

REConf Schweiz 2009  
EFFECTIVE AND PRACTICAL REUSE OF REQUIREMENTS

Milan Ignjatovic, EVOCEAN GmbH

Blaise Rey-Mermet, EVOCEAN GmbH

## AGENDA

**MOTIVATION – why reusing requirements?** [Blaise Rey-Mermet]

**TERMINOLOGY** [Milan Ignjatovic]

**REUSABLE REQUIREMENTS** [Blaise Rey-Mermet]

**REALIZING REQUIREMENTS IN THE SYSTEM CONTEXT** [Milan Ignjatovic]

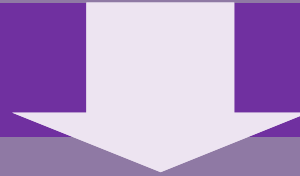
**Q & A**

## MOTIVATION– WHY REUSING REQUIREMENTS?

## WHY REUSING REQUIREMENTS

develop the next generation of a product  
at the **lowest possible costs**

produce variations for diverse markets  
**consistently and reliably**



...better share a requirement across projects / products **without unnecessary duplication** of artifacts

## TERMINOLOGY

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- **Product line:**

A set of systems sharing a common, managed set of features that satisfy the specific needs of a particular market segment or mission and that is developed from a common set of core assets in a prescribed way.

- **Features:**

Features are user-visible aspects or characteristics of a system fulfilling a set of requirements and are organized into a tree of and/or nodes to identify the commonalities and variabilities within the system.

- **Core Asset:**

Is a reusable artifact or resource that is used in the production of more than one product in a product line.

A core asset may be an architecture, a component, a domain model, a requirements statement or specification, a document, a plan, a test case, a process description, or any other useful element of a development process.

## TERMINOLOGY

- **Attached Process:**

Is the process associated with a core asset that tells a product builder how the core asset will be used in the development of products.

- **Use Case Modeling:**

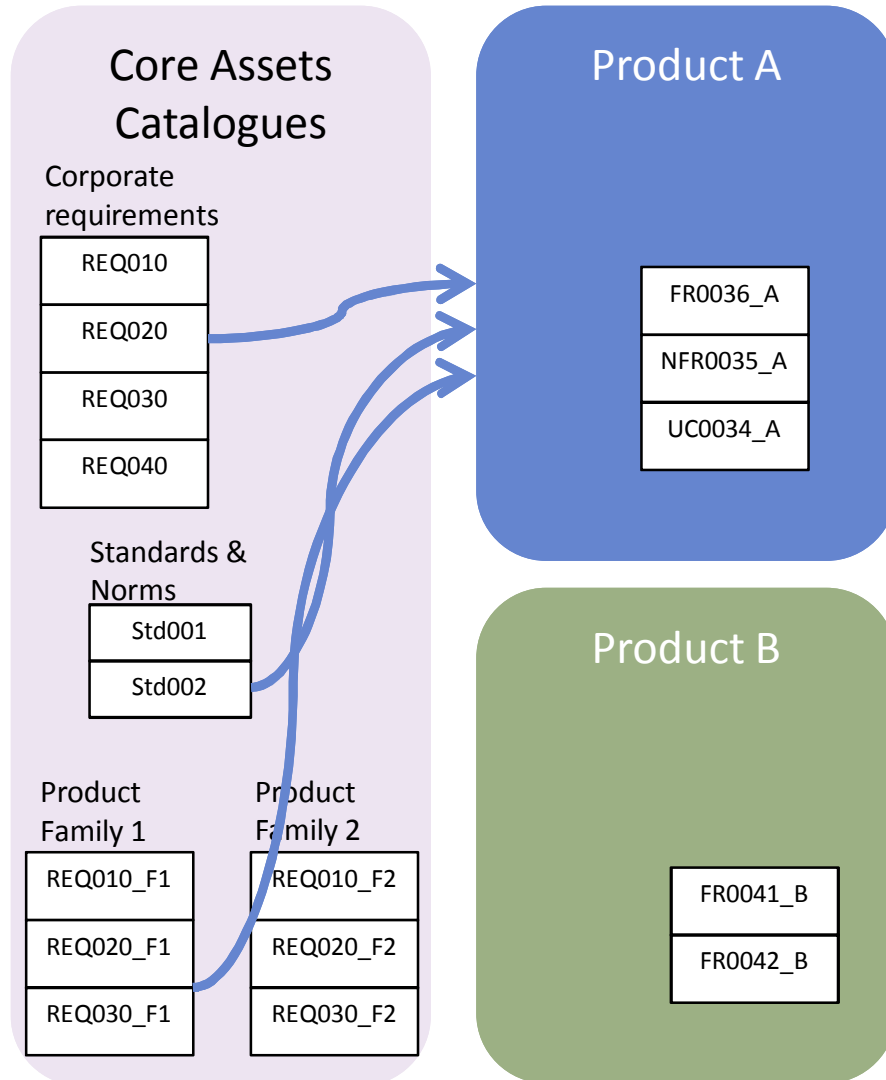
Use case modeling is used with variation points to capture and describe commonality and variability within product line requirements.

- **Variation Point:**

A variation point is a location within a use case where variability occurs. That variability is captured in a variant that describes the context and mode of the variation. The mechanisms supported for capturing and describing different types of variation within use cases include **inheritance, uses, extensions, extension points, and parameterization**

## REUSABLE REQUIREMENTS

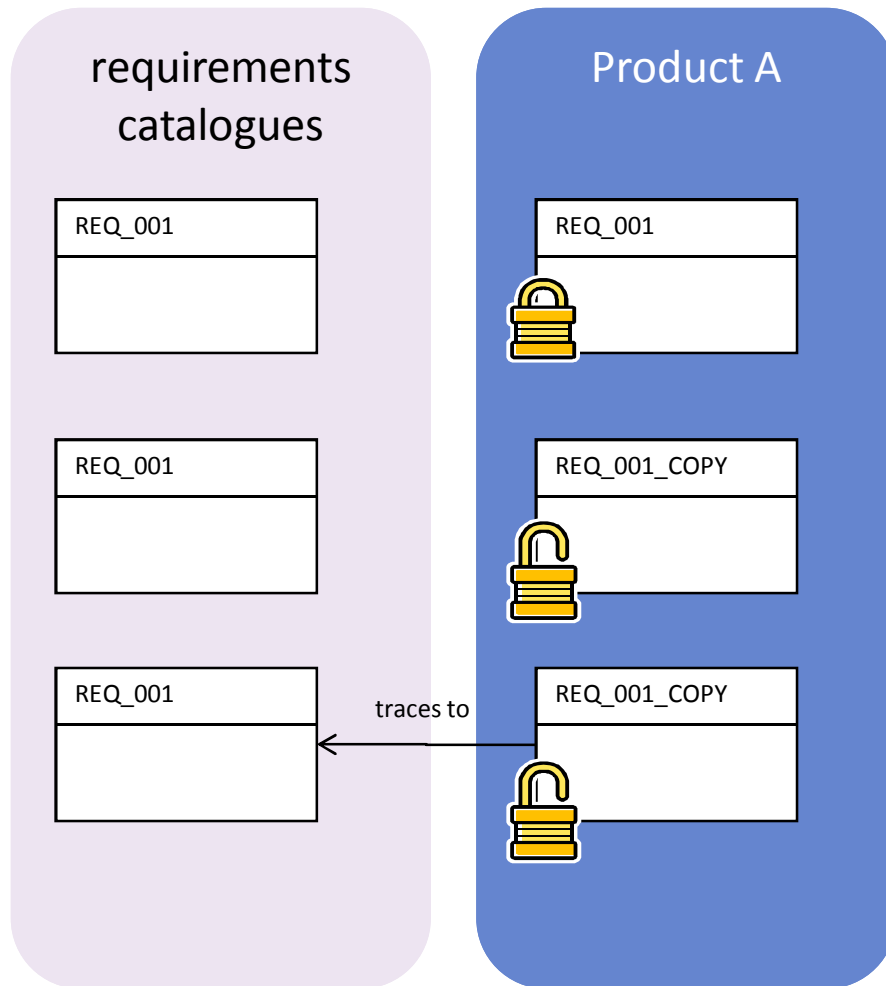
## A SINGLE PRODUCT CAN REUSE REQUIREMENTS FROM DIVERSE CONTEXT



Reusable requirements may be

- **Corporate requirements**, such as branding requirements and company policies.
- **Standards and norms** requirements: this may includes design constrains such as the non-functional requirements related to a particular development platform
- **Product family requirements**, common to a particular products range.

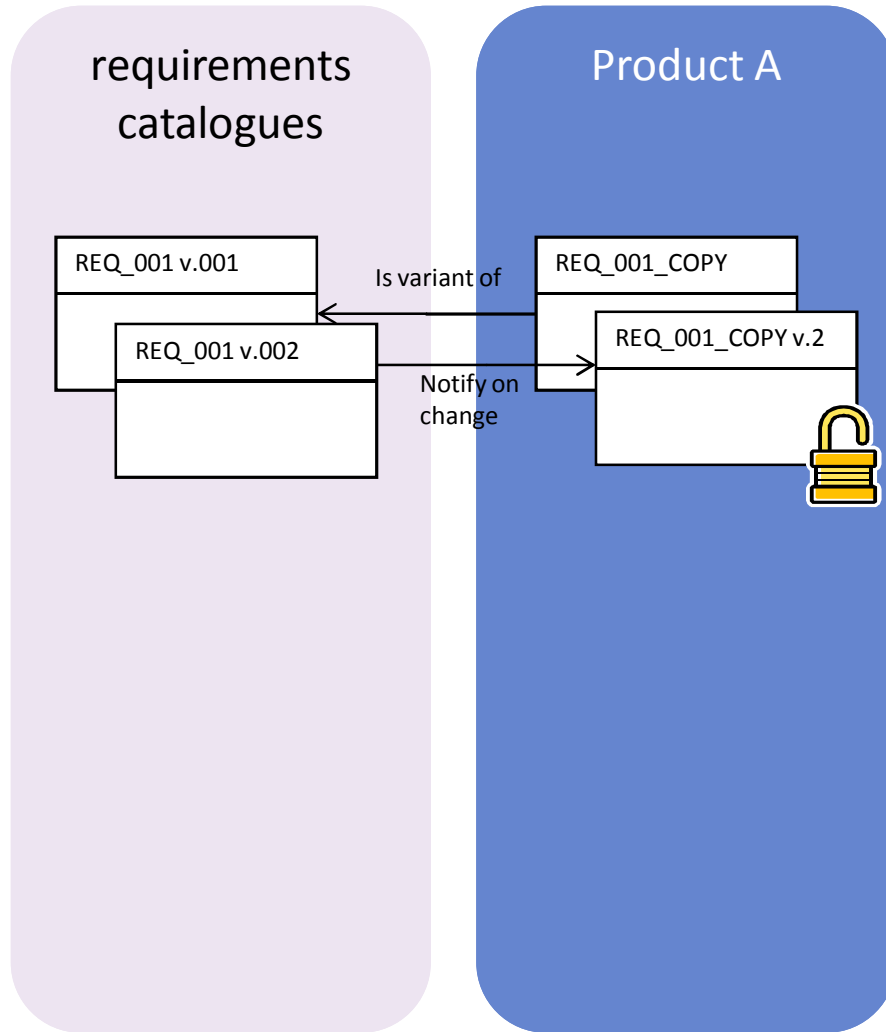
## SHARED REQUIREMENTS CAN EITHER TRACK TO THE ONGOING CHANGE MADE BY THE AUTHOR OR BE MODIFIED BY THE PROJECT



When a component is published to a project, it is possible to reuse it in several modes:

- **Share:** The elements are read only and cannot be modified. However, they can take attributes and can be related to other elements.
- **Copy:** The elements become part of the destination project and loose the link with the original one.
- **Copy and link:** The elements are imported in read/write, so they can be modified and updated. They can also take attributes and can be traced to other elements.

## MORE WAYS TO REUSE REQUIREMENTS



Further modes to publish requirements to a project:

- **Share requirements with change notification** The elements are read only and cannot be modified. However, they can take attributes and can be related to other elements.
  - They can be traced their origin.
  - Modifications of the component in the source project are notified and its elements can be upgraded to the new version.

## VARIATIONS AS ALTERNATIVE FLOW OF EVENTS IN USE CASES

commonality

Name	<b>Obtain appliance working mode</b>
Identifier	UC_0030_P1
Short description / goal	Displays the working modes of all connected appliances. The Administrator uses this function to ensure that all appliances are remotely available.  Event: The administrator requires an overview of the appliance modes.
Actor(s)	Administrator
Pre-conditions	The CCC System is started. The appliances are available on the WAN.
Basic flow	1. The actor starts the control unit. 2. The system displays the appliance groups. 3. The actor selects an appliance group 4. The system retrieves (...)
Alternative flow 1 (IP devices)	(start after basic flow step 4) 1. The System requires the connection protocol access key (...) <b>variants</b>
Post-conditions	The working modes are displayed on the control unit.

The use-case describes:

- a basic flow of events („happy days“ flow) that is common to all products.
- alternate flows, that are either
  - variants
  - exceptions
  - errors

**The challenge:** how to manage these variants and specify what product use the variant in a product line?

## BETTER: VARIATION POINTS IN USE CASE AS ATTRIBUTES

### Core Assets Catalogues

Name	Obtain appliance working mode
Identifier	UC_0030_P1 <b>commonality</b>
Short description / goal	Displays the working modes of all connected appliances. The (...)
Actor(s)	Administrator
Pre-conditions	The CCC System is started. The Appliances are a available on the WAN.
Basic flow	<ol style="list-style-type: none"> <li>1. The Actor starts the control unit.</li> <li>2. The system displays the appliance groups.</li> <li>3. The Actor selects an Appliance group</li> <li>4. The system retrieves (...)</li> </ol>
Post-conditions	The working modes are displayed on the control unit.
Variation points	Communication protocol, appliance type, interface type.

**Variation point:** describes the type of variability

### Product A

**Goal:** Goal to be achieved by extension

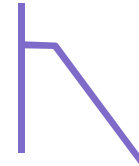
**Condition:** The condition that must be satisfied if the extension is to take place

Name	Obtain IP appliance working mode
Identifier	UC_0035_PA
Short description / goal	Displays the working modes of connected appliances depending on the communication type.
Condition	The appliance is connected remotely / by a wireless protocol.
Related requirements	extends UC_0030_CORE. <b>variants</b>
Variation	Communication protocol
Variant	IP appliance
Alternative flow 1	(starts after the basic flow step 4) <ol style="list-style-type: none"> <li>1. The System requires the connection protocol access key (...)</li> </ol>

**Variant:** describes a set of elements that represents a complete requirement

## VARIATIONS IN NON-FUNCTIONAL REQUIREMENTS CAN BE DESCRIBED WITH ATTRIBUTES

**Variation point:**  
describes the type of variability



**Variant:** describes a set of elements that represent a complete requirement



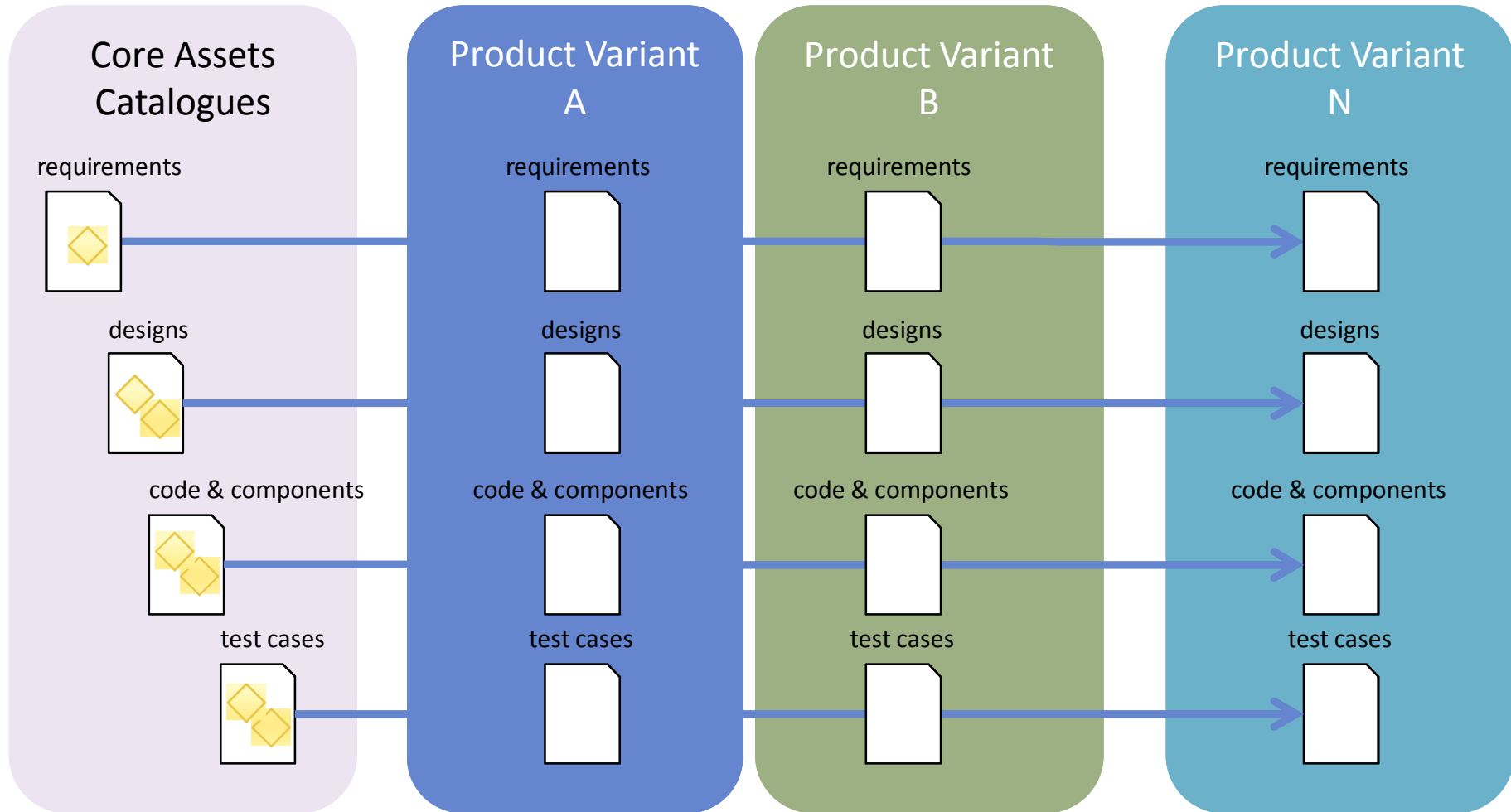
ID	Name	Description	Variation points	Variant	Related requirement
NFR_00445	Appliance driver	The communication with the appliance requires a secure device authentication.	communication protocol, appliance type		
NFR_00450	IP appliance driver authentication	The access point authentication requires a 8-63 alphanumeric characters WPA-PSK Key.		Communication protocol: IP appliance	is a variant of NFR_00445
NFR_00455	Bluetooth appliance driver authentication	The device authentication requires a device name and a 8-16 characters password.		Communication protocol: Bluetooth appliance	is a variant of NFR_00445

**commonality**

**variants**

# VARIATION POINTS ARE FURTHER EXPRESSED IN ALL PHASES OF THE PROJECT

◆ Variation points



## REUSE REQUIRES A REQUIREMENT MANAGEMENT TOOL WITH CONFIGURATION MANAGEMENT AND REUSE CAPABILITIES

When managing complex requirement reuse, be sure that your tool sets allows you

- to track the requirements **history** and **versions**
- to establish **baselines**
- to package the requirements in **sub-sets** of variable size
- and of course to support reuse by some way for cloning or copying requirements, and **maintaining a relationship** between the copy and the original requirement.

# REQUIREMENTS DEFINITION AND MANAGEMENT TOOL

## EXAMPLE: RE-USABILITY IN IRQA 4

- Save time and improve quality through the reuse of components
- Requirements, use cases, tests and the relationships between them can be “packaged” in components which can then be reused through the whole company.

**Component version**  
Select the specific version to be shared

**Projects**  
Select the projects in which the component will be published

**Reused elements**  
Elements are imported and marked in the destination

**Import and update**  
Import into the destination project

Select the component from the catalogue  
Non functional requirements (security, performance, usability, etc.), functionality and all the associated tests or use cases can be included in the catalogue.

Component Publishing

Component Version: 01

Repository Projects: 01, 02

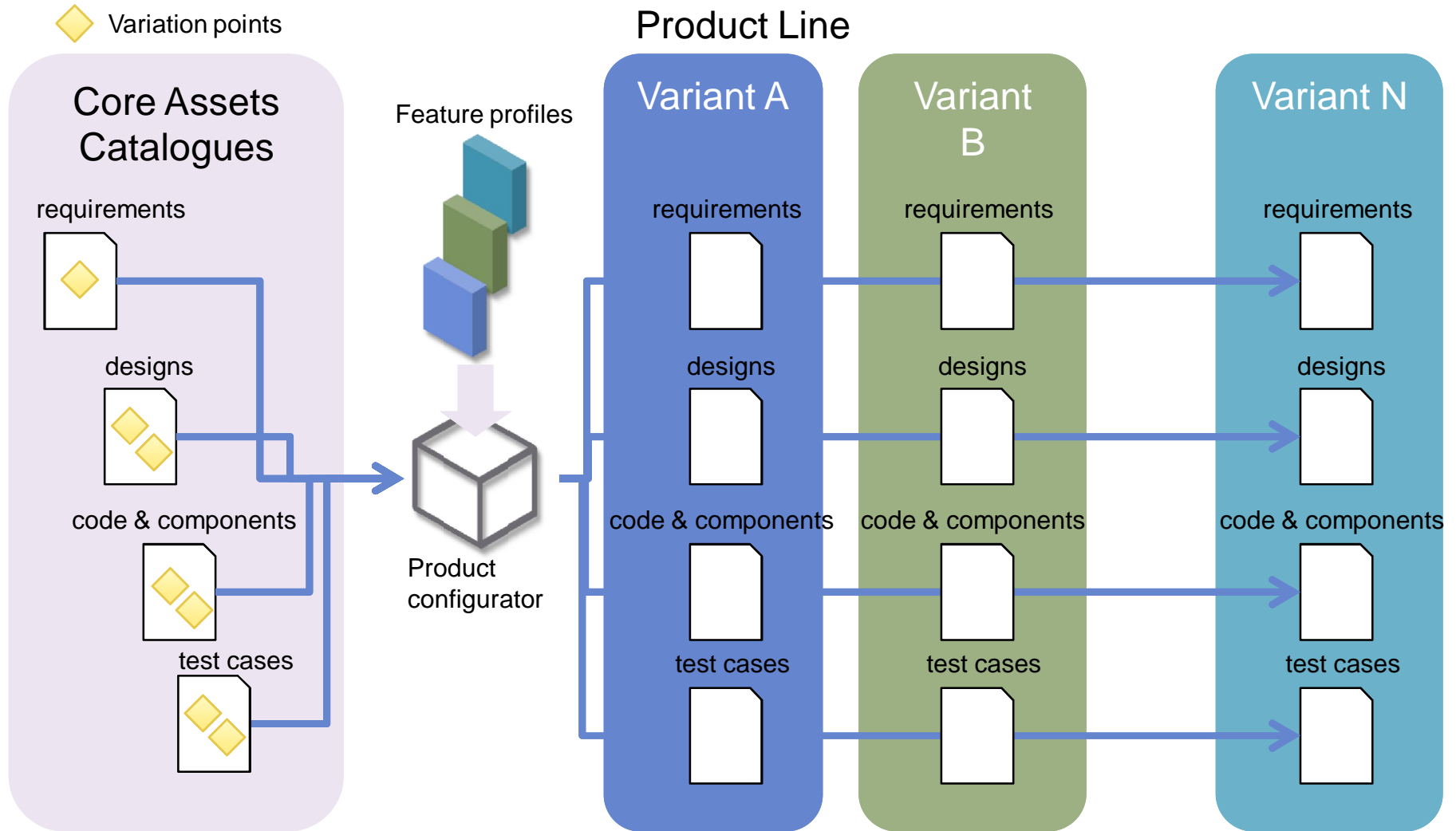
Source Project: Standards and Norms

Projects: CCC System - 25 appliances, CCC System - 50 appliances

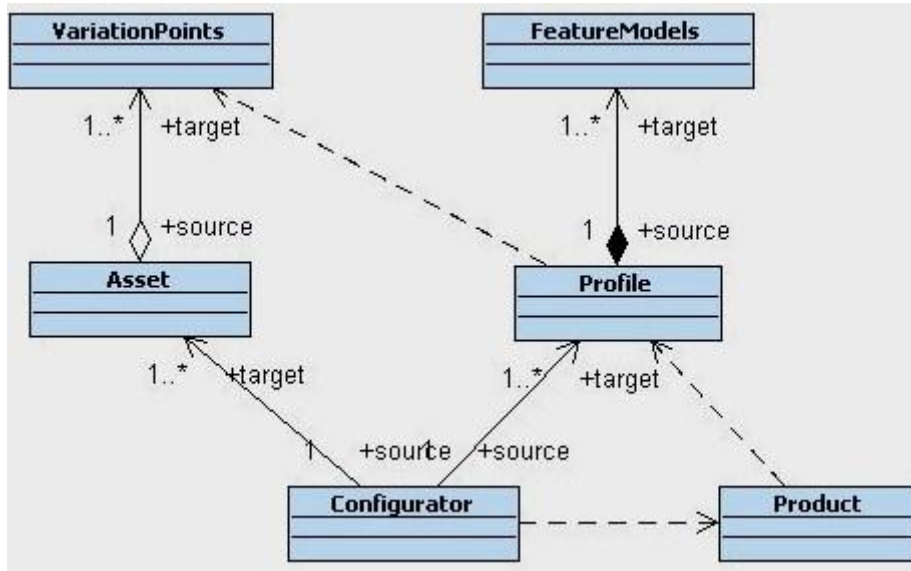
RNF/Std_0135	WAP-100 support
RNF/Std_0140	WAP-195 support
RNF/Std_0145	WAP-190 support
RNF/Std_0150	WAP-191 support
RNF/Std_0155	WAP-192 support
RNF/Std_0160	WAP-193 support
RNF/Std_0165	IEEE 1394 compliance
RNF/Std_0200	Home security legislation

## REALIZING THE REQUIREMENTS IN THE SYSTEM CONTEXT

# HOW IT WORKS: PRODUCT LINE ENGINEERING OVERVIEW



## HOW IT WORKS: PRODUCT LINE ENGINEERING MODEL



- A product feature **profile** is created for each product to specify desired product features
- **Assets** are specified using variation points
- A **variation point** has the ability to configure itself based on a product feature profile
- The **configurator** uses the feature profile to compose the required assets and configure its variation points to produce a **product** matching the feature profile

## THE IMPORTANCE OF PRODUCT LINE ENGINEERING

- Product Line Engineering (PLE) allows you to:
  - Capitalize on **strategic reuse** of commonality across a product line portfolio
  - Efficiently **minimize the complexity of managing variation** among products
  - Take a **holistic approach for product line delivery**, across the full systems and software development lifecycle

## WHY DO WE DO PLE?

Apply PLE to eliminate duplication, divergence, merging, ad hoc variation techniques and manual production

Apply PLE to gain reusable core assets e.g. requirements, analysis, design, implementation / source code / test cases

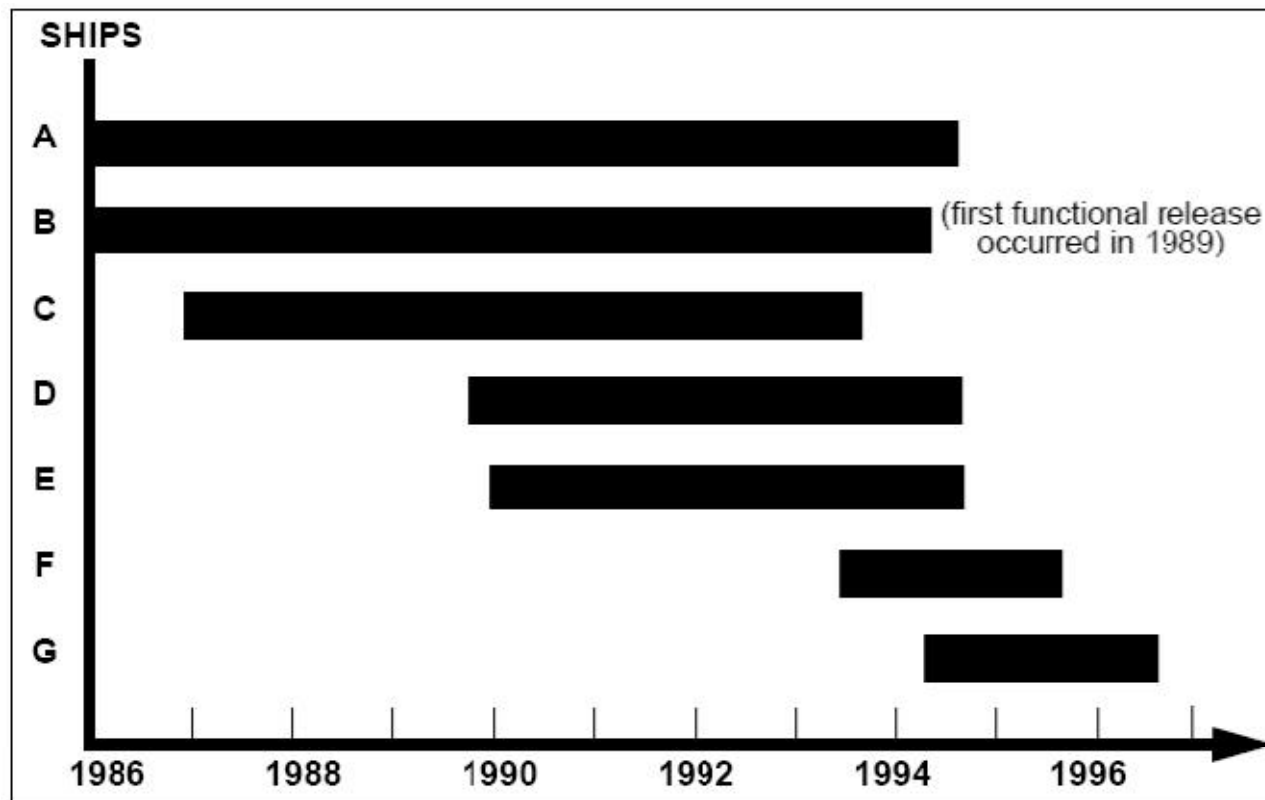
Reduce defect rates






...Leads to optimized productivity, cost and quality

## EXAMPLE 1: CONCRETE BENEFITS

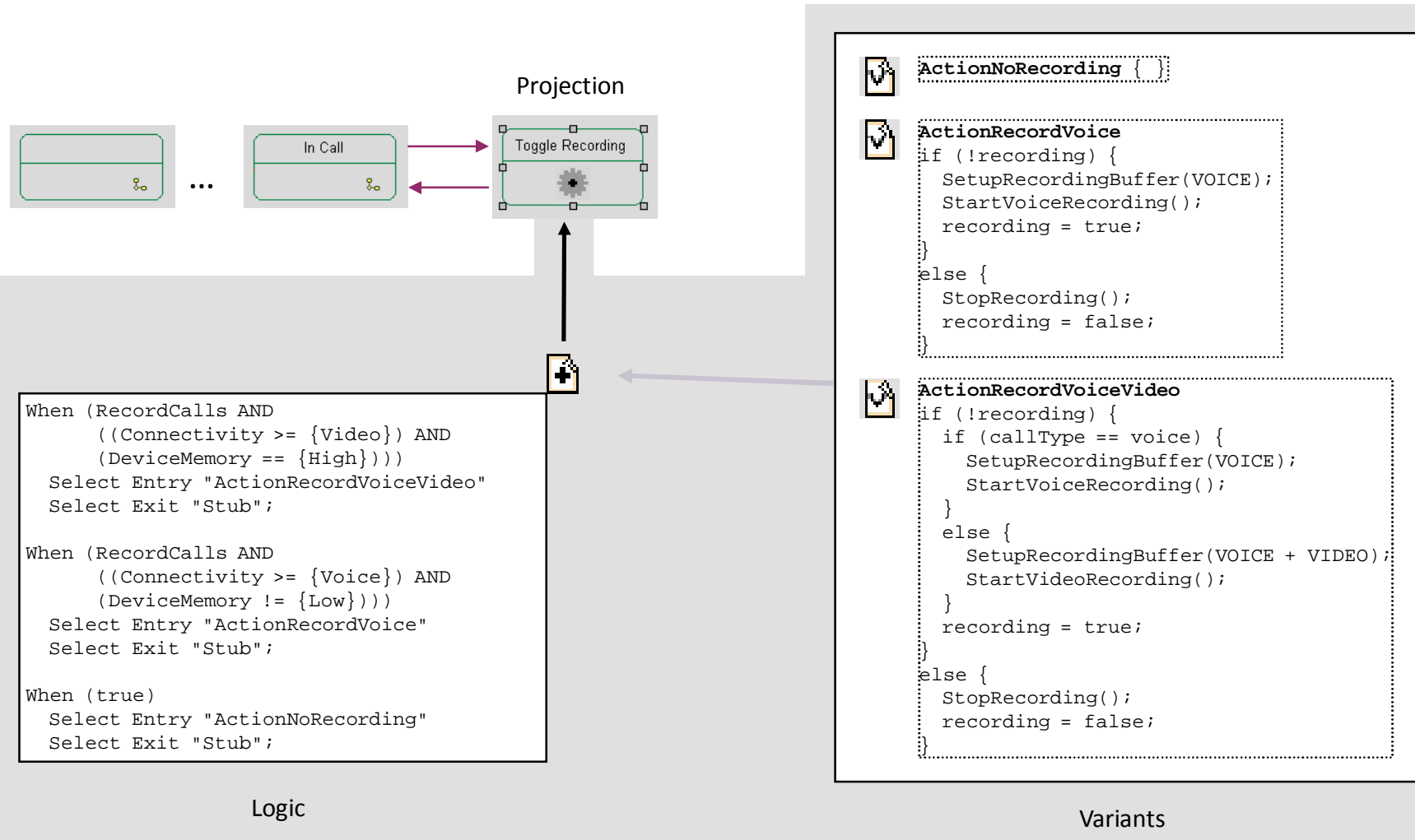
- Pattern: Shift in product schedules from start to delivery



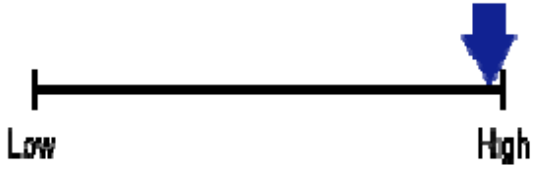
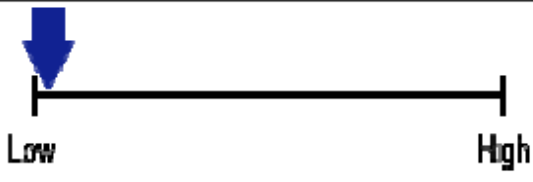
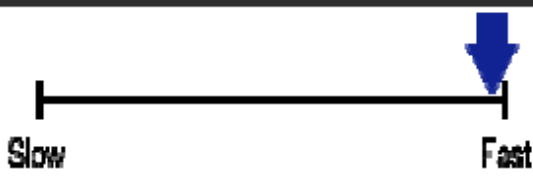
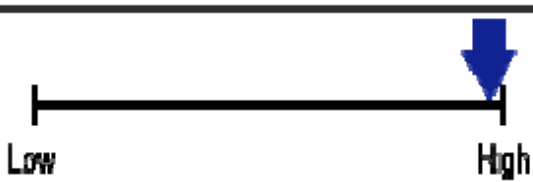
## HANDSET EXAMPLE

Phone	Call Connectivity	Memory	Call Recording
Low End 	Voice	Low	No
Mid Range 	Video & Voice	Medium	Voice
High End 	Video & Voice	High	Voice & Video

# GEARS VARIATION POINTS FOR RHAPSODY MODEL ELEMENTS



## BUSINESS RATIONALE FOR ADOPTING PLE

Available Benefits	
Transition Time, Cost & Effort	
Return-on-Investment	
Cost of Doing Nothing	

## PROPOSAL: HOW TO GET STARTED?

- Treat variation management as 1st class engineering technique and **core architectural competence**
  - Don't let variation management be handled on implementation level
  - Don't think "product-wise"
  - Orthogonal, "PLE-wise", thinking is required
- Start with what you've got  
Start by consolidating: user documents, requirements, analysis, design, DR, monitoring and other artifacts across the product line portfolio using a single set of SPL artifacts:
  - Challenges ahead: mitigate risks
    - Create a pilot as the catalyst for change
- Continue by consolidating: implementation (source code), test, build and remaining artifacts
- Ultimate objective:
  - in the long run, achieve deep core asset analysis

## Q&A

# THANK YOU!

## Contact details

EVOCEAN GmbH, Tel: +41 41 790 78 88, [www.evocean.com](http://www.evocean.com)

Milan Ignjatovic

Senior Consultant, Trainer & Coach

BSc El.-Eng. MSc Computer Science

Mobile. +41 79 376 59 11

Email: [milan.ignjatovic@evocean.ch](mailto:milan.ignjatovic@evocean.ch)



Blaise Rey-Mermet

Principal Consultant, Trainer & Coach

Dipl. Natw. ETHZ

Tel. +41 41 790 78 88

Mobile: +41 79 276 6419

Email: [blaise.rey-mermet@evocean.ch](mailto:blaise.rey-mermet@evocean.ch)



## REFERENCES

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- IRQA from Visure Solutions S.L. [www.visuresolutions.com](http://www.visuresolutions.com)
- Various Whitepapers from Charlie Krüger, [www.biglever.com](http://www.biglever.com)