Balancing Switching Costs and Opportunity Costs: Market-Based Architectures for Defense Acquisition

Motivating a New Approach: The crescending of "Software-Defined Warfare" has re-ignited the debate on the fundamental design trades needed to meet evolving mission needs, including the value of "Owning the Technical Baseline" (OTB) and a modular open systems approach (MOSA).

MOSA aims to accelerate the development and deployment of capabilities within defense acquisition programs. This is accomplished by strategically decomposing systems into critical functions, each with standardized interfaces and designed for open communication with other modules. In theory, this modular approach reduces complexity, leading to greater competition among capability providers and to shorter upgrade cycles.

However, several challenges have limited the full realization of MOSA's potential. To fully capitalize on its benefits, significant upfront time and resource investment is required to accurately define the system architecture. The magnitude of this investment is primarily driven by overly prescriptive definitions of system components, rigid enforcement of data standards, and the complexities of verifying "openness" and interoperability across various system elements.

External factors are prompting a reassessment of MOSA principles, or at least a reconsideration of the default assumptions and methodologies. The nature and set of feasible solutions in the optimization between often competing attributes, like speed and modularity, has fundamentally changed due to the rise of a venture-backed commercial industrial base and availability of commercial and/or Non-Developmental Items (NDI) with relevance to defense missions.

The rise of commercial and NDI, coupled with the accelerated pace of change in available solutions (supply) and emerging challenges (demand), motivates a new approach for market-based architectures and design considerations.

This approach aims to build upon the principles of OTB and MOSA while accounting for shifts in the distribution of technology sourcing and refresh rates. An optimized approach will enable broader competition, accessibility to dynamic responses to evolving demands, and ensure users have access to the best possible capabilities now and in the future.

Solutions require a shift from traditional metrics of Cost, Single-Pass Schedule, and Performance to include Switching Costs and Opportunity Costs for continuously evolving system solutions. Switching Costs represent the impacts across all funding,

Key Questions

- How can DoD leverage market-based architectures to address the accelerating pace of technological innovation and evolving mission complexity with immediate capability and continuous tech refresh?
- What architectural principles are necessary to ensure adaptability, interoperability, and mission effectiveness in defense systems?
- How can DoD foster collaboration with industry and leverage competition to drive innovation while safeguarding mission-critical commercial capabilities?

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time, risk, and other second-order effects (interoperability, certification, training, etc.) associated with transitioning from one solution to another with better or equivalent performance at reduced cost.

Opportunity Costs can arise from developing overly conservative architectures to hedge against an uncertain future. These costs include both the upfront investment—cost and schedule—required to deliver an enabling architecture that might not otherwise be necessary, and potential loss in value from excluding a solution that does not conform to that architecture.

To address the limitations of traditional approaches, the DoD must adopt new architectural principles that balance adaptability, interoperability, and mission effectiveness. These principles include:

Open Access to Federated Data. Data discoverability and accessibility are critical for reducing switching costs and enabling seamless integration of modular solutions. DoD's 2021 "Data Decrees" outlined foundational requirements for data management, including maximizing data sharing, publishing assets in a federated catalog, and using industry-standard interfaces. However, implementation remains incomplete, with data siloed in inaccessible repositories and lacking centralized infrastructure for discovery and access management.

To overcome these barriers, the DoD must enforce the Data Decrees, establish an authoritative catalog of data and interfaces, invest to crack open existing systems, and implement enterprise-wide authentication and authorization systems. Contract clauses can mandate compliance with these standards, ensuring that data incorporated into solutions is universally accessible through open interfaces. By leveling the playing field for solution developers, this approach fosters competition based on capability rather than exclusive access to government-owned data.

Defining Modular Boundaries. Effective MOSA implementation requires careful design of modular boundaries to align mission outcomes with market dynamics. Smaller modules encourage competition and iterative development but must not exclude commercial solutions. Modular boundaries should focus on areas where frequent commercially available upgrades are expected while addressing gaps requiring purpose-built development.

Market research is essential to identify competitive landscapes, existing solutions, and areas needing investment. Modular boundaries should be regularly revisited to ensure adaptability to evolving mission needs. Open interfaces at all boundaries are critical for interoperability, enabling "plug-and-play" capabilities and reducing switching costs. By fostering collaboration between government and industry, modular boundaries can evolve organically to deliver mission-critical performance.

Measures of Effectiveness (MOEs) as Decision Drivers. Design and acquisition decisions must prioritize Measures of Effectiveness (MOEs) over Measures of Performance (MOPs). While MOPs evaluate technical specifications, MOEs assess how effectively a system achieves mission objectives. Anchoring decisions in mission outcomes such as speed to field ensures investments align with operational needs while not prescribing technical solutions or biasing against new approaches. MOEs should guide progress assessment, architecture design, and acquisition priorities, enabling deliberate trade-offs between switching costs and opportunity costs. Solutions that deviate from initial modular architectures should be evaluated based on performance gains and timeliness versus the potential loss of modularity. By focusing on mission effectiveness, programs can develop architectures that balance immediate needs with long-term adaptability.

Balancing Intellectual Property Rights and Sourcing for Best-in-Class Capabilities. Achieving best-in-class capabilities requires a strategic balance between intellectual property (IP) rights and MOE-guided sourcing decisions. This approach ensures solutions are mission-effective and adaptable to evolving operational needs and technological advancements.

To maintain flexibility, acquisition decisions should avoid over-constraining based on IP rights. Assume Government Purpose Rights (GPR) are not required for most solutions, except in cases where the absence of GPR would significantly increase switching costs or where the functions are mission-critical with limited existing market competition. Defaulting to non-GPR except in specific edge cases prevents unnecessary restrictions while safeguarding critical functions requiring stability and protection due to their operational importance or a lack of competitive alternatives.

Government solutions, whether government off-the-shelf or GPR-based, should be continuously assessed to identify and fund opportunities to enhance government capabilities with innovative commercial

solutions. This proactive approach ensures government systems remain competitive, technologically relevant, and aligned with the latest advancements.

The nature of needs and capabilities changes over time, based largely on new threats and the state of market competition. Leveraging MOEs as the guiding metric ensures upgrades are driven by mission effectiveness rather than technical specifications alone, optimizing performance while maintaining adaptability.

By balancing IP rights considerations with sourcing flexibility, and leveraging MOEs to drive decisions, programs can create architectures that are both resilient and responsive. This strategy enables the integration of cutting-edge commercial solutions while protecting critical functions, ensuring systems remain mission-effective.

Summary

The accelerating pace of available solution options and the evolving complexity of mission challenges necessitate a fundamental shift in how defense architectures are designed, acquisitions are executed, and capabilities are sourced, utilizing a more adaptive and nuanced framework. Building on OTB and MOSA, future systems must be designed for continuous modification, emphasizing speed, modularity, and open-system architectures for rapid upgrades and seamless technology integration. The increasing prevalence of Commercial and Non-Developmental Items (NDI) requires a shift from traditional metrics to include Switching Costs and Opportunity Costs as critical factors in decision-making.

To meet these demands, architectures must embrace open interfaces, modularity, and federated data access to reduce switching costs and foster interoperability. Acquisition strategies should minimize opportunity costs by enabling a diverse range of solutions (including proprietary and commercial off-the shelf options) to compete effectively. By defaulting to non-Government Purpose Rights programs can preserve flexibility while safeguarding essential functions. The integration of commercial solutions and continuous enhancement of government systems must be driven by market competition and mission effectiveness, ensuring capabilities remain relevant and aligned with the latest advancements.

Success of future architectures hinges on the ability to dynamically respond to mission demands. By embedding Measures of Effectiveness and including speed-to-field as an MOE into every aspect of design and acquisition, fostering collaboration between government and industry, and embracing competition as a catalyst for innovation, the Department of Defense can create resilient, adaptable, and mission-effective systems. This strategy ensures warfighters are equipped with the best capabilities—both today and in the future—while maintaining the agility to pivot as challenges and technologies evolve.

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