01 OpenSE Cookbook

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1 Introduction

Engineering cookbooks are a compendium for the engineer which captures best practices, lessons learned, and provides guidance on how to use languages and tools to achieve a certain engineering task, such as "How-to Verify Requirements".

The OpenSE Cookbook is such a reference that is an open-sourced collection of patterns, procedures, and best practices targeted for systems engineers who seek guidance on applying model-based and executable systems engineering using SysML. Its content has emerged from the system level modeling effort on the European Framework Program 6 (FP6) and the Thirty Meter Telescope.

Application of the OpenSE Cookbook practices enables consistent delivery of engineered products using a well-defined modeling approach called the Executable Systems Engineering Method (ESEM), which is a refinement of the Object Oriented Systems Engineering Method (OOSEM).

ESEM introduces the next phase of system modeling emphasizing executable models to enhance understanding, precision, and verification of requirements.

The OpenSE Cookbook provides a consistent, comprehensive, detailed, and background-agnostic set of operational procedures to guide practitioners through MBSE. Unlike existing SysML literature whose goal is to provide the foundations of descriptive modeling to newcomers and bring forward the arguments in favor of MBSE, the OpenSE Cookbook represents an implementation of what such literature often refers to as best practices or organization-specific procedures. It provides goal oriented guidance for systems engineers explained by a set of combinable patterns. Systems engineering workflows drive each of the pattern definitions, such as how to verify requirements, roll-up technical resources, and analysis.

The OpenSE Cookbook demonstrates how to build and analyze system models using OpenMBEE as applied to educational examples as well as actual usages in the TMT production model.

The overall goal of the OpenSE Cookbook in conjunction with OpenMBEE is to commoditize the Executable Systems Engineering Method, i.e. remove the cost and barriers to entry that allows for expanded innovation and broader operations driven by increased user access and decreased costs, in order to foster the broadest adoption.

2 Pattern Template

Each design pattern consists of the following views:

View	Description
Intent	A brief description of the problem which is addressed by the design pattern. The intent should prove useful when searching through design patterns, and to quickly understand the purpose of the pattern.
Motivation	Explains a representative problem of a broad class of problems that the pattern seeks to address. The representative problem is a widespread concern and not trivial. In addition, the Motivation provides conditions that must be satisfied in order for the pattern to be used. After the conditions have been satisfied, the goals that the designer is trying to fulfill can be met. Any complicating design aspects and design constraints will be mentioned as well.
Concept	A description of the structure of the pattern using SysML diagrams. All elements are generalizations of those that appear in the specific example given in the Motivation view. Each element of the structure is described, and a description of their responsibilities, purpose, and important relationships/interactions among participants are provided.
Consequences	A description of the results, side effects, and trade-offs caused when applying the design pattern to the modeler's system. The actions and the positive or negative consequences are described. Additionally, a listing of possible conflicts that can occur while applying or using the pattern are provided. The possible scenario is described, and an explanation of the conflict is provided. It should be understood to the reader of the design patterns that both positive and negative consequences could occur. The designs are a compromise between available options and no design can avoid some negative consequence.
Implementation	A sample model for instructional purposes that addresses the problem which is presented in the Motivation view. The example illustrates in detail how the pattern is applied a the particular problem.
Known Uses	Other efforts that have dealt with the design problem which is addressed by the design pattern. An example system may have used a variation or the same design pattern as a solution.
Tooling	Tooling information that can aid the implementation of the pattern is provided. Note, the information provided is meant only to aid and provide a faster method for implementing an aspect of the pattern. Tooling support is provided in several ways. If a specific software or plugin is recommended, information and links regarding such will be provided. Assuming the reader will proceed with the suggested tooling, screenshots of the expected input and output will be shown.
Related Patterns	Other design patterns from the Cookbook that could be used in combination with the selected pattern. The similarities and differences between the patterns serves to provide guidance as to which pattern may prove more useful.