

Workshop on the Development of Large System Dynamics Modeling Projects

This workshop addresses model development and management in large system dynamics modeling projects. The workshop will describe and demonstrate methods and tools to facilitate model reuse that aid in the development of larger models built from several smaller models. While in this session we use Vensim,[®] many concepts are applicable to other system dynamics simulation environments.

Large modeling projects are often distributed over several participants, potentially at different sites. Techniques such as normalization (common modeling standards), modularization (developing models around distinct and small modeling domains), and automation (automated merging of small models into larger models, and automated consistency checks) are extremely helpful in allowing such projects to produce high quality models while achieving project goals.

Most of the techniques described in this workshop are adapted from common techniques used in software development (especially object-oriented patterns). These techniques yield a highly productive development environment to manage common issues in the development process, e.g., variable scoping and namespace control, modularization, version control, configuration management, and code extensibility. Workshop content is appropriate for people involved in large modeling projects who must cope with complex model development yielding large models, with regular reuse of model components, and anyone desiring to know alternative methods for system dynamics model development practices.

Workshop content will cover the following sections.

Organization and Prerequisites. This section will cover the essential elements for a large modeling project. Project development standards, a defined model development process, a code repository (such as CVS), and preparing modelers to understand the roles of standardization, modularization, and normalization. Standardization refers to the aspects of development that must be done consistently, and coordinated with a development team, in order to create coherent models. Standardization includes normalization, modularization, automation tools, and model development practices. These elements of standardization are further understood by what they include.

Normalization includes:

- Common semantics, modeling philosophy, level of detail, naming practices, input data accuracy, diagramming practices (colors, fonts), etc.
- Categorization/taxonomy of variable types.
- Scope (i.e. what one intends to model)
- Metrics

Modularization includes:

- Component development and reuse.
- Pattern development and reuse.

Automation can include mechanisms to aid in:

- Model merging.
- Managing name spaces.
- Instantiation of reusable components.

Application of Concepts. In this section participants will be guided through the application of the concepts in an example problem. Participants will create a multi-module model in multiple files and use the Conductor tool to merge them into a single file. The concept of modeling patterns will be explored. Two useful patterns are the Extension and the Adaptor patterns. These patterns will be presented in the context of a flexible architecture concept.

Use of Automation Tools. This section will review the capabilities of the *Conductor* tool. This tool may be analogous to what in software development is called an integrated development environment. This tool can merge separate models into a single one, perform syntactical checks on variables and equations, allow the user to examine variables and equations, assess incomplete variable links, as well as other higher level functions.

This workshop has been motivated by our experience in developing a large system dynamics modeling project involving three geographically separate sites, 53 models comprising over 5000 variables. The combined model for our most recent study includes 32 of the models yielding 94 Vensim model views.

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Abstract for Proceedings

This workshop will lay the foundation for effective development of large system dynamic modeling projects using Vensim. A key to this development process is the automated combining (merging) of models. Even small system dynamics models can be fairly complex. When the size of the model gets large, such models often become unwieldy, difficult to maintain, and hard to understand by any but the original modeler involved in the development. This workshop will provide specific methods in standardization to alleviate these issues and apply concepts from modern software development practices to system dynamics modeling. Participants will learn techniques for modularization, normalization, and the application of automation tools. While much of the workshop is specific to Vensim, many of the concepts are generic and can be applied to any system dynamics simulation environments.

Link for information

<http://www.systemdynamics.org/conf2005/proceed/papers/LECLA437.pdf>