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THE SYSTEM KNOWLEDGE OFFICE: A TRANSFORMATION ENABLER

RESPONSE TO THE CHAIRMAN'S CHALLENGE

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INTRODUCTION

Revolutionary leaps in battlespace capabilities are the direct result of successful military transformation. By definition, transformation requires mobilizing skills, people, programs, funding and policies. The four major elements that form the foundation of a successful transformation of any large organization are intellectual, cultural, technical and leadership. The Department of Defense (DoD), like most large complex organizations, struggles to embrace transformation.

Disruptive weapon systems are the principal determinants for transformation. A disruptive weapon system is the synergistic integration of disruptive technologies with new operational concepts, doctrine, organizational structure, personnel policies, education and training. The fielding of these weapon systems shatter the national security community status quo and transform the art of war. Therefore, the transformation required to field disruptive systems faster, cheaper, and better is a critical element in the overall transformation of our national security' forces for the 21^{st} century.

The Chairman of the Joint Chiefs of Staff (CJCS) challenged the National Defense University to propose innovative solutions to a problem or impediment to adapting/transforming America's armed forces to meet the security demands of the 21" century. For two warriors who have fought the intellectual battles to field revolutionary capabilities, this was a welcome opportunity to identify problems inherent in the current DoD process for fielding disruptive weapon systems and recommend a new way forward.

This paper starts with a brief background section. With the context defined, we transition into the core of the proposal by discussing the strategic challenges to transforming the processes which pull a disruptive weapon system out of science and technology through research and development into the system development process. The proposed system knowledge office (SKO) is the open and flexible organizational construct around which to mobilize skills, people, programs, funding and policies into integrated solutions to those strategic challenges. The SKO is a generic concept clearly applicable to a wide range of disruptive systems with revolutionary potential. The current stage. of maturity, and disruptive nature, of the Unmanned Combat Air Vehicles (UCAV) concept presents a logical first test case of this construct.

The current global security environment and the information revolution demand a new paradigm for quickly fielding interoperable complex capabilities. The time has come to transform our hardware centric mindset into a knowledge centric customer obsession. We must develop a national security core competency in knowledge creation and application. The SKO provides the missing link to accomplish that vital objective. It should be used not only to generate and nurture new ideas, but leveraged at the strategic level to better enable our national ability to integrate a growing range of critical defense and commercial technologies. Most importantly, SKOs will improve our ability to integrate complex systems across the elements of national power to best support senior national security decision makers.

BACKGROUND

Change is the only constant in history. Those who fail to adapt perish. As humans have come together in large complex organizations, it has become increasingly more difficult to proactively adapt to an ever-changing environment. As we transformed from an agrarian age through the industrial and into the information age, the pace of change continued to accelerate. The time to observe, orient, decide and act (OODA) at all organizational levels (strategic, operational and tactical) has been correspondingly compressed. This was clearly accentuated by the convergence of telecommunications and computers. Given the current global availability and utility of information, the consequences of failing to create an adaptable, flexible and creative organization have never been more disastrous.

Man's creativity in developing and harnessing technology has been the key driving force for change throughout history. However, it has always been a struggle to bridge the gap between revolutionary ideas and concepts and fielded products. and capabilities. It is rare when any large complex organization comes to market first with the product of a disruptive technology. Large organizations responsible for manning, training and equipping by their nature tend to embrace slow evolutionary change within an existing hierarchy with a clearly defined low risk reward path. The transition to the post-industrial and information age is littered with examples of successful innovative organizations failing to maintain competitive advantage.

Polaroid invented, and over the years perfected, instant photography but missed the transition to digital photography. Digital Equipment Corporation invented the affordable mini-computer and was the market leader and acknowledged innovator in digital technology, but didn't read the market shift and business model transformation. They had the technology and the intellect, but not the leadership and culture to continue to embrace change. The researchers at Xerox invented the key elements of the modem desktop computing environment but corporate leadership failed to exploit the transformation and business opportunity. Two individuals in a garage in California had the vision and courage to bring the desktop to market in a company we know as Apple Computer. Apple failed to see the shift from hardware to software centric computer applications and by not licensing the hardware, turned over market leadership to a less technically sophisticated vendor named Microsoft.

IBM also initially failed to see the transition in comparative advantage from hardware centric to software centric customer focus. When they created the market leading PC, they chose to give up the intellectual property rights to the operating system despite having an abundance of talented software engineers. It took a "near-death experience" in the later part of the last decade for this once dominant computer products company to transform itself into a market leader in electronic commerce service and systems solutions. What actually occurred was that IBM leaped past itspeer software competitors by embracing a knowledge centric customer focus. The parallels to the current Department of Defense (DoD) predicament are eerie!

Militaries throughout history have adapted or perished from their ability to embrace new ideas and concepts. The history of military transformation is well documented. Changes through the 1990's (such as longbow, rifling, steam power, tanks, manned flight, radio, radar, nuclear submarine and stealth) have tended to be platform/hardware centric. People built the hardware, then figured out how to best evolve it into a desired war fighting capability. This was appropriate when faced with a monolithic symmetric peer competitor with an equal or less advanced economy. Similar to IBM, we developed our mainframes (platforms) and then evolved a myriad of successful customer applications for them. As we shift from the industrial age to the information age there will still be critical hardware components, but the research and development efforts must be focused on providing actionable knowledge to our key decision makers. The ability to quickly gain the knowledge necessary to stay ahead of our asymmetric competitors in the 21St century must become a core competency. Like IBM, we must reason out how to adapt existing doctrine, operational concepts, and organizations to the promise of disruptive technologies and blend them together into revolutionary leap ahead capabilities. How to accomplish a critical element of this transformation, within the military industrial complex, is the subject of the remainder of this paper.

DISCUSSION

Strategic challenges to maturing disruptive weapons systems

Quickly fielding weapons systems is a complex task. On the way to fielding a weapon system, the acquisition process moves through the four phases of science and technology, research and development, system development, and production. The time required in each stage varies, but all phases have a definite purpose and value added. Skipping steps, while a compelling temptation, is not the answer. Spiral development is an important piece of reform, but not a complete solution. A critical impediment still must be addressed.

The application of Advanced Concept Technology Demonstrations (ACTDs), battlelabs, and joint experiments all have their niche within the generic acquisition process. Those instruments were designed to combine mature, not disruptive, technologies in unique, and even transformational ways. DoD has bent those original intentions in attempts to bring disruptive weapons to the field (Predator and Global Hawk are recent examples), but the lessons learned from those efforts point to a better way. Unfortunately, there is no silver bullet to achieve the required' fundamental transformation the current national security environment demands.

In order to accelerate the fielding of disruptive weapon systems, we must adapt our current processes to more efficiently and affordably move disruptive concepts from science and technology through research and development into system development. This complex problem requires an integrated approach for mobilizing the resources necessary and sufficient to solve the following set of eleven strategic challenges.

Bridging the gap between science and technology and systems development. A new weapon system acquisition leaves the science and technology phase after completion of an Advanced Technology Demonstration (ATD). In the recent revisions to the DoD acquisition process, there remains a significant real world gap between the end of that ATD and entry into system development for a disruptive weapons system concept. The plain fact is the process is still designed to support industrial age hardware centric technology evolution/insertion. Only potential weapon systems with a defined mission needs statement and identified FYDP funding leap over the bureaucratic hurdles when exiting the laboratory environment. At this point in the development cycle, the disruptive concept/technology is at a decided disadvantage if not embraced by the operational commanders and visionaries within OSD and service staffs. The paradox is that those staffs are simply doing their job. They have a responsibility to field effective weapon systems and should not trade away an existing capability for the promise of an unproven one.

The crux of the problem is no ATD can answer all the technical feasibility, military utility and operational value questions unless the capability being developed is the further evolution of an existing capability. In this case, the operational community can extrapolate from an existing knowledge base and reduce the technical and operational concept uncertainty to a level of risk they are comfortable with. For disruptive systems, holes in the knowledge base will always result in an unacceptable level of peacetime risk. In the past, it has taken a wartime environment to create the conditions where the risks of battlefield failure outweigh the knowledge uncertainty. The successful solution in peacetime was/is to go outside the normal bureaucratic process. Select teams with strong intellectual leadership and vision operating outside the bureaucracy (often in the black world) and under the umbrella of senior leadership top cover was the rule for a successful gap crossing. This is not an acceptable solution for retaining competitive advantage in the information age.

We must recognize the inherent differences in acquiring evolutionary and disruptive weapons systems and transform accordingly. The fundamental problem is the standard DoD acquisition process is based on the premises of the industrial age. Fortunately, the entire process is not broken. Once you have the knowledge to adequately define the most effective and affordable weapon system solution, the remainder of the process merely reflects the realities of our democratic society. In fact, unless the concept/technology is disruptive, experience has shown us that acquisition reform consists of tinkering at the margins. The solution is to create a new fork in the road at the end of an ATD. Evolutionary programs still follow the existing path. Disruptive systems enter into a new research and development period focused on acquiring the knowledge to bridge the gap to system development.

<u>Transforming from product focus to knowledge focus.</u> The DoD transformation efforts from a threat based to capabilities based operational architecture and force structure is predicated on a false implicit assumption for the information age. An acquisition process that continues to focus on product development cannot provide the level of knowledge needed by decision-makers to correctly parse the capabilities trade space and select the best path to the desired capability. This is especially true when a disruptive weapon system enters the trade space.

Traditionally, the acquisition process and program offices focus on cost, schedule and the desired product performance. It is easier and natural for both the warfighter and the acquirer to focus on the obvious physical characteristics of their joint collaboration. This approach served us well when creating the physical entity was the most difficult aspect of weapons system development. Organizing into system program offices (SPOs) based on the product was a logical approach to system development. The advances in information technology turn this construct on its head. The focus on product leads to early decisions that guarantee suboptimization in a capabilities based environment. When the knowledge embedded in software is the key' element in competitive advantage, one must move the program emphasis into a new domain and transform the SPO construct into a new knowledge based organization.

Building requirements based on knowledge. Generating the "right" set of system requirements (technical, doctrinal, operational concept, manning, etc) is the toughest and most critical part of fielding any weapons system. For disruptive systems, it is counterproductive to focus on generating the requirements/capabilities documentation prior to properly populating the corresponding knowledge base. Paper studies, simulations and component level, small scale demonstrations (normal outputs of an ATD) are all important but fall short of providing the knowledge necessary and sufficient to accurately specify the full set of system requirements. To go beyond the ATD level of knowledge and flesh out military utility and operational value, while at the same time continuing to mature the technology, requires a significant investment in operationally relevant experimentation/demonstrations. This class of operational experimentation is dedicated to populating the knowledge base with respect to military utility and operational value. Objectives for these experiments are the result of a collaborative process between' the researcher, acquirer, tester and user. The results provide the intellectual framework for the early and informed discussions on doctrine and concepts of operations critical to shrinking fielding timelines and total lifecycle cost. This emphasis on experimentation is inherently service independent and enables the necessary early consideration of interoperability and standards.

Experimental operational prototypes. Operationally relevant demonstrations mandate a set of operationally representative system prototypes (tool sets) to conduct the experiments/demonstrations. These tools must have the requisite fidelity to demonstrate technical feasibility, military utility and operational value to a degree necessary and sufficient to define a stable set of system requirements for the next spiral. In the ideal, the experimental prototypes are a 60-80 percent solution with reference to the desired final spiral system capabilities. However, the going in assumption must be a toolkit is not equivalent to a post system development production system. The specifications for the operational prototypes are derived from the objectives of the operational experiments/demonstrations, which are derived from the need to populate the knowledge base. By so doing we bound the complexity and cost. These prototypes remain owned by the contractor teams for continued use in conducting experimentation for future spirals. When the final spiral is fielded, the prototypes go to museums

For this approach to be viable, we must accept the upfront cost associated with operationally representative experiments. One must remember the primary purpose of prototypes is as a toolset to conduct operational experiments from which to gain system knowledge and reduce total life cycle costs. We cannot afford to solve all the production issues in a prototype designed to refine the capabilities trade space. We must work with the user to determine which set of functionality makes the cut for the operational prototype and save the time, talent and treasure of production for a future system development phase.

It bears repeating that building prototypes doesn't eliminate the need for further system development. The knowledge gained will reduce the time and cost, but you cannot skip any of the major steps in the acquisition process without paying a high price. The obvious point is not to complete the full acquisition process until the full suite of system requirements are clearly understood and accepted by all stakeholders.

Shift from hardware to software integration focus. Military hardware is becoming a commodity. Aside from a few specialized and unique subsystems, the vast majority of the components are available "off the shelf'. In this environment, comparative advantage resides with organizations with the knowledge, management, and leadership expertise to conduct large-scale system integration. Moving forward, the overall system integration relies on the ability to design, develop and integrate software components into large, complex system solutions. A quick study of any current major weapon system, or large-scale commercial project; illustrates this is complex and expensive. The reasons are many, but the key to the solution is straightforward. The emphasis/priority needs to shift from hardware development to software integration. The authority to proceed from research and development into system development must be based on a demonstrated potential to understand and overcome the intellectual, technical, cultural and leadership challenges inherent in large scale embedded software systems integration.

The Joint Strike Fighter must be the last example of a multi-billion dollar decision to enter system development largely based on a hardware fly off (or the equivalent). We simply cannot afford to push the known risks associated with large-scale software integration out of the competitive environment. The path to fielding new weapon systems must be structured to tackle the software integration risks head on prior to system development. The winning competitor will not have the final production code, but will have demonstrated, in an operationally representative environment, the key tenets of their architecture, scalability, interoperability and the expertise (including tools and processes) to meet schedule and cost goals. Those aspects must form the key performance evaluation criteria.

Operationally representative demonstrations ensure the knowledge base is sufficiently populated to validate the full set of system requirements. The production run cost savings will more than offset the increased front-end research and development costs. Most importantly, history clearly shows the more risk you pull forward, the higher the probability of meeting cost, schedule and performance goals. Reducing software integration risk must become the highest priority. No other single action will have a greater impact on reducing the timeline for fielding information age weapon systems.

This approach is also a natural fit regarding the emerging emphasis within the acquisition community on spiral development. For disruptive weapons systems, software functionality will be the key delimiter between spirals. A demonstrate before down-select approach provides the knowledge to properly specify realistic spiral performance capabilities, lot size, and high fidelity cost estimates and develop the initial doctrine and operational employment concept.

Preserving intellectual capital and leadership continuity. Another byproduct of the difficult transition from science and technology to system development is a loss of intellectual capital and leadership stability. Without a timely migration out of an ATD, and a well-funded and politically supported plan to get to the first system development spiral, invaluable knowledge and lessons learned gained by the original leadership and design team are lost. The individual members of the team are too valuable to leave idle, and equally important, are not the type of folks who stay with an unsure program when other projects solicit their services. Therefore, any significant gap or delay is a program killer. Even if the program restarts, the earlier team migration makes it nearly impossible to recreate the expertise, passion, and team chemistry so critical to the development of disruptive weapon systems.

While important, program continuity alone doesn't solve our intellectual capital and leadership challenges. We need to increase the advanced project opportunities and institute innovative personnel policies to attract, grow, and maintain a world-class DoD workforce capable of meeting the security challenges of the 21" century. The complexity of fielding tomorrow's weapons systems invalidates the methods by which we grow military program leaders, i.e. IPT leads, program managers, directors and program executive officers (PEOs). The era of the generalist leader is over for weapon system research and development. We must capitalize on the expertise and skills of our best and brightest mid-career officers and continue to assign them to levels of increasing responsibility within a single system knowledge, area. Competent in research and development, capable of dissecting the issues and serving as honest brokers this cadre of "knowledgeable warriors" will ensure disruptive systems achieve their maximum battlespace potential in a timely manner at reasonable cost.

The key challenge on the contractor side is developing and maintaining the intellectual capital of their top design teams. When the focus was on product, industry and government naturally focused on preserving the production workforce. As the weapon system development focus shifted from numerous design competitions to a handful of big programs there was less opportunity to educate and maintain the company design teams, which are a national treasure. While the industry consolidation reduced this concern, it did not eliminate it. As we shift to a knowledge focus, preservation of the intellectual capital associated with analysis and design becomes' the imperative. A renewed emphasis on rapid prototyping and operational experimentation is needed to create the opportunities to preserve the design teams, the main source of innovation and new concepts, and hence our competitive edge.

The synergy created by the partnership among the military, civilian and contractor elements of the research and development community remains key to efficient knowledge generation. Demographics will provide a once in a generation opportunity to recapitalize our acquisition workforce. To attract and retain this generations best and brightest we must institute policies consistent with the best commercial information age enterprises.

Encouraging failure. Intellectual capital seeks challenge and reward. Seeking knowledge entails risk. Taking risks will inevitably lead to "failures". These failures are a vital source of knowledge. A culture that is risk adverse cannot be knowledge centric. The key going forward in the information age is to ensure failures are numerous, early, cheap and constructive. The proper time and place for "planned" failure and experimentation is prior to a weapon system development spiral downselect. The reward/promotion system must be modified to incentivize and embrace the desired behavior. These changes must extend across the spectrum of military, civilian and contractor partnership.

Healthy' Competitive Environment. The advantages of a healthy competitive environment are significant. Competition ensures the desired diversity of intellectual thought and fosters the curiosity critical to discovering the true potential of disruptive concepts. Multiple teams ensure a deep and experienced cadre of subject matter experts across the industrial base. Those experts not only, perform the experiments, but also form the foundation of the teams who will compete for each system development spiral. No team is eliminated from the research and development effort based on a single spiral downselect. This inclusive philosophy creates an environment conducive to taking risk and accepting failure. Team members benefit from the long-term commitment to gaining knowledge. This approach rewards innovation and creativity throughout the weapons system spiral development life cycle.

Interoperability and standards. Incorporating interoperability and standards into system development is an elusive challenge. The most useful and enduring standards evolve as the knowledge of the problems mature. The window to efficiently address interoperability and standards opens between ATD and system development. With a basic understanding of the underlying science and technology, it is possible to create a strawman to be fleshed out with subsequent operational experiments. Experiments focused on populating the interoperability and standards knowledge base must be explicitly defined and conducted. The strawman and experiments are shared across the multiple teams, ensuring a common development environment. The forcing function for accepting this approach is the requirement that interoperability, like software functionality, be demonstrated prior to entering a development spiral. A system is not ready to continue the march to fielding a capability until interoperability risk has been mitigated and bounded. Standards are. then determined based on the knowledge gained and are spiral specific. An underlying premise is an adherence to open architectures, which enable flexibility and adaptability to the inevitable increased understanding gained from continual operational experimentation/demonstration.

Funding. The current financial approach to research and development of disruptive weapons systems is counterintuitive. The people who currently have the most incentive to kill a disruptive concept hold the purse strings for its research and development. In order to properly nurture transformation opportunities, the user community cannot hold the purse strings until there is sufficient knowledge to accurately derive and defend the desired system capabili ies/requirements. Disruptive programs must be funded by a separate program element. The competition for funding within that element should be centrally adjudicated amongst competing disruptive concepts. These research and development expenditures are national priorities and must be treated as the cost of doing business in the information age.

Operational experimentation carries a non-trivial cost burden. Gaining the necessary knowledge about military utility and operational value while mitigating software integration risk requires a significant increase in investment. Whereas a large, expensive ATD costs tens of millions of dollars per year, the funding requirements for subsequent prototyping and operational experimentation could easily reach hundreds of millions of dollars per year. Operational prototypes and demonstrations are serious investments justified by the cost avoidance of bringing risk forward and forming a rock solid foundation for entry into spiral development.

It bears repeating that funding stability for disruptive weapon system operational experiments is an acknowledged critical factor in success. The threat of year-to-year variation runs counter to creating the level of government/contractor trust necessary to encourage innovation and value added failures. Simply put, money speaks louder than words. We must commit to stable, multi-year funding based on a realistic estimate of the cost necessary to populate the knowledge base sufficient to justify an approval to proceed with the next spiral. This will require a modification to the existing budget planning and oversight arrangements amongst all the stakeholders, including Congress.

Oversight. Striking the proper balance on program responsibility and accountability between the research community and the user community is always a challenge. It is more demanding and important to get that balance right for disruptive systems. User involvement is absolutely essential to properly craft the operational experiments, i.e., determine the questions (WHAT) the knowledge team needs to answer. However, any attempt on their part to describe the answers (HOW) short circuits the creative process needed to produce truly innovative solutions. At the team level, the sharing of roles and responsibility is orchestrated by the program director. At the senior level, the proper balance is achieved via an executive steering committee.

The executive steering committee has three primary functions. First, they determine the scope and funding of the *effort.* Second, they adjudicate the inevitable seams in individual representative organizational interests. Third, they provide senior level oversight and insight to the program director. The executive steering committee is the program decision authority. The program director reports directly to the committee chairperson.

The composition of the executive steering committee must be commensurate with the transformation potential of the program and level of funding. The committee chairperson must have the freedom of action to coordinate at the highest level of the services and OSD.

The System Knowledge Office (SKO) Construct

The system knowledge office (SKO) is the open and flexible organizational construct within which to integrate the solutions to all the strategic challenges to research and development of disruptive weapon systems. The people and operational experiments of the SKO are the bridge that closes the gap between science and technology and spiral system development. It provides the intellectual and programmatic glue during research and development to meld those disparate 0
phases into a seamless process. The raison d'etre is the pursuit is knowledge, not the advancement of a specific product solution.

Individual SKOs are formed in response to national level decisions regarding the revolutionary potential of a disruptive weapons system. The SKO's most important asset is its human capital. A small, selectively manned core team is augmented by subject matter experts matrixed from across the government. The SKO is resourced by stable multi-year block funding, which supports the efforts of multiple contractor teams in a competitive environment. Senior level oversight is provided by an executive steering committee. Other transactions authority (OTA) is used to establish contractor relationships where the deliverable is the knowledge gained from operational experiments/demonstrations.

The SKO is not meant to be a permanent entity. Once the technical feasibility, military utility and operational value knowledge base is established (positively or negatively), the office has completed its mission. If the knowledge gained reduces risk sufficient to justify a spiral development decision, weapons system responsibility and selected core staff transition to a joint program office (JPO). Other staff move up to new knowledge challenges.

The basic SKO construct is illustrated in Figure 1. In the remainder of this section we discuss the key organizational tenets.

Science & Technology   Research & Development   System Development

A **Program lead to SKO**   **A** **Program lead to JPO**

Figure 1: SKO Construct

<u>Organizational Tenets.</u>

<u>Leadership.</u> Leaders make the difference. Throughout the timeframe shown in Figure 1, authority, responsibility and accountability is vested in a single. visionary individual. The traditional boundaries associated with colors of money and program ownership are eliminated to enable the freedom of action to exploit innovation and knowledge gained. Elements of a traditional ATD exist inside the SKO and operational demonstrations planned by the SKO continue' under the JPO. Eliminating artificial boundaries is the only logical way to shorten the timelines and provide the agility to rapidly field disruptive capabilities.

The leadership team transitions through the phases. The ATD leadership forms the core of the SKO team. In a similar fashion, the SKO leadership forms the core of the JPO team. The leader of the current phase is responsible for all the planning associated with the following phases. This is a holistic approach of fielding a weapon system. The phase office (ATD, SKO, JPO) leader is the single focal point for all external interfaces and information requests. There are no shadow offices. The fact that the leadership skill set changes as the program transitions from ATD to SKO, and from SKO to JPO, doesn't invalidate the need for a single visionary point of authority, responsibility and accountability.

Stability. The SKO is directed and managed by a stable leadership team. The core team follows the JSF and aviation squadron models (you are assigned as the deputy and relieve the director at the end of his tour). Taking that concept a step further, the downstream JPO directors should have SKO experience. In addition, selected team members will transition to the JPO with each subsequent spiral. Government (military and civilian) team members must be given the opportunity to develop a core competency and viable career path across the stages of an individual disruptive weapons development and employment. Multiple tours - with increased responsibility - along the fielding path of a single weapon system must be career enhancing not limiting.

Seeding the future. Advocacy at all levels is vital to the eventual acceptance of a disruptive weapons system. The SKO provides the incubator to grow those advocates across specialties and rank. A tour in the SKO provides an excellent broadening experience for mid-grade operational personnel while forming the pool of advocates within the joint staffs and command positions, which will ultimately employ the capability. Traditional laboratory and engineering personnel interact and learn about each other's strengths and challenges. Matrixed personnel distribute the knowledge gained during their time in the SKO to a wide range of existing and future developments.

Partnering. The backbone of the SKO is effective innovative partnering across the national security community. Effective partnering selectively pulls together the entire range of talent and stakeholder interests as far forward as possible. Operators, technologists, engineers, maintainers and acquirers all work together toward a single goal - efficient and affordable fielding of the disruptive weapon system. Since the talent mix and intensity of participation is variable, the SKO must be given the management flexibility to make optimal use of matrixed team members. The SKO must also have visibility into and support from the appropriate special access programs and projects. This partnership is a two-way street.

The SKO maintains a collaborative partnering relationship with the multiple contractor teams. The contractor's primary role is to fill the knowledge base. They conduct the analysis, design and build the prototypes, write the code and conduct the operational experiments. The government team members provide value added oversight and insight. The primary organizational construct to accomplish the above is the integrated knowledge teams (IKT). The IKT is the IPT of the information age.

Pragmatic virtual office. Knowledge focused enterprises pragmatically blend information technology and physical presence. For obvious advocacy and visibility reasons, the SKO leadership and systems engineering teams are home ported in Washington, DC. Satellite offices are located at major contractor and government technical support sites. The SKO is self-contained. Technical and engineering support is matrixed from existing service laboratories and functional organizations. The operational and test communities are responsible for providing dedicated support. IKTs are located across the country at appropriate contractor facilities and test sites. Key government IKT members are assigned at those locations. All locations share a dedicated common IT infrastructure. All program data (government and contractor) is shared and stored on common secure servers. Every team member is able to access the network at every location. Extensive use is made of peer-to-peer and collaborative tools, but there is no substitute for leadership physical presence at select meetings and reviews.

External support. The diversity of intellectual thought the SKO must exploit is not solely resident in the government and prime contractor workforces. There is a wealth of talent "outside the system". To fill the gaps, the SKO leadership taps those external resources through a task order systems engineering and technical assistance (SETA) contract. SETAs provide critical weapon system expertise across the entire spectrum of office responsibilities as consultants, IKT members, graybeards, internal review panels and office support.

The Case for an UCAV SKO

The research and development of Unmanned Combat Air Vehicles (UCAV) is the logical first application of the SKO construct. The Under Secretary of Defense for Acquisition, Technology and Logistics (USD AT&L) has stated the Joint Strike Fighter (JSF) is the last manned fighter program. Unmanned combat weapon systems arguably represent the most significant transformation in the application of aerospace power since the development of stealth. As with stealth, UCAV is clearly a disruptive technology whose emergence challenges the established doctrine, operational concepts, force structure and major acquisition program plans of the services. The first nation to integrate this disruptive technology with new operational concepts, doctrine, organizational structure, personnel policies, and education and training will field a disruptive weapon system that transforms the nature of air warfare.

In recognition of the technical risk, disruptive nature and combat potential, the Defense Advanced Research Projects Agency (DARPA) and the Air Force initiated the UCAV ATD in 1998. The program built on the lessons learned and expertise gained from Predator and Global

Hawk while taking the next leap in unmanned systems capabilities. From the beginning, the ATD focused on populating the UCAV knowledge base by demonstrating the technologies, processes and system attributes necessary to provide the warfighter effective and affordable battlespace capabilities against an advanced 2010 threat. The program recently successfully completed the first block of flight demonstrations. The emphasis now shifts to the software development and integration required to demonstrate its true transformational potential; multi-ship command and control and on-board adaptive attack planning.

Since FY01, Congress and OSD have provided incremental funding to the Air Force and DARPA to continue development past the ATD. The focus of that next phase is already on operational experimentation/demonstration. The FY04 President's budget contains funding through the first system development and procurement spiral. With design efforts underway for the operational prototype necessary to conduct the experiments required to fill the knowledge base leading to an initial procurement spiral, the program has entered the gap between ATD and system development.

Based on the potential demonstrated during the first phase of the UCAV ATD, DARPA and the Navy initiated studies to determine naval variant suitability of the concept. The DARPA/Navy UCAV-N effort lagged the DARPA/Air Force program by two years and has not yet transitioned past paper into the demonstration phase. In conjunction with its UCAV-N contract, Northrop Grumman launched an internally funded flight demonstration effort called Pegasus, which made its initial flight in February of 2003. The FY04 President's budget includes funds to finish an ATD and proceed through system development. .

The Air Force zeroed UCAV funding in their FY04 POM. OSD restored the funding and directed the two services and DARPA to develop an integrated joint research and development program and maintain a competitive environment. While a UCAV JPO modeled on the JSF has been suggested, it is premature. This is an ideal opportunity to test the SKO construct. Only the SKO construct addresses all of the strategic challenges associated with this critical phase in the fielding of a disruptive weapon system. We can make UCAV a model for faster, cheaper, better fielding of leap-ahead battlespace capabilities.

CONCLUSION

The current global security environment and the information revolution demand a new paradigm for quickly fielding interoperable complex capabilities. A disruptive weapon system is the synergistic integration of disruptive technologies with new operational concepts, doctrine, organizational structure, personnel policies, education and training that produces a revolutionary leap-ahead capability on the battlefield. The transformation required to field disruptive systems faster, cheaper, and better is a critical element in the overall transformation of our national security forces for the 21st century.

In response to the Chairman of the Joint Chiefs of Staff challenge, we identified the problems inherent in the current DoD process for fielding disruptive weapon systems and recommended a new way forward. Our proposal centered on identifying and solving the strategic challenges associated with movement of a disruptive weapon system out of science and technology through research and development into system development. A new organizational construct titled the System Knowledge Office (SKO) provides the open and flexible organizational framework within which to integrate the solutions to those strategic challenges.

DoD has stated the desire to embrace transformation, yet history is about to repeat itself. A disruptive weapons system has entered the no man's land between science and technology and system development. The UCAV programs are at a critical juncture. Now is the time to validate the generic potential of the SKO concept. As a logical first application of the SKO, UCAV provides our national security leadership with the opportunity to demonstrate the will to shift the research and development focus from product to knowledge. Without intervention, the opportunity to rapidly field a revolutionary capability will be lost.