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Monday 8th September
Barcelona, Spain

Visualizing the Impact of Non-Functional Requirements on Variants – A Case Study

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Visualizing the Impact of Non-Functional Requirements on Variants – A Case Study

The importance:

Many developers must address NFRs.

e.g. Teamcenter software non-functional requirements are represented as Items and are the criteria for setting views of the Product Structure (performance view and the security view).

The problem:

Current visualization techniques lack convenience and do not provide sufficient clarity about impact of non-functional requirements on variants.

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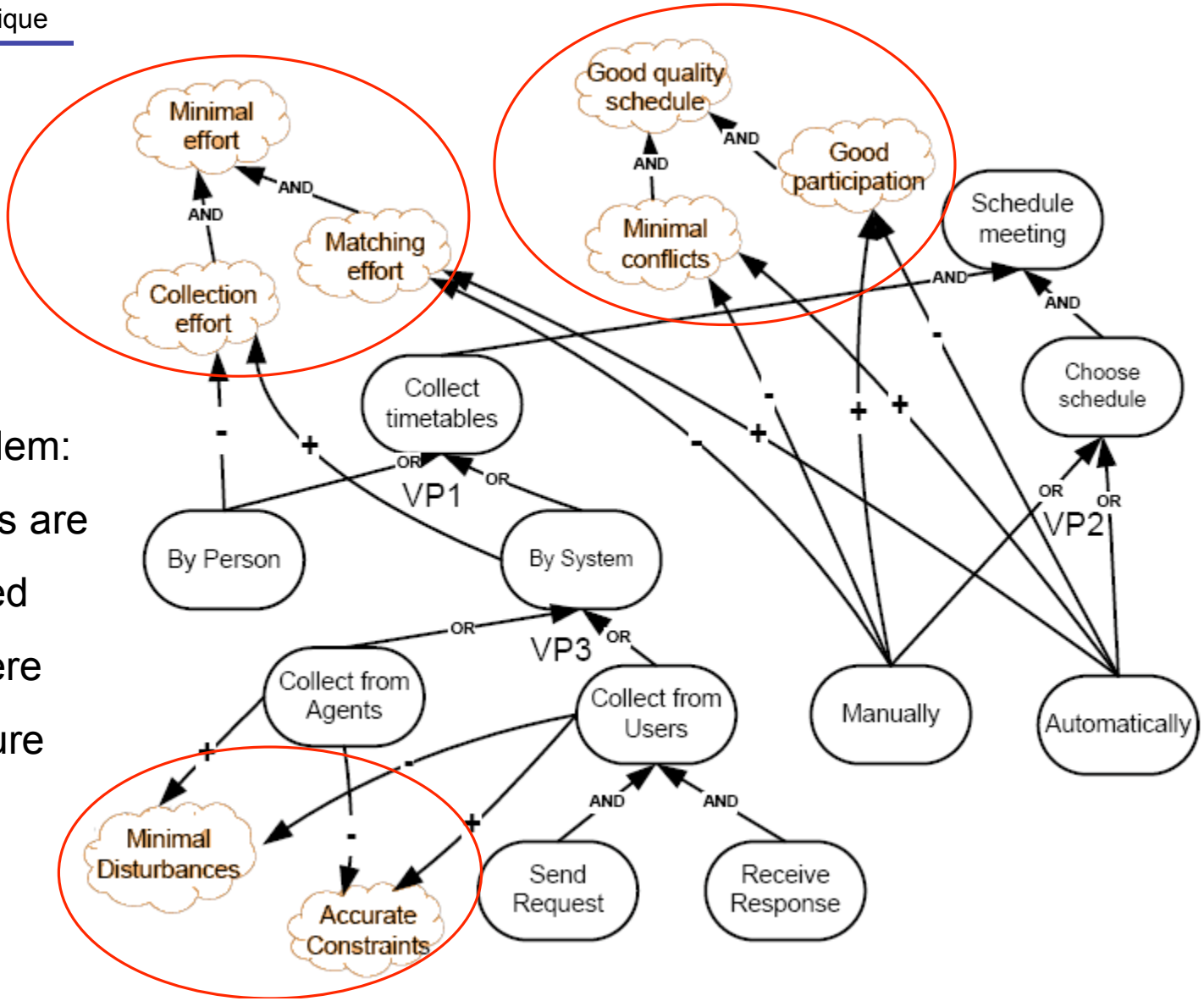
The problem:

The NFRs are dispatched everywhere in the figure



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Who is the visualization for?

Every stakeholders that has to deal with non-functional requirements and their impact on variants:

- From the vendor side: technical sales support, benchmarker, developers, prototypers, project leaders, implementators etc.
- From the customer side: managers, project leaders, users, etc.

What is the visualization for?

The visualization should support the work of stakeholders in each business and product lifecycle management steps when one has to deal with non-functional requirements and their impact on variants:

- Benchmark (incl. Prototype)
- Process Accessment
- Specification
- Implementation
- Testing and Validation
- Change Management Process

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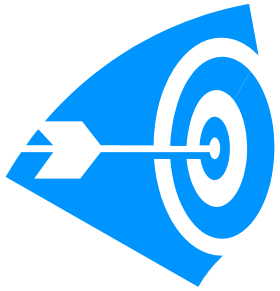

We propose a visualization that expects to help to see at first glance:

- the Non-Functional Requirements (NFRs)
- the Functional Requirements
- the Impact of NFRs on variants

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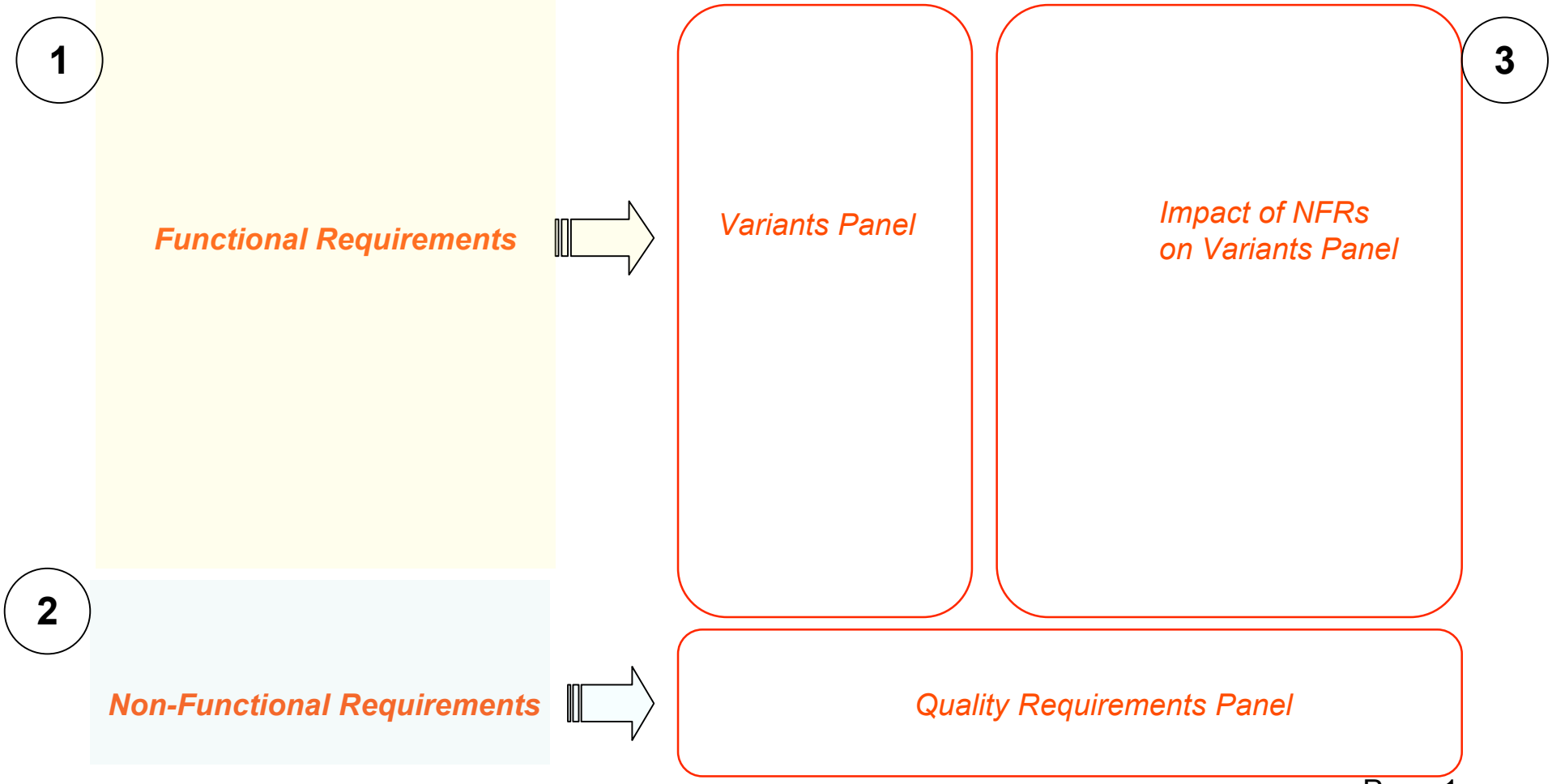

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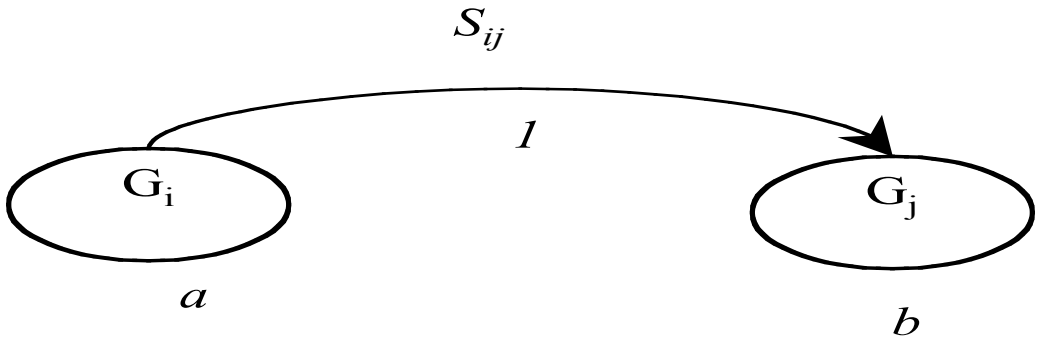
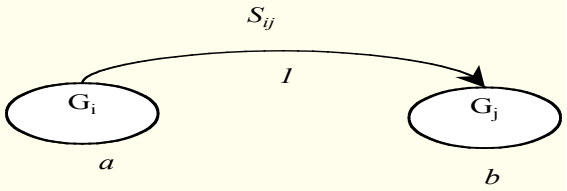
Functional Requirements

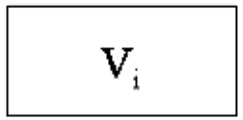
Map model [Rolland 2000, Rolland et al. 2007]



Functional Requirements



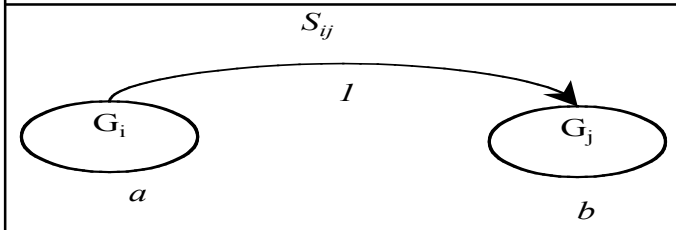
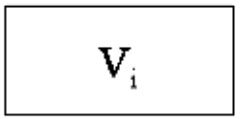
Variants Panel



Variants are based on map model.

Why variant representation based on MAP model?

The visualization supports all variant types:
optional variants, alternatives, mandatory, iterative.

MAP graphical representation of a section	Atomic Variant
	

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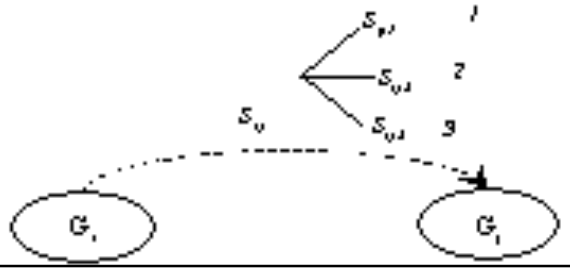
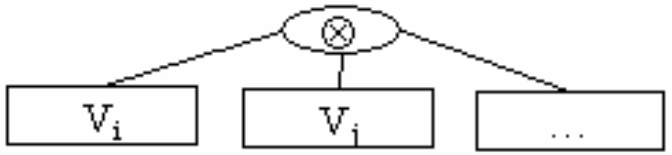
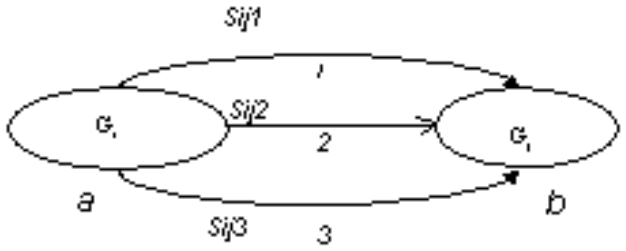
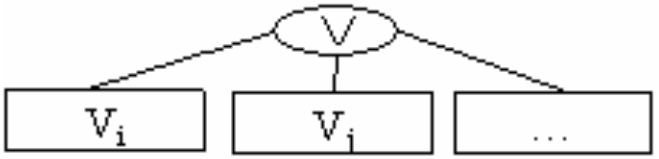
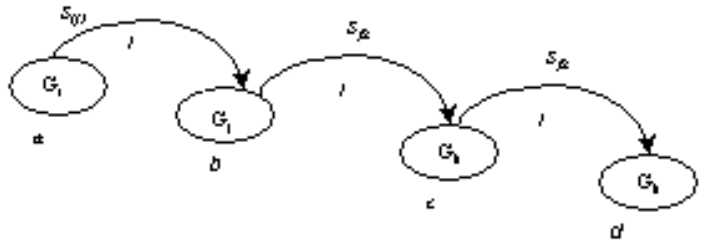
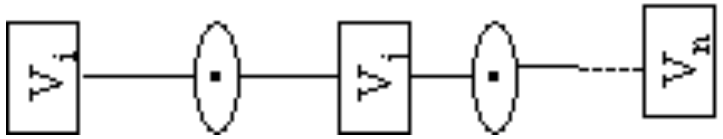
Map sections linked by a bundle relationship	Simple Variant with Alternate Choice
	
Map sections linked by a multi-thread relationship	**Simple Variant with Multiple Choice**
	

Map sections linked by a path relationship	Path Composite Variant
	

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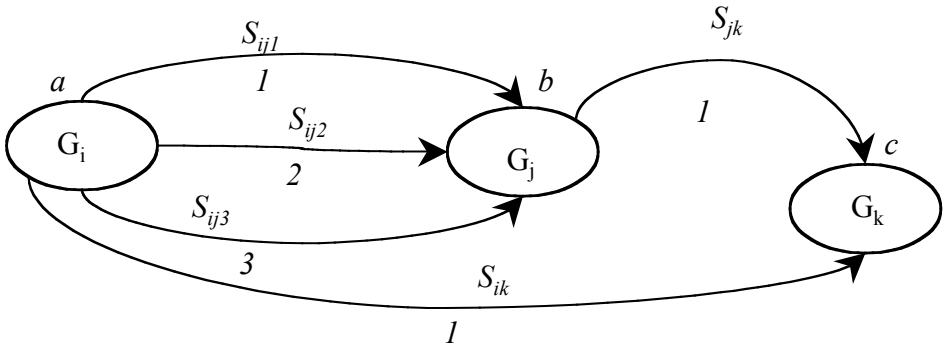
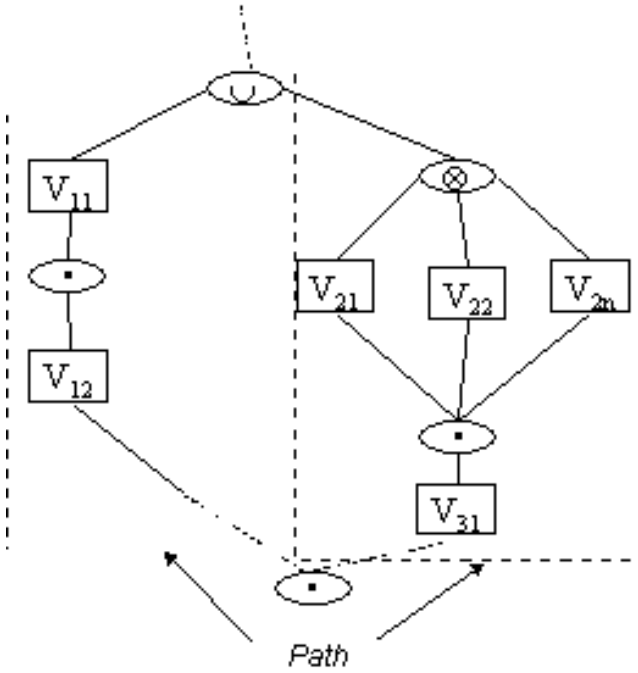
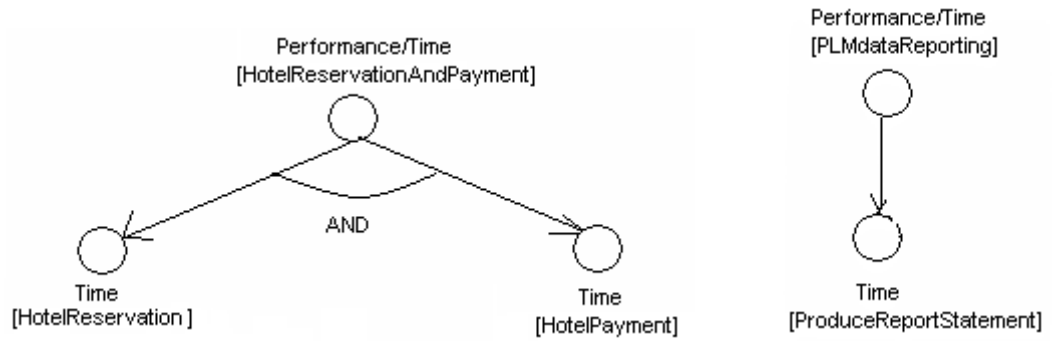
Map sections linked by a multi-path relationship	Multi-Path Composite Variant
	

NFR Visualization

Using the representation of [Chung et al., 1996]

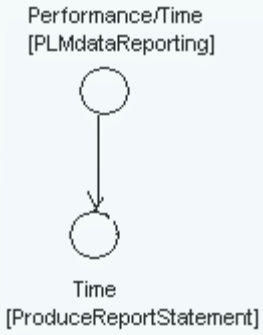
Decomposition of NFR goal Performance/Time into one or two sub-goals

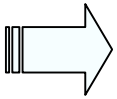
Non-Functional Requirements

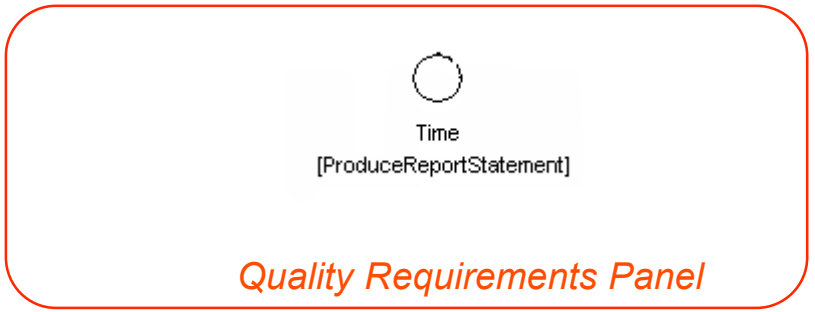


Quality Requirements Panel

Non-Functional Requirements



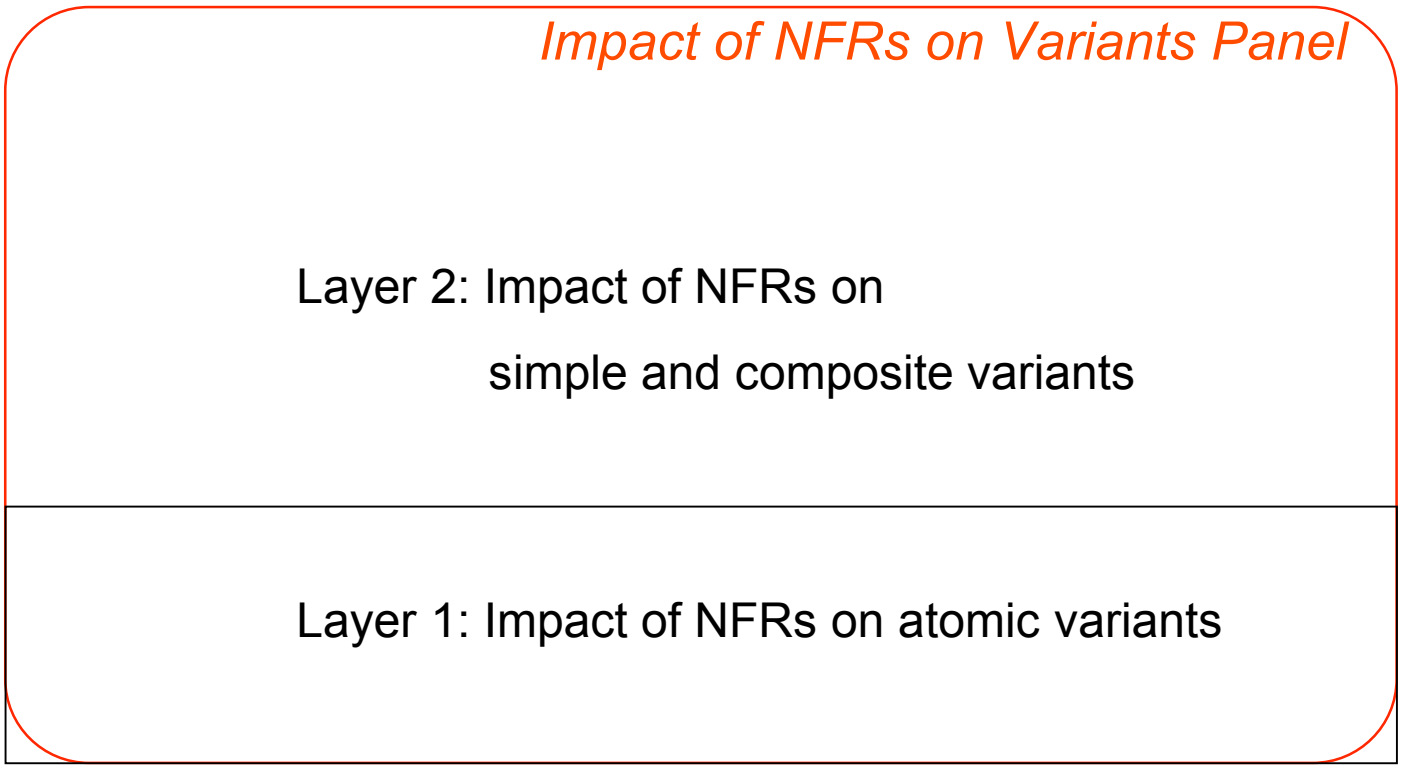




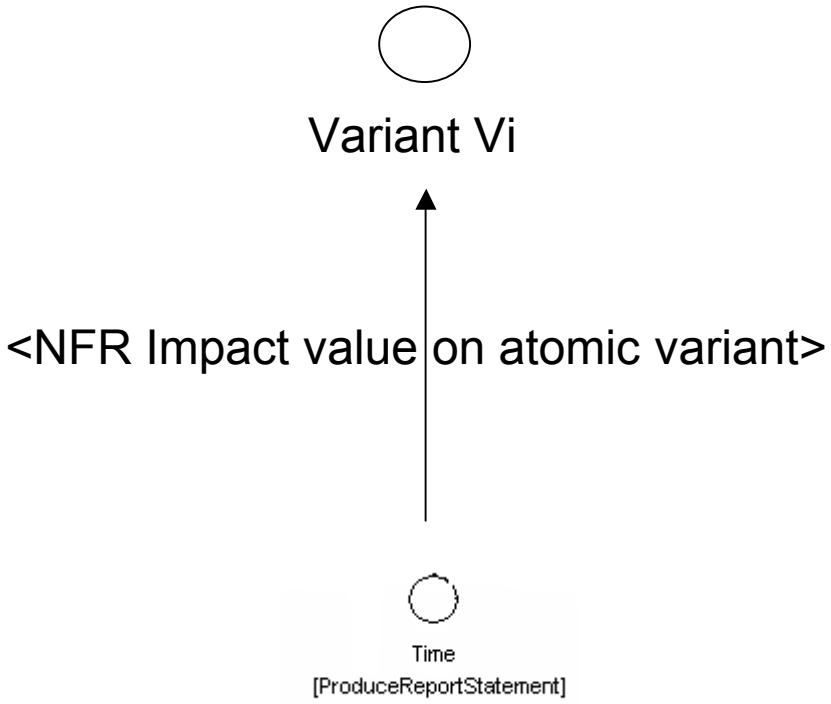
Impact of NFRs on Variants Panel

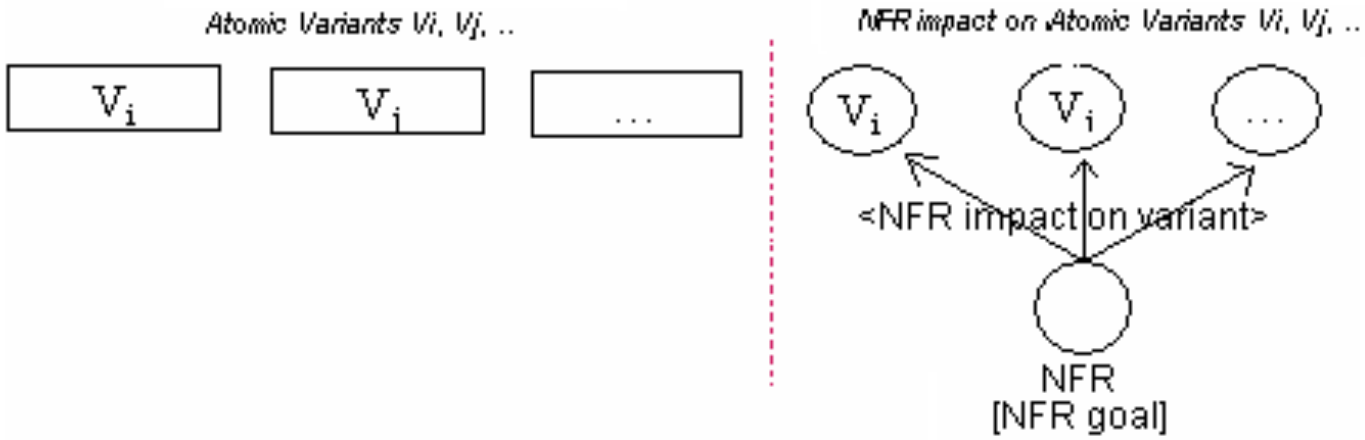
Correlation links, adopted from [Chung et al., 2000]

--	-	?	+	++
BREAK	HURT	UNKNOWN	HELP	MAKE


Impact of NFRs on Variants Panel
Layer 2: Impact of NFRs on
simple and composite variants
Layer 1: Impact of NFRs on atomic variants

- NFRs Impact on atomic variants



Map rel.	Representation of the corresponding variant	Visualization of NFR Impact on variant
None		

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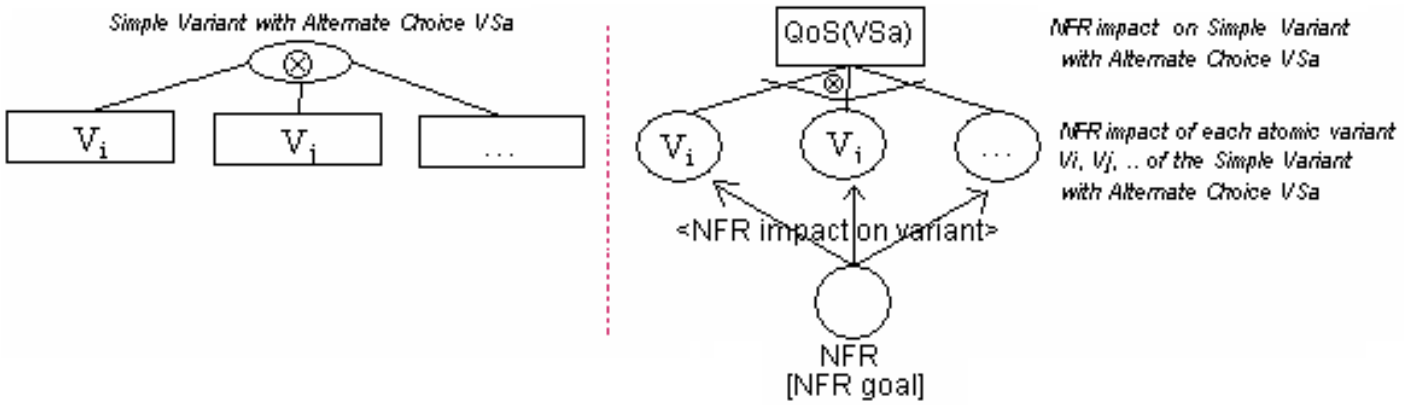
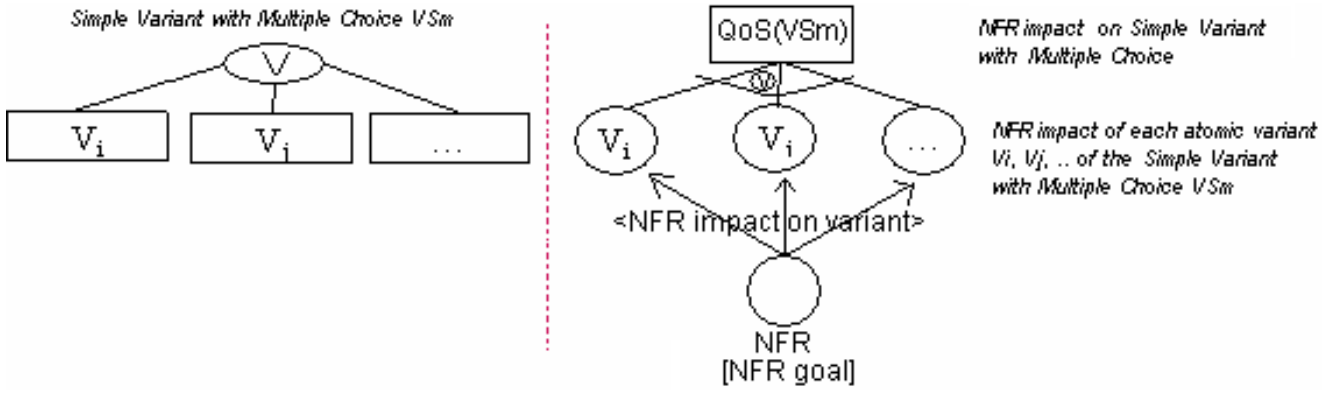
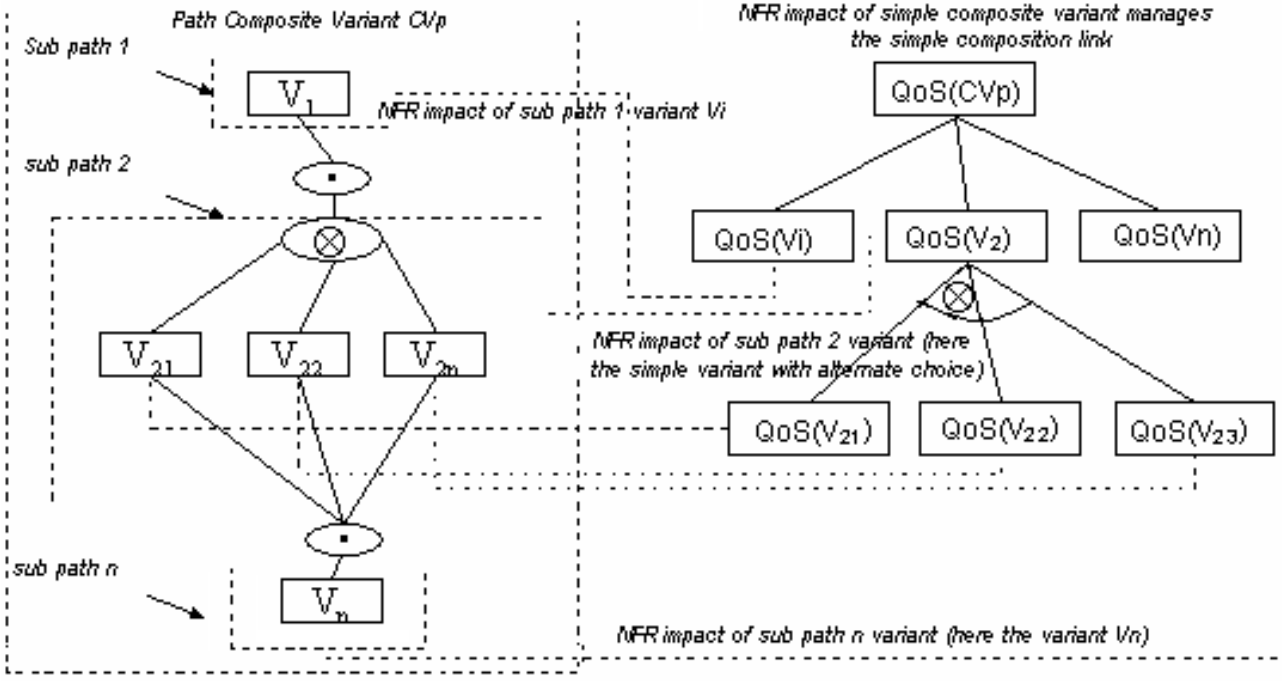
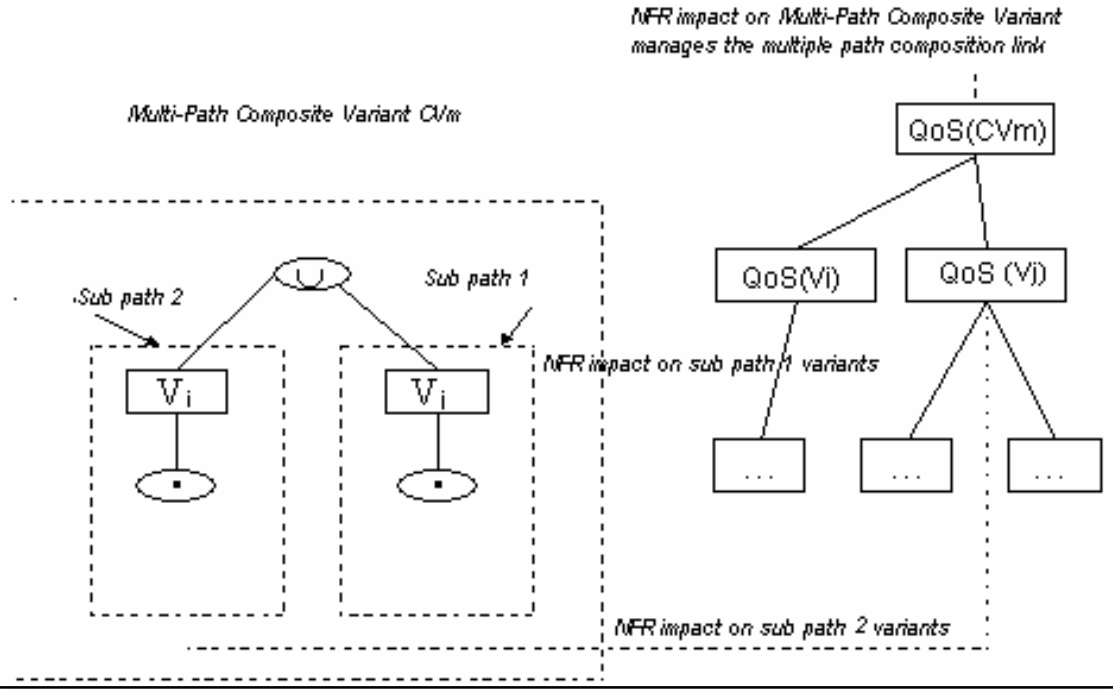
Multi-Thread relation-ship	
Bundle relation-ship	

Map relationship	Representation of the corresponding variant	Visualization of NFR Impact on variant
Path relationship		

Map relationship	Representation of the corresponding variant	Visualization of NFR Impact on variant
Multi-path relationship		

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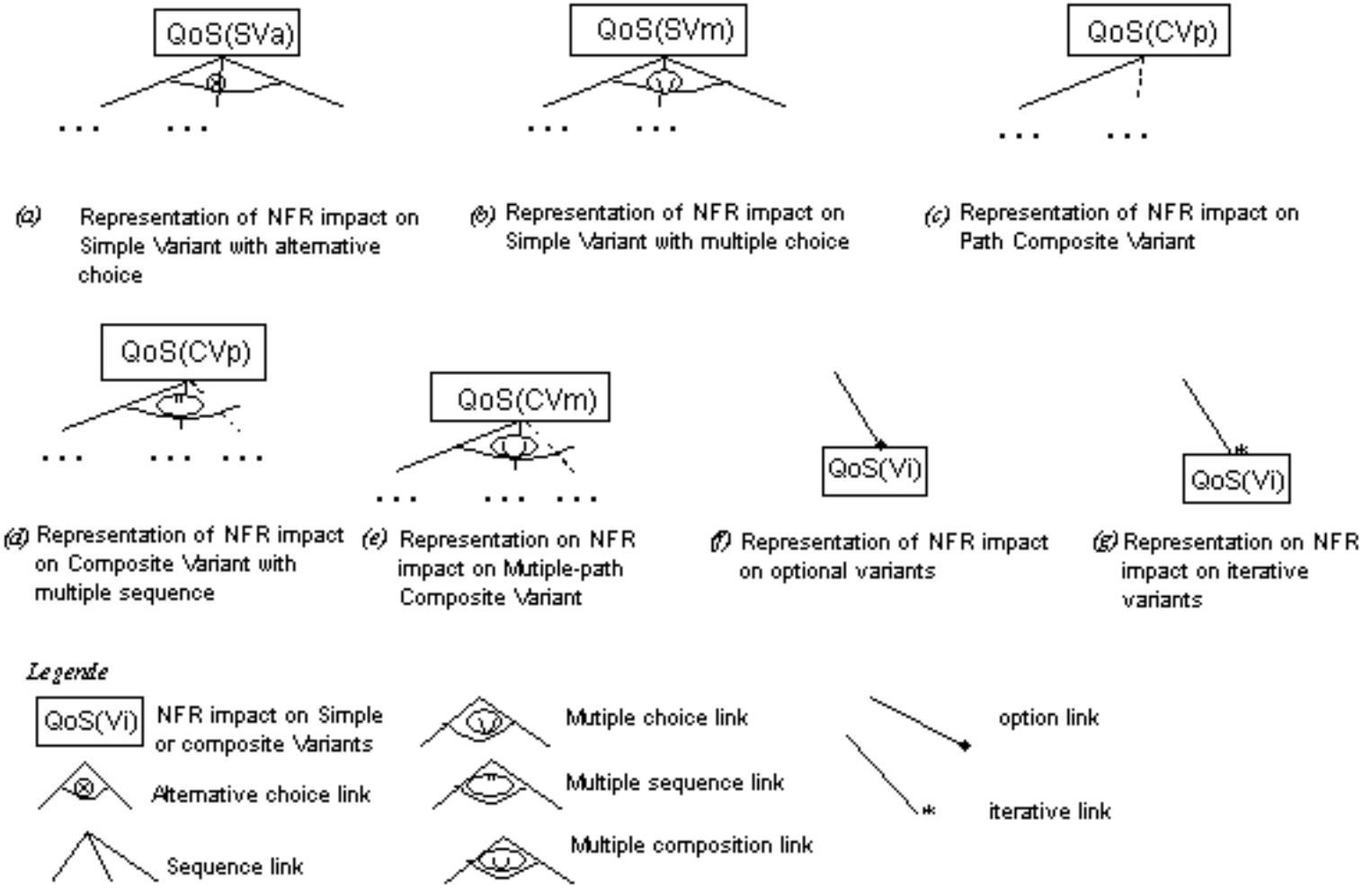
Summary Graphical Representation on NFR Impact on Simple & Composite Variants



NFR's testing and ISO compliance

Example

No	NFR	Test Scenario	Example	ISO Compliance
1	Suitability The capability of the test object to provide an appropriate set of functions for specified tasks and user objects.	Execution of instructions and function blocks, transfer of data, time response.	Transfer of bytes per second	Yes

Scalability of the representation:

The scalability is enabled by

- 1) the decomposition method of the map for the functional requirements and
- 2) the typology of NFR according to the Chung NFR types or ISO9126.

As requirements become more complex, one can keep the representation uncluttered by showing a map of the highest level. The user may view details by traversing the hierarchy of maps.

Also, rather than viewing a total representation, the user can view NFRs according to their NFR types. For example, one could view first the NFR decomposed goals of performance and then the NFR decomposed goals of user-friendliness or security.

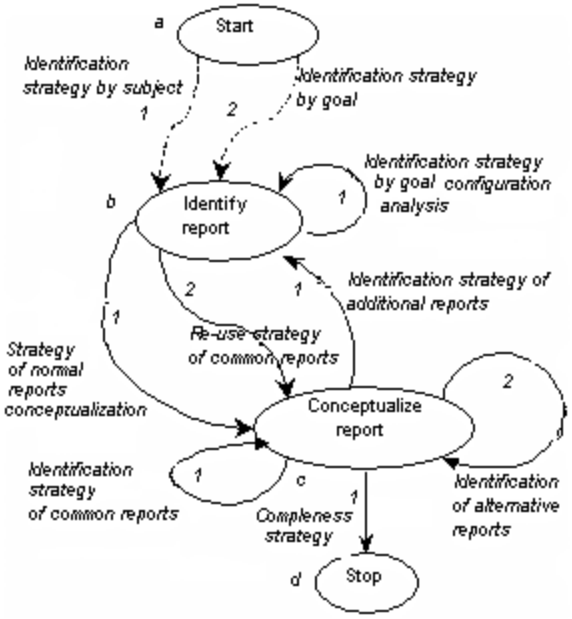
The case study

The visualization has been used in practice for validating the work

This study addressed software for reporting Product Lifecycle Management (http://www.siemens.com/plm)

Map of data reporting tool for Product Lifecycle Management

Functional Requirements



Where used information

Where referenced information

BOM information

Workflow information

Master information

etc.

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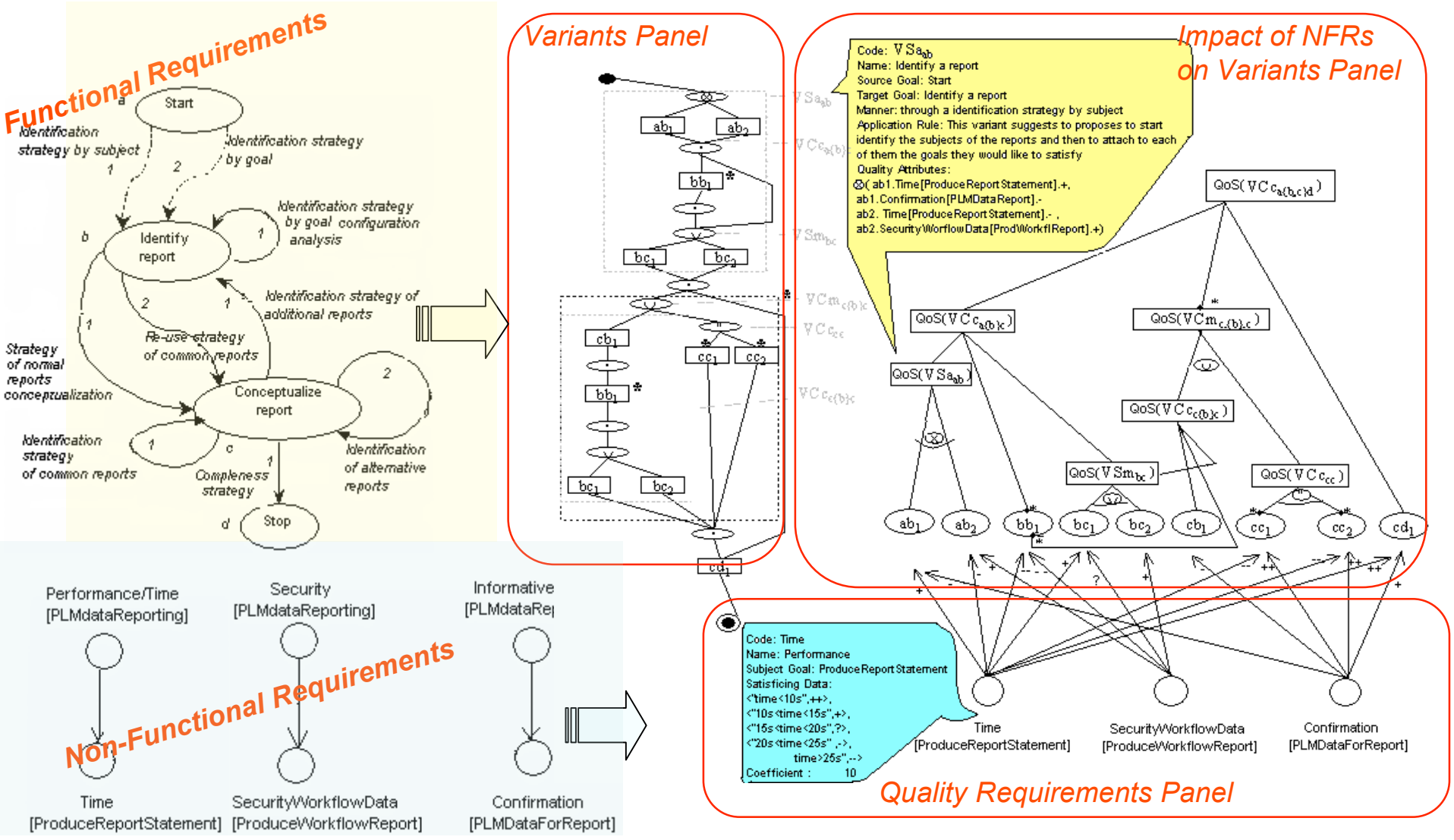
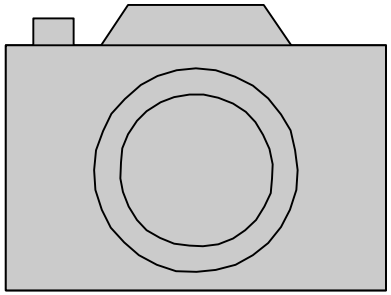


- Evaluation

All variability representation types

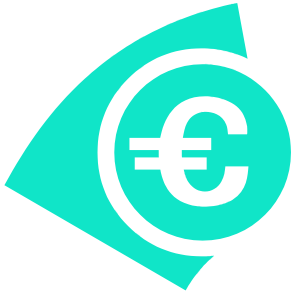
Type of expressed variability	Variant type according our approach
Alternative bundles	Simple Variant with multiple choice Multi-path Composite Variant
Alternatives	Simple Variant with Alternate Choice
Options	Optional Variant like Simple Variant with multiple Choice or Path Composite Variant or Multi-path Composite Variant or atomic Variant which belongs to a Path Composite Variant
Optional Alternatives	Optional Variant like Simple Variant with Alternate Choice belonging to a Path Composite Variant



Evaluation

- Dependencies
- NFRs representation
- Clarity

The results



This visualization approach clarifies use of variant combinations based on non-functional requirements. One can navigate through the variants and get information about the quality attributes according to the approach.

Applying our approach, we obtained preliminary design views for the reporting tool that were implemented in the resulting reporting system. Leaders who participated in this case study responded positively.

Thanks for your attention!

Questions?