



The Air Force Develops an Initiative to Manage Change in Avionics Systems

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CROSSTALK

While the U.S. Air Force (USAF) systems are remaining in service longer than planned, the industrial base of prime and original equipment manufacturers and suppliers is declining. Thus the USAF is faced with developing a plan for designing avionics systems that precluded their obsolescence. Weapons in the field need to remain current and supportable. Future systems require a design that facilitates substitution of modern electronics over a system's life. As a result, the Viable Combat Avionics initiative was developed.

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Earlier this year, Lt. Col. Glenn A. Palmer, program director, Computer Resources Support Improvement Program, and Pam Bowers, CROSSTALK managing editor, met with Jon Ogg at Wright-Patterson Air Force Base to discuss the initiative. Ogg is a member of the Senior Executive Service and director, Engineering and Technical Management Directorate, Aeronautical Systems Center (ASC), Air Force Materiel Command, Dayton, Ohio. He provides overall management guidance for the development of systems engineering programs for ASC with annual expenditures of more than \$10 billion. He ensures the proper allocation and expenditure of fiscal and personnel resources and provides engineering tools to the program offices.

Ogg entered federal civil service as a project engineer with the Flight Systems Directorate in 1975. He is recognized as the Air Force's leading authority on integrity for programs propulsion and power systems. He spent 15 years in propulsion and has been involved with every phase of a system's life cycle on nearly all gas turbine engines in the Air Force inventory. In addition, Ogg has provided technical and programmatic support to many ASC weapon system programs, including as chief engineer for the F-22 Program for nearly a decade. He has led numerous reviews spanning acquisition strategies, request for proposal preparation, independent cost estimates, technical risk assignments, and flight certification. He helped pioneer the current integrated product process development and product team approach on the F-22 program.

Q: Why has avionics modernization recently gained so much attention in the Air Force?

Ogg: The catalyst for focusing a laser beam on the subject of aging avionics came about in the mid- to late-1990s when it became apparent that the diminishing manufacturing sources (DMS) and out-of-production parts were driving costs to programs. We began to see a subsystem development program nested within a development program driven by part obsolescence.

A classic example was the F-22. Three years into its development we determined the current avionics suite was not going to be producible due to rapidly changing technology, and key suppliers getting out of the business, including Intel. We never thought they would stop producing the I-960 for the F-22. They had committed to long-term plans back in the late 1980s. However in the 1990s, Intel said that the processor technology had far superseded the 25-Megahertz I-960 processor; the commercial industry was out with 200-

300-Megahertz processors. Our [Department of Defense] market was no longer economically attractive to them.

That triggered a lot of interest at the configuration management level across the Air Force. It became necessary to fund \$1 billion into the ongoing F-22 research and development and planned production program to address the out-of-production electronics and avionics.

The event that kicked us into high gear happened in the fall of 1998. At a quarterly acquisition program review the chief of staff tasked the Air Force Materiel Command to study the design of avionics systems to preclude obsolescence.

Well, the irrefutable fact is that you can't preclude obsolescence. You have to figure out how you're going to manage it. In spring 1999, Gen. (Ret.) Skantz wrote on "Aging Avionics Systems" about aging aircraft, especially avionics and the enormous future cost of sustaining these systems, if we did not move to adopt more commercial technologies and practices. Simply put, we needed to do business differently. So from mid-1999 through December 1999, we brought industry in to help put together an approach called

Affordable Combat Avionics (now called Viable Combat Avionics) to look at the effectiveness of the architectures while identifying actions necessary to set a course for the future. We found that the more viable or open the architecture, the less costly it was to produce, sustain, or upgrade. (After all, the bottom line is still dollars.)

Q: Why does it cost so much to migrate to new hardware considering that electronics technology has decreased from five-year cycles to one year or less?

Ogg: Many of the current architectures are unique and make software dependent on hardware. So when hardware changes, you have to redo software at an enormous cost.

Today there is a big push on open systems and to insulate or isolate the hardware from the functional/program software. At some future point, the hardware component technology will change. Open systems minimize the dependency of exe-

cutting software on the underpinning hardware. The focus is on making the system more adaptable to future change.

In addition to the F-22 standing out as an example of this problem, we had the F-15, F-16, B-1, C-5, and C-130 – multi-billion-dollar programs – all slated for modernization. The end-user [warfighter] wanted enhanced capabilities and functionality that couldn't be accommodated with existing avionic architectures. So we were faced with modernization that typically spans four to six years due to the need to rebuild existing software for hardware technology that was out of production.

Most of our fielded systems were developed back in the days when we could influence the electronics industry. We had a large portion of their business; today, we're less than 1 percent. We are now faced with having to jump onto their track. Instead of being a leader in the electronics industry, we're a follower. In all cases as we modernize our fielded systems, we're focused on looking at the commercial world; where they are today, and, more importantly, forecasting where they are going in the future.

Clearly it is in our best interest to structure architecture to accommodate the inevitable changes over the course of time. From year to year you'll see technologies changing to provide better capability as well as lower cost. If you can't accommodate it within your architecture, you drive up the development costs and in turn the overall Total Ownership Cost (TOC). That's something we are obviously working to avoid.

Q: Is there an overarching strategy for approaching avionics modernization?

Ogg: ASC was tapped to head up the avionics modernization initiative in the summer of 1999 because we have product line management responsibilities for a majority of the aircraft systems. We sponsored a forum that included industry, multiple programs, and folks at the depots. Here's what we saw as the challenge: Where do the responsibility lines fall: which is industry, and which is us? How should we deal with obsolescence and diminishing manufacturing sources? How do we make it transparent to the ultimate customer, the warfighter?

Modernization of the C-5 and C-130 aircraft constitutes a multi-billion dollar investment. In the current environment, there is no common approach across plat-

forms to leverage any specific architectural definition. Every program has a unique strategy. Furthermore, modernization is done, i.e., funded to provide enhanced capability. Using this approach, the move to an open system must tie into changing the architecture for providing the enhanced capability thereby making it

the government – the taxpayers. However, it's still tough to get the folks' support because it's likely to cost a particular program more for the initial investment.

It is also important that we look at the second- and third-tier suppliers as the principal folks to do the long-haul support as technology changes. If they are

“A year ago we went to the chief of staff with the need to recognize this [avionics modernization] as a new paradigm. You've got to look across platforms. Without that support, programs will continue to operate as they always have even though it's not the most cost effective and efficient way to do business.”



more supportable as a by-product of the enhanced capability funded upgrade. In the past, we have gone to the warfighters to say, “Here's a great investment opportunity. If you spend a dollar today to migrate to an open system, you'll realize a 5-to-1 return during the course of the next three to five years through savings accrued across production and/or support.” However, modernization dollars are so limited that the investment does not occur even though the status quo means paying out more in the long run. Colors of monies, i.e., 3600 (Development), 3010 (Production), and 3400 (Support) create major impediments to prudent investment in reducing TOC.

This is where I see the acquisition community taking the lead with our industry partners. Industry can make the up-front investment, and based upon a negotiated share of production or support savings during a specified period of time, the contractors accrue a return on their investment. We structure it over a reasonable period of time so that it represents an attractive investment opportunity for industry. Furthermore, if contractors can drive costs down even further, I say go for it. If, as a result, they realize a higher return, great. We [government] will benefit when we renegotiate the production or support contract in three years or so.

Our solution looks at how we can leverage the total modernization costs across multiple programs. While it may cost a little more to do the up-front work, all the programs on the upgrade platter benefit, and the net result is a savings to

motivated by having a stake in supporting the [sub]system, they'll make the right decisions up-front because they stand to share in the downstream benefits. With open systems you can still have competition at the appropriate level. If contractor X owns a chunk of the avionics suite at the first-tier supplier level, I believe we ought to stay with contractor X. What we ought to mandate is that they maintain at least two or three suppliers for the piece parts. Contractor X is most likely a design/integration/assembly house, but the bulk of components are supplied by second- and third-tier suppliers. When told they will be involved in sustainment, we find a lot of original equipment manufacturers, without customer intervention, determining smart ways to select an architecture that minimizes downstream impacts [costs] as technology changes over time.

Q: Where does the avionics modernization program stand at this point in time?

Ogg: In January 2000 we went to headquarters to present a plan for a viable combat avionics architecture template. This was a direct response to the tasking action item from fall of 1998. This is what we captured as the team's charter:

- Present a plan to study the design of avionics systems to preclude their obsolescence. This includes weapons in the field and how to keep them current and fully supportable, and new systems with a design strategy that

facilitates substitution of modern electronics during a system's life.

- Plan how to manage the ever-accelerating rate of change in avionics systems.

We put forth a solution focused on defining a future operating state for weapons systems in the field in terms of an architecture based on open-systems principles (see Figure 1). We advocated an integrated strategy that 1) supports evolutionary acquisition, 2) utilizes integrated change road maps, and 3) promotes designing for affordable change. It requires an institutionalized and evolutionary acquisition program that invests every two to three years. Insurmountable? I think not. Difficult? You bet!

We recognized up front that the primary way money is put into programs today is for increased capability. Warfighters budget and fund to provide enhanced capabilities, therefore we have to leverage this investment in migrating our systems to a more open/affordable architecture.

For future systems, again we proposed using open systems and master plans that advance evolutionary acquisition with an investment about every two or three years. In support of this thrust, we advocated getting the enabling language [requirements] into our solicitations. We used this approach for the first time with the C-130 Avionics Modernization Program solicitations. We required a description of the architecture with test cases. This included scenarios where in a few years certain parts were postulated as going out of pro-

duction. We asked the offerors to address what it would take to address that situation in the form of time and cost? Or, five years out the warfighter will want a new capability. Tell us how your architecture accommodates providing it, and what the cost will be for development and implementation.

Q: What is necessary to achieving your avionics modernization plan?

Ogg: What we're trying to do is maximize common areas, which include modernization focused upon providing the warfighter with more capability, the ever present out-of-production parts, and inserting new or emerging technologies aimed at reducing the cost of ownership. Some continuing factors plague us: stovepipe thinking (every program does their own thing), avionics complexity and the dependency within systems and subsystems, interdependency across systems, the rapid pace of changing technology, and the fact that we are no longer drive this technology train. And, clearly, the budget constraints that face us all. Our solution was a three-pronged approach:

- Embrace evolutionary acquisition. Accept the fact that every two to three years you're going to have a change. The technology is going to change, and you'll need, or better want to accommodate it at a minimum cost [impact].
- Prepare avionics road maps. Factor in the modernization effort, your tech-

nology refresh, and the fact that about every two or three years you'll be faced with DMS problems. Develop and integrate these road maps, taking into account like efforts across multiple platforms. Be a realist and tie as many of these parallel thrusts into modernization [capability enhancement] since this is the principal source of funding. Make these synergistic focused on providing the capability while driving down the future development, production, and sustainment costs, or in short, reducing TOC.

- Design for affordable change by migrating to open systems. Take advantage of open systems' set of protocol and interfaces.

When we presented these needs to the chief of staff in January 2000, he responded with top-down support by issuing interim policy. It explained simply that open systems meant designing for ease of change, which is the ability to accommodate constant turnover of the underpinning technology every few years and to do so in a manner that is affordable. He charged the warfighter/acquisition/sustainment communities with taking lead in migrating the Air Force's weapon systems to a more open/viable/supportable architecture.

To support and gain momentum for our activities, we held up the Aging Avionics office with a focus of providing support to all weapons systems as they embark on this journey. We are surveying other services' and agencies' to gain an appreciation of how they are coping with this challenge. We are educating the warfighters' on the magnitude of this future bill to pay while working to gain their support for our initiatives. And lastly, but most importantly, we are developing language for solicitations focused on open-system principles. With this as a backdrop, we sponsored two affordability studies: the Boeing Open Avionics Systems Integration Study (OASIS), and Lockheed's Systems, Technologies, Architectures & Acquisition Reform (STAAR) program. Both studies are looking at opportunities to capitalize on like improvement efforts across platforms, quantifying the potential savings possible in leveraging these efforts across modernization programs.

Q: Have you had the opportunity to use the integrated change road maps to assess and grade the current state of the Air Force's architecture?

Figure 1: *Affordability Initiatives in Open Avionics Systems*



Ogg: Previously David G. "Butch" Ardis, technical adviser for Avionics Systems Architecture, and the program offices had initiated work on preparing modernization road maps – a concentrated effort over the past nine months.

The process has been somewhat painful and a learning experience for many of the stakeholders. In the year since we received approval to move forward, we've assessed these architectures to determine their viability. We looked at current architectures, funded upgrades, and yet unfunded but planned enhancements, from the perspective of three viability objectives:

- **Producibility** – The ability to produce the subsystem in the future based upon the current design.
- **Supportability** – The ability to sustain the subsystem and meet the required Mission Capable Rates.
- **Future Requirements Growth** – The ability of the subsystem to meet projected combat capability requirements with the current design and avionics architecture.

Ratings were assigned per these evaluation criteria. We broke out each system through its projected life and based on current architecture, it was given a color-coded rating. Questions asked included:

- Can you accommodate what the user has defined to you as requirements growth?
- Can you accommodate increased functionality?
- Can you continue to support or sustain that into the future?
- Is it producible?

Each subsystem was scored. In summary, of the weapon systems where the avionics architectures were assessed, all exhibited some form of viability shortfall. Realizing this the warfighters, in concert with the acquisition community, are making investments to increase capability and in the process working to migrate to more open and affordable systems for the long haul.

Our next step in the assessment process is to see how we can influence the future. We are going to the program offices to see how we could leverage across platforms to make more architecture green, i.e., viable. The real test will be a year or two from now when we will see how we've influenced the programs' paths to achieve a more viable/affordable system.

That's where we are today, about four miles into this marathon. Just how successful we will be in the future depends on our ability to leverage programs and to get



NEW DIRECTION

Operating and Cultural Changes Shadow Avionics Modernization

To accomplish a true avionics modernization program that goes beyond simply increasing capabilities to a true cross-platform open system will require operating and cultural changes in government and industry. What must emerge is an operating environment where the Department of Defense (DoD) has in place the necessary business practices and life-cycle focus to make the problem of diminishing manufacturing sources and out of production parts (DMS/OP) transparent to the customer, says Jon Ogg, director, Engineering and Technical Management Directorate, Aeronautical Systems Center, Wright-Patterson Air Force Base, Ohio. Ogg stresses that the DMS/OP is not going away. He lists the following enablers to accomplish this change in state:

- **Prime/Original Equipment Manufactures Proactive DMS/OP Management:** This means both government and industry getting into a proactive vs. reactive role in dealing with the ever-accelerating rate-of-change in electronic technologies.
- **Long-Term Prime/Original Equipment Manufactures Relationships Fostered by DoD Commitment:** These long-term relationships are absolutely paramount. You need to maintain competition at the right level, but not prescribe it at all levels.
- **Defense Industry Defined/Supported Open System Architecture-Based Standards:** Part of the problem we inherited from the past is the mandated standards across our business. We need to support standard interfaces, protocol and operating systems similar to the way it is done by industry in the personal computer domain. We should not mandate but rather encourage and support industry's development and maintenance of standards.
- **Price-Based Procurement/Sustainment:** This provides an incentive [business case] for prime/original equipment manufactures investment in the long-term producibility/sustainability of products.

the acquisition community, especially our defense industry to step out in front. Customer [warfighter] funding will remain tied to increased capability, not on reducing life-cycle costs, and our ability to drive real improvements in the cost of ownership will be marginal unless we take a step forward and capitalize on these 'investment-return' opportunities. However, there is no such thing as a guarantee

for industry, and they will assign these investment opportunities risk factors and rack them with other investment options. To be successful in getting them to invest, we need to be able to allow them reasonable returns. We're convinced that this can be a win-win for both industry and government. First we need to gain the momentum, get a few small wins, and then it will take off. ♦