

Exploring the use of Model-Based Systems Engineering (MBSE) to develop Systems Architectures in Naval Ship Design

by

Nadia A. Tepper

Submitted to the Department of Mechanical Engineering and the System Design and Management Program on May 7, 2010 in Partial Fulfillment of the Requirements for the Degrees of

Naval Engineer

and

Master of Science in Engineering and Management

Abstract

The U.S. Navy designs and operates the most technologically advanced ships in the world. These ships incorporate the latest in weapons technology, phased array antennas, composite structures, signature reduction, survivability, modularity, power systems, computing systems, and automation. The modern day warship is an exceptionally complex system and the design process is long and intricate, spanning several years from feasibility studies to detailed design. The plethora of new technologies being introduced in any single ship design increases the complexity of the ship design process making it ever more challenging to meet the needs of the stakeholder in terms of capability, cost, and risk. Systems architecture provides a way to understand, design, and manage this complexity by representing the system as an abstraction of elements and the relationships between those elements.

Model-Based Systems Engineering (MBSE) has been a recent initiative in the systems engineering community to enhance the systems engineering process by streamlining requirements traceability and improving communication amongst the various stakeholders. MBSE methods have been used in industry to develop systems architecture in a robust and comprehensive manner. In the ship design process, there is a significant need to ensure that the architecture is not only well-defined, but also addresses the needs of the stakeholders. This thesis explores the use of MBSE to develop systems architecture with application to Navy ship design and acquisition.

Thesis Supervisor: Trent Gooding
Title: Associate Professor of the Practice

Thesis Supervisor: Pat Hale
Title: Director, Systems Design and Management Fellows Program