Practical Implications of Using Challenge-Based Acquisition to Acquire Capabilities for Large Software Systems

Dr. R. Cherinka, J. Prezzama and K. Aitkenhead
4830 W. Kennedy Blvd., Tampa, FL 33609
Phone: 813-287-9457, Fax: 813-287-9540
rdc@mitre.org, prezzama@mitre.org

ABSTRACT

Federal agencies are seeking new ways to innovate, procure and enhance enterprise capabilities. Competitions are one tool that these agencies can use to drive innovation and solve mission-centric problems—whether technical, scientific, or creative. In this paper we present our experience in using challenge-base acquisition on a large Department of Defense software system. We describe the process, scenarios, technologies and criteria for success used during the acquisition. We then discuss results and highlight some lessons learned throughout the process.

Keywords: Continuous Innovation, Challenge-Based Acquisition, ChBA, Competitions, Gamification

1. INTRODUCTION

In a previous paper, we presented an examination of several approaches to foster open innovation through challenges and competitions in support of key business operations in the workforce [3, 4]. We highlighted specific examples of their use in "real world" environments and provided an assessment of applicability, benefits and challenges for implementation in large organizations.

In this paper, we take a closer look at one of those approaches and highlight a case study of applying challenge-based acquisition (ChBA) to acquiring a complex analytical capability for a large Department of Defense (DoD) system. The ChBA process promotes a competitive environment, demonstrated performance, and an increased partnership with industry.

We share our experience in designing the acquisition process from the start to include the use of competitions to evaluate the technical functionality and usability of the system. We describe the process, scenarios and criteria for success used during the acquisition. We also discuss the technical architecture, key technologies and administrative process used to execute the effort. We then discuss results and highlight some lessons learned throughout the process.

2. BACKGROUND

Our organization, over the years, has provided acquisition support to various DoD program offices [1]. In this role, we have assisted one particular program manager with the acquisition of a software based database search capability. This tool will enable the customer to properly collect, process, exploit, and disseminate data within the enterprise and across its services, and partner networks. The goal of this desired capability would significantly increase the user's ability to efficiently discover patterns, anomalies, connections, and other such data analytics. Further, this capability will be used to enable user-driven collaboration across organizational, functional, and geographic boundaries thereby promoting a unified, current, and enterprise-wide analytical picture with users sharing data and products. Additional specific customer program office objectives for this acquisition included:

- Develop a comprehensive analytical capability for connected and disconnected operations that will also optimize total system performance.
- Minimize total ownership costs, and ensure that the system is built to optimally accommodate both the characteristics of the user population that will operate, maintain, and support the system, and the key missions, operations, and decisions the system must be designed to support.
- Provide direct support to broader System and Software Engineering goals, utilizing proven methods to elicit and prioritize user requirements, develop effective and usable designs, foster and measure user acceptance, and assess end-to-end system performance.
- Incorporate frequent opportunities for interaction with the end-user through activities such as user groups, feedback sessions, and design reviews, etc.
- Leverage both open source and traditional approaches to software acquisition in order to foster innovation and speed delivery.

In support of the tool solicitation for this effort, we proposed a challenge-based acquisition approach to the customer. This customer typically employs traditional acquisition methodologies in the procurement of equipment, services, and software. With a challenge-based acquisition approach, private-sector entities were incentivized to develop and demonstrate their solutions in real-world conditions as a source selection mechanism for the award of contracts or task orders for additional testing, refinement, or production of their proposed solution. The award of contracts and task orders occurred if, and only if, the vendor successfully met the real-world requirements of the challenge. In this vein, we assisted the customer in thinking innovatively about novel approaches to fielding a solution to fulfill complex, analytically-focused requirements. The overall goal of this hybrid challenge-based approach was to introduce competition, innovation, and agility, while ensuring rigor and defensibility, in selecting the absolute best solution to efficiently and effectively meet current and future needs of the user community.

Throughout this paper, we will focus on the use of challenges and competitions, and how they can be used to foster a robust acquisition strategy.

3. THE CHALLENGE-BASED PROCESS

Traditional acquisition processes often require a deep understanding of requirements and a profound knowledge of the potential solutions that are available in the market place. Traditionally federal acquisition approaches tackle this challenge by conducting a market analysis prior to formal acquisition activities. The results of these analyses are then used to scope the technical procurement approach. There are instances when the lack of understanding of the potential solution space may preclude the development of a market analysis. In these cases, the use of challenges or competitions has proven useful. Some have even chosen to conduct ChBAs in a contest-like manner to encourage greater innovation and private sector participation, when the payment of a prize is for a good or service for the benefit of the customer. At its core, the use of ChBA, allows the government to communicate its needs through challenges that are analogous or identical to a desired capability. Then, industry would respond to the challenges without extraneous constraints. In turn, these challenges can abstract away irrelevant concerns and can in many cases be substitutes for loose requirements [6].

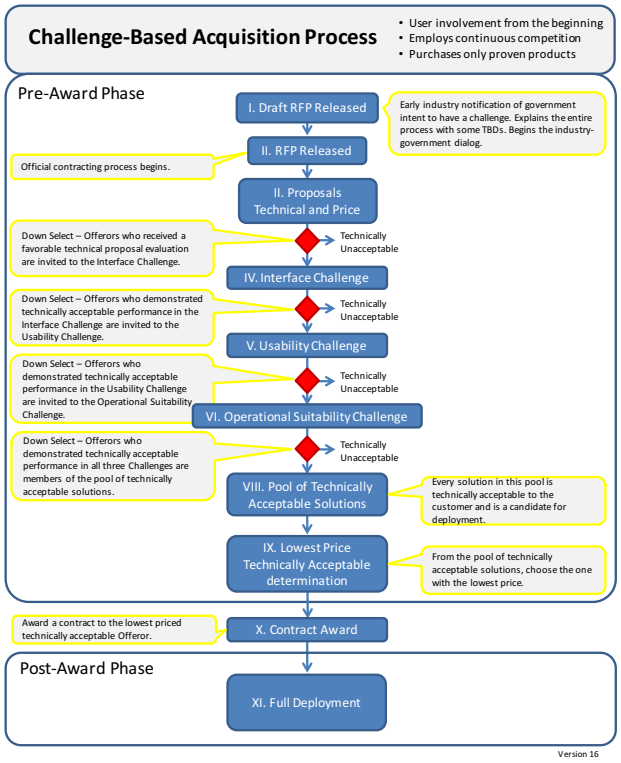

Figure 1. Challenge-Based Acquisition Process

Figure 1 highlights the use of challenge events by a customer to assess user experience or functional utility and readiness of products and capabilities.

By using challenge events, vendors can show that they understand and can demonstrate the capability sought by the customer. Vendors are asked to prove the technical applicability and user functionality of their solutions to fill the need based on the outcome of the challenges. The overall challenge itself is typically compromised of one or more events that exercise various aspects of a solution, such as an Interfaces, Usability and Security. The general execution strategy taken in this effort was to:

- Locate a strong User Advocate to champion Challenge-Based Acquisition approach and outcomes
- Seek Contracting Officer buy-in to Challenge-Based Acquisition approach and outcomes
- Design the challenge and challenge parameters from existing statement of objectives for the program
- Determine the scope of each iteration of the challenge

- Execute the source selection as a series of down selects based on the content and demonstrated performance of the offerors

In this example, our customer used an Interface Challenge to perform a Technical Assessment of the vendor's ability to successfully integrate their solution into a virtual test environment, and demonstrate their technical ability to integrate and perform necessary functionality based on the criteria established by the the customer. The customer then conducted a Usability Challenge focused on a user evaluation of a vendor's solution in the context of an operationally relevant scenario. The intent of the Usability Challenge is to determine if the solution is functionally relevant, performs efficiently and is aesthetically appropriate from a user perspective based on predetermined user scenarios. Finally, the customer also conducted an Operational Security Challenge to perform an Information Assurance (IA) Assessment of the vendor's ability to integrate their solution into the operational test environment and prove compliance with existing policy and security requirements. The use of commercial cloud services and formal usability testing methods (e.g. standard surveys) were used to capture user experience. The results from all events were used to evaluate and select the capabilities and how to use them.

To evaluate and assess the vendor solutions fairly, a set of criteria was developed for each of the challenges. During the technical evaluation, the vendors were asked to demonstrate functionality relating to requirements previously determined by the customer. A numerical score was provided for each function being demonstrated, with the aggregate total score (using a 100-point scale) being used to determine if a particular vendor passed the challenge.

	The System Usability Scale Standard Version		Strongly disagree				Strongly agree
			1	2	3	4	5
1	I think that I would like to use this system.		O	O	O	O	O
2	I found the system unnecessarily complex.		O	O	O	O	O
3	I thought the system was easy to use.		O	O	O	O	O
4	I think that I would need the support of a technical person to be able to use this system.		O	O	O	O	O
5	I found the various functions in the system were well integrated.		O	O	O	O	O
6	I thought there was too much inconsistency in this system.		O	O	O	O	O
7	I would imagine that most people would learn to use this system very quickly.		O	O	O	O	O
8	I found the system very cumbersome to use.		O	O	O	O	O
9	I felt very confident using the system.		O	O	O	O	O
10	I needed to learn a lot of things before I could get going with this system.		O	O	O	O	O

Figure 2. Standardized System Usability Scale

The usability challenge allowed a set of users to use each vendor's solution while trying to solve a realistic problem and perform typical daily operations in the context of a scenario. Figure 2 depicts the system usability scale that was used by each of the users to evaluate and score each vendor solution. This scale is an Industry standard method for measuring usability of a system [2].

4. TECHNICAL ARCHITECTURE

The basis for ChBA can be found in the application of game theory, or "gamification" [5]. Gamification is the use of game thinking and game mechanics in non-game contexts to engage users in solving problems. Gamification has been studied and applied in several domains, such as to improve user engagement, physical exercise return on investment, data quality, timeliness, and learning. A review of research on gamification shows that most studies on gamification find positive effects from gamification.

As noted earlier, the use of commercial cloud services from Amazon were used to implement a safe and secure distributed and virtualized sandbox environment for each of the offerors to develop, integrate and demonstrate their potential solutions as well as for our customer to perform their evaluation.

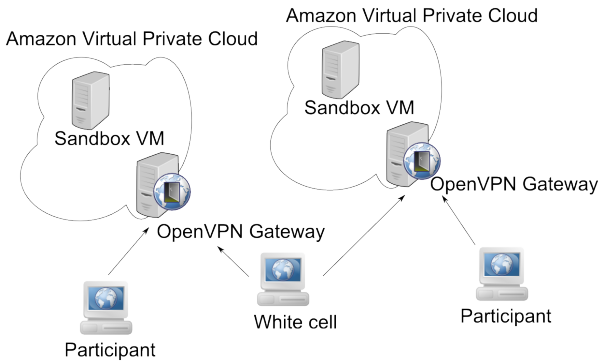

Figure 3. Cloud-Based Technical Architecture

The cloud architecture used is depicted in Figure 3. While not an exhaustive list, some of the key technologies used during this effort included Amazon Web Services, open Virtual Private Networking (VPN), Virtualization, Chef, Java, extensible markup language (XML) and commercial database tools.

The general concept of the technical approach used in support of this ChBA effort can be described as follows:

- The government customer configured a virtual machine sandbox baseline with the necessary software, datasets, and documentation

- The government "white cell" team deployed private virtual sandbox cloud instances for each offeror and "clean rooms" using Amazon cloud services
- Participants and the customer's "white cell" connected to assigned private cloud sandbox instances using OpenVPN via the provided IP and URL settings
- Participants interacted with the sandbox to develop, integrate and test proposed solutions
- White cell team members monitored and logged activity as well as provisioned updates to all instances as-needed
- During the Technical Interface and User Functionality Challenge events, participants interacted with the "clean room" cloud instance controlled by the customer team
- Offerers integrated their solutions into a "clean room" sandbox
- Users and evaluators interacted within the "clean room" sandbox

5. RESULTS

In this section, we briefly discuss results of this effort and our assessment of potential benefits and challenges associated with utilizing competitions and challenge events in the work environment.

The acquisition effort discussed in this paper was conducted successfully. Initially, over ten vendors started the process by submitting written proposals detailing their solutions and how they believe they would address each of the customers' requirements. These were carefully evaluated by the evaluation team, and seven vendors were chosen to participate in the first technical challenge to demonstrate the necessary functionality of each of their solutions in their virtual sandbox environments. This process allowed the evaluation team to select three vendors to participate in the final usability challenge, ultimately with contract awards being offered to the winner.

As discussed previously in [3, 7], there are numerous challenges to innovation, related to idea generation and solution development, sponsorships and funding, scalability, customer outreach, competition and timeliness.

With respect to our case study, using the challenge-based acquisition approach allowed the customer to realize the following benefits:

- Allows non-traditional sources to supply current and/or enhanced analytical functions
- Incentivizes Industry participation and engages the user community
- The customer can "buy the winner"
- Challenges provided a clear path for adding new capabilities
- Demonstrates the program baseline extensibility
- Encourages user buy-in
- Challenges enable the selected solution to become the preferred system across the entire user base

In general, our customers have found ChBA processes to be more complex than expected. More traditional programs of record have attempted ChBA, only to revert back to more traditional approaches due to limitations and concerns expressed by their contracting and legal departments.

In some cases a happy medium was found by maintaining the traditional approach to the procurement solicitation process, while injecting key aspects of ChBA. In these cases, challenge problems were introduced and conducted as part of the overall solicitation proceedings.

We have found that there is no "best approach" to ChBA. Ultimately, the correct course of action will be dictated by the program/project in question. It's tolerance to technical scrutiny will have to be weighed against its need for innovative solutions.

6. CONCLUSIONS

This paper provided a summary examination of our approach and results to applying a "real world" application of ChBA to acquire new capabilities for a large DoD system.

This challenge-focused approach did set the bar higher for potential vendors through a series of challenges designed to test interoperability and functionality. Further, it allowed the customer to embrace the user community through their involvement in the usability challenge which has been a challenging proposition for our customer in the past. The challenge-based approach is a new concept in the acquisition domain, in general, and has not been undertaken before by our customer. Through the approach developed for the customer, we have ensured a high degree of innovation, rigor, and defensibility by building out a series of dynamic, agile challenges which were required of all vendors who were selected to participate. In doing so, we helped the customer develop a repeatable template from which numerous other efforts can draw in the future.

We are helping shape the way the government considers acquisition efforts. Our customer believes that this

inaugural effort represented their test case for a challenge-based acquisition approach and has socialized the concept quite intensely with various stakeholders and leaders across the community. Although a hybrid approach was adopted, it will certainly serve as a template for multiple other efforts and can be readily applied to future acquisition efforts. Finally, the approach resulted in a successful contract with no protests.

7. REFERENCES

[1] MITRE Strategy for Challenge-Based Acquisition in the Government, The MITRE Corporation, http://www.mitre.org/capabilities/acquisition-effectiveness/acquisition-initiatives/challenge-based-acquisition.

[2] Brooke, J. (1996). "SUS: a "quick and dirty" usability scale". In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & A. L. McClelland. Usability Evaluation in Industry. London: Taylor and Francis.

[3] Cherinka, R. and J. Prezzama, *Emerging Trends, Technologies and Approaches Impacting Innovation*, International Multiconference on Engineering and Technology Innovation, IMETI 2013.

[4] R. Cherinka and J. Prezzama, The Impact of Using Challenges and Competitions in the Workforce, 7th International Multi-Conference on Engineering and Technological Innovation, July 2014.

[5] Sloane, P., *A Guide to Open Innovation and Crowdsourcing: Advice from Leading Experts*, Kogan Page Publishing, 2012

[6] Weatherly, Richard PhD and Wydler, Virginia, Challenge Challenge -Based Acquisition: Stimulating Innovative Solutions Faster and Cheaper By Asking the Right Questions, 13 August 2012

[7] Zients, Jeffrey D., Deputy Director for Management (OMB), *Guidance on the Use of Challenges and Prizes to Promote Open Government*, 8 March 2010.

The author's affiliation with The MITRE Corporation is provided for identification purposes only, and is not intended to convey or imply MITRE's concurrence with, or support for, the positions, opinions or viewpoints expressed by the author.