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Paper Session I-C - IPT Paradigm for Long Range Planning

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IPT Paradigm for Long Range Planning

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Abstract:

Historically, concepts proposed for future DoD systems are often incremental improvements of existing systems. In addition they are specifically tailored for a particular task, and are independent of other Air Force, DoD, National, and Civil systems. An Integrated Planning Team (IPT) paradigm can break down many of these stove-pipe barriers in planning and acquisition and allow synergy in research and development, production, and operation by examining the task via a system of systems approach. Recently, Air Force Materiel Command was tasked to investigate the possibility of moving the surveillance functions of the Airborne Warning And Control System (AWACS), and the Joint Surveillance, Tracking And Reconnaissance System (JSTARS) into space. A broad range of organizations were invited to participate in Integrated Planning Teams (IPTs) to perform the necessary studies. The multiple viewpoints of the IPT members led to innovative concepts which built on the research of traditionally isolated communities. These concepts should satisfy the needs of multiple organizations. Without the IPT paradigm cutting across organizational barriers, the historical, incremental approach would likely have led to concepts which were specialized, satisfying the needs of a much smaller group of users. In the long term, the Air Force and the DoD will save time and money if future system planning is transitioned from a specialized, incremental improvement approach to the multiple organization, IPT paradigm.

Past system acquisition methods: Looking Ahead From The Present

> "The control of air and space is a critical enabler for the Joint Force because it allows all U.S. forces freedom from attack and freedom to attack. With Air and Space Superiority, the Joint Force can dominate enemy operations in all dimensions - land, sea, air and space."
>
> *GLOBAL ENGAGEMENT: A Vision for the 21st Century Air Force*

Since the beginning of Air Force acquisition programs, the driving motivation in aircraft design has been the desire to achieve control of the air (and later space) via technologically superior air and spacecraft. For example, when plans were being made to build the F-15, there was a perceived lack of air superiority, particularly over the MiG-25 [1]. The technologically superior F-15, once produced, eliminated this “deficiency,” giving the Air Force the desired air superiority. However, as time passed, other countries “caught up” to the F-15 technology, and the perceived deficiency returned. This led to a series of incremental modifications to the aircraft over a period of many years (as new technologies became available) and a fleet comprised of many different versions of the F-15 (based on which aircraft had what modifications). This stratification of the fleet created a tremendous logistical burden in keeping the necessary parts on hand, and documenting specific repairs to specific aircraft. While the incremental upgrade approach seemed inexpensive initially, it created a significant logistical tail that would have to be carried throughout the lifecycle of the aircraft.

This cycle of incrementally upgrading aircraft after they are initially produced goes on for virtually all aircraft in the Air Force fleet. In some cases, the upgrade costs and the logistical burden created by these upgrades may be more expensive than designing an entirely new aircraft. In all cases, there comes a time when incremental changes are no longer practical, either technologically or economically. For example, advanced aircraft such as the Russian MiG-29, MiG-31, Su-27, and France’s Mirage family of aircraft are in the hands of many third world countries. These aircraft are aerodynamic equals to the F-15, which indicates that some type of upgrade would be appropriate to maintain air superiority. One very desirable upgrade would be to incorporate stealth technology. However, when the Air Force investigated the possibility of “bolting on” stealth technology to the F-15, they found that the amount of “stealth” achieved would be modest, and the cost for an incremental upgrade which would yield one third of the relative combat effectiveness of the F-22 would amount to 90 percent of the cost of the F-22 itself. [2]. Thus, to regain air superiority a new aircraft was called for, since incremental upgrades to the current aircraft were not practical. In testimony to Congress, Gen. John Loh, commander of Tactical Air Command, stated [1]

> “it is impossible to give the aging F-15 the combination of stealth, supersonic cruise, supportability, and the weapons we get with the F-22 - a combination we must have to maintain our advantage in the air.”

Shortly after Desert Storm, where stealth proved its value, John J. Welch, Jr., assistant secretary of the Air Force stated [1]

> “Stealth gives us back that fundamental element of war called surprise, … Anytime you’re able to keep surprise, you keep the advantage.”

Thus a perceived lack of total air superiority, combined with a currently available “new” technology, led to new aircraft with dramatically improved capabilities. As stated earlier, these factors (the desire to maintain air superiority combined with currently available technology) have driven the development of new aircraft since the earliest days of the Air Force.

In those early days from pre-World War II, and continuing through the early 1980s, technology was advancing relatively slowly, and incremental aircraft upgrades were able to keep up with technology. However, since the mid 1980s technology advances have accelerated, so that an incremental change may be outdated before it is completed. For example, even though the F-117 is a relatively new aircraft, it is already in the modification cycle, with new integrated GPS/INS systems being added to reduce navigation errors. This need to enter the modification cycle virtually immediately after an aircraft goes into production is symptomatic of the current explosive rate at which technology is advancing. In this era of accelerating technological change, the incremental approach to upgrading Air Force systems by looking at perceived deficiencies and *currently available* technology, will undoubtedly lead to systems which are outdated before they are built, undergoing continual upgrades at tremendous expense, and continuously falling behind available technology. In a period of shrinking budgets, these problems point out the critical need for a new paradigm for planning, designing, building, and maintaining the space and air systems of the future.

Changing The Way We View Change: Looking Back To The Present

In order to avoid having aircraft which fall behind technologically as they are incrementally changed, or even outdated before they go into service, a new paradigm is needed in viewing perceived air superiority deficiencies and technological opportunities. Historically, the Air Force has instituted aircraft design changes based on a perceived deficiency in the current fleet, coupled with a currently available technology to address the deficiency. This paradigm could be called “looking ahead from the present:” looking primarily at today’s deficiencies and technologies in planning for tomorrow’s fleet. The new paradigm, which has been proposed by the Air Force Chief of Staff, is to plan for tomorrow’s fleet by looking at what *tomorrow’s* deficiencies and technologies will be. In a 1995 speech at the Air Warfare Symposium in Orlando, Florida, General Fogleman stated: (referring to how today’s Air Force should plan for tomorrow’s fleet) [3]

> “... we could follow the traditional, programmatic approach. This might seem most likely when you recall that the last four Chiefs of Staff of the United States Air Force have been programmers. This approach tends to look forward with a budgetary mindset that operates within the stovepipes of mission capabilities that have emerged over time. It served us well. But, I think we are on a threshold in the area of technology. I say this not because the clock is going to turn from 1999 to 2000. That’s an artificial thing. I say this because of the rate at which technology is accelerating and coming down the road toward us. I have some concerns that this programmatic approach constrains our expectations with present fiscal concerns. On the other hand, it’s fairly safe, but it doesn’t lend itself to an imaginative view of what our Air Force should and can do. The other approach, the one I suggest we need to take . . . is to fly into the future, maybe to the year 2020. Then, we should put ourselves in a low earth orbit, in a position to take a

look at what the world will most likely look like, at what society will be like, and what warfare in this period of time will be like. Armed with this perspective, we should look back to the present and identify what path we must take to get us where we need to be in the year 2020 to provide the nation the air and space forces it needs. That's very different from continuing down the path we're on today. From that perspective out there, as we look back, we can see where we ought to terminate something, shift and move down another path that offers greater opportunity, greater lethality, greater flexibility. We need to take this approach. I call this approach 'looking back to the present.' "

The First Step:
Forming a World-Class Team.

In looking back to the present, the first step is to identify who the proper people are to do the looking. Initially, there are two key organizations who must participate: those who are currently dealing with deficiencies, and those who are likely to be dealing with those deficiencies in the future. For example, if the issue is battlefield surveillance, the most recent addition to the Air Force arsenal is the Joint STARS system, which proved itself valuable during Desert Storm. Even though it was effective, it has certain deficiencies and areas where it could be improved, and system upgrades are already being planned. Additionally, there is a logistics problem in using the Joint STARS system in that there will always be a time delay while the system is en-route to the theater of interest, and being prepared for use. Considering what the Air Force might look like in 2020, it is likely that the Joint STARS system will have been replaced by a new system. To overcome the time delay associated with deployment, a space-based system would be one solution. Thus, two key participants in defining the future replacement system for Joint STARS would be Air Combat Command (specifically the Joint STARS program office), and Air Force Space Command. Together, these two organizations would look at the present system, consider strengths and deficiencies, and propose a future system to perform the Joint STARS mission.

The astute reader will note that this scheme of developing concepts for a future Joint STARS replacement has one flaw. It perpetuates a stove-pipe solution to the ground moving target indication (GMTI) problem - - a custom solution which is exactly what the Air Force is trying to get away from. To overcome this stove-pipe, more participants are needed in the concept development phase of system acquisition. By enlisting a broad array of technologists, operators, logisticians, and planners as members of an Integrated Planning Team (IPT), the probability of designing stove-pipe concepts is virtually eliminated. By using the widest possible range of participants, concepts are developed as part of an overall warfighting system. This is the "system of systems" approach to concept development, where each system design is viewed as fitting into a larger overall warfighting system. Participants in this early planning stage must have a vision of overall system goals, and of how the current system being planned fits into the broader overall system to achieve those goals. If a "world class" Integrated Planning Team can be formed, world class results will follow.

The Second Step:
Thinking Outside The Box.

Once the proper team of participants has been assembled, the perceived deficiencies of the future can be discussed, and concepts generated for meeting them. Ideas can come from the participants themselves, as well as studies done by others. The key is to find a wide range of possibilities. A number of excellent studies have been performed in recent years, such as New World Vistas and SPACECAST 2020. Studies have also been performed by the Air Force Science Advisory Board, and by Air University. All of these sources, along with MAJCOM inputs, can be used in generating concepts to meet the deficiencies of the future. General Fogleman believes that the most important part of this phase is getting people to think beyond conventional solutions:

> “All together, the concept generation phase should encourage our people to think “outside the box.” We don’t want ideas constrained by current paradigms. The reality check, if you will, comes . . . when we investigate these concepts and we select the most promising ones to pursue. We’ll ensure that these opportunities have a solid scientific foundation.”

This point of view is echoed by General Estes, Commander in Chief of U.S. Space Command and NORAD, referring to concepts for space-based surveillance radar systems: [4]

> “I would applaud anybody who looks at a non-standard solution to the problem.”

The Third Step:
Refine, Prove, and Improve

Once a list of potential concepts has been developed, it is time to determine if they are feasible, and how useful they will be. Feasibility depends on current technology and the projected technology of the future. Some technologies have already existed for a period of time, and as such incremental technology advances can be predicted using past history. Other technologies have little history and are harder to forecast. These higher risk technologies may require interim technology developments and proof of concept demonstrations as stepping-stones to the final technology needed for a given concept. This is part of the technology refinement process. There is a second refinement process which must take place concurrently: refinement of the system concept itself. For the high priced, high technology systems of the future, the initial phase of this step should be via modeling and simulation. Simulations should not be simply models of how a particular technology works. Rather, they must incorporate the expected battlefield environment and how the technology will fit within that environment. This will allow for a refining of the system concept, as users and designers adjust the concept to better meet expected deficiencies. As an example, AWACS aircraft currently operate on a 10 second revisit schedule. This revisit schedule is based on what is needed for supersonic engagements at close proximity, and is fixed on the AWACS aircraft by the rotational speed of the radar. If a space-based system were used to replace AWACS, a different, or flexible revisit interval might be appropriate. For example, longer revisit intervals might be acceptable for long range targets, and shorter revisit intervals might improve close proximity combat performance. By allowing a user (and designer) to exercise innovative concepts in a modeling/simulation environment with user/operator input, the requirements (e.g. what missions does it perform), concept, and concept of operations (CONOPS) for a space-based surveillance system could be refined to an optimal combination, outside the constraints of its predecessor systems.

Once the requirements, concept, and CONOPS have been validated through the modeling/simulation process, and the technology risks have been assessed as appropriate, a concept is ready to begin the transition from being an idea to formal acquisition and becoming a part of the DoD inventory.

Bottom Line:
Great Systems Demand Great Planning

The above outline to the planning process is much different from the methods used during and after World War II. It requires spending the time necessary to assemble an appropriate planning team, consider what the deficiencies and technologies of the future will be, generate a number of conceptual solutions to those deficiencies, and model and refine those solutions *before* an acquisition program commences. This process can easily take as long as the acquisition process itself. That is why it is imperative that this process, the long range planning process, begin far in advance of the time a system will actually be needed. It is a living process in which future system concepts must be updated continuously as modeling/simulation efforts and technology demonstrations are used to refine them. It is the goal of current Air Force leadership to fully implement this process. General Fogleman has stated:

> “we’re calling this approach “revolutionary planning.” It’s not a one-time event. We’re making this a continuous process, one we’re going to update every year. And, we’re going to institutionalize long-range planning on the Air Staff to support it.”

Long Range IPT Planning Example:
The Air Force Space Sensor Study

As an example of the long range IPT planning paradigm outlined in this paper, consider the Air Force Space Sensor Study. This study was initiated at the direction of General Viccellio, with tasking to: [5]

> “… provide to the commanders of Air Force Materiel Command, Air Combat Command, and Air Force Space Command before the November, 1995, Corona Conference a first-order analysis of the feasibility of performing from space the airborne theater surveillance and control missions currently provided by platforms like the AWACS, Joint

> Stars, and Rivet Joint — specifically to examine the feasibility of performing these missions from space, estimate when it would be possible, and identify what the technical issues are that must be resolved."

This study could be viewed as the first step in a long range planning effort. To perform this study, SMC/XR began by forming a study team.

Space Sensor Study: Forming a World-Class Team

The study was managed by SMC/XR, with co-leadership from Air Combat Command and Air Force Space Command. These team members provided a clear perspective of current system capabilities and deficiencies, as well as possibilities for a future space based system. Additional members included Rome Laboratory, Electronic Systems Center, Phillips Laboratory, Lincoln Laboratory, and the National Reconnaissance Office. In addition, the team used a number of other contributors, including the Aerospace Corporation, MITRE Corporation, the Space Based Infrared System program office, the Jet Propulsion Laboratory, and the National Air Intelligence Center (NAIC), who all provided substantial technical inputs. The study team also kept numerous interested parties informed of the study's progress and products, including the ARPA Sensor Technology Office and the office of the Deputy Under Secretary of Defense for Cruise Missile Defense. The team would likely have been even larger had it not been for the short time frame of the tasking. The combined leadership of Air Combat Command and Air Force Space Command, coupled with the support of the National Reconnaissance Office, helped ensure that the team would not develop stove-pipe solutions to the space based surveillance problem.

Space Sensor Study: Thinking Outside The Box

The study team developed a wide range of concepts for moving the surveillance functions of the given systems into space. Many of these concepts involved technologies which were well outside the realm of current technology. For example, one concept involved fielding satellites with antenna apertures in excess of 100 meters in diameter, and with weights in excess of 40,000 lbs. Such satellites would be impossible to field with today's technology, but the team wanted to generate a broad range of concepts, not limited to conventional technologies currently available. For a comprehensive overview of the concepts generated by the team, see [5].

The concepts developed by the study team were presented to the Corona conference in the fall of 1995. The Corona was impressed with the wide range of possibilities, and suggested a follow-on study to consider further concepts which time had not permitted in the first study. The follow-on study, again led by Air Combat Command and Air Force Space Command, with SMC management, lasted roughly six months and generated further possible concepts for moving the surveillance functions to space as well as concepts for transition paths. An overview of the concepts developed in the follow-on study can be found in [6].

Space Sensor Study:
Refine, Prove, and Improve

Of the many concepts developed in the two studies, several representative concepts were incorporated into the Surveillance and Threat Warning (S&TW) Development Plan. This plan, formulated by the S&TW Technical Planning Integrated Product Team (TPIPT) is a long range planning document which lists potential concepts for future Air Force systems. Thus, the studies became the first step in the long range planning for transitioning surveillance functions from air to space-based platforms. The next step in the long range planning process is to refine, prove, and improve the concepts and their associated CONOPS. This work has already begun. For example, Phillips Laboratory is currently researching a unique composite structures technology which would significantly reduce the weight of future systems. This effort represents a stepping stone to move from current technologies toward the technologies that will be needed for the future space-based system. In addition, IPTs have been established which will oversee the space-based radar technology development and modeling efforts. These IPTs have a wide range of membership, again including members from both Air Combat Command and Space Command, as well as the long range planning element of Space and Missile Systems Center, DoD Laboratories, MAJCOMs, and industry. The modeling effort is intended to model the space based radar as one piece of an overall space based surveillance system, and will allow the user to modify various system parameters in order to optimize the system. It is expected that “war-gaming” will take place using the model, so that various system tradeoffs can be explored. An overarching Space Based Radar (SBR) technology IPT has also been established, to promote the cross-flow of ideas and research among the many laboratories working associated technologies and minimize the amount of redundant effort.

It has been emphasized throughout the process that the final concept selected will likely not be a stove-piped space-based version of AWACS or JSTARS. It will be a system which can perform multiple functions, probably including functions beyond AWACS and JSTARS, as part of an overall surveillance system. This is largely because the IPT planning effort for this system involved a broad range of participants, each with their own needs and deficiencies, and an understanding of overall DoD needs.

Conclusion:

The world is going through a period of tremendously rapid technological advancement. As such, the old paradigm of system acquisition via stove-piped solutions which incrementally improve existing systems is neither cost effective or technologically adequate. A new paradigm is required—a paradigm which includes a cooperative examination of long range objectives and innovative concepts based on those objectives. As this new paradigm is adopted, the Air Force will certainly save money, and will acquire systems which are more technologically advanced and better capable of meeting the overall needs of the Space and Air Force of the future.

References

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