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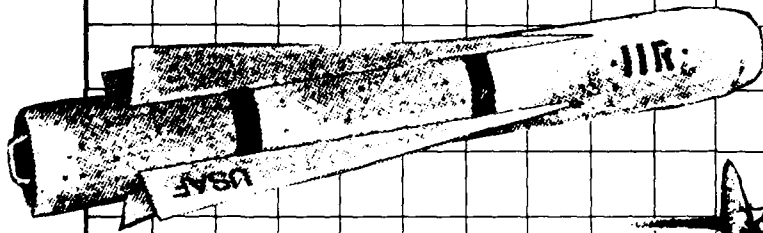
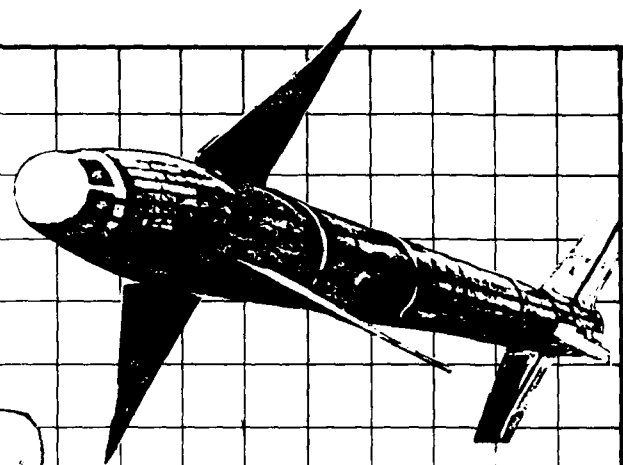
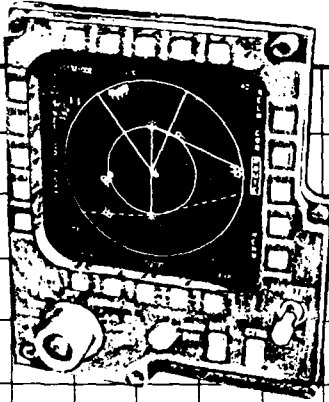
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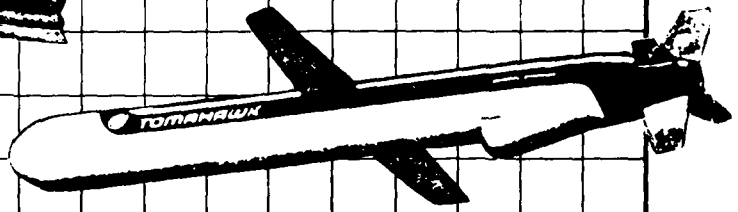
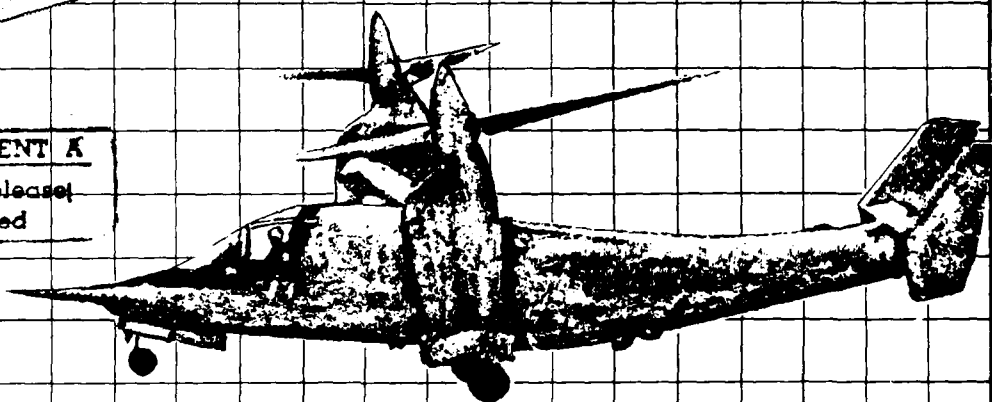
TECHNOLOGY TRANSFER

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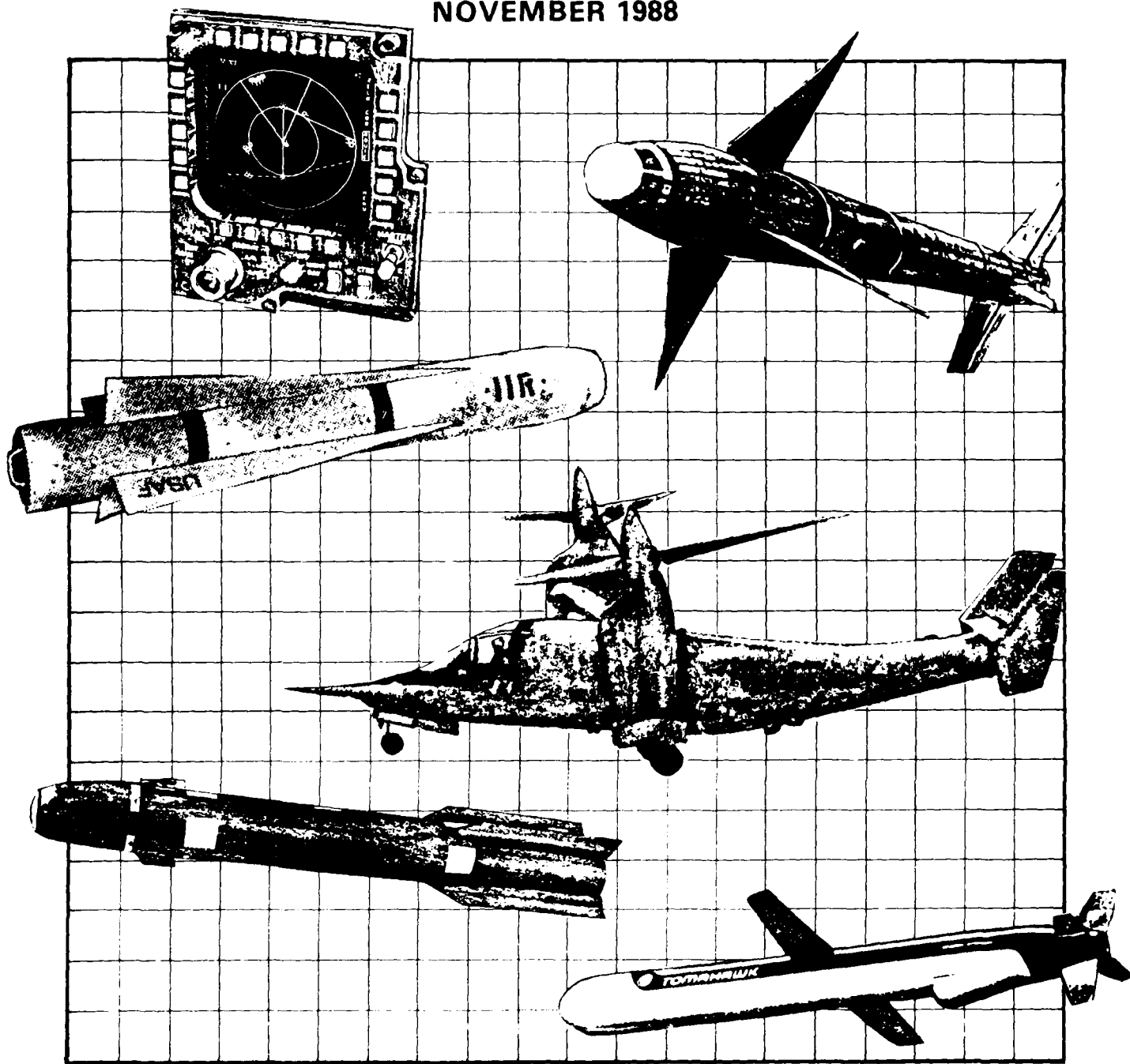
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A PROGRAM OFFICE GUIDE TO TECHNOLOGY TRANSFER

NOVEMBER 1988



PREFACE

In 1984, Defense Systems Management College (DSMC) published the handbook entitled "Establishing Competitive Production Sources" to provide program managers with a systematic approach for planning and implementing competition during the production phase of a program. Subsequently, in 1986, DSMC sponsored the development and presentation of a two-day production competition course at 30 locations across the country. Feedback from program managers indicated a need for more detailed information on the technology transfer process. As a result, this guide was developed for use in planning and executing the key activities required of the program manager, the developer, and the second source to effect a successful dual source program. This guide complements the handbook and readers are encouraged to refer to it for a more complete discussion of the alternative strategies for maintaining competition throughout the program life cycle.

This guide was developed under the direction of DSMC by The Analytic Sciences Corporation under Contract No. MDA903-87-C-0793. The principal authors were Louis A. Kratz, Michelle C. Stuart, and Denise A. Snyder.

Ongoing research and experience may identify areas where additions, modification, or deletions might enhance the usefulness of the Guide. Therefore, we solicit your comments or recommendations relating to the overall text or coverage of a specific aspect of production competition. Please use the tear sheets located at the end of the Guide or a letter if no tear sheet is available. Address your comments to:

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EXECUTIVE SUMMARY

Production dual sourcing to attain competitive production sources or to enable multinational coproduction is a major focus within the weapon system acquisition process. The critical component of a successful dual source program is a comprehensive technology transfer effort. Technology transfer encompasses all Program Office, initial source, and second source activities required to qualify a second production source.

This guide has been prepared by the Defense Systems Management College (DSMC) to assist Program Offices in planning and executing technology transfer. Key elements of the guide include the following:

- Program objectives
- Technical requirements
- Second source qualification
- Demonstration milestones
- Timing of technology transfer
- Implementation alternatives.

The cornerstone of an effective technology transfer effort is a clear statement of dual source objectives. Recent programs have employed dual sourcing to:

- Reduce or control costs
- Improve quality
- Meet delivery schedules
- Reduce risk
- Provide for mobilization or surge.

Once defined, the dual source objectives guide the technology transfer approach, qualification requirements, and configuration management plan.

As guiding principles, the dual source objectives establish a cohesive framework for an integrated technology transfer effort.

The technical requirements of a technology transfer program include the technical data to be transferred, anticipated technical support, training materials and kits, and potential qualification assistance. These elements are defined based upon the program's dual source strategy, configuration management requirements, and equipment and process complexity.

Second source qualification requirements are determined based upon equipment complexity, process criticality, interchangeability requirements, and equipment performance characteristics. Qualification includes:

- Component verification
- Interchangeability demonstrations
- Process validation fabrication and assembly demonstrations
- Process validation
- Performance testing
- Configuration audits.

The goal of the qualification effort is to incrementally demonstrate second source production capability.

Technology transfer progress and confidence in the second source's ability to produce the end item is determined based upon progressive milestones including:

- Control and validation of the data package
- Critical process demonstrations such as masking, bonding, or sealing

- Kit assembly and checkout
- Subsystem and component verification
- Interchangeability demonstrations
- Fabrication of qualification units
- Qualification testing
- Directed buy
- Physical configuration audit.

Successful accomplishment of these milestones results in second source full production capability.

Technology transfer has been initiated on recent programs during full scale development (FSD) or initial production. Several mechanisms exist for initiating technology transfer early in the acquisition cycle. The process of scheduling technology transfer involves the identification of a target completion date and the reversal of sequential activities and lead times. In determining the timing of technology transfer, the Program Office should:

- Identify a target for a first competitive lot based on economic and programmatic analyses
- Back up 18 to 24 months from the competitive lot award date to incorporate qualification testing and fabrication of qualification hardware
- Back up 12 to 18 months from the start of qualification to allow for technology transfer and production planning including initial source support.

This process identifies a preferred date for initiation of the dual source program. The reasonableness and validity of this date then can be assessed based upon factors such as maturity of design, data availability, and potential second source activities.

The contractual implementation of the preferred technology transfer approach is the culmination of all prior planning activities. The contractual requirements for the initial source and the second source must be complementary to ensure a cohesive

technology transfer effort. Once the statements of work have been defined, the contract type is developed based upon risk, schedule urgency, and potential incentives.

The contract mechanism will vary depending upon the technology transfer approach and maturity of the program. For new-start programs, technology transfer requirements are tied to the initial source's FSD contract. This provides the Program Office with the leverage of the FSD and production programs. For more mature programs, the initial source efforts are tied to the contract effort that has the greatest unexpended financial balance.

The second source contract type and the use of options also must be assessed. Key elements to consider include maturity of the system, quality of available data, and technical complexity. Incentives may be incorporated to enhance schedule acceleration or cost control. Options also could be incorporated for a limited production buy. This approach is helpful in easing contracting requirements and in providing insights into an offeror's potential production pricing during selection of the second source.

The aforementioned planning milestones are integrated in a technology transfer plan. The plan is prepared prior to the preparation of the statements of work for the first and second source to ensure clear direction to the contractors. The detail of the plan will depend upon the maturity of the program. As the program progresses, additional detail is incorporated. The plan serves as the guiding document for all program personnel associated with the technology transfer effort. As such, it functions as the foundation for more detailed, subordinate plans such as configuration management, qualification, manufacturing, quality assurance, system test and logistic support plans.

The remainder of this guide presents a logical framework for developing a comprehensive technology transfer plan. Key issues, alternative approaches, and promising techniques are highlighted.

Chapter 1

BACKGROUND

Successful technology transfer requires the development of an integrated plan that reflects a logical flow from dual source objectives through technology transfer to qualification. This chapter concentrates on the program office actions that must be taken to establish a dual source program framework including:

- Dual source objectives
- Alternative strategies
- Technology transfer activities
- Interim milestones
- Technology transfer plan.

1.1 DUAL SOURCE OBJECTIVES

The development and execution of a coherent acquisition strategy that supports program goals is one of the fundamental responsibilities of the Program Office. Dual sourcing is one of several alternative strategies that support the attainment of program goals.

Dual source objectives directly influence the strategy, technology transfer activities, qualification requirements, and the configuration management plan. As shown in Figure 1.1-1, dual source objectives are the starting point of an effective planning framework.

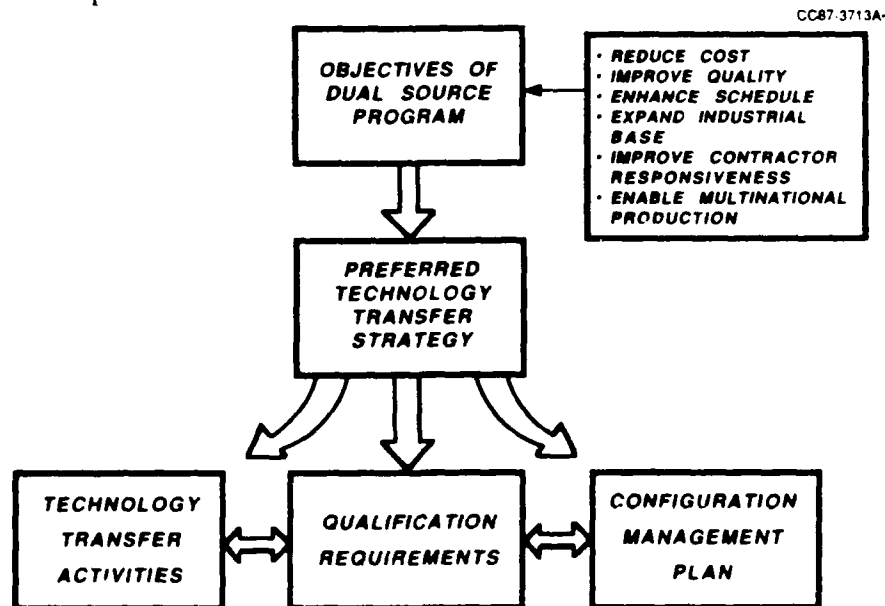


Figure 1.1-1 Dual Source Objectives Guide Program Planning

Dual sourcing has been employed to attain several objectives ranging from ensuring supply and improving quality to enhancing standardization

through multinational coproduction. Table 1.1-1 presents the primary objectives of several recent and ongoing dual source programs.

PROGRAM	EQUIPMENT TYPE	PRIMARY OBJECTIVE
Sidewinder-(AIM-9M) Alternate Fighter Engine (AFE) Airborne Self-Protection Jammer (ASPJ) Patrol Frigate (FFG-7) Hellfire Stinger V-22 Osprey Tomahawk Roland	Tactical Missile Turbofan Engine Electronics Surface Ship Tactical Missile Tactical Missile Aircraft Strategic Missile Tactical Missile	Mobilization Durability Reduce Risk Delivery Schedule Cost Control Reduce Cost Reduce Cost Reduce Cost Coproduction

Table 1.1-1 Dual Source Objectives

Dual sourcing is most effective when the objectives of the effort support overall program goals. Table 1.1-2 presents general program characteristics and associated dual source objectives. The table is

provided as a guide to indicate what the primary objective of the dual source effort should be, given a set of program characteristics.

PROGRAM CHARACTERISTICS	PRIMARY DUAL SOURCE OBJECTIVE
High Volume	Ensure Supply
Technically Complex	Reduce Risk
War Reserve Material	Expand Mobilization Base
Immediate Operational Requirement	Enhance Schedule
Poor Quality to Date	Improve Quality
Cost Growth	Reduce/Control Costs
High Value Item	Reduce Costs
High Density Electronics	Ensure Supply
Poor Reliability/Maintainability	Improve Logistics
NATO Weapon System	Enable Multinational Production

Table 1.1-2 Potential Dual Source Objectives

The potential objectives shown in Table 1.1-2 are a summarization of recent programs. Often, there are programs that exhibit several characteristics, thus requiring the program to rank order dual source objectives. This rank ordering is undertaken based upon the relative dominance of the multiple characteristics. The ranking establishes a baseline for the technology transfer strategy.

1.2 ALTERNATIVE STRATEGIES

The technology transfer strategy flows directly from the specific dual source objectives. Several strategies have been employed on prior programs to accomplish technology transfer including:

- Technical data package
- Leader-follower
- Contractor teaming
- Licensing.

These strategies are briefly described with emphasis on the special characteristics of each.* Eight example competitive programs are documented in Appendix A as case studies. Each case study presents the technology transfer strategy pursued and lessons learned.

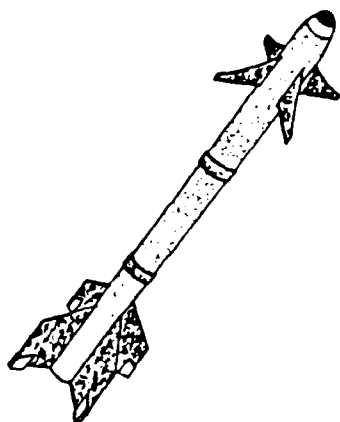
1.2.1 Technical Data Package

The technical data package (TDP) approach involves the development and validation of a complete set of engineering drawings and the delivery of those drawings to a second production source. An adequate package contains the complete system specification, complete engineering drawings, tooling and test equipment drawings, acceptance test procedures, and process instructions.

Validation of the TDP entails the following:

- Detailed inventory of the package to ensure all required data have been prepared
- Detailed review of drawings and specifications to ensure all have been prepared in accordance with directed standards
- Physical configuration audit (PCA) of the end item to ensure the drawings adequately represent deliverable hardware.

These validation activities are completed prior to releasing the TDP to potential second sources. The Government also may provide technical assistance and guidance to the second source in interpreting the TDP. The second source then builds to the TDP and attempts to qualify for production. The qualification program includes testing to demonstrate that the "as built" configuration meets the system performance and quality requirements. Currently, the TDP approach is being employed on the AIM-9M guidance package as summarized in Figure 1.2-1.



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- **AIR-TO-AIR GUIDED MISSILE**
- **INFRARED HOMING GUIDANCE SYSTEM**
- **TECHNOLOGY TRANSFER: TDP**
- **SPLIT BUYS STARTED WITH PRODUCTION LOT II**
- **GOALS OF DUAL SOURCE PROGRAM:**
 - TWO QUALIFIED PRODUCERS
 - SURGE AND MOBILIZATION
 - REDUCE COST

Figure 1.2-1 AIM-9M TDP Program

*For a more detailed discussion of the alternative strategies, see: Establishing Competitive Production Sources: A Handbook for Program Managers, DSMC, 1984.

The key issues associated with a TDP strategy include:

- Validation of the TDP against deliverable hardware may delay introduction of the second source until rate production
- Even a complete TDP may not encompass all necessary process instructions and floor practices
- The Program Office must assume an active role as the central focal point for the technology transfer and as the arbitrator of technical issues
- The qualification program must demonstrate that the second source can meet both the system specifications and the equipment drawings.

These issues must be assessed against dual source objectives. For example, a TDP approach may be inappropriate if dual sources are desired to attain rapid production ramp-up. Similarly, if the program office is manpower constrained, personnel may be unavailable to support technology transfer. Finally, the required level of second source qualification may require Government test facilities and manpower that are constrained or unavailable. Therefore, a TDP approach is most applicable under the following circumstances:

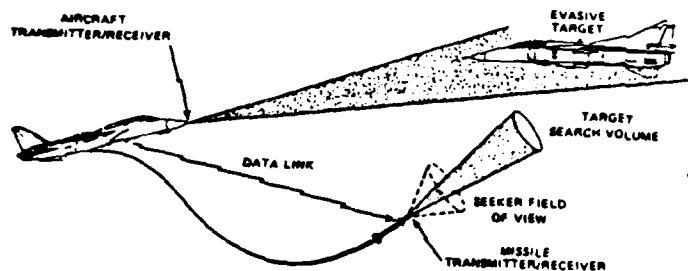
- Low to moderate complexity items
- Relatively mature production programs
- A second source is desired to reduce cost, improve the industrial base, or enhance producibility.

1.2.2 Leader-Follower

Leader-follower involves direct contractor-to-contractor transfer of all technical data that is required to establish a second production source. The system developer (leader) provides training, technical assistance, material support, vendor qualification, and detailed manufacturing support to the second source (follower). This more robust exchange provides rapid follower qualification as well as greater detailed support by the leader for complex systems. The follower can be established as a sub-contractor to the leader or both can be prime contractors to the Government with technical exchange being facilitated through an associate contractor agreement (ACA).

The Advanced Medium Range Air-to-Air Missile (AMRAAM) is an example of the leader-follower approach. Both contractors are prime contractors to the Government. As summarized in Figure 1.2-2, the AMRAAM leader-follower effort was initiated during full scale development (FSD). Table 1.2-1 presents the activities of the leader and follower in FSD and production.

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- **AIR-TO-AIR TACTICAL MISSILE**
- **INERTIAL MIDCOURSE GUIDANCE, PLUS ACTIVE RF SEEKER FOR TERMINAL GUIDANCE**
- **TECHNOLOGY TRANSFER: LEADER-FOLLOWER IN FSD AND PRODUCTION**
- **SPLIT BUYS START WITH PRODUCTION LOT IV**

Figure 1.2-2 AMRAAM Leader-Follower Program

	FSD	PRODUCTION
LEADER RESPONSIBILITIES	<p>TEACH FOLLOWER TO MANUFACTURE THE AMRAAM AIR VEHICLE</p> <p>PROVIDE HARDWARE, SPECIAL TEST EQUIPMENT, AND TECHNICAL DATA TO THE FOLLOWER</p> <p>DEVELOP AND IMPLEMENT FOLLOWER TRAINING PROGRAM</p> <p>SUPPORT FOLLOWER IN PRODUCTION PLANNING</p> <p>REVIEW FOLLOWER'S MAKE/BUY AND LONG LEAD PROCUREMENT PLAN</p>	<p>LOTS I AND II:</p> <p>ASSEMBLE, TEST AND DELIVER AMRAAM AIR VEHICLES TO THE GOVERNMENT</p> <p>PROVIDE HARDWARE, SPECIAL TOOLING DEFINITION, AND TEST EQUIPMENT TO THE FOLLOWER FOR CO-ASSEMBLY</p> <p>CONDUCT INSPECTION/ACCEPTANCE TEST ON ALL ITEMS DELIVERED TO THE FOLLOWER</p> <p>RETAIN TOTAL SYSTEM PERFORMANCE RESPONSIBILITY</p>
FOLLOWER RESPONSIBILITIES	<p>VERIFY, PROOF, AND PROVIDE INPUTS TO THE LEADER</p> <p>IDENTIFY ALTERNATIVES REQUIRED TO ACCOMMODATE DIFFERENCES BETWEEN MANUFACTURING PROCESSES</p>	<p>PERFORM CO-ASSEMBLY EFFORTS DURING LOTS I AND II</p> <p>IMPLEMENT MAKE/BUY PLAN DURING LOT II</p> <p>BUILD UP COMPETITIVE PRODUCTION RATE CAPABILITY DURING LOT III</p>

Table 1.2-1 AMRAAM Technology Transfer

The leader-follower approach is most applicable under the following circumstances:

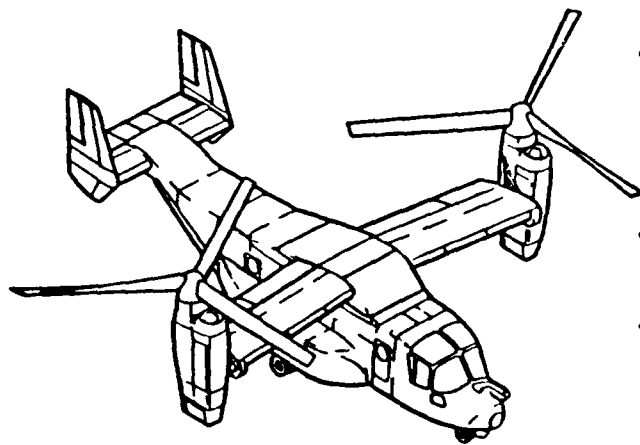
- Moderate to high complexity items
- Dual sourcing is desired early in the production program to meet high delivery requirements
- Second source involvement in FSD is desired to improve producibility.

1.2.3 Contractor Teaming

Contractor teaming involves the formation of a team by two contractors for the full scale development of a system. Both contractors fulfill specific

and distinct design responsibilities and then exchange each other's production technology. This mutual activity results in two qualified production sources for the complete system. The contractor teaming approach has been implemented through prime-subcontractor arrangements and through joint venture arrangements.

The primary benefit of a teaming approach is that it allows for design specialization during development while establishing two qualified sources early in production. A recent example of the joint venture teaming approach is the V-22 Osprey as summarized in Figure 1.2-3. The activities of the technology transfer effort are summarized in Figure 1.2-4.



- TILT-ROTOR AIRCRAFT
- JOINT VENTURE OF BELL-BOEING FORMED TO DESIGN AND DEVELOP V-22
 - BELL - WING AND NACELLE STRUCTURE
 - BOEING - FUSELAGE ASSEMBLY AND AVIONICS
- SPLIT BUYS START WITH PRODUCTION LOT 1
- GOALS OF DUAL SOURCE PROGRAM:
 - REDUCE AND CONTROL COSTS
 - ENSURE SUPPLY
 - AVOID SCHEDULE SLIPS

Figure 1.2-3 The V-22 Osprey Teaming Approach Activities

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 - NAVY ISSUED FIXED PRICE DEVELOPMENT CONTRACT TO BELL-BOEING TEAM; REQUIRED DIRECT TECHNICAL AND ENGINEERING EXCHANGE BETWEEN THE TWO CONTRACTORS
 - IN FSD, EACH CONTRACTOR IS MANUFACTURING SIX SETS OF THEIR RESPECTIVE SUBSYSTEMS WITH FINAL INTEGRATION BY BOEING
 - DURING FSD, THE DESIGN AGENT IS PROVIDING ON-SITE SUPPORT AT THE LEARNING CONTRACTOR'S FACILITY
 - EXCHANGE DATA AND SUBSYSTEMS FOR INSPECTION, DISASSEMBLY, AND REASSEMBLY BY OTHER CONTRACTOR
 - DESIGNING CONTRACTOR WILL ESTABLISH VENDORS FOR THOSE SUBSYSTEMS THE OTHER CONTRACTOR WILL BUY RATHER THAN MAKE
 - IN PILOT PRODUCTION, EACH CONTRACTOR WILL MANUFACTURE NINE COMPLETE AIRCRAFT

Figure 1.2-4 V-22 Technology Transfer Activities

Timely execution of a teaming approach implies a high degree of concurrency between development, technology transfer, and initial production. Thus, a teaming approach is most appropriate for programs with the following characteristics:

- High value items with multiple internal interfaces
- Moderate technical risk
- High initial production rates that require multiple facilities.

1.2.4 Licensing

Licensing involves the development of a second source by the system developer. The system developer is directly compensated for the technology transfer effort and receives a royalty fee for every item produced by the second source (licensee). The specific technology transfer activities, initial fee, royalty fee, and potential restrictions are defined in a licensing agreement. This approach has been used in cases where the initial source employed patent protections on certain designs or

processes. In addition, because the continuous royalty fee discourages cost reduction, the license approach has been employed on programs that established dual sources for reasons other than cost. Recent examples include the cruise missile engine and the IIR Maverick.

1.3 TECHNOLOGY TRANSFER ACTIVITIES

The selection of a technology transfer strategy is inherently linked to anticipated technology transfer activities. For example, when extensive support

from the initial source is required, a leader-follower strategy is preferred. Technology transfer encompasses several fundamental activities including:

- Transfer of technical data to the second source
- The provision of engineering, material, and training assistance to the second source
- The development of the second source production line
- Qualification of the second source as a capable producer.

These activities are summarized in Figure 1.3-1.

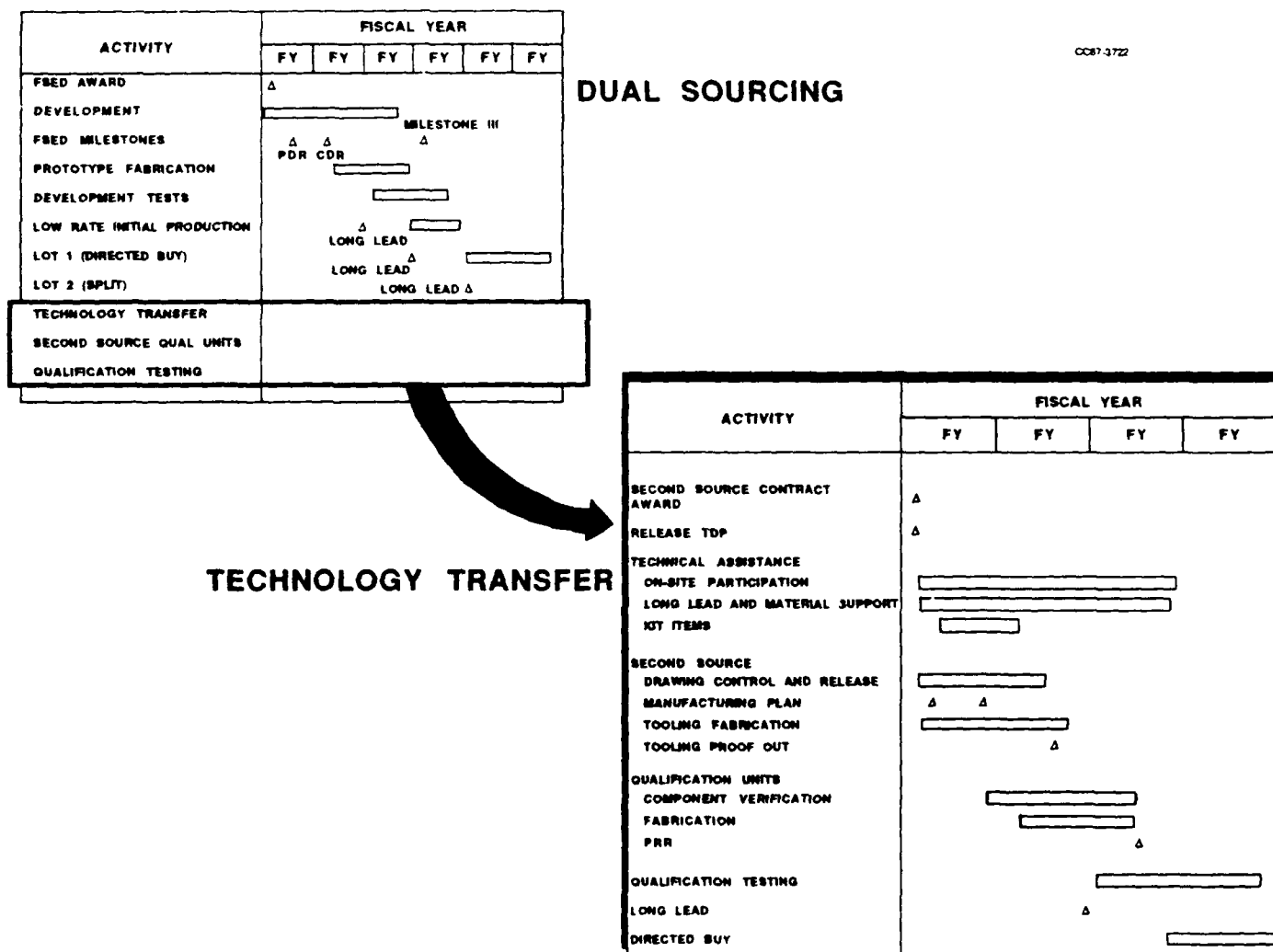


Figure 1.3-1 Technology Transfer

1.3.1 Transfer of Technical Data

The transfer of technical data encompasses the documentation, validation, and transmittal of all specifications, drawings, and instructions that are required to establish the second source as a qualified producer. Key data elements include:

- System specification
- Technical drawings
- Manufacturing work instructions
- Tooling and test equipment drawings
- In-process test procedures
- Numerical control tapes
- Referenced standards
- Contractor training manuals
- Make/buy plans.

These elements are prepared by the initial source and transferred to the second source either directly or through the Government. Technical data transfer is discussed in greater detail in Chapter Two.

1.3.2 Provision of Technical Support

Technical support is provided to the second source either to accelerate the technology transfer process or to assist the second source in mastering complex technologies. Technical support encompasses several activities including:

- Engineering support in areas such as design philosophy clarification, data interpretation, and process validation
- Training in complex processes or procedures, test equipment use and calibration, and material handling for exotic materials
- Material support in areas such as vendor base development, long lead ordering, and incoming inspection
- Provision of kit items as ready-to-assemble subsystems or end items
- Test support including test instrumentation, test data reduction, and test data analysis and interpretation.

These types of technical support are provided by the initial source under leader-follower, teaming, and licensing strategies. Under a TDP approach,

some elements such as data interpretation are provided by the Government. Technical support is discussed in greater detail in Chapter Three.

1.3.3 Second Source Production Line

Development of the second source production line includes all activities that are required to establish second source production capability. Key activities include:

- Production planning
- Tooling and test equipment procurement
- Kit assembly
- Materials acquisition
- Fabrication of qualification hardware
- Fabrication of limited production hardware.

These activities are defined in greater detail in Chapter Four.

1.3.4 Second Source Qualification

Second source qualification includes all activities necessary to incrementally demonstrate second source capability to manufacture end items that conform to specifications and drawings. Principal elements of an integrated qualification program include:

- Component verification
- Process validation
- Interchangeability demonstrations
- Contractor tests/simulation
- Performance tests
- PCA of an initial production unit
- Lot acceptance testing of initial production hardware.

These activities provide logical demonstration milestones of second source capabilities. They are discussed in greater detail in Chapter Five.

1.4 INTERIM MILESTONES

Successful completion of technology transfer activities requires periodic monitoring and assessment of progress through interim milestones. These milestones provide incremental measures of second source progress and serve as confidence factors

leading to a second source production award. Typical milestones include:

- Drawing release and control
- Manufacturing plan completion
- Component verification
- Production readiness review
- Qualification testing
- Physical configuration audit.

1.4.1 Drawing Release And Control

The initial milestone of a technology transfer effort is assimilation, release, and control of technical data by the second source. Release of the drawings from the second source's engineering team to manufacturing implies that the second source has reviewed and assimilated the engineering and technical aspects of the item establishes the necessary change control procedures, and is ready to begin hardware fabrication.

1.4.2 Manufacturing Plans

Upon receipt and assimilation of the technical data, but prior to start of hardware fabrication, the second source prepares a detailed manufacturing plan for Government review. Under a prime-subcontractor approach, the prime contractor delivers the plan to the Government. The manufacturing plan is prepared in accordance with MIL-STD-1528 to include the definition of:

- Fabrication processes
- In-line testing procedures
- Component integration
- Capital and facilities requirements
- Special tooling and test equipment
- Manpower forecasts
- Production reviews.

Prime/Government review and Government approval of the plan indicates that the second source has successfully accomplished the necessary planning to begin fabrication of qualification hardware.

1.4.3 Component Verification

Qualification of a second source is a sequential process that yields incremental measures of

progress. A major element of the process is a component verification program during which the second source demonstrates the capability to fabricate or procure critical subsystems. As an interim milestone, successful completion of the component verification program indicates that the second source has mastered all critical technologies and processes short of final assembly.

1.4.4 Production Readiness Review

The Program Office conducts production readiness review (PRR) to verify that the planning and all associated preparations for production have progressed to the point where a manufacturing commitment can be made without incurring unacceptable risks. All critical assembly and test procedures are addressed during the PRR. In addition, the second source demonstrates its facilities' competence including the procurement of parts and materials, manufacturing processes, inspection and quality procedures, tooling and test equipment, and management systems to control inventory, subcontractors, and vendors. Basic requirements and objectives of a PRR are outlined in MIL-STD-1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Programs."

1.4.5 Qualification Testing

The second source must demonstrate the ability to satisfactorily perform all steps necessary in procuring material, fabricating hardware, performing all acceptance tests and meeting all physical, performance, and specification requirements. Successful completion of qualification testing indicates that the second source can build end items to meet all documented specifications, tolerances, and performance requirements. This milestone is accomplished prior to the first competitive award.

1.4.6 Physical Configuration Audit

Successful completion of the PCA is the final milestone in second source qualification and technology transfer. Second source initial production hardware is subjected to a PCA to ensure that the hardware configuration reflects the configuration described in the TDP. The PCA is conducted by the Program Office in accordance with MIL-STD-1521B. Additional guidance can be drawn from DoD-STD-480A, MIL-STD-483A, and MIL-STD-490A.

1.5 TECHNOLOGY TRANSFER PLAN

The program's approach to accomplishing technology transfer activities and to achieving milestones is

documented in a technology transfer plan (TTP). A thorough TTP includes the following:

- The data elements to be transferred including format and medium
 - Anticipated technical support including training, materials, kits, and test support
 - Preliminary production planning for the second source including anticipated lead times, qualification units, and directed buys
 - Qualification requirements for the second source including component verification, interchangeability, and performance testing
- A clear management structure that enables effective communication
 - The contractor and Government agreements that will contractually implement the technology transfer program
 - Potential incentive fees and awards
 - Configuration management procedures including design agent responsibilities.

Further definition and development of these elements are the primary focus of this guide. Each element is discussed in detail in subsequent chapters.

Chapter 2

TRANSFERRING DATA

The level and format of technical data to be transferred are directly related to the desired level of configuration control, the required level of qualification, and program maturity. This chapter defines key data elements, alternate data formats, and data validation activities. The essential factors in determining data requirements also are presented.

2.1 KEY DATA ELEMENTS

The second source must be provided sufficient technical data to allow fabrication of end items and accomplishment of production qualification. Regardless of the technology transfer strategy, key technical data elements to be transferred include:

- Specifications
- Technical drawings
- Test requirements documents
- Tooling and test equipment drawings
- In-process test procedures
- Acceptance test procedures
- Numerical control tapes
- Referenced standards
- Manufacturing work instructions

- Contractor training manuals
- Make/buy plans.

Under a technical data package (TDP) approach, these elements comprise a "complete" technical data package. Under a leader-follower or teaming approach, these elements are the initial technical data that are further supplemented by technical assistance, as discussed in Chapter Three.

2.1.1 System Specifications

Specifications define the performance, physical, and acceptance test-requirements for an item. These requirements are documented in the following types of specifications:*

- Type A - System/Segment Specification
- Type B - Development Specifications
- Type C - Product Specifications
- Type D - Process Specifications
- Type E - Material Specifications.

Specifications are developed by the initial source, approved by the Government, and transferred to the second source. The specifications form the technical baseline for second source fabrication, qualification, and production.

*MIL-STD-490A, Specification Practices, 4 June 1985

2.1.2 Technical Drawings

Technical drawings encompass the complete set of engineering drawings, specifications, quality assurance provisions, process instructions, and associated lists that fully describe the physical, electrical, mechanical, and operating properties of an item. Drawings are organized in a hierarchical fashion to include each part, component, subassembly, and assembly of an end item. Under a TDP strategy, the drawings are prepared by the initial source in accordance with DoD-STD-1000B, accepted by the Government, and transferred to the second source. Under a leader-follower or teaming strategy, the drawings are transferred directly to the second source. When technology transfer is initiated during FSD, the drawings are transferred incrementally as the design matures. For example, on the V-22 program the contractors are exchanging data as it is developed beginning with the specifications and allocated baselines leading to level 2 and finally level 3 drawings.

2.1.3 Test Requirements Documents

The test requirements documents (TRDs) define the testing that must be conducted and the parameters that must be assessed to ensure the end item conforms to its specifications. The TRDs define the necessary in-process tests, mandatory inspection points, and final acceptance tests. The TRDs are transferred to the second source to ensure all necessary testing is conducted and to guide the development of second source test procedures and special test equipment.

2.1.4 Tooling and Test Equipment Drawings

Similar to technical drawings, tooling and test equipment drawings encompass the complete set of engineering drawings, specifications, and process instructions that fully describe the physical, electrical, mechanical, and operating properties of tooling and test equipment. Special tooling and test equipment (ST/TE) are items developed at Government expense that are unique to the manufacture and inspection of the end item. These include but are not limited to jigs, fixtures, gauges, test stands, factory acceptance equipment, and special material handling equipment.

The drawings for these items are transferred to the second source to avoid duplication of tool and test equipment design and development. In addition, availability of the drawings

accelerates second source production planning and assists in-process control by ensuring that hardware items are produced and inspected using similar equipment. The drawings for Special Acceptance Inspection Equipment (SAIE) are particularly important to ensure that end items from both contractors are accepted by the Government against the same standard.

2.1.5 In-Process Test Procedures

In-process test procedures document the inspections and tests conducted on parts, components, and assemblies during production to ensure they conform to product specifications and the TRDs. The procedures are prepared by the initial source and are unique to a particular manufacturing approach and process. Transfer of the in-process test procedures provides the second source with a foundation for manufacturing and quality control planning. The second source may adapt these procedures to reflect a different manufacturing philosophy or to increase efficiency. For example, the second source on the AIM-9M guidance package introduced automated testing of hybrids to increase quality and efficiency which was not part of the original in-process test procedures.

2.1.6 Acceptance Test Procedures

Acceptance test procedures (ATPs) document the inspections and tests that are used by the Government to accept the end item. ATPs are prepared by the initial source and approved by the Government. ATPs are applied to critical subassemblies, subsystems, and the end item and address all primary physical, environmental, mechanical, and operating properties as defined in the item specifications and the TRDs. ATPs are transferred to the second source to maintain the integrity of the acceptance process and to assist the second source in manufacturing planning. Similar to in-process test procedures, the ATPs may be modified by the second source. Suggested modifications to ATPs must be approved by the Government.

2.1.7 Numerical Control Tapes

Numerical control (NC) tapes store the programs that drive computer controlled machinery such as milling machines. The tapes are prepared by the initial source and are unique to each particular machine for each particular process for each particular part. NC tapes are directly transferrable to the second source only if identical machines are used at both contractors. When identical machines are not used, the

programs on the tapes can be adapted by the second source for similar machines.

2.1.8 Referenced Standards

Referenced standards are company-specific standards that define particular manufacturing operations such as soldering. The company standard is referenced on the item drawing or the manufacturing work instruction. The standard is required by the second source to complete the necessary manufacturing operations. Initial source contractors resist transferring company standards based on proprietary claims; however, the Program Office can insist on their delivery as necessary to accomplish weapon production.

2.1.9 Manufacturing Work Instructions

Manufacturing work instructions translate the technical drawings into specific operations to be conducted on the production floor. The instructions define the detailed process and assembly operations that must be undertaken to fabricate an item that conforms to the engineering drawings. The sequence of operations also are specified to provide production personnel with step-by-step directions for the fabrication of an item.

The manufacturing work instructions are prepared and retained by the initial source. Contractors have resisted transferring the instructions on the basis that they are proprietary and non-deliverable items. In reality, development of the instructions is fully funded by the Government during FSD. Therefore, transfer of the instructions to the second source accelerates the second source's production planning and provides a more detailed basis for qualification. Initial source proprietary claims are avoided by incorporating the manufacturing work instructions in a deferred data delivery clause in the FSD contract.

2.1.10 Contractor Training Manuals

Contractor training manuals describe in detail specific manufacturing operations. The initial source training manuals on special operations such as coating, sealing, or welding provide the second source with additional background for production planning. This background is particularly valuable for process controlled items.

2.1.11 Make/Buy Plan

The initial source make/buy plan presents the qualified vendors for purchased material. This information is provided to the second source to assist in establishing his procurement system and to assist in production planning.

2.2 DATA FORMATTING

The evolution of computer-aided design and data management has introduced a wide variety of media for formatting and storing technical data. Strict reliance on hard copy engineering drawings is neither efficient nor desired. The alternate media for transferring data are defined in the following subsections.

2.2.1 Hard Copy

Hard copy refers to traditional paper copy documents. To ensure legibility and facilitate clear reproducibility, hard copy deliverables must be "clean" and devoid of tears, folds, holes, incomplete erasures, stains, smudges or similar defects which obliterate information. Hard copy drawings are prepared in accordance with DoD-STD-1000B.

2.2.2 Cards

Aperture cards are microfilm copies of hard copy documents that facilitate storage and retrieval of the information. Relevant DoD references include MIL-HDBK-303, "Micro-Reproduction of Engineering Documents"; MIL-M-9868D, "Microfilming of Engineering Documents, 35mm Requirements for"; and MIL-M-38761, "Microfilming and Photographing of Engineering/Technical Data and Related Documents: PCAM Card Preparation, Engineering Data Micro-Reproduction System, General Requirements for Preparation of." Most modern manufacturing companies no longer use this medium, except to support Government contract data requirements.

2.2.3 CAD/CAM

CAD/CAM refers to computer-aided design/computer-aided manufacturing. In modern manufacturing plants, many design and manufacturing activities previously performed by hand and documented with paper are now performed by computer with the attending documentation stored electronically in the computer. Data stored in this manner can be transferred

directly from the original developer to the second source, assuming compatible CAD/CAM systems.

2.3 VALIDATING TECHNICAL DATA

The level of Program Office involvement in data validation is directly related to the technology transfer approach. For example, the Government may play a limited role under a leader-follower approach while a more intense Government validation effort is required under a TDP approach. The validation of technical data can be viewed as a four-tiered effort that encompasses the following steps:*

- Inventory and format
- Physical configuration audit
- Demonstration
- Hardware build.

2.3.1 Inventory and Format

The first tier of a technical data package validation effort is an audit of all drawings, specifications, and designs to establish that complete and properly formatted documentation exists for all component parts, assemblies, and end items. Documentation is further examined to ensure it does not contain special requirements and processes that are not industry standards and which only the developer can accomplish.

This validation activity to ensure the data package is consistent and complete includes:

- The tracing through system specifications
- Test requirements documents
- Engineering drawings
- Process instructions
- Tooling and test equipment drawings
- Quality assurance provisions.

The drawings are reviewed in accordance with the end item indentured list to ensure a systematic and thorough evaluation. The objective is

to identify any discrepancies or inconsistencies that must be addressed by the initial source.

2.3.2 Physical Configuration Audit

The next tier of validation is the physical configuration on audit (PCA), where the Government examines, tests, and compares the equipment against the TDP. The purpose is to verify that the production configuration of the hardware manufactured by the developer conforms to the documentation in the technical data package, that all changes resulting from test are documented, and that acceptance test procedures are completed.

2.3.3 Demonstration

The third tier in the validation process involves an on-site audit of the developer's manufacturing methods (including assembly, tooling, and test procedures). In addition, the developer conducts the actual assembly, inspection, and test of several sets of randomly selected parts and assemblies. The purpose is to verify that the technical data supplied accurately represents methods that allow a second source to produce the end item from the data.

2.3.4 Hardware Build

As a final check, the Government may build validation units in a Government-owned and operated facility. Although time and resources may not always permit this step, programs which employ this process reduce the potential risk for the Government and the second source. The purpose is to verify the technical data, understand the techniques used by the first source during manufacture, and familiarize Government personnel with unique processes and methods. Clarifications, changes, and improvements are made to the data package. The second source receives a reliable data package, and technical assistance from the Government personnel who performed the validation.

2.4 DEFINING DATA REQUIREMENTS

The data required to support technology transfer is determined based upon equipment complexity, industrial capabilities, logistics requirements, and schedule urgency.

*The steps outlined in the section are based on data validation activities conducted by the Naval Avionics Center. For more information, see: "The Competition Handbook," The Competition Advocate General of the Navy, October 1987.

2.4.1 Equipment Complexity

As the complexity of the equipment to be produced by a second source increases, so does the magnitude and level of detail of the technical data that is required. Complexity is a function of:

- Assembly procedures
- Test procedures
- Manufacturing methods
- Level of quality control required
- Sophistication of the tooling
- The degree of innovation involved in the equipment design.

2.4.2 Industrial Capabilities

The relative ease of producing an item is governed by the features of the item's design that permit economical fabrication, assembly, inspection, and testing using available production technology. The more the item's design requires deviation from available production technology, the higher will be the level of detail required in the transfer of technical data.

Conversely, the more "common" the item technology, the more firms there are with experience in that technology, and the need for detailed data transfer will be less.

2.4.3 Logistics Requirements/Configuration Control

The more detailed the level to which the Government chooses to control the configuration of an item, the greater will be the level of technical data definition. If the Government emphasizes depot maintenance for the item, detailed technical data transfer will be required to ensure proper production of spares and repair parts. In addition, a high definition technical data package is essential to successfully employ competitive reprourement of spares and repair parts throughout the life cycle of the system.

2.4.4 Schedule Urgency

As the degree of production risk or schedule risk increases, so will the required level of definition in technical data. These risks can be mollified (but not eliminated) by ensuring the transfer of accurate and complete data sufficient to allow a second source to accelerate smoothly into rate production.

Chapter 3

PROVIDING TECHNICAL SUPPORT

A successful technology transfer effort requires technical support over and above the transfer of data. Technical support includes:

- Training and engineering assistance
- Material support and long lead
- Provision of kit items and training aids
- Test support.

Support in any of the areas may be required from the initial source or from the Program Office. Technical support requirements are coordinated through a Technology Transfer Working Group (TTWG). The operations of a TTWG are discussed in Chapter Six. This chapter defines the various technical support areas and provides guidance to the program office in determining the extent of required technical support.

3.1 TRAINING AND ASSISTANCE

Training programs and engineering assistance are provided to the second source for system-specific manufacturing, assembly, and test procedures. Training and assistance are directed towards those areas where the second source may be deficient. Representative areas include:

- Material inspection techniques and procedures
- Special test procedures and equipment usage

- Fabrication and assembly procedures
- Critical process fabrication techniques and procedures
- Tooling and test equipment calibration procedures
- Clarification of the system drawings or engineering data
- Provision of additional engineering data such as product reliability and manufacturing lessons learned.

Training and assistance is provided to accelerate the development of the second source's engineering and manufacturing capabilities. This additional assistance also reduces the risk of second source mistakes due to misinterpretation of data or missing data elements. Training and assistance is provided by the initial source under a leader-follower or teaming strategy. When additional assistance is required under a technical data package (TDP) strategy, it is provided by the Government or the initial source under a separate engineering services contract.

Training and assistance requirements are determined by the system's technological characteristics and program schedule requirements. In addressing the system's technological characteristics, the following issues are considered:

- Level and type of required technology
- Uniqueness and complexity of manufacturing processes
- Status of the TDP

- Potential for technological innovation in design and manufacturing
- Proprietary data.

The degree of schedule urgency also plays a significant role in determining potential training and technical assistance requirements. If the second source schedule is demanding, more extensive assistance is required to enhance rapid assimilation of system processes and design. Under less demanding circumstances, the second source is afforded some flexibility in mastering the technology.

The Program Office determines the extent of technical assistance that is required based on the above factors. Appropriate agreements then are established between the Government and the initial source that define the requirements and specific responsibilities of the initial source and the Program Office.

3.2 MATERIAL SUPPORT AND LONG LEAD

Support in the areas of long lead materials acquisition, vendor base guidelines, inventory control procedures and quality assurance provisions are required to reduce second source development time and to reduce risk.

The Program Office determines long lead material support requirements through the following steps:

- Determine a general second source fabrication schedule based upon the qualification and initial production requirements (initial source production flowtimes are used prior to selection of a second source)
- Identify material need dates based on the fabrication schedule
- Identify order dates based on current material lead times and the need dates.

If the order dates for qualification hardware precede second source contract award, long lead material support is required. Similarly, if the order dates for initial production hardware precede second source vendor qualification, long lead material assistance is required for initial production. Under a TDP strategy, the items are provided as Government Furnished Equipment (GFE). Under a leader-follower strategy,

the leader is tasked to provide sufficient long lead material.

In establishing a qualified second source vendor base, initial source make/buy plans, qualified vendor lists, and/or master purchase lists may be supplied to the second source. In the case of the SRAM II air vehicle computer, Boeing Electronics will provide Delco with a Master Purchase List that identifies at least two qualified sources for all purchased components and materials. This approach provides the second source with available vendors to meet initial qualification requirements, while developing its own vendor base.

Incoming inspection techniques are established at the second source facility to receive purchased items and piece parts. These techniques are similar to those employed by the initial source. For critical components, the second source requires inspection instructions such as the types of inspection tools, test equipment, and all physical and functional specifications. Assistance from the initial source helps to ensure that quality assurance requirements are met and inventory is handled properly prior to assembly.

3.3 KIT ITEMS AND TRAINING AIDS

Kit items and training aids are provided to the second source to reduce qualification leadtimes and manufacturing risks. End item kits contain all parts, subassemblies, and assemblies that comprise the final end item. Kits are used to validate technical data against actual hardware, to demonstrate second source process and assembly capability, and to accelerate production line development. The use of kits is discussed in greater detail in Chapter Four.

Similarly, shop models and training aids provide the second source engineering team with mock-up hardware that can be used to validate data, develop test procedures, and assess process requirements. Kits and training aids were employed on the Tomahawk and AM-RAAM programs to demonstrate assembly capability. The items are provided by the initial source under a leader-follower strategy or through the government under a TDP approach.

3.4 TEST SUPPORT

Test support is provided on programs where the initial source retains design agent responsibility or maintains test data and failure reporting

systems. In those cases, the initial source serves as a logical complement to the program office engineering and test staff. Assistance is provided for both factory tests and operational tests of the second source equipment.

Test support for factory tests includes assistance in special test equipment calibration, observation of acceptance test procedures (ATPs) to ensure compliance with test requirements, and analysis of test data. Test data analysis includes comparison of second source test results to initial source results to identify discrepancies or problem areas. This is particularly useful when test failures occur, in that corrective actions and lessons learned by the first source can be transmitted quickly to the second source.

Support for operational tests includes preparation for ground or flight tests, provision of test instrumentation, engineering support during test, logistic support of test equipment, test data reduction, and data and failure analysis. For

major systems, this support is cost-effective in that the initial source has established test support teams for its test program. In addition, provision of test instrumentation allows for common data collection and control of initial source and second source test events. Test requirements and support are discussed in greater detail in Chapter Five.

3.5 OUTPUT OF TECHNICAL SUPPORT

Technical support reduces the risks associated with inadequate data, ensures lessons learned by the initial source are transmitted to the second source, and accelerates the development of the second source's manufacturing capability in an orderly fashion. The primary intent of technical support is to ensure the timely qualification of the second source. The provision of long lead material and kit items are particularly useful in developing the second source production line.

Chapter 4

ESTABLISHING THE PRODUCTION LINE

This chapter identifies critical activities associated with establishing the second source production line. As shown in Figure 4-1, these activities include developing the manufacturing

plan, procuring tooling and test equipment, and fabricating the qualification and the directed buys.

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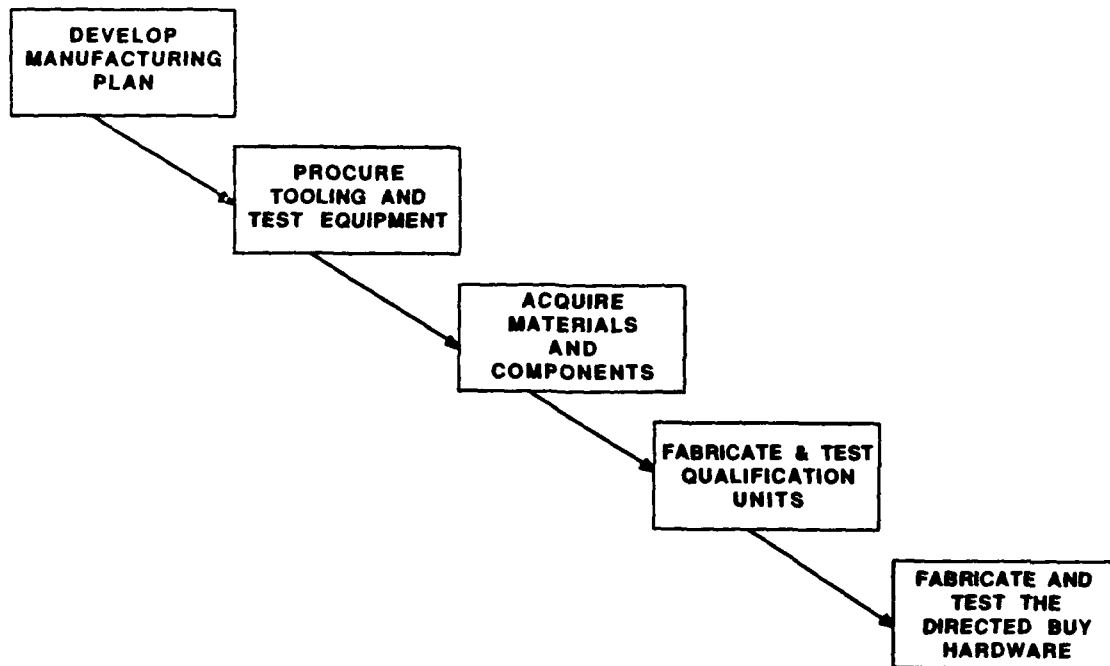


Figure 4-1 Establishing the Second Source Production Line

4.1 MANUFACTURING PLAN

The initial step in establishing the second source production line is the preparation of a manufacturing plan by the second source. The plan is based on the manufacturing information in the technical data package (TDP), the master production schedule, existing facilities and equipment, and preliminary make/buy plans. The plan is prepared in accordance with MIL-STD-1528 and contains the following critical elements:

- Manufacturing capability
 - Fabrication and assembly approach
 - Component integration
 - Materials purchasing and control system
 - Materials handling procedures
 - In-line inspection/testing procedures
 - Quality assurance
- Capital and facilities requirements
 - Plant layout
 - Production flow
- Special tooling and test equipment
 - Design of tooling/test equipment
 - Tooling and test equipment fabrication
 - Set-up, calibration, and operation of equipment
- Manpower forecasts.

Special program requirements such as hazardous materials handling, procedures for safeguarding classified data and hardware, and proper control of Government and other furnished material are presented in the second source's plan, as well. The plan should demonstrate to the Program Office the second source's understanding of the engineering data and its translation to a manufacturing approach. The manufacturing plan is solicited as part of the second source proposal and is evaluated during source selection. As the program progresses, the plan is updated and submitted to the Program Office for approval. The update is accomplished following transfer of additional data and assistance.

4.2 TOOLING AND TEST EQUIPMENT FABRICATION

Program Office assistance in procuring second source tooling and test equipment greatly enhances the second source transition to production. Early provision of tooling requirements to the second source is required to allow for the long lead times related to the acquisition or fabrication of special tooling and special test equipment (ST/STE). To accomplish this, an itemized list of all required tooling, test equipment, and specifications should be supplied to the second source as part of the TDP or supplemental data.

The itemized list should include all fabrication, testing, and qualification requirements, the associated lead times and means of acquiring each piece of equipment, and the rate capacities. Additional assistance includes copies of the initial source's tooling and test equipment data packages, potential sources, clarification of specifications, drawings, and operating instructions.

ST/STE usually are the pacing items of the second source production line. Thus, timely provision of ST/STE data determines the success of achieving the qualification schedule. Once the data is received, the second source completes the following activities:

- Validates STE drawings against the test requirements
- Validates special tooling drawings against end item specifications and tolerances
- Modifies ST/STE drawings or software as required to reflect process differences
- Determines the number of required tools and test stations based on anticipated production rates and throughput analysis
- Fabricates or procures the necessary tooling and test equipment
- Installs and calibrates equipment.

The time required to complete these activities is dependent upon the end item and required tooling level. On prior programs such as Tomahawk and Hellfire, these activities have required 12 to 24 months.

4.3 PRODUCTION PLANNING

Simultaneous with the fabrication of special tooling and test equipment, the second source

initiates its detailed production planning. This effort includes the following activities:

- Process analyses and trades
- Line-of-balance and process control plans
- Detailed facility and plant layouts
- Preparation of manufacturing work instructions
- Development of standards and work measurement processes
- Preparation of process sheets and inspection instructions
- Definition and implementation of quality assurance procedures and systems.

These activities flow from the system specifications, engineering drawings, and test requirements contained in the TDP. For complex systems, these activities may require 12 to 18 months. The activities can be accelerated through the provision of supplementary data and engineering assistance as discussed in Chapter Three.

4.4 MATERIALS ACQUISITION

Concurrent with in-plant activities, the second source also establishes his subcontractor and supplier base. This activity addresses three primary areas:

- Current suppliers to the initial source
- New suppliers for initial source buy items
- New suppliers for initial source make items.

Independent suppliers are a preferred approach; however, for high value or specification controlled items, the Program Office may elect to have both primes buy from the same vendors. When the second source employs current initial source suppliers, the second source informs the suppliers of the dual source program and provides notification that they are authorized to use special tooling and test equipment at the supplier plant. The initial source and second source then determine the details of subcontract administration and material ordering. An agreement in this area is particularly useful for high value or long lead subsystems where economics of ordering are desired and the production split is not known prior to placing the subcontract.

Agreements also are developed that address how shortages are to be distributed between the two primes, should the vendor encounter delivery problems. The details of subcontract administration are documented in a Memorandum of Agreement (MOA) and are coordinated through the Technology Transfer Working Group (TTWG), as discussed in Chapter Six.

On the Tomahawk program, McDonnell Douglas and General Dynamics negotiated a MOA on common vendors. The MOA stated that both contractors would place orders for 50 percent of the anticipated buy with plus/minus options. Following a decision on the production split, the orders would be adjusted to reflect the requirements of both prime contractors. This enabled the vendor to realize the economics of fabricating the entire buy, while accommodating the prime contractors' split awards.

The second source also develops alternate suppliers for initial source buy items. For example, for the IIR Maverick program, Raytheon developed new sources for critical subsystems including the rocket motor, cryoengine, autofocus, and pneumatic actuators. This activity includes soliciting and selecting vendors, vendor fabrication of qualification articles, and qualification testing of the vendor items. The testing is conducted according to the initial sources qualification testing and the item specification. The second source conducts the qualification or component verification effort with assistance from the initial source or the Government, as required. Component verification is discussed in greater detail in Chapter Six. Following verification, the supplier then begins to deliver material to support the second source's qualification and initial production lot.

In addition, the second source may elect to buy items that the initial source is making in-house. For these items, the second source develops acceptance procedures and qualification requirements. The requirements must be developed because they would not have been prepared by the initial source for an in-house item. Following the definition of qualification and test requirements, the second source solicits, selects, and qualifies the new vendor.

The activities associated with qualifying new vendors require 18 to 24 months to complete. As discussed in Chapter Three, long lead material support is provided to allow the second source to proceed with end item qualification while completing component verification. To maintain the end item schedule, the Program Office

could employ several options in developing the second source vendors:

- Provide key components from the initial source who would order sufficient quantities for itself and the second source
- Provide access to a master purchase list of currently qualified vendors
- Provide key components as Government furnished equipment (GFE).

Once the purchased items are delivered, the second source demonstrates incoming inspection procedures and the necessary materials handling and storage procedures. The materials are inventoried for future assembly.

4.5 KIT ASSEMBLY

Recent programs, such as Tomahawk and AM-RAAM, have employed end item kits to accelerate development of the second source production line while providing incremental demonstrations of second source capability. Kits are composed of all assemblies, subsystems, parts, and components that are required to assemble the final item. Multiple kits are provided to the second source in increasing levels of detail to provide a controlled evolution of second source manufacturing capability. A representative sequence of increasing kit detail is as follows:

- Kit 1 - all items at the assembly level. The second source completes final assembly and demonstrates final acceptance procedures
- Kit 2 - all items at the subassembly or part level. The second source completes subsystems integration and demonstrates in-process inspection
- Kit 3 - items at the part or component level. The second source completes all finishing operations such as trimming and treating and then completes integration and assembly. All critical processes short of fabrication are demonstrated.

Sequential delivery of kit materials to the second source is undertaken to achieve incremental measures of second source progress. Simultaneous delivery of kit materials accelerates the development of the second source production line. As described, delivery of the representative kits places all materials on the second source production line in various stages of assembly. Kits

allow for rapid delivery of assembled end items and enable early development, installation, and checkout of special tooling and special test equipment. During kit assembly, the second source completes all appropriate manufacturing operations and test procedures. Thus, kit assembly provides early demonstration of critical processes and verification of the second source's tooling and test equipment.

Kit material is prepared by the initial source and is provided directly to the second source under a leader-follower strategy. Under a TDP approach, the kit material is provided as GFE. The acceptance procedures for the kit material are developed by the cognizant plant representative at the initial source's facility. The material is accepted at the initial source plant and shipped to the second source under a Government Bill of Lading.

4.6 THE QUALIFICATION BUY

The qualification buy is a relatively small quantity to support the second source's qualification testing, requirements and to develop the second source's production capability. Potential qualification test requirements are presented in Chapter Five. To accomplish the buy, the second source installs all tooling and test equipment. The Government or initial source provides on-site technical assistance during fabrication of the second source qualification hardware. Any changes in the manufacturing processes or design to accommodate the second source's methods are implemented and demonstrated during end item fabrication.

During fabrication of this hardware, the second source performs all in-process test operations and acceptance test procedures. The fabricated hardware then undergoes further testing as outlined in the qualification test plan. The testing ensures that the second source's units conform to the system specifications.

4.7 THE DIRECTED BUY

The second source's first production lot award usually is directed by the Government. The objective of the directed buy is to avoid a production break at the second source facility while the qualification hardware undergoes final testing. The directed buy is limited to minimize the risk of not meeting operational requirements. This also allows the second source to ramp-up its production line to support future production rate requirements. It requires the second source

to utilize its own vendor base and manufacturing techniques prior to competitive awards to ensure qualified production units can be

fabricated, at rate. Figure 4.7-1 demonstrates the hardware deliveries associated with the qualification and directed buys.

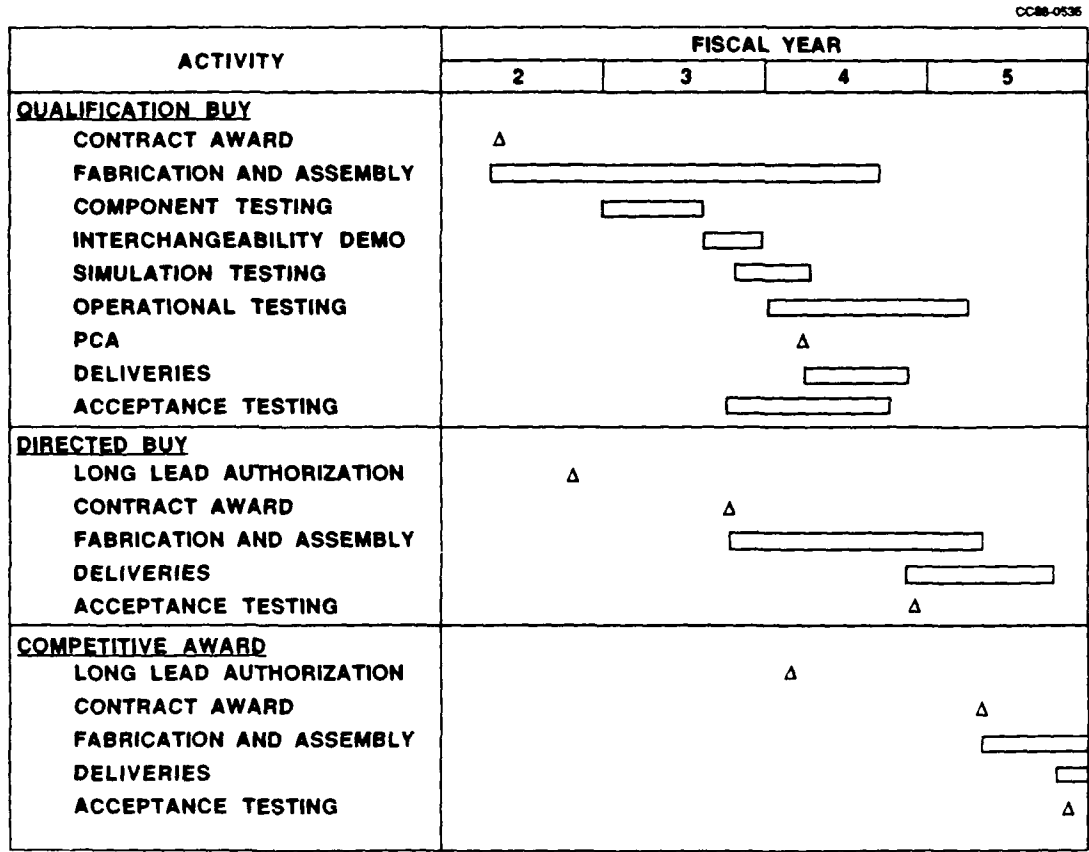


Figure 4.7-1 The Directed Buy Permits the Second Source to Ramp Up to Rate

End items from the directed buy are the initial hardware elements from the second source that are entered into the operational inventory. As such, the directed buy hardware undergoes all

acceptance tests and formal DD250 acceptance. Final acceptance of the directed buy hardware completes the second source qualification program, as discussed in Chapter Five.

Chapter 5

QUALIFYING THE SECOND SOURCE

The purpose of the qualification phase is to have the second source demonstrate ability to manufacture hardware that conforms to the technical data package (TDP) including all specifications. This phase involves hardware fabrication, assembly, and testing to determine TDP compliance by the second source. The testing phase involves a duplication of initial source production qualification tests and limited performance testing.

This chapter presents the components of an integrated second source qualification program that incrementally demonstrate second source capability. These components are shown in Figure 5-1. While presented sequentially, elements often are accomplished in a parallel or overlapping fashion. The relationship between qualification activities and configuration management also is addressed.

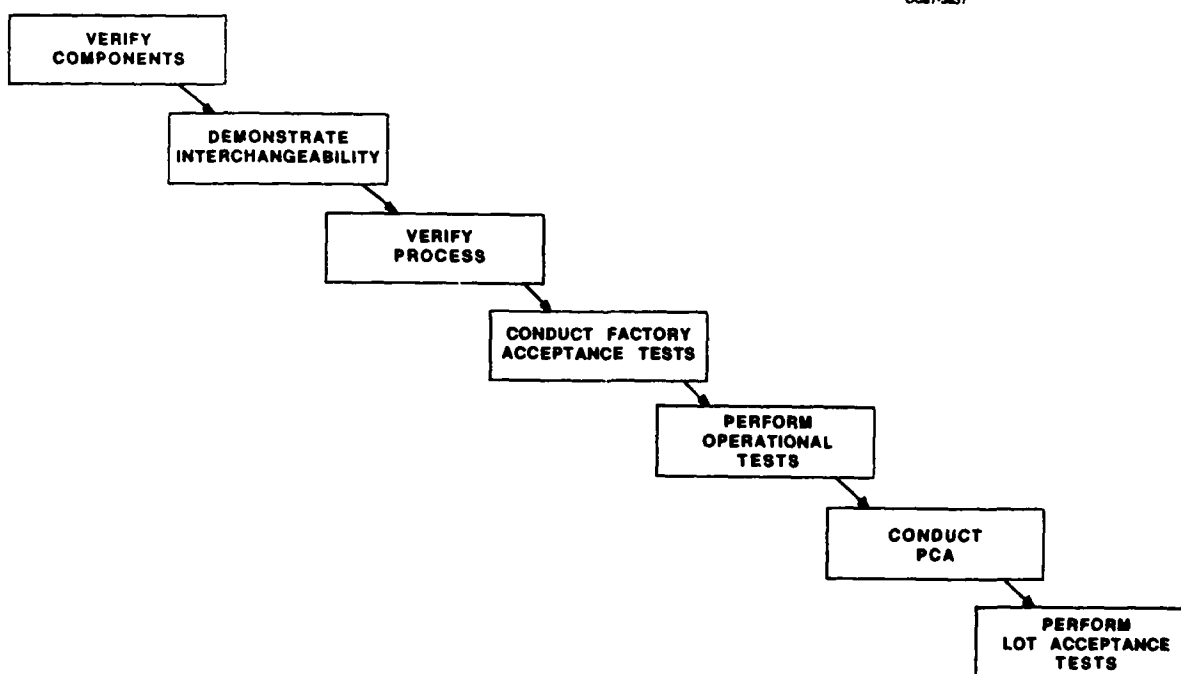


Figure 5-1 Components of an Integrated Second Source Qualification Program

5.1 COMPONENT VERIFICATION

Component verification involves the inspection, testing, and analysis of components purchased or manufactured by the second source. The purpose of component verification is to demonstrate the second source's ability to purchase or manufacture components that meet specifications. Second source component verification activities often are limited to critical or unique items, and items that are manufactured through processes that are unique from those of the initial source. For purchased items, the second source demonstrates that its suppliers are capable of producing components to specification and that prime contractor incoming inspection procedures or acceptance test procedures (ATPs) at the vendors are capable of testing supplier components to determine acceptability. For manufactured items, the second source demonstrates its ability to manufacture components that meet the specifications. In both cases, purchased or manufactured, the components are produced in accordance with the TDP and tested in accordance with applicable product specifications. For less critical items, verification can be accomplished through engineering analysis (e.g., leak testing and stress analysis), or by demonstrating the similarity of an item with a previously procured and tested item.

5.2 INTERCHANGEABILITY

Interchangeable items are ones that can be removed from one system and installed in another without alteration of the item or adjoining items and without impact on form, fit, or function. On a dual source program, interchangeability between contractor produced items is recommended to control potential logistics complications.

Interchangeability is demonstrated through a "tear-down" audit or inspection by disassembling a system produced by the initial source, and reassembling the system using components produced by the second source. As a supplement or alternative to a complete tear-down, an exchange and installation of items selected at random from available inventory may be conducted. The intent of these demonstrations is to verify that the second source can produce the exact same item as the initial source.

The level to which interchangeability must be demonstrated is a function of logistics considerations. These considerations will depend upon

the maintenance concept developed for the system and spares requirements. For example, if organizational or intermediate level maintenance facilities are emphasized, interchangeability requirements will be at the level of repair performed by these maintenance activities (usually printed circuit board). By contrast, if depot level maintenance is emphasized, interchangeability requirements are pushed lower to the component or piece part level. The contractor demonstrates form, fit, and function interchangeability of all parts on the Interchangeability Parts List.

5.3 PROCESS VERIFICATION

Process verification involves the demonstration by the second source that its materials, tooling, equipment, workmanship, and associated paperwork are equivalent to those established by the initial source and identified in the TDP. Equivalency is sufficient; however, if certain processes, such as fuel-tank sealing, are critical to system performance, the second source may be required to demonstrate that its processes are identical to those of the initial source.

The second source develops equivalency specifications for its manufacturing and quality assurance operations. This is accomplished by comparing existing internal specifications with those in use by the initial source to identify similarities and differences. After resolving the differences, the second source prepares manufacturing and quality assurance procedures and provisions on performance processes and inspections. All processes that can affect reliability or system performance, that are unique to the system, that have not been performed previously by the second source, that require certified operators, or that involve hazardous materials must be verified. Processes are verified at each location where an operation is being performed. Then the Program Office or the initial source reviews the process verification results to determine that the second source has demonstrated equivalency of its processes to those employed by the initial source and specified in the TDP.

5.4 FACTORY ACCEPTANCE TESTS

Once components have been verified and interchangeability has been demonstrated, testing of the second source's full-up system is performed. The purpose of these tests is to demonstrate under controlled conditions that the system produced by the second source is functionally identical to the system produced by the initial

source. These tests should not be viewed as an opportunity to gather additional information on system performance or to expand the test envelope. Testing in addition to that required to demonstrate a functionally identical system increases the qualification program costs. Further, such broadening of the second source's effort places it in a design role. Any critical problems must be resolved before the system can be approved for operational testing.

The contractor must comply with the testing identified by the initial source in the test requirements documents (TRDs). The second source's review of the existing TRDs identifies each test to be performed from the subassembly level through final acceptance testing. Existing ATPs are used to the greatest extent possible by the second source. New ATPs are prepared for procedures that are unique to the second source. Special test equipment (STE) requirements for the second source are based upon the TRDs and ATPs. In addition to acceptance tests, the second source also identifies in-process tests. These tests are performed throughout the manufacturing cycle to determine whether a subassembly is acceptable for the next operation.

Factory testing involves powering up the system and performing functional tests under a range of environmental conditions including temperature, vibration, corrosion, electro-magnetic, dust, salt, fog, and humidity. Every system is unique and, in some cases, it may be determined that the second source need not repeat all of the tests performed by the initial source. For example, testing may be limited to assessing performance in areas involving unique or specialized manufacturing processes. The selection of tests to be performed involves trade-offs among the complexity of the system technology, resource constraints, and acceptable levels of program risk.

5.5 OPERATIONAL TESTS

After successful performance of contractor testing, the second source is required to undergo an operational test program. The purpose of this program is to verify that the final full-up system meets its specifications in its expected operating environment. On some past "build-to-print" programs where technology transfer was accomplished exclusively via a detailed technical data package, qualification of the second source did not include operational testing. The decision to

forgo operational testing is a function of program technical risk, cost, and schedule considerations, and is an option to be pursued after only the most careful assessment.

The most important requirement of an operational test program is to have a clear up-front definition of the objectives. The Program Office should not view second source operational testing as a mechanism to gather performance data beyond that collected during the full scale development (FSD) program. The second source's system is tested to the same requirements, but it is not employed to expand the operational envelope for the overall system. The objectives of the operational test program are reflected in the system test plan prepared by the second source. Major issues to be addressed include capabilities to be demonstrated, test conditions, configuration of the system to be tested, instrumentation requirements, data reduction and analysis requirements, Government assets required to support the tests, selection of the test range, preparation of the mission test plan, test schedules, and identification of Government agencies to be involved and their role in the testing program.

The test plan is developed by the second source in conjunction with both the initial source and the Government agencies involved in the testing program. If the Program Office has tasked the initial source to develop the second source (i.e., leader-follower), then the initial source plays an active role in developing the test plan. Conversely, the test plan developed by the initial source is provided to the second source and serves as the basis for the second source test plan. Additional or revised test procedures are developed based on the requirements of the program.

5.6 PHYSICAL CONFIGURATION AUDIT

After contractor and operational testing have been accomplished, a physical configuration audit (PCA) is performed on production representative items. The purpose of the PCA is to confirm that the "as-built" production configuration of the hardware produced by the second source conforms to the system specifications and drawings.

The PCA entails a detailed audit of engineering drawings, specifications, technical data, and tests utilized in the production of hardware items to ensure that the as-built configuration of the item is reflected in this documentation. Typical activities of the PCA include:

of the item is reflected in this documentation. Typical activities of the PCA include:

- Determination that the technical data accurately describes the hardware items as-built
- Gauging, where the dimensions of parts and assemblies are checked against the drawings and manufacturing work instructions
- A visual inspection of hardware items to assess workmanship, fit, and finish of all parts and assemblies

- Analyses of hardware samples for materials, heat treatments, welding, etc.

5.7 HARDWARE ACCEPTANCE

The final step required to qualify a second source as a system producer is acceptance testing of initial production hardware and acceptance of that hardware by the Government. The purpose of acceptance testing is to verify that initial production units are meeting the same design and performance standards demonstrated by the qualification units. The Government accepts second source hardware in accordance with the DD250.

Chapter 6

ESTABLISHING THE MANAGEMENT STRUCTURE

This chapter presents a general management structure including personnel and technical requirements for the Government, the initial source and the second source to facilitate technology transfer,

as shown in Figure 6-1. In addition, the interface of these management elements through a Technology Transfer Working Group (TTWG) is defined.

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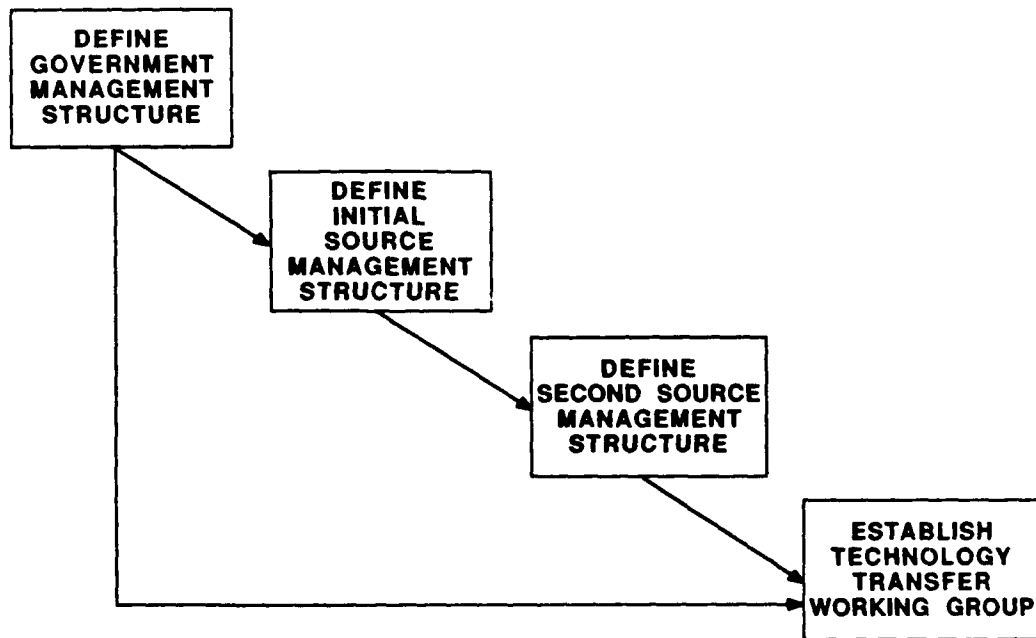


Figure 6-1 Establishing the Dual Source Management Structure

6.1 GOVERNMENT

To ensure program objectives are met, the Government must retain overall management authority for the dual source effort. Specific activities can be delegated to the contractors; however, the fundamental responsibility still rests with the Program Office. Once the decision to dual source is made, the program manager appoints a dual source

program manager, or primary point of contact (POC), within the Program Office to monitor, manage, and execute the technology transfer program. This POC has the responsibility to determine the level of Program Office involvement that is required to execute the dual source program. Figure 6.1-1 depicts the process of determining the Program Office's dual source management structure.

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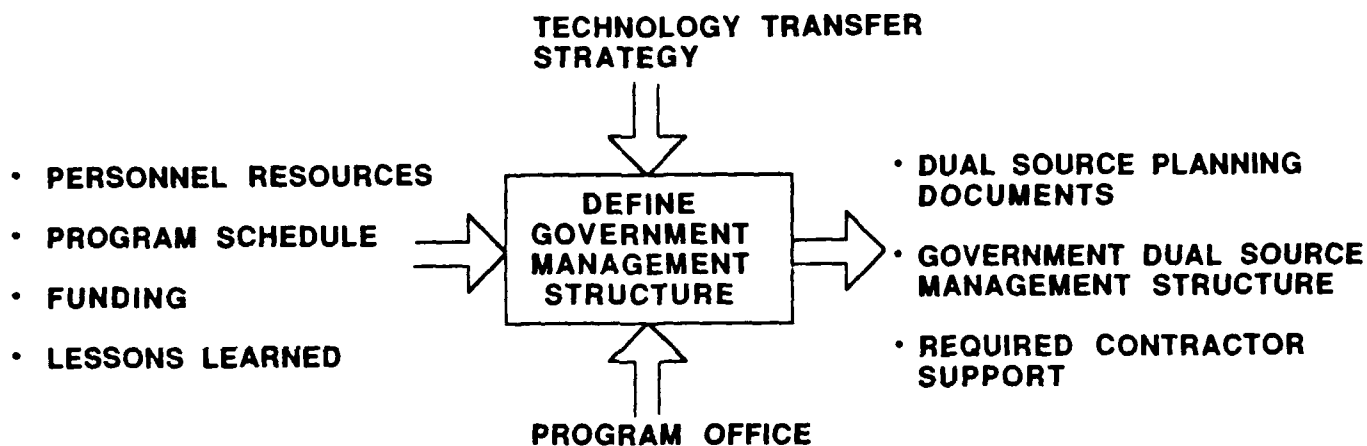


Figure 6.1-1 Determining the Program Office's Dual Source Management Structure

The POC establishes the Program Office management team. Typically, Program Offices are organized along functional lines. Each functional manager has a staff, organic or matrixed, that specializes in a particular aspect of a program, such as

is presented in Figure 6.1-2. For a dual source program, the functional managers support the POC who integrates and assesses total program progress.

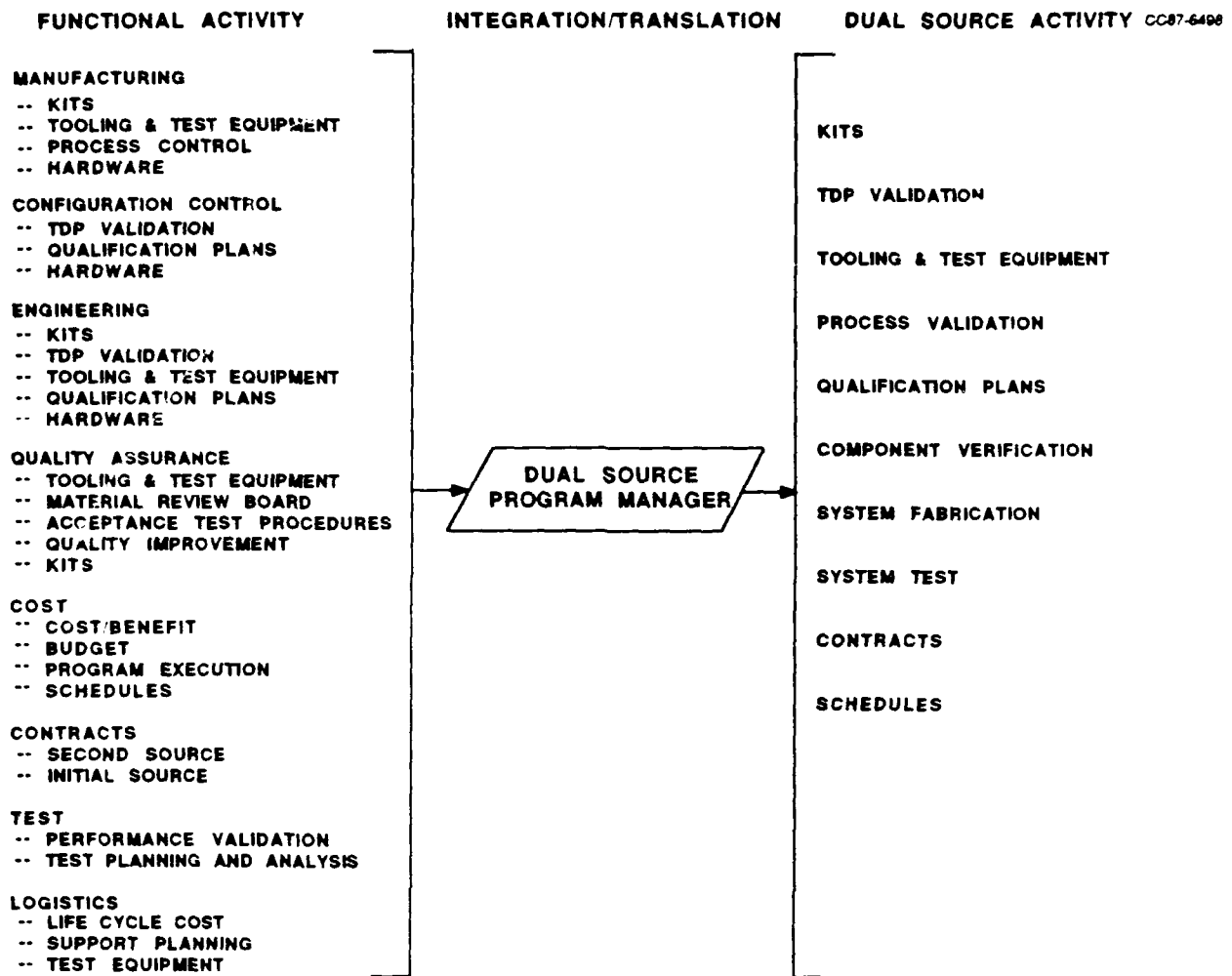


Figure 6.1-2 Dual Source Program Relationships

A functionally structured dual source program generally works best under one of two approaches. One is when the overall program is a self-supporting entity with sufficient personnel on-hand who understand and are capable of carrying out the dual source requirements, such as the Air Force IIR Maverick program. The second is when the Program Office has a clearly defined second source cadre with the responsibility and authority to manage and work with matrixed, functional support, such as the Army's Hellfire missile program.

As an alternative, an activity-oriented organization may be more responsive to a technically complex or schedule sensitive program, as shown in Figure 6.1-3. The manager of each activity reports directly to the POC and is responsible for the total performance of his respective element. For example, the kits manager ensures the complete and timely delivery of kits from the initial source or Government to the second source.

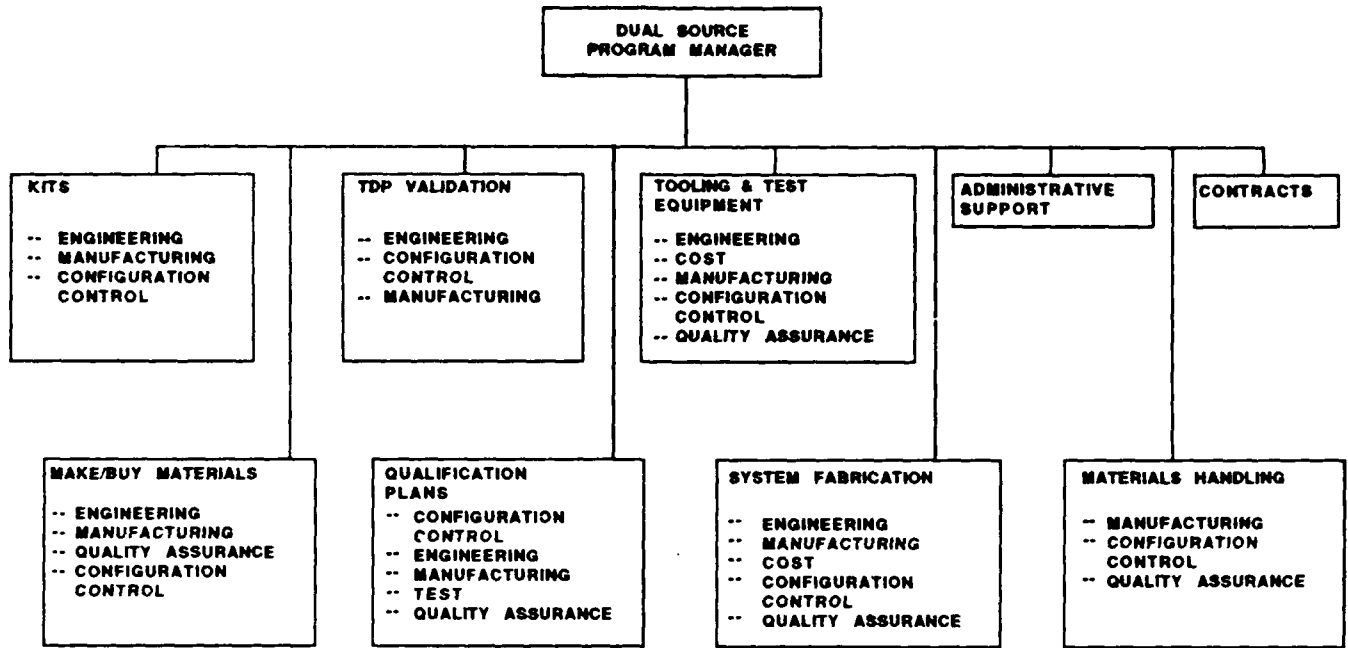


Figure 6.1-3 An Activity-Oriented Program Structure

Once the dual source program structure is determined, a manager is appointed for each functional/activity element. Clear objectives and responsibilities are developed by the dual source program manager for each subelement manager. The objective for each manager is the timely, efficient execution of the assigned task. This involves developing relevant inputs for the Technology Transfer Plan (TTP) as an internal planning document including the following:

- Government/contractor interface requirements
- Detailed schedule of all critical task activities
- Documentation required from contractors
- Milestones to measure progress of task
- Identified potential sources to provide additional internal manpower and facilities support
 - Functional specialists (cost, engineering, etc.)
 - Test ranges, labs, etc.
- Negotiated/outlined Memorandums of Agreement (MOAs) with Government in-plant

representatives (Defense Contract Administration Service (DCAS), Defense Contractor Audit Agency (DCAA), Service plant representative offices)

- Developed budget to support dual source program effort
- Coordinated functional/activity information.

Establishing the Government structure at the start of the dual source program sets the tone for the effort and demonstrates to the contractors the commitment to dual source the weapon system. It also affords the dual source program manager the opportunity to focus on as many dual source aspects as possible prior to initiation of the effort.

6.2 INITIAL SOURCE

The intent to dual source must be presented to the initial source as early as practicable. This provides the initial source with an opportunity to offer suggested changes to the program. When the initial source is the principal agent for technology transfer, the initial source should be tasked to develop its dual source plan, as presented in Figure 6.2-1.

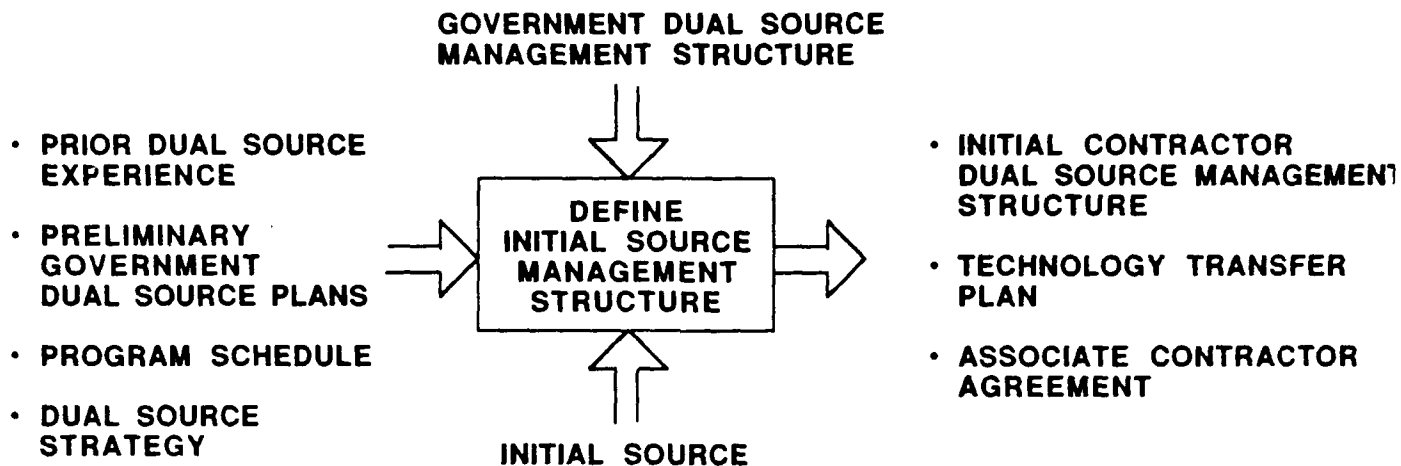


Figure 6.2-1 The Initial Source Management Structure

A comprehensive initial source plan contains the following information:

- Identification of the initial source program manager responsible for the dual source program and subelement managers
- Responsibilities of the dual source program manager:
 - Overall authority for ensuring the accomplishment of the effort
 - Liaison with other relevant corporate organizations
 - Director of technology transfer process
 - Equivalent to Government and second source program managers
 - Co-chair of TTWG (as required)
- Responsibilities of Subelement Managers:
 - Authority for ensuring the accomplishment of their respective function/activity
 - Participant of TTWG management group and respective subgroup (as required)
- System to monitor progress of the dual source effort including:
 - Detailed schedule for critical activities and milestones
 - Description of progress report contents and delivery frequency/ distribution
- Draft Associate Contractor Agreements (ACAs) to be executed with second source and subcontractors, as applicable
- Detailed facilities and manpower requirements
- Configuration management procedures.

The resulting initial source management structure and plan form the basis for a similar plan at the second source.

6.3 SECOND SOURCE

The technology transfer method will determine the requirement for second source program plans. When the initial source is responsible for developing the second source, the initial source's plans include second source activities. Tasks and responsibilities specific to the second source would be detailed as well as those similar to the initial source tasks presented in Section 6.2. In cases of mutual technology transfer, the contractors jointly develop their management structures and plans to ensure a compatible dual source effort.

For efforts where the second source is to learn the technology with either limited or no initial source assistance, the Program Office should direct the second source to develop a plan that reflects the independent nature of the effort. The plan would include the following:

- Identification of second source program manager
- Identification of second source personnel as points of contact for function/activity elements (similar to those of the initial source structure, defined in Section 6.2)
- ACAs, as applicable

- Technical data and assistance required from the Government or third party
- Component and system qualification activities
- Hardware procurement activities
- Integrated schedule of critical activities and milestones
- Configuration management procedures.

The content of the second source plan is similar to the initial source plan described in Section 6.2; however, it is tailored to reflect the more detailed second source production effort. Figure 6.3-1 presents the development of the second source management structure.

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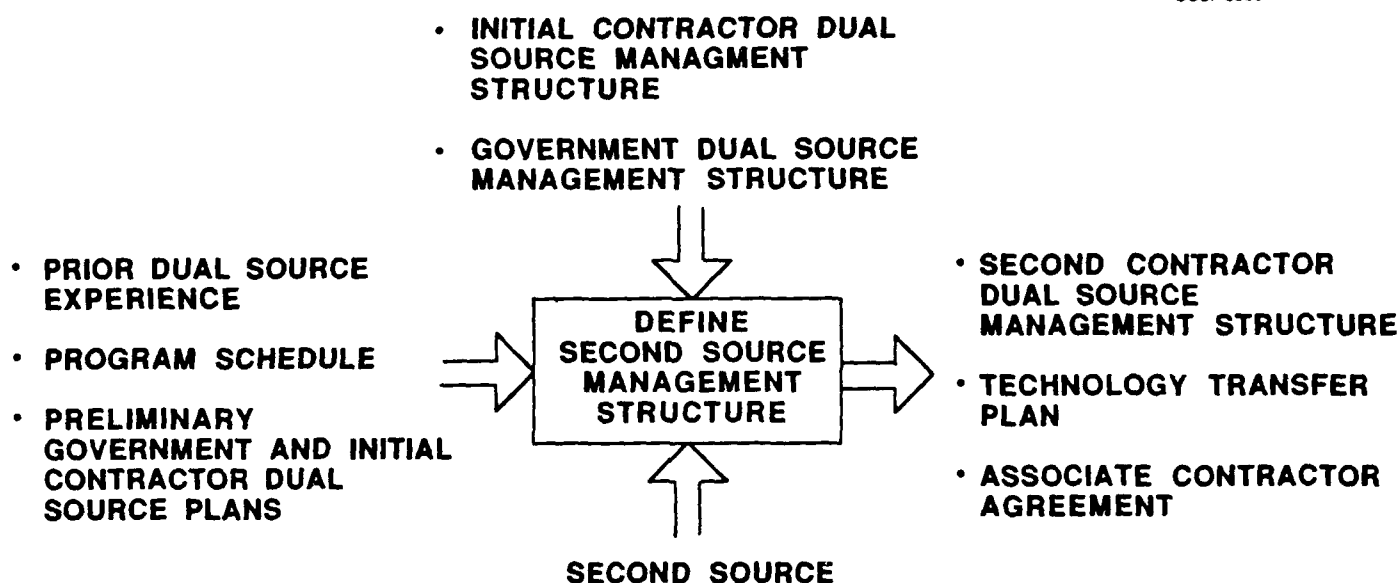


Figure 6.3-1 The Second Source Management Structure

6.4 TECHNOLOGY TRANSFER WORKING GROUP

A simple contractual requirement to have one contractor transfer technology to another does not ensure that such a transfer will occur in a timely, efficient manner. To facilitate the process, the Tomahawk cruise missile program employed a TTWG. The TTWG was chaired by the Joint Cruise Missile Program Office (JCMPO) and the two contractors. It included key functional representatives from the three organizations, defined their expected objectives and responsibilities, and established the communication lines necessary to perform daily activities.

6.4.1 Purpose

The TTWG is responsible for coordinating and facilitating technology transfer between two contractors, whether the transfer is to be a bilateral or unilateral exchange. It conducts technical reviews and technical interchange meetings to ensure program performance and control. The Program Office may request the contractors to establish or participate on a TTWG in order to efficiently achieve dual source objectives. The requirements for a TTWG should be addressed in the ACAs and the contractors' TTP.

A charter for the TTWG should be prepared that defines the structure, and procedures of the

TTWG. The charter identifies, by function and work breakdown structure (WBS) element, individuals in each organization as the focal points of activity for their relevant area of responsibility.

6.4.2 Structure

The technology transfer method and the Government's dual source program management

structure determine the need for and organization of the TTWG. As shown in Figure 6.4-1, a TTWG is structured on two levels:

- The Management Working Group, responsible for overall program direction
- The Activity Working Groups, responsible for the actual implementation of technology transfer.

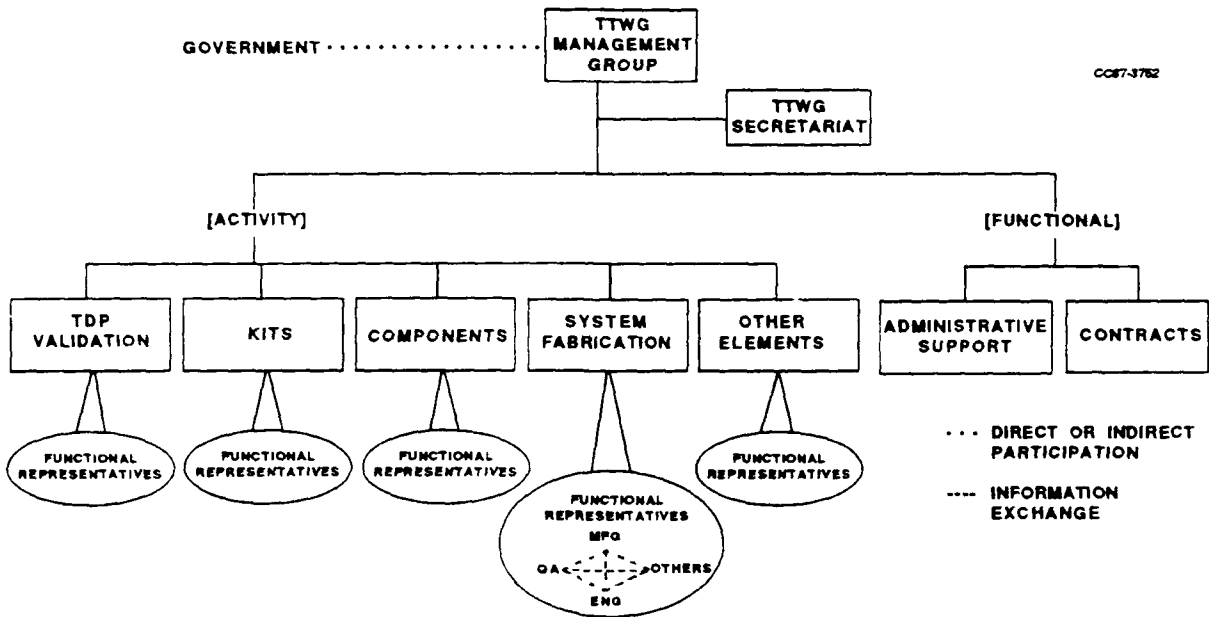


Figure 6.4-1 TTWG Structure

As shown in Figure 6.4-1, the Government's role in the TTWG is flexible to allow for as much direct participation as deemed necessary by the terms of the technology transfer approach, contractor progress, and personnel resources available. As an indirect participant, interaction is at the management level where the Government attends review meetings to monitor technology transfer progress and discusses critical issues affecting the dual source effort. As a direct participant, Government representatives at both the Management and Activity Working Group levels take an active role in the management and execution of the technology transfer effort.

The contractor's dual source program managers serve as co-chairs of the TTWG Management Working Group. This group, which is the governing body of a TTWG, directs and oversees the technology transfer process through the establishment of technical, administrative, funding, and schedule

controls. As defined in their charter, this group establishes the ground rules and procedures for conduct of the TTWG Activity Working Groups, reviews their progress, serves as a higher decision authority for problems that cannot be resolved at the subgroup level, and assesses total program effects that may result from actions taken by the subgroups. The Management Working Group ensures that the provisions of the ACAs are carried out as intended, and directs the subgroups to accomplish the technology transfer effort within the limits of the ACAs.

The Management Working Group identifies the Activity Working Groups necessary to support the TTWG. The contractors then appoint representatives to be the point of contact within each company that conduct the day-to-day technology transfer activities. The subgroups concentrate on specific areas of technology transfer such as technical data package (TDP) validation, kits, and system fabrication. The charter and procedures of each Activity

Working Group are established by the Management Working Group.

6.4.3 Procedures

The Management Working Group holds monthly progress review meetings during the technology transfer effort. The location is mutually agreed upon by the contractors and the government, and includes the contractors' facilities as potential sites. Attendees would include the Management Working Group representatives and the chairmen from the Activity Working Groups. In addition, other functional and discipline representatives may be requested to attend.

The Secretariat is responsible for organizing the meetings. Specific tasks to support the meeting include:

- Arrange for location and time for meeting
- Develop agenda
 - Assemble all issues and topics for discussion from the TTWG Activity Working Groups
 - Incorporate resolution activities and results that have occurred since the last meeting
- Distribute agenda, within a specified time frame prior to the meeting, to all planned attendees
- Maintain status of TTWG action items
- Publish and distribute the minutes and agreements within a specified time frame after the TTWG meeting.

The meeting agenda is structured to discuss issue items from the previous meeting, the actions taken to resolve them, and the results. A progress status report from each Activity Working Group then is

presented. The status report addresses accomplishments to date, future activities, and problem areas requiring resolution by the Management Working Group.

The Activity Working Groups holds regularly scheduled Technical Interchange Meetings (TIM) on a more frequent basis than the Management Group meetings during the technology transfer effort. During peak times, the Activity Working Groups may meet weekly. The location is mutually agreed upon by both contractors. Attendees include the representatives and other functional personnel as deemed necessary. In addition, the representatives may request subcontractors to attend. The TIMs consider progress to date, address and resolve specific tasks and issues, and plan for future activities. Every effort should be made to resolve problems at this working level. Results from the TIMs are presented at the Management Working Group progress review meetings.

The Secretariat is the focal point for all data requests and data transferred to and from both contractors (and subcontractors, as appropriate). As such, this function is performed by the second source contractor. The Secretariat establishes an inventory system to monitor the request and transfer of data to and from the companies. The inventory system identifies the data by source, title, number, date requested, date sent, and date received. After processing, the disposition and pertinent dates are rendered.

Upon receipt of the data request, the Secretariat logs in the request and sends it to the receiving contractor. All data requests should be answered within a specified time frame. The Secretariat receives, logs in, and sends to the requesting contractor all data to be transferred. If the issue cannot be resolved by the co-chairmen, the Program Office makes the final determination. The flow of data under this concept is shown in Figure 6.4-2.

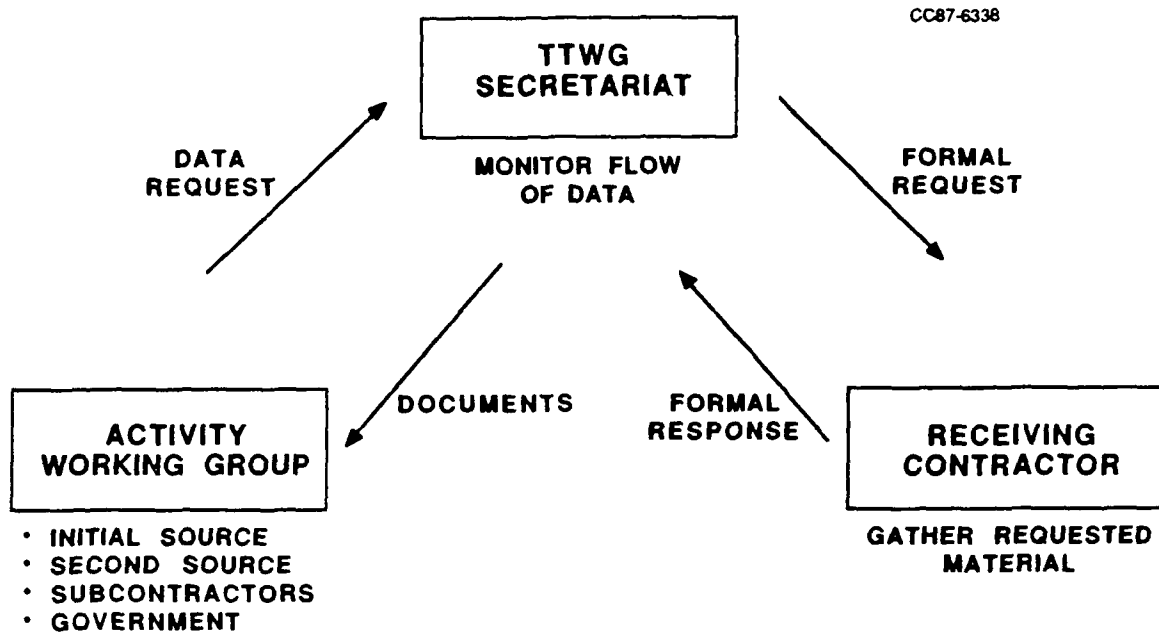


Figure 6.4-2 The TTWG Data Flow

When a data request is denied by one of the contractors, the Management Working Group co-chairmen must act as arbitrators. The co-chairmen meet with the Activity Working Group to determine

if the data request is information that the requesting company must have in order to fulfill the requirements of the second source program. If so, the data request will be approved.

Chapter 7

DEFINING CONTRACTOR AGREEMENTS

Technology transfer is implemented through Government contractual provisions with both contractors and through contractor-to-contractor agreements. The contractor agreements normally are developed and negotiated by the contractors; however, the Program Office must ensure that the contractor agreements reflect the objectives of the dual source program. This chapter identifies the essential contents of a contractor agreement and highlights those areas of particular interest to the Program Office. The tailoring of an agreement based on a specific technology transfer approach then is presented. An Associate Contractor Agreement (ACA) outline and three example agreements are presented in Appendix B.

7.1 CONTENTS OF AN ASSOCIATE CONTRACTOR AGREEMENT

An ACA to facilitate dual sourcing establishes the basis for exchange of data between contractors by defining the terms and conditions of the data exchange. Based on the Statement of Work (SOW) and Program Office objectives, an ACA details the guidelines and restrictions necessary to effect complete transfer of proprietary or company-sensitive data, and allows each contractor access to the other's facility. Roles and responsibilities of each contractor during the technology transfer phase also are defined. Figure 7.1-1 presents the essential contents of an ACA.

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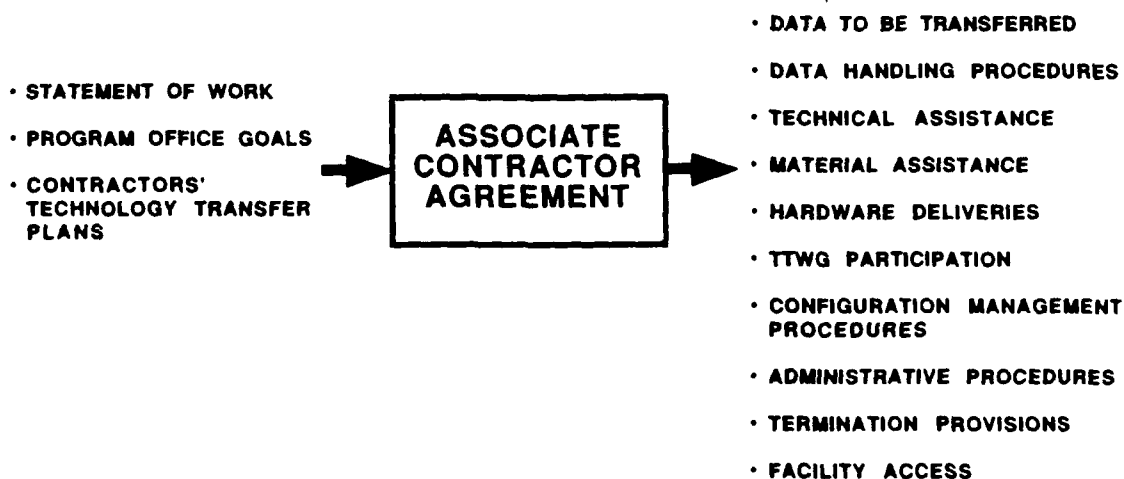


Figure 7.1-1 Contents of the ACA

The ACA describes in as much detail as possible each of the contents listed in Figure 7.1-1, including the following.

- Technical data
 - System specifications, testing documentation, software, and sample hardware or kits
 - Drawing level and manufacturing work instructions
 - Format such as hard copy, micro fiche, Numerical controlled (NC) tapes, cards, CAM/CAM files
 - Timing and frequency of data transfer and updates
 - Procedures for incorporating modifications, changes, or drawing updates
 - Data transmittal procedures
- Proprietary data
 - Delivery and handling procedures
 - Restrictions on use
 - Limitations on release
- Technical assistance
 - Data and drawing translation
 - Production process and test procedures explanation and demonstration
 - Tooling program contents and procedures
 - Special tooling and special test equipment (SLE/SPE) descriptions
 - Tooling documentation
- Material assistance
 - Material acquisition support such as joint procurement procedures or master purchase list
 - Vendor base guidelines
 - Inventory control procedures
 - Production and handling procedures
 - Quality assurance provisions
- Hardware deliveries
 - Components and subsystems for qualification or limited production
 - Acceptance procedures and the acceptance test
 - Scheduling
- Technology Transfer Working Group (TTWG) participation
 - Identification of representatives and responsibilities
 - Attendance at technical review and interchange meetings
 - Operating procedures
 - Program management guidelines and objectives
- Configuration management procedures
 - Change submittal, approval, and incorporation process
 - Status accounting methods
- Administrative procedure
 - On-site personnel provisions, resident and transient
 - Administrative and computer support
 - Access and limitations at other contractor facilities
 - Security
- ACA termination provisions.

7.2 PRIME-SUBCONTRACTOR RELATIONSHIPS

Direct technology transfer also has been accomplished by the developing contractor issuing a subcontract to establish a qualified second source. This approach places the burden on the prime contractor to develop a second source while easing demands on Government management. Even though the prime contractor awards a subcontract with the basic premise of establishing the subcontractor as a qualified second production source, explicit responsibilities and activities of each contractor must be defined by the Program Office. An ACA with similar contents as those described in Section 3.1 would be negotiated between the contractors.

A prime contractor/subcontractor arrangement yields a single point of accountability to the Government which reduces the potential need for daily Government interaction. At the system level, the actual breakdown of dual source activities would reflect the design and development tasks of the two contractors. For instance, if the weapon system is a joint design, such as Joint Tactical Information Distribution System (JTIDS), mutual technology transfer and qualification activities would occur while still providing the Government with a single contractor responsible for the development of the total system and establishment of a second qualified producer. At the subsystem level, a prime

contractor would be required to establish dual production sources for key subsystems while maintaining responsibility for the delivery and performance of the total system.

7.3 LICENSING AGREEMENTS

Under a licensing agreement, the second source engages the developing contractor to provide it with the technical capability to build an exact replica of a system or component. Usually, a royalty fee for each unit sold also is paid. The Government may use a license arrangement when the primary purpose of establishing a second producer is to ensure item availability in the event of unforeseen circumstances at one plant or to ensure mobilization/surge capability.

A licensing agreement comprises provisions similar to an ACA. In addition, second source qualification or certification activities are included. The initial source is responsible for conducting the intensive technology transfer effort, including the following:

- Transfer data and documentation and assist in its translation
- Develop and implement an in-depth training program
- Certify the second source's ability to produce exact replica hardware.

The agreement also contains provisions for limiting applications of the transferred technology, agreement termination provisions, and period of effectivity.

7.4 DATA RIGHTS

The availability of rights in data ranges from unlimited to not available. Recent weapon system programs have purchased, to the maximum extent practicable, unlimited rights in data. Unlimited rights provides the government with the ability to disseminate data at its discretion. It is the program manager's responsibility, however, to ensure that only minimum essential data are procured so as to balance the Government's need to satisfy system support requirements and establish a competitive environment, and the contractor's economic and property rights.

In most cases, the originating contractor will place some limitations on the use and dissemination of data it feels is competition sensitive. Such limits are substantiated in the data package and/or as ACA provisions when contractor-to-contractor technology transfer is involved. The limits encompass the use and handling of proprietary data or trade secrets, including the following:

- Period of effectivity
- Change of proprietary status procedures
- Liability terms of disclosing data
- Identification of proprietary elements
- Applicability of royalty or license fee
- Limitations of data application
- Delivery, receipt, and storage/protection procedures.

The Government should task the second source, independently or as part of the TTWG process, to review the initial source's data package to ensure all relevant data is included.

Chapter 8

APPLYING INCENTIVES

One of the most controversial areas of technology transfer management is the development and application of effective incentives. Several prior programs have employed incentives to enhance technology transfer; however, the effectiveness of those incentives is difficult to assess. The fundamental issue is that there is no incentive large enough to compensate an initial supplier for lost production volume due to dual sourcing.

The key component of an effective incentive program is a clear understanding of contractor motivations. Often the focus is on pure financial awards such as award fees; however, a financial award may mean little to a contractor who is faced with a large potential loss of production volume. A contractor may be better motivated by elements such as cash flow, production volume, or production stability. This chapter presents incentives that have been employed on prior efforts and provides guidance on tailoring and applying incentives to a future technology transfer program.

8.1 PRODUCTION AWARDS

The Joint Tactical Information Distribution System (JTIDS) and Tomahawk programs employed a guaranteed minimum split as a technology transfer incentive. That is, a portion of the competitive buy is committed to the initial source based upon timely completion of technology transfer. The incentive builds upon the contractor's desire for production volume and a stable production base.

The implicit threat associated with this incentive is that failure to cooperate with technology transfer would result in a penalty (i.e., a value lost) to the

contractor at fault. For the incentive to be effective, this implicit threat must be credible. In other words, the second source must be capable of completing qualification with no further assistance from the initial source, or the Program Office must be willing and able to delay production. Given these considerations, a guaranteed minimum split incentive is rarely effective in a second source program. This type of incentive has proven to be more applicable to efforts involving joint technology transfer such as Tomahawk and JTIDS. In these cases, both contractors benefit from cooperative technology transfer while minimizing immediate competitive pressure during the early buys.

8.2 FINANCIAL PENALTIES AND AWARDS

An alternative incentive approach is the use of financial penalties or awards based upon the attainment of specific milestones. For example, initial source progress payments may be tied to key second source milestones. Application of these types of incentives requires that the initial source be contractually responsible for key technology transfer efforts.

For example, awards or penalties are tied to the accomplishment of specific technology transfer milestones such as technical data package (TDP) validation, kit delivery, training program completion, or long lead delivery. The awards or penalties also include progress payments, if initial source support is being provided as part of a broader contract such as full scale development (FSD) or initial production. In cases where the Program Office has a choice of contract mechanisms, the initial source

support is incorporated into the contract that yields the greatest financial leverage.

This incentive is directly tied to a contractor's desire for cash flow. Progress payments or awards can be tied to key demonstration milestones. Alternative penalties that represent actual net losses can be invoked for failure to attain certain milestones. This incentive is most appropriate when significant financial leverage can be exercised such as with a major FSD or production program.

8.3 CONTRACTUAL LIABILITY

On new-start programs, the Program Office can require the system developer to qualify a second source as part of the FSD contract. This approach includes the delivery of initial production hardware that was fabricated by the second source. The initial source becomes financially responsible for delivery of those hardware items. Failure to qualify the second source implies the initial source must deliver the contracted items at no additional cost to the Government.

This requirement places a true financial liability on the system developer. Clearly such an approach is only appropriate for leader-follower, teaming, or licensing programs, where the developer has contractual responsibility to qualify the second source. For example, the Mark XV contract for FSD will require the system developer to qualify a second

source during FSD and initial production. Second source hardware deliveries are specified in the developer's contract thus requiring the developer to assume financial liability for that hardware.

8.4 SECOND SOURCE INCENTIVES

The recent emphasis on competitively selecting a second production source has led to the development of additional incentives that are available to the Program Office. The competitive selection has resulted in the identification of aggressive second source contractors that have been willing to invest in technology transfer, facilities, and tooling in order to gain production. In programs that are schedule sensitive, schedule incentives to the second source are appropriate. Such incentives involve a larger directed buy based upon technology transfer progress. This incentive draws upon the natural motivation of the second source to gain a better posture for the competitive portion of the program.

Similarly, if the dual source effort is undertaken to improve quality, alternative warranty provisions for the second source are appropriate. Rather than specifying a detailed warranty, a general warranty is presented and the contractors are solicited for specific Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), availability measures, and/or cost. This type of incentive is most appropriate when the contractors are allowed individual design and process flexibility.

Chapter 9

CONTROLLING THE CONFIGURATION

One of the most often-cited concerns over dual sourcing is the deployment of multiple configurations of an end item. Prior dual source programs have avoided this complication through an integrated technology transfer program and diligent configuration management. This chapter defines the interrelationship between technology transfer and configuration control. In addition, guidance to assist in developing an effective configuration management program in a dual source environment is provided. Key issues include the following:

- Definition of objectives
- The role of the design agent
- Change proposal approval
- The assurance of successful implementation of configuration control.

9.1 DEFINING OBJECTIVES

Current DoD guidance does not explicitly provide for managing a weapon system configuration in a dual source environment. It is the responsibility of the program manager to establish configuration control procedures that will satisfy all program objectives, including dual sourcing. When developing an approach to configuration control, the purpose of dual sourcing and the type of equipment involved should be the primary drivers.

As initial source involvement in technology transfer increases, the resulting second source hardware becomes more identical, both functionally and physically, to that of the initial source. The desired level of initial source assistance is directly related to

increasing equipment technical complexity, early/rapid production rate or delivery requirements, and early dual sourcing requirements. Ideally, in a dual source effort the contractors produce identical hardware using the same manufacturing processes, thereby reducing potential logistics complications. The degree of potential logistics impact is estimated by configuration trade-off analyses that include the following factors:

- Availability and cost of proprietary or sensitive data
- Total program costs – second source development, recurring production, operations and support
- User requirements – training, operation, and repair.

For example, purchasing proprietary information for dual source purposes may not generate sufficient savings to justify the expense. This situation is particularly true when alternative items are available to satisfy mobilization objectives and when the user can accommodate multiple configurations in the field. On the other hand, if the user is reliant on a minimal inventory to support the field mission, then both contractors can produce units that are similar to a specific level, resulting in stricter configuration control.

The required level of common equipment configuration control may lead to different dual source strategies. Once a strategy is selected, the degree of configuration control varies for specific items. A greater degree of configuration control is necessary for critical subsystems with stringent performance

requirements. Conversely, less demanding subsystems are afforded more design or producibility flexibility. The level of flexibility determination is made at the beginning of a dual source effort so that all participants clearly understand configuration requirements and procedures.

9.2 ROLE OF THE DESIGN AGENT

The technology transfer method and the level of configuration control required by the Program Office jointly determine the configuration relationship between the design agent and the second source. Under a teaming or leader follower approach, the lead contractor (or the team if it is a joint venture) is responsible for the overall design and performance of the weapon system. As the design agent, that contractor is responsible for ensuring all relevant technology (including changes as they are approved) is communicated to and implemented by the second source. Under a technical data package (TDP) approach, where there is no direct technical interchange between the two contractors, it is the responsibility of the program office to ensure an adequate drawing package and associated changes are distributed to the second source in a timely manner.

Possession of master drawings, particularly for technically complex equipment, usually is left with the design agent. The Government assumes configuration control at the physical configuration audit (PCA) and issues a separate engineering support contract to the design agent to act as custodian of the drawings. As custodian, the design agent is responsible for incorporating and distributing all changes, including those generated by the second source. Producibility changes that are peculiar to the second source's operations are so identified and included in the master drawings.

The schedule for change incorporation and distribution is determined by the Program Office depending upon the acquisition phase and type of change involved. For example, change transmittal is more frequent during dual source development

and the early stages of production as adjustments are made to accommodate rate capabilities. Also, the more urgent a change is, the sooner it is implemented by the contractors and incorporated into the drawing package. Otherwise, the design agent accumulates lesser changes and incorporates them as block updates to the drawings.

9.3 CHANGE PROPOSAL PROCESS

The process for handling engineering change proposals (ECPs) when multiple contractors produce the same item is determined by the program manager to ensure consistent, uniform procedures. On one hand, the design agent is responsible not only for the development and performance of the weapon system, but also for the transferral of that knowledge to a second contractor. To accomplish this task, the Program Office could insist that the second source replicate the design agent's methods and procedures, disallowing any second source changes. On the other hand, the second source may be allowed some flexibility to inject elements of competition through producibility changes (reduced costs) or design enhancements (improved quality) while still satisfying operational requirements.

To mitigate potential conflicts, the program office establishes change control procedures (or approves those proposed by the contractors) that reflect program objectives and the desired level of configuration control. In accordance with DoD-STD-480A, after the product baseline is established, all Class I changes are submitted to the Program Office for review and approval. The originating contractor sends a copy of its ECP, without cost and pricing data, to the other contractor, as presented in Figure 9.3-1. As part of the review process, a companion change is submitted by the other contractor to address the technical and cost impacts to his production program. While this approach maintains each contractor's pricing integrity, it provides the Government with technical and pricing information for each proposed change enabling it to determine total program impacts.

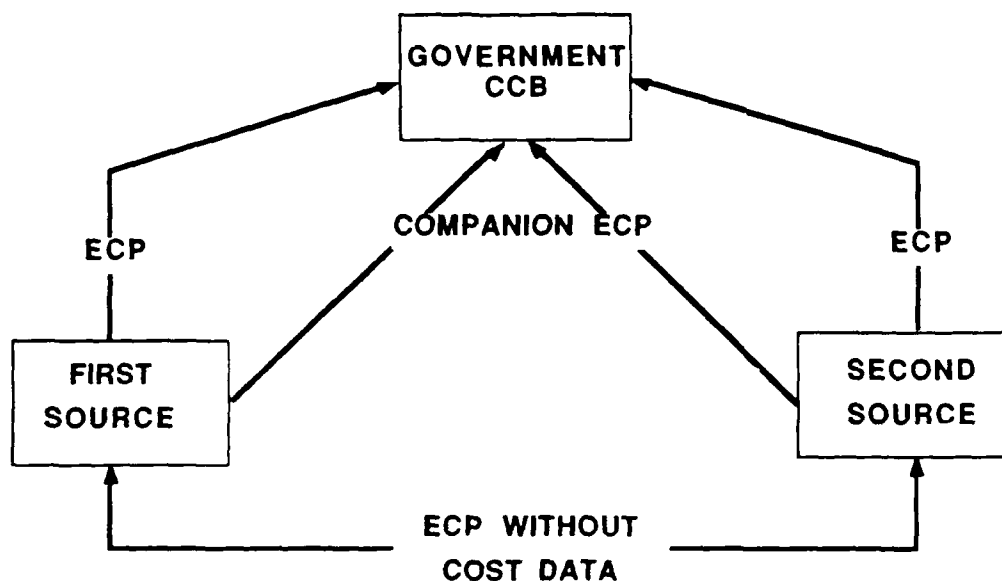


Figure 9.3-1 Class I ECP Processing

With a dual source program, Class II changes are not quite as clear cut as Class I changes. An ECP constituting a Class II change for one contractor may be a Class I for the other and vice versa. In a single source program, Class II changes are approved at a level lower than the Program Office. Usually, the contracting agency's technical personnel (such as Service plant representative offices) involved with the contract/commodity area render decisions on Class II ECPs. With dual sources, Class II ECPs are coordinated on a real-time basis. To identify potential change classifications, the originating contractor sends an information copy of the change to the other contractor at the same time it is submitting the original to the approving authority. The other contractor submits a companion ECP as Class I or II, as appropriate. This early coordination identifies different change classifications and ensures all change information is transferred on a real-time basis. Approval authority for Class II ECPs may be maintained at the Program Office level if sufficient resources are available; alternately, Class II approval authority may be delegated to in-plant Government representatives. If a proposed Class II change is determined to be a Class I change, then the procedures for processing and approving a Class I change are followed. The design agent is responsible for incorporating all approved changes into the master set of drawings.

9.4 CONFIGURATION MANAGEMENT IMPLEMENTATION

It is essential that the configuration management approach be in place from the outset of a dual source effort, particularly with direct contractor-to-contractor technology transfer. The Program Office defines configuration objectives and their relation to overall program and dual sourcing goals, and explicitly conveys them to the contractor. As part of a request for proposal (RFP) or dual source strategy, configuration management requirements are presented in terms of objectives to be achieved and tied to specific program milestones. The contractor then responds with a detailed configuration management plan that accommodates the unique aspects of its internal configuration management system, the second source's unique system, and how the two plants interface. In addition, the plan describes how baselines are to be managed including:

- What specific documentation will constitute each baseline
- When each baseline will be established
- What internal (initial and second source) and external procedures will be used to process changes

- What constitutes Class I and Class II changes.

The plan becomes part of the basic contracted effort and serves as a mechanism for the Program Office to measure dual source progress.

To ensure strict configuration management during the dual source effort, a Configuration Control Board (CCB) is established that is chaired by the Government and supported by the contractors. Having both contractors represented on the CCB ensures equitable treatment of proposed changes and direct access to the Government for final review and approval authority. The purpose of the CCB is to evaluate proposed changes and to assess the feasibility of translating the ECP into hardware. In addition, the CCB evaluates the potential effects of the ECP on:

- Interface requirements
- System performance
- Logistics requirements

- Production and production cost.

The Program Office establishes operating procedures and management guidelines for the CCB. These guidelines encompass key personnel, change classification procedures, processing and distribution procedures, contractor limitations, and analytic procedures. Key inputs to the guidelines include the desired maintenance concept, existing contractor configuration management systems, and the system's Level of Repair analyses.

In addition to contractor and Government representation on the CCB, the Program Office must ensure that the in-plant representatives understand and support the program's dual sourcing and configuration management requirements. These representatives provide information on configuration change activity at the originating contractor's facility to the Government and the other contractor. The representatives are especially critical when a TDP approach with no direct contractor interaction is pursued.

Chapter 10

PLANNING FOR SUCCESSFUL TECHNOLOGY TRANSFER

This guide has defined the key elements of a successful technology transfer program, summarized lessons learned, and provided guidance to the program office. This chapter discusses the application of the guide in developing a program specific technology transfer plan. The chapter summarizes the methods and analyses that should be employed in determining:

- Program objectives
- Timing of technology transfer
- Technical requirements
- Demonstration milestones
- Risk
- Implementation alternatives.

The results of these assessments and their documentation as a Technology Transfer Plan (TTP) is presented.

10.1 DETERMINING PROGRAM OBJECTIVES

As discussed in Chapter One, the cornerstone of an effective technology transfer effort is the clear statement of dual source program objectives. Recent programs have employed dual sourcing to:

- Reduce or control costs
- Improve quality
- Enhance delivery

- Reduce risk
- Provide for mobilization or surge.

Key elements that are considered in determining dual source objectives include program status, equipment complexity, and operational requirements. Once defined, the objectives flow through the technology transfer approach, qualification requirements, and configuration management plan. As guiding principles, the objectives establish a cohesive framework for an integrated technology transfer effort.

10.2 TIMING OF TECHNOLOGY TRANSFER

This guide has highlighted several mechanisms for initiating technology transfer early in the acquisition cycle. The process of scheduling technology transfer involves the identification of a target completion date and backfilling sequential activities and lead times. To determine the timing of technology transfer, the program office undertakes the following:

- Identify a target first competitive lot based on economic and programmatic analyses
- Back up 18 to 24 months from the competitive lot award date to allow time for qualification testing and fabrication of qualification hardware
- Back up 12 to 18 months from the start of qualification, to allow for technology transfer and production planning including initial source support.

This process identifies a preferred date for initiation of the dual source program. The reasonableness and validity of the preferred date then is assessed based upon factors such as maturity of design, data availability, and potential second source activities.

10.3 ESTABLISHING REQUIREMENTS

As discussed in Chapters Two and Three, the technical requirements of a technology transfer program include the technical data to be transferred,

anticipated technical support, and potential qualification assistance. These elements are defined upfront so that the requirements can be incorporated into the contractors' statements of work. Technical requirements are determined based upon equipment and process complexity, existing industrial capability with similar systems, and configuration management requirements. Figure 10.3-1 presents the technical requirements that are associated with key program characteristics. The figure is intended to provide representative guidance.

CC88-0584

KEY FACTOR	TECHNICAL SUPPORT			
	ENGINEERING ASSISTANCE	KITS	MATERIAL SUPPORT	TEST SUPPORT
COMPLEX END ITEM	+	+	+	+
COMPLEX PROCESSES		+	+	
INDUSTRY CAPABILITY	+			+
STRICT CONFIGURATION CONTROL	+	+		+

- SUPPORT IS BENEFICIAL OR REQUIRED
 SUPPORT IS NOT REQUIRED

Figure 10.3-1 Potential Technical Requirements

10.4 DEFINING MILESTONES

Interim program milestones are crucial to assessing technology transfer progress and to establishing confidence in the second source's ability to produce the end item. Careful definition of interim milestones provides the program office with a mechanism for managing and reducing risk. Potential milestones include:

- Control and validation of the data package (Chapter Two)
- Critical process demonstrations (Chapter Five)

- Subsystem and component verification and interchangeability demonstrations (Chapter Five)
- Kit assembly and checkout (Chapter Four)
- Fabrication of Qualification Units (Chapter Four)
- Qualification testing (Chapter Five)
- Directed buy (Chapter Four)
- Physical Configuration Audit (Chapter Five).

As discussed throughout this guide, these milestones demonstrate incremental improvements in

second source ability and provide a mechanism for managing risk.

10.5 ASSESSING RISK

The risk associated with technology transfer and dual sourcing must be carefully assessed. The development of a second source is conducted in parallel with the ongoing program. Thus, the second source effort presents limited programmatic risk in relation to equipment deliveries and program schedule.

Consideration of risk concentrates on the technology transfer effort and the financial exposure of the Government. As discussed, careful definition of program milestones can assist in managing risk.

The principle risk of a technology transfer effort is that the second source fails to qualify for production in a timely manner. This ultimate risk is broken down into its constituent parts including the following:

- Timely delivery and assimilation of technical data
- Development of production capabilities including special tooling, test equipment, capital equipment, and process demonstration
- Vendor base development including supplier qualification, vendor delivery to the prime, and integration of the subsystem into the end item
- Successful qualification including delivery of end items at rate that meet all system specifications.

These risks are mitigated through the provision of additional technical support, material support including Government furnished equipment (GFE), and assistance in tooling and test equipment development.

In assessing second source and technology transfer risk, the program office considers the following:

- Schedule intensity and concurrency
- Degree of unique processes and design elements
- Practicality of workarounds and substitutes
- Degree and level of anticipated support from the initial source.

The risk and intensity of the key elements determine the level of financial exposure to the Program Office and designate the preferred contract type to manage that risk. For example, a fixed price incentive contract may be awarded to a second source for technology transfer, qualification, and limited production if the system is mature and within the state-of-the-art. For a more challenging system, the second source contract may encompass only technology transfer with qualification and limited production as options. This latter approach limits the Government's financial exposure.

10.6 CONTRACTUAL IMPLEMENTATION

As discussed in Chapter Seven, the contractual requirements for the initial source and the second source are complementary to ensure a cohesive technology transfer effort. Once the statements of work (SOWs) are defined, the contract type is developed based upon risk, schedule urgency, and potential incentives.

The contract type varies depending upon the technology transfer approach and the maturity of the program. For new-start programs, technology transfer requirements are tied to the initial source's full scale development (FSD) contract. This provides the Program Office with the leverage of the FSD and production programs. For more mature programs, the initial source effort is tied to that contract effort that has the greatest unexpended financial balance.

If the second source is to be a prime contractor to the Government, the contract type and the use of options must be assessed. Key elements that are considered include maturity of the system, quality of available data, and technical complexity. Incentives are incorporated to enhance schedule acceleration or cost control. Options also are incorporated for a limited production buy. This approach is helpful in simplifying contracting requirements and in providing insights into an offeror's potential production pricing during selection of the second source.

10.7 THE TECHNOLOGY TRANSFER PLAN

The aforementioned planning elements are integrated as a TTP. The plan is prepared prior to the preparation of the contractors' SOWs and serves as the technical baseline for second source contract provisions. The level of detail of the plan depends upon the maturity of the program. As the program progresses, additional detail is incorporated. The plan serves as the guiding document for all program

personnel associated with the technology transfer effort. As such, it functions as the cornerstone for more detailed, subordinate plans such as configuration management, qualification, manufacturing,

and logistic support plans. A high level outline of a TTP is presented in Figure 10.7-1. A more detailed outline is presented in Appendix D.

CC89-0119

TECHNOLOGY TRANSFER PLAN
1. INTRODUCTION
2. SYSTEM DESCRIPTION
3. ACQUISITION OVERVIEW
4. FIRST SOURCE MAKE/BUY PLAN
5. SECOND SOURCE MAKE/BUY PLAN
6. SCHEDULES
7. MANAGEMENT STRUCTURE
8. FIRST SOURCE REQUIREMENTS
9. SECOND SOURCE RESPONSIBILITIES
10. CONFIGURATION MANAGEMENT
11. LOGISTICS PLAN
12. DATA
13. RELIABILITY AND MAINTAINABILITY

Figure 10.7-1 The Technology Transfer Plan

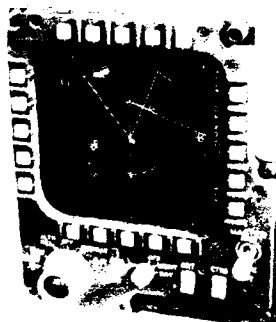
APPENDIX A
CASE STUDIES



AMRAAM



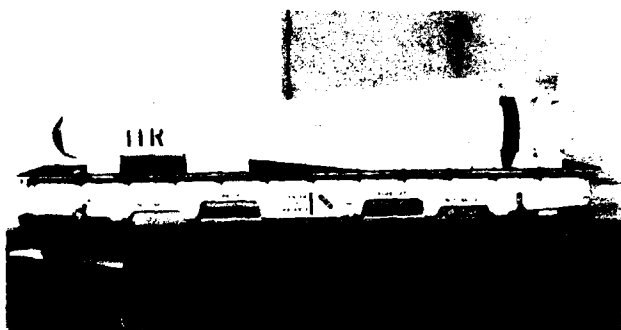
SIDEWINDER AIM-9



JTIDS



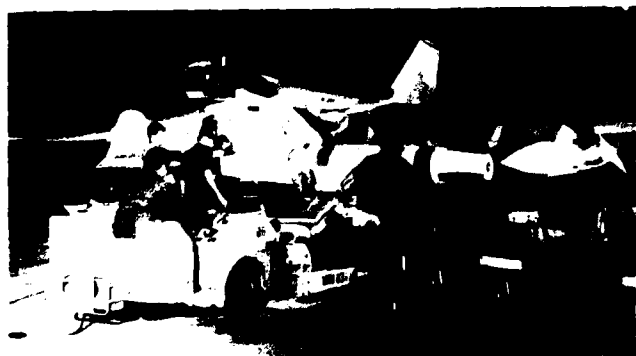
TOMAHAWK



A-10 THUNDERBOLT II



V-22 OSPREY



SRAM II



HELLFIRE
A-1

Appendix A

PRIOR COMPETITIVE PROGRAMS

This appendix presents case study data and lessons learned from prior dual source programs. The case studies have been drawn from ongoing programs across the three Services. Key components of the case studies include system description, technology transfer approach, goals of the dual source effort, dual source schedule, the program office management approach, and configuration management procedures.

A.1 AMRAAM

A.1.1 System Description

The Advanced Medium Range Air-To-Air Missile (AMRAAM) is an all-weather, beyond visual range tactical missile. It is being developed in response to U.S. Air Force, Navy, and allied operational requirements. As such, AMRAAM will be compatible with the F-14, F-15, F-16, and F/A-18 and other appropriate U.S. and allied aircraft. AMRAAM features a command-update initial guidance for midcourse control plus an active radar seeker with home-on-jam capability.

The Air Force request for proposal (RFP) for Full Scale Development (FSD) required the offerors to submit a summary Technology Transfer Plan (TTP) for a leader-follower effort. The offerors also were required to price the option so that the Air Force could exercise it later in the program, yet receiving a fixed price while in a competitive mode. The Air Force reserved the right to award the follower contract to whomever they determined could satisfy program requirements, including the loser of the leader FSD contract award. No guarantees were made to the leader contract offerors that the loser

would become the follower. Hughes was competitively awarded the FSD contract in December 1981 based on their technical proposal. To enhance their potential to be the follower, Raytheon gave all data rights of their design to the Air Force and a complete debrief of their design to Hughes. The Air Force awarded the follower contract to Raytheon in July 1982.

A.1.2 Dual Source Goals

The AMRAAM dual source effort was undertaken to accomplish several objectives. The primary emphasis was on developing a responsive industrial base while controlling costs. The leader-follower approach enabled the program office to introduce the second source early in the development phase and, thus, to attain additional engineering and production planning efforts.

A.1.3 Technology Transfer Approach

During FSD, Hughes taught Raytheon how to manufacture, test, perform failure analysis, and repair the air vehicle and associated special tooling and test equipment. Hughes provided design drawings and test processes, all-up-round (AUR) hardware, and special test equipment specifications.

Hughes also supported Raytheon's production planning effort and developed a training program to educate Raytheon on the configuration, operation, and construction of the AMRAAM. Raytheon was responsible for verification, proof, and provision of inputs to Hughes resulting from its data review. In addition, Raytheon conducted a producibility program focusing on critical design and manufacturing risk assessments and technology modernization.

During FSD, Raytheon disassembled the AUR hardware produced by Hughes to learn the AMRAAM design. In addition with reviewing the drawings as they became available, Raytheon must build 15 qualification missiles to the functional baseline rather than to print. Interchangeability must be demonstrated at the section, chassis, and piece-part level. Hughes is responsible for developing and maintaining the vendor base for both prime contractors throughout production Lot II. Raytheon has the option of developing separate vendors at its own risk for production missiles; however, to reduce risk while learning the design, Raytheon was required to use Hughes' vendors.

In addition, Raytheon is responsible for developing special test equipment (STE) to prove interchangeability at the chassis level and above. Below the chassis level, the subsystems are to be built to the same data package, however, interchangeability is not as critical. Raytheon also is to witness Hughes' qualification tests.

Through the technology transfer effort, Hughes was responsible for maintaining configuration control to ensure interchangeability at the lowest repairable level.

An Associate Contractor Agreement (ACA) was developed to detail the terms, conditions, and period of applicability of the technology transfer effort. The agreement addressed key responsibilities and activities of each participant as well as any other critical understandings which were agreed to by Hughes, Raytheon, and their subcontractors and vendors.

The Hughes leader-follower manager was specifically charged with the responsibility for the conduct of the leader-follower program. He reported directly to the AMRAAM Program Manager and had access to the Government's matrix organizational personnel. The Hughes program manager was responsible for carrying out all specific items in the TTP, and for working closely with Raytheon to provide additional assistance. All Raytheon questions and requests were given to the Hughes program manager who was responsible for ensuring they were answered. A semi-formal communications structure was established where interface memos were acted on by focal points at each company. The status of action items was tracked weekly.

The government program office was structured as a matrix organization that drew on functional support specialists throughout the command. Support areas included systems engineering,

production engineering, quality assurance, material, configuration management, and logistics.

A.1.4 Schedule

In the AMRAAM program, Raytheon was granted production release prior to full qualification. The follower's qualification deliveries began in mid-FY88, coinciding with delivery of Hughes' last qualification missiles. The first two production lots (FY87 and FY88) are directed buys to ensure Raytheon builds and delivers production hardware prior to the first competitive award (Lot III, FY89). Delivery of Raytheon Lot I missiles will begin at the end of FY88.

A.1.5 AMRAAM Configuration Management

Hughes is responsible for configuration management and control of those system components until the Government takes over control. The government will take control incrementally:

- FSD prime contract award - functional and allocated baselines (system and configuration item Part I specs)
- Preliminary Design Review - air vehicle section (Part I specs)
- Software Critical Design Review
- System Critical Design Review - Level 2 drawings
- Functional Configuration Audit - Level 3 drawings.

Hughes' responsibility for maintaining control of all configuration items ensures complete form, fit, and function compatibility at the lowest depot repairable item level between all Hughes and Raytheon air vehicle hardware. Identical computer resources and common depot support equipment are also program requirements. The hardware and software to be provided were built and assembled in accordance with the allocated and product configuration baseline.

The data package was transmitted incrementally to Raytheon as Hughes developed items. Drawings were sent to Raytheon as information only with final versions released by Hughes' manufacturing personnel. Early release of the drawings was required so that Raytheon had sufficient time to review them thoroughly and implement them to maintain schedule.

Follower Class I change activity will be initiated after the Physical Configuration Audit (PCA). Class I

engineering change proposals (ECPs), without cost data, will be coordinated between Hughes and Raytheon prior to submittal to the government (with cost data). Class I ECPs and critical/major requests for deviations/waivers (RDWs) require government approval. Government approved Class I ECPs and RDWs shall be incorporated by both contractors.

Class II changes, minor deviations, and waivers will be reviewed and approved by Hughes and provided to Raytheon. The government will be informed of the disposition of these changes.

A.1.6 AMRAAM Program Results

The AMRAAM technology transfer effort has proven successful to date. The early presence of Raytheon has enhanced the quality of the data package and has demonstrated to Hughes early competitive pressure while still working with them. Both contractors are involved extensively in the Producibility Enhancement Program where both participate as design agents recommending cost-controlling improvements. Technology developed by one contractor must be transferred to the other although not all improvements are required to be implemented by both. The program concentrates on the specific cost drivers of the AMRAAM and is a competitive effort between Hughes and Raytheon. The contractors have offered approximately 40 projects of which the Air Force has selected about 20 to study further; most have been won by Raytheon. As a secondary benefit to the Air Force, Raytheon has proven to be a less expensive alternative for associated support equipment contracts that normally would have been awarded to the developing contractor. Hughes, however, submitted bid prices the Program Office felt were high and did not negotiate to a more acceptable level as did Raytheon.

Four important points that have contributed to this successful dual source effort are the following:

- The Air Force required the transfer of special tooling (ST) and STE specifications and drawings. Without this information, second source redevelopment costs for the ST/STE might have been excessive. The ST/STE drawings and specifications also ensured identical level requirements are met
- The Air Force assured Raytheon access to the vendor base at prices similar to what Hughes paid. The Air Force was able to implement this with minimal problems, as it paid for the development of the vendors and owned the data rights for the majority of the subsystems

- The Air Force bought the right to establish a second source while in a competitive environment. The TTP was a formal deliverable that the Program Office uses as a contractual mechanism to monitor the dual source effort. The Instructions to Offerors in the RFP required a summary TTP that was made a part of the source selection criteria
- The Air Force has fully supported the technology effort from the start. A high level, large Program Office staff has maintained routine effort to ensure technology transfer occurs. The only leverage available has been the FSD contract and the potential loss of future production awards.

A.2 JTIDS

A.2.1 System Description

The Joint Tactical Information Distribution System (JTIDS) is a spread-spectrum, frequency-hopping, digital (data and voice), crypto-secure, high data rate communications system. The system operates in the low MHz frequency band, providing beyond line-of-sight communication with aircraft and surface relays and communications to low altitude or ground systems. The JTIDS system is nodeless, may be composed of single, multiple, or subnets, and will use a common message standard to ensure interoperability between all users.

Three classes of JTIDS have been developed. Class II, the one addressed, is a smaller version of the Class I which was developed for the E-3A and the Adaptable Surface Interface Terminal. The Class II was developed specifically to meet Army infantry/ground requirements.

A firm fixed price FSD contract for design and development of the three basic line replaceable units (LRUs) that comprise the Standard Class II Terminal was awarded to Singer-Kearfott in January 1981, with Rockwell-Collins as the follower. Under the FSD contract, each contractor designed a portion of the terminal, and then cross-transferred technology with the other.

A.2.2 Dual Source Goals

The goals for dual sourcing in the JTIDS program were to establish an industrial base, to increase overall capacity, and to introduce competition in the program during the development stage. This stage was chosen because it showed increased probability of success, and it maximized the payback period.

A.2.3 Technology Transfer Approach

A follow-on FSD contract was awarded in 1985, which included procurement of additional terminals of the existing configurations for new test requirements and development of a new terminal configuration for the E-3 AWACS (Airborne Warning and Control Systems). The Class II Development Test and Evaluation/Initial Operating Test and Evaluation (DT&E/IOT&E) took place in FY86, which led to a Defense Systems Acquisition Review Council (DSARC) III decision and production award in January 1987.

The Class II Terminal leader-follower program was developed and planned early in the program development phase. Competing validation phase contractors were solicited for leader follower plans in the FSD RFP. The follower was selected before the FSD award and this was reflected in the FSD proposal. Also, the implementation plan and ACA was submitted in the proposal.

After the FSD award, the follower was phased in starting no later than the Critical Design Review. The follower then fabricated systems for test. The first production quantity was coproduced by the leader and the follower under a single contract. Future production quantities will be separate, competitive awards.

The leader-follower management and organizational approach to the JTIDS program is structured in parallel fashion. JTIDS program objectives were met by the Rockwell-Collins team utilizing a Statement of Work (SOW) containing task descriptions which were keyed to the Work Breakdown Structure (WBS) and the Master Program Schedule for performance and reporting milestones. Technical, administration, funding, and schedule controls were charted, monitored and controlled by the two program teams. Regular technical review and technical interchange meetings were conducted to ensure program performance and control.

A.2.4 Configuration Management

A key contract feature through a second sourcing plan was the design and configuration management approach. Configuration management is led by Singer to ensure form, fit, and functional equivalency.

A.2.5 JTIDS Program Results

Due to a detailed, thorough implementation plan and mutual design responsibility, a successful

technology transfer was accomplished, although, an increase of almost 12 percent was estimated in FSD cost using the leader-follower approach.

A.3 IIR MAVERICK

A.3.1 System Description

AGM-65D (Maverick) is an air-launched, electro-optical missile designed for use against hard or discrete ground targets. The guidance system utilizes an imaging infrared guidance to provide day/night capability. The missile is compatible with the F-4D/E/G, A-7D, A-10, F-16, and F-111D/F aircraft. The propulsion is provided by a solid propellant rocket motor. The missile has a length of 8.2 feet, a diameter of 1.0 foot, a span of 2.4 feet, and a weight of 496 pounds. The missile was developed by Hughes for the Air Force. It has a range of 12 miles at supersonic speed.

The technology transfer approach was leader-follower in production, with Hughes Aircraft Company as the leader and Raytheon as the follower. Raytheon is a prime contractor to the Government. Raytheon was provided with a Level 2 TDP. Minimal technical assistance was provided by Hughes.

A.3.2 Dual Source Goals

In 1982, the decision to dual source was made. The primary reason for introducing a second source for the Maverick was to reduce the cost.

A.3.3 Technology Transfer Approach

Hughes provided a Level 3 TDP to the Government; however, the government did not guarantee the accuracy of the TDP. In addition, Raytheon did not receive any STE or the drawings for STE.

A level of effort second source contract was awarded to Hughes to support quarterly configuration meetings to be held with Raytheon. All ECPs were to be submitted to both Raytheon and the Government by Hughes.

A.3.4 Schedule

The IIR Maverick dual source schedule involved a 48-month technology transfer and qualification program. The program encompassed the provision of hardware items to potential second sources, competitive selection of the second source, a 15-unit qualification program, and a directed buy. Competitive production splits were not initiated until the fifth production lot.

A.3.5 Configuration Management

The configuration management plan was incorporated into both contractors' contracts. A technical assistance requirement replaced the associate contractor agreement and Raytheon paid Hughes for technical support on the TDP during the qualification phase.

Raytheon, as the second source, was responsible for meeting missile performance and interchangeability requirements at the depot/field repair levels. To enhance change control and processing, Hughes, Raytheon, and Program Office representatives formed a Commonality Control Working Group (CCWG).

A.3.6 Program Results

The required level of technical support from Hughes was actually less than originally expected. Through Raytheon's aggressiveness as the second source, it completed the qualification milestone on time.

A.4 SRAM II

A.4.1 System Description

The Short Range Attack Missile (SRAM) II is being developed by the Air Force as an improved nuclear strike weapon capable of penetrating advanced defensive threats using either high or low altitude approach trajectories at high speeds. Anticipated mission applications include striking pre-planned, fixed, hardened, and defended targets, rapid retargeting, and off-axis range. Sufficient range will be provided to improve carrier survivability and targeting flexibility. To fulfill these mission

requirements, the SRAM II will take full advantage of emerging technology, primarily in the area of avionics.

The RFP for FSD required the prime contractor to establish dual production sources for three key subsystems, the rocket motor, the navigation/guidance unit, and the actuator assembly. Boeing Aircraft Company was competitively awarded the FSD contract in March 1987. Low rate production is scheduled to begin in FY91. Split buys will start with the second full scale production lot.

A.4.2 Dual Source Goals

The SRAM II dual source effort was undertaken to accomplish several objectives. The primary emphasis was on reducing costs during production. Initial cost/benefit analyses indicated a net loss from dual sourcing at the system level; however, similar analyses at the subsystem level supported the dual sourcing decision. As approximately 2/3 of the missile will be produced by subcontractors, establishing two producers for the high cost and technically critical components will satisfy the dual source goals to reduce production costs and schedule risk.

A.4.3 Technology Transfer Approach

In response to the FSD RFP, Boeing submitted a dual source management plan that detailed how it will develop dual production sources for the key subsystems using a leader follower approach. The system developer (leader) will provide technical assistance and training to the second source (follower) to enhance production qualification. Boeing has subcontracted with a lead vendor for each subsystem. The second vendor also has been identified. Figure A.4-1 presents the contractual arrangements Boeing has established for the subsystems.

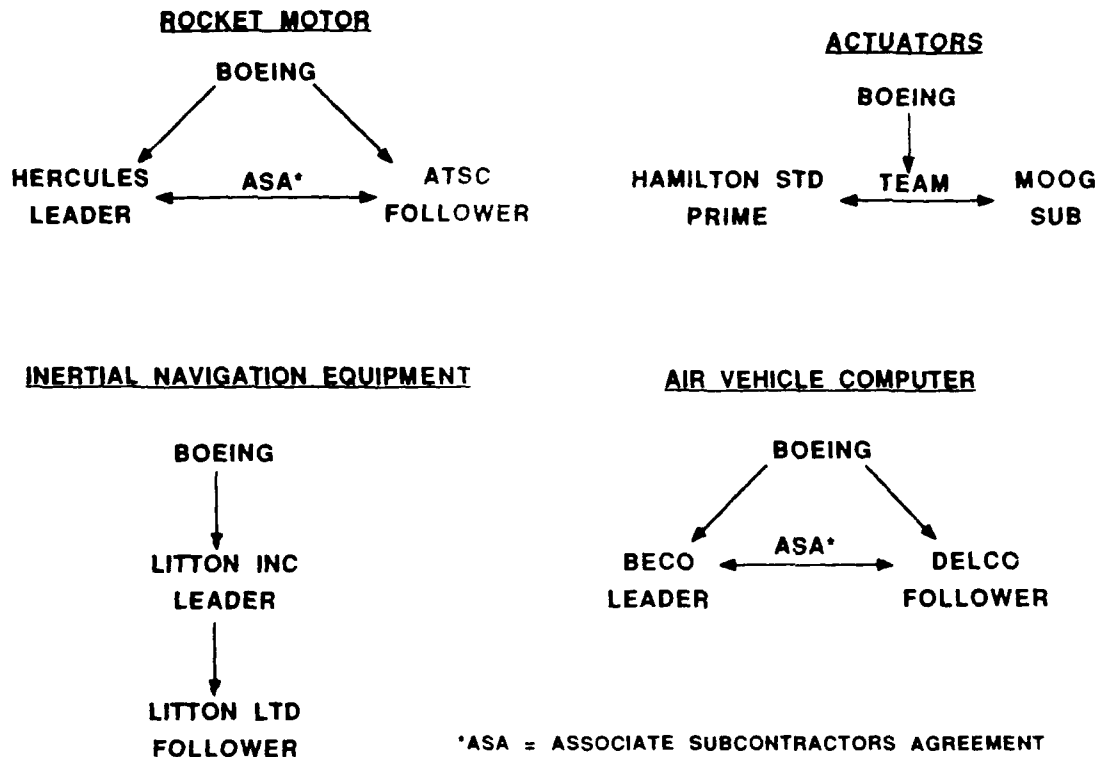


Figure A.4-1 Boeing Subcontracts Structure

At the beginning of low rate initial production (LRIP) long lead, Boeing will issue subcontracts to the leaders, Hercules and Boeing Electronics (BECO), to formally transfer all data to the followers, Aerojet and Delco, for their qualification effort. Hamilton Standard and Moog have teamed to design and develop the flight control element during FSD but will not effect mutual technology transfer until the start of LRIP. For the inertial navigation element (INE), Boeing has contracted only with Litton Inc. As the leader, Litton Inc. will issue a subcontract to Litton Ltd. to accomplish technology transfer and qualification. Although the second sources will not contractually begin the technology transfer effort until LRIP, all will participate in a technical coordination phase. This pre-LRIP, noncontractual effort will begin the process of educating the followers in the subsystem designs.

By contracting directly with the subcontractors, Boeing will retain control over the dual production sources for the subsystems. Boeing will be an active participant at both subcontractors' facilities during the technology transfer and qualification process. This approach mitigates any technical or managerial/administrative problems experienced by the

second sources early in the program ensuring that two capable producers are available to effectively compete by the second production lot.

A TTWG will be established by Boeing to facilitate technology transfer. The TTWG will be chaired by Boeing, with appropriate functional representation from the two subcontractors.

The leaders will deliver all subsystem documentation as it is developed to the followers including product specifications, tooling and test equipment specifications, manufacturing process information, and hardware kits. On-site technical assistance will be provided to demonstrate critical manufacturing and testing methods and to train the followers' workforce. Unique assistance proposed by the leading subcontractors includes the following:

- Rocket motor - Hercules will provide sufficient tooling and test equipment to Aerojet to assemble and fabricate qualification and initial production hardware
- Air vehicle computer - BECO will provide to Delco a Master Purchase List of qualified sources for all purchased components and materials.

A.4.4 Program Schedule

During FSD, development, test, and demonstration activities will be undertaken to ensure that operational and support requirements are met. FSD will include detailed design, manufacture, and flight testing of prototype missiles. The first FSD missiles will be delivered in FY90, incorporating subsystems from the leading subcontractors.

LRIP will be split into two lots, LRIP 1A and 1B, beginning in FY90 and FY91. Long lead release for LRIP is expected in early FY90. Full authorization of LRIP is anticipated as a Milestone IIIA decision in early FY91. During LRIP 1A, the leading subcontractor will manufacture 25 complete subsystems while qualifying the second source. In LRIP 1B, the second source will manufacture ten units of the remaining 75 subsystems. The first lot of rate production, FY92, will be a directed buy to allow full qualification of the second source and to allow the second source to build to rate. Competition between the two subcontractors will begin with the second production lot, FY93.

A.4.5 Configuration Management

Boeing has the initial responsibility of establishing configuration control during the FSD phase of the program. An allocated baseline, established and controlled by Boeing, will be submitted to the SRAM II program office for approval during FSD. Boeing also will be responsible for configuration identification in the form of technical documentation. Configuration control will be assumed by the Government at PCA, but Boeing will maintain formal status accounting records for all production articles.

As presented in Boeing's dual source management plan, a Configuration Control Board (CCB) for subsystems will be established and chaired by Boeing. Functional representatives from the subcontractors also may be included to ensure each participant has access to Boeing concerning changes in the configuration.

Boeing has the overall responsibility for maintaining control of and ensuring uniform implementation of configuration management. Boeing also has the responsibility for ECP processing (Class I and Class II), establishing priorities and processing deadlines, and developing recommendations to the Government. As the prime contractor with system performance responsibility, Boeing will determine the level of design flexibility to be afforded the second sources.

A.5 SIDEWINDER (AIM-9M)

A.5.1 System Description

The Sidewinder family of missiles has evolved over the past three decades with many and varied modifications. The AIM-9M (Sidewinder) is a short-to-medium range "fire and forget" air-to-air missile with all-weather capability designed for dogfight engagements. The guidance system consists of an infrared (IR) homing head, with AM/FM conical scan. The propulsion is provided by a Mk 36, single stage, solid fuel rocket motor. The missile has a length of 9.4 feet, a diameter of 0.4 feet, a span of 2.1 feet, and a weight of 190 pounds. The missile was developed by Raytheon for the Navy and the Air Force.

A.5.2 Dual Source Goals

The Sidewinder Program Office has employed dual sources for the AIM-9 series of procurements using a TDP technology transfer approach. The goals of the AIM-9M dual source program are to establish two qualified producers and to maintain surge and mobilization capability. Also, the existence of two producers was expected to help control production costs.

The program was required to maintain a dual-mobilization requirement at all times. If a third producer was needed because of nonperformance from one of the existing competitors, the Government was to carry all three contractors until the third competitor was fully qualified. In reality, selection of the second production source was always limited to the two chosen, Raytheon and Ford.

A.5.3 Technology Transfer Approach

The Sidewinder Program Office used a TDP technology transfer approach. The Navy developed a Level 1 TDP to implement a product improvement program. The Level 1 package was released to both contractors to compete for the design of the production package. The winning contractor designed the production version and delivered a Level 3 TDP to the Program Office. The first year of production went to the Level 3 designer. After validation of the Level 3 TDP, the second source was qualified and produced one production lot. The two sources then compete for the remaining production awards.

The Program Office maintained the technical data package. The Navy designed the technical changes necessary to meet the planned product improvement objectives and delivered the technical data to the appropriate firm in the form of a Level 1 TDP. The firm translated the technical design into a

production package and delivered a Level 3 TDP to the Navy. After Navy validation, the other firms deemed qualified prior to solicitation received the Level 3 TDP and a qualification contract to prove their ability to produce the new package. Both contractors then make bids.

The Naval Weapons Center at China Lake validated the Level 3 TDP, performing the necessary audits required to ensure that the design met all requirements.

A.5.4 Configuration Management

Configuration control is maintained by the program office. All Class I and II ECP's are approved by the Government before implementation can proceed. The contractors must submit ECP documentation to the Missile Change Control Board (MCCB) for approval. China Lake is consulted, as required, to explore the technical consequences of the proposed changes. Technical responsibility resides with the China Lake technical staff.

A.5.5 Program Results

Among the major benefits of the Sidewinder AIM-9M Guidance and Control System (GCS) competition are the demonstrated increase in reliability and the decrease in unit cost over all applicable versions of the family of missiles. Reliability has steadily increased, with Ford first achieving superior results and then Raytheon overtaking Ford in the 1985 production buy.

Both contractors exhibit a steadily downward sloping unit price curve for the production years 1981 through 1986. As expected, the developer, Raytheon, had a lower unit price during the first two years of the procurement. The reduction in Ford's third-year price caused a subsequent reduction in Raytheon's fifth-year price.

The success in establishing the second source early in production (second year) is due to four related factors. First, a sound technical data package was developed and validated. Second, the second source was awarded a qualification contract to prepare for production using the first source TDP. Third, the second source had produced the AIM-9L and was very familiar with the program. Fourth, and most important, China Lake, as design activity for the GCS, understood the TDP as well as, if not better than, the second source. As a result, production start-up problems were quickly resolved, and the second source delivered its first lot on schedule.

A.6 TOMAHAWK

A.6.1 System Description

The BGM-109 A/E (Tomahawk) is a sea launched cruise missile with strategic and tactical applications against land and sea targets. The guidance package includes a Terrain Correlation Matching (TERCOM) initial guidance, and a Digital Scene Matching Area Correlator (DSMAC) terminal guidance. The missile has a length of 18.7 feet, a diameter of 1.75 feet, a span of 8.6 feet, and a weight of 2650 pounds. It has a range of 1500 miles at a speed of 550 mph.

The missile was designed by General Dynamics Convair Division (GD/C). Prior to FY82, GD/C produced the airframe and McDonnell Douglas Astronautics Company (MDAC) produced the guidance set as a subcontractor to GD/C. A technology transfer program was implemented to allow GD/C and MDAC to each produce the airframe and guidance set.

A.6.2 Dual Source Goals

Initial goals of the Tomahawk dual source effort included:

- Improve the industrial base
- Reduce production costs
- Enhance technical performance.

A second production source would increase surge capabilities and reduce potential bottlenecks. In addition, potential delivery problems rising from a strike or earthquake would be lessened. With program costs increasing, dual sourcing represented a way to help control production costs. Also, the Navy had concerns over the quality of the GD/C missiles. Dual sourcing was implemented to help emphasize the quality requirements.

As the dual source program proceeded, other goals arose. The Navy used competition to help absorb costs from increasing warranty requirements, especially when warranty coverage was extended to the AUR. Also, the Navy experimented with using quality as a selection criteria, thus directly addressing the quality concern.

A.6.3 Tomahawk Technology Transfer Technique

The initial technology transfer process began with fixed-price incentive (FPI) contracts, including indemnification of capital equipment, and tooling

and test equipment. Congressional action restricted test equipment and tooling coverage in 1985.

The initial contracts specified three phases for each contractor:

- GD/C Phases
 - Transfer of two completed guidance sets for dual source evaluation
 - Transfer of kits for 10 guidance sets for assembly and checkout
 - Transfer of raw material and vendor supplied parts for 22 guidance sets for fabrication, assembly, and checkout
- MDAC Phases
 - Transfer of one completed AUR for dual source evaluation
 - Transfer of kits for six AURs for assembly and checkout
 - Transfer of raw material and vendor supplied parts for four AURs for fabrication, assembly, and checkout.

MDAC was eventually required to complete 10 FY82 AURs and 22 FY83 AURs. GD/C was required to complete assembly of 10 FY82 and 22 FY83 Guidance Sets.

The contractors established various TTWGs to help ensure the efficient transfer of technology relating to components, manufacturing processes, and test equipment. The TTWGs consisted of representatives from GD/C, MDAC, and the Joint Cruise Missile Program Office (JCMPO). A management working group co-chaired by GD/C and MDAC coordinated the activities of subgroups supporting the technology transfer. The subgroups addressed specific technical areas and supported the day-to-day interaction between GD/C and MDAC. Each subgroup was usually chaired by a representative from the receiving company. Most of the groups met on at least a monthly basis. The major TTWGs were:

- Planning, Processing, and Tooling - Airframes
- Planning, Processing, and Tooling - Guidance System
- Test Equipment and Software - Airframe and AUR

- Test Equipment and Software - Guidance System.

While technology transfer was on time, GD/C did not have full Level 3 drawings available. The drawings were "tailored Level 3" which called out GD/C specifications as opposed to military specifications.

A.6.4 Schedule

The technology transfer process was originally planned as a 2-year effort. Although the original schedule slipped by approximately 6 months because of initial planning delays, the transfer of technology was timely. The kit deliveries experienced minor (1-3 months) delays, but did not affect the qualification schedule. GD/C was qualified on the guidance system in 26 months, 2 months behind schedule. MDAC was fully qualified for the AUR in 28 months.

Under the original plan, FY84 was to be the first year of full up competition. This was delayed a year until the FY85 buy, however, because MDAC was not ready and the technical risk was considered too high. This decision was made after the FY84 proposals were in hand. It was apparent through the technology transfer period that MDAC was aggressive while GD/C was complacent. As the competition point neared, GD/C increased its efforts.

A.6.5 Configuration Management

For Class I ECPs, either contractor could initiate a change and submit it to JCMPO and the other contractor. The other contractor would submit a companion ECP to JCMPO. The JCMPO CCB would render a decision and was responsible for incorporating the approved ECPs into the TDP. For Class II ECPs, either contractor could initiate a change; however, concurrence of the other contractor as well as JCMPO was required. Upon review, JCMPO would approve the classification of an ECP as submitted or require resubmittal as Class I. In addition, the Naval Weapons Center at China Lake reviewed the ECPs. Both contractors were required to implement approved Class II changes. As with Class I ECPs, JCMPO was responsible for Class II ECP incorporation into the TDP.

Hardware from both contractors had to be physically and functionally interchangeable on an item-by-item basis. Therefore, configuration issues had to be resolved during technology transfer and qualification; however, a Configuration Plan was not included as part of the TTP. Both GD/C and MDAC retained design agent responsibilities up to FY87. As a result, both had the authority to disapprove

changes at the four levels depicted in Figure A.6-1. For example, an air vehicle ECP submitted by MDAC had to be approved at all four GD/C levels.

Provisions for the originating contractor to appeal were not provided.

CC88-0646

GD/C - AIR VEHICLE	MDAC - GUIDANCE SYSTEM
PRODUCTION	PRODUCTION
DEPOT	DEPOT
SYSTEM ENG INTEG AGENT	SYSTEM ENG INTEG AGENT
DESIGN AGENT*	DESIGN AGENT*

* DESIGN AGENT SUPPORT OWN PRODUCTION AND BOTH DEPOTS

Figure A.6-1 Tomahawk ECP Responsibilities

The ECPs were difficult to track and pinpoint; thus, a cumbersome coordination process evolved. Also, a separate support engineering team was required to manage the ECPs.

A.6.6 Program Results

The first production competition occurred for the FY85 buy. For 1985 and 1986, MDAC could only supply about 50 percent of total production and their price was high; as a result they received 40 percent of the production in both years. By 1987 the situation had changed substantially. MDAC had shown a good track record and was competing aggressively. Their deliveries were on time and they were capable of filling up to 70 percent of the production requirements. MDAC received 60 percent of the 1987 production because of better price and prompt delivery. GD/C had been exhibiting delivery problems for some time.

By optimizing their plant for the program, MDAC created some advantages in the production area. Their production processes differed significantly from GD/C's. Both contractors made use of the same vendors. For FY87, MDAC had undertaken an aggressive cost cutting program. This included

aggressive make/buy analysis, production cost reductions, and layoffs, particularly in the white collar areas. MDAC also pays substantially less for labor than GD/C. MDAC was judged to be a low to moderate risk on production.

A.7 V-22 OSPREY

A.7.1 System Description

The V-22 Osprey is a vertical lift, tilt-rotor aircraft currently being developed to fulfill multi-Service requirements such as medium assault transport, multi-mission transport, amphibious assault, combat search and rescue, and special operation support. The basic mission for the aircraft is to lift internal/external payloads up to 10,000 pounds and be self-deployable worldwide. The V-22 airframe will be composed of approximately 57 percent composite materials, including primary structure. The aircraft will feature an advanced fly-by-wire control system and will be able to fly as a fixed wing aircraft or as a helicopter.

A Bell-Boeing joint venture exists during FSD and pilot production where each contractor designs a designated portion of the aircraft. Bell will design

the wing, nacelle, transmission, and rotor group. Boeing is responsible for the fuselage, landing gear, and flight control system.

A.7.2 V-22 Technology Transfer Approach

Technology transfer under the V-22 teaming approach is to be accomplished through direct technical and engineering exchange, with special emphasis on ensuring concurrent production qualification of Bell and Boeing. Exchange of data and subsystems for inspection, disassembly, and reassembly by the other manufacturer must begin concurrent with subsystem development. In order to ensure that delivery requirements are met, fabrication and testing of subsystems by the other team member will be initiated as soon as the design is finalized.

Each contractor will manufacture six sets of the subsystems they are responsible for designing. Boeing will perform final integration during FSD. Bell and Boeing will each manufacture six complete aircraft in pilot production.

A.7.3 V-22 Program Schedule

A key factor specific to the V-22 program is a contractor teaming arrangement where both sources participated in engineering development during FSD. The procurement is structured to schedule operation of two full production lines by FY93. As shown, in Figure A.7-1, rate tooling and production awards are planned prior to full qualification.

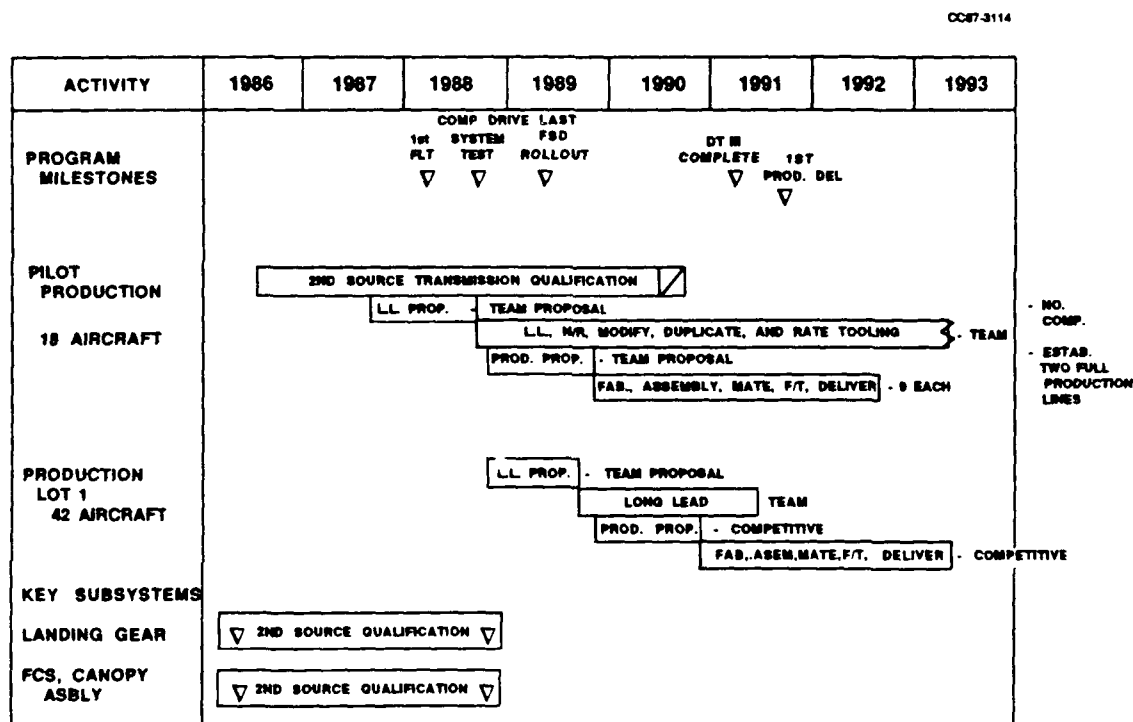


Figure A.7-1 V-22 Program Schedule

A.7.4 Configuration Management

The Bell-Boeing team has the initial responsibility of establishing configuration control during the FSD phase of the V-22 program. The V-22 program office has the overall responsibility for main-

taining control of and ensuring uniform implementation of configuration management. To avoid a proliferation of configurations, Bell and Boeing should maintain fully compatible management systems for the life of the program. In addition, contractors will provide up-front funding of tooling and facilities.

Due to the demanding requirements of V-22 dual source production, a CCB should be established. The CCB is normally established by NAVAIR who then performs the configuration management tasks. Thus, the Program Office does not become involved in these configuration management activities; however, due to the uniqueness of the program, a Program Office chair of the CCB for the V-22 may be more appropriate.

A.7.5 V-22 Program Results

Because of the relative newness of the program, results to date cannot be based on actual testing but rather on present development. An extensive pre-contract effort was required to ensure adequate details of the technology transfer process. This was agreed upon by both contractors and the Navy. Also, extensive management in the program office is required to ensure that Bell-Boeing does, in fact, transfer technology. Development is still in progress and on schedule to meet planned first flight in mid-FY88.

A.8 HELLFIRE

A.8.1 System Description

Hellfire is a third generation anti-armor weapon that can be air or surface launched. It is presently intended for use as the main armament of the advanced attack helicopter. Hellfire homes on a laser spot that can be projected from a number of sources including: ground observer, other aircraft, or the launching aircraft. This enables the advanced attack helicopter to launch its missiles indirectly in some situations without seeing the target. The propulsion is provided by a single stage solid propellant rocket motor. This missile has a length of 5.4 feet, a diameter of 0.6 feet, a span of 1.1 feet, and a weight of 98.5 pounds. The missile was developed by Rockwell International for the Army. It has a range of 4.3 miles at supersonic speed.

The strategy was a dual source leader-follower with Rockwell as the prime contractor (leader), and Martin Marietta as the subcontractor (follower). The award for the AUR competition in FY84 came late in the year while the delivery began in March of 1986.

A.8.2 Dual Source Goals

Prior to FY82, Hellfire remained in a sole source environment. After the award of the FY82

production contracts, it became apparent that if the sole source environment was continued, the Hellfire program would experience a cost growth in excess of \$100 million. This served to enhance the attractiveness of a competitive acquisition strategy.

The goals of this acquisition strategy were three-fold. First, a cost avoidance in excess of \$100 million would be realized by developing a second source. Second, the production base would be broadened, and third, tooling and test equipment were reimbursed under competitive conditions requiring the contractors to be more cost conscious and efficient in design than they would be under "up-front" sole source funding.

A.8.3 Technology Transfer Approach

The Hellfire leader-follower acquisition strategy consisted of: (a) Rockwell International Corporation (RIC) in the role of manufacturer of the missile bus and systems integrator, (b) Martin Marietta Corporation (MMC) as the manufacturer of the laser seeker, and (c) with each providing technical assistance to the other under an approved TTP for production of the complete missile. Under this acquisition methodology, MMC was qualified to produce the missile bus and integrate it with the laser seeker, while RIC was qualified to produce the seeker.

Additionally, the contractors are providing the capital equipment, tooling, and test equipment essential to produce the portion of the missile that is new to them. Therefore, any charges to the government for tooling and test equipment will be proposed under competitive conditions. The government has assumed a contingent liability in order to repay the contractors for unamortized facilities, tooling, test equipment, in addition to technology transfer costs, should the program be cancelled before the 5-year amortization period is over or until the government has procured 6,000 missiles from each contractor.

A.8.4 Schedule

In April of 1982, the Hellfire Program Office became aware of the similarities between Hellfire and JTIDS with respect to the acquisition strategy. A Hellfire acquisition concept briefing was held and the FY82 buy was awarded. The Memorandum of Agreement (MOA) and TTP took six months to negotiate, at which time the contractors implemented them. The FY82 delivery began late in FY83, while the FY83 buy was awarded in July. FY84 began the first year of AUR competition.

A.8.5 Configuration Management

The contractors have established a production configuration management program that effectively addresses several issues. The first issue is to update the TDP to the latest configuration as changes are made. Next is to establish configuration controls to include a CCB and to prepare a Configuration Management Plan for Government approval to implement the provisions of the contractors' efforts.

Both contractors have experienced different costs for implementation of ECPs and different effectivities; therefore, the originating contractor submits a copy of the ECP, without cost or effectivity information, to the other contractor. In each case, the design contractor or TDP custodian provides a detailed technical evaluation to Missile Command (MICOM). The TDP custodian also prepares and submits the TDCMS EAM cards with the completed ECP when the TDP custodian distributes microfilm of the incorporated ECP. Engineering

Release Record (ERR), revised documents, and NOR's.

A.8.7 Program Results

Since the competitive production of Hellfire is ongoing, clear results from this competition cannot be identified. Many actions were accomplished directly among the Program Office, Department of the Army, and the Office of the Secretary of Defense (OSD). Part of this can be attributed to some of Rockwell's activities in its efforts to reverse the strategy.

Finally, more constraints in the TTP should be injected to minimize the Government management involvement. Some difficulty was experienced by Hellfire in development of the TTP. While Tomahawk obtained its TTP contractually, Hellfire depended upon its contractors to submit a plan solely by virtue of a request from the program office. This afforded the program manager little leverage on the contractor in expediting development of the plan and resulted in delays and concomitant pressures in the review by the Government.

APPENDIX B
ASSOCIATE CONTRACTOR AGREEMENTS

Appendix B

ASSOCIATE CONTRACTOR AGREEMENTS

This appendix presents a high level draft outline for a contractor agreement as an example. Program Offices may tailor this example to incorporate specific program characteristics. The second part of

this appendix presents actual contractor agreements used under different technology transfer approaches.

B.1 DRAFT ASSOCIATE CONTRACTOR AGREEMENT OUTLINE

I. INTRODUCTION

- A. Contractors/Participants
- B. Purpose - objectives of technology transfer
- C. General Exclusions, if any

II. APPLICATION

- A. Scope - technology transfer effort in general
- B. Order of Precedence - associate contractor agreement vs. other Government contracts

III. TECHNOLOGY TRANSFER PROGRAM

- A. Design Responsibilities
- B. Data
 - 1. Content - drawing level, processes, instructions
 - 2. Type - system specifications, software, hardware
 - 3. Format
 - 4. Timing
- C. Technical Assistance
 - 1. Training program
 - 2. Data clarification
 - 3. Process and procedures demonstration
- D. Materials Assistance

- 1. Make/Buy plans
- 2. Long lead assistance
- 3. Vendor access
- 4. Vendor qualification
- 5. Quality control requirements

E. Hardware Deliveries

- 1. Elements
- 2. Acceptance procedures
- 3. Schedule

IV. CONFIGURATION MANAGEMENT

V. PROPRIETARY DATA

- A. Description of proprietary data
- B. Transmittal and Handling Procedures
- C. Restrictions for Use
- D. Liability Limitations
- E. Identification of Elements

VI. ADMINISTRATIVE PROCEDURES

- A. Points of Contact
- B. Resident and Transient Services - on-site personnel
 - 1. Office space and facilities
 - 2. Communications support
 - 3. Reproduction facilities
 - 4. Security
 - 5. Secretarial services

C. Facility Access Provisions

VII. AGREEMENT TERMINATION PROVISIONS

B.2 EXAMPLE CONTRACTOR AGREEMENTS

B.2.1 Hellfire Memorandum of Agreement

FOREWORD

This Memorandum of Agreement (MOA) sets forth an understanding between Rockwell International Corporation (Rockwell) and Martin Marietta Corporation (Martin), herein after referred to as contractors, in support of the U.S. Army HELLFIRE Project Office (HPO), for the purpose of establishing both Rockwell and Martin as All-Up-Round (AUR) Missile contractors for the HELLFIRE Laser Missile AUR. An AUR is defined as Guided Missile, Surface Attack: AGM-114A, and Guided Missile, Training: M-36. This program is intended as a means to provide the HPO procurement of HELLFIRE Laser Missile AUR including missile and seeker on a competitive basis and is in support of industrial mobilization requirements.

No changes to any contracts are made by this agreement. Any changes to contracts will be made in accordance with the terms of the respective contracts. This agreement does not contemplate changing Rockwell's role as the design authority for the HELLFIRE Missile System or Martin's role as the design authority for HELLFIRE Laser Seeker.

1.0 PURPOSE AND APPROACH

WHEREAS, it is understood by the parties to this MOA that no obligations will be assumed by the contractors unless and until appropriate contractual direction is received; and

WHEREAS, the Government, represented by the HPO, is desirous of establishing two HELLFIRE Laser Missile AUR contractors (as defined in the foreword); and

WHEREAS, by having two such AUR laser missile contractors, the Government will be able to contract for support by two separate contractors for various activities including verification of flight missions and investigation of flight accidents; and

WHEREAS, the HPO is interested in obtaining competition throughout the HELLFIRE missile program; and

WHEREAS, the HPO wishes to obtain the ability to expand production facilities rapidly to meet industrial mobilization needs; and

WHEREAS, the HPO is interested in geographical dispersion of the manufacturing sources to ensure redundancy and survivability in the event of natural disasters; and

WHEREAS, the HPO has determined that only through establishing Rockwell and Martin as AUR missile prime contractors, can HELLFIRE laser missile production requirements be competitively obtained; and

WHEREAS, the HPO awarded dual source contracts to both Rockwell and Martin based upon each of them undertaking to engage in a reciprocal technology transfer to attain the above objective; and

WHEREAS, this agreement establishes the conditions and understandings between Martin and Rockwell for the purpose of effecting a reciprocal technology transfer to enable both contractors to become certified and independent suppliers of the HELLFIRE Laser Missile AUR.

NOW, THEREFORE, the parties hereto agree as further presented herein.

Both Rockwell and Martin, as production certified AUR suppliers, shall be totally responsible for the delivery, support, and a warranty for the AUR missiles that each produces. The AUR deliveries shall include demonstrated compliance with Government approved acceptance test procedures. The shipping, handling, logistics, and warranty terms and conditions shall be defined in detail in the respective Rockwell and Martin prime contracts.

The following list of items, although not all inclusive, are Government Furnished Equipment (GFE) and are therefore not covered by this agreement: Missile transport and storage container P/N 13012182, Warhead explosives (LX-14 and PBXN-5) and other materials and services related to Warhead Load, Assembly, and Pack (LAP) as defined in applicable production contracts.

2.0 APPLICATION

2.1 SCOPE

The methodologies and procedures agreed to by Martin and Rockwell incidental to the transfer of technologies required for the two contractors to produce each other's design-responsible portion of the HELLFIRE AUR and HELLFIRE Training Missiles, as those end items are defined in the "Foreword" of this MOA, are delineated in the

Technology Transfer Plan (TTP) which has been jointly developed and approved by both contractors, and incorporated in Martin's and Rockwell's respective HELLFIRE production prime contracts with the Government. This MOA sets forth the further understandings and obligations between Rockwell and Martin for implementing the technology transfer requirements.

2.2 ORDER OF PRECEDENCE

In the event of conflict between this agreement and any Government contract with either Rockwell or Martin, the Government contract shall govern.

3.0 DUAL SOURCE CERTIFICATION PROGRAM

3.1 TECHNOLOGY TRANSFER PROGRAM

There will be an open and full reciprocal exchange of information. The Technology Transfer Program is based on the principle that each contractor will become a certified supplier for the AUR as defined herein.

A TTP which delineates the data and knowledge to be transferred has been jointly developed by Rockwell and Martin and incorporated in applicable prime contracts. The contractors shall furnish technical assistance to each other during the term of the TTP. This technical assistance shall be provided by appropriate contractual arrangements between the contractors as defined below.

3.1.1 Technical Assistance Support Payment Provisions

The cost of support services to furnish technical assistance to the other contractor, whether incurred at the supporting contractor's own facilities or in the facilities of the other, will be treated by each contractor in accordance with its agreements with the Government until a total of five thousand (5,000) hours has been expended.

At least 30 days prior to the date that either contractor projects that it will have expended 5,000 hours in support of the other contractor, it will notify the other contractor and arrange for a meeting within the following seven days to mutually determine whether or not the number of hours should be increased and if so, by how much. Upon such agreement, this MOA shall be amended accordingly.

In the event that either party decides not to increase the number of hours, the continuation of technical assistance shall be handled as follows:

- 1 The contractor who has spent the lesser number of hours at the point in time that the other contractor has spent 5,000 hours shall continue to contribute support until it has also expended 5,000 hours.
- 2 If either contractor requires additional support from the other after having received the 5,000 hours of support, the contractors will negotiate hours and rates, by functional disciplines, for such additional support and the requiring contractor shall provide a purchase order for same to the supporting contractor.

3.1.2 Procedures

3.1.2.1 Charges to the technical assistance accounts shall be made only in response to requests for assistance. Requests may be written or oral. Oral requests will be confirmed in writing within 24 hours. Lists of personnel authorized to make requests shall be exchanged and updated as required. Assistance and/or data shall be furnished only if the requestor is named on the list of personnel authorized to make such requests and if a TTP request serial number is given by the requester. Each written request will indicate the requestor, to whom the request was made, the date of the request, the TTP request serial number, and a brief, concise description of the request.

3.1.2.2 The furnisher of the data or assistance requested shall keep a daily log of the time expended in providing these data or assistance. This log shall include the date of the request, the TTP request serial number, the time spent each day by date, who made the request, a brief description of the request, the date the reply or assistance was provided, and the name of the furnisher.

3.1.2.3 Both contractors will set up separate and discrete cost accounts against which these support services will be accumulated and reported to each other on a biweekly basis. (This frequency may be revised if the contractors mutually agree.) These reports will include a listing of the hours expended by functional category (Engineering, Quality, etc.) and a copy of the daily logs in 3.1.2.2 above substantiating the expenditures.

3.1.2.4 Either contractor may request that the other's Defense Contractor Audit Agency (DCAA) and/or Defense Contract Administration Service (DCAS) audit the above information for verification purposes.

3.1.2.5 Exchange of the non-technical data package (TDP) data identified in the TTP within the section entitled "Documentation Transfer" shall be accomplished at no charge to the receiving contractor's technical assistance accounts but will be charged to the technology transfer accounts described in the contracts between Missile Command (MICOM) and the contractors.

3.2 MATERIAL EXCHANGE

In support of the certification program, seeker material for the 7 AUR's and 6 sets of piece parts in Rockwell's FY82 contract will be furnished to Rockwell from Martin. Missile bus material for the 7 AUR's and 6 sets of piece parts in Martin's FY82 contract will be furnished from Rockwell to Martin. No-cost purchase orders will be exchanged by the contractors defining the quantities and delivery schedules for each item of material. The acceptance criteria for this material is set forth in the TTP. Each contractor shall be liable for loss or damage to the material furnished by the other contractor. Additional seeker or missile bus material may be purchased by the contractors from each other, if required, during the certification program.

3.3 EFFECTIVITY

Contractual coverage has been provided by the Government under separate contracts with each contractor. Neither Rockwell nor Martin shall be obligated by this MOA to furnish or to receive any materials, equipment, data, or to perform any services not so authorized. Each contractor shall separately provide to the HPO its plans for corporate financial commitments and personnel and other resources to be dedicated to this reciprocal technology transfer.

4.0 COOPERATIVE PROCUREMENT

Cooperative procurements by the contractors will be necessary in some cases and encouraged in other cases where it benefits the Government in protecting technical performance and/or schedule and limiting costs. In this respect, the following ground rules apply for implementation of cooperative procurements.

4.1 DEFINITIONS

4.1.1 The term "Cooperative Procurements," as used in this memorandum refers to (1) "Joint Procurements," as further defined below;

and (2) AUR supplies and services that Rockwell and Martin purchase from each other.

"Joint Procurements" refers to a specific list of supplies and services (see 4.2 below) for which joint procurement actions are to be conducted with already established sources.

4.1.2 Leader/Follower

"Leader" refers to Rockwell for those Cooperative Procurements involving the bus and seeker/bus integration portion of the AUR and to Martin for those Cooperative Procurements involving the laser seeker portion of the AUR. "Follower" refers to Rockwell for those Cooperative Procurements involving the laser seeker portion of the AUR and to Martin for those Cooperative Procurements involving the bus and seeker/bus integration portions of the AUR.

4.2 OBJECTIVE

Rockwell and Martin will jointly identify those AUR supplies and services that will be subject to the cooperative procurement understanding set forth herein. For those supplies and services so identified the contractors will, to the best of their abilities, cooperate with each other to ensure that the greatest possible advantage is taken of combined quantity price breaks and cohesively integrated manufacturing and inspection (including sell-off) schedules.

4.3 SELECTION OF SUPPLIES AND SERVICES

Rockwell and Martin will furnish to each other all data reasonably necessary to develop candidate lists of cooperative procurement supplies and services. Representatives of the two contractors will arrive at a mutually acceptable list of cooperative procurement items. For those items which the contractors agree should be handled as Cooperative Procurements, the contractor having "leader" responsibility shall furnish to the "follower" contractor all information required to support the timely placement of purchase orders including, but not limited to, DD Form 633 and/or adequate supporting cost and pricing data to satisfy applicable Defense Acquisition Regulations (DAR) requirements. The "leader" shall provide these data to the "follower" not less than ten working days prior to purchase order placement. "Leader" and "follower" purchase orders will be released simultaneously to each common source. Further, purchase orders that the contractors place with each other shall be released concurrent with the producing

contractor's own internal work order(s) for the item(s) involved.

4.4 LEADER-FOLLOWER RESPONSIBILITIES

4.4.1 General

The leader shall act as primary spokesman in matters involving third party common sources if the subject under discussion has the potential of affecting cost, schedule or performance under both the leader's and follower's current or planned purchase orders.

4.4.2 Request for Proposals, Negotiation Plans and Negotiations

4.4.2.1 For each cooperative procurement, the leader will develop a schedule for each step of the purchase order placement process, including, but not necessarily limited to request for supplier proposals, preparation of negotiation plans (as required), negotiation, preparation of negotiation summary memoranda, and purchase order placement. This schedule will be furnished to the follower in sufficient time to allow the follower to participate in those activities discussed under Paragraphs 4.4.2.3 and 4.4.2.4 below. If the planned date for any of the above mentioned events is changed by the leader, the follower will be promptly advised.

4.4.2.2 Leader and follower will strive to portray to third party common sources as much commonality as possible with respect to terms and conditions, data requirements, inspection sell-off procedures, etc. However, there may be certain peculiar requirements for which neither company is able or otherwise willing to compromise. In such cases, the follower shall negotiate his own peculiar requirements for inclusion in his purchase order.

4.4.2.3 The leader will have primary responsibility for: (1) coordinating the development of all requests for proposals to third party common sources, (2) developing and documenting the negotiation strategy; and (3) chairing the subsequent negotiations. However, the follower may participate, at his option, with the leader in evaluating proposals and developing mutually agreed to negotiation objectives.

4.4.2.4 The follower may, at its discretion, be present at negotiations but will not actively participate in the actual negotiations with third party common sources; however, if during the negotiation process the leader encounters significant

difficulties achieving procurement objectives (e.g., cost, schedule or technical) that had been previously established in concert with the follower, the leader will consult with the follower prior to proceeding with the negotiations. The leader will notify the follower of the time and place of negotiations in sufficient time to permit the follower to be present in said negotiations.

4.4.2.5 If disagreements between the leader and follower develop during the pre-negotiation or negotiation process, either party's principal procurement representative may elevate the matter to whatever higher level of his respective company's management he considers appropriate. It is incumbent on both parties' representatives to ensure that third party common sources not be given the advantage of a divided position between the leader and follower. If disagreements cannot be resolved between leader and follower, however, either party may choose to prosecute a separately negotiated order with the common source.

4.4.2.6 If, during the course of proposal preparation, pre-negotiation or negotiation, it becomes feasible to co-locate follower personnel at the leader's facility to enhance coordination, leader shall provide adequate support in accordance with paragraph 7.3 of this MOA at no cost to follower.

4.4.2.7 When the contractors engage in a joint procurement action, the originator of correspondence to a third party common source relating to such joint procurement shall provide a copy of same to the other contractor.

4.4.3 Purchase Order Placement and Administration

4.4.3.1 The leader and follower will each issue their own purchase orders to third party common sources.

4.4.3.2 In the event the follower requires on-site visits to a third party common source by management or technical personnel, the leader will be notified and will arrange for such visits. The follower may have permanent representation at a supplier's facility if the leader is notified to arrange same with the supplier. In addition to normal technical and management administrative visits, it is agreed that the follower, at its own option, may have a quality representative on-site at the supplier's facility to conduct or witness inspection and receiving activities for its deliverables. The

provisions of this paragraph apply to common source suppliers and to procurements by the contractors from each other. The follower agrees that if the follower is not present to conduct or witness inspection and receiving at the leader's supplier's, or producer's facility, the leader's acceptance of the follower's items shall constitute final acceptance by the follower.

4.5 HARDWARE DELIVERIES

4.5.1 If Rockwell, for those items it furnishes to Martin, or Martin for those items it supplies to Rockwell, or a Joint Procurement third party common source develops difficulties that prevents the delivery of cooperatively procured items in accordance with the requirements of Rockwell's and Martin's purchase orders, the distribution of such items to the contractors as they become available for delivery shall be based on the same percentage relationship that each contractor's individual monthly HELLFIRE requirements bear to both contractors' monthly HELLFIRE requirements for the affected parts or services.

4.6 PROCUREMENT BY CONTRACTORS FROM EACH OTHER

4.6.1 Either contractor may choose to procure seeker or missile bus components or equipment from the other. The contractors' prices offered to each other shall be those prices which are offered to their most favored customers and/or the Government for the same items with the same contract requirements and terms and conditions.

4.7 OBLIGATIONS

Nothing in Section 4 will be construed by either contractor or by others as anything more than a commitment by the contractors to cooperate in the procurement of selected AUR materials.

5.0 OPERATIONAL PROCEDURES

5.1 CONFIGURATION MANAGEMENT

Configuration control shall be conducted in accordance with the TTP. Costs associated with the control and maintenance of the HELLFIRE AUR, HELLFIRE Training Missile and related Test Equipment TDP will be charged to the Government pursuant to the provisions of each company's respective engineering services prime contracts.

5.2 TRANSMITTAL OF DATA

Data and information that is transmitted by one contractor to the other shall be delivered by means of a TTP transmittal form. This form shall contain the following information: (1) a sequential TTP transmittal number, (2) description of the data/information being transmitted, (3) name of requestor, (4) name of sender, (5) date sent, and (6) indication of whether data is proprietary. Data and information shall be addressed to the single point of contact identified in paragraph 7.1.

6.0 PROPRIETARY RIGHTS

6.1 EXCHANGE OF INFORMATION

During the term of this MOA, the contractors agree to receive information and data (hereinafter referred to as "data") from each other for the purpose of implementing the HELLFIRE Laser Missile AUR Technology Transfer Program.

Notwithstanding that this MOA shall have terminated or expired, each contractor agrees to keep in confidence and prevent the disclosure to any person or persons outside each contractor's organization or to any unauthorized person or persons, of all data which is designated in writing, or by an appropriate stamp or legend by the disclosing contractor to be of a proprietary or confidential nature, and is received under this MOA and which pertains to proprietary or confidential data; provided however, neither contractor shall be liable for use or disclosure of any such data if the same:

- (a) Is in the public domain at the time it is disclosed; or
- (b) Is known to the receiving contractor at the time of disclosure; or
- (c) Is used or disclosed with the prior written approval of the other contractor; or
- (d) Is disclosed to the Government or an authorized representative thereof, properly marked with the restrictive legends, under the provisions of DAR 3-5 07.1, or DAR 7-104.9 or similar regulations of other Government agencies, or to fulfill the obligations of either contractor under a HELLFIRE AUR Government contract or subcontract, if such disclosure is contemplated by the purpose set forth above; or
- (e) Is independently developed by the receiving contractor; or
- (f) Becomes known to the receiving contractor from a source other than the disclosing

contractor without breach of this Agreement by the receiving contractor; or

- (g) Is used or disclosed after 60 months after the date of this MOA.

Neither contractor shall be liable for inadvertent, accidental or mistaken use or disclosure of data obtained under this MOA despite the exercise of the same reasonable precaution as the receiving contractor takes to safeguard its own proprietary information.

6.2 CHARGES

The contractors shall perform their respective obligations under this Section 6 without charge to the other except as set forth elsewhere in this MOA.

6.3 RELATIONSHIP OF CONTRACTORS

Nothing in this MOA shall grant to either contractor the right to make commitments of any kind for or on behalf of the other contractor without the prior written consent of the other contractor. Nothing contained herein shall imply a license to either contractor under any patent or be construed as affecting the scope of any license or other rights held by either contractor under any patent. Where data delivered under this MOA carries a copyright notice, the receiving contractor may reproduce the material only in the performance of the HELLFIRE AUR TTP.

6.4 SECURITY

To the extent the obligations of the contractors hereunder involve access to information classified "Top Secret," "Secret," "Confidential," or otherwise classified information, the provisions of DAR 7-104.12, or corresponding regulation of the appropriate Government agency, as applicable, shall apply.

6.5 DELIVERY OF PROPRIETARY DATA

All data that is proprietary that is exchanged between the contractors to this agreement shall be delivered only by certified mail to the address and to the attention of the single points of contact set forth herein. Failure of the delivering contractor to deliver proprietary data in this manner shall relieve the receiving contractor of the requirement to protect the proprietary data.

6.6 PROPRIETARY RIGHTS/TRADE SECRETS

6.6.1 The contractors have under various HELLFIRE related contracts granted unlimited rights (as defined in DAR 7-104.9(a)) in all technical data and computer software and royalty-free licenses for Government purposes in any inventions, whether or not patented, which dominate the AUR and components thereof and the manufacture thereof. Additionally, the contractors may grant more such unlimited rights and royalty-free licenses in future contracts. Each contractor agrees that both contractors may use those data and those inventions in the AUR and manufacture thereof at no cost. Also, the contractors will not mark any information furnished to each other as proprietary data or limited rights data unless the Government is entitled to no rights or only limited or restricted rights (as defined in DAR 7-104.9(a)) under Government contracts.

6.6.2 There shall be no royalty or license fee of any kind charged by the contractors to each other for patents, trade secrets, technical data, know-how, or other form of intellectual property in the technology transferred. Neither contractor is required to divulge manufacturing processes related to custom large scale integration, hybrid circuits, or other micro-electronic activities, except to the extent that the Government owns rights in such processes.

6.7 SUPERSEDING INSTRUMENT

This MOA supersedes the Proprietary Information Agreement between the contractors dated 23 August 1982.

7.0 COMMUNICATION AND COORDINATION AND SERVICES

7.1 SINGLE POINTS OF CONTACT

Single points of contact have been designated for the parties and initially are:

- Martin Marietta Corporation
- Rockwell International Corporation

7.1.1 The single points of contact shall have the responsibility of direct coordination between Rockwell and Martin. All data, information material, correspondence, etc., that transfers between the contractors will be under the cognizance and control of the single points of contact. The con-

tractors may change the single points of contact provided written notice of change is given to the other contractor to amend this MOA.

7.2 RESIDENT REPRESENTATIVES

Martin and Rockwell will establish resident representatives in each other's facility for the purpose of carrying out those responsibilities delineated in the section entitled "Technical Assistance" of the TTP.

7.3 RESIDENT SERVICES

Resident services required will be requested by the single points of contact designated herein and will be limited to the following at no expense to the other contractor:

(a) ADEQUATE OFFICE SPACE

Adequate office space for the designated number of residents including secretarial support and administrative storage.

(b) ADEQUATE OFFICE FACILITIES

Adequate office furniture, files, supplies, and stationery for the functioning of the resident force.

(c) COMMUNICATIONS

Access to communications to include: telephones, data fax, and teletype.

(d) AREA ACCESS

Access shall be provided for resident personnel to their assigned work areas, pertinent shop working areas, parking facilities, and cafeteria. This shall be provided by issuance of identification badges requiring escort by host company personnel.

(e) PARKING

Reasonably convenient parking facilities.

(f) FIRST AID

First aid medical services while resident personnel are in-plant.

(g) RECREATION

Access to recreation facilities while a resident.

(h) REPRODUCTION

Access to adequate reproduction facilities.

(i) DISCIPLINE

Breaches of discipline of resident personnel will be reported to the designated single point of contact by the host contractor, with recommendations for correction.

(j) SECURITY

Resident contractor will provide necessary security clearances for its resident working force personnel.

7.4 TRANSIENT SERVICES

As requested by the single point of contact to support any visits from one contractor to the other, the host contractor will provide the following facilities and administrative services to the visiting personnel in order to perform the requirements of this MOA:

(a) Temporary private office space as required and available.

(b) Secretarial service as required and available.

(c) Access to telephone service.

(d) Access to teletype and datafax service.

(e) Limited reproduction services as required.

8.0 TERMINATION

Except for the rights and obligations of the parties under subparagraph 6.1 herein, this MOA shall automatically terminate coincidental with the expiration or termination, whichever first occurs, of the TTP pursuant to the contractors' HELLFIRE production contracts with the Government.

B.2.2 Memorandum of Agreement for (Missile Subsystem)

In order to satisfy the Government's desire to have a second source for the (component), the (prime contractor) and (designing subcontractor-Vendor X) have agreed to work together to establish (second subcontractor-Vendor Y) as a manufacturer of the Vendor X designed (component). This MOA and its appendices outline the basic framework of this joint effort.

The process for a rapid establishment of Vendor Y as a viable (component) manufacturer is divided into a series of time-phased actions involving the Government, the prime contractor, Vendor X, and Vendor Y. These actions in chronological order are:

- 1) Government/prime contractor concurrence that this MOA meets the program requirement for initiating second source development
- 2) License agreement for second source data transfer and production
- 3) Data transfer and technical assistance from Vendor X to Vendor Y for the purpose of determining Vendor Y costs for becoming qualified as a second source and preparing a proposal for same
- 4) Qualification of Vendor Y as a second source.

Each of the phases in the second source development process is addressed in this MOA. Phase I Initiation of Second Source Development

Vendor X and Vendor Y will initiate the development of Vendor Y as a second source manufacturer of the (component) upon Vendor X being awarded the Lots 1 and 2 production quantities and upon concurrence by the Government/prime contractor that this MOA reflects an acceptable approach to second source development. Since time is of the essence, Vendor X and Vendor Y will proceed as far as practical prior to the occurrence of these events but, in any case, cannot begin the transfer of technical data until the above events have occurred. To this end, Vendor X and Vendor Y have signed a proprietary data agreement to facilitate discussions.

Phase II License Agreement

The basic terms of a license agreement for the Vendor X (component) design are outlined in Prime Contractor/Vendor X documents. Vendor X and Vendor Y are proceeding on the assumption that

Vendor X will license Vendor Y directly. Since royalty payments would be a cost to Vendor Y in any Vendor Y production contract, early prime contractor concurrence is necessary for a direct license.

Phase III Data Transfer/Technical Assistance

Vendor X and Vendor Y believe co-production is possible by Lot IV provided that an expeditious go-ahead is given by the Government and the prime contractor. During this phase Vendor X would transfer the data and technical knowledge to Vendor Y which would enable Vendor Y to accurately determine the cost of becoming a second source.

Vendor X will accept prime responsibility for this phase under contract to the prime contractor with Vendor Y as a subcontractor to Vendor X. The result of this phase will be:

- 1) Vendor X will provide the technical knowledge and documents to Vendor Y sufficient for manufacturing the (component)
- 2) Vendor X and Vendor Y will jointly prepare a detailed plan for establishment of Vendor Y as a viable co-producer by Lot IV
- 3) Vendor Y will submit a cost proposal for the plan developed in (2)
- 4) Vendor X and Vendor Y will jointly prepare a plan and initiate development for utilizing alternate sources for critical components
- 5) The prime contractor will establish (component) configuration control and implement procedures for handling engineering changes to the (component). Vendor X and Vendor Y will serve as members of the prime contractor's CCB for the (component). The prime contractor, Vendor X, and Vendor Y will maintain fully compatible (component) configuration management systems.

Phase IV Qualification of Vendor Y

Vendor X will accept prime responsibility for this phase under contract to the prime contractor with Vendor Y as a subcontractor to Vendor X. The prime contractor will maintain configuration control and design cognizance. The result of this phase will be:

- 1) Vendor Y will be qualified as a producer of the (component)
- 2) Vendor Y will produce 25 percent of the units from the end of Lot III to facilitate ramping up

to the production rates required in future production

- 3) Vendor X will warrant the performance of Vendor Y's pilot production (component) for one year.

This AGREEMENT is not intended by the parties to constitute or create a joint venture, pooling arrangement, partnership, or formal business organization of any kind, other than a MOA and the rights and obligations of the parties shall be only those expressly set forth herein. Neither party shall have authority to bind the other except to the extent authorized herein.

This AGREEMENT may not be assigned or otherwise transferred by either party in whole or in part without the prior written consent of the other party, which consent will not unreasonably be withheld. The foregoing shall not apply in the event either party shall change its corporate name or merge with or be acquired by another corporation.

This AGREEMENT contains all of the agreements, representations and understandings of the parties hereto and supersedes and replaces any and all previous understandings, commitments or agreements, oral or written.

This AGREEMENT shall be enforced and interpreted under the laws of the State of _____).

This memorandum of agreement becomes effective when signed by the last of the parties below. It shall remain in effect until one of the following events occur:

- 1) Program is terminated
- 2) Government/prime contractor determines a second source is not required
- 3) The establishment of Vendor Y as a qualified producer of the (component).

B.2.3 Tomahawk Memorandum of Agreement

FOREWORD

This MOA sets forth an understanding between General Dynamics/Convair (GD/C) and the Government for the purpose of establishing certain conditions and ground rules that will lead to a contractual relationship resulting in establishment of GD/C as a fully qualified supplier of the Tomahawk Cruise Missile AUR for the Government.

1.0 PURPOSE AND APPROACH

WHEREAS, on 18 January 1982 the Assistant Secretary of the Navy made determination and finding in CDF 82-40 which authorizes the necessary contracts required to implement this agreement, and it is understood by the parties that no obligations will be assumed by GD/C unless and until appropriate contractual direction is received from the Joint Cruise Missile Project (JCMP); and

WHEREAS, the Government represented by the JCMP is desirous of establishing two AUR Tomahawk Cruise Missile contractors (as hereinafter defined); and

WHEREAS, by having such two AUR Tomahawk Cruise Missile contractors, JCMP will be able to contract for support by two separate contractors of various activities including verification of flight missions and investigations of flight accidents; and

WHEREAS, the JCMP is interested in obtaining competition throughout the Tomahawk Cruise Missile Program; and

WHEREAS, the JCMP wishes to obtain the ability to expand production facilities rapidly to meet industrial mobilization needs; and

WHEREAS, the JCMP is also interested in geographical dispersion of the manufacturing sources to ensure redundancy and survivability in the event of natural disasters; and

WHEREAS, the JCMP has determined that only through establishing MDAC GD/C as AUR missile and navigation/guidance prime contractors can FY84 Tomahawk cruise missile production requirements be competitively obtained with a

minimal technical risk to the Government of acceptable technology transfer; and

WHEREAS, the JCMP plans to award sole source contracts to both MDAC and GD/C based upon each of them undertaking to engage in a reciprocal technology transfer to attain the above objective; and

WHEREAS, in addition to this MOA, JCMP plans to enter into a separate MOA with MDAC and MDAC and GD/C plan to enter into another separate MOA to confirm the transfer of technology;

NOW, THEREFORE, the parties hereto agree as further presented herein.

This document establishes the agreements between GD/C and the JCMP for the purpose of establishing GD/C as a certified and independent supplier of each presently defined production Sea Launched Cruise Missile (SLCM) including airframe and guidance, both ship and submarine launched and both Tomahawk Anti-Ship Missile (BGM-109B), including the advanced anti-ship guidance system common to Harpoon and Tomahawk Cruise Missile and Tomahawk Land Attack Missile (BGM-109A/C), conventional and nuclear configurations; and Ground Launched Cruise Missile (GLCM) including airframe and guidance, now a Tomahawk Land Attack configuration (BGM-109G); and Tomahawk MRASM (AGM-109H & L) including airframe and guidance. Future Tomahawk missiles procured by the Government that are outgrowths of existing contracts for Tomahawk are also included under this agreement. Likewise, advanced technology changes to subsystems used to existing Tomahawk missiles are also included under this agreement.

GD/C, as a production certified AUR supplier, shall be totally responsible for the delivery, support, and development of a warranty for the AUR missile system, defined as a flight-worthy missile contained in launch compatible canister or capsule. The AUR delivery shall include demonstrated test compliance with Government approval acceptance test procedures. The shipping and handling, logistics, and flight test support plus the warranty terms and conditions shall be defined in detail in the GD/C contract.

The following list of items, although not all inclusive, are GFE: F107 and J402 engines, warhead, selected elements of Cruise Missile Guidance Sets (CMGS), Inertial Sensor Assembly (ISA), Booster Motor Assembly, and Digital Scene

Matching Area Correlator (DSMAC), and are therefore not covered by this agreement.

The production missile (AUR) does not include Armored Box Launcher (ABL), Common Weapons Control System (CWCS), Mission Planning System (MPS), the Transporter Erector Launcher (TEL), the Launch Control Center (LCC) or the Capsule Launching System (CLS).

2.0 APPLICATION

2.1 SCOPE

The JCMP and GD/C enter into this agreement for the purposes of establishing GD/C, under a separate contract, as an independent supplier for the Tomahawk Cruise Missiles (hereinafter called Tomahawk), AUR including airframe and guidance. The Tomahawk Cruise Missile is defined as all warrants of the BGM-109 (A, B, C, D, G) and series and the MRASM AGM-109 (AGM-109H & L) series Tomahawk. Contractual roles of various Tomahawk contractors during the Full Scale Engineering Development (FSED) will continue unchanged, with Airframe Systems development the responsibility of GD/C. Notwithstanding this responsibility, it is also the intent of this agreement that the Government may at some future time choose to use MDAC to develop changes in the airframe design production phase of the Tomahawk missiles, the two AUR contractors, GD/C and MDAC will be competitors for shares of the Government's yearly production buys. It is the intent of GD/C to offer the Government a warranty, under its contract for the AUR missiles it produces (including GFE) and for which it provides the required depot services. In addition, it is intended that GD/C will provide an appropriate design warranty to MDAC for those systems for which it has design agency responsibility and will warrant that which is GFE to GD/C from other suppliers to the extent that the suppliers will warrant their equipment to GD/C.

Any changes to this agreement must be agreed to in writing by both parties to this agreement.

2.3 ORDER OF PRECEDENCE

In the event of conflict between this agreement and any respective Government contract with GD/C, the Government contract shall govern.

3.0 DUAL SOURCE SUBSTANTIATION PROGRAM

3.1 TECHNOLOGY TRANSFER PROGRAM

A technology transfer program which delineates the data and knowledge to be transferred will be developed by MDAC and GD/C. The schedule developed for implementation of the technology transfer program has been agreed to by GD/C and the Government.

3.2 COMPETITIVE PROCUREMENT

During the technology transfer phase and substantiation phase, GD/C shall deliver a minimum of 10 AURs as part of the FY82 Tomahawk procurement quantities and 52 AURs as part of the FY83 Tomahawk procurement quantities. These deliveries are premised upon JCMP providing contractual authorization to the contractor for quantities specified. JCMP will incorporate certain annual award procedures into each of the production contracts with MDAC and GD/C, respectively, which will be as follows:

After GD/C has been certified as an independent AUR production source, (scheduled prior to the FY84 production deliveries), it will be awarded a minimum of 30 percent of annual FY missile quantities of new production missiles and 30 percent of any recertifications, refurbishments, and spares procured from U.S. commercial sources by the Government for the AUR Tomahawk. (This provision is contingent upon annual appropriation by the Congress.) GD/C understands that similar or identical award percentages will be set forth in the separate MOA between JCMP and MDAC. GD/C will be allowed to compete for the remaining percentage and this remaining percentage will be split between MDAC and GD/C according to procedures to be determined by JCMP. This award procedure will become effective with the Government's AUR procurement for FY84 for BGM-109's.

If JCMP decides not to award GD/C more than the minimum annual quantity, JCMP and GD/C shall negotiate in good faith a fair and reasonable price for the minimum quantity. If the parties are unable to mutually agree, the contracting officer shall issue a final decision determining a fair and reasonable price which may be appealed by GD/C in accordance with the Disputes Clause of the applicable contract.

3.3 COOPERATIVE PROCUREMENT

During the technology transfer program, cooperative procurement with MDAC will be necessary in some cases and encouraged in other cases where it benefits the Government in protecting technical performance and/or schedule and limiting costs. For production, however, and subject in each case to prior JCMP approval, MDAC and GD/C shall establish separate equipment suppliers, that do not require requalification, where and/or when appropriate, to maximize an industrial mobilization and strategic base and AUR cost competition. The JCMP will review and grant approval for requalification of any new suppliers prior to GD/C issuing the purchase order. In this regard JCMP retains the final approval authority for the AUR make/buy plan.

3.4 EFFECTIVITY

Contractual coverage shall be provided by the U.S. Government under a separate contract with GD/C. GD/C shall not be obligated by this MOA to furnish or to receive any materials, equipment, data, or the work described in this document will continue as long as Government contract coverage exists. This document shall be incorporated by reference to its title and data in the contract to GD/C for the Tomahawk AUR.

3.5 FINANCIAL CONSIDERATIONS

3.5.1 GD/C shall segregate the following Cruise Missile Program costs into the following categories:

3.5.1.1 Airframe Special Tooling and Test Equipment

- (a) Tools
- (b) Manufacturing Aids
- (c) Factory Support Equipment
- (d) Special Test Equipment
- (e) Numerical Control and Special Test Equipment Programming and Proofing

Except for

- (a) the SLCM production which is included in the FY80 production contract, and

- (b) to the extent possible the MRASM missiles will be produced on the existing Tomahawk production line. However, to the extent that the MRASM missiles require adaptation to existing manufacturing processes, all MRASM research and development (R&D) tooling and the initial production contract design effort for all the items in paragraph 3.5.1.1 which will be paid for by the Government as a direct charge to the applicable contract.

These costs will be collected in asset accounts and liquidated in accordance with the schedule.

3.5.1.2 Airframe Non-Hardware

- (a) Planning, including descriptive planning and setup sheets
- (b) Manufacturing Engineering Project Office, Tool Administration and Manufacturing Technology department.
- (c) Maintenance and Calibration of items in paragraph 3.5.1.1 above.

These costs shall be allowable direct charges to any and all resultant contract and subsequent contracts and the Government agrees to pay these costs as a normal part of the contract payment procedure.

3.5.1.3 Guidance Special Tooling and Test Equipment

- (a) Tools
- (b) Manufacturing Aids
- (c) Factory Support Equipment
- (d) Special Test Equipment
- (e) Numerical Control and Special Test Equipment Programming and Proofing

These costs will be collected in asset accounts and liquidated in accordance with the designated schedule.

3.5.1.4 Guidance Non-Hardware

- (a) Planning, including descriptive planning and set-up sheets
- (b) Manufacturing Engineering Project Office, Tool Administration and Manufacturing Technology
- (c) Maintenance and Calibration of the items in Paragraph 3.5.1.3 above.

These costs shall be allowable direct charges to any and all resultant contract and subsequent contracts and the Government agrees to pay these costs as a normal part of the contract payment procedure.

3.5.1.5 Technology Transfer Costs for BGM-109 (Guidance Production Start-up Costs)

- (a) Purchase of Required Data/Assistance from MDAC
- (b) Training/Familiarization of GD/C Personnel

GD/C shall establish a special cost collection account for these costs. JCMP agrees that GD/C has the option to recover these costs in the following manner: GD/C may add 1/1200 of the total cost accumulated in this cost category as a direct cost for all BGM-109 AURs procured from GD/C commencing with the Government's FY84 procurement and continuing until 1500 BGM-109 AURs have been procured from GD/C. This cost addition will be included in the AUR price for competitive considerations. GD/C may, at its option, choose not to include the 1/1200 of these costs, for AURs procured by the Government. Should GD/C elect to exercise its option not to include the 1/1200 of these costs against any future procurement, the BGM-109 AUR count shall remain sequential commencing with the FY84 procurement and shall not exceed 1500 units procured from GD/C counted sequentially from that point.

3.5.1.5.1 JCMP agrees to actively pursue obtaining the authority to incorporate and to include in any and all resultant contracts, contracts to which agreement is applicable, a special Termination Clause, such clause to provide that in the event less than 1200 BGM-109 missiles are procured from GD/C by the Government by January 1991 or the Tomahawk production program is terminated for any reason whatsoever before the 1200 units are procured from GD/C, then GD/C shall recover the unliquidated balance of the Technology Transfer Costs. These costs shall be construed as a termination liability until liquidated by GD/C or waived by GD/C as provided in the option set forth in 3.5.1.5 above. If the clause is not included in the FY81 contract by 30 September 1982, GD/C may terminate this MOA.

3.5.1.5.2 A similar clause will be included for the technology transfer cost for MRASM (AGM-109).

3.5.1.6 General Purpose Equipment

The cost of this equipment shall appear on GD/C's cost ledgers in accordance with the GD/C disclosure statement in effect at the time of this agreement.

3.5.2 It is agreed that GD/C, in order to accommodate the agreements contained herein will establish accounting procedures. These procedures will be documents in an amendment to its Cost Accounting Standards Disclosure Statement. It is understood that GD/C's obligation under this MOA is predicated upon acceptance by the appropriate Government agencies of the above-mentioned amendment to the Cost Accounting Standards Disclosure Statement. Should such acceptance be withdrawn or for any reason be ineffective for the purposes herein intended, the affected contracts shall be subject to a negotiated adjustments.

3.5.3 Any modification to tooling and test equipment covered by this agreement, or to existing tooling or test equipment, necessitated by a contract change, shall be fully paid for by the Government in the manner prescribed by the changes clause of the applicable contract; however, title to all such modified tooling or test equipment will not be affected.

3.5.4 As consideration for capital funds expended, the Government agrees to actively pursue obtaining the authority to incorporate the Capital Investment Sensitive Clause in the contracts to GD/C for the Tomahawk AUR. It is understood by the Government that GD/C has the right not to expend capital funds until such time as the clause is approved by higher authority and subsequently incorporated into the FY81 AUR production contract. If the clause is not included in that contract by 30 July 1982, GD/C may terminate this MOA and upon GD/C's request, the Government and GD/C shall negotiate an adjustment to the FY81 AUR contract. The foregoing date is contingent upon receipt by JCMP within thirty (30) days of the execution of this MOA of the priced list of equipment which is to be capitalized from GD/C.

3.5.5 Additional Government Consideration - To recognize the importance of both GD/C and MDAC completing the technology transfer with each other in a timely and complete manner, an incentive will be established in the FY84 AUR contract. Should MDAC fail to be certified in accordance with the certification schedule, as defined in the approved TTP, and the schedule delay can be demonstrated clearly, to the satisfaction of the Government and GD/C, to be the faults of GD/C, a negative incentive will be applied. The Government may invoke the penalties specified; however, failure of the parties to agree as to the causation of MDAC's failure to be certified shall be

subject to the Disputes Clause of the appropriate contract.

Should MDAC be certified within 30 days of the certification schedule as defined in the approved TTP the failure incentives are:

- (a) If the aforesaid certification is delayed for more than 30 days up through 180 days from the schedule certification date, 15 percent of the progress payments due GD/C for the FY82 and FY83 AUR production program contracts shall be withheld. In the event certification is delayed for more than 180 days up through 270 days, 15 percent of the progress payments due GD/C for the FY82 and FY83 AUR production program contracts shall be withheld. In the event certification is delayed for more than 270 days up through 360 days, 20 percent of the progress payments due GD/C for the FY82 and FY83 AUR production program contracts shall be withheld. Not later than 30 days after the deficiency attributable to GD/C has been rectified all progress payments that have been withheld will be paid. In no event shall there be any withholding of progress payments beyond 12 months from the original scheduled certification and at that time all payments withheld pursuant to this provision will become payable.
- (b) Should MDAC be certified as a Tomahawk AUR second source within thirty days of the scheduled completion as defined in the approved TTP, (understanding that the intent of this agreement is that this certification date allows for an FY84 AUR competition), GD/C will receive at least 40 percent of the total AUR quantity available in FY84 and 40 percent of the total AUR quantity available in FY85. This provision, however, also recognizes that the Government will initiate long lead support for AUR's for up to the total fiscal year buy quantity for either FY84 or FY85 with either GD/C or MDAC to protect the Government's scheduled requirements.

4.0 OPERATIONAL PROCEDURES

4.1 CONFIGURATION MANAGEMENT

A configuration baseline definition of the Tomahawk AUR shall be established between MDAC and GD/C and approved by the Government and used in the execution of the TTP. Any changes will follow Section 4.2.

4.2 CONFIGURATION CONTROL

A CCB shall be established and will consist of both MDAC (guidance design agent) and GD/C (air vehicle design agent) with JCMP as the chairman. MDAC or GD/C can introduce producibility or product improvement changes. Any such change generated by the non-design agent will be submitted with a technical and cost evaluation to the Government and the technical evaluation to the applicable design agent for evaluation. The design agent will submit to the Government a technical and cost evaluation of the proposed change. Any design agent producibility or product improvement change generated by the design agent will be submitted with a technical and cost evaluation to the Government for resolution and a copy of the proposed change with a technical evaluation will be submitted to the nondesign agent. The Government will control the configuration and will direct all changes to both GD/C and MDAC. It is understood that to the extent any changes are accepted by the Government, appropriate favorable consideration will be given to the contractor initiating the change as part of the following year's competitive award determination.

5.0 PROPRIETARY RIGHTS

5.0.1 GD/C has under various cruise missile contracts granted unlimited rights [as defined in DAR7-104.9(a)] in all GD/C technical data and computer software and royalty-free licenses for Government purposes in any GD/C inventions, whether or not patented, which dominate the AUR and components thereof and the manufacture thereof. Additionally, GD/C may grant more such unlimited rights and royalty-free licenses in future contracts. GD/C agrees that MDAC or any follower may use that data and those inventions in the AUR and manufacture thereof at no cost. GD/C will not mark any information furnished to MDAC or any follower as proprietary data or limited rights data unless the Government is entitled to no rights or only limited or restricted rights [as defined in DAR 7-104.9(a)] under Government contracts.

5.0.2 There shall be no royalty or license fee of any kind except as provided for elsewhere in this MOA charged by GD/C to MDAC or other follower, or to the Government, for GD/C patents, trade secrets, technical data, technical assistance, know-how or other form of intellectual property in the technology transferred to MDAC or other follower.

5.0.3 GD/C agrees that the Patent Indemnity Clause of DAR 7-104.5 shall be included in all production contracts between GD/C and

JCMP for any component or collection of components of the AUR developed under the design cognizance of GD/C.

5.0.3.1 GD/C agrees to include in all production contracts provisions to indemnify the Government under patent indemnity provisions substantially similar to those contained in DAR 7-104.5 for any component or collection of components of the AUR acquired by the Government from MDAC or other follower and developed under the design cognizance of GD/C.

5.0.4 If any limited rights data [as defined in DAR 7-104.9a)] or otherwise restricted data is furnished to GD/C in the course of the technology transfer between GD/C and MDAC or other follower, GD/C agrees to protect that data in the same manner it protects its own data of similar character.

5.0.5 GD/C shall make all reasonable efforts to obtain assurance from its subcontractors that MDAC or other follower is provided with no lesser rights in terminal data and computer software than are provided to GD/C by its subcontractors.

5.0.6 In future contracts, GD/C will not incorporate into the AUR or components thereof or manufacture thereof anything for which GD/C owns limited rights or restricted rights or patent rights in which the Government has no royalty-free license without prior written approval by the Contracting Officer for the respective contracts after notice of those rights has been given to the Contracting Officer.

6.0 COMMUNICATION AND COORDINATION AND SERVICES

6.1 SINGLE POINTS OF CONTACT

Single points of contact have been designated for the parties and initially are:

- JCMP
- GD/C

The single points of contact shall have the responsibility of direct coordination between the JCMP and MDAC. They will have the capability of obtaining decisions or commitments from their respective parent organizations on an expedited basis. All data, information, material, correspondence, etc., that transfers between the parties will be under the cognizance and control of the single points of contact. JCMP and GD/C may change the single points of contact providing written notice of the change is given to the other party.

7.0 EQUITY OF POSITIONS

It is the intent of JCMP that the separate MOAs between JCMP and MDAC and between JCMP and GD/C will result in both sources being competitive for annual production quantities. It is not the intent of JCMP to afford either source an undue advantage over the other source in the annual production competitions. The JCMP will consider MDAC and GD/C suggestions to ensure maximum parity between the parties in the annual competitions.

APPENDIX C
CONTRACT CLAUSES

Appendix C

CONTRACT CLAUSES

This appendix contains draft and example contract clauses for various acquisition strategies. Section C.1 portrays draft contract clauses for a leader-follower strategy. Section C.2 contains actual examples of clauses employed for a variety of acquisition strategies.

C.1 DRAFT CONTRACT CLAUSES

C.1.1 Leader-Follower

The contractor shall establish a leader-follower program at FSD contract award to develop both contractors as qualified system producers who will compete for annual awards starting with the first full scale production lot. To ensure the successful development of dual production sources, the contractor shall submit a detailed leader-follower management plan.

C.1.2 Leader-Follower Contractual Agreement

An agreement shall be implemented by the leader and follower which will allow the two contractors to effect mutual technology transfer and qualification. The agreement shall specify the guidelines and restrictions for transferring proprietary data and methodologies associated with the system. The agreement also shall define the roles and responsibilities of the two contractors through low rate in-

itial production (LRIP) at which time the leader-follower arrangement shall terminate.

C.1.3 Technology Transfer Plan

The contractor shall submit an updated technology transfer plan (TTP) which details how technology will be transferred between the leader and follower including the following:

- Data Package – format contents, requirements for incorporating additional information and changes
- Technology Transfer Working Group (TTWG) – chair, members, purpose, activities, responsibilities, meeting requirements/ frequency, output
- Second Source Training Programs – purpose, participants, responsibilities
- Preparation of Manufacturing Plans – purpose, contents, review authority, make/buy planning assistance.

The TTP also shall present a detailed schedule that identifies major milestones which will serve as checkpoints to determine the timeliness and completeness of the technology transfer and qualification process. These milestones should include, at a minimum, approval of second source manufacturing plans, authority to proceed, and final acceptance and delivery of qualification units.

C.1.4 Qualification Hardware Fabrication

The leader and follower shall each produce two lots of qualification units. Each will fabricate and test a designated percent of the first lot requirements of their respective design to be integrated and tested by the leader. For the second lot, each contractor will fabricate a designated percent of the total system requirements including integration.

C.1.5 Follower Qualification

The contractor shall be required to qualify the follower as a system producer to support LRIP requirements. Tests to be conducted include component verification, interchangeability demonstrations, and system level tests. The leader shall be responsible for delivering all qualification units, including those fabricated by the follower, to the Government for final qualification testing. The leader shall conduct a preliminary Production Readiness Review (PRR) of the follower's facility to ensure the follower understands the system design and will be capable of fabricating LRIP units.

C.1.6 Follower Facilitization

The contractor shall ensure the follower will be facilitized to meet production rate requirements by Full Scale Production Lot I.

C.1.7 Supplier Base Development

Based upon the make/buy plans, the contractor shall ensure independent vendors are established for the follower to support LRIP requirements.

C.1.8 Configuration Management

The contractor shall be responsible for configuration control during the leader-follower program.

C.1.9 Warranty Administration

The contractor shall be responsible for warranty administration during the leader-follower phase.

C.1.10 LRIP

The leader and follower shall produce a designated percent of the total system requirements including integration. Both contractors shall conduct and document the results of complete in-process testing and production acceptance tests of the LRIP units. The leader shall be responsible for delivering all

LRIP units, including those produced by the follower, to the Government for final qualification and acceptance. Both contractors also shall prepare detailed manufacturing plans addressing their full rate production abilities to be submitted to the Government prior to the final PRR. The leader shall assist the Government in conducting a final PRR at the follower's facility.

C.2 EXAMPLE CLAUSES

C.2.1 Subsystem Competition (Competition Plan)

The offeror shall submit a competition plan to promote and ensure high levels of competition at the subsystem and component piece part levels during this and future phases of the program within 150 days after contract award. Offeror shall recommend candidates for dual (or multiple) sourcing in their competition plan when such is practical and shows potential savings. The plans will include:

- a. Identification of existing subcontract competition, if any.
- b. Planning (alternatives) for meeting the competition requirements and for increasing the amount of competition.
- c. Identification of goals for increasing the amount of competition.
- d. Anticipated savings resulting from the competition.
- e. Methods of measuring results.
- f. Procedures for updating the plan and recommended courses of action for implementing changes.
- g. Discussion of the interrelationships of this plan to other elements, e.g., life cycle cost, design changes, program risks, system engineering, producibility, etc.
- h. In the event that it is impossible to negotiate the right to use proprietary technical data for certain components/parts for the system for competition purposes, identification of your plan for introduction of alternate components/parts to achieve competition is required. All those items for which such rights cannot practically be obtained shall be identified in the plan.

i. It is anticipated that this plan will be incorporated in the resulting contract and that progress reports will be required on a quarterly basis.

j. Detailed rationale and explanation of costs anticipated to be incurred in securing competition and savings expected to be realized are to be identified (e.g., qualification, historical experience in dual source savings) and quantified to the extent possible at this stage. Learning/ price curve effects should be discussed.

C.2.2 Leader-Follower (Technology Transfer)

The primary activity of the contractor shall be the validation of the technical data package (TDP) and associated reference documents. The contractor shall submit management activities to be accomplished in the next phase and shall conduct reviews of these efforts.

C.2.3 Technical Data Package Validation

The contractor shall conduct a detailed review of the TDP. The contractor shall review the TDP for completeness of required technical information to support manufacturing. The contractor shall compare the TDP with the Government Furnished Property (GFP) hardware to the extent necessary. The contractor also shall assess its ability to produce end items from the TDP. The contractor shall document its efforts to validate the TDP. The contractor shall brief the Government, at the contractor's facility, on the results of its TDP validation efforts approximately 15 days after submission of the validation report.

C.2.4 Program Management

The contractor shall have total responsibility for the successful conduct of the second source Technology Transfer Phase. The contractor shall plan, direct, control, and report all program management activities to ensure the Technology Transfer Phase requirements are fulfilled. The contractor shall appoint a program manager specifically charged with the responsibility for the contractor's conduct of the Technology Transfer Phase.

C.2.5 Second Source Qualification Master Plan

The contractor shall develop and implement a Second Source Qualification Master Plan. The plan shall identify all major events and activities required for successful completion of the Qualifica-

tion Phase. A brief description of activities to accomplish each event or delivery shall be included. The critical path required to meet each milestone shall be identified. Schedule risks shall be described. The method to reduce and control each schedule risk shall be specifically addressed. The plan shall also address activities necessary for transition to production. The contractor shall identify any changes to the plan for execution of the second source program as they occur. (DI-R-1724)

C.2.6 Manufacturing Plan

The contractor shall develop a detailed plan and schedules that describe the qualification manufacturing approach. (DI-MISC-80074)

C.2.7 Quality Assurance Plan

The contractor shall develop a detailed plan that describes the quality assurance program to be employed during the Qualification Phase. (DI-R-5297, 20330, 23743)

C.2.8 Configuration Management Plan

The contractor shall develop a detailed plan for configuration management that describes activities and procedures for the Qualification Phase. (DI-E-1100)

C.2.9 Data Management Plan

The contractor shall develop a detailed data management plan for the Qualification Phase. (DI-A-3022)

C.2.10 System Test Plan

The contractor shall develop a detailed system test plan for the Qualification Phase that includes planning factors, objectives, and program scope. (DI-T-3701A/T)

C.2.11 Program Management Reviews

The contractor shall plan and conduct monthly program management reviews (PMRs) with the Government to provide a review of the contractor's program status and progress toward completion. The PMR shall be conducted at the contractor's facility or at a location mutually agreed upon by the Government and the contractor. The contractor shall develop an agenda for each PMR and include any agenda items requested by the Government. The final Technology Transfer Phase PMR will include summary briefings describing each plan or report delivered during this phase. The contractor shall be

responsible for maintaining and organizing the minutes/charts from the PMR. The contractor shall support PMRs at associate contractor facilities, as required. The contractor shall support and interface with other Government-contracted efforts, including Scientific and Engineering Technical Assistance (SETA) contractors.

C.2.12 Technology Transfer Working Group

The contractor shall support all levels of the Technology Transfer Working Group (TTWG), which shall be established by the Government to facilitate communications and resolve issues impacting technology transfer. TTWG meetings shall be conducted at the contractor's facility or at a location mutually agreed upon by the Government and the contractor. The highest TTWG level shall meet as required and includes multifunctional and multidisciplined group meetings involving program management, engineering, test, manufacturing, configuration control, material control, facilities, contracting, and product assurance personnel. Lower level TTWG activities shall meet as required and include special reviews or meetings (i.e., Test Reviews or Technical Reviews) involving only a few of the above disciplines, and Technical Interchange Meetings (TIMs) involving very few people addressing a specific issue.

The contractor shall provide the appropriate management and technical personnel for each level of the TTWG to support agenda requirements. The contractor shall identify issues impacting technology transfer, submit issues for the TTWG agenda, and resolve action items assigned by the TTWG in a timely and responsive manner.

The contractor shall provide the necessary personnel, administrative, and graphics support to conduct TTWG Secretariat activities. Secretariat activities shall include publishing and distributing agenda, minutes and agreements of TTWG meetings at all levels; tracking, statusing and reporting all technical data requests or data transferred between GD/C and the contractor; and tracking, statusing and reporting all TTWG and PMR action items under the same approved system.

C.2.13 Master Schedule

The contractor shall develop, implement, and maintain a Technology Transfer Phase Master Schedule.

C.2.14 Program Support

The contractor shall provide graphics, publications, and photographic support for the Technology Transfer Phase. Subject matter for photographic coverage shall be selected by the Government.

C.2.15 Problem Status Reporting

The contractor shall apprise the Government of the ten most important areas of difficulty or anticipated problems in a brief weekly status report.

C.2.16 Associate Contractor

The contractor shall establish an associate contractor agreement (ACA). The ACA shall delineate the method and practice of the transfer of technical knowledge and information between the initial source and the contractor. The transfer shall include knowledge and information necessary to qualify the contractor as a second production source for the system. The transfer also shall include contractor information to improve production procedures. The contractor shall interface with other associates, as required.

C.2.17 Technical Data-Withholding of Payment (DFAR 52.227-7030)

(a) If "Technical Data" (as defined in the clause of this contract entitled "Rights in Technical Data and Computer Software"), or any part thereof, specified to be delivered under this contract, is not delivered within the time specified by this contract or is deficient upon delivery (including having restrictive markings not specifically authorized by this contract), the Contracting Officer may until such date is accepted by the Government, withhold payment to the Contractor of ten percent (10%) of the total contract price or amount unless a lesser withholding is specified in the contract. Payments shall not be withheld nor any other action taken pursuant to this paragraph when the Contractor's failure to make timely delivery or to deliver such data without deficiencies arises out of causes beyond the contractor and without the fault or negligence of the Contractor.

(b) After payments total 90 percent (90 %) of the total contract price or amount and if all technical data specified to be delivered under this contract has not been accepted, the Contracting Officer may withhold from further payment such sum as the Contracting Officer considers appropriate, not exceeding ten percent (10 %) of the total contract price or amount unless a lesser withholding limit is specified in the contract.

(c) The withholding of any amount or subsequent payment to the Contractor shall not be construed as

a waiver of any rights accruing to the Government under this contract.

APPENDIX D

DRAFT TECHNOLOGY TRANSFER PLAN OUTLINE

Appendix D

DRAFT TECHNOLOGY TRANSFER PLAN OUTLINE

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release, distribution unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION The Analytic Sciences Corporation	6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION Business Department Defense Systems Management College (DSMC)	
6c. ADDRESS (City, State, and ZIP Code) 1700 North Moore Street Suite 1800 Arlington, Virginia 22209		7b. ADDRESS (City, State, and ZIP Code) Ft. Belvoir, VA 22060-5426	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION DSMC	8b. OFFICE SYMBOL (if applicable) SE-B	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Contract No. MDA903-87-C-0793	
8c. ADDRESS (City, State, and ZIP Code) Ft. Belvoir, VA 22060-5426		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) A Program Office Guide to Technology Transfer (Unclassified)			
12. PERSONAL AUTHOR(S) Louis A. Kratz, Michelle C. Stuart and Denise A. Snyder			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) June 1988	15. PAGE COUNT
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	Technology Transfer, Competition, Dual Sourcing, Second Sourcing, Production Competition, Contract Management, Acquisition Management	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The critical component of a successful dual source program is a comprehensive technology transfer effort. Technology transfer encompasses all Program Office, initial source, and second source activities required to qualify a second production source. This guide has been prepared by the Defense Systems Management College (DSMC) to assist Program Offices in planning and executing technology transfer. Key elements of the guide include the following: <ul style="list-style-type: none"> . Program objectives . Technical requirements . Timing of technology transfer . Second source qualification . Demonstration milestones . Implementation alternatives <p>This guide presents a logical framework for developing a comprehensive technology transfer program. Key issues, alternative approaches, and promising techniques are highlighted.</p>			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
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**Comment Sheet
for
A Program Office Guide to Technology Transfer**

Technology transfer encompasses all Program Office, initial source, and secondary source activities required to qualify a second production source. This guide presents a logical framework for developing a comprehensive technology transfer program. Your comments and suggestions are solicited.

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