

Conceptual Modeling of Complex Systems via Object Process Methodology

Ammar Ahmed and Dov Dori
Massachusetts Institute of Technology

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ABSTRACT

Knowledge mapping is a first and mandatory step in creation of system architecture. This paper considers the conceptual modeling of automotive systems, and discusses the creation of a knowledge-based model with respect to the Object Process Methodology an approach used in designing intelligent systems by depicting them using object models and process models. With this knowledge, systems engineer should consider what a product is comprised of (its structure), how it operates (its dynamics), and how it interacts with the environment. As systems have become more complex, a prevalent problem in systems development has been the number of accruing errors. A clearly defined and consistent mapping of knowledge regarding structure, operation and interaction is necessary to construct an effective and useful system. An interactive, iterative and consistent method is needed to cope with this complex and circular problem.

In this paper, the Object-Process Methodology (OPM) approach is considered, along with OPCAT, a tool for OPM-based knowledge modeling. OPM is a systems-modeling approach that represents knowledge about systems concurrently and bi-modally through graphics (a set of Object-Process Diagrams, OPDs) and text (Object-Process Language, OPL, a subset of English), yielding a single, unified and consistent view. In this paper we propose a foundational modeling and conceptual construction approach

for Antilock Braking System a complex automotive system that incorporates electrical, mechanical and software components

INTRODUCTION

In this paper, we introduce OPCAT (Object Process CASE Tool) as an integrated system development software environment. OPCAT supports system development using Object Process Methodology (OPM), which weaves the object oriented paradigm with the process oriented approach. To enhance modal legibility and comprehension, OPM uses two semantically equal formalisms: a visual programming tool, called Object Process Diagram (OPD), and a textual counterpart, called Object Process Language (OPL). Making use of the modality human cognition principle, OPM engages the power of both sides of the brain – the visual interpreter and the lingual one.

Being an OPM based tool, OPCAT enjoys the advantages of supporting most of the system development lifecycle tasks, starting from requirements analysis, through system design and implementation, to system testing, simulation, and validation. Since OPM enables modeling system dynamics and control structures, such as events, conditions, branching, and loops, the generated implementation can definitely be more advanced than a mere standard skeleton code. Moreover, OPM ability to capture the system's structure and behavior in a single view also enhances

OPCAT simulation capabilities and makes it most suitable for interactive testing and validation. I exemplify these features through a small case study of Antilock Braking System.

SYSTEM ARCHITECTURE

Architecture is a way to manage complex systems which may have interactions in unexpected ways. A good architecture effectively communicates designs intent, concept and planning through the use of models. System architecture is an abstract description of the entities of a system and the relationships between those entities. The communication of a system's architecture through simplified models can assist in illuminating the inner most and outer most determinants of system operations.

The understanding of a system starts with simplification. This can be achieved by focusing on the systems essentials. Simplification of the system can be accomplished by grouping needs into intent and goals to understand system's true objectives. The system architecture process combines basic aspects of the system: intent, concept, function, form and context into an understanding of the system as a whole. Other properties like durability, maintainability, flexibility and manufacturability are also important to the architecture and are related to the life cycle of the system. Architecture can assist the analyst with establishing expectations in addition to providing a snapshot of the system's form and function. So the contrast between system architecting and engineering is that architecting is an inductive process and engineering is concerned with quantifiable costs. Engineering is more of a science, architecting more of an art.

APPLICATION OF SYSTEM ARCHITECTURE TO SYSTEM DESIGN

Creating the system architecture of a new system ensures that desired behaviors and needs are well understood from the beginning of the design process. This ensures that the beneficiaries' needs and the intent of the stakeholders are foremost in the minds of the designers as they determine the system concept.

Specifying a system concept greatly assist with the difficulty of keeping all members of the design team on the same page. The concept, a clear brief statement, defines the core ideas and references from which the rest of the system design will flow. Selecting a system concept can provide access to canonical patterns with well understood behaviors, or to help specify sub-systems, which can be designed separately, but whose interfaces are well defined.

The architecture also conveys the arrangement of system elements within the system context. The identification of this arrangement enables analysis for unexpected, emergent behaviors within the system, as well as design for unexpected behaviors. Understanding the context and environment within which the system will operate ensures completeness of design and suitability to task in the field.

Architecture includes planning for life-cycle concerns related to platform alignment, reusability and supportability. These are concerns to be considered early in the designing effort to ensure that the system remains viable throughout its lifespan, and that the concept continues beyond that lifespan.

The complexity of a large scale system is such that, unless design begins with a clear reference, it is easy to lose the concept of the system in the details of interfaces and behaviors. Well planned system architecture will simplify this process by laying much of the foundation for the system before there is a great deal of investment in detailed design and by allowing the details to be worked out later within the architectural framework.

APPLICATION OF SYSTEM ARCHITECTURE TO SYSTEM ANALYSIS

Architecture is useful in system analysis in a different way than in design. There are advantages to discovering and modeling a system which are beneficial to the stakeholders and managers of the system as well as to the operators. The architectural model of the firm is a simplified representation of the system, a model to be used as an effective communication tool that provides detailed information about how the system functions and how the sections