

DEFENSE PROCUREMENT: FACTORS FOR SUCCESS AND LESSONS FOR THE F-35

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## I. Introduction

The F-35 is intended to be the fifth generation replacement for the US Air Force (USAF) F-16s and the US Navy's F-18s. It has been designed mainly for air-to-ground combat with advanced abilities to counter surface-to-air missiles, and it will cost an estimated \$82 million per aircraft.<sup>1</sup> However, the F-35 has not been without controversy. Most recently, commentator Winslow Wheeler claimed that the estimated costs for the F-35 will increase by \$15 billion.<sup>2</sup> The Pentagon's joint estimate team determined that "current program plans would span sizeable cost growth and schedule delays."<sup>3</sup> With the F-35 still in the development stage in the procurement process, it is important to understand the factors that can affect its successful procurement and procurement of other programs in general.

### *Project Focus*

The focus of this essay is to explore the process of defense procurement. Because the decision-making processes within the Department of Defense, Congress, and White House are often byzantine in nature, it is only natural that questions surface about the factors that may affect the process. From the point of view of the DOD and the defense industry, the most basic question is, "What conditions are necessary for successful procurement?"

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<sup>1</sup> O'Rourke, Ronald. "F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress." *Congressional Research Service*. (16 October 2009). Page 14.

<sup>2</sup> Wheeler, Winston. "Tactical Air's Gloomy Future." *Military.com*. (9 November 2009). <http://www.military.com/opinion/0,15202,205499,00.html>

<sup>3</sup> Bennett, John T. "Carter: Plan Afoot to Halt F-35 Cost Hikes, Delays." *Defense News*. (9 November 2009). <http://www.defensenews.com/story.php?i=4367942&c=AME&s=AIR>

It is important to answer this question not only to shed light on an oftentimes opaque process but also to examine the explanatory power of competing explanations for defense procurement choices. While parochial politics predicts that members of Congress will vote in favor of weapon systems that bring jobs to their districts, organizational politics will predict that choices about procurement are the output of organizational processes.<sup>4</sup> Bureaucratic political theory emphasizes the importance of the individual in the decision-making process while the rational actor model would predict that weapons are procured to respond to specific security threats.<sup>5</sup> By determining the conditions necessary for success, it will be possible to dispel certain myths surrounding the defense procurement process. Identifying these conditions can lead to greater efficiency by helping the DOD and the defense industry to determine where to put their resources and evaluate their business cases and program management processes under a different light. This essay identifies conditions that correlate with success and failure, discusses the policy implications of these conditions, makes policy recommendations, and assesses the F-35.

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<sup>4</sup> Lindsay, James. "Parochialism, Policy, and Constituency Constraints: Congressional Voting on Strategic Weapons Systems." *American Journal of Political Science*. Vol. 34. No. 4. (November 1990). Page 936; Allison 153

<sup>5</sup> Halperin 112; Allison 27

## **II. Hypothesis and Methodology**

### *Hypothesis and Sub-Hypotheses*

This essay tests the following hypothesis:

- There are factors common to successful defense procurement.

In order to test this hypothesis, this essay tests six sub-hypotheses to determine the extent to which there are common factors to successful defense procurement. The dependent variable is success or failure while the independent variables are: spreading production sites across many congressional districts, GAO reports, the availability of cost-effective alternative technologies, demonstrated need, the role of the Secretary of Defense, and cost overruns.

- Sub-Hypothesis #1: Spreading production facilities across a large number of congressional districts correlates with successful procurement.
- Sub-Hypothesis #2: There is a correlation between negative GAO reports and unsuccessful procurement.
- Sub-Hypothesis #3: The availability of more cost-effective alternative technologies correlates with unsuccessful procurement.
- Sub-Hypothesis #4: A demonstrated need is necessary for successful procurement.
- Sub-Hypothesis #5: The support of the Secretary of Defense is necessary for successful procurement.

- Sub-Hypothesis #6: Large cost overrun correlates with unsuccessful procurement.

Taken together, it is possible to distill a list of factors associated with successful procurement. This essay then uses these factors to assess the progress of the F-35 and makes policy recommendations for the F-35 and the procurement process in general.

### *Definitions*

Procurement: systems that are appropriated, authorized, and produced

Successful procurement: systems that reach full-rate or high-rate production and avoid cancellation

### *Case Selection and Criteria*

I use the following three case studies to test the extent to which each sub-hypothesis holds. It is then possible to distill a list of common factors by taking the aggregate of accepted hypotheses.

- F-22 Raptor – failed procurement
- V-22 Osprey – successful procurement
- Mine Resistant Ambush Protected vehicles – successful procurement

I chose these three cases because they span a period of time covering the end of the Cold War through the events of September 11, 2001 and the Iraq and Afghanistan wars. With the change in the international security environment since the end of the Cold War, this time period is relevant for finding lessons that can be applied to future defense procurement. The population from which to choose the case studies for this essay is

large, with approximately \$85 billion in procurement funded in the 2008 Department of Defense Appropriations Act alone.<sup>6</sup> I also chose this set of cases because it includes both successes and failures. This set of cases is not meant to be a comprehensive study of defense procurement over the past 20 years. Rather, these cases provide an insight into the procurement process and can be used as a base for future study.

### *A Different Take on Defense Procurement*

This essay differs from previous works because it uses a typology to identify factors behind the success or failure of defense procurement. It also uses case studies to do a comparative assessment over a period of time that cuts across a range of defense procurement examples in addition to a range of possible explanations. Much of the existing research and literature on defense procurement has sought either to answer why certain systems are procured or to describe the decision-making process behind individual systems.<sup>7</sup> The literature has also often been descriptive in nature. With this in mind, I examine whether there are commonalities in the defense procurement process by doing a comparative study of three cases: the F-22 Raptor fighter jet, the V-22 Osprey tilt-rotor aircraft, and the mine resistant ambush protected (MRAP) vehicle program. For example, Carl Fosnaugh takes a historical approach in describing the development of V-22. While he identifies the key actors involved and describes the dynamics of the decision-making process, it is not meant to be a comparative study that searches for

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<sup>6</sup> Title III. 2008 Department of Defense Appropriations Act. Bill HR 3222. (13 November 2007). [http://thomas.loc.gov/cgi-bin/query/F?c110:7:./temp/~c110dG641P:e26152:](http://thomas.loc.gov/cgi-bin/query/F?c110:7:./temp/~c110dG641P:e26152)

<sup>7</sup> As an example, James Kurth provides four broad explanations (strategic, bureaucratic, democratic, and economic) as to why the United States bought the weapons that it did in “Why We Buy the Weapons We Do.”



common trends. Because the F-22 and MRAP programs are very recent, much of the procurement analysis on these programs has been done by the Congressional Research Service (CRS). Similar to Fosnaugh's analysis of the V-22, CRS analysis has focused on individual systems.

This comparative study searches for common factors and will take each case out of isolation and stovepiped theoretical frameworks. Other authors emphasize one theory or one factor to explain how weapon systems are procured. In "Who Makes Weapons Procurement Decisions?: A Test of the Subsystem Model of Policymaking", Lauren Holland examines the organizational or subsystem level's explanation of defense procurement and argues that the military services are in a preeminent position during the process.<sup>8</sup> Karl Derouen and Uk Heo focus on the president and the defense budget in "Defense Contracting and Domestic Politics." Derouen and Heo conclude that the president is likely to use the defense budget when he needs to increase or gain public approval and that this process does not necessarily coincide with the election cycle.<sup>9</sup>

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<sup>8</sup> Holland, Lauren. "Who makes weapons procurement decisions? A test of the subsystem model of policymaking." *Policy Studies Journal*. v. 24 (Winter 1996).

<sup>9</sup> Derouen, Karl Jr. and Uk Heo. "Defense Contracting and Domestic Politics." *Political Research Quarterly*. Vol. 53 No. 4 (Dec. 2000)

### III. Factors for Analysis

*Sub-Hypothesis #1: Spreading production facilities across a large number of congressional districts correlates with successful procurement.*

That parochial politics are the driving force behind the voting patterns of members of Congress on defense procurements seems to be common wisdom.<sup>10</sup> Robert Higgs goes so far as to say that “members of Congress treat the defense program as a means to serve their own selfish, parochial, and wasteful ends.”<sup>11</sup> Higgs claims that members of Congress strive to bring defense spending dollars back to their home districts in an effort to be re-elected.<sup>12</sup> If this is true, it would make sense for the defense industry to spread the production facilities over a large number of congressional districts in order to appeal to a particular member’s parochial interests.

The idea that parochial interests will drive voting patterns is widespread. Secretary Gates appealed to members of Congress not to let parochial interests affect their votes on the procurement of new weapon systems or the continued funding of systems in the pipeline.<sup>13</sup> Even members of Congress echoed these sentiments in the 1999 Defense Appropriation Act.<sup>14</sup> It is thus important to test whether spreading production across numerous districts correlates with successful procurement.

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<sup>10</sup> Lindsay, James. “Testing the Parochial Hypothesis: Congress and the Strategic Defense Initiative.” *The Journal of Politics*. Vol. 53 No. 3 (August 1991). Page 860.

<sup>11</sup> Higgs, Robert. “Hard Coals Make Bad Law: Congressional Parochialism versus National Defense.” *Cato Journal*. Vol. 8 No. 1 (Spring/Summer 1988); 80

<sup>12</sup> *Ibid.* 81-82

<sup>13</sup> “Congress reacts to Gates’ Pentagon budget shifts.” (7 April 2009). <http://www.cnn.com/2009/POLITICS/04/07/congress.defense/index.html>

<sup>14</sup> 1999 Defense Appropriations Act. Page 12.

The production of the V-22 would appear to support this hypothesis. Boeing and Bell Helicopter are the prime contractors for the V-22, and the production facilities are spread across multiple sites, with fuselage assembly at Ridley Park, PA and final assembly and checkout in Amarillo, TX.<sup>15</sup> In light of Secretary Richard Cheney's effort to cancel out funding for the V-22, Boeing's and Bell's lobbyists emphasized that the V-22 program had contracts with approximately 2,000 companies across 45 states and claimed that the program would create up to 10,000 jobs.<sup>16</sup> At the same time, Boeing and Bell launched a television advertising campaign urging members of Congress to keep the V-22 funded.<sup>17</sup> In Congress, vocal supporters were present in both parties, with the strongest supporters being Senator Arlen Specter (R-PA) then House Speaker Jim Wright (D-TX), with Wright adamantly supporting the V-22 to protect 2,500 jobs in his district.<sup>18</sup> It thus would seem that the parochial interests of Congressional members defeated Secretary Cheney's attempts to cut funding.

Similar to the V-22, the production of MRAPs are spread throughout the country. For example, BAE's Caiman 4x4 alone has production facilities in Ohio, Kentucky, Arizona, North Carolina, Texas, and South Carolina.<sup>19</sup> BAE's family of MRAPs

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<sup>15</sup> "Boeing: V-22 Osprey." [http://www.boeing.com/rotorcraft/military/v22/docs/V-22\\_overview.pdf](http://www.boeing.com/rotorcraft/military/v22/docs/V-22_overview.pdf)

<sup>16</sup> Griffiths, Dave. "Congress May Ram a Chopper Down the Pentagon's Throat." *Business Week*. Page 92. (5 June 1989).

<sup>17</sup> Farhi, Paul. "Weapons Firms Carry Out Ad Blitzes: TV, Print Campaigns Aim to Convince Congress to Keep Programs." *The Washington Post*. Page F1. (20 July 1989).

<sup>18</sup> Ibid.

<sup>19</sup> "BAE Systems Completes Production of Mine Resistant Ambush Protected Vehicles." *BAE Systems*. (20 November 2008)

[http://www.baesystems.com/Sites/GTSElectronicPressKits/Newsroom/autoGen\\_1081020181550.html](http://www.baesystems.com/Sites/GTSElectronicPressKits/Newsroom/autoGen_1081020181550.html)

employs approximately 2,000 employees and sources materials from suppliers in 30 states.<sup>20</sup>

In contrast to the V-22 and MRAPs, the F-22 had a similar production map, but Congress ultimately voted to cut funding. Lockheed Martin was the prime contractor, and Boeing and Pratt & Whitney acted as two major subcontractors. There were major production facilities at seven sites, and there were over 1,000 subcontractors involved across 44 states.<sup>21</sup> As a result, many members of Congress would have had some parochial interests in keeping the F-22 production lines open. Lockheed engaged in a campaign claiming that the F-22 program directly or indirectly affected the employment of some 95,000 constituents across the country.<sup>22</sup>

These efforts to appeal to parochial interests did not succeed. On one hand, Senators Christopher Dodd and Saxby Chambliss both voted against striking funding for the F-22.<sup>23</sup> With Pratt & Whitney's engine production facility in Middletown, CT and Lockheed's production line in Marietta, GA, these votes align with parochial interests.<sup>24</sup> On the other hand, however, all four senators from New York and Illinois voted in favor of striking the F-22's funding, even with three manufacturing sites in New York and two

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<sup>20</sup> "BAE's Diverse MRAP Orders (Updated)." *Defense Industry Daily*. (8 September 2009).

<http://www.defenseindustrydaily.com/bae-wins-2124m-mrap-order-mruv-ambulance-socom-03405/>

<sup>21</sup> Dilanian, Ken and Tom Vanden Brook. "Raptor in Dogfight for its Future: Powerful Critics Take Aim at Costly F-22 Fighter Jet." *USA Today*. Page 6A. (26 February 2009).

<sup>22</sup> *Ibid.*

<sup>23</sup> U.S. Senate Roll Call Votes 111<sup>th</sup> Congress - 1<sup>st</sup> Session on Levin Amdt. No. 1469. (21 July 2009)

[http://www.senate.gov/legislative/LIS/roll\\_call\\_lists/roll\\_call\\_vote\\_cfm.cfm?congress=111&session=1&vote=00235](http://www.senate.gov/legislative/LIS/roll_call_lists/roll_call_vote_cfm.cfm?congress=111&session=1&vote=00235)

<sup>24</sup> "F-22 Raptor: Air Dominance Achieved" *Lockheed Martin*.

<http://www.lockheedmartin.com/data/assets/corporate/press-kit/F-22-Brochure.pdf>

in Illinois directly being affected by this vote.<sup>25</sup> The model of parochial politics would predict that members of Congress would vote in favor of defense spending that brings jobs and funds to the member's constituency. The split in voting on the F-22, however, suggests that parochial interests are not always paramount to members of Congress.

While the case of the F-22 may be viewed as an outlier, previous works of other scholars have said that ideology tends to be the driving force behind congressional voting patterns on defense procurement issues.<sup>26</sup> Moreover, statistical analyses have shown parochial interests are simply not a factor in defense procurement votes.<sup>27</sup> Thus, the effort to spread production sites across a vast number of constituencies will be limited in its efficacy in terms of providing votes for funding.

Result: Sub-Hypothesis #1 Not Supported

*Sub-Hypothesis #2: There is a correlation between negative GAO reports and unsuccessful procurement.*

As the investigative and auditing arm of the legislative branch, the GAO is tasked with investigating issues of interest to members of Congress. GAO reports also often affect the decisions that policymakers make. Baker Spring links recommendations made in the GAO's March 2008 assessment on the DOD's major weapons system acquisitions

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<sup>25</sup> Senate Roll Call Votes on Levin Amdt. No. 1469. (21 July 2009).  
[http://www.senate.gov/legislative/LIS/roll\\_call\\_lists/roll\\_call\\_vote\\_cfm.cfm?congress=111&session=1&vote=00235](http://www.senate.gov/legislative/LIS/roll_call_lists/roll_call_vote_cfm.cfm?congress=111&session=1&vote=00235)

<sup>26</sup> Lindsay 873

<sup>27</sup> Ibid.

to the inclusion of a section on acquisition reform in Rep. Duncan Hunter's National Defense Authorization Bill.<sup>28</sup> Spring also links Senator Carl Levin's proposal to create an office within the DOD to track costs to GAO recommendations.<sup>29</sup> In aggregate, these reports may shift the policy discussion and influence the outcome of an issue up for a vote. It is thus important to test whether a correlation exists between GAO reports and procurement.

The F-22 regularly received negative assessments from the GAO. Consistent themes in the GAO reports included significant delays to testing and development, systems integration issues, and exceeding Congressional cost limits.<sup>30</sup> From 1999 to 2003, GAO reports noted that delays in development constantly necessitated pushing back production and delivery dates.<sup>31</sup> The reports even went so far as to recommend a limit to low-rate production in 2001. Moreover, a 2005 GAO report said that changing threats and mission requirements significantly weakened the F-22's business case.<sup>32</sup> With this in mind, GAO assessments overall of the F-22 can be characterized as mostly negative.

In contrast with the problems with costs and scheduling associated with the F-22, GAO reports have been positive the MRAPs' costs and scheduling during the

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<sup>28</sup> Spring, Baker. "Congress Should Not Permit Negative GAO Report to Curtail Weapons Programs." *The Heritage Foundation*. Backgrounder #2160. (11 July 2008).

<http://www.heritage.org/Research/NationalSecurity/bg2160.cfm>

<sup>29</sup> Ibid.

<sup>30</sup> "F-22 Aircraft: Issues in Achieving Engineering and Manufacturing Development Goals." *GAO* (15 March 1999), "F-22 Development and Testing Delays Indicate Need for Limit on Low-Rate Production." *GAO* (21 March 2001).

<sup>31</sup> Ibid.

<sup>32</sup> "Tactical Aircraft: Air Force Still Needs Business Case to Support F/A-22 Quantities and Increased Capabilities." *GAO* (March 15, 2005)

procurement process. The GAO report published in July 2008 commended the DOD's use of and the defense industry's response to the procurement of MRAPs and the emphasis on using proven and readily available technology.<sup>33</sup> The GAO followed up on this report in October 2009. Again the GAO praised the rapid production and delivery of MRAPs as well as the performance of MRAPs in the field. Both the 2008 and 2009 reports raised concerns over the sustainability of the program. Because MRAP procurement was expedited, indefinite delivery, indefinite quantity contracts (IDIQ) were awarded to nine contractors, resulting in an array of different MRAP vehicles, each with different designs. Because the DOD procured a number of different MRAP models, each needs has its own maintenance and support needs. The GAO highlights the need for the DOD to consider plans for managing emerging maintenance issues. While these concerns were raised, the GAO's assessment was on the whole positive.

While the V-22 suffered delays during its development in the late 1980s and early 1990s, the GAO's assessments raised concerns but did not recommend withdrawing funding from the program. In 1989, the GAO was concerned that minor slippages in the timetables would cause delays but not major delays. This sentiment was echoed in the following year's report when it recommended that the V-22's production be delayed but funding be kept for research and development. Along similar lines, the GAO reports partially attributed those delays to the threats of funding cuts.<sup>34</sup> When Secretary Cheney deleted the V-22 in the DOD budget request in 1990, contractors Boeing and Bell

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<sup>33</sup> "Rapid Acquisition of Mine Resistant Ambush Protected Vehicles." *GAO* (15 July 2008)

<sup>34</sup> "NAVAL AVIATION: Status of V-22 Osprey Full-Scale Development" *GAO* (11 April 1991)

immediately ceased work on development.<sup>35</sup> Because the stability of the V-22's funding was unclear, the GAO regarded it as an extenuating circumstance surrounding the delay, and in this sense, the GAO's assessment of the V-22 was not entirely negative.

GAO reports on V-22 have become more negative with the most recent recommending that the DOD re-consider alternatives to V-22 before continuing with full production.<sup>36</sup> The GAO report did raise concerns about the limitations of V-22. It also stated that the V-22 may not be suitable for all of the missions for which it was originally envisioned to complete.<sup>37</sup> However, in contrast with the F-22, the GAO reports noted that the V-22s in Iraq met expectations and acknowledged that there remains an operational need for them. The GAO assessments overall of V-22 can be characterized as mixed rather than strictly positive or negative.

A program's assessment from the GAO need not be overwhelmingly positive for successful procurement. The MRAPs generally received praise, but the reports still expressed some concerns in the long-term about the program. GAO reports on the V-22 ranged from acknowledging their performance in Iraq to identifying potential limitations. In contrast, the F-22 received generally negative feedback which correlates with unsuccessful procurement.

**Result: Sub-hypothesis #2 Supported**

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<sup>35</sup> Ibid.

<sup>36</sup> "V-22 Osprey Aircraft: Assessments Needed to Address Operational and Cost Concerns to Define Future Investments." *GAO* (June 23, 2009)

<sup>37</sup> Ibid.



*Sub-Hypothesis #3: The availability of more cost-effective alternative technologies correlates with unsuccessful procurement.*

Faced with “a number of fiscal pressures” on the DOD budget, policymakers, particularly members of Congress, have emphasized the need for the DOD to “get the best value for every dollar” invested.<sup>38</sup> In order to determine whether the DOD is making the best investment possible, the DOD is required to investigate the costs, risks, and operational effectiveness of alternative technologies early in the procurement process.<sup>39</sup> Taken to its logical end, if an alternative technology review identifies a more cost-effective or better performing technology, the alternative would be favored over the original system.

The F-22 is a fifth-generation fighter designed with advanced stealth capabilities, greater than mach 2 speeds, and is suitable for air-to-air combat. It costs approximately \$142 million per plane.<sup>40</sup> Concurrently, the F-35 is also being developed as the fifth-generation successor to the F-16 for the Joint Strike Fighter Program. While less sophisticated, it has similar capabilities such as maximum speeds approaching mach 2 and stealth capabilities. It also fares favorably in air-to-air engagements with fourth

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<sup>38</sup> “Defense Acquisitions: DOD Must Prioritize its Weapon System Acquisitions and Balance Them with Resources Available.” *GAO* (18 March 2009)

<sup>39</sup> DOD Instruction 5000.02

<sup>40</sup> Darnell, Daniel J., Mark D. Shackelford, and Raymond E. Johns. *Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives*. (20 May 2009). Page 9

generation fighters.<sup>41</sup> Most importantly, it has a much lower cost at approximately \$82 million per plane.<sup>42</sup> While the F-35 is not meant to replace the F-22, their capabilities are similar enough and the cost savings are high enough to justify to Secretary Gates to end production of the F-22 in favor of more F-35s.<sup>43</sup>

The V-22 has the flexibility of vertical take off with the range of a conventional plane, and final costs are estimated at \$68 million per plane.<sup>44</sup> At the time of initial development, there were no other aircraft that had the same or similar capabilities. When Secretary Cheney attempted to cancel out the funding and proposed that existing helicopters be used for the V-22's missions, he was met with responses that those helicopters were not acceptable alternatives to the V-22.<sup>45</sup> Without an alternative technology available, the branches of the armed forces were able to argue to members of Congress that the V-22 was vital to complete important missions, and Congress ultimately agreed with them.

Similar to the V-22, there were no comparable technologies that would compete with the MRAPs developed and procured in the mid- to late-2000s. When the DOD and the Marine Corps expressed a need for a vehicle able to handle mines and improvised explosive devices (IEDs), the Marines and the Army only had high mobility multipurpose

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<sup>41</sup> "Setting the Record Straight on F-35." (19 September 2008)

[http://www.lockheedmartin.com/news/press\\_releases/2008/0919ae\\_f-35settingrecordstraight.html](http://www.lockheedmartin.com/news/press_releases/2008/0919ae_f-35settingrecordstraight.html)

<sup>42</sup> O'Rourke, Ronald. "F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress." *Congressional Research Service*. (16 October 2009). Page 14.

<sup>43</sup> Stoddard, Ed. "Gates backs Lockheed F-35; cost and schedule key." *Reuters*. 31 August 2009.

<sup>44</sup> FY 2009 Air Force Budget Estimate. (February 2008). Page 133.

<http://www.saffm.hq.af.mil/shared/media/document/AFD-080204-081.pdf>

<sup>45</sup> Gordon, Michael. "Feeling Pressure, Cheney Agrees to Allow Work on Novel Aircraft." *The New York Times*. (3 July 1992). <http://www.nytimes.com/1992/07/03/us/feeling-pressure-cheney-agrees-to-allow-work-on-novel-aircraft.html?pagewanted=all>

wheeled vehicles (Humvees) available. The Army stated that they were not an appropriate alternative to an MRAP because even the uparmored versions of the Humvee did not provide the type of protection that troops needed.<sup>46</sup> The soft-skinned Humvees did not have adequate armor and could not handle IEDs.<sup>47</sup> At the time that the MRAPs were being procured, the joint-light tactical vehicle (JLTV) was not yet developed. While the JLTV and MRAP seem to have similar capabilities, the Army stated that there is no conflict between the two programs. With no competing technologies, the procurement of MRAPs was quick and it looks like the follow-on MRAP II's procurement appears to be secure.

Because there are budgetary pressures, the defense industry and the DOD must justify choosing one technology over another. When there is a cost-effective alternative, it becomes more difficult to justify something much more expensive. However, when there are no alternatives present, there is a positive correlation with successful procurement.

Result: Sub-hypothesis #3 Supported

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<sup>46</sup> Gervais, Maria. "Finding of No Significant Impact for Fielding and Using the Mine Resistant Armor Protected Vehicles at Army Installations in the United States." *US Army*. [http://aec.army.mil/usaec/nepa/mrap\\_impact.pdf](http://aec.army.mil/usaec/nepa/mrap_impact.pdf)

<sup>47</sup> Ibid.

*Sub-Hypothesis #4: A demonstrated need is necessary for a program to be procured.*

The White House has highlighted the need to reform DOD procurements and cut unnecessary or wasteful programs. In an August 2009 speech, President Obama emphasized that he will go against “the impulse in Washington to protect jobs back home [by] building things we don’t need.”<sup>48</sup> Conversely, he said that the White House and DOD would “increase spending on the equipment and weapons our troops do need.”<sup>49</sup> This would suggest that demonstrating an operational need for a weapon system or any other kind of defense product is a necessary condition for successful procurement.

The idea for F-22 was conceived during the Cold War, and its capabilities were designed to fit a particular mission set. The F-22 was expected to engage in air-to-air combat with other fifth-generation fighters, and it was meant to ensure US supremacy in the skies. However, threats to the United States changed. After the Cold War, the United States was unrivaled in terms of air superiority, and the F-22 became a fighter designed to fight a non-existent enemy. The development of Russian fifth-generation fighters remains years away.<sup>50</sup> It then follows that calls to cap orders at 187 and close the production lines pointed to the lack of need. More importantly, those backing the F-22 were not able to articulate the need for such an aircraft. While there were claims for its necessity from the

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<sup>48</sup> Obama, Barack. Speech at the Veterans of Foreign Wars Convention. (17 August 2009). [http://www.whitehouse.gov/the\\_press\\_office/remarks-by-the-president-at-the-veterans-of-foreign-wars-convention/](http://www.whitehouse.gov/the_press_office/remarks-by-the-president-at-the-veterans-of-foreign-wars-convention/)

<sup>49</sup> Ibid.

<sup>50</sup> Cohen, Ariel. “Russia trails US in pursuit of a fifth-generation jet.” *UPI.com*. (14 January 2009). [http://www.upi.com/Business\\_News/Security-Industry/2009/01/14/Russia-trails-US-in-pursuit-of-a-fifth-generation-jet/UPI-35761231951126/](http://www.upi.com/Business_News/Security-Industry/2009/01/14/Russia-trails-US-in-pursuit-of-a-fifth-generation-jet/UPI-35761231951126/)

Air Force and Lockheed Martin, their claims failed to convince key decision-makers such as Secretary Gates and a majority of members in Congress.<sup>51 52</sup>

In contrast to the F-22, the V-22's operational need has been more convincingly demonstrated. Developed in the aftermath of the failed hostage rescue attempt in Iran in 1980, the V-22 was designed for "long-range, high-speed, vertical lift missions ... capable of getting troops into and out of an area in one night."<sup>53</sup> The V-22 has since been deployed on AFRICOM missions, and it was successful in completing its missions in Iraq. While there may be critics who suggest that there is no operational need for V-22 and that it can be replaced by other helicopters and planes, DOD approval to increase orders and Congressional approval for funding suggest that V-22 does address a demonstrated need.

The operational need for MRAPs became clear when US troop casualty rates were increasing due to IED attacks on their Humvees. The MRAPs were designed with a V-shaped hull to deflect explosions away from the vehicle's occupants. Since the MRAPs have been deployed to Iraq, Admiral Michael Mullen noted how they have met an operational need with the MRAPs absorbing more "hits, many, many hits that would have killed soldiers and marines in uparmored Humvees."<sup>54</sup> With an estimated 88% drop

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<sup>51</sup> Wolf, Jim. "US Air Force says needs more F-22 fighters." *Reuters*. (17 February 2009). <http://www.reuters.com/article/marketsNews/idUSN1719852220090217>

<sup>52</sup> Wolf, Jim. "Lockheed F-22 cast as nuclear substitute." *Reuters*. (16 December 2008). <http://www.reuters.com/article/AerospaceandDefense08/idUSTRE4BF5M720081216>

<sup>53</sup> Kreisher, Otto. "Finally, the Osprey." *Air Force Magazine*. (February 2009).

<sup>54</sup> Vanden Brook, Tom. "Roadside bombs decline in Iraq." *USA Today*. (22 June 2008). [http://www.usatoday.com/news/world/iraq/2008-06-22-ieds\\_N.htm](http://www.usatoday.com/news/world/iraq/2008-06-22-ieds_N.htm)

in US casualties attributed to the MRAPs, Secretary Gates ordered an additional 15,000 vehicles, and Congress quickly approved continued procurement.

Result: Sub-hypothesis #4 Supported

*Sub-Hypothesis #5: The support of the Secretary of Defense is necessary for successful procurement.*

The Secretary of Defense holds great influence over the DOD budget and the levels of funding that each program receives. In part, this due to power shifts within the organizational structure of the DOD.<sup>55</sup> There has been a growing trend of power and authority over budgets and resources flowing toward the Secretary of Defense and away from the heads of the individual services.<sup>56</sup> The authority over budgets and resources of the individual services has been diluted with the growing influence of agencies such as the Defense Threat Reduction Agency and the Defense Information Systems Agency.<sup>57</sup> Combined with an organizational emphasis on the joint service model, more influence over resources has been concentrated with the Secretary of Defense.<sup>58</sup>

The F-22 appears to be a case that would support this hypothesis. In early 2009, Secretary Gates announced he intended to cap orders for the F-22 at 187, prompting

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<sup>55</sup> Smith, Perry M. and Daniel M. Gerstein. *Assignment: Pentagon, How to Excel in a Bureaucracy*. 4<sup>th</sup> ed. Dulles, VA: Potomac Books. (2007). Page 131.

<sup>56</sup> Ibid.

<sup>57</sup> Ibid.

<sup>58</sup> Ibid.

Lockheed Martin and its partners to announce that the F-22 production lines would be forced to shut down.<sup>59</sup> With partners Boeing and Pratt & Whitney, Lockheed led a vigorous lobbying campaign, both to Congress and individuals in DOD to keep the F-22 production lines open. However, Secretary Gates affirmed his position and urged President Obama to veto any bill that contained funding for the F-22. Ultimately, Congress approved a defense appropriations bill without F-22 funding.

The procurement of MRAPs for the war in Iraq was similar in the sense that procurement was not successful when Secretary Rumsfeld did not support the program and became successful when Secretary Gates did give his support.<sup>60</sup> In his effort to transform the US military into a lighter, swifter force, Secretary Rumsfeld favored the lightweight Humvees which were more vulnerable to IED attacks.<sup>61</sup> However, seeing the need for MRAPs, Secretary Gates pushed for their procurement soon after being appointed.<sup>62</sup> His support has been consistent throughout the procurement process for the MRAPs, and the procurement has been viewed as successful.

In contrast however, the V-22 is a case where the program did not have the support of the Secretary of Defense. Secretary Cheney twice attempted to cancel the program by not including it in either the FY1990 or FY1991 DOD budget requests,

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<sup>59</sup> Hedgpeth, Dana A. and Steven Mufson. "A Retreat in Spending; As Obama's White House Shifts U.S. Priorities, The Defense Industry Prepares to Retrench." *The Washington Post*. Page D1 (6 February 2009).

<sup>60</sup> "Pentagon dithering turned U.S. forces into sitting ducks." *USA Today*. Page 10A. (17 July 2007).

<sup>61</sup> *Ibid*.

<sup>62</sup> Roosevelt, Ann. "DoD Executing Accelerated MRAP Acquisition, Officials Say." *Defense Daily*. Vol. 235 No. 13. (19 July 2007).

saying that the V-22 missions could be performed by standard helicopters.<sup>63</sup> However, Secretary Cheney was undermined by Marine Corps leaders such as when General A.M. Gray stated that the most pressing requirement was for an aircraft with a medium lift assault capability, the V-22.<sup>64</sup> General C.H. Pitman went further by demanding an aircraft with capabilities that only the V-22 had.<sup>65</sup>

It is important to remember that although the Secretary of Defense holds a powerful position in the DOD bureaucracy, there are other actors such as members of Congress or heads of the military branches that can derail a Secretary's efforts to reform or cut back spending. Laurence Lynn and Richard Smith describe the dynamic between the Secretary of Defense and the inertia of established practices as "an unequal struggle," and they describe what Secretary Gates was able to do and what Secretary Cheney was not in their respective efforts to cut the F-22 and the V-22:<sup>66</sup>

"For the rest of the decisions, the official's best bet is to look for allies wherever they can be found – among factions within the services, in OMB and the White House, in congressional subcommittees, and among influential outside groups and individuals – and to build a constituency for the changes he regards as important."<sup>67</sup>

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<sup>63</sup> Bolckcom, Christopher. "V-22 Osprey Tilt-Rotor Aircraft." *Congressional Research Service*. (7 January 2005). Page 2.

<sup>64</sup> Enoch, John T. "Will the Marine Corps Get the V-22?" *Globalsecurity.org*. (1991). <http://www.globalsecurity.org/military/library/report/1991/EJT.htm>

<sup>65</sup> Ibid.

<sup>66</sup> Lynn, Laurence Jr. and Richard I. Smith. "Can the Secretary of Defense Make a Difference?" *International Security*. Vol. 7, No. 1 (Summer, 1982)

<sup>67</sup> Ibid.



Result: Sub-Hypothesis #5 Not Supported

*Sub-Hypothesis #6: Large cost overruns alone will result in failed procurement.*

In the past, Congress has taken measures to exercise oversight over defense procurement.<sup>68</sup> In the DOD Authorization Act of 1982, Senators Sam Nunn and Congressman Dave McCurdy added an amendment which aimed specifically to control costs during the procurement process. The amendment called for the cancellation of any procurement that went over the original estimated cost by 25%.<sup>69</sup> The most recent attempt to control costs is the Weapon System Acquisition Reform Act passed in May 2009. The Act requires the DOD to establish a Director of Cost Assessment and Program Evaluation for greater oversight.<sup>70</sup> With such measures in place, it is important to test whether large cost overruns alone will result in failed procurement.

The case of MRAPs is an example of successfully procuring the desired number of vehicles within the budget appropriated.<sup>71</sup> Totalling approximately \$22.7 billion, the procurement for the MRAPs was done mainly through supplemental funding bills rather than through the regular appropriations process.<sup>72</sup> Because appropriations through supplemental funding bills have the potential to obscure future costs of procurement, the GAO has raised concerns that the costs for MRAP procurement and maintenance will

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<sup>68</sup> Before the 1960 Russell Amendment, Congress' main oversight tool was funding appropriation. The Russell Amendment required Congress to authorize procurements as well.

<sup>69</sup> 1982 Department of Defense Authorization Act. Title IX. (3 November 1981). <http://www.cdi.org/missile-defense/s815-conf-rpt.cfm>

<sup>70</sup> Weapon System Acquisition Reform Act of 2009. Title I (6 January 2009). <http://thomas.loc.gov/cgi-bin/query/F?c111:5:./temp/~c111wkg1E5:e0>

<sup>71</sup> "Rapid Acquisition of MRAP Vehicles." GAO (8 October 2009). Page 6

<sup>72</sup> Ibid.

exceed current funding levels.<sup>73</sup> However, the MRAP provides an example of controlled costs leading to successful procurement.

In contrast, the F-22's cost overruns in both development and production support this sub-hypothesis. The 2000 GAO report on the F-22's progress toward meeting its performance parameters was optimistic that the Air Force and its contractors could manage the increasing costs because the Air Force had identified more than enough cost offsets to keep the program close to within budget.<sup>74</sup> By 2001, however, the GAO had revised its estimates and predicted that the F-22 would be over budget by \$359 million, and it turned out that the program was \$373 million over.<sup>75</sup> With similar cost overruns over the next several years of development and production, costs were cited by Secretary Gates as a primary reason for the F-22's cancellation.<sup>76</sup>

The V-22 suffered from similar cost overruns to the F-22. In June 1990, the estimated cost overruns were \$250 million over the target cost and \$150 million over the budget ceiling.<sup>77</sup> Over the following year, the V-22's cost overruns jumped with an increase of approximately \$3 billion to the V-22's budget.<sup>78</sup> However, Congress voted to maintain funding both times Secretary Cheney attempted to cancel the program.

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<sup>73</sup> "GAO Warns of Runaway MRAP Costs." *The Associated Press*. (17 July 2008).

<http://www.military.com/news/article/gao-warns-of-runaway-mrap-costs.html>

<sup>74</sup> "Recent F-22 Production Cost Estimates Exceeded Congressional Limitation." *GAO* (August 15, 2000)

<sup>75</sup> F-22 Development and Testing Delays Indicate Need for Limit on Low-Rate Production (21 March 2001)

<sup>76</sup> Jaffe, Greg. "Gates Sharpens Rhetoric in Dispute over F-22 Funds." *The Washington Post*. (17 July 2009).

<sup>77</sup> "The V-22 Osprey--Progress and Problems." *GAO* (October 12, 1990)

<sup>78</sup> "Status of V-22 Osprey Full-Scale Development." *GAO* (11 April 1991)

The contrast between the experiences of F-22 and V-22 suggests that the drive to terminate a program because of cost overruns can be tempered by other factors. While the Nunn-McCurdy Amendment sets 25% as the ceiling for cost overruns before required termination, the amendment also has a loophole that allows programs to continue even with large cost overruns when a program is deemed necessary for national security by the Secretary of Defense or when there are no alternatives available.<sup>79</sup> With this loophole in place, it is possible to push through procurement if either the Secretary of Defense or Congress takes a sufficiently position of support.

Result: Sub-Hypothesis #6 Not Supported

#### *Alternative Explanations*

Instead of a list of factors that correlate with successful procurement, an alternative explanation is the “tipping point” explanation. Malcolm Gladwell defines the tipping point as, “the moment of critical mass, the threshold, the boiling point” where change occurs.<sup>80</sup> In the case of defense procurement, it may be possible to identify the tipping point at which a weapon system is procured regardless of the other factors surrounding it. A program may reach the tipping point when enough money has been spent that canceling the program would cost more than continuing it or when production

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<sup>79</sup> 1982 Department of Defense Authorization Act. Title IX. (3 November 1981).

<sup>80</sup> Gladwell 12

and development are far enough along in the process that restarting would cause significant delays.

Also, the sub-hypotheses that I have tested are by no means an exhaustive list of factors that may affect the successful procurement of a weapon system. I have not included the President as a factor, but I consider the role of Secretary of Defense as a proxy for his influence. The Secretary of Defense submits his budget to the President before being sent to Congress. Once the budget is submitted to Congress, DOD requests can be attributed both to the President and Secretary of Defense. Another possible factor that fell outside of the scope of this essay is the financial contributions that the defense industry's political action committees (PAC) have made toward key decision-makers' campaigns. It is entirely possible that there is a correlation between PAC contributions to members of the Senate and House Appropriations Committees or to the President. These factors can be used as the basis of future research.

#### **IV. Policy Implications and General Recommendations**

*Congress sets rules and expectations that must be met.*

Of the factors in the procurement process that this essay examined, those that correlated either with success or failure related ultimately to Congressional approval. Beyond simply appropriating and authorizing funds, Congress has moved from a pre-1960 “approval and consent” body to one that actively sets rules and expectations during the procurement process.<sup>81</sup> This marks an important shift in the balance of influence among the actors involved in the process. While the determination of costs and need originates with the president, secretary of defense, and military services, there is an added step of needing to weigh Congressional considerations of costs and needs. That the role of Congress in the procurement process has gradually expanded does not necessarily mean that the executive branch or military services have been pushed out in the decision making process. Certainly, the Secretary of Defense and the heads of each military service still develop requirements and award contracts. The DOD and the defense industry must also to orient their processes to meet Congress’ rules and expectations to ensure a successful procurement.

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<sup>81</sup> The Russell amendment to the 1960 Military Construction Authorization Act (Section 412) dramatically changed the defense procurement process. Section 412 provided a requirement for Congressional authorization for principal weapon systems and raised the profile of Congress in a process long dominated by the executive branch and military services. Raymond Dawson cites Section 412 as a watershed moment that “strengthened the access of Congress to processes of policy formulation,” making Congressional support vital for successful defense procurement. For more information, see Raymond Dawson’s “Congressional Innovation and Intervention in Defense Policy.”

*Congress is risk tolerant when a demonstrated need must urgently be filled.*

The cases of the V-22 and MRAPs are examples of Congress tolerating risks in order to fulfill a gap in military technology capabilities. In providing funding for the V-22 when the technology was thus far unproven and immature, Congress showed a willingness to incur increased costs and suffer further delays in order to fill that gap. With minimum but clearly defined requirements provided by the DOD, Congress agreed to provide funding for the rapid acquisition of MRAPs for the Iraq war in 2007. Because Congress has taken a gradually more active stance on procurement issues, the DOD and the defense industry must remember that they must convince members of Congress that there is in fact a need for a given product.

**Recommendation #1: Reconsider multiple production facilities.**

Negative GAO reports correlate with unsuccessful procurement. One factor frequently cited in a negative report is high costs. While cost overruns alone will not necessarily lead to failed procurement, they can lead to a negative report. It is thus necessary to point to a RAND study about spreading final assembly and checkout (FACO) across a number of states. The report concluded that using multiple sites resulted in increased labor and overhead costs and decreased overall efficiency, point particularly to many redundancies that arise with having multiple production facilities.<sup>82</sup>

A number of factors may influence a defense contractor to use multiple production facilities such as contractual obligations to organized labor, low fixed costs at

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<sup>82</sup> Cook, et al. Ch. 2

particular sites, and specialized production lines. However, without a strong correlation between spreading production sites to numerous congressional districts and successful procurement, the defense industry should reconsider this widely used business model and manufacturing structure. Because parochial interests tend not to drive the decision making process for lawmakers, spreading production sites with the expectation of appealing to parochial interests should not factor into the industry's business plan.

**Recommendation #2: Place greater emphasis on proven technologies.**

Another point that GAO reports make is that using unproven technologies usually causes significant delays. A pattern appeared that designs were submitted and approved by the DOD that contained overly optimistic projections about both production capabilities and technological maturity. While it is possible that a product off of the production line will work well after initial testing, GAO reports have indicated that delays usually occur. The defense industry should thus factor more time into their proposals to account for delays in unproven and immature technology. Along similar lines, the DOD should emphasize the use of proven technologies when requesting proposals. This way, those contractors that do factor in more time to use proven technologies should not be penalized.

**Recommendation #3: Differentiate products to respond to operational needs.**

There is an inherent risk in developing two products that appear superficially similar and have broadly similar capabilities. In order to avoid one product cannibalizing the sales of another, it is important for companies within the defense industry to

differentiate their products clearly and to differentiate the missions each was designed to fulfill. As seen with the F-22 and the F-35, this risk is highlighted when there is a significant difference in their prices. In the case of the F-22 and F-35, the message communicated from Lockheed Martin and its partners blurred the differences between the two aircraft. Lockheed trumpeted the air-to-air and air-to-ground fighting capabilities, short take-off and landing features, and stealth technology for the aircraft for the F-22, but emphasized those same capabilities for the F-35.<sup>83 84</sup> Along similar lines, the differentiators between the products must respond to operational needs. Lost among the similarities between the F-22 and the F-35 were the aspects that made the F-22 a superior aircraft. As discussed above, however, that differentiator did not respond to the operational needs of its customers.

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<sup>83</sup> “F-22 Raptor.” <http://www.f22-raptor.com/about/index.html>

<sup>84</sup> “F-35 Lightning” <http://www.lockheedmartin.com/products/f35>



## V. F-35: An Assessment and Recommendations

*The F-35 fulfills a demonstrated need and is a cost effective alternative.*

The F-35 has two factors of the three factors that correlate with successful procurement, a demonstrated need and the lack of a cost-effective alternative. With the F-22's production capped and the production lines shutting down, the need for the F-35 has grown. Together with the F-22, the F-35 will provide for continuing US air superiority, according to Secretary Gates.<sup>85</sup> The F-35 is expected to be fielded in 2011, and its high-rate production will allow the United States to increase the gap between US fifth-generation fighters and both the rest of the world's technology and the size of the rest of the world's fifth-generation fleet.<sup>86</sup>

The F-35's three highly common variants fulfill the needs of the Air Force, Navy, and Marine Corps. It meets the need for an aircraft able to counter surface-to-air missiles and resist jamming.<sup>87</sup> The Air Force version will have conventional take-off and landing while the Navy's will be suitable for carrier take-offs and landings.<sup>88</sup> The Marine's version will be capable of short take-offs and vertical landings.<sup>89</sup>

As discussed in sub-hypothesis #3, the F-35 has been touted as the cost-effective alternative to the F-22. At an estimated \$82 million per plane, it is approximately \$60

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<sup>85</sup> Malenic, Marina. "Gates Questions 'Fighter Gap,' Sees Extended US Air Dominance." *Defense Daily*. Vol. 243. No 55 (17 September 2009).

<sup>86</sup> Ibid.

<sup>87</sup> Darnell, Daniel J., Mark D. Shackelford, and Raymond E. Johns. *Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives*. (20 May 2009). Page 10

<sup>88</sup> Ibid.

<sup>89</sup> Ibid.

million cheaper per plane than the F-22.<sup>90 91</sup> With the F-22 and the F-35 being the only fifth-generation fighter jets, there are no other cost-effective technologies comparable to the F-35.

*GAO reports identify risks.*

The F-35 has not been the subject of many GAO reports, but in the three reports where the F-35 has been a main subject of inquiry, the GAO reports have been more negative than positive.<sup>92</sup> The 2005 report criticized the DOD for making decisions based on incomplete information. The 2006 report raised concerns about concurrent testing and production, judging the method to be risky. The 2009 report identified delays in production. With this in mind, the DOD and the F-35's defense contractors must take steps to either to address the GAO's concerns either by implementing GAO recommendations or finding other ways to reduce risk and minimize delays.

*The Alternate Engine Program should continue.*

One best practice identified by the GAO is the use of competition in procurement. Two engines are currently being developed, the primary Pratt & Whitney F135 and the alternative GE/Rolls Royce F136. Using the successful procurement of MRAPs as an example, competition during the procurement process can result in a more efficient process with better quality and more cost-effective products. The rationale behind a

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<sup>90</sup> Ibid.

<sup>91</sup> O'Rourke, Ronald. "F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress." *Congressional Research Service*. (16 October 2009). Page 14.

<sup>92</sup> See the following GAO Reports: "Strong Risk Management Essential as Program Enters Most Challenging Phase." (20 May 2009); "Recapitalization Goals Are Not Supported by Knowledge-Based F-22A and JSF Business Cases" (16 March 2006); "Status of the F/A-22 and JSF Acquisition Programs and Implications for Tactical Aircraft Modernization." *GAO* (3 March 2005)

competition during the procurement process is that competition provides an incentive to all contractors to develop a better, more reliable product at the lowest possible costs.<sup>93</sup> Without competition, the sole manufacturer lacks the incentive to operate efficiently. The GAO estimates that using competition will likely result in savings equal to or greater than the investment necessary to continue the Alternative Engine Program, approximately \$4 billion.<sup>94</sup>

Another best practice drawn from the MRAP case is the use of proven and mature technologies. While the current engine for the F-35 is promising, there have been problems during tests as recently as September 2009 which warrant the continuation with the parallel program.<sup>95</sup> Because the technology is not yet mature, it is a prudent measure to continue both engine programs until one engine is proven reliable. While the DOD has indicated that it does not want additional funding for an alternative engine, the benefits of competition and hedging against unforeseen failures will allow the program to operate more efficiently and more cost-effectively.

*The F-35 should move to high-rate production.*

The Air Force has proposed accelerating the production of 28 F-35s into FY 2010. It has claimed that accelerating production will result in a cost savings of approximately

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<sup>93</sup> *Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase, Statement of Michael Sullivan, Director Acquisition and Sourcing Management.* GAO-09-711T (20 May 2009). The GAO report concluded that “competitive pressures could yield enough savings to offset the costs of competition over the JSF program’s life.”

<sup>94</sup> *Ibid.* Page 4

<sup>95</sup> Drew, Christopher. “Mishap Raises Questions about Pratt and Whitney F-35 Engine.” *The New York Times*. (14 September 2009). [http://www.nytimes.com/2009/09/15/business/15engine.html?\\_r=1](http://www.nytimes.com/2009/09/15/business/15engine.html?_r=1)

\$500 million over the life of the program.<sup>96</sup> Moreover, the F-35's design and most of its technology are proven and mature.<sup>97</sup> While there have been problems with the Pratt & Whitney F135 engine, the continuation of the Alternative Engine Program will guard the program's progress from issues with a single supplier. Projected to meet its Key Performance Parameters, the F-35 has had good flight test results.<sup>98</sup> It is important to note that the GAO has concluded that the F-35's production processes are still immature.<sup>99</sup> However, the potential cost savings are significant, and operational needs will be met more quickly.

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<sup>96</sup> O'Rourke, Ronald. "F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress" *Congressional Research Service*. (16 October 2009). Page 57

<sup>97</sup> Ibid. Page 57

<sup>98</sup> Ibid. Page 58

<sup>99</sup> Ibid. Page 59

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