

OSCAM: 22 years of making better operating and support estimates of fleets of ships and aircraft for the US Navy

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OSCAM is widely used by the US Navy for estimating operating and support costs for ship classes and aircraft types. It plays an important role in developing submissions for milestone decisions during the US Department of Defense procurement process. It is 22 years since the first OSCAM model was developed. It has changed from being a niche model to a standard tool used by many cost analysts, replacing bespoke spreadsheet models.

An overview of OSCAM will be provided including a description of the key principles behind the System Dynamics model, which is used to link platform activity with operating and support costs. A brief history of OSCAM will be given, with an overview of the equipment programmes that it has been used for and the types of decision-making it has supported. Both OSCAM Ship and OSCAM Air have had major System Dynamics model refreshes, having learned lessons from the previous versions. Key themes, drivers and lessons learned for these changes will be described, along with some challenging concepts to model. The presentation will conclude with a review from customers on how OSCAM has improved the ability of the US Navy to estimate operating and support costs and undertake 'what-if' analysis.

Overview of OSCAM

OSCAM Ship and OSCAM Air are software tools that allow cost analysts to develop cost estimates for the operating and support costs for a class of ships (or submarines) or an aircraft model (fixed, rotary or unmanned) throughout the life of the programs. At the heart of these tools is a System Dynamics model that is used to take inputs on activity and cost drivers, and generate both cost and non-cost results as annual time series in a cost breakdown structure. The tools have a powerful and intuitive front-end for data entry, analysis of results and comparison of results. It also has the ability to perform uncertainty analysis around input values by specifying probability distributions for inputs and performing Monte-Carlo analysis.

OSCAM is designed to be used by people with little or no knowledge of System Dynamics. As part of the built-in documentation, Influence Diagrams show the business processes used by the System Dynamics model to perform the calculations. These diagrams are divided up into bite-size "sectors" rather than showing the logic of the whole model, with diagrams indicating where they use values from other diagrams. There are about 50 diagrams for each model. Diagrams are accessible by pressing the F1 key on any input or results line to bring up the appropriate diagram. They are in the form of Adobe Flash movies that display additional information and highlight parts of the diagram as user moves the mouse over the screen.

The OSCAM Ship and OSCAM Air tools share a common heritage in terms of both the software architecture (most of the code modules are common to both) and the concepts in the System Dynamics models. However, the System Dynamics are different since the activities represented vary significantly between ships and aircraft.

The users and uses of OSCAM

The primary users of OSCAM are US Navy cost analysts, although OSCAM is also used by industries that support the US Navy. OSCAM is also used by the US Coast Guard and Homeland Security. Several OSCAM training courses are provided each year, and users comprise of Program Team leads, costs analysts and logisticians. Over the 22 years since OSCAM was first developed, close to 1000 people have attended OSCAM training courses. The training courses are often used as an introduction to operating and support cost concepts for people starting their careers in cost estimating or those migrating from procurement cost estimating.

OSCAM is used at various stages of the program lifecycle: at concept stage to compare different types of vessel or aircraft to fulfil a role; at approval stages ('Milestones') for the submission of plans and estimates to get funding; for in-service equipment to estimate costs to end-of-life for a program.

OSCAM has been used for the majority of US Navy ship and submarine programs in the last 10 years, a number of Coast Guard programs, and a number of high profile US Navy aircraft programs. Combined operating and support costs for these programs exceed 1 trillion US dollars.

Many of the cost estimates produced by OSCAM will undergo intense scrutiny. Cost analysts must be able to defend cost estimates in terms of the source and development the input data as well as the logic by which data is converted into the output cost breakdown structure. OSCAM is recognized as an approved cost estimating tool by the US DoD cost scrutiny departments, so costs analysts can be assured that they are using an approved methodology. However, they also need to understand and defend the detail of their costs analysis. Therefore, OSCAM cannot be a black-box model. Analysts can use the Influence Diagrams and documentation to understand the logic of the model, and results outputs provide a number of non-cost outputs which allow analysts to capture the drivers of the costs.

OSCAM provides a framework that helps users determine what data they require and in what format. It is also a common frame of reference which supports cooperation and hand-over between different analysts. There are number of options on the degree of detail that they can use, depending on the maturity of knowledge on the program, which allows OSCAM to be used early in the program lifecycle and then grow in detail as the program progresses through the Milestone stages.

OSCAM does not take away the hard work in procuring and checking the source data, especially for equipment that is not yet in service, which is a key part of the skill and challenge of cost estimating. However, the connectivity inherent in the System Dynamics models provides a mechanism to quickly perform 'what-if' analysis that helps to explain the cost impacts of various options. Feedback from users indicates that OSCAM allows them to turn-round questions from program offices in a matter of hours, whereas these would often take days prior to using OSCAM.

Key lessons learned from early OSCAM models

In twenty two years, a number of lessons have been learned, many of which were necessary for OSCAM to have survived to this day.

Firstly, the people that first saw the potential for System Dynamics to be used for activity driven operating and support cost estimating were right. Operating and support costs were often treated as just an extension of procurement cost estimating techniques, but System Dynamics captures not just what is being operated, but how it is being operated, which has an enormous impact on costs.

Early OSCAM Ship models evolved through a series of prototypes, starting in 1996. OSCAM Air was developed a little later with the benefit of the knowledge of the early OSCAM Ship models. In 2010, OSCAM Ship had a major revamp with a re-write of the user interface and a fundamental review and re-design of the System Dynamics model. Features that were never used were removed, while options for simpler representations were added to allow OSCAM to be used earlier in the program lifecycle. It was important to get OSCAM used early for a program since it is more difficult to get analysts to transition later on once they have invested in an Excel model. Data sources were also reviewed to ensure that OSCAM was able to be populated with verifiable data with the minimum of processing wherever possible. OSCAM Air went through a similar process in 2013.

The re-vamps were important in transitioning OSCAM from a niche tool used by an enthusiastic but small group of analysts to a standard tool used by a much larger user base. The interconnectivity in the System Dynamics models remain as the defining feature of the tool, but removal of the features that were never used resulted in very little feedback being exhibited by the new models.

The re-vamps provided a solid base for incremental changes to support development of the data sources and changes in reporting requirements, as well as some changes to improve ease of use. Much of the recent development work has been on the front-end to add functionality to the uncertainty analysis and provide mechanisms that make it quicker to set up the input data.

OSCAM has a solid and expanding user base, and has become a standard tool, supporting users throughout their careers as cost analysts.

Author Information

Stephen Curram is a Managing Consultant at Decision Analysis Services Ltd in the United Kingdom. He has a PhD in simulation modelling and artificial intelligence, and an MSc in Management Science and a BSc in Computing and Operational Research. He was formerly a lecturer in Operational Research at Warwick Business School before moving into consultancy.

Stephen has been involved in OSCAM since 2003 and was lead developer for the OSCAM Air model, as well as for the later re-vamp of the OSCAM Ship and Air models. He has worked on a number of other System Dynamics studies in the areas of defence, health and transport. He also works on a range of other studies in the fields of Operational Research, software development and cost analysis.