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Designing and Managing Successful International Joint Development Programs

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Panel 19. Organizing for Success: Managerial and Staffing Considerations

Thursday, May 5, 2016	
1:45 p.m. – 3:15 p.m.	**Chair: Reuben Pitts,** President, Lyceum Consulting, LLC ***Organization Analytics: Taking Cost-per-Dollar-Obligated (CPDO) Measures to the Next Level in Defense Contracting*** Timothy Reed, Principal Director, Beyond Optimal Strategic Solutions James Keller, Business Center Head, USMC Operations Analysis Division John Fallon, Professor, Villanova University ***Assessment of Navy Contract Management Processes*** Rene Rendon, Associate Professor, NPS ***Designing and Managing Successful International Joint Development Programs*** Andrew Philip Hunter, Senior Fellow and Director, Defense-Industrial Initiatives Group, CSIS Gregory Sanders, Deputy Director and Fellow, Defense-Industrial Initiatives Group, CSIS Samantha Cohen, Research Assistant, Defense-Industrial Initiatives Group, CSIS

Designing and Managing Successful International Joint Development Programs

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Abstract

International joint development programs are important because of their potential to reduce costs and increase partnership benefits such as interoperability, economies of scale, and technical advancement. However, the performance of international joint development programs varies greatly. This paper compares the best practices of international joint development and domestic development programs through case-study analysis to identify the key variables that contribute to a program's eventual success or failure and to understand the elements that are crucial to managing these programs.

Introduction

The DoD recognizes the value of international joint development programs that include both research funding from and technology development with multiple countries. This is especially true in light of the Budget Control Act of 2011, which imposed caps on defense spending concurrent to European defense budget reductions. Additionally, the Defense Strategic Guidance issued in January 2012 commits the United States and the DoD to strengthening partnership with and cooperation in the global community by emphasizing pooling, sharing, and specializing capabilities with partner nations (DoD, 2012b). Furthermore, the *International Cooperation in Acquisition, Technology, and Logistics Handbook* states that when considering the pursuit of an international joint development program, the Milestone Decision Authority must consider whether a program executes "demonstrated best business practices, including a plan for effective, economical, and efficient management of the international cooperative program" (Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, 2012). While the value of

international joint development programs is recognized, a theoretical basis for best practices in these programs is a paucity.

International joint development is not a novel idea. However, there is not yet consensus on what the design and management of successful international joint development programs looks like. The theoretical benefits of joint development projects include reduced costs, improved international cooperation, increased competition, and innovation. While unique combinations of these benefits drive each international program, most nations turn to international cooperation in defense acquisition to appease budget pressures and procure advanced programs that individual nations cannot financially afford. Utilizing the existing literature on best practices in both single nation and international joint development programs, this report investigates whether best practices have been actualized and what characteristics in the design and management of such programs equate to different outcomes.

Through evidence garnered from acquisition literature, the study team has established eight characteristics that are crucial to program outcomes. This report conducts an initial analysis of how the eight characteristics affect program outcomes. This interim report compares these characteristics over three initial cases, and three additional cases will be included in the full technical report. The three initial cases included in this interim report are the North Atlantic Treaty Organization (NATO) Alliance Ground Surveillance (AGS) program, the Joint Strike Fighter F-35 Lightning II (F-35) program, and the Lightweight 155mm Howitzer (M777) program.[1] For this analysis, the study team focused on defining the program characteristics that contribute to each program's challenges and successes. For the final technical report, the study team will build upon this research to develop a framework that will help guide future international cooperation in defense acquisition.

Methodology

To bolster the analysis, the study teem seeks to answer the research questions raised below. To achieve this, the study compares the defined best practices from acquisition literature with what the case studies have actualized by discussing what characteristics research has shown as crucial to international joint development program outcomes. The study team investigates these characteristics by interviewing program stakeholders from industry and government, as well as outside experts. Next, the study team uses the information gleaned from the interviews to assess the validity of the literature-derived hypotheses defined below. Lastly, the study team analyzes three cases to better understand the elements critical to managing and designing successful international joint development programs.

Research Questions and Hypotheses

In order to investigate the best practices of designing and managing international joint development programs in defense acquisition, the study team focused on two overarching research questions:

[1] The other three cases that will be analyzed in the final technical report for this study are the Medium Extended Air Defense System (MEADS), the Airbus A400M Atlas, and the Standard Missile-3 Block IIA program.

1. What are the characteristics of international joint development programs that result in positive or negative cost, scheduling, and end-product outcomes, such as a final product, interoperability, technical relevance, and development of existing defense industrial bases?[2]
2. How are best practices of international joint development programs in defense acquisition different from best practices of single-nation acquisition programs?

Additionally, four hypotheses are proposed to form a baseline for this analysis. These hypotheses were derived from a review of the existing literature on international joint development. This interim report will analyze these hypotheses to the extent feasible at this point in the research. The hypotheses are as follows:

1. The structure of cooperation in international joint development programs matters—the international joint development programs whose stakeholders cooperate only during the development or production phases will have less successful cost, scheduling, and end-product outcomes.
2. International joint development projects that are more grounded in security policies rather than economic efficiency interests are more likely to result in negative cost, scheduling, or end-product outcomes.
3. Countries that have cooperated in defense acquisition before have a higher chance of achieving positive cost, scheduling, and end-product outcomes.
4. Countries that are uniquely capable of producing complex acquisition programs benefit from working with smaller countries or industries who may have comparative advantages in certain technologies, but do not have the capacity to produce complex acquisition programs on their own.

Interviews With Program Stakeholders

The study team interviewed stakeholders from government and industry, as well as key leaders from research organizations to augment the information gleaned from the literature. The interviews focused on investigating which characteristics, out of the eight characteristics described in the section titled Case Study Analysis: Characteristics, each case manifested in addition to addressing the research questions and hypotheses. The interviews were accompanied by a Likert-scale survey to determine which characteristics the cases demonstrated. The survey results will be discussed in the section titled Case Study Analysis: Analysis. Figures 1–8 represent the results of the survey. Figures 1, 2, 4, 5, and 6 display the percentage of interviewees that voted for each response level. Figures 3, 7, and 8 report the percentage of interviewees that voted for each response level for two related questions. The questions are indicated on the y and x axes.

Case Study Analysis

While the full technical report for this study will go into greater detail on each case's history, this paper will touch upon key instances where there is evidence that the design and management of the program affected what actually happened, whether it be a success or a

[2] End-product outcomes are subjective to each case and successful end-product outcomes for each case will change depending on the purpose and goals of the program.

failure. When discussing the outcomes of the programs, the identified characteristics crucial to successfully designing and managing programs that are unique to international joint development programs will be analyzed to further investigate which characteristics are attributable to whether the program achieved its goals.

The NATO Alliance Ground Surveillance Program

The first inklings of the AGS program began in the early 1990s when NATO's Defense Capabilities Initiative (DCI) called for both higher standardization and interoperability of NATO alliance equipment and using cooperative development and production to realize the theoretical economic and technological benefits cooperation presents. Additionally, the United States' use of the Joint Surveillance Target Attack Radar System (JSTARS)[3] during Operation Desert Storm in 1991 accentuated the paramount role intelligence, surveillance, and reconnaissance (ISR) capabilities played in next-generation warfare (Chao, 2004). The original proposal for the AGS program was a "NATO-owned and operated core AGS capability, supplemented by interoperable national assets" (Chao, 2004, p. 5). Interviewees emphasized that when making decisions throughout the program, decision makers needed to ensure that there was a European face on the project, and that it was an inclusive NATO program.

It was not until 2009 that the 15 NATO partners signed a Program Memorandum of Understanding (PMOU) agreeing to the legal and budgetary framework for acquiring AGS (NATO, 2009). During the 14 years it took for the program to go from inception in 1995 to a PMOU in 2009, numerous factors were collectively responsible for the delayed beginnings of the program. In 2007, financial circumstances put pressure on defense budgets in Europe that lead NATO to buy off-the-shelf Global Hawk Block 40 RQ-4s with Multi-Platform Radar Technology Insertion Program (MP-RTIP) radars while the ground segment would be developed and procured by the European and Canadian partner nations (NATO, 2016).

The Joint Strike Fighter F-35 Program

The Joint Strike Fighter (JSF) program began in 1995 as the latest iteration of the Joint Advanced Strike Technology (JAST) program. JAST, which was initiated in 1993 following the bottom-up review of U.S. defense programs and policy, was originally designed to provide replacements for both the Navy's A-6 Intruder attack aircraft and the Air Force's F-16 Fighting Falcon multirole fighter. Two years later, an advanced short takeoff and vertical landing (ASTOVL) craft that was being developed by the Defense Advanced Research Projects Agency (DARPA) was congressionally directed to be incorporated into the JAST program, which would later be renamed the Joint Strike Fighter program.

Two years after Lockheed Martin was awarded the prime contract for the F-35 program in 2001, the Government Accountability Office (GAO) succinctly reiterated the purpose of the F-35 program: "The JSF program goals are to develop and field a family of stealthy, strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with maximum commonality to minimize life-cycle costs" (Walker, 2003, p. 49). Furthermore, a major factor that influenced the international partner nations to join this program was to not only reap the anticipated operational and monetary benefits, but to develop a stronger

[3] Northrop Grumman's E-8 JSTARS is an aircraft designed to conduct ground surveillance, command and control, and battle management.

relationship with the United States and to play a role in future strategic and military collaboration.

In 2009, then-Under Secretary of Defense for Acquisition, Technology, and Logistics, Ashton Carter, issued an Acquisition Decision Memorandum (ADM), which led to the rescinding of Milestone B certification for JSF. This followed the release of the JET II report by DoD's Joint Estimating Team, which noted that JSF's system development and demonstration (SDD) phase would need an additional 30 months to complete, and JSF's 2010 Nunn-McCurdy breach (Gertler, 2014, pp. 9, 29). Additionally, the F-35 Program Executive Officer commissioned a technical baseline review (TBR) that led the Secretary of Defense to announce that testing of the F-35A and F-35C would be de-coupled from testing of the F-35B (DoD, 2010, p. 4). The review noted that the F-35B was experiencing "significant testing problems" and placed the program on "the equivalent of a two-year probation" (Gertler, 2014, p. 31) that was lifted January 20, 2012 (DoD, 2011, p. 5).

According to the 2015 Director, Operational Test and Evaluation (DOTE) report, the greatest challenge the F-35 faces today is affordability (DoD, 2015). While cost baselines, schedule projections, and technical capabilities have consistently not been met, the program has reestablished its baselines and recently shows progress in punctuality. For instance, according to the 2015 DOTE report, the number of 2015 actual test flights[4] was only 7.4% below the scheduled amount. Compared to 2012, when only 34% of the planned flight tests had actually been executed, a 7.4 percentage point difference is a large improvement (DoD, 2012a). Cost performance is also improved since 2012.

The Lightweight 155mm Howitzer M777 Program

The M777 was designed to replace the M-198 Howitzer, previously used by both the U.S. Marine Corps (USMC) and the U.S. Army (USA), by introducing a lighter machine capable of higher fire speed and accuracy rates. M777's request for proposal (RFP) stated that the platforms competing for the contract would first be presented at Yuma Proving Ground on April 25, 1996, and that the companies who were able to provide a platform that met the operational requirements detailed within the RFP would compete in a shoot-off and evaluation phase (U.S. Marine Corps and U.S. Army, 1999).

The team of Textron and VSEL won the Engineering, Manufacturing, and Development (EMD) contract in March of 1997. Textron dropped out in 1998 and VSEL experienced some challenges in adapting to the American systems engineering process, which led to an initial delay pushed as VSEL restructured pre-production systems engineering tasks, and resulted in a program cost growth of $43 million. This restructuring also generated a 21-month program delay, from December 1999 to September 2001 (Government Accountability Office [GAO], 2000, pp. 7–8).

In 1999, BAE Systems became the new M777 prime contractor when it acquired VSEL. BAE quickly began to encounter manufacturing challenges with the M777, many of which were driven by problems with titanium welding on the M777. Despite these challenges, M777 has found a larger market, suggesting a successful end-product outcome. In the initial conceptualization of the program, it was planned that the Marine Corps and Army would be the only groups to acquire the platform. However, in the past decade the

[4] As of November 2015

United States has utilized foreign military sales (FMS) to provide the M777 to allies across the globe following the M777's successful deployment in Afghanistan and Iraq.

Characteristics

In order to address the first research question,

> What are the characteristics of international joint development programs that result in positive or negative cost, scheduling, and end-product outcomes such as a final product, interoperability, technical relevance and development of existing defense industrial bases?,[5]

the study team identified eight characteristics that research and interviews with stakeholders have shown to be the most crucial and unique to impacting outcomes of international joint programs:

1. Integration
2. Number of Participating Countries
3. Decision Making
4. Commitment
5. Flexibility
6. Alignment of Operational Needs
7. Tradeoff between Leading-edge Technology and Cost
8. Workshare Distribution

The first characteristic is integration. As part of a Center for Strategic and International Studies (CSIS) project on complexity, Jeffrey A. Drezner, a senior policy researcher at RAND Corporation, discussed how organizational complexity is inherent in modern acquisition programs. Drezner (2009) stated that, "Organizational complexity addresses the structures and interactions of the government and industry organizations responsible for system design, development, production, and support" (p. 32). One complex aspect unique to international cooperation is the transnational partnerships that must be made for governments and industries to work together. Consequently, deeper layers of complexity exist: first, between governments; second, between government and industry; and third, between industries. In 2003, GAO published a report that argued "[t]he collaborative relationship between the customer and the product developer is essential to driving down operating and support costs" (p. 6). This study decided to focus on transnational relationships by analyzing the level of integration between the players involved.

The second characteristic is the number of participating countries. In 2012, defense economist Keith Hartley claimed that the number of partner nations in acquisition programs is associated with collaboration inefficiencies. Furthermore, the increasing number of partner nations adds additional layers of complexity.

The third characteristic is whether decision making throughout the program depended more on operational needs that could not be met by competing systems or on

[5] End-product outcomes are subjective to each case and successful end-product outcomes for each case will change depending on the purpose and goals of the program.

diplomatic and political needs. Major program decisions, such as those on requirements or contracting, are either based on operational needs, or political and diplomatic needs. Making decisions based on operational needs that could not be met by competing systems is more likely to achieve efficient costs and resource allocation, while decisions based on political or diplomatic demands might not reach the most cost-efficient outcomes (Hartley, 2012, p. 20).

The fourth characteristic is commitment. For programs to achieve the theoretical cost benefits of international joint development, partner nations need to be committed to the program. If one country defects, costs for the remaining countries will rise. Additionally, lack of commitment is a major warning sign that can lead to program failure.

The fifth characteristic is program requirements and the program's flexibility to respond to changing environments. The volatile technological and security environments of today require programs that can quickly change in response to emerging innovation and threats. Therefore, the management of programs must have the capacity to respond to changing environments without necessitating the termination of the program.

The sixth characteristic is the extent to which operational goals of partner nations involved align. Having multiple militaries working together could introduce varying operational goals. In order to produce a successful end-product, partner nations need to have compatible goals so that the program stays focused and partner nations are equally invested in acquiring the capability.

The seventh characteristic is whether the program was based on demand for leading-edge technology or based on demand for affordability. There is a tradeoff between achieving leading-edge technology and affordability structures, specifically economies of scale. Economies of scale exist when the scale of output increases to a point where the average per-unit costs of production begins to decrease. The exceptionally high cost of research and development (R&D) in modern defense acquisition is crucial to procuring technologically advanced capabilities. While the costs of R&D exhibit unremitting growth, the funds necessary to support R&D have shrunk in the United States and in U.S. partner nations. It is difficult to determine whether economies of scale will be achieved for a program from the outset. If a program decides to procure a system from scratch, it is not certain that the outcome will be successful enough to produce an adequate return on the initial investments made during R&D. This is increasingly risky if the program aims to procure leading-edge capabilities. Economies of scale are impossible to achieve before a final product has been developed and production has begun. It is uncertain whether a program based on leading-edge technology will reach levels of production that create cost-efficient output. International cooperation during development presents the opportunity to share costs of R&D over participants. From the outset, however, a program should elucidate whether the key mission is to achieve leading-edge technology or economies of scale.

The eighth characteristic captures how the program distributes workshare. To achieve cost-efficient outcomes, international programs present greater opportunity for competition based on comparative advantage. Competition is critical to achieving cost-efficiency because when there are many substitutable choices for consumers to choose from, suppliers will be forced to produce at the lowest cost possible since consumers will choose to buy the lowest-priced product. The international marketplace presents greater opportunity for competition among industries, which in turn supplies procurement at lower costs to the buyer. However, the international marketplace also introduces greater political and industrial-base variables into the equation. Costs are not typically the sole incentive for nations to participate in international cooperation in defense acquisition. Countries view strategic posture, trade policy, industrial gain, and technology transfer as spillover benefits

to international cooperation. In some cases, these spillover benefits are more important to a country than cost-efficiency. Focusing on spillover benefits more than focusing on cost-efficiency will impact program outcomes and impact how countries work together.

Consequently, the last characteristic crucial and unique to impacting outcomes of international joint programs is whether the distribution of workshare was based on participating countries' comparative advantage or on political or industrial-base goals.

Analysis

Integration

For the integration characteristic, the study team asked the interviewees, "On a scale of one to six, rate the level of integration between government and industry, governments, and industries for each program." The responses are reported in Figure 1.

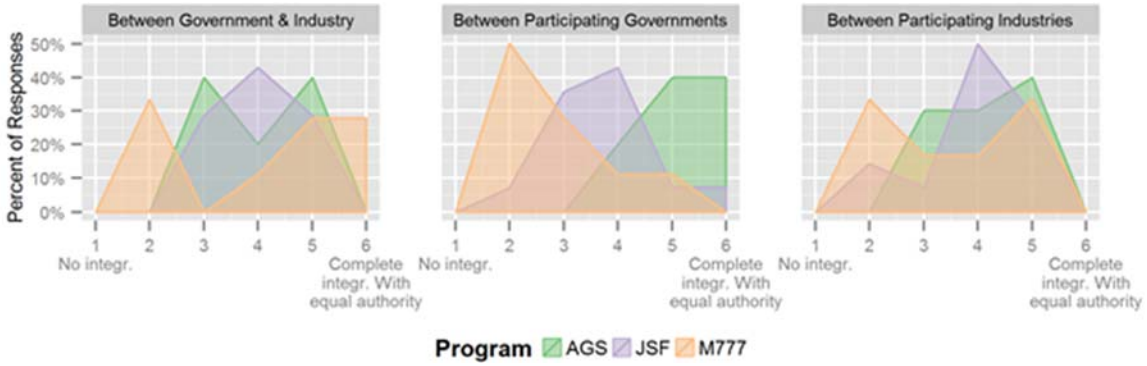

Figure 1. Extent of Integration

The AGS and the F-35 programs practiced similar levels of integration between government and industry, while the M777 program was reported as more integrated by the majority of survey respondents. For the M777 program, a higher level of integration between government and industry existed because the government made the final decisions while there was collocation of employees from both government and industry where the two participating bodies would consult before final decisions were made. This colocation increased during production. For the F-35 program, the contract was more of a top-down relationship in terms of decision making. The level of relationship between government and industry often depended on the company in question, but the government was in charge of the program for all companies. For AGS, the relationship between government and industry was very strong and positive in some instances, but in other cases caused problems for the program. The most notable and positive relationship was between NATO and Northrop Grumman (NG), who consulted regularly from the outset. For other companies, the integration between industry and government occurred domestically. Due to the fact that each country wanted to secure its own investments, issues arose because it was difficult to create work for every country based solely on investment levels. Without higher levels of transnational integration, certain countries viewed that the level of their industries' workshare was not worth the costs and defaulted from the program.

The reported level of integration between governments for the three programs varied greatly. For the F-35 program, the most frequently chosen level was "decision-making integration." The partnership between the governments involved in the program was not legally binding but did implement obligations that represented formal commitments between the partners. The decision-making mechanism between the partner nations was dominated by the United States, which had 80% voting power, while the other partners shared the

remaining 20%. The UK, which was the first partner nation involved, however, could levy requirement alterations because of its tier-one status.[6] At the outset of the partnership, countries determined what was on their "must-have" and "nice-to-have" lists. Despite the unequal share of voting power and the eventual exclusion of most "nice-to-have" items, there have thus far been minimal defections and one interviewee argued that most partner nations were satisfied with at least one F-35 variant on an operational level. In addition, there were instances where non-U.S. partner nations teamed up to push for an operational requirement not initially planned by the United States. The mechanism encouraged the U.S. military branches and the partner nations to each coordinate their opinions before facing one another.

For the NATO-operated AGS program, the survey responses for integration between governments were both higher and less variable as can be seen in Figure 1. NATO's historic establishment as an intergovernmental organization bolstered AGS' achievement of high integration between governments. Decisions made on the AGS program were consensus-based with equal voting power for each partner nation. The study team did find, however, that formal voting arrangements did not always translate into how decision making works in practice. In a consensus-based voting mechanism, notionally every nation comes to the table with an equal stake in achieving their goals. In reality, there are the strong players and the followers during decision making. Typically, newly ascended or smaller partner nations fall into the latter category. When the larger contributing nations reached consensus, the other participating nations were generally quick to follow. Additionally, when there was disagreement between the larger players, delays could and did happen. Holdout partners could be outmaneuvered as long as the remaining nations all agreed, but escalation to direct contact between national leadership was sometimes necessary to resolve disagreement. While NATO as an organization has a strong institutional memory, throughout the first 15 years of the program there was not a standing office for joint acquisition. Instead, the designated NATO equivalent to a program office—the NATO AGS Management Agency (NAGSMA)—was not created until the PMOU was signed in 2009. This late organization standup cost the program the benefits of institutional memory because NAGSMA had not been present during the previous 14 years of the program.

For the M777 program, the United States established and built the program, and while the United States consulted with the other nations involved, the program was ultimately U.S.-led with unilateral decisions on requirements. International cooperation evolved when other nations decided that this program fulfilled their operational needs and joined the program. The partner-nation governments each had a representative collocated in the U.S.-based program office, but these foreign representatives were there for information gathering, rather than for sharing leadership.

For the integration between industries in the AGS program, the prime contractor, NG, controlled intra-industry relations. The AGS program was developed on the concept that cost share equaled workshare. Some experts argue that this concept contributed to the drawn-out, 14-year process of choosing the platform and signing the PMOU. Since European industry wanted access to U.S. technology, it was less desirable for the European

[6] Tier levels were made based on investment levels. The UK is the only tier-one partner nation and is the partner nation who has invested the most money after the United States.

partner nations to choose a platform manufactured by the United States because of U.S. hesitancy to share technology. This meant that, with a U.S. platform, there was not a sufficient ratio between cost and workshare. However, from the outset of the program, NG wanted to not only become the prime contractor for the AGS program, but to build a stronger relationship with European industry. To do this, NG built personal and professional relationships through consultation with a "we're all in this together" attitude. Once the Global Hawk was chosen for the air segment, NG held responsibility for the intra-industry relations. From a U.S. perspective, any arrangement of industry cooperation was acceptable, as long as it lead to the best value.

The industries involved with the F-35 program had integrated decision-making processes; however, commercial tension between industries existed because of competition. Consequently, industries were less integrated during development and production. However, higher levels of integration during sustainment is anticipated, and tensions over competition appear likely to fade. One of the interviewees reported that, governments were more inclined to share information and work together than the industry partners.

For industry integration during the M777 program, one respondent marked the lowest value out of the three programs for this response. Interviewees, however, indicated that the prime contractor, BAE Systems, had regular consultation on decisions between the other industries involved. The prime and sub-contractors were more integrated here because BAE Systems controlled contracting with the sub-contractors. Regular consultations occurred between contractors when developing the system and throughout manufacturing. This was crucial for cutting-edge technologies. However, as the program matured, consultations happened less frequently.

Number of Participants

For the number of participating countries characteristic, the study team asked the interviewees, "On a scale of one to six, rate the extent to which the number of countries involved with the program impacted major decisions." The results are displayed in Figure 2.

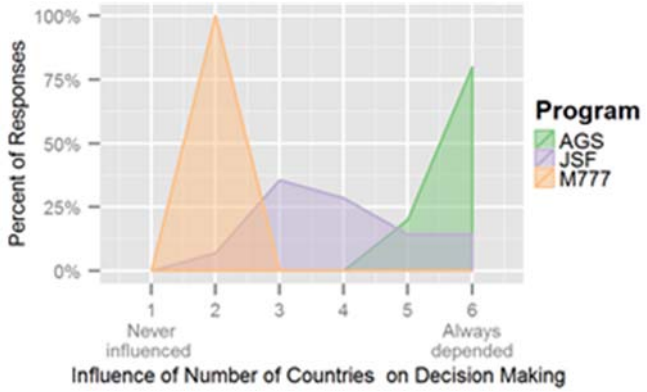

Figure 2. Number of Participating Countries

The number of countries participating in the AGS program varied from inception, and today 15 countries officially participate in the program.[7] In terms of participating countries, the AGS program has the highest number out of the cases analyzed for this study. Multiple interviewees discussed the program's core need to be an Alliance program with a European face. Furthermore, from the outset, the program wanted to include as many nations as possible while staying cost effective and maintaining operational requirements. Consequently, the number of nations involved always impacted the program, mirroring what the interviewees said. The core program characteristics of putting a European face on the program and including as many Alliance member-states as possible influenced many of the twists and turns the program took over its 20+ years of existence. Every decision made had to support inclusion and diversity at the same time that it satisfied each partner nation's investments and national interests; for instance, the United States originally offering JSTARS for the air segment faced political backlash. The United States then offered to use JSTARS radar technology on an Airbus aircraft. This caused further problems with technology gains desired by the EU and was ultimately an unsuccessful solution. Although the influence that the number of countries had on decision making throughout the program presented challenges, the large number of participating nations also kept the program moving forward. One expert from government noted that if there had been fewer partner nations, the program would have been more likely to fall apart because it would have lacked the broad political support within NATO to push the program forward.

Similarly, multiple interviewees from the F-35 program argued that the higher number of countries participating in the F-35 program prevented the program from being cancelled in the face of challenges. Unlike the AGS program, the experts interviewed responded very differently from each other on the characteristic describing the number of participating countries in the program. The study team has concluded that the varied responses for this characteristic can be attributed to different perspectives from different partner nations. Unlike the NATO-driven AGS program, the F-35 program is U.S.-centric. The United States is harder to integrate with for many of the participating nations because of the size and technical edge of the U.S. defense industrial base as well as technology transfer laws. Historically, the UK, Canada, and Australia have an easier time with this because of the long-term relationship that they have had with the United States and information sharing. Consequently, some partner nations feel that the sheer number of participants influenced decision making during the program, while other partner nations do not view the number of participants as a unique driver of decision making.

The interviewees for the M777 program unanimously chose "slight influence" for how the number of participants affected decision making during the program. The small number of partner nations coupled with the U.S.-centric program left little room for the number of partners to cause complications.

Decision Making

For the decision making characteristic, the study team first asked the interviewees, "On a scale of one to six, rate the extent to which decisions regarding the program were made depending on operational needs that could not be met by competing systems."

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[7] Bulgaria, Czech Republic, Denmark, Estonia, Germany, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Romania, Slovak Republic, Slovenia, and the United States.

Second, the study team asked, “On a scale of one to six, rate the extent to which decisions regarding the program were made depending on diplomatic or political needs.” The results are in Figure 3.

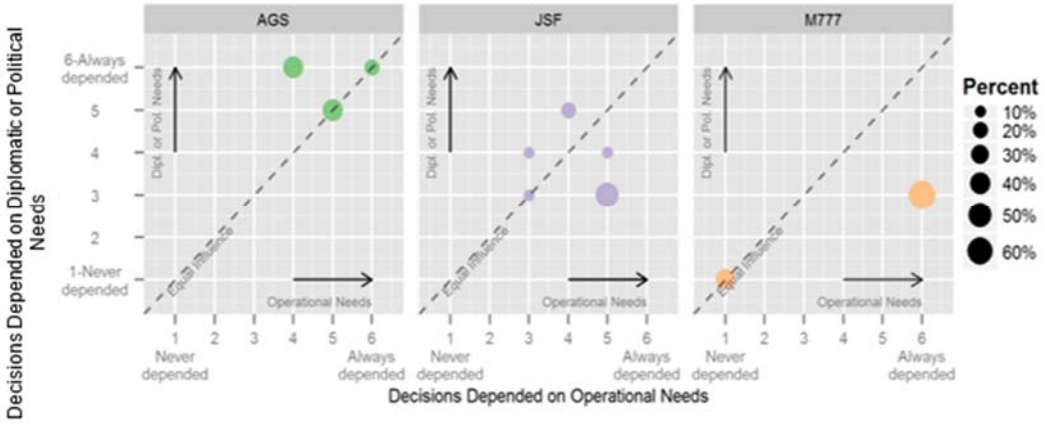

Figure 3. Decision Making

For the AGS program, one of the interviewees noted that decision making depended on different factors that changed over the different stages of the program. Another interviewee noted that, for some nations, decision making depended on operational needs in some instances, but considered industrial-base needs other times. AGS directly responded to NATO’s demand for both ISR capabilities and NATO Alliance equipment standardization and interoperability in the early 1990s. However, political factors for the AGS program were typically rated higher, which is not surprising given the inclusive alliance goals discussed in the Analysis: Number of Participants section. For some member states, acquiring the AGS system did not necessarily respond to their domestic strategic goals. Instead, these member states participated with the intention of either being good NATO partners or investing for the benefit of domestic industrial-base interests. For instance, governments who wanted their domestic constituent industries to benefit would be more likely to participate and contribute money. Additionally, the political and diplomatic pressures of periodic summits and major NATO events facilitated decision making during the program. When examining the timing of major decisions throughout the program and major summits or events, there is clear alignment. For example, the AGS procurement contract was signed at the 2012 Chicago Summit. These types of events accelerated key program milestones and decisions.

For the F-35 program, one interviewee was reluctant to rate “always depended” on operational needs, even though at the outset, the goals were to pursue, develop, and design based on the operational requirements of the predicted evolving security threats. As the program developed, additional countries joined through scheduled foreign military sales (FMS). FMS decisions were partially based on competing interests and best value rather than purely operational requirements. The responses rating the extent to which decision making depended on diplomatic or political needs for the F-35 program are more in the middle. One of the interviewees from a foreign government chose “depended more than occasionally,” because that country chose to participate in the F-35 program not only to reap the operational capabilities, but to also strengthen their interoperability with the United States and allied nations in the future. One interviewee discussed how operational requirements concerns drove decision making during the development stages of the program, while during and after the transition to follow-on development and production, political and diplomatic needs became more important. This could be attributed to the fact

that the UK and United States cooperated from the outset, and as the program moved forward, other partner-nations joined, which added political concerns, national sovereignty requirements, and diplomatic interests.

The responses for the M777 program on whether decision making depended on operational needs conflict each other. While two interviewees rated decision making depending on operational needs as a six, “always depended,” one interviewee rated a one, “never depended.” For the United States, there were no competing systems at the time. The USMC and the USA jointly needed the lightweight and digitized firing system capabilities the M777 offered. The UK similarly had a demand for this technology that at the time had no competing systems. The Falklands War made it obvious that the UK’s land munitions lacked M777’s capabilities. The UK’s large stakes in this operational requirement made them the dominating industry when competing for the contract. The interviewees rated lower for the dependence of decision making on diplomatic or political needs for the M777 program. The reason why some of the survey respondents chose the third level, “depended occasionally,” is that the UK had already been developing this type of capability in response to their operational gaps during the Falklands War. Yet, due to the U.S. Arsenal Act, the United States had to establish a domestic supply chain. In the end, 70% of the program was made in the United States despite the UK’s effort at establishing the capacity to do so.

Commitment

For the commitment characteristic, the study team asked the interviewees, “On a scale of one to six, rate the extent to which commitments for the program stated in the contract or PMOU were binding.” No particular conclusions could be drawn from the M777 program for this characteristic. The responses rating the extent to which commitments are binding are displayed in Figure 4.

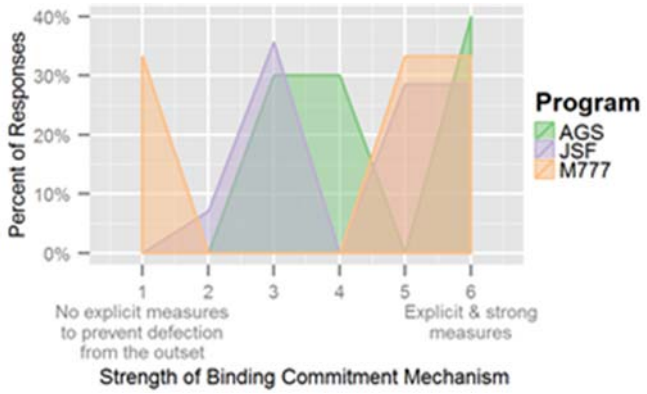

Figure 4. Commitment

There is evidence that these divergences can be imputed to differences in point of views from government and industry. For the AGS program, one interviewee expressed that NATO worked hard to put in disincentives for partner nations to quit. At the same time, another interviewee emphasized the importance of having disincentives, but not to the point that nations only stay in the program because the consequences of defecting are too harsh. It was equally important for the partner nations to benefit from participation as it was to prevent defection.

Responses to the commitment characteristic are also split for the F-35 program. When following-up with the interviewees, the study team found that one point of view argued that there are limited explicit measures to prevent defection. Instead, the partner nations made large investments that are ultimately a sunk cost if the country exits the program

without procuring the capability. This situation acts as a measure to prevent defection but was not explicitly planned in the PMOU or contracts. Furthermore, countries who are benefiting from industrial spillovers have a disincentive to defect because exiting the program would mean losing industrial benefits. Another interviewee concluded that instead of being contractually binding, countries have moral, ethical, and political commitments to the program that act as measures to prevent defection.

Flexibility

For the flexibility characteristic, the study team asked the interviewees, "On a scale of one to six, rate the level of flexibility the program had in being able to change requirements in response to program updates such as an addition of participating countries or new developments." The results are displayed in Figure 5.

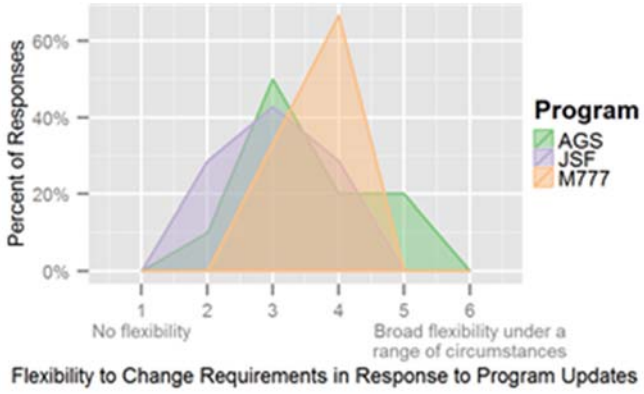

Figure 5. Flexibility

While the AGS program maintained its operational and political requirements made from the outset, the technical specifications on which these goals would be executed changed multiple times over 14 years of negotiations. These changes were made not necessarily because the program was flexible, but more so because the political nature of the program demanded it. To reiterate, the original mantra of the program was to include as many flags as possible. This level of complexity inherently faced political stalls, aggressive workshare negotiations, and affordability challenges. Whether or not these changes were "high hurdles" or "easy" depends on who is talking. Ultimately, the program had to be flexible, even if this meant 15 years of negotiations before the PMOU.

The interviewees for the F-35 program emphasized that the number of partner nations and increasing cost pressures created high hurdles for change. As a result of schedule delays, certain nations had to invest additional money to maintain their existing fleets on top of the money already invested in the F-35 program. These countries would have been more flexible and able to manage this situation if these risks were addressed from the outset. Daunting cost estimates were another barrier to flexibility. According to an interviewee, the vast majority of proposed changes were generally dropped after the proposing country saw the estimated cost increases. Additionally, bureaucracy imposed organizational constructs that controlled decision making within cost, schedule, and performance and did not work well with change.

From the discussion on the M777 program, there is evidence that the highest hurdles to flexibility existed between the services and not the international partners. Otherwise, there were a limited number of cases demanding a change to the program.

Operational Mission

For the operational mission characteristic, the study team asked the interviewees, "On a scale of one to six, rate the extent to which the countries involved with the program were compatible in operational requirements." The responses are displayed in Figure 6.

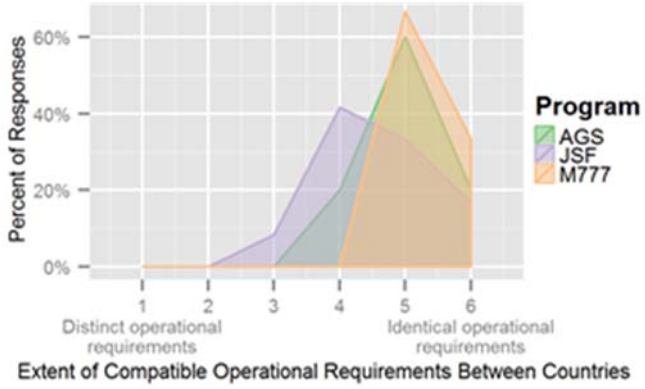

Figure 6. Alignment of Operational Needs

For the AGS program, the individual countries were less coherent on their core operational demands. Since this was a NATO program, however, the countries participating all agreed that the Alliance needed to satisfy the demand for ISR capabilities and greater interoperability and collaboration within NATO. The United States, for instance, already had access to this capability. Their interests were centered on helping NATO achieve this capability so that the United States would not be called upon to bolster strategic demands requiring ISR. Conversely, smaller nations could not achieve this capability on their own. Even if the need for leading-edge ISR capabilities is not in a nation's core strategy, having a more public access to ISR technology through NATO, benefits both their domestic and international security. Consequently, the participating partner nations do not perfectly align with their domestic interests, but, as a whole, the AGS program supports a common demand.

Similar to the AGS program, the partner nations of the JSF program did not have identical operational requirements, but because there are three variants of the program, major requirements for each country were met. The level of operational commonality between partner nations changes according to the country. Compared to the United States, the UK's level is more of a five or a six while Turkey's level is more a three or a four. Strategically, all partner nations are interested in interoperability, which acquiring the F-35 promotes. One interviewee suggested that the variance of responses is a result of changing operational requirements between times of peace and times of war.

Program Mission

For the program mission characteristic, the study team first asked the interviewees, "On a scale of one to six, evaluate the extent to which the mission of the program was based on the demand for leading-edge technology and a lower number of initial output." Second, the study team asked, "Evaluate the extent to which the program was based on the demand for developing low-cost economies of scale." The results are displayed in Figure 7.

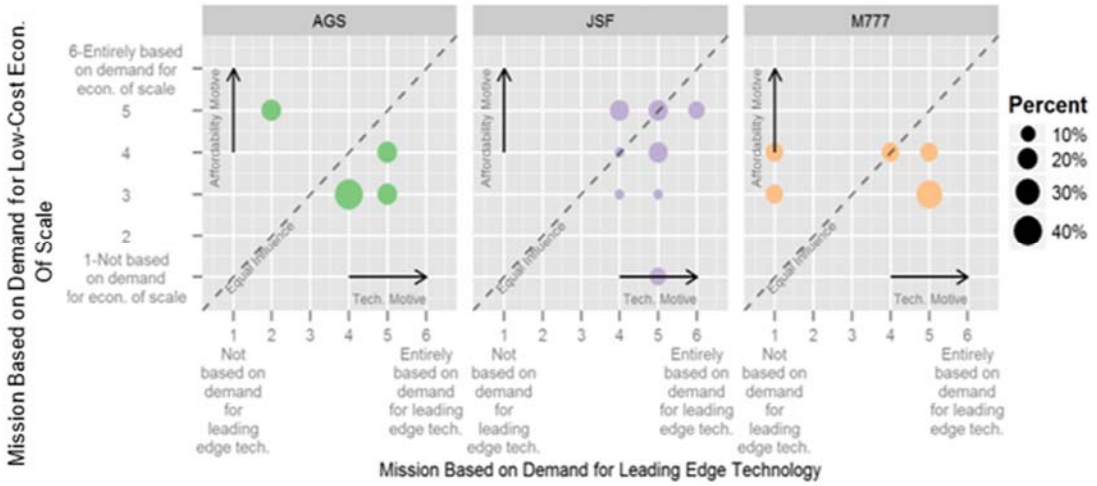

Figure 7. Tradeoff Between Leading-Edge Technology and Cost

The study team hypothesized that there is a tradeoff between these two underlying program goals. The survey responses, however, suggest that this is not the case. Or, rather, program directors did not consider them to be a tradeoff. For the AGS program, NATO was acquiring a leading-edge technology, but not necessarily developing it. The ISR capability NATO wanted to acquire already existed (JSTARS), just not as a platform that was NATO owned and operated. The United States tried its best to preserve and expand upon the leading-edge technology they had already developed with JSTARS to meet AGS requirements, despite understanding that there were other political dimensions it had to simultaneously account for. The underlying tradeoff was achieving new technology for Europe and keeping the program affordable. Before deciding on the Global Hawk RQ-4B Block 40 for the air segment, NG tried to work through the International Traffic in Arms Regulations (ITAR) process and make the more leading-edge capabilities exportable and deliverable to NATO. However, no new development solution was found that could satisfy export regulations, European participation requirements, nor the affordability requirements, which is why compromises continually had to be made. Financial circumstances in the 2000s caused the program to procure the RQ-4B Global Hawk Block 40 which was an already developed capacity. Even after the PMOU in 2009, AGS on its own does not achieve economies of scale. The additional USAF's procurement of RQ-4B Block 40, however, does create economies of scale, which helps AGS achieve higher cost efficiency.

What is notable about the responses for the F-35 program is that most respondents rated high levels for the program mission being based on both leading-edge technology and economies of scale. On the surface, the survey results reject the hypothesis that there is a tradeoff between leading-edge technology and low-cost economies of scale. The discussions with interviewees confirm, however, that this tradeoff still exists. Since the inception of JAST, which later became the F-35, the program was entirely based on acquiring a leading-edge fifth generation fighter. One interviewee, however, did note that the extent to which leading-edge technology prioritized over affordability depended on the service or partner nation. For example, while the USAF is buying the most F-35s and as a replacement fighter, the USN is using the F-35 to augment its current capabilities. Consequently, the USAF is more likely to rate the level of demand for leading-edge technology as a five or a six while the USN is more likely to rate it at a level four or five. Despite this difference, all the interviewees rated the program on the higher end of the scale of demand for leading-edge technology.

Affordability has been advertised from the outset of the F-35 program. Whether the program emphasized affordability to gloss the brochure sent to potential partner nations, or as a primary focus is unclear. Nothing about the leading-edge technology in the F-35 program is low cost. From the Nunn-McCurdy cost breach to the continuous LRIP, the program has consistently pushed prospects for economies of scale into the future. The program does, however, present opportunities for relatively low-cost production down the road if a global fleet in the four-digits is procured. With a large global fleet, low-cost sustainment will more likely be able to reap the benefits from global spare parts and supply chains, as well as economies of scale. Tagging affordability to this program from the outset was not realistic and could be considered a major source of the criticism the program has seen to date. One interviewee from government emphasized that the entire purpose of acquiring a fifth-generation fighter was technology. If the services wanted economies of scale, they could have procured more F-16s and F-18s for the Air Force and Carrier versions, respectively.

Workshare Distribution

For the workshare distribution characteristic, the study team first asked the interviewees, "On a scale of one to six, rate the extent to which the distribution of workshare was based on participating countries' comparative advantage." Second, the study team asked, "Rate the extent to which the distribution of workshare was based on political or industrial-base goals." The responses are displayed in Figure 8.

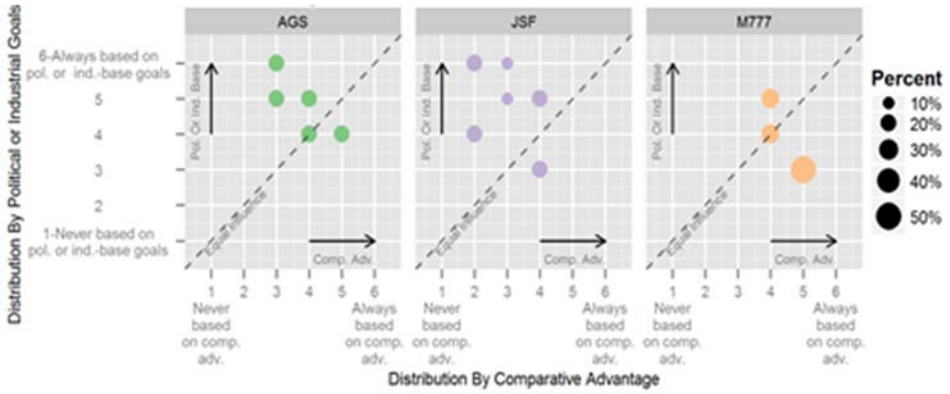

Figure 8. Basis of Workshare Distribution

The responses for the AGS program reflect the program's blueprint. Interviewees rated the workshare level based on political or industrial-base goals generally higher than how they rated the workshare level based on comparative advantage. This is no surprise, given the political nature of the AGS program's core goals. On the ground segment, stations were already available from the United States; however, this would have defeated the goal of high participation levels from the European partner nations. The program paid for a NATO ground station because it was ITAR-free and available for use in other European programs. While basing workshare distribution on comparative advantage is often times more economically efficient, the program would not have been able to exist without politically-based decision making. Spain, for example, withdrew from the program after not receiving enough industry participation. Although distributing workshare based on comparative advantage presents opportunities for cost efficiency, political and industrial base factors can be equally crucial in order to sustain program participation.

The workshare distribution for the F-35 program is proportionate to the level of investment a partner-nation contributes to the program. There would not have been factories built from scratch in Turkey where workforces were trained from ground zero if the workshare distribution was not constructed in this fashion. Additional political factors influenced workshare distribution as well. For example, supplementary wing production opened in the state of Georgia because that facility was facing an existential crisis from lack of work, not because producing wings in Georgia was the most efficient allocation of resources. Some countries were disappointed from the low-level of integration for technology-transfer, as technology-transfer laws significantly influenced the distribution of workshare. As one interviewee explained, if a country writes a piece of software, that software is property of the country, not the program. Because of this, technology-intensive production was automatically allocated to the United States.

The M777 program is a prime example of when political factors become more important than comparative advantage. Despite the fact that the UK had been developing the technology needed for this program, the USA and USMC were ordered by the Senate and House Appropriations Subcommittees on Defense in 1999 to develop a plan to utilize Rock Island Arsenal in producing various portions of M777 (U.S. Marine Corps and U.S. Army, 1999). This is yet another example of how monetary costs and benefits are not the only ways to measure efficiency with international cooperation. Furthermore, economic efficiency should not be the only measure of success here.

Initial Results

This interim report discusses what the study team can preliminarily conclude, while the full technical report of this study will provide a more comprehensive conclusion of the hypotheses. The final report will also develop a framework for designing and managing successful international joint development programs. In regards to the second research question,

> How are best practices of international joint development programs in defense acquisition different from best practices of single-nation acquisition programs?,

the study team found that both the single-nation and international defense acquisition programs of today face the different levels of complexities that Drezner (2009) recognized: organizational, environmental, and technical. The underlying difference between single-nation acquisition programs and international joint development programs is the high level of organizational complexity inherent in international cooperation. While modern single-nation defense programs face the complexities associated with integrating government and industry, international programs must also intermingle governments and international industries. To successfully overcome both the environmental and technical complexities of modern programs and manage the inherent organizational complexities of international programs, appropriate governance models that practice consolidation, flexibility, risk-management, and institutional memory are more likely to succeed in reaping the benefits international programs theoretically can achieve.

The following discussion considers the four hypotheses to the highest extent possible at this point in the research effort.[8]

The first hypothesis of this study is as follows:

> The structure of cooperation in international joint development programs matters: The international joint development programs whose stakeholders cooperate only during the development or production process will have less successful cost, scheduling, and end-product outcomes.

The countries participating in all three of the programs analyzed for this report participated during both the development and production phases. Consequently, the study team cannot confidently conclude whether the international joint development programs whose stakeholders cooperated only during the development or production process will have less successful program outcomes. However, the study team can use the results of the survey to extrapolate correlations between how successful programs were in achieving their goals and the level of integration between governments and industries. The interviewees from the M777 program, for example, rated higher levels of integration between government and industry than the interviewees from the F-35 and AGS programs. Looking at the history of the three programs, the M777 program executed the quickest contracting and signing of the PMOU. Additionally, unlike the F-35 program and the AGS program, the M777 program interviewees rated lower levels of integration between governments. The AGS and F-35 programs' interviewees similarly rated higher levels for these two characteristics. The AGS program took the longest to reach contracting and signing of the PMOU, while the JSF has experienced the most cost increases and schedule delays.

Second, the study team hypothesized,

> International joint development programs that are more grounded in security policies rather than economic efficiency interests are more likely to result in negative cost, scheduling, or end-product outcomes.

The AGS program's interviewees rated that the AGS program "often depended" or "always depended" on diplomatic or political needs, while the F-35 and M777 program interviewees never rated more than "often depended" for decision making based on diplomatic or political needs. Similarly, the AGS and F-35 program interviewees rated higher levels for workshare distribution being based on political or industrial-base goals than the interviewees for the M777 program. Program decision making and distribution of workshare are two areas where programs based decisions on costs and comparative advantage, or on political and industrial base goals that often reflect international and domestic security policies. While there were a high number of instances where the AGS program depended more on diplomatic or political needs, this does not always translate to negative outcomes. On the one hand, this could have contributed to the long period of time it took the program to reach a contract and PMOU. On the other hand, this was critical for the program to maintain its end-product goal of including as many NATO member-states as possible in order to put a European face on the program. The program successfully achieved its

[8] At this point in the research effort, the study team has only analyzed three out of the six case studies of this case-study analysis.

Alliance-based goals thanks to the program's ability to meet political factors reflecting different nation's security policies.

Third, the study team hypothesized,

> Countries who have cooperated in defense acquisition before have a higher chance of achieving positive cost, scheduling and end-product outcomes.

As previously discussed, the number of participating countries in a joint international program is a notable characteristic. While the study team has found that a higher number of partner nations supports a program's ability to move forward without cancellation, the number of countries involved often means that choices must be made in light of a diverse number of actors and while satisfying numerous investments, international interests, and domestic interests. Based on this hypothesis, the study team expected to see more positive outcomes with the AGS program based on the fact that the countries involved have historically worked together before through NATO. Information gleaned from the stakeholder interviews suggests that the office dedicated to integrating the program, NAGSMA, did not achieve the positive outcomes of a strong institutional memory because this office was not set up until the official PMOU was signed in 2009, 14 years after program inception. The F-35 program partially reaped benefits from having partner countries who have a history of cooperation in the past. Multiple interviewees noted how the United States, UK, Australia, and Canada were more fluidly integrated in the F-35 program because of their past experiences working together. However, it is hard to connect this to overall program outcomes because most participating nations are not a part of this construct.

Fourth, the study team hypothesized,

> Countries who are uniquely capable of producing complex acquisition programs benefit from working with smaller countries or industries who may have comparative advantages in certain technologies but do not have the capacity to produce complex acquisition programs on their own.

The research conducted thus far strongly supports the fourth hypothesis. For the AGS program, the United States had the ISR capabilities demanded by the program from the outset. They benefited, however, from working with the various-sized countries of NATO, as it ensured that the United States would not be the sole provider of support for NATO operations requiring ISR capabilities. Additionally, the United States benefitted from the partner nation's requirement to have a European face on the program because of the shared maintenance and lifecycle costs. Furthermore, all nations benefitted from international participation for the F-35 program because the leading-edge technology achieved by the program would not have been financially feasible by any one nation.

Concluding Thoughts

Globalizing the defense market at the research and development stages of acquisition poses crucial benefits for partner nations in light of budget pressures in the United States and Europe. In order to reap these benefits, international joint development programs must follow best practices. This interim report has identified eight characteristics critical to programs' capacity to achieve best practices. These eight characteristics impact the program's ability to achieve desired cost, scheduling, and end-product outcomes.

Based on the work conducted thus far, several of the characteristics are promising grounds from which best practices can be derived. For instance, interviewees across multiple programs agreed that including more member countries adds organizational complexity which can cause negative program outcomes such as schedule delays. Starting

with a small group before reaching the PMOU may avoid some of these problems, although as AGS showed, a large group of countries does give a program momentum. Choosing the right partners is also important; as discussed in hypothesis three, institutional memory of past collaboration can contribute to better results. In other words, countries who are new to working together face greater challenges but simultaneously pave the way for future success. Additionally, many programs appear to be overestimating their ability to simultaneously pursue leading edge technology and economics of scale, with the latter often falling by the wayside. Multiple interviewees mentioned setting key parameters and anticipating technology transfer hurdles early in the process. However, adopting an attitude of humility about what joint development projects can actually achieve from a cost perspective may also be a critical first step.

The study team will continue analyzing three additional cases, the Standard Missile-3 Block IIA program, the A400M Atlas program, and the Medium-Extended Air Defense System program, in addition to those discussed in this report. This analysis will further develop the results of the hypotheses and bolster the framework for designing and managing international joint development programs in the future.

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Designing and Managing Successful International Joint Development Programs

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DEFENSE-INDUSTRIAL INITIATIVES GROUP

Research Questions

1. What are the characteristics of international joint development programs that result in positive or negative cost, scheduling, and end-product outcomes, such as final product, interoperability, technical relevance, and development of existing defense industrial bases?

2. How are best practices of international joint development programs in defense acquisition different from best practices of single-nation acquisition programs?

Methodology

- Identify the best practices defined in acquisition literature.
- Select and research the six cases to determine how they were structured and implemented.
- Identify characteristics research shows as specifically crucial to the outcomes of international joint development programs.
- Investigate case studies by interviewing stakeholders from industry and government, as well as outside experts.
  - Ask interviews to categorize their project for each of the characteristics using a Likert-type scale.
  - Record other key characteristics and other incidents key to each individual case suggested by interviewees.

Hypotheses (1 of 2)

1. **The structure of cooperation in international joint development programs matters** – the international joint development programs whose stakeholders cooperate only during the development or production phases will have less successful cost, scheduling, and end-product outcomes.

2. International joint development programs that **are more grounded in security policies** rather than economic efficiency interests are more likely to result in negative cost, scheduling, or end-product outcomes.

Hypotheses (2 of 2)

3. **Countries that have cooperated in defense acquisition before** have a higher chance of achieving positive cost, scheduling, and end-product outcomes.

4. Countries that are uniquely capable of producing complex acquisition programs **benefit from working with smaller countries or industries who may have comparative advantages in certain technologies**, but do not have the capacity to produce complex acquisition programs on their own.

Cases: the NATO Aerial Ground Surveillance (NATO AGS) Program

	Program Goals
Overall Capability	NATO-owned and operated airborne ground surveillance platform with the capability to provide continuous, wide area surveillance to all levels of command
Core Capability	A radar with similar capabilities to JSTARS' radar with synthetic aperture radar (SAR) and ground moving target indicator (GMTI) modes was preferred but not required
Program Development	Platform was to be developed cooperatively by industries of partner nations, radar to be adapted from JSTARS radar
Type of Platform	Aerial ISR
Level of Interoperability	Interoperability between NATO and national airborne, ground, and support platforms was a critical goal of the program
Spectrum of Operations	Surveillance, situational awareness, target acquisition, and damage assessment

	Cost Goals
Total FY 2009 United States Cost Estimate, as of 2003	$195,228,000
Actual FY 2009 United States Cost, Reported 2010	$22,471,000
Total FY 2015 United States Cost Estimate, as of 2009	$252,668,000
	Schedule Goals
Planned Initial Operational Capability	Initial Operational Capability (IOC) planned for 2010 according to 2002 AGS Master Schedule
Planned Full Operational Capability	Full Operational Capability (FOC) planned for 2013 according to 2002 AGS Master Schedule

Image of NATO AGS craft arriving at Edwards Air Force Base by Chris Okula.

Cases: the Joint Strike Fighter (JSF/F-35) Program

	Program Goals
Overall Capability	"Develop and deploy a family of strike aircraft by capitalizing on commonality and modularity to maximize affordability"
Core Capability	"Single-seat, single-engine aircraft capable of performing and surviving lethal strike warfare using an affordable blend of key technologies"
Program Development	Utilize platform commonality (70%-80%) to reduce costs by integrating test plan, achieving economies of testing (2000 DOTE)
Level of Interoperability	Interoperability is a central feature of JSF.
Spectrum of Operations	Next generation platform designed to meet advanced threats in 2010 and beyond – USN wanted "first-day-of-the-war, survivable aircraft to complement the F/A-18E/F, USAF wanted a "replacement for the F-16 and A-10 and complement [for the] F-22," USMC wanted a "single-STOVL platform to replace the AV-8B and F/A-18C/D," UK RN and RAF wanted a "supersonic STOVL fighter/attack aircraft to replace the Sea Harrier and GR-7, respectively"
International Development/Sales	Platform designed to address the needs of US Armed Forces, UK Royal Navy and Royal Air Force – high foreign interest in the program has translated to numerous cooperative agreements to participate in program – joint development and foreign military sales viewed as opportunity to reduce cost of program

	Cost Goals
Total Program Cost Estimated 2000	$200 billion over 3000 aircraft
F-35A Unit Cost Estimated 2000	$28 million (according to USAF)
F-35B Unit Cost Estimated 2000	$30 million - $35 million (according to USMC)
F-35C Unit Cost Estimated 2000	$31 million - $38 million (according to USN)

Image of F-35 A-Variant Testing.

Cases: The Lightweight 155m (LW155) or M777 Program

	Program Goals
Overall Capability	Provide Army and USMC with lightweight, general support artillery with strategic deployability, tactical mobility, survivability, and digitization
Core Capability	155mm Lightweight Howitzer, weighing approx. 5,500lbs less the platform it was developed to replace, equipped with towed artillery digitization (TAD), a self-locating electronic aiming system
Program Development	Original contract planned for 70% of program development to occur in U.S., other 30% in U.K.
International Sales	None originally planned

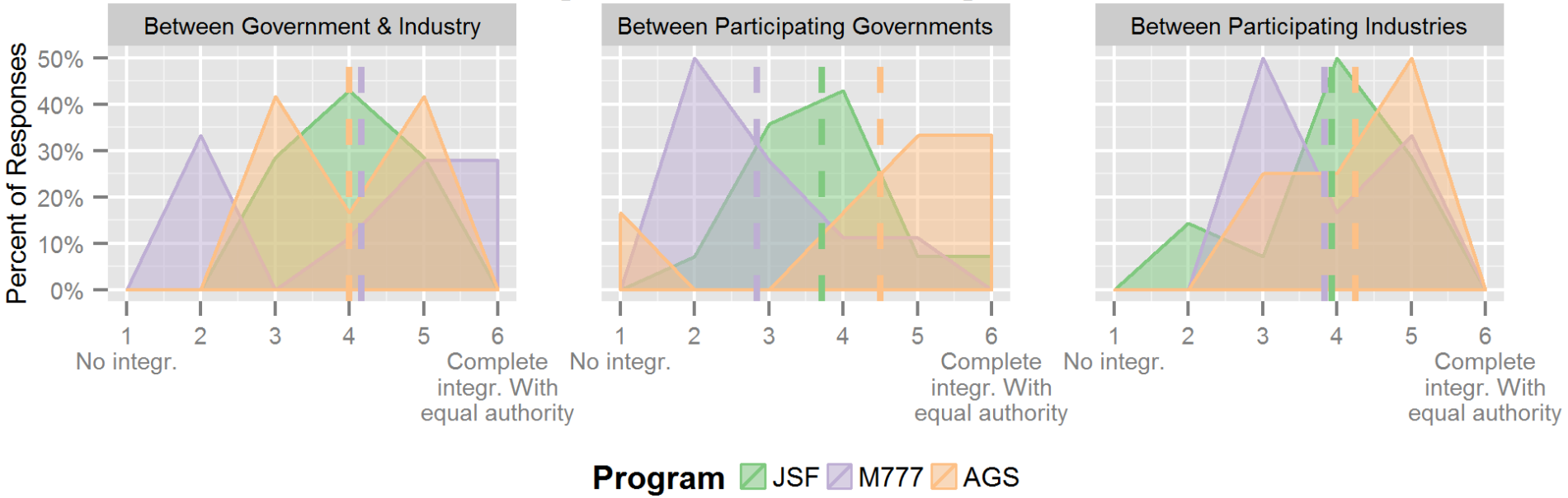
	Cost Goals
Program Baseline Cost as of 2000	$1,087 million
	Schedule Goals
First Test Howitzer Delivery	June 1998
Production approval (Milestone III)	December 1999
Production Contract Award	December 1999
First Production Howitzer	March 2001
Marine Corps Initial Operational Capability	March 2002
Army Initial Operational Capability	March 2005

Image of U.S. Marines firing an M777 155 mm howitzer at Fire Base Fiddlers Green, Afghanistan, by Cpl. Jeff Drew.

Survey Results: Characteristic 1

1. Integration	The transnational partnerships that must be made for governments and industries to work together cause exceedingly complex organizational structures and how governments and industries are integrated matters.

Figure 1. Extent of Integration



Survey Results: Characteristic 2

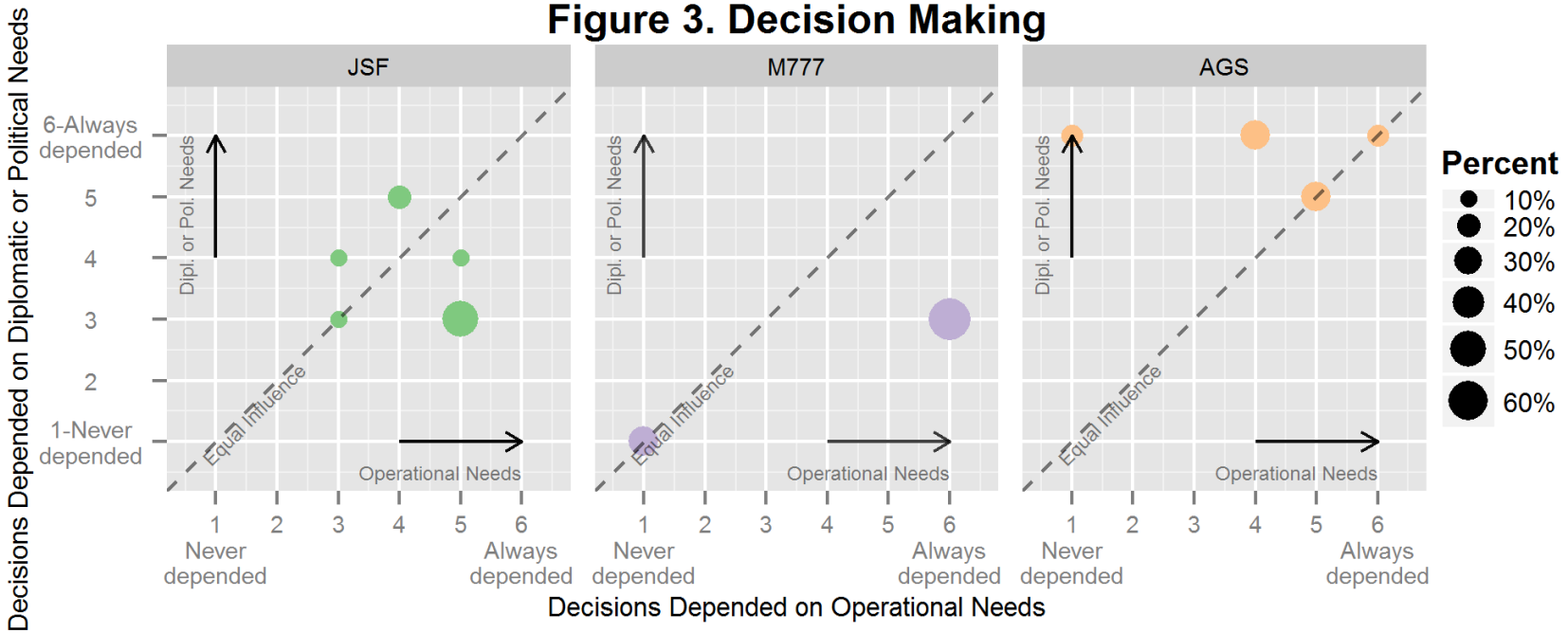
2. Number of Participating Countries	The number of partner nations in acquisition programs is associated with collaboration inefficiencies based on evidence Keith Hartley (defense economist) has found. Furthermore, the higher the number of partner nations, the higher the level of complexity.

Figure 2. Number of Participating Countries

Survey Results: Characteristic 3

3. Decision Making	Programs' ability to reach certain outcomes is affected by whether or not decisions were made more often on operational needs that could not be met by competing systems versus on diplomatic or political needs.

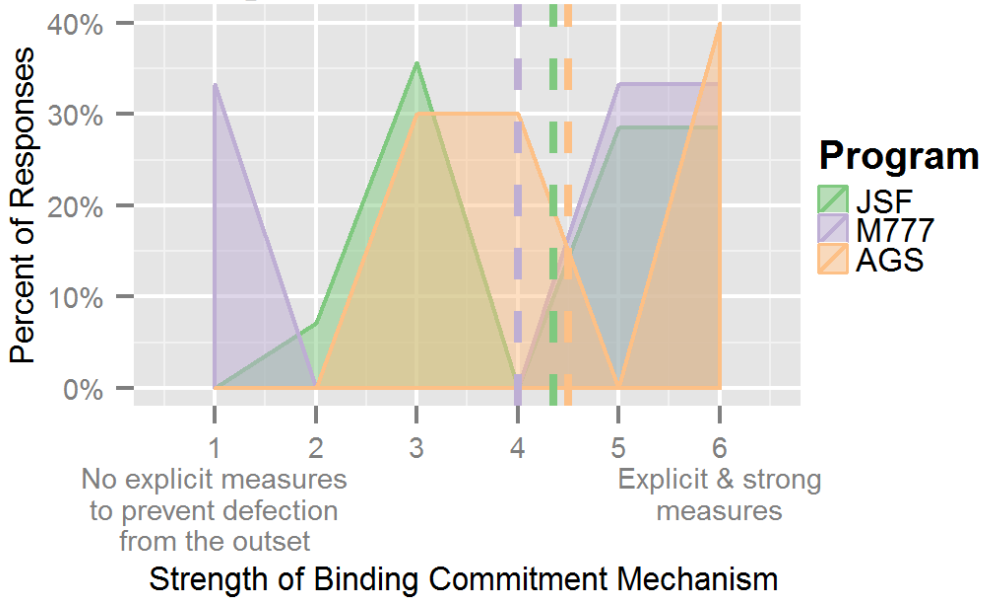
Figure 3. Decision Making



Survey Results: Characteristic 4

4. Commitment	The degree to which programs enforced commitment impacts the program's ability to achieve cost goals and end-product goals. When a country defects, costs rise for the remaining participants, program could be killed, and schedule delays are likely.

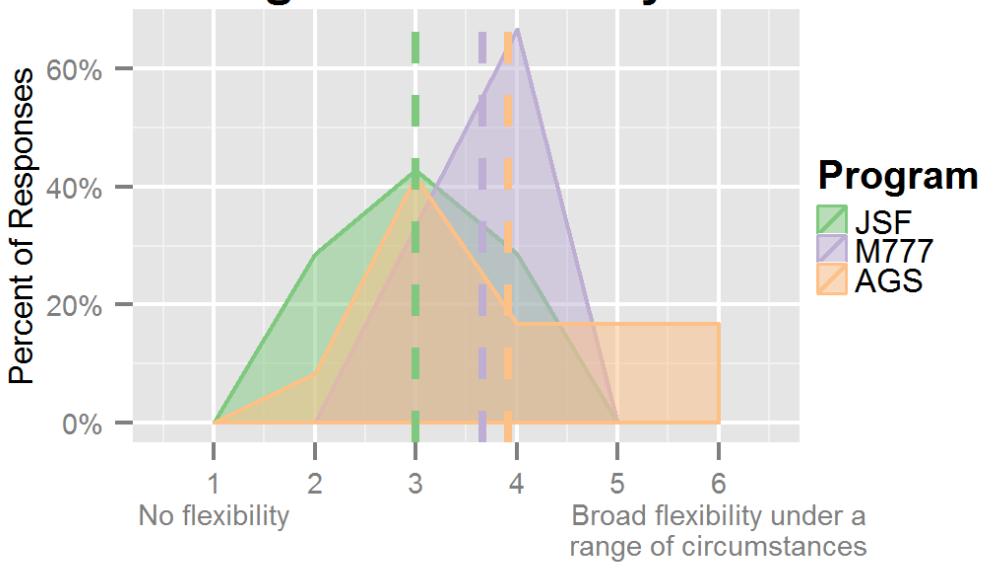
Figure 4. Commitment



Survey Results: Characteristic 5

5. Flexibility	The volatile technological and security environment facing the international security theater today requires programs that can quickly respond to the changing internal and external environments. Therefore, the management of programs must have the capacity to respond to changing environments without killing the program.

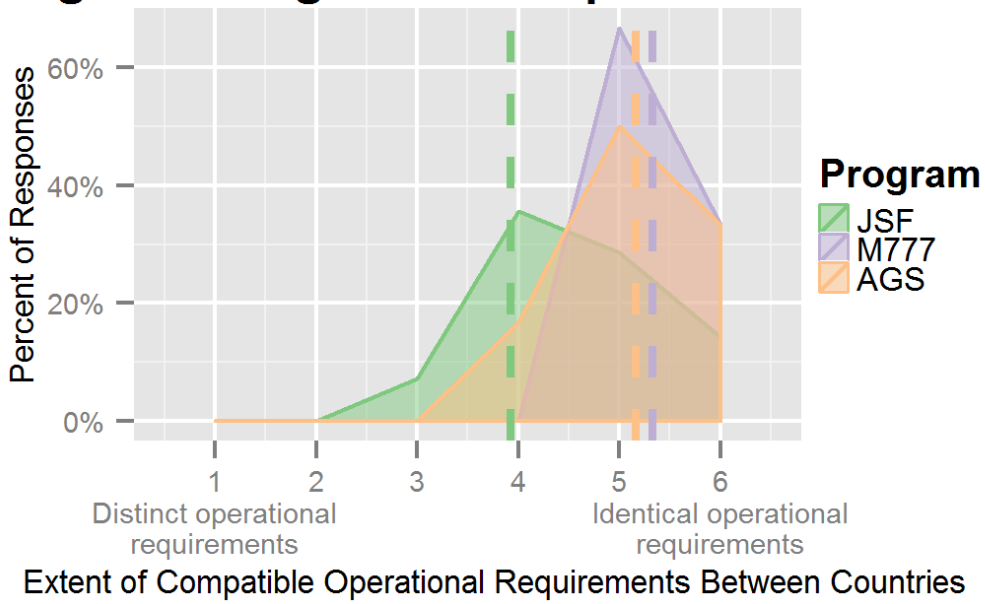
Figure 5. Flexibility



Survey results: Characteristic 6

6. Alignment of Operational Needs	Having multiple militaries working together could introduce a variety of different operational goals. In order to produce a successful end-product, partner nations need to have reciprocal goals so that the program stays focused and partner nations are equally investing in acquiring the capability.

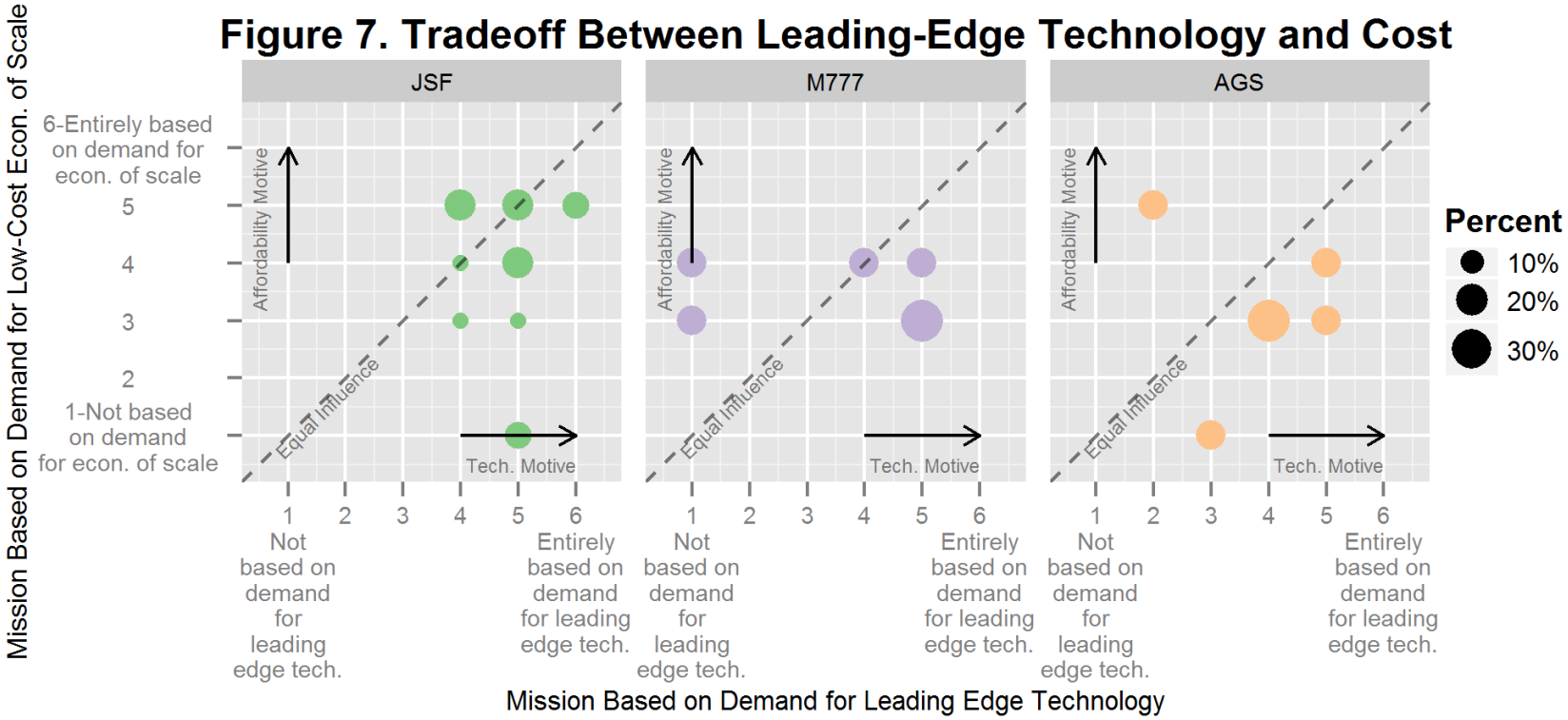
Figure 6. Alignment of Operational Needs



Survey results: Characteristic 7

7. Leading-edge Technology versus Affordability	There is a trade-off between achieving leading-edge technology and affordability structures such as economies of scale. The exceptionally high cost of R&D in modern defense acquisition is crucial to procuring technologically advanced capabilities. Economies of scale should be focused on after a successful and advanced capability has been developed and in high demand.

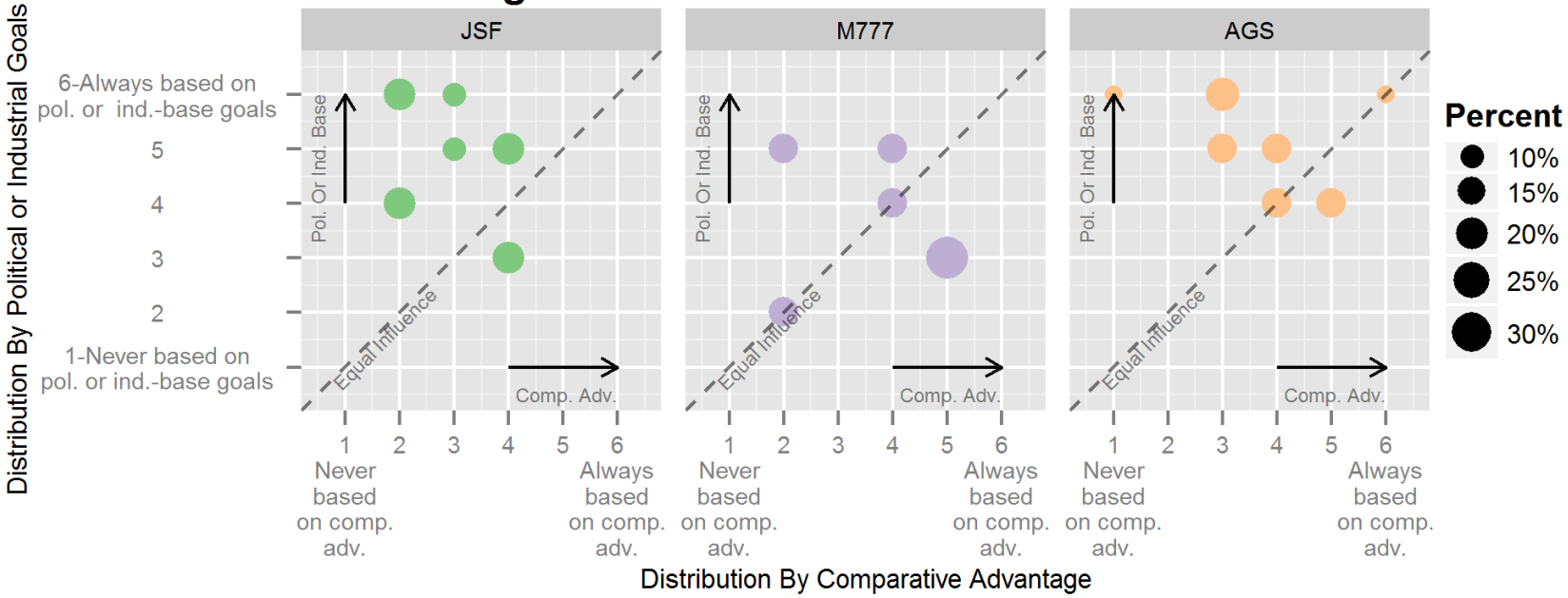
Figure 7. Tradeoff Between Leading-Edge Technology and Cost



Survey Results: Characteristic 8

8. Workshare Distribution	To achieve cost-efficient outcomes, international programs present greater opportunity for competition based on comparative advantage. However, international collaboration also presents a higher level of political and industrial-base variables into procurement and acquisition. Strategic posture, trade policy, industrial gain, and technology transfer are spillover benefits to international cooperation and may be more desirable than cost-efficiency for some nations.

Figure 8. Basis of Workshare Distribution



Notable Conclusions (1 of 2)

Hypothesis 1 – Structure Matters

- Organizational complexity is the key difference and challenge international programs face compared to single-nation programs.
- The incentives for participating in development are not necessarily derived from the demand to achieve an individual end product outcome. Instead, the demand is for spill over benefits (e.g. industrial development or operations and maintenance savings).

Hypothesis 2 – Security Policies vs. Economic Case

- The two cases with a larger number of participants based decisions on political or industrial-based goals more than the case with fewer participants.
- While programs that are more grounded in security policies rather than economic efficiency interests experience more negative cost and scheduling outcomes, for some programs political and security policies are crucial to achieving program goals.

Notable Conclusions (2 of 2)

Hypothesis 3 – Prior Cooperation between Countries

- While some of the cases suggest that prior cooperation can improve outcomes, the program with the highest institutional memory had experienced the greatest challenges throughout the first 15 years of the program.
- In two cases, development laid the groundwork for future cooperation by working through tech. transfer or building industry to foreign government relationships.

Hypothesis 4 – Platform Producing and Specialists Countries Cooperating

- All three cases support the hypothesis that countries who are uniquely capable of producing complex acquisition programs can achieve cost sharing or interoperability benefits from working with smaller countries or industries.

Emerged from Interviews

- In most cases programs overestimate their ability to simultaneously pursue leading-edge technology and cost efficiency, with the later often not achievable.
- Interviewees regularly mentioned that setting key parameters and anticipating technology transfer hurdles is crucial to avoiding cooperation problems.