Evolutionary Acquisition Strategies and Spiral Development Processes

Delivering Affordable, Sustainable Capability to the Warfighters

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Many people think of Evolutionary Acquisition (EA) as the new buzzword; however, EA has been in use at least since the early 1990s. With any major change, things take time; as such, we're on the downside of the implementation of EA as not just an alternate strategy, but as the preferred strategy or the strategy of choice within the Department of Defense.

EA was not considered within DoD acquisition guidance documents until 1995, when it was discussed as an alternate strategy to the traditional single-step to full-capability approach. Then in 2001, an EA strategy became the DoD's preferred strategy for acquiring operational needs. This status has carried through to the current DoD acquisition guidance as follows: "Evolutionary acquisition strategies are the preferred approach to satisfying operational needs. Spiral development is the preferred process for executing such strategies."

Additionally, the individual Services have revised guidance and policy. For instance, within the office of the Assistant Secretary of the Air Force for Acquisition, Research, and Development, Dr. Marvin Sambur, on June 4, 2002, issued a memo titled "Reality-based Acquisition System Policy for All Programs," which outlines the Commander's Intent relative to acquisition as follows:

> "The **primary mission** of our acquisition system is to **rapidly deliver** to the warfighters affordable, sustainable **capability that meets their expectations**. All actions by any leader, staff, or supporting organizations will support the Commander's Intent."

Further in the memo, Sambur states:

> "Evolutionary Acquisition is the preferred acquisition **strategy** for achieving the Commander's Intent. Spiral Development is the preferred **process** to execute the EA Strategy. …"

Terminology and Definitions

Although the policy differentiates EA as a strategy and spiral development (SD) as a process, these terms are often used interchangeably. The definitions listed here will clarify how these terms are different yet complementary.

Evolutionary Acquisition

What do we mean by "Evolutionary Acquisition Strategy"? First, let's break this down into its component parts and look at the dictionary definition:

- ***Evolutionary, adv****: process in which something changes (develops) into a different and usually better or more complex form.*
- ***Acquisition, n****: the act of gaining possessions.* [In the DoD we tend to not just gain possessions but to deliver warfighting capability.]
- ***Strategy, n****: a plan of action.*

Putting these three component definitions together, a dictionary definition would be:

> ***Evolutionary Acquisition, n:*** *Plan to develop and deliver warfighting capability over time.*

Several working definitions are available to describe EA. Three of the more common definitions follow:

No.1

"… overarching acquisition strategy that a program can use to develop and field a core (initial increment) capability meeting a valid requirement with the intent to develop and field additional capabilities in successive increments." (Air Force Instruction [AFI] 63-123, EA for C2 Systems, April 1, 2000.)

No.2

"An acquisition strategy that defines, develops, produces, or acquires and fields an initial hardware or software increment (or block) of operational capability. It is based on technologies demonstrated in relevant environments, time-phased requirements, and demonstrated manufacturing or software deployment capabilities. These capabilities can be provided in a shorter period of time, followed by subsequent increments of capability over time that accommodate improved technology and allowing for full and adaptable systems over time. Each increment will meet a

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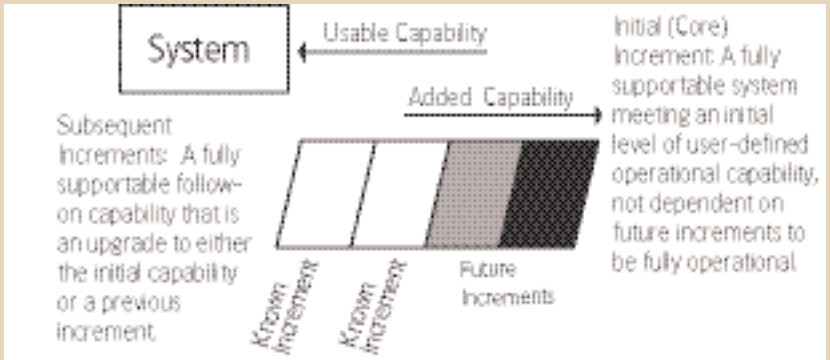
FIGURE 1. Evolutionary Acquisition



[militarily] useful capability specified by the user …" (Memorandum from the Under Secretary of Defense for Acquisition, Technology and Logistics [USD/AT&L] to the Services, April 12, 2002.)

No.3

"An evolutionary approach delivers capability in increments, recognizing up front the need for future capability improvements. ... The success of the strategy depends on the consistent and continuous definition of requirements and the maturation of technologies that lead to disciplined development and production of systems that provide increasing capability toward a materiel concept." (DoD Instruction 5000.2, May 12, 2003.)

Three common themes emerge from these definitions. First and foremost, *EA is a* ***strategy*** *that develops and delivers (or fields) an initial capability and continues the development and production of the system to provide additional capability over time*. Second, EA recognizes up front the need for future enhancements or improvements to the capability. Third, EA recognizes up front the need to plan accordingly for the evolution.

Figure 1 shows an initial usable increment of capability as well as the subsequent increments as added capability. An increment is a distinct set of planned activities supporting the goal of delivering an operational capability to the user. (Note that each increment of capability must meet a defined user need and be fully supportable.) The early subsequent increments may be relatively known increments, but future increments may be for the most part unknown.

Increments beyond the initial increment accommodate the development and delivery of new capabilities supporting the operational requirements and goals of the system; exploit opportunities to insert new technologies that reduce cost of ownership or accelerate fielding of new capabilities (resulting from technical demonstrations); or refine current capabilities based on user feedback, testing, or experimentation.

Now that we've defined EA as a strategy, let's look at why we should consider using it. Figure 2 shows several different weapon systems. Each of these sys-

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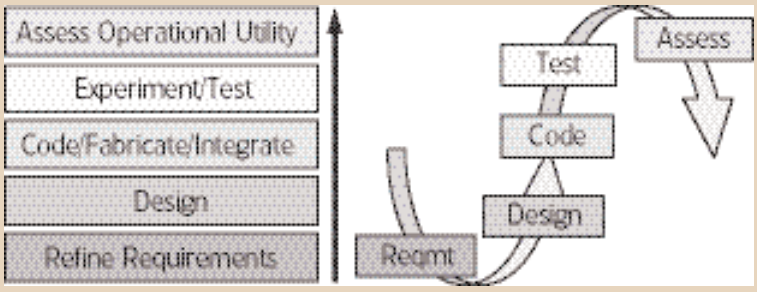
FIGURE 2. Programs Evolve Naturally

FIGURE 3. A Single Spiral



tems—whether a major aircraft, a missile system, a complicated software system, or pieces of life support equipment—evolved from initial fielding of the system.

Why do programs evolve? The most prevalent reason: Requirements change! Other reasons why programs evolve:

- Threat changes
- New missions
- New users for the system
- Technology improvements
- Parts obsolescence
- Congressional influence
- Funding cuts

Knowing that a program will evolve, what can be done to leverage this knowledge to better plan the program's evolution? Maintaining an understanding of those items that typically impact a program will provide the best leverage.

For instance, by being aware and connected to the intelligence community, we can better facilitate changes that occur due to a change in the threat environment. By being aware and connected to the science and technology community, we can better facilitate changes that occur due to improvements in technology. Additionally, by being aware of and connected to the user community, we can better facilitate changes that occur due to improvements in how a system is used, how a new user is planning to use the system, or when subsystems begin to fail and parts are no longer available.

Congressional influence and funding cuts are a little more difficult to plan ahead; however, if a strategy is developed that quickly fields a capability that meets a definite user need, then other potentially negative impacts, such as congressional influence or funding cuts, are minimized. Actually, the opposite may be true. If a system is fielded and proves to be invaluable, then additional missions (capabilities) may be required of the system and additional funding will be provided to support improvements to the system.

A familiar adage reminds us that "the only constant is change." Taking this into account, why not plan for the change? An EA strategy accommodates change, and for the most part welcomes it. We should, therefore, build a strategy that develops and delivers an initial capability and should lay out the enhancements in an incremental manner to be delivered over time. The enhancements will be planned based on the risk associated with various aspects of the system and the potential for change. Additionally, an EA strategy accommodates changes to future increments and at least allows for some lead time before baselining the increment.

Spiral Development

Once the strategy is in place to incrementally deliver warfighting capability, a process has to be used to develop these capabilities. The SD process is the preferred process, as identified in the current acquisition guidance. Like EA, several working definitions describe SD. Three of the more common definitions follow:

No.1

"... is an iterative set of sub-processes that may include: established performance objectives; design; code, fabricate, and integrate; experiment; test; assess operational utility; make trade-offs; and deliver. Other sub-processes may be added as needed. Spiral development characteristics include: a team of stakeholders motivated to collaborate and mitigate risk; a development plan and

FIGURE 4. Spirals Through the Increments

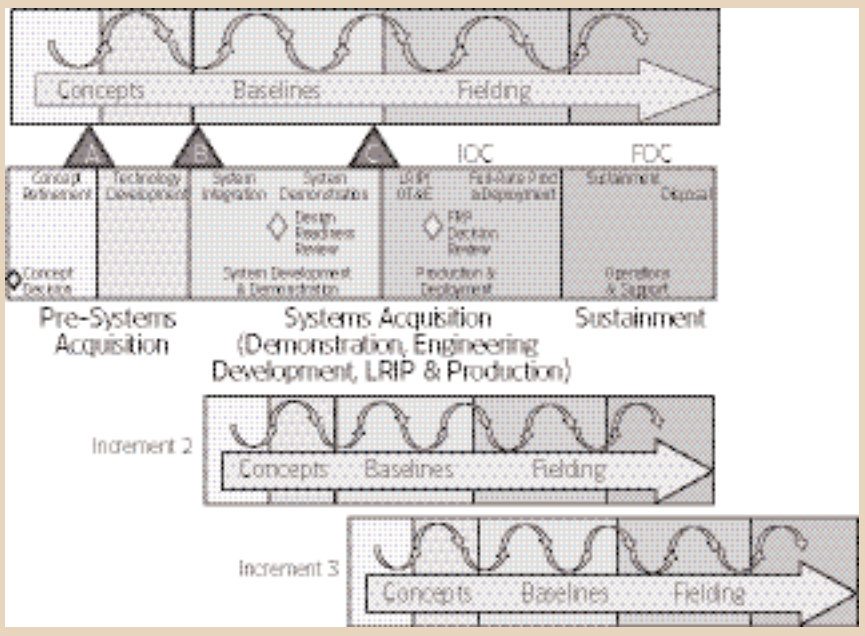
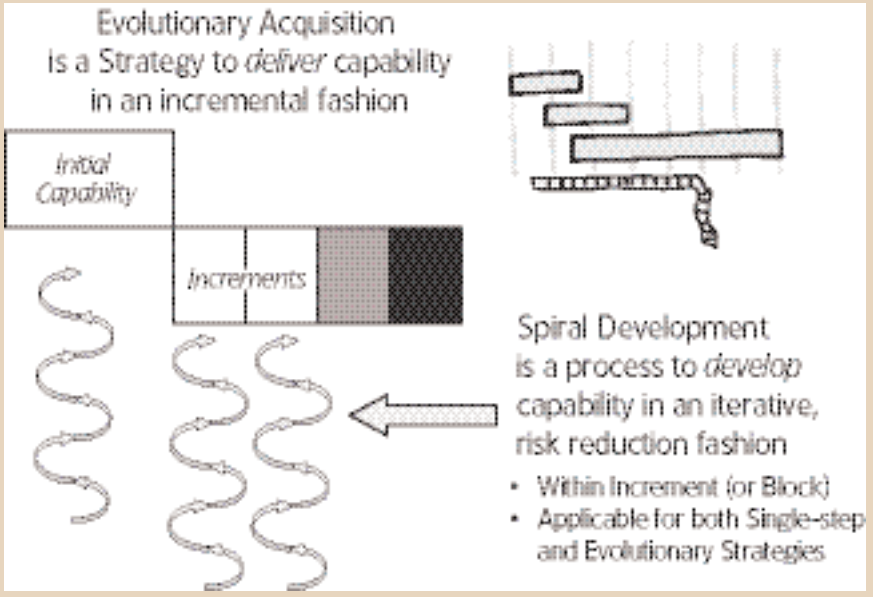


FIGURE 5. Evolutionary Acquisition with Spiral Development



decision process; a process to refine requirements; a firm schedule per increment; continued negotiation of performance and cost goals; test/experimentation; and a user decision to field, continue development, or terminate any portion of the increment." (AFI 63-123, Evolutionary Acquisition for C2 Systems, April 1, 2000.)

No.2

"... iterative process for developing a defined set of capabilities within one increment. This process provides the opportunity for interaction between the user, tester, and developer. In this process, the requirements are refined through experimentation and risk management, there is continuous feedback, and the user is provided the best possible capability within the increment. Each increment may include a number of spirals." (Memorandum from USD/AT&L to the Services, April 12, 2002.)

No.3

"In this process, a desired capability is identified, but the end-state requirements are not known at program initiation. Those requirements are refined through demonstration and risk management; there is continuous user feedback; and each increment provides the user the best possible capability. The requirements for future increments depend on feedback from users and technology maturation." (DoD Instruction 5000.2, May 12, 2003.)

Each of these three definitions describes SD as a **process**, an iterative process that includes collaboration with the stakeholders/users and continuous feedback in the decision to refine requirements to provide the best possible capability for a specific increment. Whereas EA is the strategy to deliver capability, SD is the process to develop, refine, and ready the capability for fielding.

All three of the definitions include a reference to risk or risk management. Risk is associated with all programs; identifying and managing risk is considered within the SD process. Earlier we mentioned that all programs evolve and that this evolution encompasses changes associated with threat, technology, or user needs. A level of risk is associated with each of these reasons; therefore, SD, if implemented properly, will address the risks associated with concept and technology development, baseline development, and then the fielding of systems.

A single spiral (Figure 3) will include establishing performance objectives; designing; coding, fabricating, integrating; experimenting; testing; assessing operational utility; making trade-offs; and delivering. Each spiral ends in a decision affecting the development of a concept or baseline. This decision will be to continue the spiral process toward developing a concept or baseline, baseline the requirements (if continuing from concept to baseline development), field the system (if completing baseline development), or stop the process (process not continuing toward a needed capability or capability no longer required).

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Per AFI 63-123, the spiral process would be used to develop concepts and technologies into well-defined capabilities, refine capabilities into something ready for fielding, or once fielded, for updates to existing capability.

Concept Development: "... matures new concepts, ideas, and technologies into well-defined requirements and initial capabilities. These activities may be separate from a formal acquisition program. Concepts are generated out of operational needs or deficiencies, new technology opportunities, or innovative ideas. The concept, initially a general statement of an objective or hypothesis, is matured through any mix of analysis, rapid prototyping, experimentation, simulation, battlelabs, operational evaluation, and/or exercises. The development process is managed by decisions to repeat, continue, or kill concept spirals and shall consider remaining risks, return on investment, and net benefit. Concepts are developed with operator "hands on" involvement early and often."

Baseline Development: "... begins with the requirements and capabilities developed during Concept Development and then refines, integrates, and tests them (capabilities) into a solution ready for fielding. ... These activities are part of a formal acquisition program. Acquisition organizations such as System Program Offices will normally lead, manage, and execute this activity with frequent user participation. Baseline Development must include training of an appropriate number of users in anticipation of fielding fully supportable capabilities. … Baseline Development concludes when the user accepts the results of the increment for fielding."

Fielding and Operations: "... these activities include fielding ... subsystems (systems) from Baseline Development and then operating and supporting them throughout the system's remaining life cycle. These activities are part of a formal acquisition program. An initial portion of a system normally will be fielded with only the core (initial) capabilities of the envisioned final system. Feedback from the system operators is used to improve or change upcoming increments or may alter the envisioned final state of the system."

Simultaneously, the initial and subsequent increments may be in concept and baseline development and fielding and operations. Each increment builds upon or adds to previous capabilities, progressing toward an envisioned final state of the system.

Looking at a single increment in relation to the DoD requirements and acquisition process, one can equate the concept development as that portion up to Milestone B that is essentially the pre-acquisition activity. Baseline development encompasses the activities that begin with the Milestone B decision (when an acquisition program is initiated) up through production and deployment of the capability. The fielding and operations are those activities accomplished during the sustainment phase. This is captured in Figure 4 on p. 12.

EA and SD—Different but Complementary

The DoD and Air Force guidance highlights that EA is the preferred strategy to acquire weapon systems and that spiral development is the preferred process to implement an EA strategy. Figure 5 on p. 13 represents another way of looking at how EA and SD are different yet complementary.

EA recognizes the need for future enhancements to provide capability. An EA strategy allows for the inclusion of new technology, changes in users' needs, and lessons learned as the system progresses from the initial increment through the full fielding of a system. SD is the process to reduce the various risks associated with acquisition of a weapon system beginning with initial fielding of an increment. Concept Development reduces the risk associated with concepts and technology. Baseline Development reduces risk associated with integration of technologies and preparation for production of units. Once a system is fielded and lessons learned captured from using the systems, the opportunity is there to implement improvements to the system in subsequent increments.

Editor's Note: The authors welcome questions or comments on this article. Contact Farkas at Kenneth.farkas@afit.edu or Thurston at Paul.thurston@afit.edu. For more information on EA and SD, go to the EA Community of Practice Web site at https://afkm.wpafb.af.mil/ASPs/ACQ/EntryCoP.asp?Filter=AS-01.