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CAPABILITY-BASED ACQUISITION IN THE MISSILE DEFENSE AGENCY

INDEPENDENT RESEARCH PROJECT

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WHY CAPABILITY-BASED ACQUISITION?

Historically, the DOD acquisition process requires more than 10 years to develop and field a new weapon system.' It also often produces systems with capabilities that are no longer relevant, and that rely on technology that is obsolete by the time they are fielded.[2] Part of the reason for this seems to a tendency to develop systems that rely on new, unproven technology and a process that establishes specific performance requirements too early in the program cycle. These requirements are then incorporated into an Operational Requirements Document (ORD) and System Specification (spec), which become the focus of the program and the criteria for success. Not surprisingly, the technologies often prove to be more difficult to develop than anticipated, and changes in the world environment often makes many of the requirements irrelevant by the time the system goes into production. Due to the mandate of meeting the thresholds and goals in the System Specification, large amounts of effort are expended on the technology needed to meet the spec, and areas overlooked by the spec are not pursued, even when advances in technology may reduce cost or improve capability. Capability-based acquisition is, at least in part, an attempt to avoid these problems and produce systems with relevant capability and current technology.

This paper takes an in-depth look at how one organization, the Missile Defense Agency, is implementing capability-based acquisition, and then reviews a recent proposal for implementing capability-based acquisition on a DOD-wide basis. Issues it will address include implications capability-based acquisition may have for acquisition policy, and potential obstacles to implementing capability-based acquisition across the Department of Defense.

CAPABILITY-BASED ACQUISITION AND THE MISSILE DEFENSE AGENCY (MDA)

On January 2, 2002, the Secretary of Defense established the Missile Defense Agency (MDA) and charged it with developing a ballistic missile defense system (BMDS) for the United States. He further directed that the MDA use a "capability-based requirements process" and that the military services would retain responsibility for production.[3] In order to allow the government to rapidly incorporate new technology and expand capability to counter an evolving threat, the MDA has adopted an evolutionary acquisition strategy incorporating spiral acquisition.

Industry "Best Practices"

A central motivation for the MDA's capability-based acquisition strategy is to implement recommendations from a series of Government Accounting Office (GAO) reports on commercial industry "best practices."[4] One of the criticisms levied against the Department of Defense by these reports is that system requirements are often set too early, too high, and are too inflexible.[5] One reason cited for this is that the product developer is relatively uninvolved in setting requirements. Another factor is that the competitive nature of obtaining funding motivates the Military Services to "over-promise" the level of performance expected from a system in order to obtain approval for the program. A Service will then request, and usually obtain, additional funds to cover the costs associated with using immature technology. This over-promising of performance combined with the inflexible nature of the requirements once they are set, means that programs invariably cost more than initially planned, and the systems they produce take considerably longer to reach the field. These factors yield a process that requires years of development before any useful military capability is actually delivered .[6] Capability-based acquisition attempts to mitigate these problems.

The MDA is using capability-based acquisition to do several things: quickly deploy an initial, limited, missile defense capability, incrementally improve this capability using spiral development, mitigate risk by spending money on large numbers of new ideas before committing to extensive development of the most promising, ensure a high degree of technology readiness before deciding to formally start a program, and evaluate the success of the program (or element) based on whether or not the new capability is worth the funds invested, rather than meeting specific performance requirements established early in the program.

Capability-Based Acquisition and S iral Development

If it is to have the intended results, capability-based acquisition must incorporate some kind of evolutionary acquisition process. The method that seems most suited to developing a BMDS is spiral development. Spiral development allows a program to keep abreast of technology by delivering capability in increments, called spirals. These spirals provide for the continuous evaluation of new ideas to determine if they either add capability to the system being developed, or offer a more cost-effective method for achieving the target capability already established for the system. These ideas are then grouped into blocks of improvements that are incorporated into the system on a scheduled basis, every two years for the MDA. This process provides a formal mechanism for maturing a new idea for several years before incorporating it into a system.

Establishing the Capability to be Developed

The MDA is developing a system that has never before existed, an integrated ballistic missile defense system that may eventually be able to stop "any missile, anywhere, any time." Unfortunately, it is not possible to build an overarching system of this type with the technology that is available today, or that will be available in the near future. The MDA is attempting to avoid this problem by developing a limited BMD capability based on today's technology along with advances that should be available in the next two years (the first "spiral" of development).

To quantify the threat to be defended against, the MDA has created an "Adversary Capability Document (ACD)" which estimates what a potential rogue nation could realistically be capable of deploying within the same two year period. The assessment made in the ACD is based on three limits:

- Intelligence - what the adversary is currently able to do
- Engineering - what is possible with the technology of today or the near future
- Physics - the limits that the adversary cannot exceed

The MDA uses this assessment to narrow the program's overall technical objectives and goals to specify the capability that will be developed within a particular spiral. In this way, the capability being developed will improve incrementally as the threat being defended against becomes more challenging.

<u>A Shift in Emphasis</u>

A key aspect of capability-based acquisition is to shift the focus of acquisition away from attempting to completely describe a system's performance requirements early in the concept definition stage. Instead, capability-based acquisition describes a shortfall in capability, and then devotes funds to developing the technologies that may resolve this shortfall in order to determine a realistic estimate of how much capability can actually be produced. The intent is to mature a promising technology *before* it becomes part of the program.

This shift in emphasis should reduce the risk inherent in new technology by ensuring that it is considerably more mature than has been the case in previous programs. Using only mature technology will in turn allow the MDA will to generate a "System Capability Specification"

(SCS) (which is established at Milestone B) that more realistically describes the capability being developed. In addition to reducing risk, this process will allow the MDA to manage expectations and avoid establishing stakeholders for something that turns out to not be worth the effort.

New Ideas Will Always Come Along

The MDA's capability-based acquisition process incorporates spiral development in order to account for the fact that new ideas will continue to be discovered while a system is being developed. The MDA considers a wide range of ideas and expends funds to develop them while acknowledging that many, if not most, will not pan out. Spiral development allows the MDA to systematically evaluate these ideas to determine if they will add capability, and determine when (or if) it will be feasible to incorporate them into a system. For those ideas that prove feasible, the MDA determines when they will be ready and integrates them into the "block" for a particular spiral and incorporates them into the System Capability Specification. This process is designed to reduce the risks associated with new technology and incorporate into a system those that prove feasible.

The Importance of Technology Readiness Levels (TRLs)

In order to evaluate the maturity of new concepts, it is necessary to have criteria by which to measure them. In their investigations into industry Best Practices, the GAO used `technology readiness levels,' or TRLs to do this. These TRLs ranged from 1, which entails only paper studies of the basic concept, to 9, which means that the technology has been proven on the intended product.[8] The GAO discovered that successful programs, both commercial and DOD, waited until concepts were mature before making key decisions.

After evaluating 23 technologies that were actually put into production, they discovered that in successful programs the concepts were managed by science and technology organizations until they reached a TRL of at least 6, and'usually 8. On the other hand, one DOD program began weapon system development, to include an approved ORD, with a TRL of only 2 or 3 for key technology. It subsequently had cost growth of 88% and schedule slip of 62%.[9] Based on these findings, the GAO recommends that a program not be initiated, and the cost, schedule and performance baseline not be established, until the key technologies have reached a TRL of at least 7[10] (which means that a system prototype has been demonstrated in an operational environment)."

Since DOD does not usually fund science and technology past a TRL of about 5, the requirement for a TRL of 7 implies that the program office will need to devote more funds to concept development.[12] This is why a capability-based approach using spiral development becomes necessary. It provides a mechanism for the continuous development and refinement of concepts so that new technologies can be reliably incorporated into a system as soon as they are ready. Capability-based acquisition uses TRL criteria to determine if a technology is ready by conducting evaluations at "knowledge points" during the development process.

Knowledge Points

A key part of capability-based acquisition is the use of Knowledge Points (KPs), which are levels of knowledge that must be attained before a new concept is ready for further development. This concept derives from GAO investigations into industry Best Practices, and stipulates how much a developer should know about key technologies at certain critical decision points in the product development cycle. The GAO defines these knowledge points as follows:[13]

- Knowledge point 1 occurs when a match is made between the customer's needs and the available resources-technology, design, time, and funding. To achieve this match, technologies needed to meet essential product requirements must be demonstrated to work in their intended environment. In addition, the product developer must complete a preliminary product design using systems engineering to balance customer desires with available resources.

- Knowledge point 2 occurs when the product's design demonstrates its ability to meet performance requirements. Program officials are confident that the design is stable and will perform acceptably when at least 90 percent of engineering drawings are complete. Engineering drawings reflect the results of testing and simulation and describe how the product should be built.

- Knowledge point 3 occurs when the product can be manufactured within cost, schedule, and quality targets and is reliable. An important indicator of this is when critical manufacturing processes are in control and consistently producing items within quality standards and tolerances. Another indicator is when a product's reliability is demonstrated through iterative testing that identifies and corrects design problems.

The MDA has re-cast these definitions in terms relevant to their program: [14]

- KP 1: when technology and advanced concepts have matured and shown viability to enhance BMDS capability or fill **BMDS** gaps through system-level predictive assessment transition from technology baseline to development baseline

- KP 2: when elements/components have matured sufficiently for system integration into a test bed

- KP 3: when elements/components: have demonstrated capability, to include military utility, and criteria for transition to Services have been met (including producibility Services have budgeted in FYDP, etc.)

The knowledge point evaluations mark the transition from RDT&E into component or element development (KP 1), from there into system integration and development (KP 2,) and finally into production (KP 3). While these KPs may seem to be equivalent to traditional program Milestones, they actually represent levels of knowledge that are needed to successfully transition from one phase to the next. For instance, the current acquisition process requires an Operational Requirements Document (ORD) at Milestone A, which occurs before a program conducts the technology development needed to reach KP 1. In contrast, capability-based acquisition does not establish a "Capability Requirements Document" (CRD) until the system enters production at KP 3, which is approximately equivalent to Milestone C.

Capability-based acquisition hinges on the KP 1

The intent of capability-based acquisition is to avoid having to start a program based on "promises" of technology and cost that cannot be known with certainty ahead of time. To meet this intent, capability-based acquisition focuses on attaining the requisite knowledge necessary to make an informed decision to enter the next phase of development. KP 1 is critical because it is where a new technology's intrinsic value and maturity are evaluated. The review also determines *when* the new technology will be available, and evaluates affordability and the remaining risks. This ensures that the key technologies for the program, or those technologies providing added capability on subsequent spirals of an established program, are ready (TRL of at least 6) so that the program will be able to maintain cost and schedule going forward.

A new kind of system specification. After a successful KP 1 evaluation, called a System Design Review (SDR) by the MDA, the new technology is incorporated into the previously mentioned System Capability Specification, which differs considerably from the traditional System Specification derived from an ORD. One difference is that there should now be a much higher level of confidence that the system will meet cost and schedule estimates than under the current process. This is because a SCS is essentially a prediction of the amount of additional capability that the system will achieve in the relevant spiral of development, rather than a series of discrete end-state performance requirements for the system as a whole. This difference in perspective has many implications for the development process.

Once the baseline SCS for the current spiral of development has been written, the chosen technology is developed further before it goes into production. When the technology is mature, the MDA transitions them to the Services for production. At this point, capability-based acquisition uses documents that are very similar to those of the current requirements based acquisition process,[15] although the manner in which the system is evaluated should be a little different

A major difference between capability-based acquisition and requirements-based acquisition is that with capability-based acquisition the system is considered successful if it provides additional capability that is worth the cost, even if it fails to provide as much capability as was expected when the SCS was written. Failures to achieve the predicted capability should be rare, since the capability requirements document should only be written for mature technology. On the other hand, judging a system to be a success when it does not provide all of the target capability will be difficult to defend if the contract is not carefully written.

An example of how the MDA addresses this issue is the way in which they evaluate a contractor's performance in meeting his schedule. The MDA first has the contractor submit a schedule for developing a technology or system. The MDA program managers then make a judgment about how realistic the schedule is, based on factors such as past performance, and create a schedule of their own. When they write the contract, the MDA evaluates the contractor's performance on the MDA-generated schedule, but makes the award fee contingent on meeting the contractor-generated schedule.[16]

This approach is in sharp contrast to the hard and fast requirements of the ORD-based process which would cause a program to be considered a failure (and require considerable justification to Congress) if the contractor failed to meet cost, schedule and performance requirements that were established years in advance. While the current process allows the program office to change early requirements before Milestone B, getting requirements approved is so contentious that this rarely happens. This is regardless of whether or not the technology is mature or the developer has even initiated the systems engineering.[17] Capability-based acquisition avoids this problem by updating the SCS, or establishing a new one, for each spiral of the development. This makes it easier to establish (and put on contract) a realistic estimate of how much capability can be delivered.

The unanswered question remaining is what happens if a program element or component still falls short of the expected capability. The first step would be to draw any lessons from why the product failed to yield the expected capability (and probably fire the program manager). The second step would be to determine if the capability developed is worth the cost of producing it and if so put it into production. Finally, spiral development would upgrade or replace the under-performing element in the next iteration.

When do you know you are done? The MDA is developing a BMDS that does not have a specified final configuration and therefore no predefined measure of how much capability the final system will have. This brings up the question of how to tell when it is finished. In theory the system will never be finished because new ideas and new technologies will continue to be developed in order to defend against the ever-increasing capability of the adversary. If the adversary's capability should stop increasing, then investment in BMD should stop when one of two things happens: either a point is reached at which the capability developed provides sufficient protection, or the new ideas stop providing enough additional capability to be worth the cost (diminishing returns). A more likely outcome is that the system will be considered adequate when the political climate changes to the point that additional funds are no longer provided to the program.

Expected Benefits

Capability-based acquisition provides a process for rapidly meeting warfighter needs by fielding a limited capability at the earliest possible date. The ACD keeps the program focused on the threat, while spiral development provides a mechanism to improve the system's capability as both technology and the threat evolve. In addition, the KP evaluations should minimize risk by ensuring that the technology being incorporated is sufficiently mature.

Gold plating. An additional benefit of capability-based acquisition is that it provides a process to manage "requirements creep" and should minimize "gold plating." It manages requirements creep by using spiral development to evaluate whether or not the added capability is worth the additional cost, which can now be more accurately estimated. It mitigates gold plating by forcing a new idea, regardless of source, to enter the concept development process and compete against all other new ideas to determine which will add the most capability to the system as a whole. By forcing new ideas to compete for development funding, the true cost of gold plating should become known before a commitment is made to add something to the program. If applied rigorously, this process should serve to highlight gold plating and minimize requirements creep.

Innovation. As mentioned previously, capability-based acquisition is intended to foster innovation by providing a mechanism for maturing new technologies. The MDA is attempting to reinforce this objective by using a "Technology, Concept, and System Management and Development Process to evaluate new ideas and make investments in those that are most promising.[18] The MDA allocates funding for this process at the top level to ensure that the chosen technologies are the ones that have the most potential to help the program as a whole and plans to spend about $1.4913 over the future years defense plan (FYDP) to do this,[19] but some aspects capability-based acquisition may inhibit innovation.

Capability-based acquisition could tend to make program managers less inclined to quickly embrace new technology. This is because technological maturity is often a subjective evaluation, and conservative program managers may avoid using new technology in favor of older, proven concepts, despite the theoretical maturity of the new idea. A cultural bias of most engineers to not release a new product until they have perfected its design may reinforce this tendency.[20] To mitigate these possibilities, the MDA is attempting to maintain an atmosphere that encourages and rewards rapid innovation.

Applicability to Other Programs

New programs. Capability-based acquisition seems to be particularly well suited for programs that are developing a totally new and unprecedented capability, such as a ballistic missile defense system, but it should work equally well for more traditional systems. In fact, many of the systems produced in the past have been developed incrementally, although not as part of a formal process. Most programs have delivered an initial version of a system that was subsequently upgraded to improve its capability, although it normally took from 10 to 15 years to deliver the initial system. The difference between traditional acquisition and capability-based acquisition is that spiral development is planned from the start.

Even if the capability being developed is not unprecedented, capability-based acquisition offers several advantages. It allows the fielding of the next generation of capability much sooner, since early versions will use mature technology, and it will keep the system technologically up to date by incorporating new technology as it matures. Perhaps even more importantly, it establishes a systematic process for doing this and enables decision-makers to better plan for the needed funding.

There are some types of systems where the benefits of capability-based acquisition may not be as obvious. These are systems where the capability being sought hinges on the technology required for the major structural components of a system, such as an aircraft or armored vehicle. If the design of the basic structure is what provides the new or enhanced capability and producing this design requires years of development and testing, then it may not be worthwhile to produce a system using current technology. In such a case it will be necessary to devote as much time as necessary to technology development. What capability-based acquisition provides is a process for evaluating the merit of new ideas and for developing the needed technology to ensure its maturity before the system goes into production.

A perceived disadvantage of capability-based acquisition is that it may make it difficult to obtain funding for subsequent spirals of additional capability, since the program will have to compete with other projects during the budget cycle. While this competition may seem like a disadvantage to those who feel that the subsequent improvements are essential, it will allow decision-makers to determine if the added capability is truly more important than other requirements that may have emerged more recently. The advantage of capability-based acquisition is that it will have already produced a system with at least a limited capability at the same point in time that a program developed with the traditional process would not have delivered any capability at all.

Legacy programs. Transitioning a legacy program to capability-based acquisition may prove difficult on a number of levels. At the program level, capability-based acquisition will theoretically require a new evaluation of the merits of the system being developed. The legacy system will have to compete against newer ideas for providing a given capability that have emerged since the legacy program was established, and it may no longer be the best choice. Likewise, engineers of a legacy program will also resist a change to capability-based acquisition because of the discipline it requires for the evaluation of new ideas. Engineers will not want to have their new ideas fed back into the beginning of the process, where they will have to compete against other new ideas, particularly if the reason for a new idea is that the original approach was failing. When combined with the vested interests of others involved, and the difficulty the government seems to have writing off sunk costs, these factors may make it difficult to transition a legacy program to a capability-based acquisition process.

Implications of Capability-Based Acquisition

Transition to production. One area in which the MDA approach to capability-based acquisition may have a weakness is the process used to transitioning new technolo to the Services for production. While there do not appear to have been any problems so far, only one "element" of the BMDS (Patriot PAC III) has been transitioned to a Service. A formal process including periodic reviews with the Services would be beneficial for not only the initial handoff of a program element, but also when it is necessary to transition new technology into a system that is already in production.

A formal transition process is needed because the Services that will be producing the system will need to arrange for funding by submitting a Program Objective Memorandum (POM) about two years before the transition occurs. A potential obstacle is that the Services will be requesting funds for programs that are not under their control, and possibly before the specific technology has even been determined. While this transition can be coordinated on an ad-hoc basis, a formal annual process would provide the Services with insight into the status of developing projects, and would ensure that the funds to produce the systems would appear in the FYDP. This latter point is important because it provides industry with more certainty about which systems will actually enter production and allows them to plan accordingly.[21]

Production implications. Another obstacle to implementing capability-based acquisition is the potential for terminating systems that have recently entered production. In theory, spiral development calls for an entire system to be replaced if a new technology yields a better solution. In reality, there are at least two reasons why it is unlikely that this will. actually happen. The first is that a new technology would have to need little development and have dramatic advantages if phasing out a system just entering production is to be cost-effective. The second reason is that the political implications of terminating a contract will probably make doing so extremely difficult. These factors may mean that spiral development in practice may fall short of its theoretical potential, but it still appears to be an improvement over the current process.

Capability-based acquisition will also require a change in the mindset of those deciding which capabilities to develop. This is because it goes against ingrained cultural biases within the DOD acquisition system. Most of today's incentives, that push requirements up, make them more difficult to meet, and less flexible to negotiate-such as competition for program . funding-will still exist .[22] Capability-based acquisition offers the potential to circumvent these incentives, but it will take a concerted effort to change the culture within the acquisition system if it is to be truly different from the current system.

Another cultural change that will be needed is the perspective of the program managers developing the systems. A key to making capability-based acquisition successful is the extensive research and development (R&D) needed to mature technology. While technology development (especially prior to KP 1) should be conducted with a mindset that most, and perhaps all, of the new ideas will fail, accepting this may be difficult for program managers adapted to a system where failure can end a career. A potential outcome is that program managers may push a technology into further development, or even production, before it is mature because they may feel that not finding a quick solution will mean they have failed. Program managers charged with maturing technology will need a more flexible mindset, more akin to that of a laboratory researcher, than they have had in the past. If capability-based acquisition is to be effective, the program manager's performance evaluation system will have to support this new perspective.

Potential im lications for ac uisition olic . The mechanics of obtaining the funds needed to start a program have not yet changed. Capability-based acquisition places a lot of emphasis on extensive development before Milestone B so that a program is not initiated until the technology is considered mature. Unfortunately, there is no programmatic mechanism to obtain significant funding until a program is initiated.[23] This will make it difficult to develop the knowledge needed to "match customer expectations with developer resources" before program initiation. While the MDA is funded in a manner that allows them to develop this knowledge, most other DOD programs are not. If other programs are to effectively use capability-based acquisition, then a process must be created to fund technology development before the program is formally initiated.

The MDA approach to capability-based acquisition uses commercial "best practices" to rapidly deliver relevant capability to the warfighter, and seeks to keep this capability on the leading edge of technology through the use of spiral development. If this approach is to be applied to DOD as a whole, then what is needed is an acquisition process that focuses on enduring military capabilities, and integrates the effort to provide these capabilities across all of the Services. This would allow decision-makers to balance acquisition funding over the entire spectrum of required capabilities, and respond quickly to advances in technology, and changes in the world environment.

IMPLEMENTING CAPABILITY-BASED ACQUISITION ACROSS DOD

A recent study published by the Office of the Under Secretary of Defense for Industrial Policy (USD/IP) and titled "Transforming the Defense Industrial Base: A Roadmap" proposes a process that could be used to implement capability-based acquisition across DOD. The study supports Secretary of Defense Rumsfeld's transformation goals and draws on extensive research in order to develop a new way of looking at the defense industrial base. One outcome of this analysis is a recommendation for DOD to reorganize its decision-making processes to provide decision-makers with an integrated view of the force structure. The intent is twofold, to refocus the acquisition process on operational effects, and to make it more efficient. [24]

Six Problems

The study presented six problems with the current DOD acquisition system that were identified by defense suppliers. The problems most relevant to this discussion are: inadequate funding and advocacy for transitioning new technology, a cumbersome system of design specifications, and limited access to development and investment capital. [25] Taken together, these problems not only make it difficult to rapidly incorporate new technology into military systems, they make it difficult for industry to even do business with the DOD. These are the same problems that the processes developed by the MDA are intended to mitigate. When combined with the study's recommendations, the MDA processes may form the basis of an integrated approach to acquisition.

Refocusing Defense Acquisition

The defense acquisition process needs to be refocused because the current process pits the Services against one another in the quest for funding. This causes each service to champion its own approach to war in order to justify funding for the systems it deems important. Because of this "stovepipe" development process, the services tend to integrate capabilities after the systems are produced rather than first developing an integrated concept. A broader, DOD-wide focus would allow for the development of overarching capabilities that provide the warfighter with the "operational, effects" needed to win on the battlefield.

One of the study's primary recommendations is to organize the DOD decision-making process in a manner that will focus on optimizing operational effects, and articulate them in terms of capability shortfalls. [26] This is also a common thread running through the MDA's approach to capability-based acquisition. Both of these processes emphasize measuring success in terms of the capability provided to the warf ghter rather than in terms of the systems produced.

The USD/IP study proposes that DOD divide the effects needed by the military into five "operational effects-based industrial sectors." The intent is to focus development efforts on systems that provide the *capability* to produce these effects on the battlefield. The five sectors are: [27]

- Combat Support
- Power Projection
- Precision Engagement
- Homeland and Base Protection

- Integrated Battlespace (sensors, sensor platforms, C4ISR)

As proposed by the authors of the study, these "sectors" refer to a method of viewing the defense industry, and should evolve as the international environment changes. (As they are defined in the study, the MDA is included in the "Homeland and Base Protection" Sector.) The intent of establishing these Sectors is to "allow decision-makers to identify capability gaps, overlapping functions, and potential trade-offs among sectors." [28]

Improving Efficiency

Best Practices. A common characteristic of the MDA's capability-based acquisition and the USD/IP study is that they both attempt to implement industry "best practices." In the study, the authors identified "best practices" advocated by industry that would help firms to better meet the needs of the DOD. Many of these best practices are already part of the capability-based processes used by the MDA. They include: [9]

- Decreased use of cumbersome design requirements
- Increased direct DOD involvement in second and third tier suppliers
- Use of more small long-term contracts
- Centralizing decision-making capabilities along technological lines
- Protecting companies' intellectual property rights while assuring military usage rights

The MDA has already developed processes to implement most of these best practices. The MDA's "National Team" concept is developing processes to protect companies' intellectual property rights, even when more than one firm is responsible for developing a system. The team structure also helps_ ensure that the government learns when sub-tier suppliers develop innovative ideas, even if the team leadership does not adopt them. [30] This latter point is important because research indicates that most innovation originates from second tier and niche contractors. [31] The MDA process also centralizes decision-making along technological lines and seeks to reduce cumbersome design requirements by using a capability-based acquisition process. The only best practice that capability-based acquisition, as implemented by the MDA, does not specifically address, is the one that prescribes using more, small, long-term contracts. This practice may encounter problems with the political aspects of defense acquisition and will be discussed later.

Transformation Boards

To implement these business best practices across the DOD, the study recommends that the DOD restructure its internal R&D and acquisition planning programming and budgeting process.[32] As mentioned above, the current DOD process has a tendency to allocate resources along Service lines and does not have an effective method for integrating the capabilities of the systems across Service lines before the systems are designed. The process proposed in the study attempts to change this by transforming the resource allocation and acquisition process so that the battlefield effects being sought are broken down into the capability required of each system before the systems are developed. To this, the study proposes "Transformation Boards" that are aligned with the "operational effects-based sectors."[33]

The study proposes that there be a single Transformation Board for each of the five operational effects-based sectors. The board would be comprised of both standing and sector-specific members. The standing members of the boards would be the same individuals that are on the current Defense Acquisition Board (DAB), but would also include the Service Chiefs. The intent is to ensure that the Service perspective is included in all decisions and to promote Service support of the boards' decisions.

The purpose of having standing members on the boards would be to provide the cross-board (or cross-Sector) perspective that will be necessary to minimize duplication of effort between boards and ensure that the initiatives of all of the boards will be mutually supporting. The sector-specific members of the boards are there to provide focused expertise in that board's operational sector. This combination of standing and sector-specific members should allow the boards to provide conceptual unity for DOD acquisition, and apply new technology across the spectrum of needed capabilities. This process would also serve to integrate the expertise of the individual Services into the operational effects needed on the battlefield. sa

The process advocated by the study would start with the Defense Planning Guidance (DPG) in which the Secretary of Defense would allocate funding based on the five operational effects Sectors. The next step would be for an enhanced Joint Requirements Oversight Council (JROC) to identify and prioritize programs for each sector. The JROC would then present the prioritized programs to the Component Commander of the Joint Forces Command for a warfighter assessment. Once the JROC had determined the array of programs to be pursued, they would hand these programs over to sector program managers. These sector program managers would then report to the boards at annual "sector reviews." At the sector review, "each Board would issue a single, binding acquisition and funding decision memorandum,"[35] that would convey budget and funding decisions for each program, regardless of which Service was responsible for it [36]

Industry monitoring. Similar to the processes created by the MDA, the Transformation Boards should promote better monitoring of competition in the defense industry. Since the perspective of the boards would cross Service boundaries, and the contractors supporting them, they would have visibility into situations where a single contractor is acquiring too large a percentage of the available defense work. They would also be able to monitor the large, integrated contractors to determine if a contractor is favoring an internal solution, to enhance profits, vice a better external solution. [37]

Applying Capability-Based Acquisition to the Transformation Board Process

In theory, the Missile Defense Agency's capability-based acquisition process could be expanded into a process similar to the Transformation Board process proposed in the study. The perspective of the standing members of these boards could allow them to foster the application of innovative technology across all "operational effects sectors" in the same way that the MDA promotes the rapid incorporation of new technology across program "elements." [38] A common thread of the two processes is that the operational concepts developed under each would depend on systems produced and employed by more than one Service. Similar to the MDA process, the Transformation Board concept is intended to sponsor the development of critical technologies for each sector by providing the funding and advocacy necessary to pull new technology into weapon systems. [39] A combined process would use spiral development to rapidly incorporate the new technology into all programs that could benefit from it.

Obstacles to Acceptance

This study advocates a more rational process for defining warfighter needs and seeks to ensure joint, integrated solutions by giving multi-service boards the authority to review and control which capabilities are developed. In theory, this process should help provide better conceptual unity for defense acquisitions. It would do this because the standing members of the Transformation Boards would be able to form a coherent integrated vision of how the U.S. will fight future wars and ensure that the Services develop the capabilities to implement this vision. In practice, there are many obstacles to making this process work.

DOD resistance. Perhaps the greatest obstacle to implementing this process is that it takes power from the Services and gives it to multi-service boards. If the memorandum signed by each of the boards is truly binding, then the Services will be obligated to spend their procurement funds in accordance with directives of the boards. When it does become necessary to reallocate funds between programs, then the Transformation Boards would have to authorize any changes. This means that the Services would be unable to reallocate the funds in accordance with their own priorities.

Forcing the Services to do this would be good in that it would give primacy to a joint perspective, but it would also prevent the Services from reallocating funds to pay for unforeseen contingencies. This is a two-edged sword; it could force the Services to spend funds in accordance with Board directives, but would require Congress to quickly appropriate additional funds in the event of unforeseen contingency operations. It is likely that neither the Services nor Congress would be quick to embrace this process.

If this process is adopted, a potential outcome is that inter-Service politics may prompt each of the Services to support the other Services' pet programs. This would allow each Service to obtain what it believes to be most important, but would not truly evaluate and prioritize funds according to the operational effects being sought. This view may seem cynical, but the nature of politics makes such an outcome plausible.

Congressional resistance. Capability-based acquisition requires considerable funding for R&D, but allows the program manager to invest the funds based on what is in the best interests of the program. Congress often has a different perspective on the best method of obtaining a given capability, and a rigorous process based purely on the technical merits. of a solution may run into political resistance. This could make it difficult for capability-based acquisition to fulfill its potential.

Congress may also present obstacles to implementing the "best practice" not directly addressed by capability-based acquisition. This is the recommendation to use more small, long-term contracts. Gaining Congressional approval for long-term contracts is often difficult, even when they offer substantial savings. This is because long-term contracts decrease the flexibility that Congress has in directing where funds are spent. Members of Congress need to be able to show their constituents how they are helping their district if they are to be reelected. A multi-year contract only allows a member of Congress to take credit for bringing jobs to a district once, as opposed to being able to take credit every year that a "new" contract is awarded. In light of this, Congress will probably be reluctant to embrace the idea of using more long-term contracts.

To be successful, a process such as the one described here will have to include provisions to garner the support of the current stakeholders. Congress will have to be convinced that they will retain all of the prerogatives that they have now, and the Services will need to be convinced that the new process will not significantly increase the power of one over the others. Unfortunately, the provisions needed to do this could result in merely replicating the current system, albeit with new names (i.e. each Service would own a Sector).

CONCLUSIONS

In actuality, capability-based acquisition is something that the U.S. military has been doing for quite some time. From the battleships of the turn of the last century, through the aircraft carriers of World War II, to the air, sea and land forces currently fighting in Iraq, the United States has been pursuing the capability to project power on a global scale for over a hundred years. The fighters, bombers, tanks and warships of today are merely updated versions of the systems we built 50 years ago. The capability to project power that these systems provide has evolved incrementally as new systems were developed or old systems were modified to incorporate new technology (a prime example of this being the B-52). This paper has presented the elements of a process for managing this evolution in a more systematic and efficient manner.

The process outlined in this paper has the potential to transform the U.S. military into a truly integrated fighting force. Merging the Missile Defense Agency's capability-based acquisition process with the ideas contained in the USD/IP study could yield a process that provides for the DOD as a Whole, the same benefits that capability-based acquisition provides for the MDA. These benefits include: a process to quickly field of an initial capability and then upgrade it incrementally, the ability to incorporate new technology into systems as soon as it is ready, focusing development efforts to produce integrated operational effects on the battlefield rather than individual systems, and ensuring that the capability being developed evolves along with the threat being addressed. Implementing this process faces formidable obstacles that will be difficult to overcome, but the benefits of doing so will greatly outweigh the costs involved.

' "BEST PRACTICES: Better Management of Technology Development Can Improve Weapon System Outcomes," GAO-NSIAD-99-162, July 1999, 17.

[2] For example, the Air Force was compelled to test the capability of the C-17 to perform low-altitude parachute extractions (LAPES) even though the Army no longer had the requirement for this capability a decade after the original specification was written. The C-17 was also still relying on Intel "8088" computer technology well after the commercial industry had progressed to "Pentium"- e computers. Personal experience in the C-17 system rogram office, December 1993 - June 1996.

Donald H. Rumsfeld, "Missile Defense Program Direction," Memorandum from the Secretary of Defense, 2 January 2002.

[4] Col Stephen Gourley, Director of System Architecture, Missile Defense Agency, interview with the author, 7 February 2003.

'"BEST PRACTICES: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes," GAO-01-288, March 2001, 64-67.

[6] Ibid., 67.

[7] In order to keep the program focused on the BMD system as a whole, the MDA has broken it down into "elements." Each of these elements was a major development program in its own right (e.g. Patriot PAC III) before it was transferred to the MDA.
[8] GAO-NSIAD-99-162, Appendix I, 68.
[9] Ibid., 4-5.
[10] Ibid., 64.
[11] Ibid., Appendix I, 68.
[12] Ibid., 6.
[13] "BEST PRACTICES: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes" GAO-02-70 1, July 2002, 18
[14] Gourley.
[15] Dennis Nihiser, Deputy for Engineering, Missile Defense Agency, Powerpoint briefing dated 9 January 2001, slide 24, 26.
[16] John Lyttle, Program Manager for KE Interceptors, Missile Defense Agency, briefing to the ICAF Space Industry Studies seminar, 20 March 2003.
[17] GAO-01-288,69.
[18] Gourley.
[19] Missile Defense Agency Fiscal Year (FY) 2004/FY 2005 Biennial Budget Estimates Submission, 22.
[20] Reese Delorey, Program Director, C2BMC Program, Lockheed Martin Corporation, interview with the author, 14 March 2003. An example of this tendency may be the development of the first clock suitable for establishing a ship's longitude at sea. John Harrison produced what was arguably and acceptable version in 1737, but did not consider his product to be good enough until he produced his fourth version in 1759. As a result, the sailors of the world did without this invaluable capability for 22 years. Dava Sobel, Longitude, (New York: Penguin Books USA, 1995), 83, 99.
[21] This is important because uncertainty about whether or not a system will actually be produced has prompted firms to dispose of capital assets and reassign personnel that will be needed if the system is actually produced. Douglas P. Crawford, PhD, Technical Assistant to the SEO, Missile Defense Agency, interview with the author, 25 February 2003.
[22] GAO-01-288, 8.
[23] Crawford.
[24] "Transforming the Defense Industrial Base: A Roadmap," Office of the Deputy Undersecretary of Defense (Industrial Policy), February 2003, 1, 2.
[25] Ibid., 22.
[26] Ibid., 1.
[27] Ibid., 16, 17.
[28] Ibid., 17.
[29] Ibid., 21.
[30] William L. Spacy II, "The Missile Defense Agency and the Space Industry," A paper submitted to the Space Industry Study, Industrial College of the Armed Forces (Washington D.C.: Ft McNair, 2003), 2, 3.
[31] "Transforming the Defense Industrial Base: A Roadmap," 10.
[32] Ibid., 19.
[33] Ibid., 23.
[34] Ibid., 24.
[35] Ibid., 27.
[36] Ibid., 27, 28.
[37] Ibid., 30.
[38] Ibid., 27.
[39] Ibid., 29.