Chapter 3

Use of Semantic Mediation in Manufacturing Supply Chains

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EXECUTIVE SUMMARY

This chapter discusses lessons learned about enabling interoperability using semantic methods in three automotive industry projects spanning 8 years. In these projects the authors attempt to automate systems integration tasks typically performed manually. The essential form of the solution is to define ontologies of (1) the joint action of the required business process, (2) business domain objects from the viewpoints of the components playing roles in the process, and (3) the engineered interfaces through which the interaction occurs. The authors then use these ontologies, in semi-automated processes, to generate mediators that translate message content to the form required by message recipients. They discuss briefly how these methods suggest the need for a more methodical and rigorous systems engineering practice and semantically richer, computationally accessible exchange and interface standards.

INTRODUCTION

This chapter reports on our experience investigating issues of semantic interoperability through three related research projects. The common thread throughout our work is the central role that system engineering processes and their formalization and automation play in facilitating semantic interoperability. Systems engineering is any methodical approach to the synthesis of an entire system that (1) defines views of that system that help elicit and elaborate requirements, and (2) manages the relationship of requirements to performance measures, constraints, risk, components, and discipline-specific system views. The projects described in this chapter automate tasks traditionally performed by human systems engineers. Our perspective is that today’s service-oriented architectures, tomorrow’s semantic web, and other efforts in interoperability seek to do the same. In these efforts, the task to be
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automated determines the knowledge that needs to be formally represented. Qualities of that representation and the soundness of the process that automates the task will determine the characteristics of the solutions produced. Among these characteristics, confidence in the assessments of risk, and performance of the solution produced, stand out as key issues in determining the solution's effectiveness in a given problem space. The search for a new paradigm in systems integration is a search for an approach that provides a good return on the cost of producing the formal representation that enables the automation.

The three projects discussed in this chapter focus on providing semantic interoperability by reconciling differences of viewpoint that may be present in the system components whose joint work provides a system function. Reconciling differences in viewpoint that are exposed in component interfaces is a systems engineering task. Though the three projects differ with respect to the nature of the solutions that they deliver, they share important aspects of design.¹

BACKGROUND

System components interoperate when they act jointly for the purpose of achieving a shared goal. Their joint work is coordinated through their communication with each other. This is as true for wholly mechanical systems as it is for information systems and agencies with human components. With respect to information systems particularly,

Figure 1. A message prompts a behavior, but the relationship between the message and behavior is hidden from the sender