Streamlining the Process: Improving Defense Acquisitions through Rapid Prototyping

A Candid Survey of Federal Employees

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About

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Through analysis, insight and analytical independence

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GBC studies influential decision-makers to produce intelligence-based analysis
An efficient and effective defense acquisitions process is vital to the success and safety of the modern warfighter. The Department of Defense, its subcomponents, and the military services are under great pressure to ensure American troops and those that support them have the tools they need to achieve their mission. In a time of budget constraints, defense leadership also has a responsibility to the taxpayer to ensure that these tools are delivered in a cost-effective and timely manner.

In order to assess the state of the defense acquisitions process, the Government Business Council, with sponsorship from Booz Allen Hamilton, undertook a comprehensive research project that surveyed defense managers about the current acquisition process and how it has been improved since the Weapon Acquisition Reform Act of 2009 (Reform Act). Rapid prototyping and platform modernization, important parts of the Reform Act, has been shown to be an effective way to make the procurement of complicated defense systems faster and within budget.

**Methodology**

From January 22, 2013 to February 1, 2013, the Government Business Council deployed a survey via email to a sample of managers employed by the Department of Defense or military services. A total of 474 respondents completed the survey. For the purposes of this survey, prototyping is defined as part of the product design/development process that allows engineers, designers, and users the ability to explore design alternatives, test theories and confirm performance prior to starting full scale production of a new product.

The following reports contains insights gleaned from analysis of survey responses, secondary research, and primary research in the form of interviews with experts in the fields of rapid prototyping and defense acquisitions.
In 2009, the President Obama signed into law the Weapon Systems Acquisition Reform Act of 2009, which is intended to improve the acquisitions process by speeding development, streamlining bureaucracy, and giving acquisitions officers the power to stem costs from contract overruns. The act was a response to persistent cost overruns totaling $295 billion in numerous major defense weapon acquisition programs, a figure placed at nearly 70 percent of the Pentagon’s 96 major programs by the GAO in 2008.1

With regard to the Reform Act, Senator Levin, who sponsored the bill, has noted, “the key to successful acquisition programs is getting things right from the start with sound systems engineering, cost-estimating, and developmental testing early in the program cycle.”2 That being said, more work remains to be done. The GAO estimates that inefficiencies in system production accounted for $31.1 billion of the DoD’s $74.4 billion cost growth (about 42 percent) in 2012, while research and development cost growth accounted for $13.7 billion.3

In the past several years, the DoD has increasingly begun to use a set of technologies known as rapid prototyping, and its sister technologies, reverse engineering and platform modernization, to drive down costs by streamlining the acquisitions process. Rapid prototyping allows for fabricators and designers to create a system that is almost complete. The system is then put in the hands of the user for testing in order to make incremental changes until the system is complete and meets all requirements. In doing so, this alleviates time to market, system failures, and expanding costs due to unforeseen circumstances.

How Edgewood Chemical Biological Center Leverages Prototyping to Develop Defense Systems Faster and More Efficiently

Can you tell me about prototyping integration facilities (PIF) like yours?

At RDECOM, we all have specialties that we focus on. At ECBC, we are focused on defense against weapons of mass destruction. We have about 120 people in the PIF and we do about 300 projects a year. Some of our projects require an incredibly fast turn around, with deployment in a matter of weeks. We actually specialize in product development, not just prototyping. Like other PIF facilities, we take a requirement and develop a solution as quickly as possible so we can get it into the hands of users and then turn around incremental improvements. This is really how rapid prototyping works. We put something in the hands of the user, they try it out, and we make it better. In fact, we actually develop our own in-house mobile applications to better prepare users to install, train, maintain and test our prototypes.

Applications are a pretty new way to get a prototype into the hands of the user. Does a facility like yours undergo a lot of changes?

3D technology has significantly enhanced our prototyping capabilities. At ECBC, we have been using 3D technology since the 1980s. What this allows us to do is more data sharing especially of very realistic virtual prototypes prior to hardware fabrication. After 9/11, we were pushed to develop new systems very quickly. Prior to that, our departments worked together but several of the processes were very disjointed because sharing of information would sometimes take days or a week. However, with the requirement to make the process faster, our engineers would go and work literally side-by-side with the fabricators and this cut our time in half. We like to call this the Rapid Product Development process where we pull design and manufacturing together. But it was really the new technology that allowed us to transition rapidly from design to prototype.

It seems like prototyping requires a lot of very specialized knowledge. When procurement offices are looking to acquire prototyping technologies knowledge, is there ever a disconnect between what they want and know to ask for?

That might have been the problem 20 years ago, but the new generation of employees coming out of school are very familiar with these technologies. In fact, our technologies provide procurement offices the ability to really visualize what they need or are looking for. In fact, our applications allow the user to start optimizing what they are looking for hours or even minutes after they bring the requirement to us. It’s pretty amazing how fast these technologies are changing procurement and defense systems in general. Where do you see the future of prototyping?

I think prototyping adds so much value that it’s going to keep growing. For example, as virtual prototyping gets more and more robust we may need less prototype hardware. Machine intelligence will also change. As time goes on, we are going to learn new ways to transfer data from design to logistical support faster thus giving us the ability to learn more over the lifetime of the project and better optimize performance and lifecycle costs.
Respondent Profile
• A total of 474 federal managers, from GS-11 to Senior Executive Service or equivalent grade levels completed the survey.

• Almost two-thirds (62 percent) of respondents are GS/GM-13 or above and 66 percent oversee at least one direct report.

• Given that the majority of respondents oversee at least one direct report and 5 percent oversee at least 200 employees. The following sample represents the thoughts and opinions of senior defense leadership.

Oversees/Reports

- 34% None
- 19% 1-5
- 24% 6-20
- 11% 21-50
- 7% 51-200
- 5% Over 200

Job Grade/Rank

- SES: 2%
- GS/GM-15: 16%
- GS/GM-14: 16%
- GS/GM-13: 25%
- GS/GM-12: 21%
- GS/GM-11: 10%
- Colonel: 1%
- Lt. Colonel: 1%
- Major: 1%
- Other: 7%

62% of respondents are GS/GM-13 or above

66% of respondents oversee at least 1 direct report
Survey Respondent Profile

• Respondents include executives from various areas of responsibility. The largest group of managers work in operations, followed by technical and finance occupations.

• Most managers are civilians employed by the Department of Defense. However, a portion (17 percent) are veterans now serving as managers in the DoD.

Area of Responsibility

- Operations: 38%
- Technical: 25%
- Finance: 24%
- Agency Leadership: 12%
- Other: 9%
- Human Capital: 8%
- Information Technology: 8%
- Facilities and Fleet Management: 6%
- Legislative: 3%

Personnel Makeup

- Civilian: 80%
- Veteran: 17%
- Military Personnel: 3%

*Percentage of respondents

n= 471*
Respondent Profile: DoD Agencies and Departments Represented*

- Department of the Army
- Department of the Air Force
- Department of the Navy
- Office of the Secretary of Defense (OSD)
- Defense Contract Management Agency (DCMA)
- United States Marine Corps
- Defense Contract Audit Agency (DCAA)
- Defense Finance and Accounting Service (DFAS)
- Defense Logistics Agency (DLA)
- Defense Intelligence Agency (DIA)
- Missile Defense Agency (MDA)
- Defense Security Cooperation Agency (DSCA)
- Joint Chiefs of Staff (JCS)/Joint Staff (JS)
- Defense Commissary Agency (DeCA)
- Defense Information Systems Agency (DISA)
- Department of Defense Office of the Inspector General (DODIG)
- National Geospatial-Intelligence Agency (NGA)
- National Guard Bureau (NGB)
- National Reconnaissance Office (NRO)
- TRICARE Management Activity (TMA)
- Washington Headquarters Services (WHS)

*Agencies listed in order of frequency
Executive Summary
Respondents note unfavorable views of the acquisition process.
Fifty-three percent of respondents characterize the current acquisition process as not at all efficient. Of those who indicated the process is inefficient, 61 percent are agency leadership. Some of the areas that provide managers the greatest challenge are the lack of clear procurement goals and the requirement generation phase of procurement. Prototyping would help define agency needs by allowing for a testing and remediation phase. In doing so, specifications can be finalized via an iterative process and procurement offices will learn more clearly what they will need to procure in the future. As a result of the benefits, the Weapons Acquisition Reform Act of 2009 (Reform Act) leveraged competitive prototyping as an important fixture for large defense procurement projects.

Potential solutions should incentivize platform modernization and prioritize budgetary rigor while achieving performance parameters.
A strong majority of managers (61 percent) believe their agency would be better suited investing its budget in upgrading existing systems in lieu of purchasing new systems. Further, 68 percent of respondents agree that the rapid pace of technology development creates challenges for procuring new systems. The processes of platform modernization and rapid prototyping could alleviate these concerns. Prototyping holds the potential to drive down costs and speed-up the delivery of systems while achieving performance parameters. In fact, nearly one-third of managers (29 percent) have used rapid prototyping, and of those who have, 93 percent note they have seen a benefit in the acquisition process.

Rapid prototyping offers a more efficient process for defense system development.
The Reform Act requires competitive prototyping in large scale defense acquisitions projects due to its inherent benefits. By using commercially available or pre-approved tools and parts, rapid prototyping can speed up delivery date while delivering full functionality at the end of the prototype cycle. Rapid prototyping has already had significant, proven field success in the areas of improvised explosive device (IED) detection and experts are optimistic that new technological advancements will only make the prototyping process an essential strategy in the federal and defense leader’s toolkit.
Current State of Acquisitions
Process Of Improving Acquisitions Shows Pitfalls

- As a result of the Reform Act, DoD has been making efforts to improve the acquisition process of defense systems.

- About half (46 percent) of respondents indicated that they have not seen any listed improvements. That being said, the RFP process was rated as having the highest incidence of improvement.

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Steps For Improving Acquisition Planning

- Acquisition strategy and request for proposals and review: 36%
- Including quantitative data in cost estimates: 25%
- Pre-engineering and manufacturing development review: 19%
- Competitive Prototyping: 19%
- Implementing production rates affordability analysis: 11%
- None of the above: 46%

Percentage of respondents, n=474

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Acquisitions Considered Inefficient, Leadership Most Critical

- Overall, managers view the acquisitions process as fairly inefficient. And 53 percent of respondents characterize the acquisition process as not at all efficient.

- Those identifying themselves as agency leaders are the most critical of the process, as the largest percentage by respondent group stating the process is “not at all efficient.”

*Percentage of respondents

n=249*

n=474*

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Requirement Generation Phase Creates Challenges for Most Managers

- The largest number of managers are having trouble with requirement generation in the process of acquiring defense systems.

- Other phases scored similarly, with approximately one-third of respondents noting each phase creates challenges for their organization.

Percentage of respondents, n=470
Outside Factors Also Complicate Acquisitions Process

• Managers note facing challenges out of their control. The rapid pace of technological development creates acquisitions challenges for over two-thirds of managers (68 percent).

• Numerous managers also cite the issue of being forced to go through the full acquisitions process for procurements as a challenge. One manager responded:

  “The biggest challenge we face is that we are not buying defense systems, but have to obey rules generated for them…It is unbelievable the hoops we have to jump through to buy a training class or subscription are the same as a major system.”

Rapid Pace of Technology Development Creates Challenges

Percentage of respondents, n=473
No One Challenge Causing Acquisition Problems

- Challenges in the process of acquisition and procurement are widespread. Nearly all tested challenges scored highly, suggesting similar issues plaguing numerous departments.

- Although unclear procurement goals from leadership was rated similarly to other top items, creating clear agendas from leadership may assist in alleviating challenges.

Percentage of respondents, aggregate of “challenging” and “very challenging,” n=429
**Challenges Break-Out**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Not at all challenging</th>
<th>Somewhat challenging</th>
<th>Challenging</th>
<th>Very challenging</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of new system development cycle</td>
<td>5%</td>
<td>15%</td>
<td>32%</td>
<td>39%</td>
<td>9%</td>
</tr>
<tr>
<td>Schedule/cost estimating</td>
<td>4%</td>
<td>21%</td>
<td>39%</td>
<td>32%</td>
<td>5%</td>
</tr>
<tr>
<td>Unclear procurement goals from leadership</td>
<td>4%</td>
<td>19%</td>
<td>26%</td>
<td>45%</td>
<td>5%</td>
</tr>
<tr>
<td>Addressing third-party stakeholder interests</td>
<td>4%</td>
<td>20%</td>
<td>27%</td>
<td>41%</td>
<td>8%</td>
</tr>
<tr>
<td>Interdependency on other systems in system-of-system environment</td>
<td>4%</td>
<td>20%</td>
<td>33%</td>
<td>31%</td>
<td>12%</td>
</tr>
<tr>
<td>Reliance on original equipment manufacturer to modify existing systems</td>
<td>6%</td>
<td>23%</td>
<td>36%</td>
<td>25%</td>
<td>10%</td>
</tr>
<tr>
<td>Cultural barriers between the OSD and military services</td>
<td>9%</td>
<td>22%</td>
<td>24%</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td>Engineering trade-off analysis</td>
<td>9%</td>
<td>34%</td>
<td>29%</td>
<td>14%</td>
<td>14%</td>
</tr>
</tbody>
</table>

*Percentage of respondents, n=465*

**Unclear Procurement Goals, Addressing Third-Party Stakeholder Interests Most Severe Challenges**

- Further investigation of challenges show that unclear procurement goals from leadership was indicated to be “very challenging” the most often at 45 percent.

- Other issues such as length of new development cycle (39 percent) and addressing third-party stakeholder interests (41 percent) were among the most commonly cited “very challenging” items.
The Reform Act: How To Make Acquisitions More Efficient & Cost-Effective
An Acquisitions Solution Must Prioritize Cost and Achieving Performance Parameters

- In order to better understand the current state of acquisitions, respondents were asked to rank order their top program priorities when procuring defense systems.

- Achieving performance parameters and keeping within budget were the top two priorities among managers.

### Top Acquisition Program Priorities

<table>
<thead>
<tr>
<th>Rank</th>
<th>Top Priorities</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achieving performance parameters</td>
<td>34%</td>
</tr>
<tr>
<td>2</td>
<td>Keeping within budget</td>
<td>31%</td>
</tr>
<tr>
<td>3</td>
<td>Agility in meeting changing requirements</td>
<td>20%</td>
</tr>
<tr>
<td>4</td>
<td>Delivering on schedule</td>
<td>17%</td>
</tr>
</tbody>
</table>

Percentage of respondents based on choosing each item to be ranked as number 1, n=447
Respondents Want To See More Improvements

- In 2009, Congress passed the Weapons Systems Acquisition Reform Act (Reform Act) in order to improve the efficiency and cost-effectiveness of the defense acquisitions process.

- Despite the Act, managers see little improvement in major acquisition areas. Fifty percent have seen no improvements. However, almost one-third (29 percent) of respondents reported that accountability and oversight was improved as a result of the Reform Act.

Percentage of respondents “Total”, n=474
Managers Prefer Upgrading Existing Systems Over Purchasing New Systems

- Moving forward, 61 percent of defense managers would prefer leadership invest in upgrading existing systems rather than purchasing new systems.

- In doing so, platform modernization and rapid prototyping techniques can be employed to allow the defense community to get the tools they need without investment in new services.

"My agency should invest more in upgrading existing systems in lieu of purchasing new systems."

Percentage of respondents, n=474
Managers Employing Rapid Prototyping See Numerous Benefits

- Nearly a third of all respondents (29 percent) have been involved in the use of rapid prototyping for a defense system. Of those managers, 93 percent note that rapid prototyping positively impacted their program in some way.

- The most common benefits were refined requirements (54 percent) and reduced technical risks (53 percent), while 50 percent note rapid prototyping helped validate designs for their defense system.

Benefits of Rapid Prototyping

- Refined requirements: 54%
- Reduced technical risks: 53%
- Validated designs: 50%
- Solidified cost estimates: 38%
- Evaluated manufacturing process: 31%
- Other: 19%
- No impact: 7%

93% of respondents who have used rapid prototyping experienced some kind of benefit.
How Experts Make the Business Case for Rapid Prototyping
Using Rapid Prototyping to Stay One Step Ahead

Where have you seen rapid prototyping successfully deployed?
Rapid prototyping is about taking things that are readily available and combining them together to create a new system. Essentially, it’s repurposing and reusing commercially available items to develop a system that the modern warfighter can use. And we’ve had some great success in numerous areas with this process, especially in the area of countering improvised explosive devices (IEDs). This area is unique because of the rate of constant development of new kinds of IEDs, and the variety of explosive mechanisms. Every time we figure out how to counter an IED, the bomb maker has to change his method, so we are constantly having to develop new ways to counter IEDs. And the success we’ve had has translated to a significant reduction in IED related fatalities.

The use of rapid prototyping is specifically mentioned in the Weapon Systems Acquisition Reform Act of 2009. What do you think is driving this need in the defense space?
For a little context, I think it’s important to consider that in the ‘90s, Defense Secretary Perry issued an order that all DoD components should use commercial products when available—and at the time, it was radical. I think the rapid prototyping movement is a similar movement where because of the budgetary pressures there is a radical shift increasing the use of commercial devices in weapon systems. The movement has made the most significant progress in smaller weapon systems programs, such as counter-IED programs, and has yet to break into “big” systems. But that time is coming.

Can rapid prototyping, or related platform modernization technologies such as reverse engineering, help managers overcome the troubling requirements generation phase?
Requirement generation is difficult because it exists nowhere else on the planet, it is totally unique, only the DoD has this process. And it worked well for large aircraft carriers, where you could say, ok, it needs to carry X number of airplanes. But for most weapon systems, this way of thinking about solving a problem is no longer useful. The world, and the threats in it, are changing so fast that requirements are no longer meaningful. Given this rapid pace, managers no longer have the time to both manage personnel, programs, and acquisitions. That’s where rapid prototyping, platform modernization, and reverse engineering come in. Using existing products or platform saves time and money, leaving managers time to focus on achieving the mission.

According to our survey, respondents think the acquisition process is relatively inefficient—how can rapid prototyping help fix something as monolithic as the acquisition process?
Well, there is no silver bullet for this issue. It’s going to take a variety of measures working together to solve the problem. However, rapid prototyping is an important part of that. The problem lots of managers we speak to are facing is that there are hundreds and hundreds of little bottlenecks in the process that attempt to do good things, such as protect the safety of the warfighter. However, all these little steps have become a tangled yarn of requirements that paralyzes programs. What rapid prototyping allows managers to do is use products that have already gone through this process, letting them avoid many of the major bottlenecks that slow delivery time and increase costs.
Solving Business Challenges With Rapid Prototyping

How have you seen prototyping improve business processes in defense organizations?

The current acquisitions process is a very robust, comprehensive process that involves many reviews, reports, and assessments be created. The fundamental concern is that those take a lot of time and energy to generate. And over the course of the project, constantly changing battlefield and threat conditions means there will likely be changes which will complicate the process. Thus, it’s very difficult to plan and execute a given schedule or budget. Rapid prototyping helps address that by getting an initial and partial capability in the hands of users as quickly as possible. It’s an approach that says an incremental improvement in capability in the hands of the warfighter is better than waiting a longer time to get the full capability.

In acquisitions, keeping within budget is the number one priority, according to our survey. What advice do you have for defense leaders who need to stay within budgets?

Put more emphasis and requirements on meeting schedules. Its an old cliché, but time is money. By characterizing an acquisition in terms of “I want an improved capability, but the most important thing is that I want it in six months” will shift the paradigm of how contractors and acquisitions people respond to requests. Asking for the best you can get in six months is also a step in the right direction, and will help you get warfighters and essential personnel necessary tools. Schedule should be viewed as an independent variable, just as cost is an independent variable. When timelines are extended, you end up paying more, and also paying people to do jobs for which they don’t have the right tools – not a wise investment.

What are some of the potential business challenges related to rapid prototyping?

The biggest challenge we find is when users try to bite off more than they can chew. Rapid prototyping has the potential to upgrade or build major weapon systems, but developers tried to bring together all the technologies at once. Instead, they would have been better suited using an incremental approach to prototyping, incorporating complete technologies one or a few at a time. One good example is a case where an organization hoped to develop the next generation ground combat vehicle. There were too many technological advances brought together at once, and developers were unable to get all the components to work together. Had they brought in technologies incrementally, those issues could have been resolved and the development better managed.

What do you see for the future of rapid prototyping in the defense community?

There is already tremendous growth in the use of rapid prototyping. Specifically, I think it will play a bigger and bigger role in combat simulations and combat training, but it can also be used in fields outside of war fighting capabilities, such as space programs or in the automotive industry, so its future is bright. Even system prototyping, fielding internal capabilities, will increase because of the budget pressures. With the drive for efficiency across the federal government, I think we’ll see fewer and fewer new system developments. There will be more emphasis on rapidly getting new capabilities that allow us to react more quickly than if we were to try to develop a whole new design.
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