

## **Model-Based Systems Engineering Achieves a Positive Return on Investment for the US Submarine Fleet**

The Submarine Warfare Federated Tactical System<sup>1</sup> (SWFTS) is a rapidly evolving, COTS-based combat system of systems (SoS) acquired by the US Navy for deployment across the Fleet. The SWFTS program integrates the combat system from component systems produced by multiple programs of record.

The Program Executive Office for Submarines practices continuous process improvement in an unending quest to improve efficiency and deliver greater capability to the fleet despite increasing budget pressures. As part of this quest, in 2011 the SWFTS SoS engineering team started a three-year transition from a traditional document-based systems engineering process to a model-based systems engineering (MBSE) process utilizing UML and SysML. That transition has been successfully completed, and is now producing a positive return on the customer's investment (ROI).

SWFTS is a level-of-effort contract, so the ROI manifests in a combination of increased number of baselines developed, improved quality of systems engineering products, and expanded scope of work within constant funding. Since the transition to SysML-based MBSE, the average number of baselines produced on a monthly basis has increased by approximately 30%. The number of subsystems and combat system variants integrated in these baselines has increased by 60%. Over the same time period, the complexity of an average baseline, as measured by numbers of requirements and defined interfaces, has grown at 7.5% per annum. The efficiencies achieved through the transition to MBSE have also enabled the SWFTS SoS engineering team to accomplish additional tasks that had previously fallen below the funding line. One measure of this growing engineering scope is that the number of discrete systems engineering products produced by the team has increased by over 60%, with most generated directly out of the SoS model.

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<sup>1</sup> Zingarelli, M. A., Wright, S. R., Pallack, R. J., and Mattos, K. C., "SWFTS - System Engineering Applied to Submarine Combat Systems," Falls Church, VA: 2010, pp. 1-14.  
<https://www.navalengineers.org/SiteCollectionDocuments/2010%20Proceedings%20Documents/ETS%202010%20Proceedings/Zingarelli.pdf>  
Also described in [http://www.navy.mil/submit/display.asp?story\\_id=46371](http://www.navy.mil/submit/display.asp?story_id=46371) and [http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue\\_44/australian.html](http://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue_44/australian.html)