SYM-AM-25-370

Excerpt from the Proceedings

of the

Twenty-Second Annual Acquisition Research Symposium and Innovation Summit

Volume III

Employing a Variable, Portfolio Contract Model to Accelerate Innovation Incorporation, Enhance Operational Sustainability, and Reduce Supply Risk in the Procurement Process

Published: May 5, 2025

The research presented in this report was supported by the Acquisition Research Program at the Naval Postgraduate School.

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Employing a Variable, Portfolio Contract Model to Accelerate Innovation Incorporation, Enhance Operational Sustainability, and Reduce Supply Risk in the Procurement Process

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Abstract

This paper focuses on providing solutions to two problems plaguing federal acquisition processes: (1) limited ability to rapidly incorporate innovation into contracted procurement and (2) supply risk associated with high-volume quantity contracts that engage individual contractors. The author proposes solutions which are designed to resolve these problems, which include (a) capability requirement documents written to increase design flexibility and uniformity in operations and maintenance, and (b) a variable, portfolio contract model which simultaneously engages multiple contractors—to increase overall contract production capacity and reduce supply risk—and is able to change the quantity demanded from each contractor ("market share"), based on innovative improvements to cost, schedule, and/or performance. The contract model is applied to a high-end, near-peer, maritime competitive environment, requiring high-volume procurement. An evaluation of the contract model, consisting of 120 individual simulations, demonstrated (i) increased contract production capacity, (ii) consistent increase in procurement quantity demanded from innovative contractors, and (iii) increased product performance rating—which translates to a higher quality capability delivered to Warfighters. The paper concludes with a recommendation to implement a variable, portfolio contract to ensure timely, risk-mitigated delivery of high-volume, high attrition capability for the future, maritime fight.

[T]he security environment is rapidly evolving, and the current PPBE process is not capable of responding as quickly and effectively as needed to support today's warfighter. The Department of Defense (DoD) needs a new process, one that enables strategy to drive resource allocation in a more rigorous, joint, and analytically informed way. The new process should also embrace changes that enable the DoD to respond effectively to emerging threats while leveraging technological advances.
(Commission on PPBE Reform, 2024)

Background and Problem Statement

Background

Historically, defense acquisition has struggled with the adoption of and incorporation of innovative technologies—focused on improving the cost, schedule, and performance of acquisition programs—into materiel capabilities. This is due, in part, to the reliable but rigid nature of the Big "A" process.

Efforts to inject agility and adaptability into the process resulted in the development of the Adaptive Acquisition Framework (AAF), which provides multiple, tailored avenues for acquisition.

Despite the flexibility the AAF provides, one barrier to innovation remains. Once a contract is awarded, there is no incentive for contractors to innovate. This occurs because contractors develop and manufacture based on the Government's requirements. Overly prescriptive requirements documents define capabilities in a way that forces contractors to build systems that "are exactly this thing," as opposed to "a thing that is capable of accomplishing minimum operating requirements." Further, because the contract exists exclusively between the contractor and the Government, the element of competition—a key driver of innovation—is eliminated.

For certain acquisition programs—like aircraft carriers, submarines, and advanced aircraft—intra-contract competition may not be a factor. These programs produce relatively low numbers of systems, procured at higher costs, over long periods of time. However, for higher volume acquisition programs—like munitions or unmanned sensor platforms supporting hybrid fleet, maritime domain awareness—the ability to quantify the value of innovation, incorporate the innovation into a contracted capability, and reward a contractor for their investment would be invaluable in the quest to get the best equipment into the Warfighters' hands.

Another aspect of this discussion is the management of risk. Specifically, the focus is on supply risk and its impact to mission risk. In his 2003 *Journal of Purchasing and Supply Management* article, George Zsidisin defines supply risk as the "probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety," (Zsidisin, 2003).

Supply chain disruptions observed during the COVID-19 pandemic demonstrated the vulnerability of production processes. In order for the Government to appropriately manage mission risk through supply risk mitigations—specifically for high volume acquisitions—it must employ contracts that can ensure the production capacity necessary to fulfill required operational capabilities <u>and</u> maintain surge capacity in reserve.

The center of gravity for injecting innovation and effectively managing risk is the relationship between the Government and contractors, which takes place in the form of a contract. As such, the Government must leverage the contract as a tool to incentivize innovation and reduce risk to acceptable levels.

Problem Statement

The following is a list of problems that drive the efforts of this research:

1. **Current conditions disincentivize innovation:** Under the current system, the Government bears the burden of creating the conditions that facilitate and enable innovation, including writing contracts that compensate contractors for their research and development expense. This runs contrary to private industry, in which competition forces you to innovate or die. The Government must employ contracting methods that place this burden squarely on the contractors and rewards the results of innovation—as opposed to compensating the effort.
2. **Overly prescriptive requirements inhibit innovation and adaptation:** The way requirements documents are written can either enable or hinder the ability for contractors to innovate during the term of the contract. Overly prescriptive requirements ("build this exact thing") inhibit innovation. The Government must write requirements in a way that establish minimum operating requirements <u>and</u> allow contractors the flexibility to "solve the problem" in their own way.
3. **Managing supply risk manages mission risk:** For acquisition programs that provide high volume materiel capability contracts, engaging with individual contractors increases supply risk. Since supply risk influences mission readiness, reductions to supply risk—via increasing the number of contractors engaged—translate into reductions to mission risk.

Scope and Goals

Scope

The scope of this research focuses on the development of contracting practices which incorporate competition as a driver of innovation, relies on capabilities requirements that do not inhibit innovation, and effectively reduce supply and subsequently mission risk.

Goals

To accomplish this, the following goals are established to drive research efforts:

1. **Research Goal 1:** Understand the current capabilities and limitations of Government contracting with regard to innovation generation
2. **Solution Goal 1:** Develop solutions which place the impetus of cost, schedule, and performance innovations in the hands of contractors
3. **Research Goal 2:** Understand the fundamentals of requirements documents and how these documents can either enable or hinder innovation
4. **Solution Goal 2:** Provide recommendations for writing requirements documents that enable innovation
5. **Research Goal 3:** Identify instances in which private industry has employed portfolio contracting and determine the resultant levels of success/failure
6. **Concept Goal 1:** Use knowledge gained from research to develop a contract model that achieves the aim of Solution Goal 1 and test the model under a range of scenarios
   a. **Contract model characteristics:**
      i. Able to engage multiple contractors (portfolio contract)
      ii. Able to rate individual contractor's proficiency in managing cost, schedule, and performance against all contractors engaged
      iii. Able to reward contractors who innovate by increasing the quantity of supply demanded (modifying the terms of the contract)—at the expense of the competing contractors
7. **Analysis Goal 1:** Analyze the results of model testing to assess the theoretical viability of the contract concept

Summary of Literature Review

The review of literature pertaining to the research goals was focused on three main areas: feasibility of employing a portfolio contract, requirements documents as adaptation-enablers, and identify instances in which private industry has employed portfolio contracts and the degree of success or failure experienced.

This section concludes with a discussion on concerns regarding the implementation of a portfolio contract.

Contracts

Federal Acquisition Regulations

The following summarizes research into the Federal Acquisition Regulations (FAR) focused on determining (1) if current regulations support a single contract engaging multiple contractors and (2) whether the mechanisms exist to alter the conditions of a contract during the term of engagement.

Indefinite-delivery contracts are contracts for supplies that do not procure or specify a firm quantity of supplies (other than a minimum or maximum quantity) and that provide for the issuance of orders for the delivery of supplies during the period of the contract. Essentially, they provide the Government with flexibility to increase/decrease demanded quantity supplied by the contract, based on changing operational conditions. This is beneficial for high volume acquisition programs (FAR 16.5, 2025).

Subordinate to indefinite-delivery contracts are two, applicable subgroups. The first, requirements contracts, provide for filling all actual purchase requirements of designated government activities for supplies or services during a specified contract period, with deliveries or performance to be scheduled by placing orders with the contractor. A critical caveat for requirements contracts states that "no requirements contract in an amount estimated to exceed $100 million (including all options) may be awarded to a single source unless a determination s executed in accordance with 16.504(c)(1)(ii)(D)," (FAR 16.503, 2025).

The second, indefinite-quantity contracts, provide for an indefinite quantity, within stated limits, or supplies or services during a fixed period. Quantity may be stated as number of units or as dollar values. Additionally, a subcomponent of indefinite-quantity contracts is the multiple award preference, which directs contracting officers to give preference to making multiple awards of indefinite-quantity contracts under single solicitation for the same or similar supplies to two or more sources, to the maximum extent possible (FAR 16.504, 2025).

Contract structure, as a limitation to building a portfolio contract, is addressed by the uniform contract format. Its core components: schedule, contract clauses, list of documents, and representations & instructions all provide the foundation on which to build a functional, portfolio contract (FAR 15.204, 2025).

The ability to alter the conditions of the contract—to reward an innovating contractor—exists in the form of contract modifications. Specifically, bilateral contract modifications provide the mechanism for contracting officers to structure contracts to be adaptable to contractors' innovations resulting in improvements in cost, schedule, and performance and to reward them with increased "market share" (FAR 43, 2025).

Vital to contract modification is the Government's responsibility to notify contractors of any changes to the conditions of the contract. Notification of contract changes allow contractors—when they consider that the Government has effected or may effect a change in the contract that has not been identified as such in writing and signed by the contracting officer—to notify the Government, in writing and as soon as possible, to permit evaluation of the alleged change (FAR 43.104, 2025).

Finally, contract clauses are available for use primarily in negotiated research and development or supply contracts for the acquisition of major weapon systems or principal subsystems. Further, they are used when the contracting officer anticipates that situations will arise that may result in a contractor alleging that the Government has effected changes other than those identified as such in writing and signed by the contracting officer (FAR 52.243, 2025).

In summary, the FAR currently contains the components to accomplish the aims of Concept Goal 1. The results of the research revealed that there is currently no way to engage multiple contractors on the same contract—or a portfolio contract. However, the FAR contains components which, if reconfigured, would support the implementation of a functional portfolio contract.

Separately, the research revealed that the ability to alter the terms of contracts currently exists. However, the intent of this ability is focused on being prepared to alter the contract in response to changes in supply/service demand or extraordinary contractual relief. This runs contrary to the intent of this project: designing a contracting model that can incorporate innovation and reward contractors that outcompete other contractors by investing in product improvement.

Requirements Documents

Manual for the Operation of the Joint Capabilities Integration and Development System

The following summarizes research into the manual for the operation of the Joint Capabilities Integration and Development System (JCIDS) and capabilities requirement document fundamentals. The focus of this research was to (1) understand the fundamentals of requirements documents and (2) determine how these documents can either enable or hinder innovation.

JCIDS operates through organizational structure and provides baseline for documentation, review, and validation of capability requirements across the Department of Defense (DoD). Validated JCIDS documents facilitate doctrine, organization, training, materiel, leadership, personnel, facility, and policy (DOTmLPF-P) changes, guide the AAF pathways, and inform planning, programming, budgeting, and execution (PPBE) processes.

Once validated, regardless of validation authority, Sponsors upload final versions of JCIDS documents and their associated memoranda into the knowledge management / decision support (KM/DS) system. This is done for archiving purposes and for visibility in the capability portfolios (Joint Chiefs of Staff [JCS], 2021).

Regarding science and technology (S&T) and innovative approaches, once proven at the appropriate technology level and S&T effort, prototype, and/or other innovative approach must align with existing capability requirements (which is the case for this research), or be supported by an analysis that makes a defendable case for a new capability.

There are two main entry points into JCIDS for S&T and innovative approaches. For evolutionary technologies that support an expeditious deployment of successful weapon system component or technology prototypes in accordance with Title 10, U.S. Code, Section 2447d, JCIDS is flexible enough to consider entry at Milestone B with a new or updated capability development document (CDD) provided there is traceability to a validated capability requirement (joint or DoD component urgent or emergent operational need, or initial capabilities document).

For disruptive, game changing technologies, such as those concepts that would be generated from the National Defense Strategy (i.e., robotics and system autonomy, miniaturization, big data, human-machine collaboration, development of new Joint Operating Concepts, etc.), there is a requirement (concept, threat informed) for the Warfighter community to determine whether it changes their CONOPS. If it does, then the appropriate entry point would be an updated capabilities based assessment (CBA) to determine what new set of missions/task/capabilities are required to fulfill a new or existing capability gap (JCS, 2021).

Consolidated Requirements Document for Search-Based Unmanned Underwater Vehicles in Support of Expeditionary Operations

Pivoting to a specific requirements document, the Consolidate Requirements Document (CRD) for Search-Based Unmanned Underwater Vehicles (UUV) in Support of Expeditionary Operations provides a comprehensive explanation of requirements for the development, production, employment, and maintenance of UUVs. A thorough review of the document revealed six key components that drive the development of capabilities and determine the degree of flexibility that contractors have, in terms of innovation.

Joint capability areas are collections of like DoD capabilities functionally grouped to support capability analysis, strategy development, investment decision making, capability portfolio management, and capabilities-based force development and operational planning. They provide a common capabilities language for use across the activities and processes of the DoD.

Tier 1	Tier 2
Joint/Maritime/Littoral Operations	Undersea Warfare
	Maritime/Littoral Expeditionary Operations
Joint Access & Access Denial Operations	Forcible Entry
	Sea Lines of Communication (SLOC) protection
	Freedom of Navigation
Stability Operations; Military Support for Stability, Security, Transition, and Reconstruction (SSTR)	Security
Joint Special Operations & Irregular Warfare	Special Reconnaissance
	Unconventional Warfare
Joint Homeland Defense	Maritime Defense
	Critical Infrastructure Protection

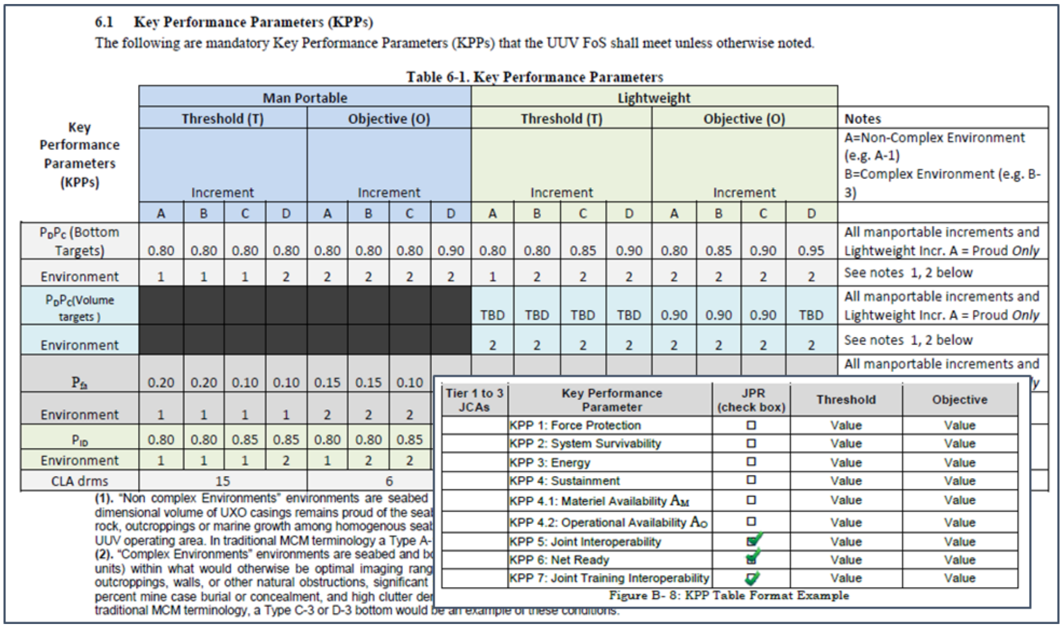
Figure 1. Search-Based UUV in Support of Expeditionary Operations—Joint Capabilities Areas

The family of systems (FoS) concept describes multiple system that are similar enough to be developed in support of fulfilling an operational capability gap. System(s) can be developed by a single contractor or by multiple contractors, designing to common operational requirements. This facilitates configuration control and consistency in operations and maintenance.

The threat summary describes the potential operational conditions the system can reasonably be expected to encounter, which translates into risk to mission and force. This summary drives the risk mitigations that must be considered for incorporation into system design.

The program summary describes the conceptual architecture of program management. This includes key operational system attributes and program intent for the evolution of the system, informing efforts to balance cost, schedule, and performance constraints.

Key performance parameters (KPP) establish the key aspects of performance that determine the overall operational effectiveness of the system.



6.1 Key Performance Parameters (KPPs)

The following are mandatory Key Performance Parameters (KPPs) that the UUV FoS shall meet unless otherwise noted.

Table 6-1. Key Performance Parameters

Key Performance Parameters (KPPs)	Man Portable								Lightweight								Notes
	Threshold (T)				Objective (O)				Threshold (T)				Objective (O)				A=Non-Complex Environment (e.g. A-1) B=Complex Environment (e.g. B-3)
	Increment				Increment				Increment				Increment				
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	
$P_D P_C$ (Bottom Targets)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.90	0.80	0.80	0.85	0.90	0.80	0.85	0.90	0.95	All manportable increments and Lightweight Incr. A = Proud *Only*
Environment	1	1	1	2	2	2	2	2	1	2	2	2	2	2	2	2	See notes 1, 2 below
$P_D P_C$ (Volume targets)									TBD	TBD	TBD	TBD	0.90	0.90	0.90	TBD	All manportable increments and Lightweight Incr. A = Proud *Only*
Environment									2	2	2	2	2	2	2	2	See notes 1, 2 below
P_{fa}	0.20	0.20	0.10	0.10	0.15	0.15	0.10										All manportable increments and ...y
Environment	1	1	1	1	2	2	2										
P_{ID}	0.80	0.80	0.85	0.85	0.80	0.80	0.85										
Environment	1	1	1	2	1	2	2										
CLA drms	15				6												

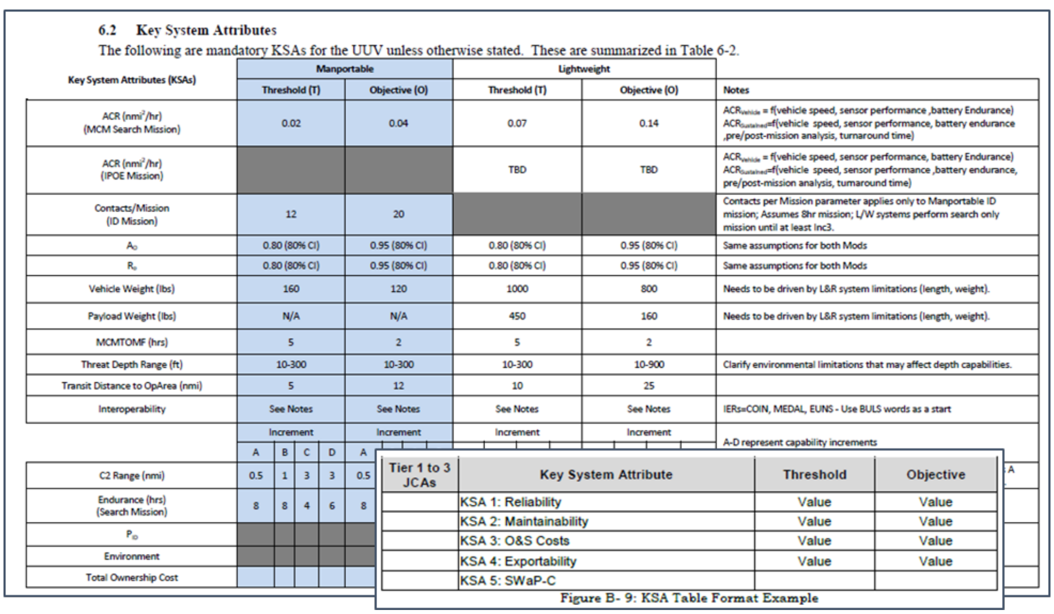
(1). "Non complex Environments" environments are seabed ... dimensional volume of UXO casings remains proud of the sea... rock, outcroppings or marine growth among homogenous sea... UUV operating area. In traditional MCM terminology a Type A-...
(2). "Complex Environments" environments are seabed and b... units) within what would otherwise be optimal imaging rang... outcroppings, walls, or other natural obstructions, significant ... percent mine case burial or concealment, and high clutter de... traditional MCM terminology, a Type C-3 or D-3 bottom would be an example of these conditions.

Tier 1 to 3 JCAs	Key Performance Parameter	JPR (check box)	Threshold	Objective
	KPP 1: Force Protection	☐	Value	Value
	KPP 2: System Survivability	☐	Value	Value
	KPP 3: Energy	☐	Value	Value
	KPP 4: Sustainment	☐	Value	Value
	KPP 4.1: Materiel Availability A_M	☐	Value	Value
	KPP 4.2: Operational Availability A_O	☐	Value	Value
	KPP 5: Joint Interoperability	☑	Value	Value
	KPP 6: Net Ready	☑	Value	Value
	KPP 7: Joint Training Interoperability	☑	Value	Value

Figure B- 8: KPP Table Format Example

Figure 2. Search-Based UUV in Support of Expeditionary Operations—KPPs

Key system attributes (KSA) establish the key measures that influence cost, schedule, and performance management for the full life of the system.



6.2 Key System Attributes

The following are mandatory KSAs for the UUV unless otherwise stated. These are summarized in Table 6-2.

Key System Attributes (KSAs)	Manportable		Lightweight		Notes
	Threshold (T)	Objective (O)	Threshold (T)	Objective (O)	
ACR (nmi^2/hr) (MCM Search Mission)	0.02	0.04	0.07	0.14	$ACR_{Vehicle}$ = f(vehicle speed, sensor performance ,battery Endurance) $ACR_{Sustained}$=f(vehicle speed, sensor performance, battery endurance ,pre/post-mission analysis, turnaround time)
ACR (nmi^2/hr) (IPOE Mission)			TBD	TBD	$ACR_{Vehicle}$ = f(vehicle speed, sensor performance, battery Endurance) $ACR_{Sustained}$=f(vehicle speed, sensor performance ,battery endurance, pre/post-mission analysis, turnaround time)
Contacts/Mission (ID Mission)	12	20			Contacts per Mission parameter applies only to Manportable ID mission; Assumes 8hr mission; L/W systems perform search only mission until at least Inc3.
A_O	0.80 (80% CI)	0.95 (80% CI)	0.80 (80% CI)	0.95 (80% CI)	Same assumptions for both Mods
R_o	0.80 (80% CI)	0.95 (80% CI)	0.80 (80% CI)	0.95 (80% CI)	Same assumptions for both Mods
Vehicle Weight (lbs)	160	120	1000	800	Needs to be driven by L&R system limitations (length, weight).
Payload Weight (lbs)	N/A	N/A	450	160	Needs to be driven by L&R system limitations (length, weight).
MCMTOMF (hrs)	5	2	5	2	
Threat Depth Range (ft)	10-300	10-300	10-300	10-900	Clarify environmental limitations that may affect depth capabilities.
Transit Distance to OpArea (nmi)	5	12	10	25	
Interoperability	See Notes	See Notes	See Notes	See Notes	IERs=COIN, MEDAL, EUNS - Use BULS words as a start

	Increment				Increment	Increment	Increment	Notes
	A	B	C	D	A			A-D represent capability increments
C2 Range (nmi)	0.5	1	3	3	0.5			A
Endurance (hrs) (Search Mission)	8	8	4	6	8			
P_{ID}								
Environment								
Total Ownership Cost								

Tier 1 to 3 JCAs	Key System Attribute	Threshold	Objective
	KSA 1: Reliability	Value	Value
	KSA 2: Maintainability	Value	Value
	KSA 3: O&S Costs	Value	Value
	KSA 4: Exportability	Value	Value
	KSA 5: SWaP-C		

Figure B- 9: KSA Table Format Example

Figure 3. Search-Based UUV in Support of Expeditionary Operations—KSAs

The CRD aptly summarizes its functionality by addressing the nature of the program: "The [UUV] FoS consists of small, man-portable unmanned systems for confined area operations and larger, lightweight unmanned systems for search operations in complex environments, each of which will use a common operator interface. The development of the FoS in achievable increments, or alternatively in pursuit of a next generation system, will also allow a FoS architecture to be developed while accommodating effective risk management," (Chief of Naval Operations, N957, 2012).

Thus, the JCIDS process combined with a CRD written to enable generational system evolution already exists. The responsibility to write the requirements document in a way that enables innovation integration lies with the human in the loop.

Private Industry

An article entitled *How Procurement Portfolio Management Supports the Procurement Process* discusses the concept of and benefits provided by procurement portfolio management. This term refers to the "strategic management of an organisation's procurement activities" and "promotes a holistic approach to procurement process management as it considers the organisation's overall procurement needs, goals, and strategies" (Kronos Group, 2023).

Procurement portfolio management focuses "not on individual procurement projects, but on the overall impact and value of procurement to the organization. This involves making informed decisions about resource allocation, procurement initiative prioritization, and optimizing performance and outcomes across the entire procurement profile."

Implementing portfolio management practices enable strategic alignment, risk management, and resource optimization.

"With a procurement portfolio established, organisations can match it up with business objectives and manage priorities effectively. As a procurement portfolio provides a centralized view of an organization's procurement needs and goals, aligning the procurement process with the organization's overall objectives becomes straightforward."

"With a procurement portfolio established, organizations have the potential to identify and mitigate risks and ensure supply chain resilience. A well-established procurement portfolio also provides an overview of the risks an organization could face throughout the procurement process, allowing it to formulate strategies for avoidance or mitigation."

"With a procurement portfolio established, organizations can cut costs and improve efficiency with optimal resource allocation. Since a procurement portfolio provides an extensive amount of information in a concise, condensed format, identifying opportunities for spend optimization and effective resource allocation becomes much simpler," (Kronos Group, 2023)

An article entitled "The Procurement of Strategic parts. Analysis of a Portfolio of Contracts with Suppliers Using a System Dynamics Simulation Model" investigates the employment of procurement portfolio management in the valuation of real options. Because procurement and financial managers use real options to "secure price and availability in the face of volatile world demand," portfolio valuation is "critical to option pricing models" (Marquez & Blanchar, 2004).

The above articles describe how procurement portfolio management can benefit the Government, with regard to strategic alignment, risk management (supply and price), and optimizing resource allocation. But this is only part of the solution. To shift innovation ownership to contractors, the Government must leverage the drive for competitive advantage after contract award.

The article entitled "Market Share: Understanding Competitive Advantage through Market Power" evaluates the validity of measures that relate to market share—like stability and concentration metrics—as indicators of a company's sustainable competitive advantage (Mauboussin & Callahan, 2022).

The dictionary definition of market share is "the percentage of the market for a product or service that a company supplies." (Merriam-Webster) As such, "market share is an outcome of a company's product or service offering, distribution channels, marketing initiatives, and customer relationships" (Mauboussin & Callahan, 2022).

These are all business aspects that the contractor owns and has the power to improve. Figure 4 diagrams how companies can generate and sustain advantage.

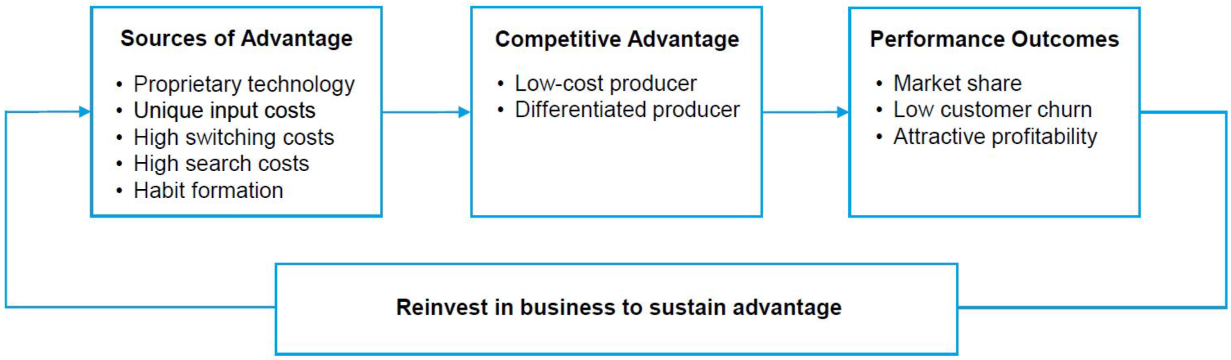


Figure 4. Traditional Competitive Strategy Analysis (Mauboussin & Callahan, 2022)

By controlling market share, the Government can establish micro-markets (portfolio contracts), which contain multiple contractors, competing to increase market share through innovation.

This takes us back to the third precept of Concept Goal 1—develop a contract able to reward contractors who innovate by increasing the quantity of supply demanded (modifying the terms of the contract)—at the expense of the competing contractors. Another way of stating this is: develop a variable, portfolio contract.

Variable, Portfolio Contract

Concept

The variable, portfolio contract (VPC) conceptually combines aspects of currently existing FAR-based contract components, to create a single contract capable of simultaneously engaging multiple contractors, in a relationship with the Government.

The VPC is fundamentally an indefinite-delivery contract, either designated as a requirements contract or indefinite-quantity contract, employing multiple award preference.

The current uniform contract format is sufficient to document contract conditions necessary for the Government to engage multiple contractors, in fulfillment of materiel capability delivery.

Bilateral (or multilateral, in the case of the VPC) contract modifications provide the mechanism for contracting officers to structure contracts to be adaptable to cost, schedule, and performance improvements/innovations by contractors and to reward them with increased market share.

The use of contract clauses provide the legal standing, dependent on collective agreement, to modify the contract when triggered by innovations.

Contracting officers must proactively communicate notifications of contract changes to ensure all parties are aware of impending changes to the contract's conditions so that no one is surprised by market share changes.

Model

The VPC relies on the Government's ability, represented by the contracting officer, to accurately rate contractors based on their management of cost, schedule, and performance—against each other. Additionally, this rating system must be complex enough to capture the effectiveness/efficiency of cost, schedule, and performance management, but simple enough to rapidly assess these factors and update changes in comparative ratings. Further, the VPC must be able to apply a weighting system to enable decision makers to apply priorities in contractor rating. Thus, the VPC model to assess contractor rating includes the following components:

1. Rating Factor:
    a. Production Schedule (or Productivity; Schedule Factor)
    b. Production Cost (Cost Factor)
    c. Product Performance (Performance Factor)
2. Rating Factor Score: a number representing the rank of individual contractors out of the total number of contractors engaged by the Government (reverse order, i.e., worst score is "1," best score is total number of engaged contractors)
3. Rating Factor Weight: scale of 0.0–1.0; all factor weights must add up to 1.0
4. Contractor Rating: sum of individual contractor's factor score multiplied by the factor's weight (sum of all contractor ratings is 1.0)
5. Periodicity of contractor rating reevaluation (i.e., monthly, quarterly, semiannually, etc.; based on the duration of the contract)

Table 1 depicts a sample VPC Contractor Rating Calculator for a contract engaging four contractors with the Government. In this example, the Rating Factors are all weighted equally.

Table 1. VPC Contractor Rating Calculator

		Factor Weight	0.3333333	Factor Weight	0.3333333	Factor Weight	0.3333333		
Producer	Contractor Rating	Production Rate (per month)	Score (1-4)	Production Cost (per unit)	Score (1-4)	Product Performance	Score (1-4)	Producer	Market Share
A	0.23	21	2	$ 90,000.00	2	8	3	A	23%
B	0.30	30	4	$ 70,000.00	4	6	1	B	30%
C	0.20	17	1	$ 100,000.00	1	10	4	C	20%
D	0.27	25	3	$ 80,000.00	3	7	2	D	27%

Once initial contractor ratings are calculated, their decimal value is converted to a percent and these values represent the market share—or percentages of total units demanded from the individual contractors.

When individual contractors implement an innovation that improves the metrics in the cost, schedule, and performance factors (enough to alter the factor score), a contractor rating review is initiated and updates to ratings and market share are enacted followed by notifications of contract change.

Implementation Concerns

The following is a summary of discussions with a broad spectrum of Defense professionals. This includes Project Managers, Program Executive Officers, Task Group Commanders, Joint Staffers, and contracting experts. The main concerns for VPC implementation focus on mitigating risk to contractor operations, configuration management, and addressing the potential for unanticipated PPBE benefits.

Several discussions focused on the business operations of the engaged contractors. Specifically, in a system where market share is variable—i.e., the units demanded from a contractor can increase and decrease—how does a business engage in a way that validates its production investment?

Issues that were identified included the fact that "*industry* needs to maintain levels of production to validate infrastructure investments (people, machinery, factories, etc.)." Also, "large ramp-up/ramp-down orders are not sustainable for small businesses" (E. Hui, personal communication, March 7, 2025).

Another question that was asked focused on the potential for contractors to resist the intra-contract competition aspect of the VPC (S. Clark, personal communication, March 4, 2025). This concern appears to be rooted in the desire for businesses to maintain stability of operations and reduce uncertainty.

Another focal point centered on the concern for configuration management. Specifically, configuration management "ensures that personnel know exactly how to op test, mission plan, employ, and recover equipment" (E. Ford, personal communication, February 24, 2025).

Further, the "difficulty of maintaining a baseline (physical and logical components that make up a product) is increased with the VPC's 'micro-market'" (J. Haase, personal communication, February 25, 2025).

This is an extremely valid concern, considering that the VPC concept intentionally engages multiple contractors in the development, production, and delivery of Warfighter capability. As such, it is absolutely vital that requirements documents mandate certain common, system aspects be incorporated into the products. This ensures that no matter what contractor delivers the product—or what mixtures of product are held in inventory—the set-up, employment, operation, and maintenance are as identical as is feasible.

The last main focal point addressed the potential, positive effects of the VPC construct. The scenario posed involved the situation in which a "VPC contractor funds innovation on an existing product and that product now meets or exceeds a requirement the Government has a separate R&D contract for."

The proposed response for this scenario was that the "government should be able to reprogram the R&D funds to buy more of the improved, existing product," thus filling funding gaps in other programs (D. McDonald, personal communication, February 24, 2025).

This insightful questions addresses a key imperative of Government acquisition and procurement: How does the Government maximize positive, second-, and third-order effects through process improvement?

Methodology

This section identifies the scenario developed to test the VPC model, defines the experimental conditions, and presents a hypothesis for the VPC's performance.

Scenario

Based on the Navy's efforts to develop and employ a bi-modal—or hybrid—fleet model, the VPC will be tested in a scenario requiring the provision of unmanned systems in support of maritime domain awareness (MDA) and underwater (UW) effects. Specifically, this experiment focuses on developing a contract to provide UUVs, to scan from just beneath the surface to just above the seabed, to provide baseline operational environment awareness and change-detection for full-spectrum (from passive MDA to UW "hellscape"), underwater effects (kinetic and non-kinetic).

The UUVs provided by the VPC will be deployed in a specific geographic location (sector), for a limited period of time in support of sea denial and sea control. They are tended by unmanned surface vehicles/vessels (USV) which download sensor data and upload new tasking (providing a greater degree of autonomy to the unmanned assets of the bi-modal fleet). These USVs then transmit downloaded data to a fusion cell to feed the MDA common operational picture (COP).

Anticipating support to major combat operations (MCO), the expectation is that the UUVs will experience a high rate of attrition, due to environmental hazards and adversary actions. This necessitates the following:

1. An initial operating inventory, sufficient to cover the assigned sector
2. A reserve inventory, sufficient to reduce impacts of estimated attrition (casualty or kinetic effect-based) of operational units of action
3. Contract capacity to expand procurement of operational units of action (UoA) in the event of a greater-than-capacity (GTC) expense event (casualty or kinetic effect-based)

Capability Requirements

As addresses in the requirements document portion of the research section, producers engaged in a VPC working to (1) provide a product that meets required standards and (2) have the flexibility to invest in cost-benefit-positive innovation, requirement must be broad enough to enable unique capability solutions and include common design elements that facilitate uniformity of operations/maintenance for the end user.

The following requirements and common design elements seek to enable both design flexibility and uniformity of operations/maintenance:

1. Design Flexibility:
    a. Must be able to operate in the full spectrum of physical operating environmental conditions (temperature, salinity, turbidity, current, etc.)
    b. Must be able to operate from very shallow water (10 FSW) to maximum depths (as identified for MDA)
    c. Must be transportable/shippable via air, sea, rail, road safely/securely and arrive in operating condition
    d. Must be deployable based on maximum acceptable time from unpacking (from transit) to ready-for-deployment
    e. Must be deployable into the operational environment via all platforms (surface vessel, subsurface vessel, air-delivered, etc.) and man-transportable and/or lightweight
    f. Must be able to accomplish all anticipated effects-based missions:
        i. Intelligence preparation of the operational environment
        ii. Environmental (UW) change detection
        iii. Specific location/identification/mapping/targeting of critical UW infrastructure
        iv. Payload delivery of kinetic/non-kinetic effects, etc.
    g. Must be able to carry full spectrum of anticipated effects-based payloads (sensors, communications, munitions, mechanical devices, etc.)
    h. Must incorporate “scuttle” options to prevent adversary exploitation

i. Must meet minimum operational duration
j. Must meet minimum data storage capacity
k. Must be able to receive programming system upgrades
l. Must be able to receive hardware upgrades or be exchanged (swapped) at lower-than-procurement cost

2. Uniformity of Operations and Maintenance:
    a. Must be controlled on a common, user interface device
    b. Must be able to interface with an autonomous/semi-autonomous, controlling UoA (USV)
    c. Must be able to recharge via universal charger (location-agnostic: seabed-, "mothership"-based)
    d. Must be able to upload data to and interface universally with government systems [note: this potentially identifies the demand signal for a Government-procured/developed, universal data share platform]
    e. Must be serviceable by a system-agnostic field service representative (FSR), based on:
        i. Level of field maintenance capability required
        ii. Mean corrective maintenance time per operational mission
        iii. Minimum, universal repair kit available

Experiment Boundaries

UoA Quantity Requirements

1. Required operational duration (contract): 36 months (October 1, 2025–September 30, 2028)
2. 1,000 UoA operational at any given time for a 24-month period
3. Estimated attrition rate (per month): 50 UoA (5%)
4. Reserve inventory: 100 UoA
5. Total estimated quantity requirement (contract): 2,300 UoA
6. Total start-up requirement (due October 1, 2026): 1,100 UoA

Assumptions

1. Contractor production cost is equal to Government cost of procurement
2. Contractors all produce UoA that meet minimum capability requirements (product performance score of 6)
3. All contractors voluntarily adhere to requirements of VPC (including acceptance of market share changes)
4. The Government is able to engage enough contractors to meet the minimum, required production capacity of the VPC

Rules

1. Producer ratings assessed prior to contract execution and:
    a. Experiment 1: reassessed when triggered by innovation event
    b. Experiment 2: reassessed periodically (quarterly, semiannually, annually)
2. Acceptable product performance range: 6–10
3. Government cost of procurement ceiling: $110,000 per UoA (2026 dollars)

4. Inflation component applied annually (at start of fiscal year): Producer Price Index (PPI; 2.97% as of December 30, 2024)

Experiment Variables

Control Variables

1. Factor weights
2. Innovation events
3. Inflation component

Independent Variables

1. Contractor's production rate (per month)
2. Contractor's production cost
3. Contractor's product performance

Dependent Variables

1. Contractors:
    a. Factor Weight rank
    b. Contractor Rating / Market Share
    c. Initial UoA quantity demanded (out of 1,000 total)
    d. Reserve inventory UoA quantity demanded (out of 100 total)
    e. Replacement UoA quantity demanded (out of 50 monthly)
    f. Contribution to total contract procured UoA
    g. Average cost per UoA (full contract)
2. Total Contract:
    a. Total contract cost (for each scenario)
    b. Total UoA produced (for each scenario)
    c. Average cost per UoA (for each scenario)
    d. Average performance rating (for each scenario)
    e. Replacement Time (based on excess production capacity available)

Experiment Conditions

Contractor Rating Information

Table 2 identifies four contractors (Producers A, B, C, and D) engaged with the Government via a VPC, and provides the cost, schedule, and performance information used to calculate contractor rating.

Table 2. VPC Contractor Rating Information

Contractor	Production Rate (UoA, per month)	Production Cost ($, per unit)	Product Performance (1-10)
Contractor A	#	$#	#
Contractor B	#	$#	#
Contractor C	#	$#	#
Contractor D	#	$#	#

Innovation Events (Experimental Scenarios)

The following is a list of scenarios used to test the VPC:

1. Static operational conditions scenario(Control; no innovations occur during execution of the VPC)
2. Production Schedule Improvement Scenario
    a. October 1, 2026: Producer A increases productivity by 57.9%
3. Production Cost Improvement Scenario
    a. October 1, 2026: Producer C decreases production cost by 21%
4. Product Performance Improvement Scenario
    a. October 1, 2026: Producer D increases product performance by 28.6%
5. Various Factor Improvement Scenario (sequenced)
    a. January 1, 2027: Producer C increases productivity by 76.9%
    b. April 1, 2027: Producer A decreases production cost by 21.5%
    c. October 1, 2027: Producer B increases product performance by 25%
6. GTC Expense Scenario
    a. March 2028: Operational units suffer 25% casualties (250 units)

Experimental Weights

The following is a list of weights applied to each of the scenarios identified above:

1. Even weight
2. Productivity-weighted
3. Cost-weighted
4. Performance-weighted

A foundational component of this research centers on reducing supply risk through the employment of a portfolio contract. As such, preference in weighting is given to the productivity (schedule) factor. For this reason, productivity is not given the lowest weight for any of the scenarios, as depicted in Table 3.

Table 3. VPC Experiment Weighting System

Contractor Rating Factor Weights	Production Rate (per month)	Production Cost (per unit)	Product Performance
Even	0.333	0.333	0.333
Schedule	0.5	0.3	0.2
Cost	0.3	0.5	0.2
Performance	0.3	0.2	0.5

VPC Model Evaluation Hypotheses

1. Implementation of a VPC will create an environment in which innovating contractors are rewarded with increased market share
2. Innovations will accomplish the following:
    a. Reduce total contract cost
    b. Improve average UoA performance
3. Productivity-weighted VPC will yield greatest reduction to supply risk

VPC Model Evaluation and Results

Model Evaluation Tool

The evaluation tool was built on the Microsoft Office Excel application. The tool consisted of three separate sheets within a single workbook.

The first sheet, entitled Data Input, provided the following functions (Tables 2 and 3 data inputted for each experiment):

1. Contractor factor input table, including:
    a. Contractor Production Rate
    b. Contractor Production Cost
    c. Contractor Product Performance
    d. Contractor Factor Score
    e. Factor Weight
2. Calculated the contractor rating and market share
3. Calculated and depicted market share of total UoA demanded from each contractor, broken down into the following categories:
    a. Operational UoA: 1,000 units
    b. Initial Reserve UoA: 100 units
    c. Estimated Attrition Replacement Rate (EARR): 50 units per month
4. Calculated maximum VPC production capacity
5. Calculated VPC EARR surplus/deficit

The second sheet, entitled Schedule-Cost, provided the following functions:

1. Calculated and displayed the VPC costs, broken down by:
    a. Month
    b. Year
    c. Total Contract Cost
    d. Total contract average cost per UoA
    e. Contract Cost per Contractor
2. Calculated and displayed UoA procured by the VPC, broken down by:
    a. Contractor per month
    b. Contractor per year
    c. UoA producer per contractor
    d. Total produced by contract
3. Calculated and displayed Contractor Rating, broken down by:
    a. Final contractor rating (at contract termination, or post-Contractor Rating reevaluation)
    b. Average contractor rating of the contract
4. Calculated and displayed Product Performance, broken down by:
    a. Final contractor Product Performance (at contract termination, or post-Contractor Rating reevaluation)
    b. Average product performance of the contract

The third sheet, entitled Data Analysis, depicted consolidated results for each scenario as well as comparisons of data to the Control. The result categories depicted included:

1. Contractor Rating
2. Total Cost of Contract
3. Total UoA procured
4. Average cost per UoA for total contract
5. Average Product Performance for total contract

The comparison between the Control and the individual innovation scenarios, included:

1. Change in average cost per UoA for total contract
2. Change in total cost of contract
3. Change in average product performance for total contract

For access to the model evaluation tool and/or raw data, contact the author.

Model Evaluation Results

The model evaluation consisted of 120 experiments run, broken into four, 30-scenario batches. These batches each employed one of the four Contractor Rating Factor Weights.

Data Analysis

Tables 4, 5, 6, and 7 display the analytical results of the four batches of experiments (contact the author for raw data).

Tables 4, 5, 6, and 7. VPC Experiment Summaries (Weights: Even, Schedule, Cost, and Performance; respectively)

Even-Weighted	Change in Average Contract Performance (from Control)								
	Total Cost	% Change	Std Dev	Contract Capacity (UoA per month)	% Change	Std Dev	Performance Rating	% Change	Std Dev
Control Scenario	$ 177,692,395.52			99.8367			7.8380		
Schedule Improvement Scenario	$ 177,828,354.84	0.0951%	0.0108	113.8311	14.0545%	0.0194	7.8640	0.3605%	0.0147
Cost Improvement Scenario	$ 171,427,410.33	-3.5266%	0.0069	99.8367			7.8830	0.5918%	0.0079
Performance Improvement Scenario	$ 177,187,468.71	-0.3008%	0.0051	99.8367			8.4403	7.6892%	0.0204
Various Improvement Scenario	$ 183,385,819.65	4.1534%	0.0630	117.9338	18.1613%	0.0375	8.4583	7.8660%	0.0207
G-T-C Scenario	$ 196,969,203.12	10.8473%	0.0022	99.8367			7.8380	0.0000%	0.0000

Market Share Analysis	
Average Contractor Minimum (%)	Average Contractor Maximum (%)
18.0783%	33.3148%
Minimum UoA Demanded (individual Contractor)	Maximum UoA Demanded (individual Contractor)
423.3333	780.1222
Average Total Contract Cost	$ 180,748,442.03
Percent Change	1.7199%
Standard Deviation	0.0108
Avg Contract Perfromance Rating	8.0536
Percent Change	2.7508%
Standard Deviation	0.0059

Schedule-Weighted	Change in Average Contract Performance (from Control)								
	Total Cost	% Change	Std Dev	Contract Capacity (UoA per month)	% Change	Std Dev	Performance Rating	% Change	Std Dev
Control Scenario	$ 176,800,603.90			99.8367			7.7450		
Schedule Improvement Scenario	$ 177,004,542.72	0.1662%	0.0163	113.9662	14.1896%	0.0198	7.7847	0.5740%	0.0225
Cost Improvement Scenario	$ 171,049,281.79	-3.2468%	0.0086	99.8367			7.7867	0.5570%	0.0072
Performance Improvement Scenario	$ 176,490,158.02	-0.1884%	0.0031	99.8367			8.3503	7.8135%	0.0119
Various Improvement Scenario	$ 183,050,204.91	4.4981%	0.0641	118.1132	18.3407%	0.0378	8.3950	8.3669%	0.0256
G-T-C Scenario	$ 196,015,454.96	10.8655%	0.0013	99.8367			7.7450	0.0000%	0.0000

Market Share Analysis	
Average Contractor Minimum (%)	Average Contractor Maximum (%)
15.8598%	36.0685%
Minimum UoA Demanded (individual Contractor)	Maximum UoA Demanded (individual Contractor)
371.3833	844.6040
Average Total Contract Cost	$ 180,068,374.38
Percent Change	1.8483%
Standard Deviation	0.0116
Avg Contract Perfromance Rating	7.9678
Percent Change	2.8764%
Standard Deviation	0.0079

Cost-Weighted	Change in Average Contract Performance (from Control)								
	Total Cost	% Change	Std Dev	Contract Capacity (UoA per month)	% Change	Std Dev	Performance Rating	% Change	Std Dev
Control Scenario	$ 174,671,674.91			99.8367			7.7297		
Schedule Improvement Scenario	$ 174,794,038.20	0.0896%	0.0100	113.9662	14.1896%	0.0198	7.7553	0.3575%	0.0135
Cost Improvement Scenario	$ 168,876,628.03	-3.3030%	0.0064	99.8367			7.7993	0.9292%	0.0119
Performance Improvement Scenario	$ 174,361,229.02	-0.1882%	0.0031	99.8367			8.3397	7.8942%	0.0121
Various Improvement Scenario	$ 181,151,016.49	4.6471%	0.0622	118.1132	18.3407%	0.0378	8.3533	8.0335%	0.0222
G-T-C Scenario	$ 193,654,605.65	10.8655%	0.0013	99.8367			7.7297	0.0000%	0.0000

Market Share Analysis	
Average Contractor Minimum (%)	Average Contractor Maximum (%)
15.6114%	35.8903%
Minimum UoA Demanded (individual Contractor)	Maximum UoA Demanded (individual Contractor)
365.5667	840.4307
Average Total Contract Cost	$ 177,918,198.72
Percent Change	1.8586%
Standard Deviation	0.0108
Avg Contract Perfromance Rating	7.9512
Percent Change	2.8656%
Standard Deviation	0.0067

Performance-Weighted	Change in Average Contract Performance (from Control)								
	Total Cost	% Change	Std Dev	Contract Capacity (UoA per month)	% Change	Std Dev	Performance Rating	% Change	Std Dev
Control Scenario	$ 181,202,970.06			99.8367			7.9670		
Schedule Improvement Scenario	$ 181,325,333.34	0.0774%	0.0095	113.9662	14.1896%	0.0198	7.9917	0.3319%	0.0131
Cost Improvement Scenario	$ 174,333,164.95	-3.8060%	0.0089	99.8367			7.9937	0.3423%	0.0046
Performance Improvement Scenario	$ 180,408,592.13	-0.4610%	0.0076	99.8367			8.6193	8.1629%	0.0153
Various Improvement Scenario	$ 185,817,251.18	3.4968%	0.0635	118.1132	18.3407%	0.0378	8.5770	7.5908%	0.0238
G-T-C Scenario	$ 200,818,090.53	10.8260%	0.0032	99.8367			7.9670	0.0000%	0.0000

Market Share Analysis	
Average Contractor Minimum (%)	Average Contractor Maximum (%)
19.6078%	31.6780%
Minimum UoA Demanded (individual Contractor)	Maximum UoA Demanded (individual Contractor)
459.1500	741.7933
Average Total Contract Cost	$ 183,984,233.70
Percent Change	1.5349%
Standard Deviation	0.0106
Avg Contract Perfromance Rating	8.1859
Percent Change	2.7481%
Standard Deviation	0.0045

The following is a summary of observations from the model evaluation.

VPC Model Averages

1. Average, total contract cost increase: 1.7404%
2. Average, total UoA performance increase: 2.8102%
3. Average production capacity increase (translates to reduced supply risk):
    a. Schedule Improvement Scenario: 14.1188%
    b. Various Improvement Scenario: 18.2615%
4. Average Market Share Increase/Decrease per innovation:
    a. Average Market Share Increase: 22.986%
    b. Average Market Share Decrease: −13.682%
5. Theoretical, Minimum Contract Value (worst-case scenario):
    a. $23,030,122.16 (13.4348% market share) [Based on the following: Minimum total contract cost observed ($171,421,621.27), minimum average cost per UoA @ 2,300 procured UoA ($74,531.14), and minimum observed UoA procured by individual contractor (309)]

Individual Scenario Observations

1. Performance Scenarios—independent of weighting—result in the most reliable decrease in average, total contract cost
2. Cost Scenarios—independent of weighting—result in the most reliable increase in average, performance rating
3. Various Scenarios, followed closely by Performance Scenarios—independent of weighting—result in the highest increase in average performance rating
4. Cost Scenarios—independent of weighting—result in the highest decrease in average, total contract cost
5. Performance-Weighted Scenarios resulted in the highest minimum Contractor Market Share (19.6078%)
6. Schedule-Weighted Scenarios resulted in the highest maximum Contractor Market Share (36.0685%)
7. Cost-Weighted Scenarios resulted in the lowest minimum Contractor Market Share (15.6114%)
8. Performance-Weighted Scenarios resulted in the lowest maximum Contractor Market Share (31.6780%)
9. Minimum Contracted UoA
    a. Even-Weighted: 343.3330
    b. Schedule-Weighted: 331.0000
    c. Cost-Weighted: 309.000
    d. Performance-Weighted: 368.0000

Overall Cost, Performance, and Quantity-Demanded Observation

1. Performance-Weighted VPC demonstrated smallest average, total contract cost increase (+1.5349%; std dev: 0.016)
2. Cost-Weighted VPC demonstrated largest increase in average UoA performance rating (+2.8656%: std dev: 0.0067)

3. Minimum procured UoA (single contractor) was 309.0000, across all 120 experiments run

Conclusion and Recommendations for Further Research

Conclusion

Analysis of VPC Model Evaluation Hypotheses

1. VPC model implementation demonstrated consistent increased market share for innovators
2. VPC model's incorporation of innovations failed to demonstrate reduced, average, total contract costs
3. VPC model implementation demonstrated improved average UoA performance
4. Productivity-weighted VPC model yielded the greatest, individual reduction to supply risk—via 14.1188% increase in contract, production capacity

The model evaluation demonstrated the VPC's ability to accomplish the following:

1. Engage enough contractors to meet minimum production capacity requirements **and** provide excess capacity to respond to unanticipated spikes in procurement demand (based on GTC scenarios) thereby reducing supply risk
2. Create a competitive environment which encourages R&D investment, solely borne by the contractor
3. Effectively restructures contractor market share in response to cost, schedule, and/or performance improvements (based on reevaluated contractor ratings) thereby incentivizing innovation
4. Provides substantial incentive for all contractors to participate in the VPC, based on the theoretical, minimum contract value
5. Minimize increases in—or, in some cases, decrease—average total contract cost, while increasing average UoA product performance

Recommendations for Further Action and Research

1. Develop a uniform contract format that is structured to simultaneously engage multiple contractors.
2. Adapt the recommended requirements documents to facilitate design flexibility and uniformity in operations and maintenance (Methodology: Capability Requirements).
3. Determine the feasibility of and process for reprogramming funding, in accordance with PPBE reform guidance, in the event that VPC-based innovations result in satisfaction of R&D objectives and efforts.
4. Implement the VPC as soon as practical to ensure timely, risk-mitigated delivery of high-volume, high attrition capability for the future, maritime fight.

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