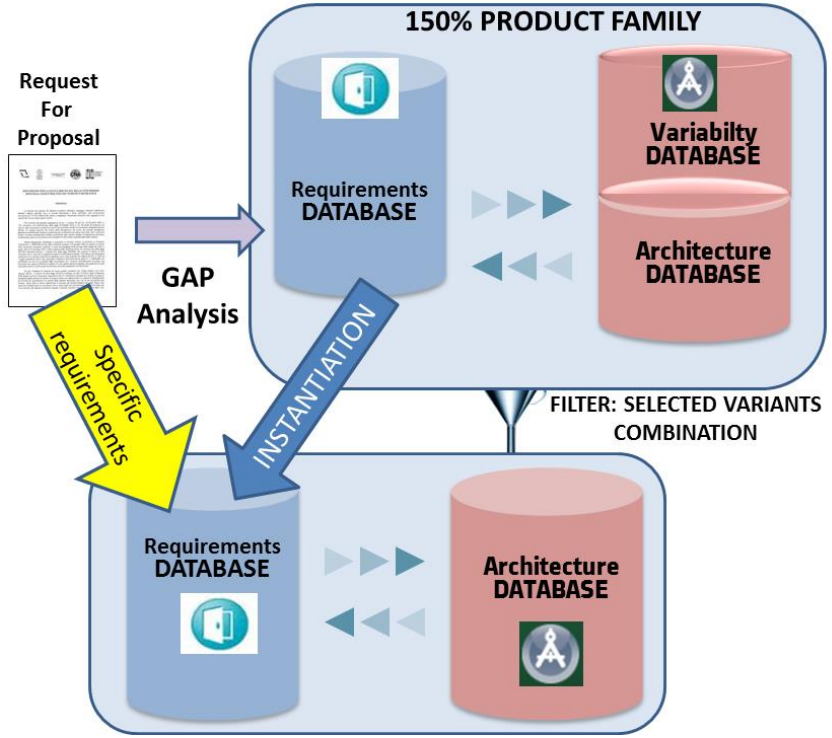
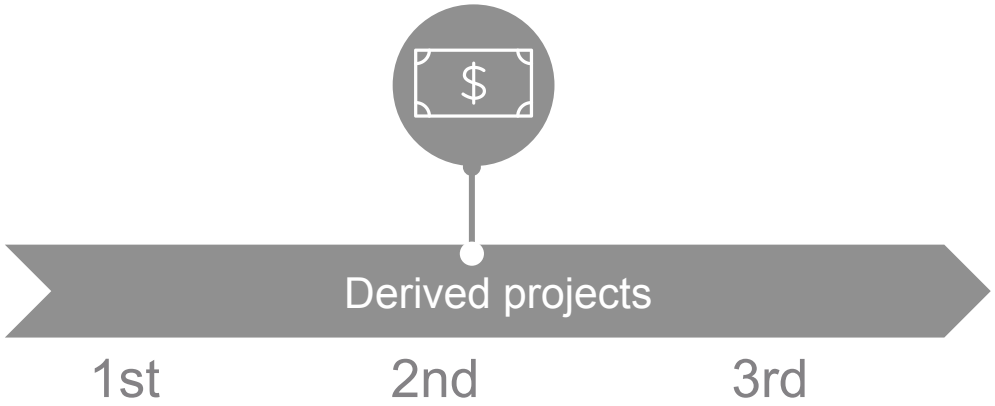
Light at the End of the Tunnel

1st Initiative : Platform Concepts Anew

Gap analysis performed directly on the 150% Product Family database.



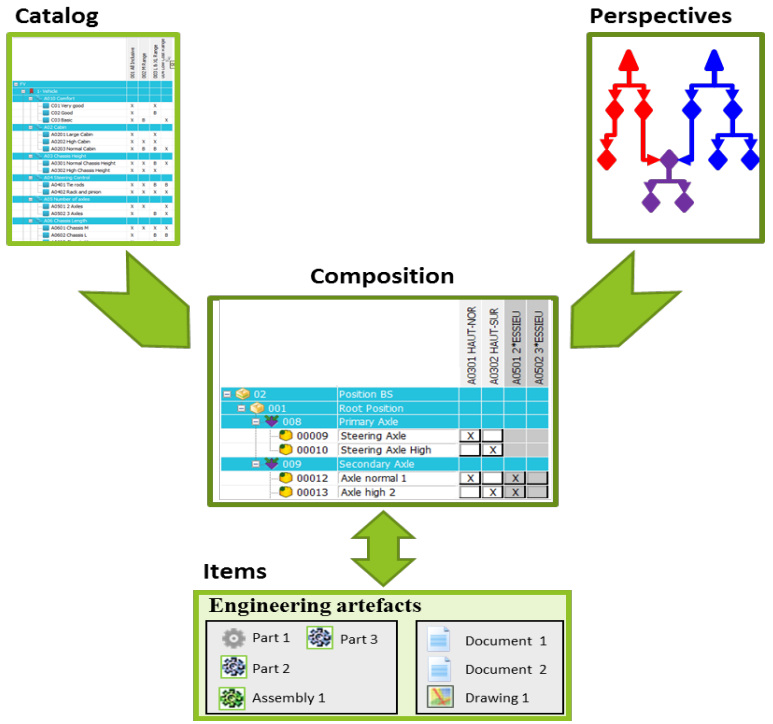


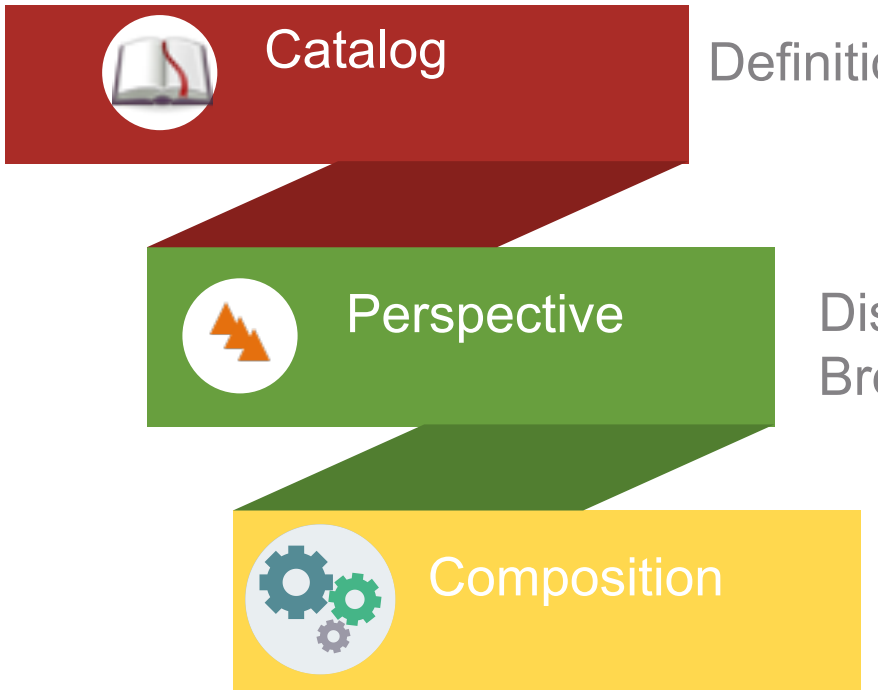
Reduction of fixed engineering costs in requirement development process compare to typical “White page”

Light at the End of the Tunnel

2nd Initiative : Variability Management

On single point of truth for the variability of product lines and catalog of train subsystem





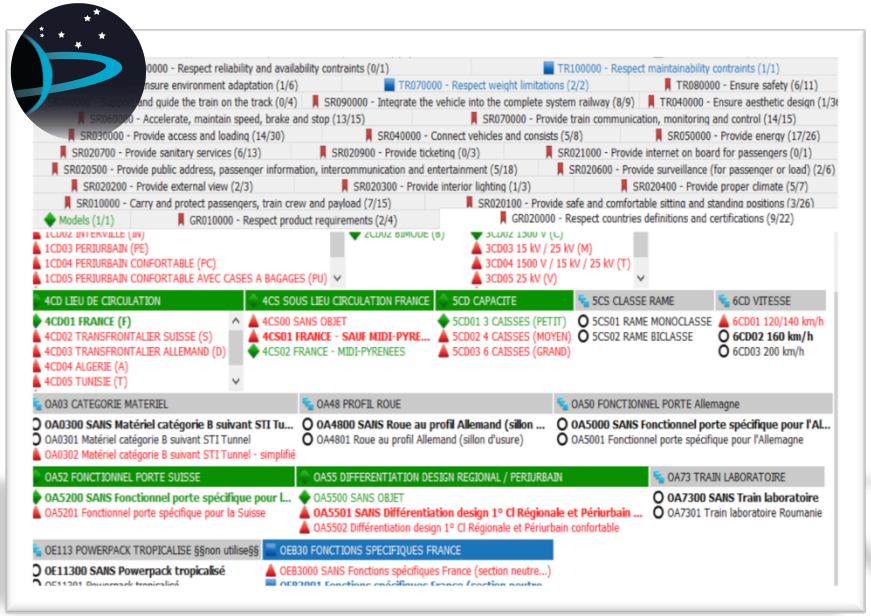
Definition of product variability

Discipline's Product Breakdowns and relationships

Dependencies between variants and engineering artefacts

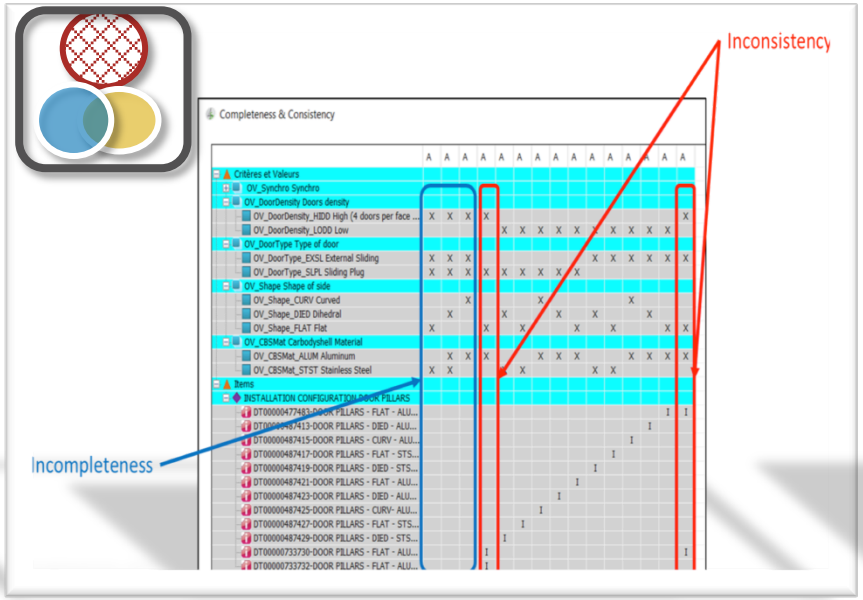
Light at the End of the Tunnel

2nd Initiative : Variability Management



Mechanisms to configure products :

- Guided route to valid configuration
- On Click generation of filtered views of assets



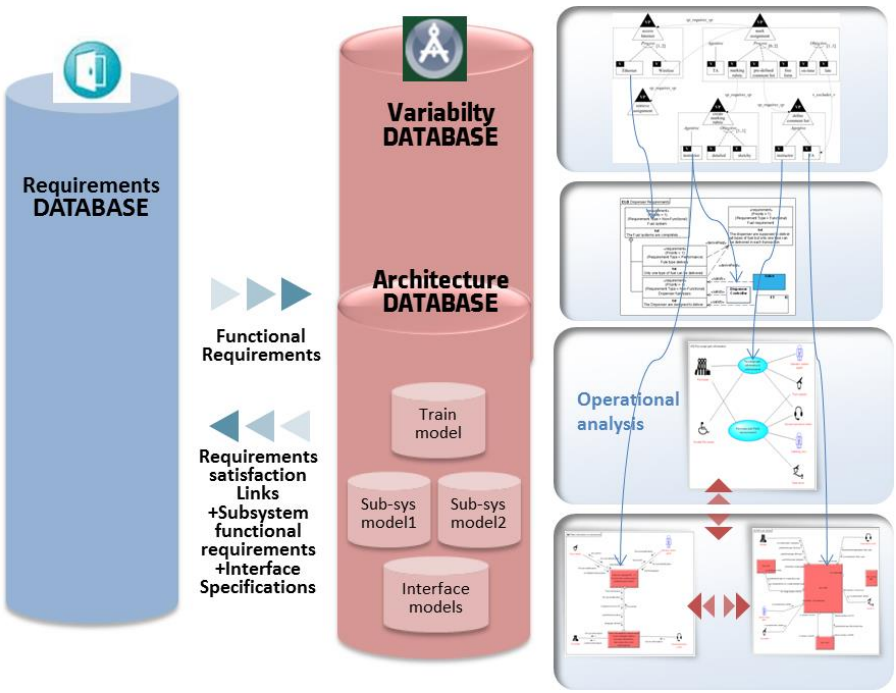
Mechanisms to check completeness and consistency

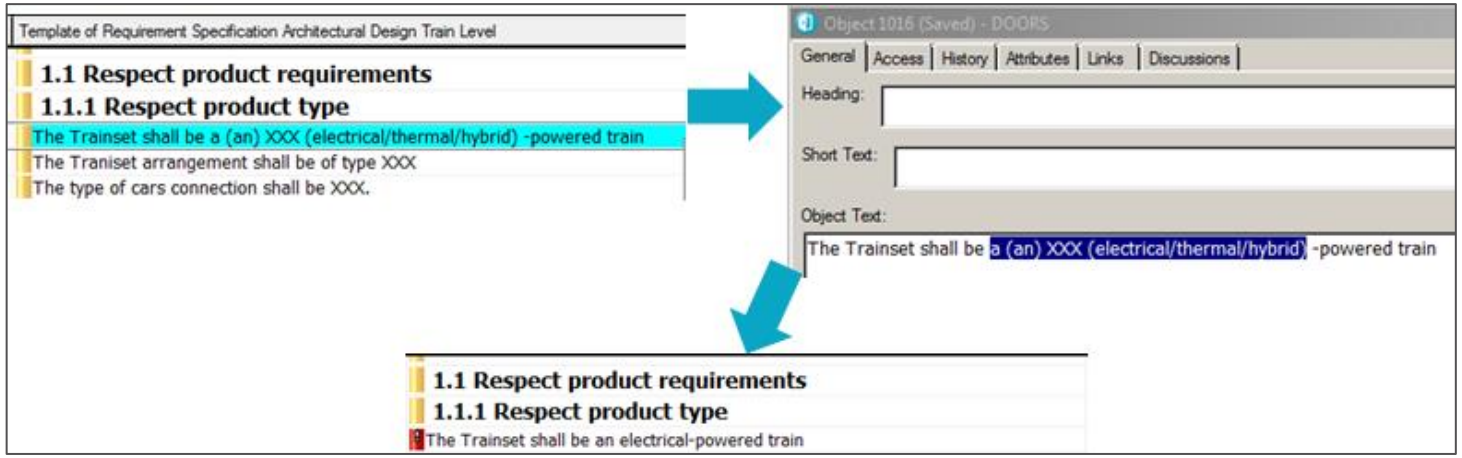
Eligible Solutions Comparison with respect to Subsystem Configuration

Implementation in PLEIADE® by Acuity Solutions of those concepts and use of its dedicated tools to master Diversity

Light at the End of the Tunnel

3rd Initiative : Configurable, Reusable Assets





Example :
A generic requirements module is created following a standard structure and "pre-filled" requirements .
The generic module is configured and then made available for a particular project.

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Put on your 

The work done

- Intermediate results are very encouraging, given the relatively small resources allocated to PLE initiatives
  - The duration of the requirements development process of successive instantiations from one product have gone from 12 to 6, then to 5 and 3 months
    → This could be brought down to **3 weeks**
- Other engineering activities could benefit from similar improvements enabled by PLE
  - Increased effectiveness, decrease of non-quality issues
    → Cost avoidance

Tremendous improvement potential in profitability

Put on your 

Optimize Product Lines Scopes

Define more “inclusive” Product Lines without managing every single artifact as a reusable asset nor targeting a perfectly stable planning of variability

IT and tool interoperability

Get more information OUT of tools than what is put INTO tools

Pursue current efforts

- Create reusable assets repositories
- Promote the sharing of engineering assets across product families
- Extend variability management across disciplines/domains

Cultural change

- Put the company’s money in the right place
- Define and achieve an organizational PLE transition strategy

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