SEMPER:
A Logical Approach to Avionics Upgrades

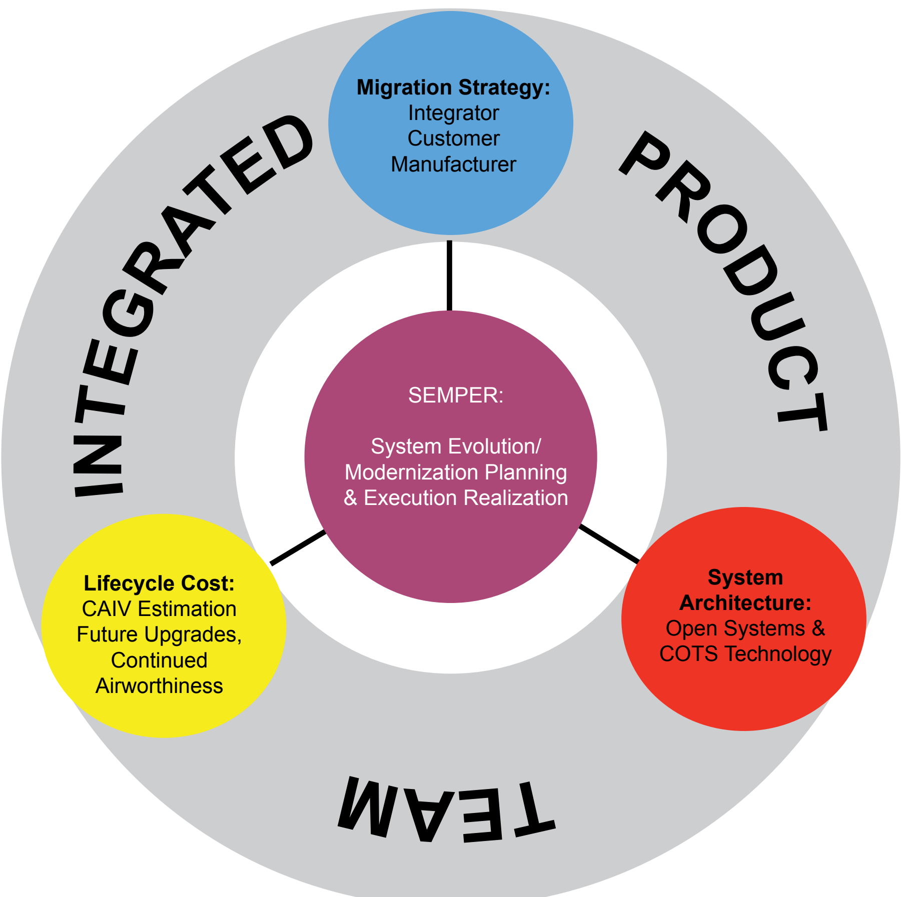
Editor's note: The following is an excerpt from the white paper, "SEMPER: A Model for the Planning & Implementation of Avionics & Systems Upgrades." This white paper is a collaborative effort by Luke Ribich, managing director of the Avionics Systems Integration Group, and the entire ASIG team.

As airframes and their associated flight systems age, the needs of aircraft owners and operators to meet safer, more efficient airframe sub-systems dictate these needs be met by modifications to classic and contemporary aircraft currently in service.

For aircraft avionics, the need for technological currency also is compounded by the various mandates to operate within the safety boundaries of the national and international air transportation systems. The result is a "full plate" for many flight operations, integration engineers and maintenance managers in establishing a rational plan to acquire and install updated systems in the aircraft they are managing.

One approach to this avionics planning process is described as the SEMPER model (system evolution/modernization planning, execution and realization). This model process identifies how to incorporate technical avionics requirements and modification preparation into an effective and integrated plan that considers technical as well as business case issues.

Concepts such as the development of an overall avionics migration strategy, the application of open systems architecture and commercially available technology, when combined with the use of lifecycle cost in the decision process, are key elements of the SEMPER model process.



The SEMPER model has evolved from a series of systems upgrade planning activities conducted in support of commercial, civil and government aircraft. The SEMPER model embraces both systems engineering and business planning processes and focuses on structuring relevant information for the customer to use during the modification decision process.

The need for a SEMPER-like process becomes more apparent with the requirement to install new capabilities on all aircraft operating in national and international commercial airspace. For example, the domestic congressional "mandate" to install global positioning system capability on all aircraft by the year 2000 presented engineering and program managers with a need to incorporate additional upgrades into other requirements for dissimilar aircraft programs.

Program managers concede that internal development of specific modifications requirements and other avionics upgrade planning processes is often piecemeal, particularly among the legacy-tier operators and freight haulers; whereas, with each modification evolved and funded, little consideration is given to the relationship of how a particular modification affects the context of the overall aircraft capability or intent, much less how proposed rulemaking activity could affect current integration plans.

End-users, namely pilots and mechanics, often lack an overall view of how the aircraft capability and supportability of aircraft will evolve because of the uncertainty of the funding approvals from executive decision-makers — airframe systems budgeting had been changed from the operational and supporting departments, such as flight ops, maintenance, engineering and quality, to the administrative elements, such as finance and risk management.

The SEMPER model is intended to be a process method that can yield a successful modernization program meeting user needs and applies current Sarbanes-Oxley acquisition policies in the event this is a concern for publicly held organizations. The concept provides the information for an end-user approval process by incorporating cost evaluation as an independent variable and by open systems and components off the shelf (COTS) applications to ease later upgrades and costs.

The aerospace downturn, particularly with respect to airlines and operators, compounded by the lessening of capital upgrade expenditures from both civil and government flight departments, has resulted in few new systems under development and, as a consequence, has necessitated additional modifications to legacy aircraft to extend service life while adding new capabilities required to ensure the safety and efficiency of operations and to comply with new national airspace rules.

Budget reductions also have changed the airlines' impact on the marketplace and, together with acquisition reform such as the Sarbanes-Oxley law, operators have changed from the role of technical and operational managers to "buyers" of systems rather than "builders" or "envisioners" of systems.

Greater use of COTS components and parts, all the way down to the computer-chip level, can result in avoiding non-recurring engineering costs, thus, yielding lifecycle cost savings.

Careful selection of system elements for integration into an aged aircraft is paramount; therefore, program managers and systems integrators must evaluate carefully the availability of existing sensory inputs, expected life limits, operational capabilities and system scalability, as well as operational and reliability improvements of the system, in addition to the overall likelihood it will be upgraded by the manufacturer as a product in a family with later products being backward compatible.

The components or elements on which systems architecture are based vary greatly in length of service life. Thus, open systems/COTS application can be a challenging task in developing systems architecture but an essential ingredient in lowering lifecycle costs by permitting both competition and less complexity to facilitate future upgrades.

While the "standard" systems engineering process is an essential ingredient, there are three unique elements of the SEMPER model:

• The development of a migration strategy for the aircraft, time-phased to the budgeting process.

• Lifecycle cost estimation.

• Open systems and COTS technology application.

The migration strategy for the system should be projected over the longer term, usually 10 to 15 years.

The second element is the use of lifecycle cost estimates throughout the process to support the entire integration product team, which is comprised of system integration engineers and customer program managers, budgeting managers and executive decision-makers.

Open systems and COTS technology application is the third element and the primary mechanism to effect the modification while retaining the ability to perform later upgrades at reasonable cost.

The SEMPER model can be considered to be the incorporation of new techniques for integrators and customers to collaboratively develop a technical migration and evolution strategy, performing CAIV estimation as a recurring process throughout the pre-RFQ activities, and applying open systems and COTS technologies.

In aggregate, the SEMPER model is comprised of no startling new techniques. Many of these SEMPER precepts came from the retrofit of classic and contemporary transport-category airframes by capturing lessons learned and, subsequently, consolidating and applying these methodologies as a formal process for the accomplishment of analogue-to-digital conversions to legacy aircraft.

The SEMPER model adds safety, capability, reliability and expediting return on investments and is a proven technique toward modernizing aircraft cockpits. Much of the success has been experienced in getting various DC-8, B737 and MD-80 programs

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through customer approval and budget approvals, and can be attributed to the migration strategies identifying viable alternatives.

The lifecycle cost estimates also were a key factor allowing the customer to determine his specific level of affordability for his unique upgrade program.

The application of the SEMPER model is discussed in relation to the traditional steps in a major avionics upgrade. The SEMPER approach can be accommodated best by use of the operating principles that modifications program managers observe during any avionics planning effort. These are, in effect, the lessons learned in how to apply the concept to better develop and manage the avionics capability and currency for an aircraft type.

Since the SEMPER process as defined in this paper has evolved, ASIG and its teaming customers have exclusively applied the SEMPER model. Neither ASIG nor the author claims that the SEMPER model represents all new concepts. Rather, it is an approach to avionics planning and implementation that emphasizes use of a formal migration strategy, lifecycle CAIV cost estimation, and the application of open systems and COTS concepts.

The planning and execution of avionics upgrades to classic and contemporary aircraft can be a challenging process for system engineers and program managers as they work to incorporate operators' needs into the aircraft systems in a timely and affordable manner. The SEMPER model suggests an overall migration strategy for the avionics upgrades, greater use of lifecycle cost estimation and the application of open systems/COTS technology and concepts, which are the three principal legs of the process.

5 considerations when evaluating avionics upgrades:

- Aircraft mission or utilization
- Total number of airframes to modify
- Existing systems architecture/Integration effort
- Available technologies and certification basis
- Cost of continued airworthiness

Avionics Systems Integration Group, Maumelle, Ark., performs integration engineering, FAA certification program management, PMA kit manufacturing, and the assembly of structural components, wire and cable harness assemblies, as well as the installation of communications, navigation, situational awareness and air traffic management equipment for aircraft and other air vehicles. Additionally, the company performs research and development of emerging technologies in support of aircraft operations, maintenance, modification and repair for civil, commercial, government and foreign flight departments.

To receive a complimentary copy of ASIG's expanded white paper document, contact Luke Ribich at lribich@asigllc.com or 866-890-2744. ❑