TRANSATLANTIC COOPERATIVE WEAPONS DEVELOPMENT: HOW CAN WE BETTER ENSURE SUCCESS?

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This paper evaluates and compares two multinational weapons development efforts: a cancelled program (Multiple Launch Rocket System Terminal Guidance Warhead) and a new program (Medium Extended-Range Air Defense System). The research identifies multinational political and management issues that exacerbated technical and schedule problems. Risk areas include: number of countries and industries; differing and excessive requirements; cost share and technical work share decisions; consortia versus prime contractors; and international program office staffing and decision making. The paper makes concrete recommendations to improve potential for success in the new program.

For decades, the United States and its allies have spent billions of dollars on collaborative weapons development projects that have generally eluded success. This is a puzzling phenomenon: the main objectives of cooperative weapons funding and development are to eliminate costly, competing, duplicative programs, and to pool requirements, funding, and talent to develop affordable, interoperable systems. These programs also have a fundamental political objective of cementing relationships—which tend to be stressed when multinational programs fail. Many observers attribute program failures to the lack of political support, priority, advocacy, and multiyear funding. But very few have taken a cold, hard, deep look at problem programs to identify key causes and improve the next program.

All weapons development efforts entail some level of cost, schedule, and technical risk—if they don't, they don't represent enough advancement in capability or technology to be worth pursuing. My research examined the canceled, four-nation Multiple Launch Rocket System Terminal Guidance Warhead (MLRS/TGW) program to identify some of the key political and administrative issues that added to its cost, schedule, and technical problems.

If the MLRS/TGW's schedule had not slipped more than six years, it could very

well be continuing today as a good example of cooperative development. After the program was canceled, flight tests successfully demonstrated the MLRS/TGW met its objectives as a robust tank-killing sub-munition. Had the MLRS/TGW come closer to its originally scheduled initial production (April 1989), it certainly could have been selected as the U.S. Army's submunition of choice.

Using MLRS/TGW as a baseline, I examined the same aspects of the prospective four-nation Medium Extended-Range Air Defense System (MEADS) to identify similarities and differences. At the time of this writing, a MEADS Memorandum of Understanding had not been signed and was not available for analysis. In addition, the infancy of the MEADS program did not allow full comparison with many critical aspects of the MLRS/TGW program. At the same time, however, this represents a great opportunity for MEADS to benefit from the MLRS/TGW experience.

From the research, a mosaic of uniquely multinational political and administrative/management issues emerged to explain many problems that contributed heavily to difficulties in the MLRS/TGW program. At least in theory, these problems could be avoided or mitigated for future programs, including the MEADS. An overall theme emerged: for success in multinational programs that have been well-selected, *national political issues and pride need to be subordinated to what is best for the program.* The main goal—to develop and produce a multinational weapon system that meets operational requirements on time and at a reasonable cost—must always be the driver. It is difficult enough to overcome technological and other program challenges without the unique complexities of successfully managing a multinational development effort.

Some limitations to the research are noteworthy. The ingredients for success identified were not based on an examination of a successful program. Moreover, experience in one program may not always be applicable to another program, as each multinational development effort is unique in many ways. Finally, there is no guaranteed prescription for success, as many more variables than were examined here have important effects on a weapon development effort.

The Environment for Transatlantic Cooperation

Many ongoing and new codevelopment programs have been managed in an environment fraught with tensions among political pressures for pan-European versus transatlantic cooperation, and each nation's sharpened concerns over the survival of their defense industries. In the mid-1980s, Europe made great political strides for pan-European cooperation in weapons development. NATO's Confer-

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ence of National Armaments Directors established the Independent European Programme Group to press for European Community-style defense cooperation. Since weapons procurement was not in the European Commission's purview, the Independent European Programme Group served as the forum for cross-border weapons collaboration and procurement in Europe.

At the same time, in an effort to gain potential savings and interoperability from codevelopment efforts and rise above a United States–only approach to weapons development and production, the Congress passed the Nunn–Quayle amendment to the Arms Export Control Act (1985) to promote transatlantic cooperation. The "top down" approach—making money available for cooperative ventures—led to a proliferation of low-priority, two-year efforts that were not continued. A number of other larger transatlantic cooperative programs, such as the North Atlantic Treaty Organization (NATO) Frigate, fell apart for various reasons, including the inability to agree on requirements.

After the Berlin Wall fell and the Soviet Union dissolved, the U.S. and European defense industries began more rapidly and radically transforming through mergers, acquisitions, and downsizing to respond to the new realities. On both sides of the Atlantic, defense spending became more constrained while weapons program costs increased. Also, concerns about losing critical national defense production capabilities and jobs were on the rise.

In the first half of the 1990s, the Independent European Programme Group was moved from NATO auspices to the Western European Union—a European defense organization with no U.S. participation. France apparently took the lead in pressing for intra-European cooperation, sometimes in competition with potential transatlantic ventures. France continues to see itself as the defense technological and industrial leader in Europe—in direct competition with the United States. At the same time, U.S. Defense Secretary Perry called for a "renaissance" in cooperative weapons development with Europe. The MEADS is the showcase project of Secretary Perry's "renaissance."

The MLRS/TGW: A Good Cooperative Weapons Program That Could Have Gone Better

What Was the MLRS/TGW and What Happened? The MLRS/TGW was actually phase three of the multinational MLRS program. The objective was to develop a target-sensing submunition and warhead for attacking armored targets at distances up to 30 kilometers or more. It was to be launched from the MLRS rocket or from an Army Tactical Missile System.

In many ways, the program attempted to go well beyond the state-of-the-art. For example, it was to use a millimeter wave seeker. The United States had only once before attempted to develop a weapon system that uses a millimeter wave seeker, largely because of technical risk and cost. In fact, one person interviewed noted that the MLRS/TGW program would have benefited from some additional up-front substantive research on the seeker and certain other components, possibly during the concept definition phase.

Political pressures to get the international program started and under way

overruled some program officials' desires to take this path to lower technical risk. Instead of performing additional research up front, the partners took a cautious three-stage development approach: a two-stage validation program (component demonstration and system demonstration) followed by a maturation and full-scale development stage. Figure 1 highlights key events in the MLRS/TGW program.

The concept definition phase began in September 1981, with competing multinational contractor teams, each with different companies from the United States, France, Germany, and the United Kingdom. The four governments signed a Memorandum of Understanding in late 1983. The governments' cost sharing was established in that agreement: The United States would fund 40 percent, and each of the European allies would fund 20 percent. In November 1984, the U.S. Army awarded a cost-plus-incentive-fee component demonstration contract to the team with the best technical concept and the lowest bid—Martin Marietta (United States), Thomson CSF (France), Diehl GmbH & Co. (Germany), and Thorn EMI Electronics (United Kingdom).

In February 1989—two years behind schedule—the Defense Department approved the system demonstration substage for the MLRS/TGW, but with several conditions attached. The conditions were that the U.S. Army had to (1) do a cost and operational effectiveness analysis comparing the MLRS/TGW to alternatives for defeating the armored threat, (2) define specific actions to improve the ability to manufacture the submunition, and (3) prepare a test and evaluation master plan defining specific quantitative test goals for entering into full-scale development.

Over time, the program slipped and encountered many difficulties. During 1990, the MLRS/TGW competed with a previously classified U.S. program, the Brilliant Anti-armor submunition (BAT), and other systems in a U.S. Army "neckdown." In March 1991, the

CONCEPT DEFINITION PHASE BEGINS	**SEPTEMBER 1981**
GOVERNMENTS' MEMORANDUM OF UNDERSTANDING	**LATE 1983**
COMPONENT DEMONSTRATION SUBSTAGE CONTRACT AWARDED	**NOVEMBER 1984**
SYSTEM DEMONSTRATION SUBSTAGE APPROVED BY DOD	**FEBRUARY 1989**
SYSTEM DEMONSTRATION SUBSTAGE CONTRACT AWARDED	**JULY 1989**
U.S. ARMY SELECTS BRILLIANT ANTI-ARMOR SUBMUNITION OVER MLRS/TGW	**MARCH 1991**

Figure 1. Key Events in the MLRS/TGW Program

Army selected the BAT. The Congress would not permit continued funding of both MLRS/TGW and BAT, and the United States withdrew from the MLRS/TGW program.

Four Countries/Industries May Be Too Unwieldy. Experts on international programs agree that the complexity and difficulty of managing a successful international program increases by a high coefficient with each additional partner. The increased complexity in decision making with four partners of differing languages, political and acquisition systems, and cultures placed stress on the MLRS/TGW program and a drag on the schedule by all accounts. Program officials interviewed unanimously agreed that two or three partners in the MLRS/TGW would have been easier to manage and less costly. They also believed fewer partners would have been more efficient for the program in terms of technical performance, program management and decision making, administrative issues, and gaining agreement on the threat (discussed further below).

For example, the more partners, the more problems a program will likely have in tracking and managing cost shares and work shares—which can be critical to ensuring fairness in a multinational program. In the MLRS/TGW, the 40-20-20-20 cost share was tracked and managed in accordance with the Memorandum of Understanding. Under the agreement, exchange rate fluctuations and inflation in any of the countries affected the cost shares and work shares.

The program was also set up to adjust the work share to cost share on the basis of cost, largely to ensure equity. That is, if a company was performing a development task and began to substantially exceed the estimated cost of the work, that task or some other work it was performing on the program would be moved or subcontracted to another company on the team for completion. While this was a difficult process to implement, some former project officials noted this had a side benefit of helping identify companies having technical and cost problems and making adjustments to solve them.

Get Detailed Requirements Agreed to Up Front. The program got underway with only the most general agreement on the need for a tank-killing submunition for use behind forward lines of troops and a broad technical approach (e.g., millimeter wave seeker). One source observed that, when the four governments could not agree on the threat details, they ignored them and moved forward with the program. Throughout much of the component demonstration phase, the four nations continued to debate the specific characteristics of the threat—the Future Soviet Tank in the year 2000. As late as 1992, the U.S. Army operational requirements document for the MLRS/TGW remained in draft form.

Many programs during that period were dealing with an evolving threat. Two changes in the requirements negatively affected the program's already high technical risk and ambitious schedule. In the first case, the requirements changed due to a newly projected reactive armor threat. Early on, the United States and the United Kingdom believed the Future Soviet Tank would require the MLRS/TGW to have a more robust lethal capability than did Germany and France. This caused the program to switch to a more lethal

submunition with a dual shape charge, and caused cost, schedule, and technical problems in the program. In the end, though, the U.S. and U.K. estimate of the tank changed to agree with that of France and Germany. The program, however, was already committed to the more lethal design.

While changing lethality requirements added time to the development schedule, another change affected the schedule even more severely. About halfway through the development effort, France and Germany raised a new requirement to overcome the effects of high reflectivity snow. This new requirement forced the program to add a backup seeker with Doppler beam sharpening to the development effort. This backup seeker also caused the team to design and develop another type of signal processor. It was a very high risk effort technically, and, in retrospect, the interviewees unanimously viewed it as unnecessary. One source had researched the historical occurrence of high reflectivity snow to find it only occurs in very few European theater locations for 5–6 days a year, in a narrow window of morning hours.

Select the Right Companies to Do the Right Jobs. As with many programs, much of the schedule slippage was caused by technical difficulties encountered by the contractors. The contractor teams that competed for the MLRS/TGW differed greatly in skill for the development tasks—particularly the European companies. The team that won on the basis of low bid included Diehl of Germany, an ammunition and cartridge producer, and Thorn EMI of the United Kingdom, an electronics firm. In retrospect, the interviewees agreed and the record showed that the best (most technically qualified and experienced for development tasks) German and British companies for the job were on the losing teams. While companies from all four countries encountered technical difficulties, Diehl and Thorn were the focus of most comments from the interviewees regarding causes for schedule slippage.

Nevertheless, the governments decided to use the same team that put together the winning bid and national political pride was put at stake. Having a team with some weaker members, alone, however, did not guarantee major problems. *The potential risk was compounded when the companies began dividing work share on the program.* Work share was not distributed on the basis of the companies' technological strengths and comparative advantage. Instead, development tasks were distributed on the basis of the work the companies (and their governments) *wanted to do* in the program. Moreover, they tried to get equality in the work shares—roughly 25 percent per company and country—in terms of quality. The quality factors for work shares were the technologies' position related to the state-of-the-art, potential importance to competitiveness, uniqueness, potential applications beyond the MLRS/TGW, and potential profitability.

The countries and companies fought over the most technologically attractive work shares—particularly the electronics. Their objectives were *not* what work share to take for the betterment of the program, but rather what work share would most advance their companies' competitiveness and capabilities. The Europeans won most of the critical electronics work. As a result, Diehl worked on electronics (e.g.,

flight computer and leading edge integrated circuits) and operational flight software development tasks it was unable to perform. During the program, Diehl essentially built these capabilities in its company from the ground up and at the program's expense. Most interviewees cited Diehl's poor performance on its flight computer and software development tasks as causing serious schedule slippage in the program. In retrospect, the U.S. and French were considered the best (most capable, causing fewest difficulties and delays) for the software development tasks—and the U.S. likely would have done the work at lower cost.

Another unfortunate decision made in the project was to allow the development work on critical components to be split among the companies. For example, the seeker development work was split up and spread among the four companies. This made integration and interface an even more complex task than it might have been. In addition, search and target detection software development tasks on the seeker were split between two companies (the United States and Germany), while the target tracking software development work went to a third (the United Kingdom).

One Production Line or Two?

The decision on a single final assembly and integration line was also afflicted by nationalistic politics. Initially, the partners agreed that all requirements would be served from one integration line in the United States, with the components coming from the other three countries' facilities. This made sense since the U.S. company's strength was in integration. In 1990, however, the European partners insisted on a second, European integration line, despite the likely quantity reduction in all the partners' requirements. One source noted that the Europeans pressed for a second production line because they wanted to freely make third country sales. However, the Memorandum of Understanding provided that sales or transfers outside NATO of articles developed in the project with the use of foreground data would require the unanimous prior approval of all participants. As a result, any sale of MLRS/TGW submunitions would require agreement of all the parties *in any case*. Another source noted that both the United States and the Europeans decided they wanted full production capability. Had the program reached the production phase, two lines would have essentially obviated any unit cost savings during the production phase—and would have added to all the partners' production costs.

Have a Prime Contractor—Consortia Are Not Optimal

Rather than assign one company the prime contractor role, the four companies formed a joint venture consortium—MDTT, Inc.—to sign the contract and provide overall management. The governments supported this approach mainly for financial reasons. A consortium would avoid the high overhead costs of a prime contractor being added to work being performed by the others.

While this was a good goal and approach from one cost control perspective, all interviewees agreed that the lack of a prime contractor on the program contributed to delays and technical issues. This

was especially true given the cost-plus-incentive fee contract, which minimized government involvement, direction, and oversight. First, there was little accountability in the consortium, and decision making on work share was hampered by the lack of leadership in MDTT. In addition, there was no project management, planning, or risk analysis from the companies. The sources agreed that a prime contractor could have and would have selected the best companies for the development tasks, determined work share more on the basis of technological strengths of the companies, and better managed the contractor efforts.

Administratively, MDTT also encountered difficulties getting staffed out of the European companies, as did the European government complement in the international program office (discussed below). More than nine months after the component demonstration contract had been signed, MDTT still did not have a full contractor team in place.

Create a Fully-Staffed, Full-Fledged International Project Office

The MLRS/TGW had an international project office, but the French, German, and British liaison officers did not represent a full complement of "program office-level" decision makers from their countries and were not vested with deciison making authority. The European national program office personnel from these three countries made periodic visits to the project office, located at the U.S. Army Missile Command, for Technical Working Group meetings and other events. Another problem in project office staffing was the serious delay in getting even a limited European government complement in the international project office. In the case of one country, it took nine months of negotiation to get a liaison officer assigned and located in the office.

Some interviewees believed a greater team culture would have been established if all the principals had been located full-time in the international project office. They believed this would have resolved many of the language barriers, nationalistic pride issues, and decision making impediments the program encountered. A source also noted many problems could have been resolved informally in a full-fledged international project office setting (e.g., over lunch). Instead, the visits created a more formal, less congenial atmosphere for timely problem solving. "You need to live together so that your honor is not placed on the line when you disagree."

Another problem that might have been overcome early on had there been more of a true team culture was the limited sharing of "national assets" in this program. For example, one interviewee noted that the countries had some background data on technologies that were critical to MLRS/TGW success. The impression was that this data was not brought to the table and shared openly and honestly. Had this data been shared, and had the countries formed a more "seamless" team, many technical problems would have been more easily overcome. Again, in this vein, the interviewees emphasized the need to keep national and international politics out of the program decision making to the maximum extent possible, and focus energy and interests on doing what is best for the program's progress.

Partnership and Consensus Decision Making Are Good and Bad

While consensus decision making can be indicative of true partnership and equitableness for all players, it can also lead to problems and a more negative and time-consuming approach to reaching agreement. The MLRS/TGW program employed a consensus decision making process, with three levels of decision authority vested in multinational committees. The top level of decision making was the multinational Joint Steering Committee (flag officer level) which met semi-annually. The next level was the Executive Management Committee (program manager level) which performed cost, schedule, and performance oversight and met semi-annually. The next level—the first level of decision making—comprised the technical, cost, and test working groups, which included lab and program technical staffs who met quarterly. Disputes that could not be resolved at the lowest levels were escalated up the chain described above. The U.S.-based MLRS/TGW program office was the "residence" for liaisons from each country.

Several sources noted that getting an answer to a single question sometimes took months. In addition, U.S. government personnel and contractors found that problems they normally solved in one meeting took three meetings. They also indicated that holidays and vacations, heavier for some partners than others, delayed progress in decision making. No program activity could be scheduled during the month of August, for example. Some sources noted that the European partners often united and "out-voted" the United States.

One interviewee characterized the decision making in the MLRS/TGW as "nominally consensus," but, in practice, it was a process based on threat of veto much of the time. When the parties could not reach full agreement on an issue, it was a matter of "who screamed and pounded the table loudest." If a party felt very strongly about an issue, they might threaten to veto a decision, which would stop the program. This sometimes resulted in a more negative approach to decision making rather than positive agreement and compromise.

The MEADS Program: What Path Is It Taking?

What is MEADS? And How Did it Become a Multinational Program? The U.S. concept of the MEADS program is that it is a multilateral extension of the joint U.S. Army–Marine Corps "Corps Surface-to-Air Missile" (CorpsSAM) begun in 1990. The MEADS is to provide a follow-on to the HAWK air defense system, initially developed in the 1950s and 1960s. It is also expected to replace the PATRIOT (Pac 3) system. It has been incorporated as a lower tier system into the Ballistic Missile Defense Organization (BMDO) approach to ballistic missile defenses. U.S. concepts state the system will be designed as an air-mobile system providing limited area and point defense to maneuver forces and critical support nodes against tactical ballistic missiles and air-breathing threats, including cruise missiles and unmanned aerial vehicles.

Technical and political issues appear to have driven the four countries to join in

the MEADS program. While the U.S. concept definition for the CorpsSAM proceeded, Germany developed a concept for a HAWK follow-on. Germany completed its concept definition for its *Taktisches Luftverteidigungssystem*—TLVS or tactical air defense system—in 1991. In 1993, having defined the U.S. CorpsSAM concept, the U.S. Army Missile Command compared and evaluated the German and U.S. concepts, finding them nearly identical. This prompted early discussions of a joint United States–German effort along CorpsSAM lines. At the same time, France and Italy, uninterested in ballistic missile defense capability, were courting Germany for funding and participation in an upgraded SAMP-T, a Franco-Italian developed and produced air defense system.

In February 1994, the Deputy Secretary of Defense invited Germany to participate in the CorpsSAM program. By the spring and summer of that year, France objected to Germany's tilt toward transatlantic versus pan-European cooperation, and discussion between the United States and Germany ceased. In August 1994, U.S., German, and French principals decided to join forces on the MEADS. Concerned about having no role in such a major program that would compete with a SAMP-T upgrade, Italy joined in December 1994. In February 1995, the four countries signed a Statement of Intent to proceed with MEADS. The four nations negotiated a MEADS program Memorandum of Understanding for the first phase and expected to sign the agreement in early 1996. The United States is expected to fund 50 percent, France and Germany 20 percent each, and Italy 10 percent of the program costs.

The U.S. political and funding environment for the program is not completely supportive or secure. The key Congressional committees have serious, fundamental questions about whether or not the requirement for the CorpsSAM and now MEADS can be satisfied more cheaply and at lower risk with a hybrid of the PATRIOT (Pac 3) and the Theater High Altitude Area Defense systems, or with the range and altitude improvements being made to the HAWK system—HAWK III.

Affordability is a major issue with six ongoing ballistic missile defense programs. There are also concerns about "reinventing the wheel" in MEADS and not using pertinent technology from other programs well under way. During 1995, while the Defense Department was negotiating internationally on the MEADS program, Congressional committees completely cut fiscal year 1996 funding for the CorpsSAM. Congress then reinstated some funding after numerous letters of support came from key Defense quarters (CINCs, JCS, etc.).

Four Countries and Six Companies Will Be Involved

As in the MLRS/TGW program, MEADS involves four government partners in a highly complex development effort. MEADS also uses six-member contractor teams, versus the four-member MLRS/TGW team. During the first phase—Project Definition–Validation—two U.S. contractors and teams will be competing against each other. The two U.S. competitors will be linked with A and B teams from the same European companies. The European companies have formed a consortium called "Euro-

TEAM A	COUNTRY	TEAM B
HUGHES–RAYTHEON	UNITED STATES	LOCKHEED MARTIN
SIEMENS	GERMANY	SIEMENS
DEUTSCHE AEROSPACE	GERMANY	DEUTSCHE AEROSPACE
THOMSON CSF	FRANCE	THOMSON CSF
AEROSPATIALE	FRANCE	AEROSPATIALE
ALENIA	ITALY	ALENIA
SOURCE: DEPARTMENT OF DEFENSE, BALLISTIC MISSILE DEFENSE ORGANIZATION		

Figure 2.
Competing Teams for MEADS Project Definition–Validation Phase

MEADS." Figure 2 illustrates the arrangement envisioned for this phase.

With six companies involved, and the defense industrial stakes high for all four countries, MEADS will probably involve a higher degree of complexity and difficulty for program management as compared to the MLRS/TGW.

Full Agreement on Detailed Requirements Remains A Goal

The United States and Germany appear to have one set of requirements for MEADS, while France and Italy seem to have another. Critical issues, including the ballistic missile defensive capability of the system, remain unresolved between the U.S.–German requirements and the French-Italian requirements. The National Institute for Public Policy recently completed a study of the differing perspectives of MEADS among United States and European representatives, indicating a wide gulf between the two groups (United States–Germany versus France–Italy) on the military function of MEADS and its origins. The United States and Germany apparently are working from the U.S. CorpsSAM concept, adjusted for certain German-unique considerations. France and Italy, on the other hand, seem to be wedded to an upgraded version of the SAMP-T. This raises the risk that, France and Italy may leave the MEADS program and apply some MEADS technical concepts to their preferred European system. However, without German funding and participation, they are unlikely to be able to proceed. Germany appears to be pivotal to success for both the United States and European program concepts.

A critical test will come in the form of the Request For Proposal (RFP) that will be issued to the two industrial teams. The RFP presumably will be based on a NATO Supreme Headquarters Allied Powers Europe military operational requirements document that was drafted but, as of January 1996, not yet approved by the North Atlantic Council. The Request for Proposal must contain sufficient information on the operational requirements for the teams to provide the deliverables. According to Defense Department officials, the deliverables will be a set of specifications and a cooperative plan for developing and

producing the system. This phase will also involve some limited hardware and simulation deliver-ables.

Will the Right Companies Do the Right Development Work?

Three U.S. teams were competing for the CorpsSAM program: a Hughes–Raytheon team, Lockheed Martin, and a Loral-TRW–Westinghouse team. The Loral team was eliminated from the competition in an October 1995 Defense Department decision. This left Hughes–Raytheon and Lockheed Martin to compete from the United States during the first phase of the MEADS program. According to Defense officials, the plan is to divide work share in accordance with cost share, as in the MLRS/TGW program.

How were the European companies selected to participate in the critical Project Definition–Validation Phase? One U.S. interviewee noted that the European companies were selected by their governments because they were the only ones that could do the development and production work at the system level. In any case, the approach of using two core teams from the same European companies seems to avoid one cause of problems encountered in the MLRS/TGW program. The "favorite" European companies apparently were selected up front. If they are the strongest technologically for MEADS those nations have to offer, the risk of technical problems affecting cost, schedule, and performance is reduced. In other words, there is no risk that weak contractors will participate in this phase of the program.

Still, the risks to success will be increased unless technical work share is determined truly on the basis of technological strengths and experience each company brings to the program. It is too early in the program to determine how technical work share will be divided among the companies in any detail. All the companies involved in the program appear to be experienced and capable for certain development tasks. The U.S. companies are already involved in the PATRIOT and Theater High Altitude Area Defense programs. Siemens is a premier communications company, making it likely to be heavily involved in the battlefield management center concept for the MEADS. Deutsche Aerospace, Thomson CSF, Aero-spatiale, and Alenia are engaged in various European national and cooperative missile programs.

One source noted that the draft Memorandum of Understanding (MOU) will provide that the work share will be equivalent to the cost share, that this will be based on fixed, negotiated exchange rates as reference points for calculating work-share value, and that work-share calculations will be determined to the second tier on a nation-by-nation basis. This is similar to the MLRS/TGW program. What is different is that the agreement would allow work share at the second tier to be subcontracted across nations with approval of the steering committee. This provision would be used, for example, if a particular company could not perform its work share. If not carefully managed, though, it is possible that from a given country's perspective, it may not ultimately get a work share commensurate with its cost share. The agreement essentially provides that since the program will use a fixed price contract, any cost overruns presumably will be absorbed by the company that experiences them.

As experience in the MLRS/TGW pro-

gram showed, technical work shares should not be determined primarily on the basis of their desirability and equitability, but rather on the basis of the companies' *current* technological strengths and capabilities. In short, *work shares should not be driven by what will be best for the companies' development, but by what will be best for the program and the system's development.* This is not to say that work shares should not be determined—to the greatest extent practicable—with fairness in terms of desirability and cost shares.

According to one interviewee, production work shares will pose the most difficult problem. For example, the contractor(s) who have integration and software tasks during the development program will need more in production work to ensure equitableness. As a result, some companies who designed and developed hardware in the program will have to give up a piece of the production work to others. Program officials believed, however, this was a workable issue, as the stakes are high for all the partners to make this program successful.

The political posturing and mistrust over who gets quality MEADS technical work shares, however, appears to have already begun. While some sources indicate the companies are postured for cooperation, they also indicate concerns about the governments' ability to work together. One source notes German experts are concerned the United States is not really willing to cooperate in the spirit of partnership and is interested only in selling black boxes. The National Institute for Public Policy study of European impressions of MEADS is replete with indications of European mistrust of U.S. government and industry, work-share arrangements, and U.S. technical requirements the Europeans do not want but will be asked to finance, etc.

One Production Line or Two?

Finally, the issue of production and final assembly lines has been only partially addressed. Apparently, the partners envision that there will be single sources for the various components, but that it is possible that there may be more than one final assembly and integration line. One interviewee noted that this will not completely obviate economies of scale to be achieved, as the greatest costs are in producing components in duplicative facilities. It remains unclear, however, whether or not the United States and Europe will want to produce critical components, such as seekers and guidance sections, domestically for national security reasons. In addition, decisions about how to handle third party transfers and sales of hardware have been left for future negotiations. For now, all foreground data transfers and uses for non-MEADS programs are subject to unanimous consent by the partners.

The Partners Currently Plan to Have A Consortium—Not a Prime Contractor

Defense officials indicate there is currently no plan to have a prime contractor, and that the companies will form a consortium, as MDTT, Inc., did for the MLRS/TGW. One source indicated that the governments support the consortium approach to maintain fairness among the partners. The sources did not indicate how they would overcome the problems caused

by the lack of a prime contractor experienced in the MLRS/TGW.

If the MLRS/TGW program experience is a good teacher, the MEADS partners will change course and assign a prime contractor. If not, at the very least, they could establish a "lead" company in the consortium. The "lead" company would be the source of authority, responsibility, and accountability for the contractors' work. The lead company would also track progress, determine risk areas, and perform other management functions. In any case, the governments, companies, and—most of all—the program would be well-served to set up the consortium in a manner that permits equitable partnership, but ensures contractor accountability, responsibility, and leadership.

Will the Program Have a Fully-Staffed, Full-Fledged International Project Office?

The MEADS will be managed by the NATO MEADS Management Agency, an international program office chartered by NATO. The agency will be located in Huntsville, AL. Current planning, reflected in Figure 3, is that there will be a multinational Program Executive Office-level Steering Committee. The U.S. Missile Defense Program Executive Office (flag officer) and its European counterparts will be members of the Steering Committee. This Committee will have authority over the NATO MEADS Management Agency. The General Manager position of this agency will rotate among European representatives throughout the entire MEADS program. Germany will provide the General Manager for the project definition–validation phase. Throughout all phases of the program, the United States will provide the permanent Deputy General Manager. In view of the 50 percent U.S. funding share, this was apparently a U.S. compromise arrangement arrived at in the negotiations.

The MLRS/TGW experience demonstrated the importance of having a truly international project office, with principals who have deciison making authority from

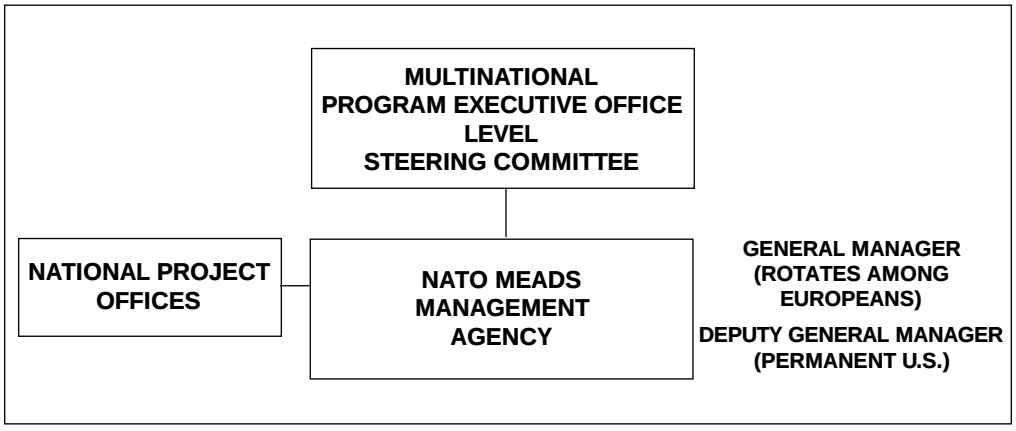

Figure 3. Planned MEADS Project Management Organization

all quarters living together to make a successful program. It remains unclear how quickly and how fully the NATO MEADS agency will be staffed, and with what authority its personnel will manage and oversee the program. The United States will continue to have a small (10-person) national project office, located in Huntsville. Will the Europeans maintain their national program offices, and retain all authority in their national capitals for decision making on tradeoffs, etc., that will inevitably arise?

How Will Decision Making Be Done?

Interviewees were uncertain about how decision making would be done in the program, both on the parts of the companies and the governments. They speculated, however, that a consensual approach was likely. One interviewee stated that the program would be managed and decision making would be on a "50:50 basis" in a true equitable partnership between the United States and the European allies. However, another noted that European block voting was already occurring on many issues during the negotiations, with Germany playing the swing vote in some issues with the United States.

A Comparative Snapshot

As shown in Figure 4, in some key program areas, the MEADS partners are following a path that is similar to the MLRS/TGW program. Having four governments and—even more complicated—six companies involved in the program will likely be problematic and costly. Through unusual teaming arrangements, MEADS

PROGRAM CHARACTERISTICS	MLRS/TGW	MEADS
Number of Countries/Companies	Four/Four	Four/Six
Mix of Countries	U.S., FR, GE, U.K.	U.S, FR, GE, IT
Percentage Cost Shares	40:20:20:20	50:20:20:10
Agreement on Threat Details	Not Fully	Not Yet
Contractor Selection	Winning Multinational Team with Some Weak Players	U.S. Companies Compete; Same Strong European Companies Win
Prime Contractor or Consortium	Consortium	Consortium
Work Share Based on Cost Share	Yes-to Second Tier	Yes-to Second Tier
Work Share Based on Company Strengths	Not Adequately	Unknown
Fully Staffed, Full-Fledged Int. Prog. Office	No	Unknown
Governments' Decision Making	Consensus; Single Vote Veto	Possibly Consensus
Companies' Decision Making	Consensus-Governments Involved	Unknown

Figure 4.
Comparison of Program Characteristics in MLRS/TGW and MEADS

partners have avoided the possibility of having weak companies participating in the program. However, having six companies operating in a consortium could lead to similar difficulties encountered in the MLRS/TGW program if leadership and accountability are not established. Moreover, some observers believe the MEADS program is already doomed to failure because the partners clearly do not agree on key elements of the requirements. However, if a prime contractor, lead company or similar approach is taken, and if the countries can harmonize their requirements or even agree on a formula for fencing off development and funding some of the requirements that are beyond France and Italy's interests, MEADS has a chance for success.

The MEADS partners are still in the early stages of establishing a cooperative program and can possibly benefit from the MLRS/TGW program experience. Front-end "damage limitation" can be applied in the areas in which decisions have not yet been made: determining technical work shares; staffing and decision making power in the international program office; and determining the approach to decision making both among the governments and the companies involved. *If the program fails, damage to the political relationships will likely be serious—it is in all the partner nations' interests to do what makes sense for the program.*

CONCLUSIONS

The MEADS partners can avoid some major pitfalls encountered in the MLRS/TGW experience if they:

- either get full agreement on a detailed set of requirements up front or fence off development and funding (and associated work shares) of requirements on which agreement cannot be reached;
- establish a prime contractor or a lead company/manager for the consortium;
- ensure technical work shares are equitably based on national cost shares and the companies' technological strengths, experience, and comparative advantages;
- quickly establish a fully-staffed, full-fledged international program office vested with national program office-level decision making power and authority; and
- avoid consensus decision making in which negative behaviors, such as single-vote veto, are available and can stop the program—adopt another, more positive team-oriented approach.

The former United States,United Kingdom, French, and German MLRS/TGW program officials and the current United States, French, German, and Italian MEADS program officials should hold a joint conference to more fully explore the problems encountered in the MLRS/TGW program, their causes, and alternative approaches to better ensure success for MEADS.