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Product Line Engineering: Reuse Techniques for Requirements

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PLE: Definition

Product Line Engineering (PLE):

PLE is a way to engineer a portfolio of related products in an efficient manner, taking advantage of products' similarities while managing their differences. [1)]

Examples are smartphones, cars, medical devices, many more.

<u>Goals (among others):</u>

- Reduce development effort
- Shorten time-to-market
- Improve quality
- Provide a self-contained set of documentation
  => reuse starts with requirements

1) INCOSE, PLE Working Group, ISO 26580

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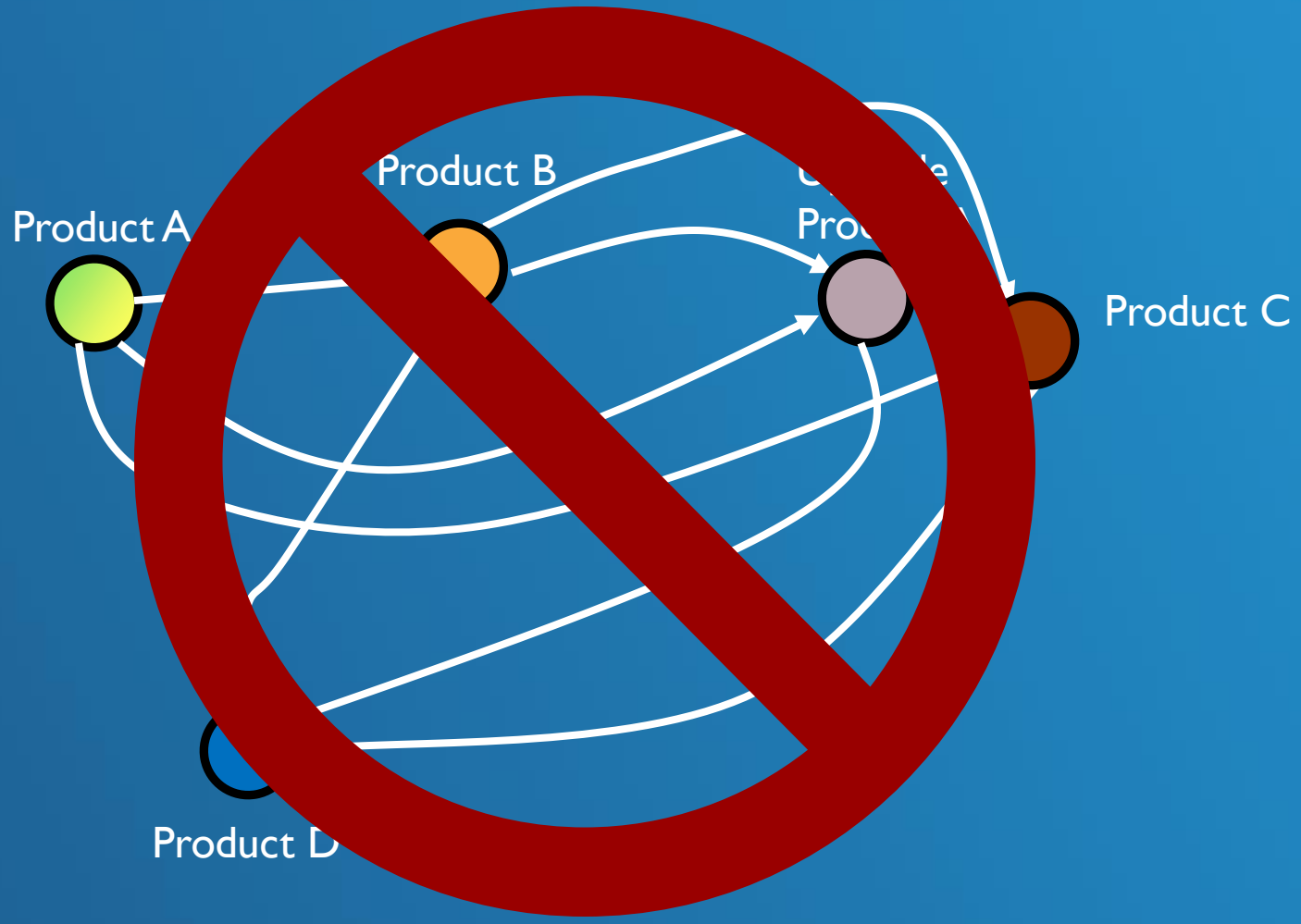
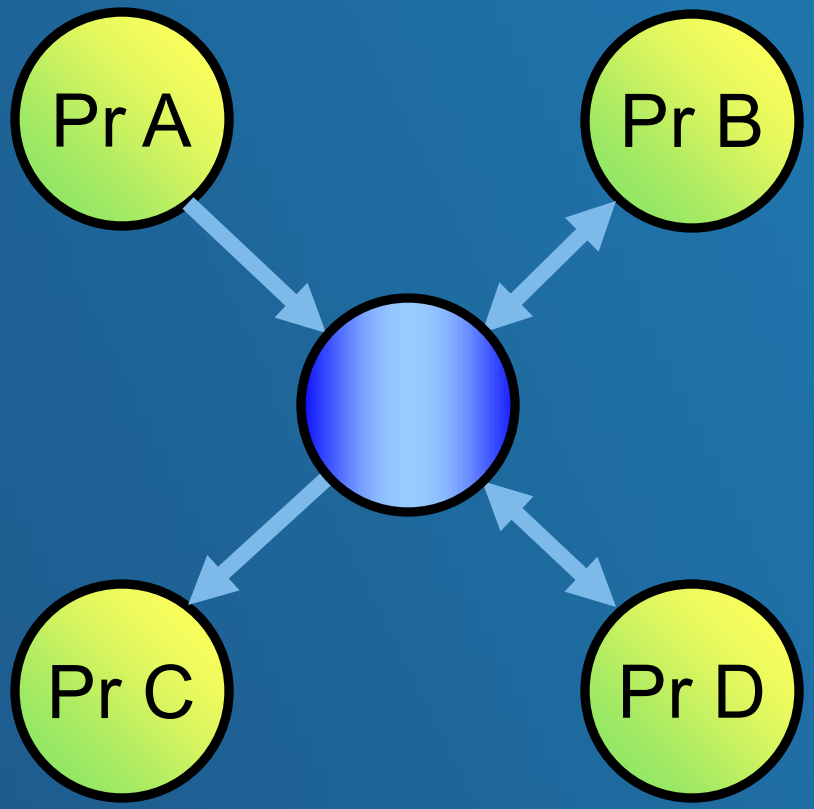
SIMPLE COPY & PASTE



WORKING WITH A COMMON BASE



Base, Repository, Core, 150% Model, Pool etc.

Derived Products

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REUSE MECHANISMS FOR REQUIREMENTS

Attribute based variants

Method for less complex use-cases. Each variant has associated its specific attributes. The variants are shown based on saved filters.

Id	Requirement	Status	Pr A	Pr B	Pr C	Pr D
100	The system shall allow…	approved	x	x	x	
101	The system shall respond…	approved		x	x	x
103	The shell color shall be green	draft			x	x
103	The shell color shall be green	draft			x	x

ADVANTAGES

- Can be done in spreadsheets etc
- Easy to understand
- Easy comparison between products

DISADVANTAGES

- Multiplication of attributes (look at “Status” – there should be Status A, Status B etc.)
- Traceability - links are usually to a requirement not to a specific attribute
- Difficult to manage with multiple authors.
- Potential accidental changes for other products than the one in scope

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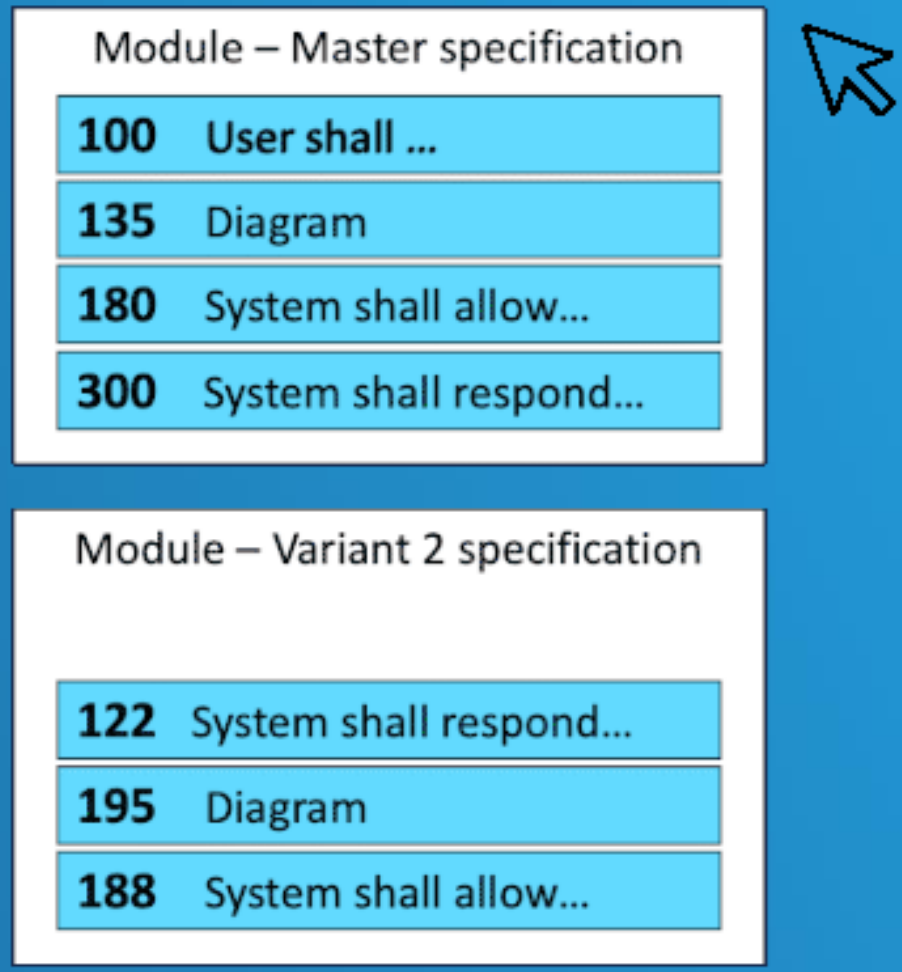
Copy, Paste & Link

Very similar to Copy & Paste. When copying, link of your choice is created between original and copied requirement.



ADVANTAGES

- Direct reference to the original requirement
- Link validity can be used to spot the changes between requirements
- Link + Link Validity = Keeping control of the copy

DISADVANTAGES

- Duplication of the data

Widely used technique in all industries where you need to track the source requirements during your project.

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Artifact based reuse

The best option for providing high integrity and a single source of truth.

- Requirements can be reused across several specifications
- Any change to a requirements in any specification is immediately propagated to all instances in other specifications

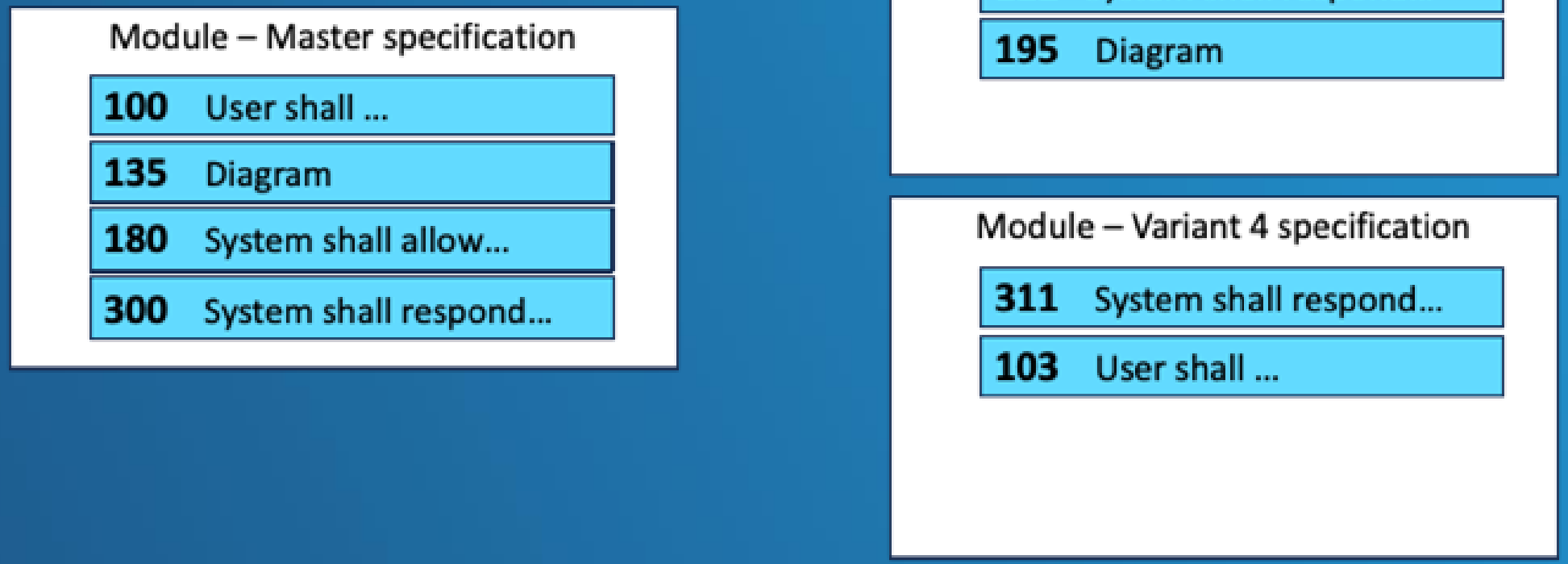
ADVANTAGES

- Preserving high integrity

DISADVANTAGES

- Giving up control of the text and attributes for individual documents
  = changes are harder to control and need to be agreed with other projects.
- Depending on the tool, there might be restrictions what can be reused into which documents.

Artifact based reuse



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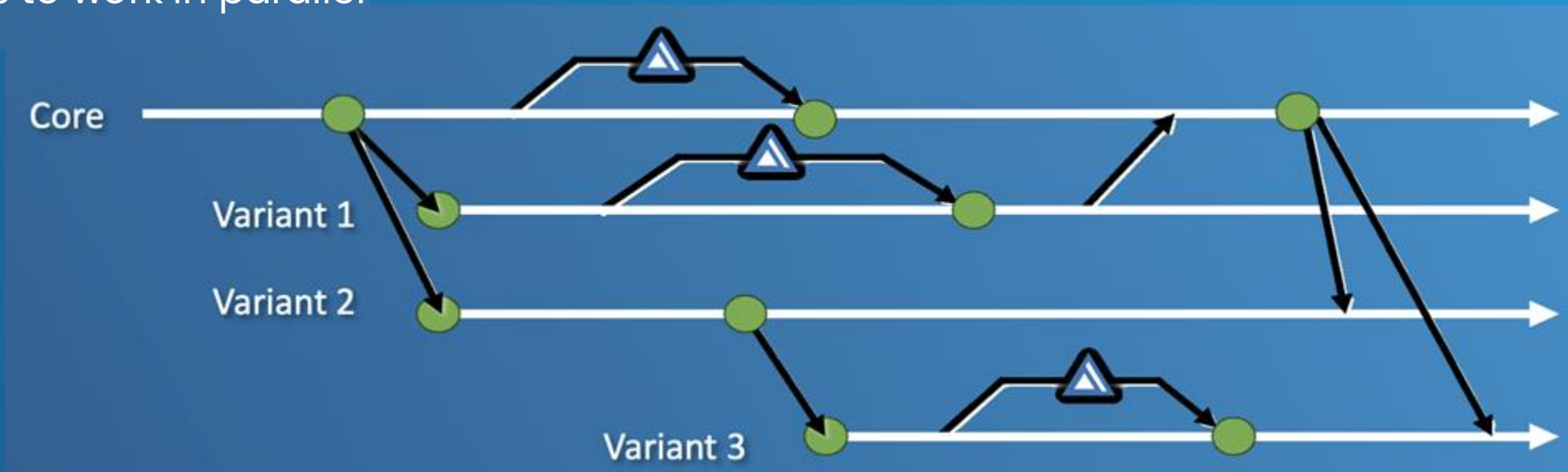
Branching & Merging

Key concept in systems and software development. Branch requirements of into several branches or "streams". Streams can later be compared and/or merged.

Branches are usually created for:

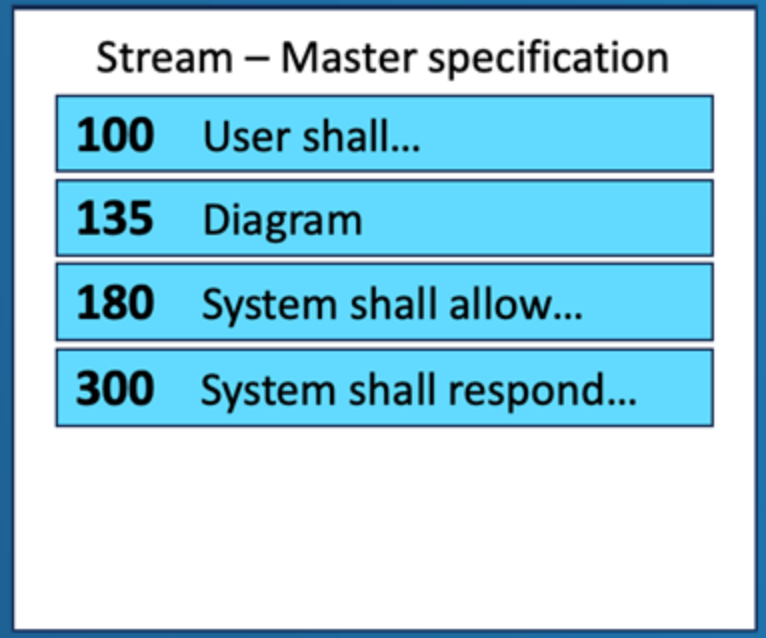
- Create different variants
- Create streams for experimental work or new features while having a stable release stream
- Control the changes and bug fixes
- Enable teams to work in parallel



Changeset

Baseline

Branching & Merging



Using expressions

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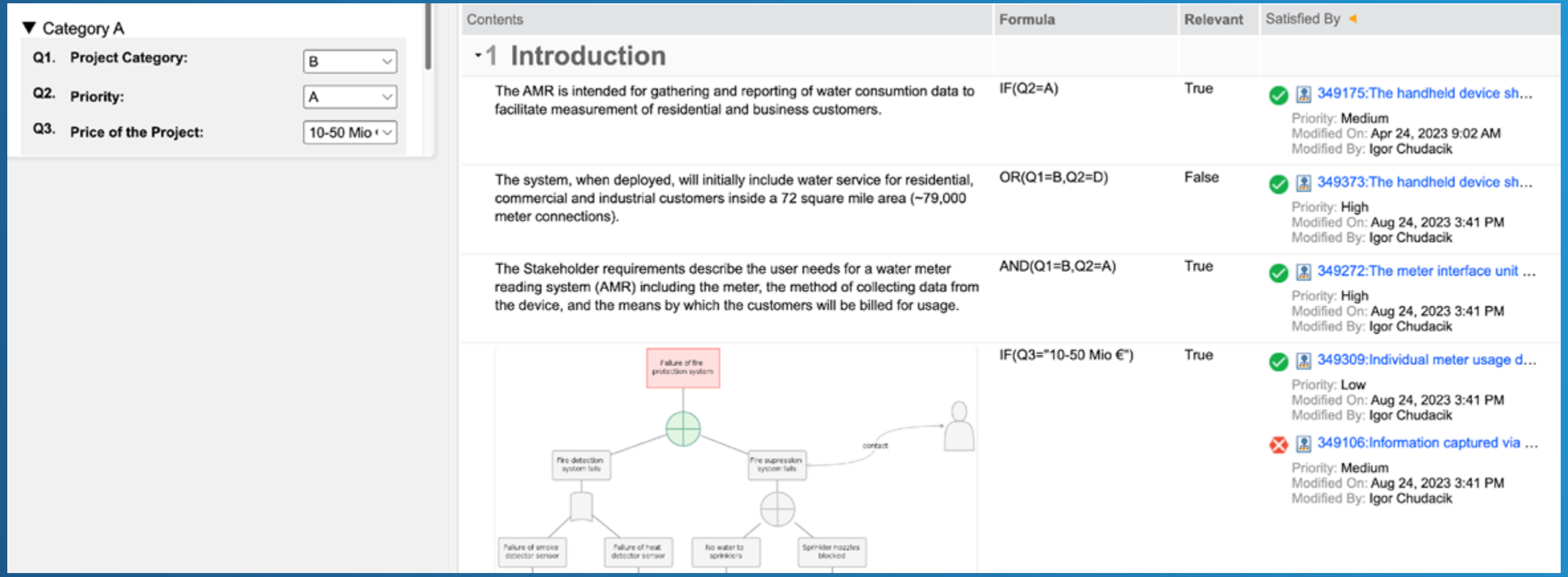
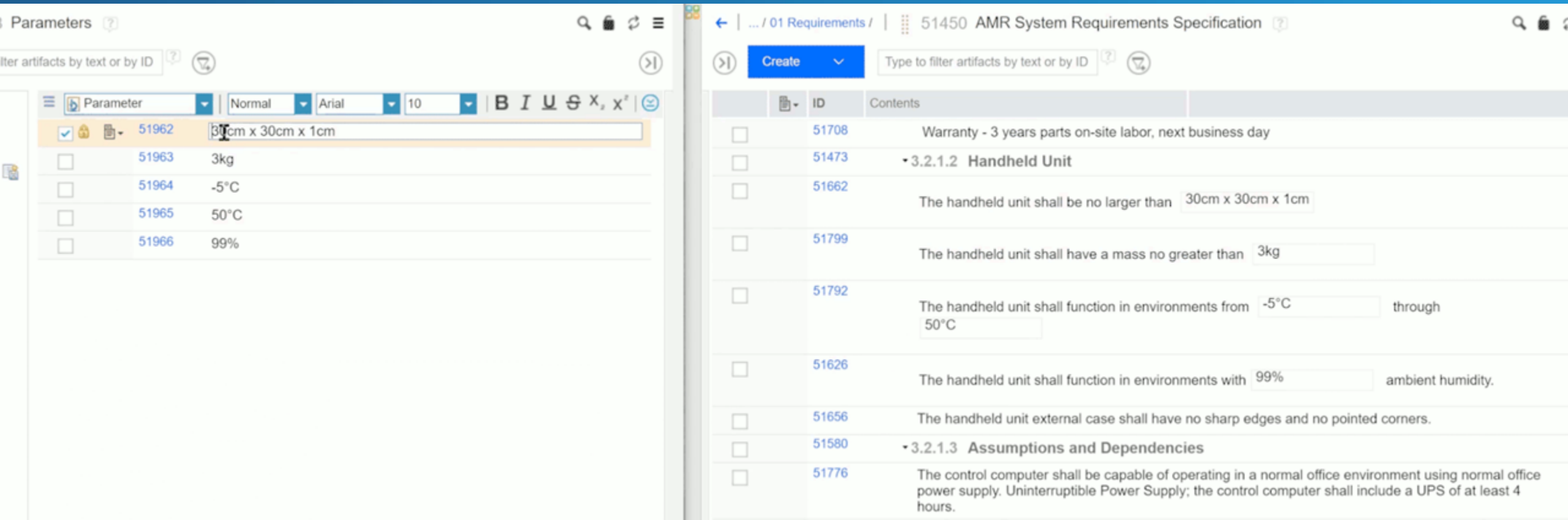
- Filter relevant requirements using expressions.
- Filtered requirements are reused in another specification.
- Every requirement has its own expression – extremely granular.
- Usually this requires custom scripting.



Parameters

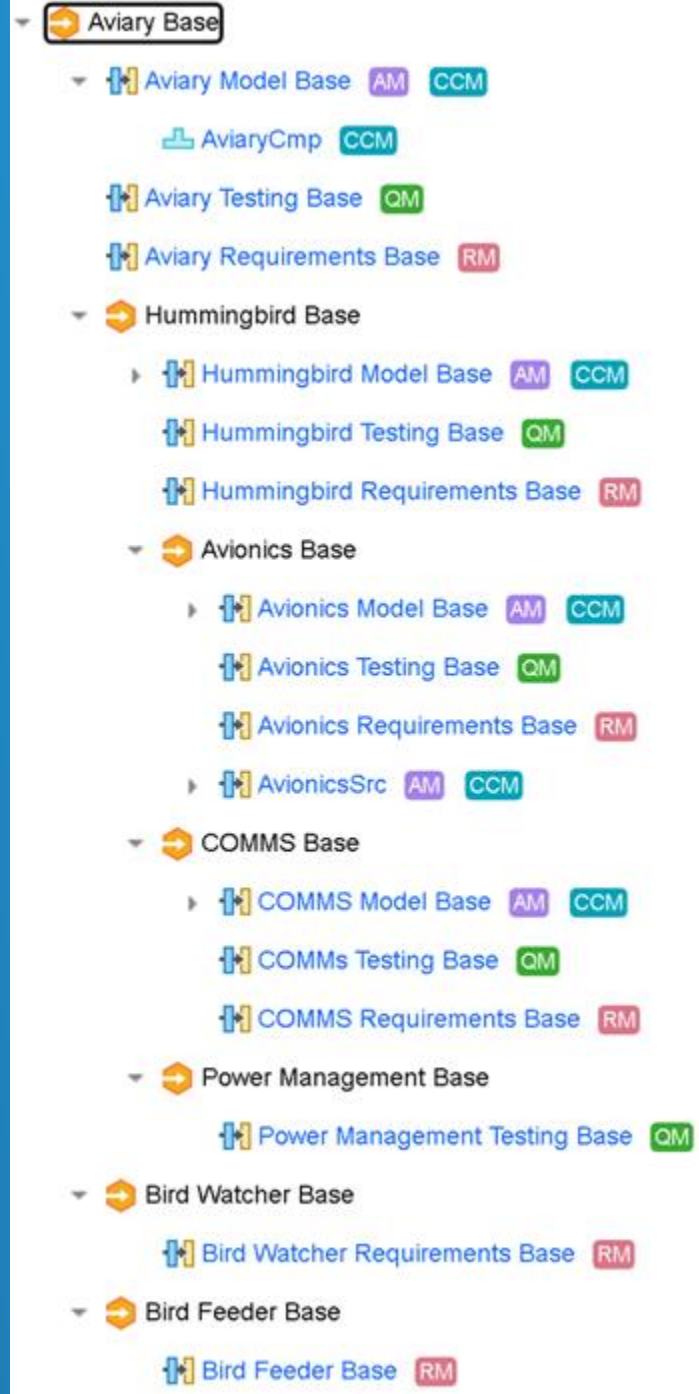
- Parameters are created, changed and stored in a separate document
- Parameter values are embedded into requirements specifications
- Updating the parameters will update parameter values in all specifications



Reuse of system components

- **Configurations:** Most advanced and most powerful form of reuse across the entire engineering lifecycle. Tool needs to support this kind of configuration management.
- Components make it possible to reuse and combine parts of the system across V model, into different versions, variants or products.
- Inside each component some of the previously mentioned approaches can be applied.

- Disadvantage – Increased complexity requires certain level of process maturity in your organisation, regarding variants management and PLE



COORDINATION

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A re-use approach requires coordination for RE:

- Formal check of new requirements before approval to ensure consistent quality.
- Promoting new requirements to the repository.
- Maintenance of the repository in regards to structure and content.

General responsibilities:

- How to apply re-use with the selected requirements management tool.
- Work with process management to define PLE processes so they integrate with the project management processes.

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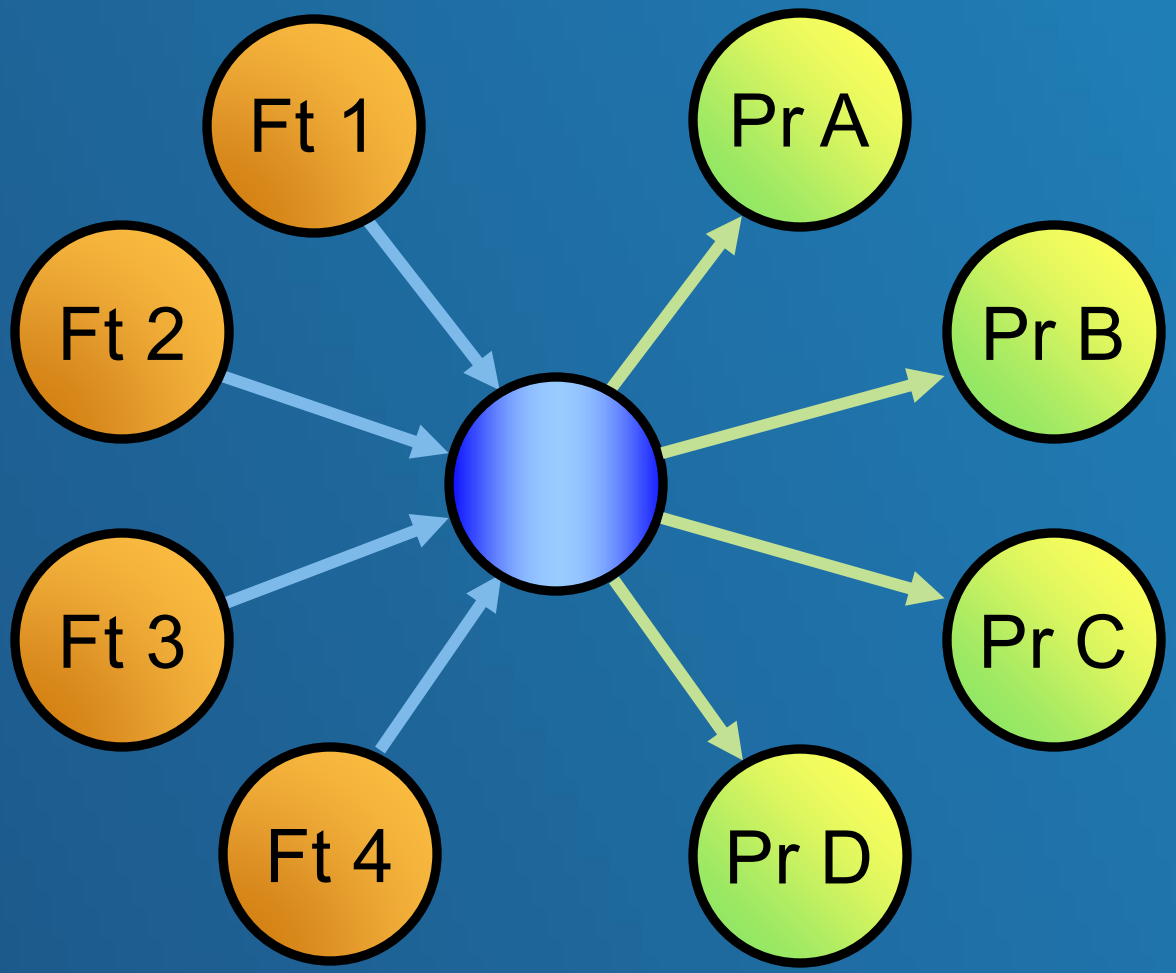
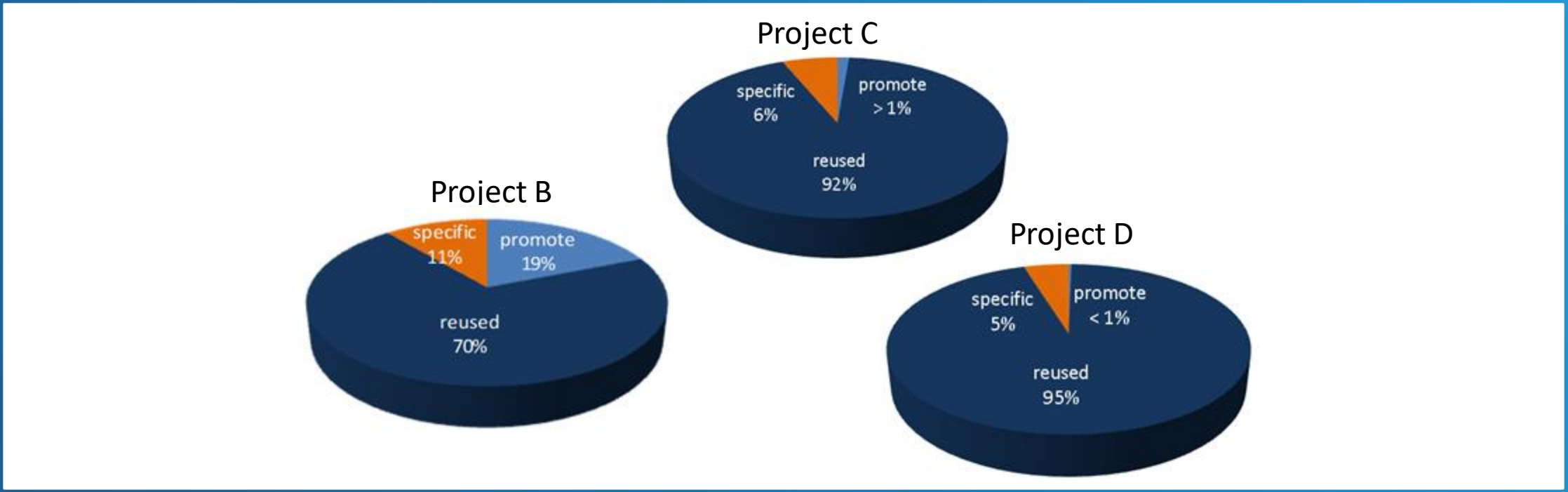
PLE PROCESSES – what is developed where and when?



- Feature development projects
- Base, repository, core, 150% model, pool etc.
- Derived products – configuration & reuse only

SUCCESS STORY (data from real projects)



Mechanism used: “Copy, Paste & Link”, later PLE based PM & development process

- Re-use >70% already for the 2nd product.
- Follow-up products >90%

=> Reduced effort for approval meetings and discussions for existing features.

=> Reduced effort for implementation because of configurable features.

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Thank you for your attention ☺

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