Goals and Scenarios for Requirements Engineering of Software Product Lines

Gabriela Guedes, Carla Silva and Jaelson Castro

ggs@cin.ufpe.br, carla@dce.ufpb.br , jbc@cin.ufpe.br

Universidade Federal de Pernambuco

DEPARTAMENTO DE CIÊNCIAS EXATAS
CENTRO DE CIÊNCIAS APLICADAS E EDUCAÇÃO
UNIVERSIDADE FEDERAL DA PARAÍBA

Agenda

- Context
- Objectives of the Research
- Scientific Contributions
- Conclusions
- Ongoing and Future Work

Software Product Lines

- In RE for Software Product Lines (SPL), feature models are used to capture:
  - similarities
  - Variability

- However, it is difficult to establish a relationship between:
  - features of a software product
  - objectives of the stakeholders

Goal-Oriented Requirements Engineering

- A GORE approach was proposed to provide a systematic way to:
  - discover the features that will be part of a SPL
  - select the features for a particular product

- G2SPL (Goals to Software Product Lines)

Silva, C., Borba, C. and Castro, J. A Goal Oriented Approach to Identify and Configure Feature Models for Software Product Lines. In: Workshop on Requirements Engineering (WER'2011), Rio de Janeiro, 2011.

G2SPL (Goals to Software Product Lines)

- G2SPL relies on i*-c (i* with cardinality) language, which is used to:
  - structure requirements according to the stakeholders intentions for the SPL
  - facilitate the gathering of the features that define the SPL
  - aid the configuration of an individual product

Scenarios

- The dynamic aspect of a SPL may be described by a scenario specification technique.

- Advantages of scenarios
  - describe the behavior of the system functionality
  - are easily understood by stakeholders

Crosscutting concerns

- Crosscutting concerns are requirements which may impact multiple modules or components.

- Two examples of scenario specification techniques that take crosscutting concerns into account are:
  - MSVCM (Modeling Scenario Variability as Crosscutting Mechanisms)
  - MATA (Modeling Aspects using a Transformation Approach)

Bonifácio, R. and Borba, P. Modeling Scenario Variability as Crosscutting Mechanisms. In: AOSD'09, Charlottesville, Virginia, USA, March 2–6, 2009.

Whittle, J., Araujo, J.: Scenario modelling with aspects. Software, IEE Proceedings, 151 (4): p. 157-171 (2004)

Objectives of the Research

- This paper proposes the definition of a RE process for SPL that integrates a GORE technique and a scenario specification technique with separation of crosscutting concerns.

- In particular, we are extending the G2SPL approach to include activities related to the generation and configuration of scenarios specifications for SPL.

Scientific Contributions

- Extended G2SPL

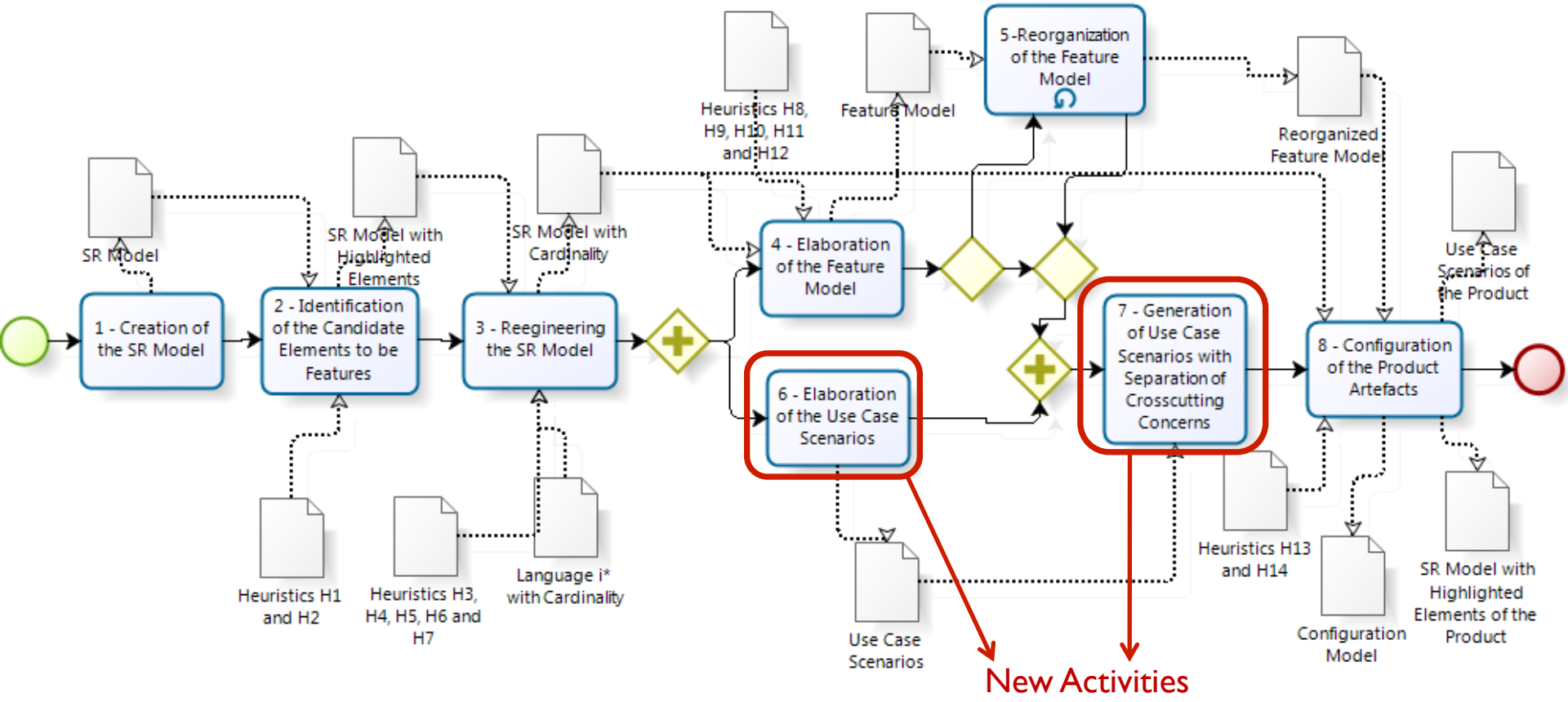


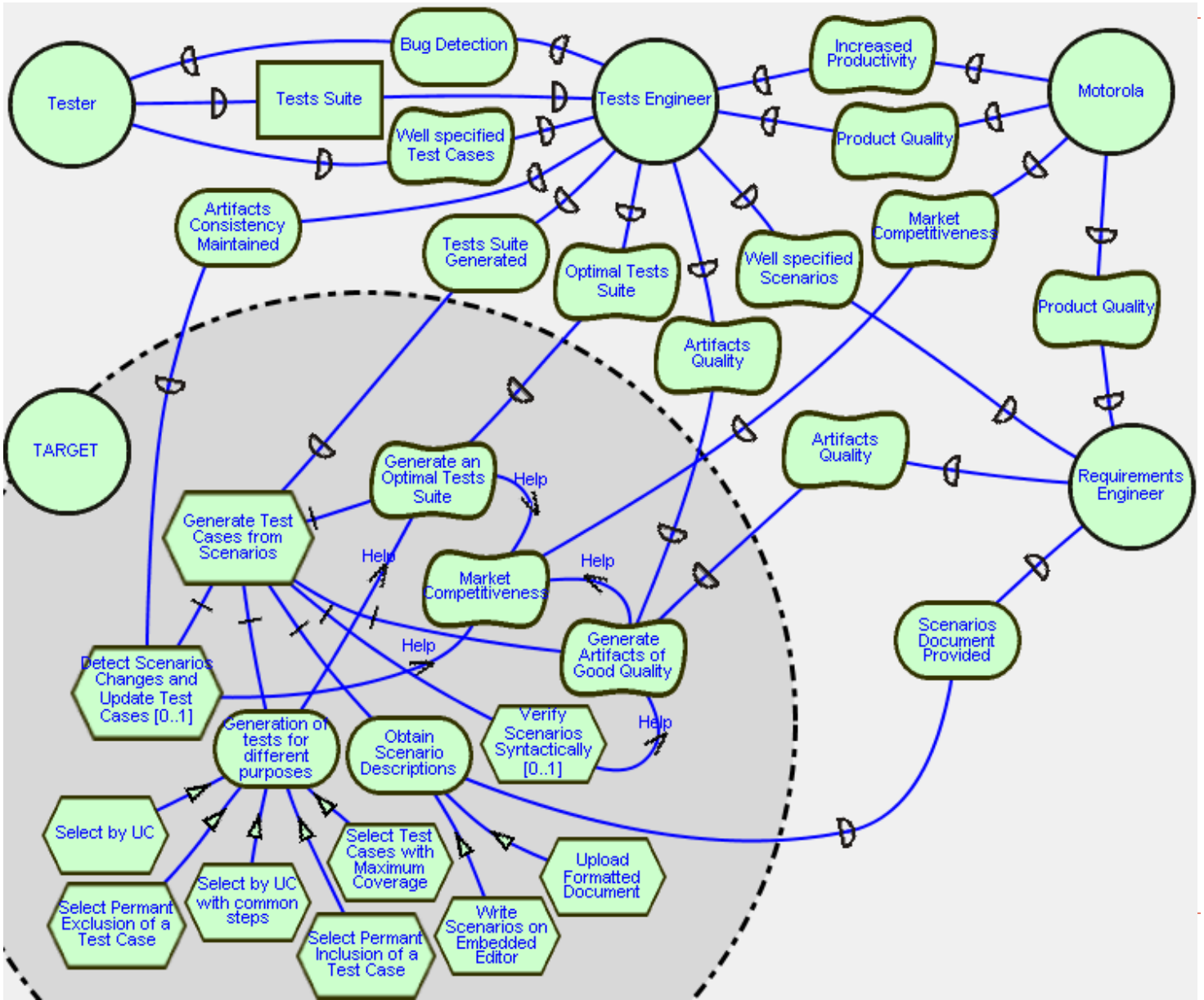
Figure 1 - Extended G2SPL process model

Case Study

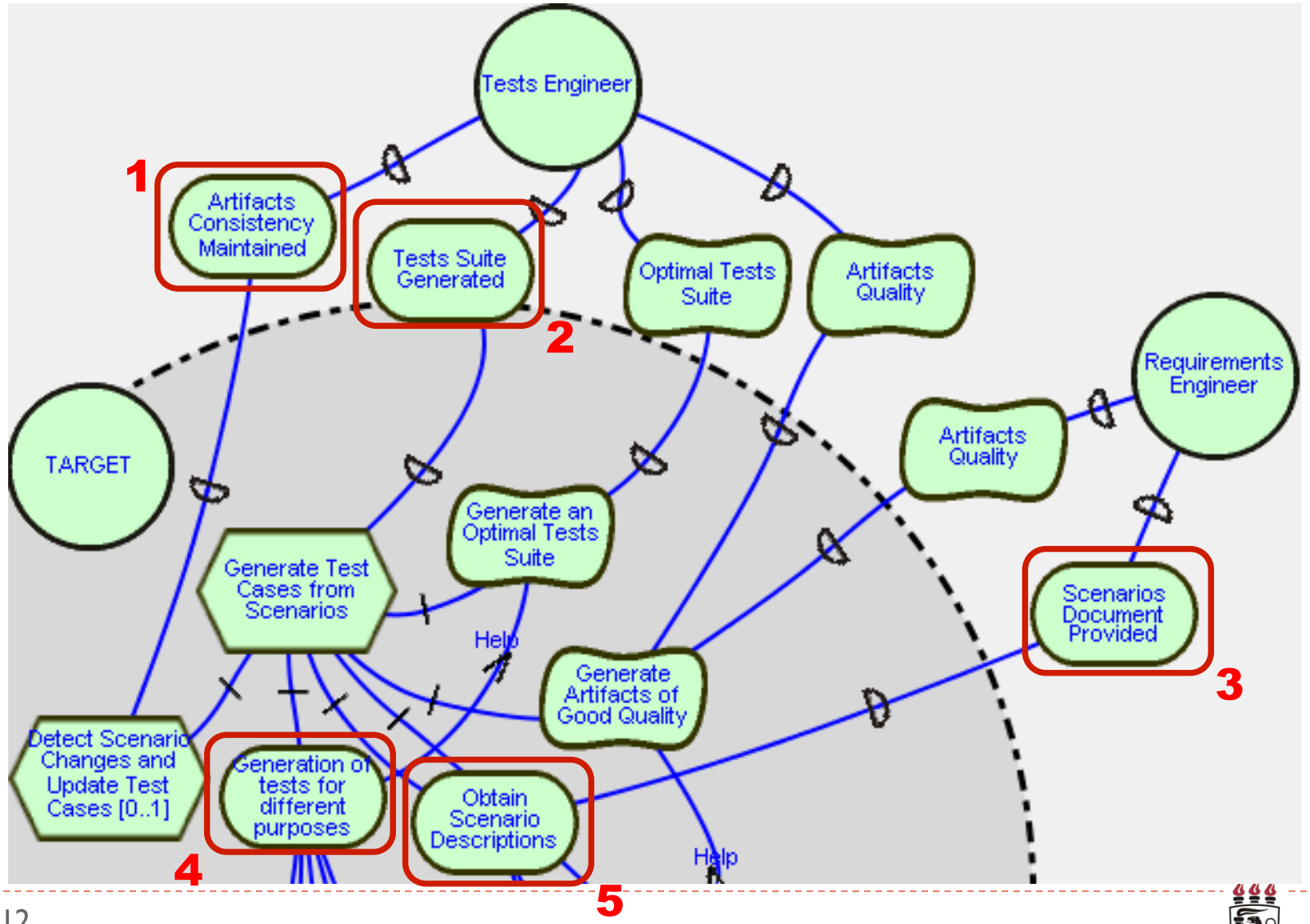
- Motorola TaRGeT (Test and Requirement Generation Tool) project :
  - a SPL whose products are tools that automatically generate tests suites from scenario specifications written in a given template
- Regarding to the case study, we have
  - produced the TaRGeT SR Model
  - produced the inicial Use Case Diagram

Test Research Project (Motorola Brazil Test Center), CIn-UFPE/Brazil and UFCG/Brazil, http://twiki.cin.ufpe.br/twiki/pub/LabPS/ModulosApredizagem/TreinamentoTaRGeT.pdf

TaRGeT

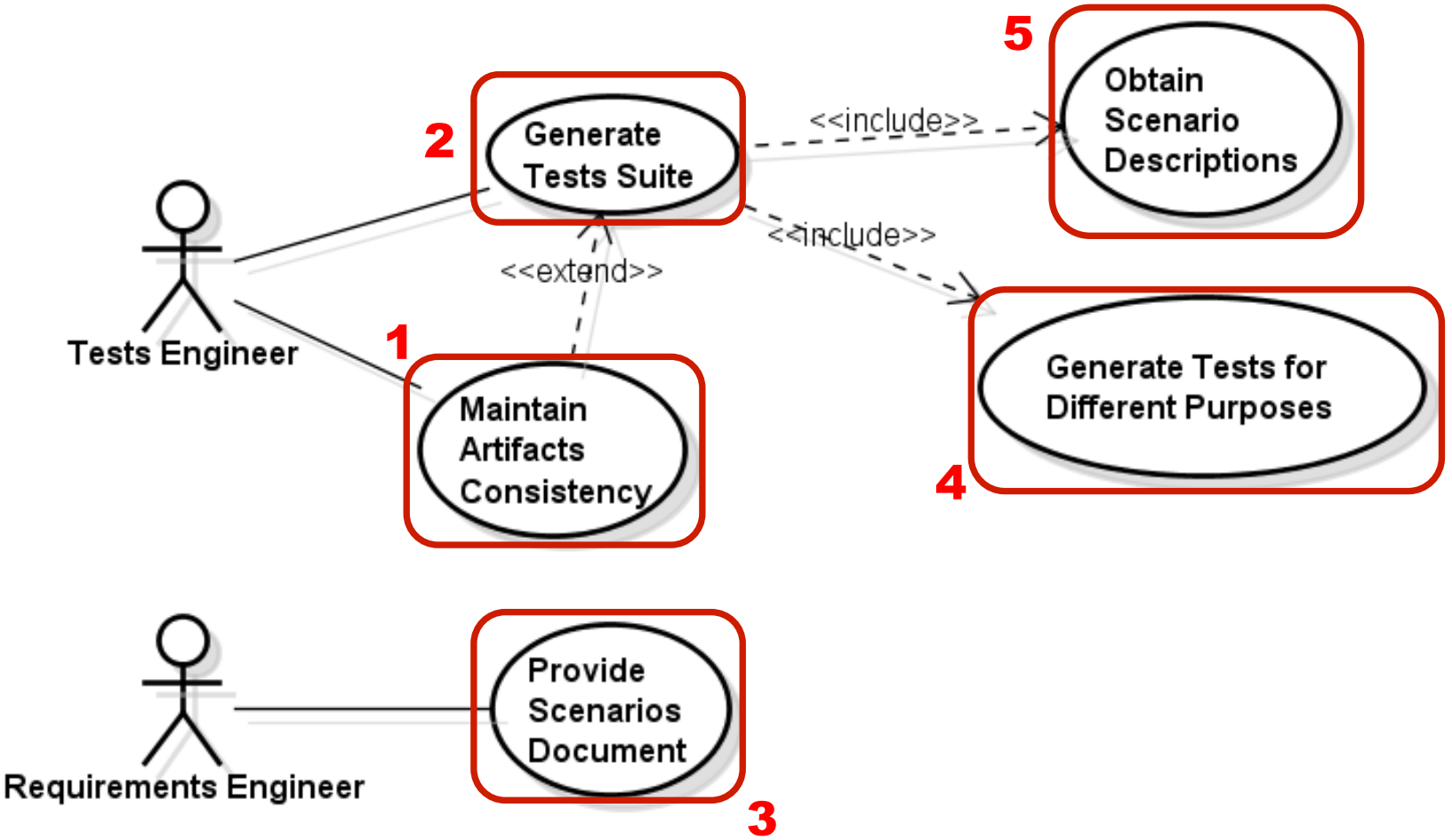

Tester
Bug Detection
Tests Suite
Well specified Test Cases
Tests Engineer
Increased Productivity
Product Quality
Motorola
Artifacts Consistency Maintained
Tests Suite Generated
Optimal Tests Suite
Artifacts Quality
Well specified Scenarios
Market Competitiveness
Product Quality
TARGET
Generate an Optimal Tests Suite
Help
Generate Test Cases from Scenarios
Help
Market Competitiveness
Help
Artifacts Quality
Requirements Engineer
Help
Generate Artifacts of Good Quality
Scenarios Document Provided
Detect Scenarios Changes and Update Test Cases [0..1]
Generation of tests for different purposes
Obtain Scenario Descriptions
Verify Scenarios Syntactically [0..1]
Help
Select by UC
Select Permant Exclusion of a Test Case
Select by UC with common steps
Select Test Cases with Maximum Coverage
Select Permant Inclusion of a Test Case
Write Scenarios on Embedded Editor
Upload Formatted Document

TaRGeT


Tests Engineer
1
Artifacts Consistency Maintained
Tests Suite Generated
2
Optimal Tests Suite
Artifacts Quality
Requirements Engineer
TARGET
Artifacts Quality
Generate an Optimal Tests Suite
Generate Test Cases from Scenarios
Scenarios Document Provided
3
Help
Generate Artifacts of Good Quality
Detect Scenario Changes and Update Test Cases [0..1]
Generation of tests for different purposes
Obtain Scenario Descriptions
4
Help
5

TaRGeT

- Inicial Use Case Diagram



New Guidelines

- Element Cardinality (Task or Resource)
  - [0..1] : optional step (alternative flow)
  - [1..1]: mandatory step (principal flow)

- Means-End Cardinality
  - [i..j]: group of alternatives, where **at least** *i* and **at most** *j* must be present

TaRGeT

Use Case 3: Provide Scenarios Document
Scope: TaRGeT tool Pre-conditions: - Actor: Requirements Engineer
PRINCIPAL SCENARIO 1. Write scenarios on embedded editor 2. Save document for future use
EXTENTIONS 1a. Upload formatted document
RELATED INFORMATION Parent Use Case: **-** Subordinated Use Cases: - Non-functional Requirements: -

Conclusions

- The proposed process aims to:
  - provide the development of more complete requirements artifacts
  - enable the systematic construction of model features
  - allow the systematic generation of artifacts for a specific product

Ongoing and Future Work

- We will execute the remaining activities of the process.

- As future work, we suggest the development of a tool to support the whole process, since only two activities have tool support (activities 1 and 6).

Castro, J., Alencar, F., Santander, V., Silva, C.: Integration of i* and Object-Oriented Models. In: Yu, E., Giorgini, P., Maiden, N., Mylopoulos, J. (eds). Social Modeling for Requirements Engineering. 1st Ed., MIT Press, 2011. Chapter 13, pp. 457-483

Discussion Points

- Cardinality in i*-c;

- Dealing with variability in scenarios in a modular way;

Goals and Scenarios for Requirements Engineering of Software Product Lines

Gabriela Guedes, Carla Silva and
Jaelson Castro

ggs@cin.ufpe.br, carla@dce.ufpb.br , jbc@cin.ufpe.br

Universidade Federal de Pernambuco

DEPARTAMENTO DE CIÊNCIAS EXATAS
CENTRO DE CIÊNCIAS APLICADAS E EDUCAÇÃO
UNIVERSIDADE FEDERAL DA PARAÍBA

G2SPL Activities (1)

1. Creation of the SR (Strategic Rational) Model:
   - modeling the stakeholders' goals using i* framework.
2. Identification of the Candidate Elements to be Features:
   - identify the elements of the SR Model that could represent features.
   - Tasks and Resources.
3. Reengineering the SR Model:
   - add cardinality to the SR model.
4. Elaboration of the Feature Model:
   - derivate the Feature Model of a SPL using the SR Model with cardinality.

G2SPL Activities (2)

5. Reorganization of the Feature Model (optional):
   - If the feature model has repeated features, sub-features with more than one father or different features with the same meaning, reorganization is required.
6. Elaboration of the Use Case Scenarios:
   - the SPL use case scenarios are specified according to an adaptation of the guidelines defined by Castro et al. [13].
7. Generation of Use Case Scenarios with Separation of Crosscutting Concerns:
   - the use case scenario specification and the feature model are used to generate use case scenarios with separation of crosscutting concerns.
   - MSVCM or MATA.
8. Configuration of the Product Artifacts:
   - derivation of the artifacts for a specific product of the SPL.