

# Applying Set Based Methodology in Submarine Concept Design

By

Matthew C. Frye

Submitted to the Department of Mechanical Engineering  
on May 7, 2010 in Partial Fulfillment of the  
Requirements for the Naval Engineers Degree and  
Master of Science in System Design and Management

## ABSTRACT

Early stage ship design decisions continue to be a challenge for naval architects and engineers. The complex interactions between the different elements of the ship and the broad spectrum of disciplines required in ship design make it difficult to fully realize the effects and limitations early decisions place on design flexibility.

Naval ship design has primarily focused on using point based design methods that do not necessarily produce the most cost effective, innovative, and high quality designs. Recognizing these shortcomings, U.S Navy design is exploring the use of Set Based Design (SBD) principles and methodology in designing the fleet for the 21<sup>st</sup> century. Existing research has shown the merits of SBD in other industries; however, research on the use of SBD in naval design does not exist.

The thesis explores how to execute SBD in light of the recent restructuring of the U.S. Navy acquisition process calling for the use of SBD in pre-preliminary design. This is undertaken using the knowledge gained from exploration of the Ship-to-Shore Connector (SSC) program, the first use of SBD in a new start acquisition program.

The thesis concludes by applying the derived information to an early stage submarine concept design. This effort focused on how to develop submarine design parameters and exploration of how to create and reduce integrated concepts.

Thesis Supervisor: Dan Frey

Title: Associate Professor of Mechanical Engineering and Engineering Systems