

## **Extension and Application of the Greenfield-Persselin Fleet Replacement Model**

- "My name is David Maybury and I'm a defense scientist with defence Research and Development Canada. I'm also the chairman of NATO SAS 099 on the economics of fleet replacement. SAS 099 is a study dedicated to the economics of military fleet replacement under uncertainty. Uncertainty in military fleet replacement, rests largely under the irreversibility of the decision. That is we can't reverse a decision, if we find the circumstances are unfavorable after we make the decision. A military fleet replacement decision contains two important features. The first, is capability improvement or obsolescence and the second, is the expected cost savings we would get from having a new fleet. When expected cost savings form an important feature in the decision, we need to properly understand the current information flow we're getting from the old fleet. That current information flow contains information on maintenance cost drivers such as supply chain, maintenance load. These kinds of pieces of information, if used correctly can help us reverse what might seem to be a trend, but in fact only be a transient fluctuation. When we balance that information flow, the rewards we could get from it, the cost savings we could get from it, against that of buying a new fleet, we put ourselves in a position to properly understand the decision-making process. Recognizing that when we make a military fleet replacement decision, it will be irreversible. SAS 099 started in 2012 as a collaboration between Canada, the United States, United Kingdom, Netherlands and Sweden. We analyzed three fleets: the Canadian CF-18 fleet, the Swedish C-130 fleet and the American US Army age 64 Apache gunship. We applied our model, with each of these fleets as an exemplar to understand what an optimal decision making would happen with each of these fleets. We extended the Greenfield person model developed at RAND in 2002. This is a real options model, it attempts to evaluate the appropriate time to replace a military fleet. We create a mathematical simplification, by imagining the fleet is replaced with itself in infinite number of times. In doing so we establish a replacement barrier in the maintenance cost space that once crossed, triggers the replacement decision. This mathematical simplification, ring fences the real world decision for decision makers. SAS 099 had a great working relationship with NATO members and the partners for peace member. In addition NATO SAS 099 had the opportunity to leverage the Canada-U.S. operational research symposium, which directly involves the Center for Army Analysis in Virginia. That particular relationship fostered the American inclusion in the study. Military fleet replacement decision represents major investment decisions for governments in the NATO alliance. With NATO SAS 099, we help those governments understand the totality of the information in that decision making and how to value information in an uncertain world