WHITE PAPER

Move from Insight to Action

Operationalizing Defense Reliance 21 through Science and Technology Roadmapping and the Adoption of an Industry Best-Practice Integrated Tool

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Abstract

A case for the U.S. Department of Defense (DOD) need to coordinate its long-term Science and Technology (S&T) planning through the acquisition and implementation of an industry best-practice, commercial off the shelf (COTS) enterprise S&T roadmapping capability. Implementation of this capability will allow the Defense Reliance 21 Communities of Interest to operationalize their efforts and take advantage of data analysis and visualization to assist strategic planners with making sense of the immense Defense S&T portfolio. We will describe the technology roadmapping challenges and key attributes of industry best practice tools, implications of transforming the DOD's existing Reliance 21 S&T roadmapping effort, present examples of technology roadmapping successes and failures based on current and past DOD and U.S. Government initiatives and provide recommendations to Reliance 21 leadership for implementation of an enterprise S&T roadmapping capability.

Context

A dynamic national security landscape, growing fiscal constraints, and increasing technology competition characterized by disruption and rapid diffusion create an imperative for innovation. Innovation is the key to achieving productivity and capability gains, to doing more with less, and to delivering these gains faster in order to stay ahead of any adversary. Despite the extensive use of the word in defense strategy and planning literature, meaningful and deliberate innovation in the absence of crisis is the exception. This paper summarizes our experience researching and implementing technology roadmapping processes and tools to support dynamic DOD innovation.

The DOD manages the development and acquisition of some of the most complex, exquisite systems on the planet. These systems are marvels of innovation in scientific and engineering methods. The underlying management processes and tools to execute these processes, however, have changed little since the days of Robert McNamara and are ill-suited to meeting the contextual challenges noted above.

In 1993, the concept of a Revolution in Military Affairs was introduced into the public debate. It provided a framework for prioritizing the development of future combat systems, systems that would capitalize on advances in information processing and networking. This framework served as a strategic foundation for expanding the second offset strategy of the United States, itself a response to the erosion of America's nuclear deterrent advantage (and first offset strategy) to counter greater conventional forces. The second offset strategy began with smart precision weapons and extended their employment and effectiveness in a warfare environment built on information – information in greater volume exploited across better connected entities to enhance and accelerate collaboration and decision making. The result was a competitive advantage based on the ability to deploy smaller forces with greater effect than those of our adversaries.

Global technology competition, built on information access, discovery and sharing, is more collaborative and dynamic than ever, confronting the U.S. military with the latest erosion of its competitive advantage. The Department of Defense has therefore embarked on a third offset strategy to restore and advance America's military competitive advantage, a strategy with an unambiguous emphasis on innovation.

> "...a third offset strategy will require innovative thinking, the development of new operational concepts, new ways of organizing, and long-term strategies."
>
> - Deputy Secretary of Defense Bob Work, January 28, 2015

Despite the revolution in the deployment of technology and warfighting envisioned in 1993, processes for strategic planning, decision making and execution that enabled and sustained the first two offsets remain fragmented and stove-piped, and the tools to support these processes, used by resource sponsors, requirements officers and senior decision makers in the S&T, acquisition and operational communities – tools such as email, presentation briefings, spreadsheets and disconnected data sets – do not support a successful third offset strategy. Existing processes and the means of organizing and sharing information actually inhibit innovation.

Achieving a third offset requires new tools for sharing and organizing information and for connecting the DOD workforce to accelerate and optimize decision making in the same way that warfighting advanced over the course of the revolution in military affairs. The use of industry best practice technology roadmapping tools represents a breakthrough, an upheaval, and a transformation based on collaborative, dynamic technology roadmapping tools and the means of organizing people and information; a sea-change to ***Move From Insight to Action***.

Background

The process of executing long-term technology roadmaps involves a synthesis of several heterogeneous data sets representing the status of research and acquisition programs to maintain and improve upon capabilities in the face of current and future threats based on national security objectives. In a sentence: An effective long term strategy requires knowing where you are, what you've got, where you want to go, and what it will take to get there: an S&T roadmap.

Addressing the background challenge to delivering purposeful and effective DOD enterprise S&T roadmaps includes acknowledging that the existing planning is organized around a **serial** process for generating **static** products…in a competitive environment that is **collaborative** and **dynamic**.

The Department of Defense (DOD) has taken a step in this direction with the Defense Reliance 21 initiative. This initiative is meant to establish an overarching framework of the Department's S&T joint planning and coordination process. To date the effort has created 17 S&T communities of interest (COIs) to improve collaboration, and while it has laudable goals – creating technology roadmaps to identify all existing capabilities, threats, gaps, and the ongoing/planned technology development to fill those gaps – the processes and tools used by the COIs are rooted in the serial and static. Each COI was tasked with a deadline to produce a briefing presentation based on COI working groups collecting and cataloging all national security related technology development efforts versus all gaps in what were referred to as technology roadmaps. The flow of information within each COI and its working groups tends toward the vertical with limited opportunities for dynamic interaction across COIs. The ability to conduct trade space analysis across COIs and portfolio optimization is not apparent. Despite claims that the "…role of the COI Lead is one with significant influence over technical policy and budget decisions…" it is not evident that the COIs are able to use budget formulation or budget execution information in their deliberations, or that they are able to link their roadmaps to technology development or acquisition programs in execution. Though Reliance 21 is a new way of organizing people, the tools to support these new organizations remain unchanged. Reference to the building blocks of Reliance 21 as technology roadmaps, when compared to industry best practice technology roadmapping, is a misuse of the term.

Defense Reliance 21 and the S&T Roadmapping Challenge

How does the DOD know what they need to do and when to do it, to achieve their strategic, service, program, capability and technology goals in 3 years, in 5 years or even in 20 years or beyond? Traditionally, this is done via some combination of a top-down (technology pull) and bottom-up (technology push) process. In this process, warfighters are challenged with describing the capability/technology needed to defeat future threats to the technologists and at the same time, the technologists are challenged with convincing the warfighters that they have "built a better mousetrap" to combat future threats, be they military or budgetary.

> As the Department faces a near future with fewer research and development dollars and increasing threats, it is imperative that we optimize our R&E investment across all components. We have started this process through the reintroduction of Reliance 21, a portfolio management approach to improve coordination and alignment of the R&E program with Departmental goals. The DOD is estimated to have approximately 10,000 unique science and technology projects. The Department has neither the manpower nor the resources to align these projects from 1-10,000, as required by a zero based budget[1]

[1] DoD Research and Engineering Enterprise, ASD (R&E) Strategic Guidance, 1 May, 2014.

To better achieve the goals of the Defense Reliance 21 S&T roadmapping effort, the DOD would benefit from an integrated and collaborative process that begins with a defined strategy. An evaluation of current plans and portfolios against threats and gaps must be dynamically linked to strategy.

Based on the DOD's own admission that there are over 10,000 unique S&T projects in their current portfolio, it is then imperative that the DOD confronts this as a "big data"[2] challenge. It should then formally evaluate the real need to acquire a tool that inclusively supports the methodologies, processes, data collection and visualization necessary to develop strategic roadmaps that produce integrated and actionable products that display S&T development goals over short-, medium- and long-term horizons.

We believe this construct will allow the individuals responsible for delivery of capability in their technical area to optimize their program. Each COI will report the overall state of their technical area to the S&T EXCOM annually, and approximately one-third of the COIs will deliver a detailed strategic roadmap each year, aligning their objectives to Department priorities.[3]

Even though the Reliance 21 effort has developed COI Steering Committees to oversee this tasking, the COIs will spend unnecessary time developing and updating the static strategic roadmaps that are the output of the COIs. A better, more accurate and dynamic solution would be to provide the COIs with a roadmapping tool that will allow them to concentrate on strategic portfolio decision-making and content development rather than unnecessary time building static roadmaps that do not allow for change, what-if analyses, risk and opportunity identification, etc.

Of course, long-term capabilities in support of strategic goals will vary depending on the specific military service or agency or its programs of record – for some it is near-term urgent or evolutionary priorities that take precedence and for some it is long-term revolutionary capabilities. This means identifying opportunities that DOD needs to address: capabilities needed to fill threat gaps, and the technology investments and resource planning in the present that will deliver future capabilities to support national security strategy.

This requires creating roadmaps at different layers in the Defense Reliance 21 S&T Roadmapping effort:

- PROGRAM ROADMAPS IDENTIFY POTENTIAL LONG-TERM BREAKTHROUGH OPPORTUNITIES.
- CAPABILITY ROADMAPS PROVIDE LONG-TERM DIFFERENTIATION FOR MULTI-SERVICE/AGENCY OFFERINGS.
- TECHNOLOGY ROADMAPS SUPPORT INTEGRATED PLANNING AND EXECUTION FOR THE DELIVERY OF CAPABILITIES OVER THE LONG-TERM.
- HORIZON PLANS IDENTIFY TOP-DOWN, KEY STRATEGIES AND OBJECTIVES RELATING TO AND INTEGRATED WITH KEY OPPORTUNITIES, AND EXTEND OVER THE LONG TERM.

[2] https://en.wikipedia.org/wiki/Big_data
[3] DoD Research and Engineering Enterprise, ASD (R&E) Strategic Guidance, 1 May, 2014.

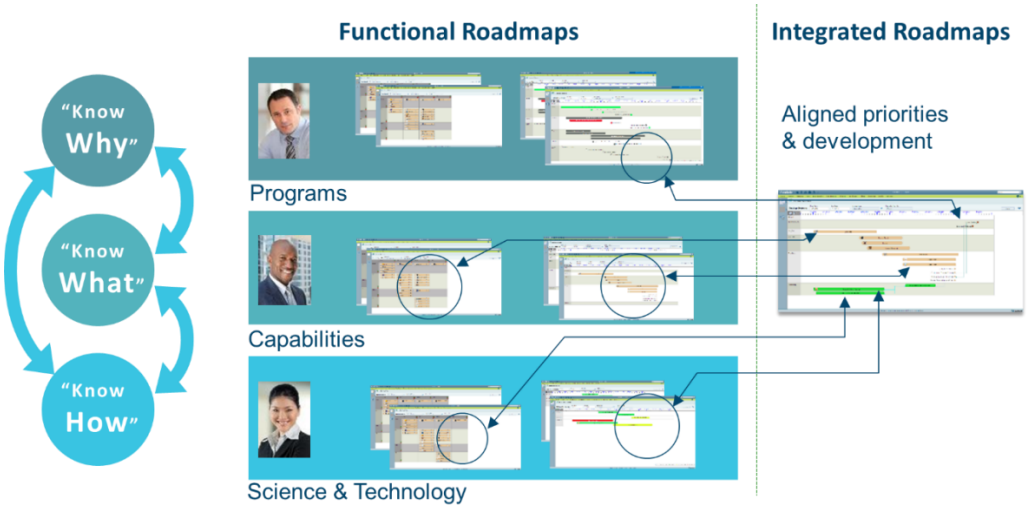

FIGURE 1. DEVELOPING A CROSS-FUNCTIONAL, INTEGRATED STRATEGY (SOPHEON CORPORATION)

This big-picture, long-term view will help DOD decision makers gain more efficient and effective understanding of DOD needs of highest-value to meet future threats to national security. Regardless of DoD's specific time horizons, its S&T roadmapping process should be informed by industry-proven best practices approach for success.

This proven roadmapping process is holistic and begins with strategy. This means identifying high priority threats that will be addressed, the capabilities needed to defeat those threats, and the technology investments needed today to achieve strategic goals.

An integrated, enterprise-level roadmapping tool is required to support this process. A tool that provides the means to develop dynamic, interlinked long-range program, capability, and technology development roadmaps. It can reduce uncertainty and risk associated with synchronizing strategic capabilities with project and program planning and execution decisions by linking and identifying capability gaps, dependencies, and redundancies, in parallel with the ability to anticipate, trace, and mitigate the impact of those risks across internal and external developments over scalable time periods, from near real time across the Future Years Defense Plan (FYDP) and beyond.

Industry best practice technology roadmapping features interactive visualizations that enhance and expand the capability of decision makers, enabling them to identify strategic gaps, zero in on the implications of investment options over time, and move quickly From Insight to Action. Standardized roadmapping language ensures that strategies are communicated clearly and consistently throughout the DOD.

An integrated roadmapping solution streamlines and automates data in real-time, enabling cross-functional teams to collaborate in a roadmapping process that featuring the sharing of secure planning and execution information with stakeholders to ensure strategic alignment, and to support more open and collaborative innovation.

The DOD can realize these key benefits by acquiring and implementing the use of an enterprise roadmapping tool that:

- ACHIEVES WIDER ADOPTION OF STRATEGIC PLANNING AND ROADMAPPING PROCESSES
- ENSURES THAT NEAR-TERM CAPABILITY AND TECHNOLOGY INVESTMENTS ALSO SUPPORT LONG-TERM NEEDS.
- MORE ACCURATELY FORECASTS THE FUTURE OF CURRENT AND PLANNED PURSUITS.
- CONFIDENTLY INVESTS IN THE RIGHT OPPORTUNITIES, CAPABILITIES AND TECHNOLOGIES TO SUSTAIN AND GROW DEFENSE CAPABILITIES OVER THE LONG TERM.

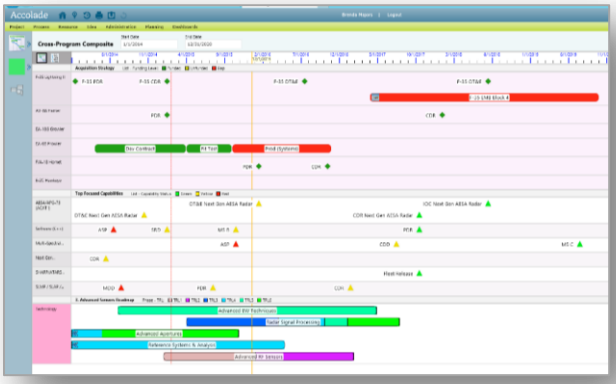

FIGURE 2. GRAPHICAL ROADMAP VISUALIZATIONS ENABLE UNDERSTANDING AND MANIPULATION OF THE LINKAGES AND DEPENDENCIES BETWEEN PROGRAMS, CAPABILITIES, AND TECHNOLOGY PLANS. (SOPHEON CORPORATION - ACCOLADE ROADMAPPING)

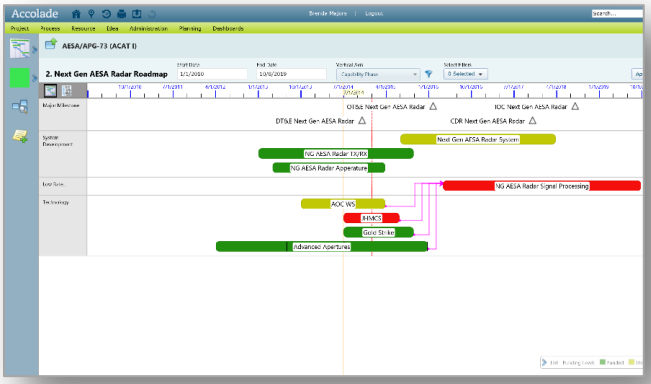

FIGURE 3. RELATIONSHIPS AND CATEGORIZATION OF PLANS AND PROJECTS ARE INTUITIVELY ESTABLISHED, MAINTAINED AND VIEWED USING FLEXIBLE GRID VIEW GRAPHICAL DATA REPRESENTATIONS. (SOPHEON CORPORATION - ACCOLADE ROADMAPPING)

An enterprise technology roadmapping tool has the potential to revolutionize the Reliance 21 assessment process and to further enhance the integration of DOD budget formulation, execution and strategic planning. The dynamic capabilities of a best practice roadmapping tool provides DOD decision makers with the ability to make better informed decisions in less time, and to communicate those decisions throughout better connected and synchronized S&T communities, both vertically and horizontally. A genuine enterprise technology roadmapping capability accomplishes the following:

- ENSURES ALIGNMENT BETWEEN INNOVATION STRATEGIES AND OPERATIONAL ACTIVITIES, WITH IMPROVED LINES-OF-SIGHT TO IDENTIFY GAPS THAT MUST BE CLOSED.
- INCREASES INPUT, COLLABORATION AND BUY-IN FROM CROSS-FUNCTIONAL SERVICE LEADERSHIP, WHILE REDUCING THE DISRUPTION TO THOSE THAT PROVIDE INPUT TO PLANS.
- ENABLES RELEVANT STAKEHOLDER'S VIRTUAL PARTICIPATION IN THE ROADMAPPING PROCESS, RESULTING IN CLEAR AND REALISTIC PLANS THAT EVERYONE UNDERSTANDS.
- ENABLES EASILY UPDATED DYNAMIC TECHNOLOGY ROADMAPS FOR RAPID AND APPROPRIATE RESPONSES TO CHANGING CONDITIONS OR UNFORESEEN THREATS.

Implementing a department-level, dynamic and integrated technology roadmapping capability will enable the DOD to operate more efficiently, affordably, and to better align its strategic planning with mission execution. The implementation of an integrated enterprise technology roadmapping capability will accomplish four goals:

- MAXIMIZE THE VALUE OF THE TECHNOLOGY DEVELOPMENT PORTFOLIO IN DELIVERING WARFIGHTING CAPABILITIES TO THE DOD.
- ESTABLISH CROSS-DOMAIN BALANCE AMONG S&T/R&D PROJECTS AND PROGRAMS.
- PRIORITIZE TECHNOLOGY DEVELOPMENT INITIATIVES TO ENSURE RESOURCES ARE ALLOCATED TO RIGHT-TIMED CAPABILITY/PROGRAM INSERTION POINTS IN SUPPORT OF THE DOD MISSION.
- ENSURE THE DOD RDT&E PORTFOLIO IS STRATEGICALLY ALIGNED.

A fully implemented technology roadmapping process along with adoption of an industry-leading technology roadmapping tool will allow the DOD to connect its long-term strategy with near-term technology development investments. Developing this enterprise capability – expressed in linked terms of present forces, threats, technology trends, requirements and capabilities – is critical in implementing an effective process that binds strategy to execution. In order to be effective, an enterprise technology roadmapping capability should possess the following attributes:

- HIGH QUALITY, CROSS-FUNCTIONAL, REAL-TIME DATA
- POWERFUL VISUALIZATION
- EFFICIENT EXPLORATION
- ALTERNATE SCENARIO DEVELOPMENT
- RESOURCING-EXECUTION LINKAGES

An enterprise technology roadmapping capability will improve strategic technology development planning by supporting the following functions:

- PRODUCTION OF INTEGRATED TECHNOLOGY (I.E., CAPABILITY) ROADMAPS
- PORTFOLIO OPTIMIZATION
- ANALYTICS
- RESOURCE PLANNING
- STRATEGIC PLANNING

Examples…Good and Bad

Enterprise technology roadmapping capabilities have begun to appear in multiple organizations and services within DOD, other government agencies, and industry. These efforts traditionally appeared as a result of innovative managers realizing the need for the capabilities described above due to the ever-increasing complexity of their S&T, R&D and acquisition programs.

A current example of an initial COTS enterprise technology roadmapping capability involves the effort in progress within Team Submarine program offices by the U.S. Navy's Under Sea Warfare Chief Technology Office (USW CTO). Over the last two years, USW CTO has conducted capability roadmapping workshops with five Team Submarine program offices, producing twenty preliminary program-level roadmaps. These program offices, along with other programs and organizations that have been briefed on USW CTO efforts have expressed interest in adopting the USW CTO process and roadmapping capability. Upon completing the acquisition of a supporting enterprise technology roadmapping tool, the data will be imported to a COTS best practice tool suite to create a capability baseline within USW CTO's roadmapping environment.

Another example, albeit more inclusive than only technology roadmapping, involves a NASA Marshall Space Flight Center (MSFC) Governance & Mission Alignment Office initiative, in which MSFC has successfully implemented enterprise innovation processes and tools, institutionalizing a more disciplined and automated management methodology that improves decision making, significantly lowers costs, and avoids rework. MSFC leadership, commitment and clear communication served to help the workforce understand the value of the process and tools, whereby innovation became a team sport oriented toward greater enterprise efficiency and effectiveness. Their program and business data management processes, which in the past were estimated to be 10% automated and 90% manual entry and manipulation, have inverted such that presently 90% of the process is supported by automation with 10% requiring manual entry and manipulation. For this accomplishment, the NASA MSFC implementation team won one of the first ever NASA MSFC Innovation awards given by MSFC Office of Chief Technologist.

Although these examples resulted from grass-roots, bottom-up approaches to implementing these processes and tools, realizing the true power of an enterprise-level capability requires the commitment of leadership at the highest levels, and an implementation plan that acknowledges resistance to exposing investment redundancies and gaps, while incrementally delivering the greater benefits of a dynamic enterprise innovation management environment – a championed approach.

A recent example of a government grass-roots effort failing due to the inability to gain leadership buy-in was displayed in the atrophy of a five-year effort embarked upon by the F-35 Joint Strike Fighter Science & Technology Team. Initially, the

innovative thinking by the Science and Technology Team Lead led to the acquisition and implementation of a of an industry-leading technology roadmapping tool that allowed the team to map S&T projects from the platform level to component level. The initiative was extremely successful at attaining the goals that were defined at the beginning of the initiative and the team proposed this as a capability that the U.S. Air Force Fighter Bomber Capability Planning Division should consider procuring for enterprise-wide implementation. Over time, personnel that initiated this grass-roots effort moved on to other positions. Due to the loss of legacy knowledge and support and current defense budget challenges, coupled with a new team that failed to articulate the case to leadership, the funding identified to continue this initiative ws withdrawn and the effort was canceled late in 2015. In our research, we identified the Naval Air Systems Command experiencing very similar results as far back as 2009.

These two previous examples not only highlight the complexity of acquiring industry leading tools to assist the DOD with its myriad technology development challenges, but detailed inquiry further revealed the complexity that is caused by numerous interrelated factors such as technology portfolio size and diversity, multi-organizational and Service communication challenges, contracting and information technology acquisition process complexity, and lack of leadership's understanding of the benefits to their organization due to poor communication by the champions of the initiatives.

Recommendation

Integrated technology roadmapping at the enterprise level will allow leadership to harnesses information in greater volume across better connected entities (people, organizations, data sets) to enhance and accelerate collaboration, strategic planning, and decision making. It transforms existing static technology development planning processes that use snap-shot roadmap representations that are frequently only as deep as a presentation slide deck backed up by short shelf life spreadsheets.

To be effective at senior decision making levels, the technology roadmapping processes and tools must manifest in a dynamic, collaborative enterprise information environment, the foundation for cataloging threats, capabilities (existing, under development, and planned), gaps and redundancies. Industry innovation management best practice is a proven solution for optimizing research and acquisition investment decisions across global organizations. It supports strategic planning and execution across near-, mid- and long-range horizons, at the DOD, military service, system, and sub-system levels.

The DOD can no longer afford to wait for a crisis to spur innovation. Absent meaningful, deliberate innovation and the high likelihood of further cuts in its top-line budget, the DOD faces the prospect not of doing more with less, but of doing less with less. Implementing an integrated, enterprise-level technology roadmapping capability presents an opportunity for technology development strategists to lead with actions that revolutionize strategic planning and achieve a break-through using new measures, methods and processes.

This approach is no easy-button and requires the commitment of leadership at the highest levels. Holistic implementation across an enterprise requires an appropriate starting point such as the Reliance 21 Communities of Interest, and ultimately long-haul commitment for scaling across every level of the DOD acquisition workforce: new tools to leverage the existing enterprise information infrastructure, and workforce training and certification akin to the Defense Acquisition Workforce Improvement Act.

To further inform the DOD's consideration of enterprise technology roadmapping as a means of revolutionizing technology planning, it is recommended that the next step involve a pilot project, a proof of concept for implementing enterprise-level functionality centered in an existing technology assessment process. Alternatively, a pilot project would involve a planned or newly forming single acquisition program, with implementation built out horizontally across the program's critical S&T nodes, and vertically to connect decision makers at the highest levels, through the program office

and down to operational end-users: an enterprise-enabled community of interest organized around technology development and capability delivery.

The technology roadmapping pilot would demonstrate eight key performance parameters that increase the effectiveness of strategic planning products and advanced capability development at lower cost through sustainable innovation, while driving significantly higher technology transition to acquisition programs of record and ultimately to warfighters. These requirements are:

- Provide an integrated platform for the DOD technology development initiatives and opportunities with dynamic links between the strategic plan, the acquisition programs and the enabling S&T/R&D.
- Support technology development from planning to decision making.
- Provide a knowledge base for enhancing organizational agility and the speed and quality of decision making.
- The ability to scale as demand for the technology roadmapping capability increases.
- Provide a framework for new program concept development.
- Provide capability requiring that supports training provided through the Defense Acquisition University's Program Management curriculum.
- Co-exist with current DOD and Service-level business software systems, such as Enterprise Resource Planning (ERP) Systems, Microsoft Office Suite, etc.
- Implementation guided by an entity that understands the DOD technology development processes and the acquisition lifecycle.

Key elements of a pilot implementation include:

- Scope assessment
- Tool/functionality demonstration and selection
- DOD IT acquisition approvals
- Installation and certification/accreditation
- Information assurance testing
- Operator training
- Customization based on user roles and responsibilities
- Assessment of enterprise technology roadmapping capability by users
- Follow-on phase recommendation based on user assessments