Model Based Document Generation

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The Problem

- Document is culturally the primary artifact
- Models of system live a separate life
- Diagrams are copy/pasted into documents
- Description of model elements is partially kept separate from model (description added to diagrams in document)
- Two sources of information (Model and Document) have to be maintained – get out of sync
- Document generation engines (velocity template) have typically hard-coded references to model elements and diagrams
Suggested solution

• Create a model of the document
• Reference existing system model elements by unique identifiers
• Document model and system model may be aggregated in same project model
• A subset of the DocBook ontology is mapped to model elements using a dedicated SysML profile
Implementation

• Use standard documentation format:

• Use SysML profiles to introduce DocBook elements in SysML models, in a tool independent fashion

• Use customization facilities provided by SysML Tool vendor to write code for export
Software

```java
if (content.indexOf("<html>") != -1) {
    if (Debug) { System.out.println(" contains HTML ");
        prefix = postfix = "";
        content = convertHTML2DocBook(content);
        //
        ma = pa.matcher(content);
        //content = content.replaceAll("<head></head>" , "");
        if (ma.find()) {
            content = "<para" + content + ">");
        // final check that the content contains a paragraph construct
        if (!content.contains("<para") ") {
            content = "<para" + content + ">/para";
        }
    } else {
        if (Debug) { System.out.println(" does not contain HTML ");
            prefix = "" + lineEnd;
            //System.out.println("Size is:" + value.size());
            postfix = "="/para" + lineEnd;
        }
    if (Debug) { System.out.println(" is Paragraph " + lineEnd); }

    List value = StereotypesHelper.getStereotypePropertyValue(e1 , theParagraphStereotype, "xref");
    for (int k = 0; k < value.size(); ++k) {
        // tag value
        Object tagValue = value.get(k);
        if (tagValue instanceof Element && isXReference || Element.tagValue ||
            NamedElement refX = null;
            String tempString = null;
            int to = content.indexOf(tokenName);
            int l = tokenName.length();
            if (to == -1) {
                System.out.println("MSOE: DocBook: mismatch in number of references");
                // we have a mismatch in the number of xref and the number
                // of occurrences of the string TOKEN
                break;
            }
        }
```
Usage

• Stereotype tags are used to reference to system element models
• Text is entered in comments (which can be visualized in diagrams)
• References to model element or diagrams are selected using the tool navigation facilities
Usage Example: adding a chapter

Adding a chapter B to a book A
1. Create a package B for the chapter, give it a name
2. Stereotype package B by «chapter»
3. Modify properties of «book» element A, by adding a reference to B, e.g. modifying the tagged value to include B in its list
Internal References

• Unique elements ID are generated following containment tree hierarchy

```xml
<chapter
    xml:id="APE_Project_Views__Cookbook__CookbookforMBSE
    withSysML__MBSEinTelescopeModelling__Introduction" />
```
Usage: adding internal reference

Paragraphs may contain references to book elements
Shortcomings

• Missing validation rules (but could be added)
• Difficult deployment
• Dependency on API version (potentially)
• The insertion of document hierarchies is tedious without a WYSIWIG editor or similar
Shortcomings 2

• which subset of DocBook should be supported?
• creating cross-references (also internal ones) is possible but a bit cumbersome
• comments are elements without a name and therefore a bit difficult to find in the model browser
• MagicDraw's text editor supports only HTML which is not compliant with DocBook and the text has to be transformed (which is done automatically when generating)
Advantages

• It adds advantages for configuration control since different document parts may be modified concurrently by different authors (assumes a version control system for underlying model from vendor’s side)
Using comments

• Pros and Cons of using the *comment* element:
  1. Comments can be visualized directly in a SysML diagram
  2. Comments do not have a name, which makes it difficult to identify them.
Cookbook for MBSE with SysML

Foreword

This book contains guidelines, recipes, and best practices for Model Based Systems Engineering (MBSE) with the Systems Modeling Language (SysML) on the basis of an interdisciplinary model of a complex real-world project, a high-tech opto-mechanical system called the Active Phasing Experiment (APE).

The book addresses:

- Model structure and overview
- Objectives and Requirements
- Context, System Structure
- Behavior and Data
- Verification
- Model library and domain specific profiles

Part: MBSE in Telescope Modelling

Chapter 1: Introduction

In the framework of INCOSE’s strategic initiative, the Systems Engineering Vision 2020, one of the main areas of focus is model-based systems engineering. In keeping with this emphasis, the European Southern Observatory (ESO; [http://www.eso.org/](http://www.eso.org/)) is collaborating with the German Chapter of INCOSE ([http://www.gfse.de/](http://www.gfse.de/)) in the form of an “MBSE Challenge” team. The team’s task is to demonstrate solutions to challenging problems using MBSE. The Active Phasing Experiment (APE; see Goote et al. 2004), a European Union Framework Program 6 project, was chosen as the subject of the SE’10 Challenge Team ([http://aepse.gfse.de/](http://aepse.gfse.de/)). Many technical products in the telescope domain show an increasing integration of mechanics with electronics,
Advantages

• consistent integration of system model and system documentation
• direct linking to model elements (also diagrams) from the document
• changes of diagram names is automatically reflected in the document
• using proper definition of the stereotype associations only compatible elements can be selected to compose the document, e.g.
• a figure references diagrams, a chapter references paragraphs.
• the documentation is at the same time navigable in the model and printable
• documents are modeled in a tool independent way. Only a small plugin is needed to generate DocBook XML.