NASA Contractor Report 177569

Industry Liaison Section Implementation Plan

Stephen Lakowske

(NASA-CR-177569) INDUSTRY LIAISON SECTION IMPLEMENTATION PLAN (NASA) 81 p CSCL 01C

N91-10048

Unclas
G3/05 0309750

CONTRACT NUMBER 177569
September 1990

NASA
National Aeronautics and
Space Administration

NASA Contractor Report 177569

Industry Liaison Section Implementation Plan

Stephen Lakowske
Sterling Federal Systems, Inc.
1121 San Antonio Road
Palo Alto, CA 94303-4380

Prepared for
Ames Research Center
CONTRACT NUMBER 177569
September 1990

NASA

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035-1000

TABLE OF CONTENTS

PAGE ii INTENTIONALLY BLANK

PRECEDING PAGE BLANK NOT FILMED

APPENDICES

LIST OF FIGURES

Industry Liaison Section Implementation Plan

Computational Human Engineering Research Office
Aerospace Human Factors Research Division
NASA/Ames Research Center

SYMBOLS AND ABBREVIATIONS

A3I	Army/NASA Aircrew-Aircraft Integration
AAAV	Army Advanced Amphibious Vehicle
AFDD	Aeroflightdynamics Directorate (Army)
AMM	Ames Management Manual
BBN	Bolt, Beranek and Newman
CCB	Configuration Control Board
CI	Configuration Item
CM	Configuration Management
CMP	Configuration Management Plan
COSMIC	Computer Software Management and Information Center
CPU	Central Processing Unit
CSCI	Computer Software Configuration Items
DOE	Department of Energy
FAA	Federal Aviation Administration
FLI	Computational Human Engineering Research Office (NASA)
IAA	Interagency Agreement
ILS	Industry Liaison Section
JEA	Joint Endeavor Agreement
MIDAS	Man-Machine Integration Design and Analysis System
MMI	Man-Machine Integration
MOU	Memorandum of Understanding
NMI	NASA Management Instruction
NASA	National Aeronautics and Space Administration
NTSC	Naval Training Systems Center
PSTA	Program Support and Technical Assistance
RCS	Revision Control System
SBIR	Small Business Innovative Research
SCCS	Source Code Control System
SCT	System Construction Tool
SDDD	Software Detailed Design Document
TACOM	Tank and Automotive Command
TASCS	Training Analysis Support Computer System
TEA	Technical Exchange Agreement
TU	Technology Utilization
VACP	Visual, Auditory, Cognitive, Psychomotor
WBS	Work Breakdown Structure
YBI	Computational Human Engineering Research Office (Army)

1.0 SUMMARY

The Industry Liaison Section is a new function of the Army/NASA Aircrew-Aircraft Integration Program that is intended to bridge an existing gap between Government developers (including

contractors) and outside organizations who are potential users of products and services developed by the A^3I Program. Currently in its 6th year, the Program is experiencing considerable pull from industry and other government organizations to disseminate products. Since the A^3I Program's charter is exploratory and research in nature, and satisfying proper dissemination requirements is in conflict with the rapid prototyping approach utilized by the design team, the A^3I Program has elected to create an Industry Liaison Section to serve as the Program's technology transfer focal point. This report describes the process by which the Industry Liaison Section (ILS) may be established, organized and managed, including the baseline organizational structure, duties, functions, authority, responsibilities, relationships and policies and procedures relevant to the conduct of the ILS.

2.0 INTRODUCTION

The A^3I Program began development in 1985 as a joint project funded by the U.S. Army, located within the Computational Human Engineering Research Office at NASA/Ames Research Center. The Program's objective is to devise a rational, predictive methodology for aircraft cockpit design that integrates human factors engineering with other vehicle design disciplines (including training implications) at an early stage in the development process. The technical approach is to utilize off-the-shelf computer hardware with standard operating systems and languages (UNIX, C, Common LISP) in the development of prototype software tools, which are the essential products of this R&D effort. The methodologies employed include rapid prototyping, incremental software development and object-oriented programming. The approach and methodologies chosen are consistent with the requirements for Army R&D level funding, but may fall short of requirements for use of these software products outside the developing organization. There is also the potential for significant gaps between the user community's needs and the capabilities under development by the Program design team. Lastly, there is a greater emphasis on leveraging existing staff through cooperative relationships with organizations that are performing similar research or who are actively involved in the use of computational human factors design techniques. The ILS charter is to aid the bidirectional flow of technology between the A^3I Program and other organizations by facilitating transfer of software products to industry as well as providing feedback to the Program design team regarding current needs of the user community. This document was developed to provide guidelines for ILS staff members during the ILS' formation and initial operations.

3.0 MANAGEMENT

3.1 Organization

Figure 1 is a toplevel organization chart beginning at the Center level. Details of the Computational Human Engineering Research Office, including the result of a recent reorganization of FLI/YBI, appears in Figure 2. This reorganization establishes a government position titled Project Manager for User Liaison and several support staff positions.

3.2 Organizational Interactions

The ILS Project Manager will ideally be a government position, while ILS staff members may be either government or contractors. The projected scenario for staffing the ILS organization is a NASA or Army Project Manager and ILS staff from the Software Support Task 216 contractor (Figure 2).

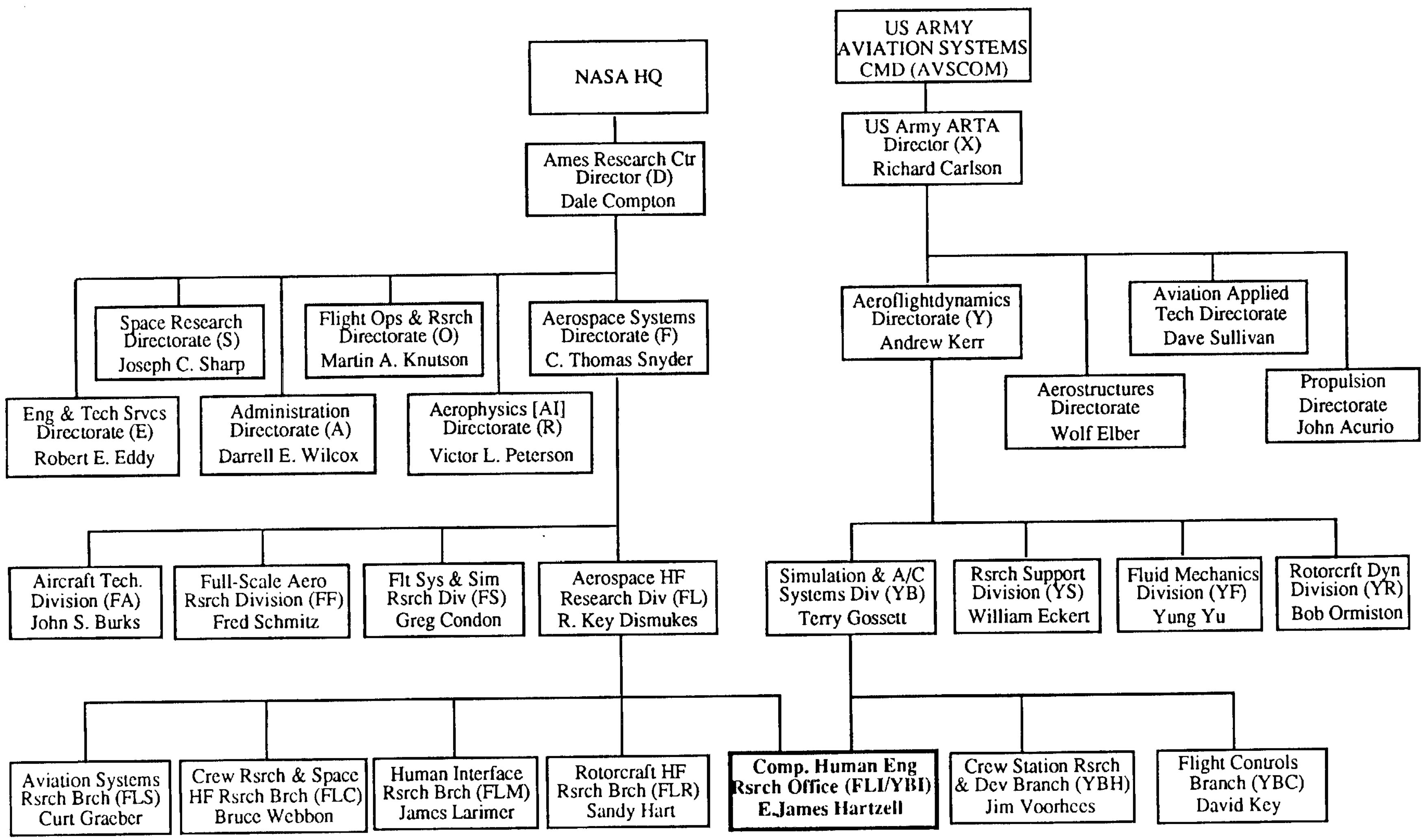


Figure 1. Toplevel Organization

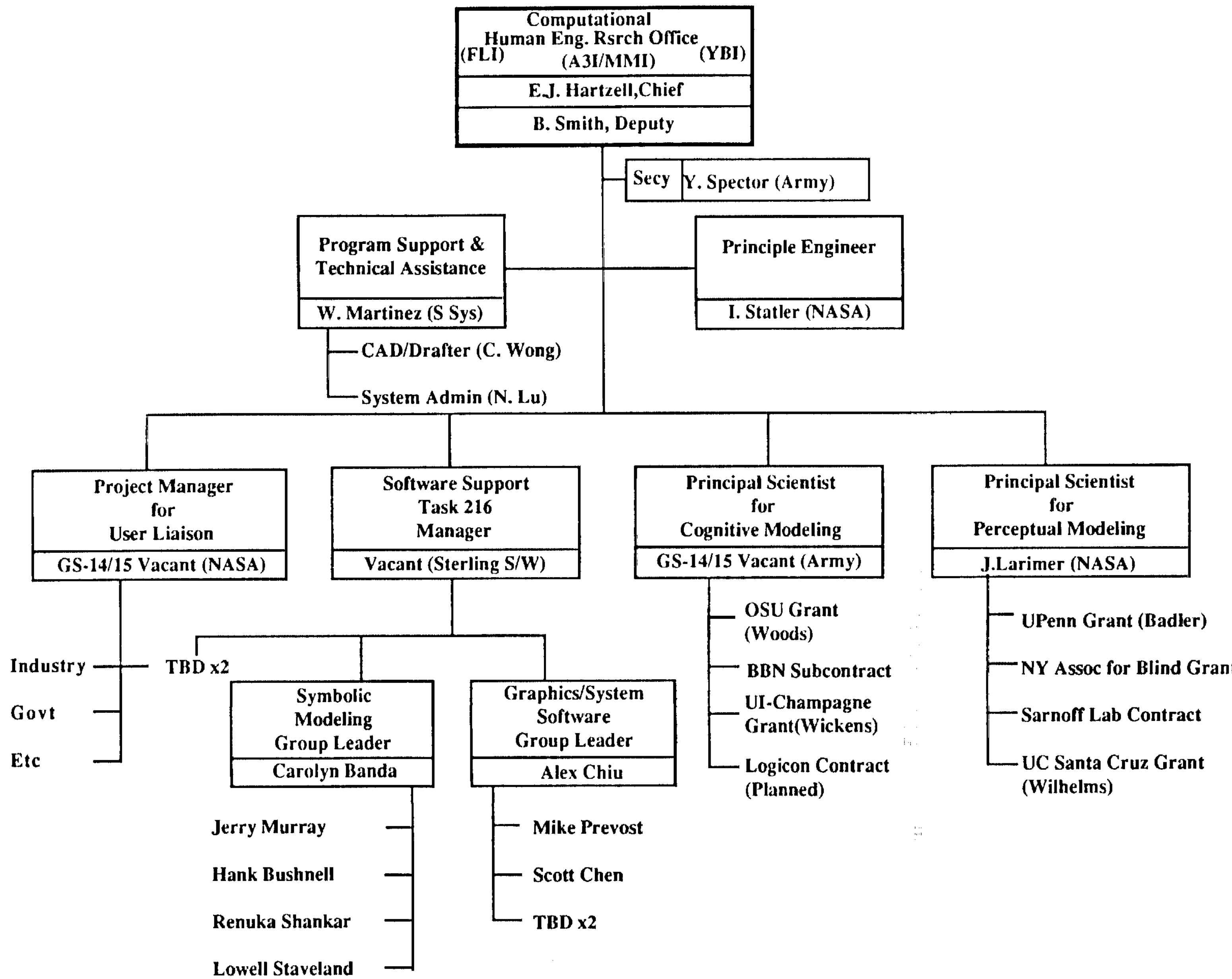


Figure 2. FLI/YBI Organization

3.2.1 Project Manager

The Project Manager will report directly to the Chief, Code FLI/YBI. ILS requirements may be dictated to the Project Manager by the Branch Chief or A^3I Deputy Director. Input to requirements may be provided by Principal Scientists, Software Support or Program Support, but implementation is subject to approval by the Branch Chief or A^3I Deputy Director.

To facilitate open, efficient and effective interactions between the ILS and outside organizations, the Project Manager should be a government position. This avoids any real or perceived conflict that may arise if the Project Manager were contract personnel when interacting with industry on potentially sensitive topics. Interactions with outside organizations include industry, other government agencies or NASA centers and academia. The ILS manager will generally make initial (with respect to the ILS) contact with an organization, followed by more detailed interactions by ILS staff members, as appropriate.

Assuming ILS staff are provided by the Software Support Task 216 contractor, the Project Manager will interact on a regular basis with the Task Manager to apprise the manager of the performance of ILS staff. Any difficulties with ILS staff should be directed to the Task Manager if personal consultation proves ineffective. The Project Manager will also discuss staffing requirements with the Task Manager to aid the Task Manager in effectively using their company recruiting resources. The Project Manager will participate in interviews (after first level screening) of prospective contractor employees for assignment to the ILS. Staffing will be discussed in more detail in the Staffing Section.

The Project Manager will work closely with the PSTA Manager in identifying, defining and implementing the policies and procedures assigned by FLI/YBI. These may include configuration management, quality assurance, reliability and documentation.

The Project Manager will establish and maintain communications with the NASA TU office, appropriate legal representatives and NASA Headquarters to ensure dissemination and receipt of products conforms to current NASA (and Army) policy. The Project Manager may delegate routine interactions with NASA TU and NASA COSMIC to ILS staff, but will continue to monitor these interactions.

The Project Manager may be required to interact with public relations professionals in cases where technology transfer is the prevailing topic and increased FLI/YBI visibility is desirable. It may be appropriate for the Project Manager to establish communications with the NASA external relations office and other organizations to explore the possible benefits and side effects of increasing public exposure to FLI/YBI developments.

3.2.2 ILS Staff

ILS staff will report to and receive technical direction, assignments and responsibilities from the ILS Manager. Staff may have additional reporting responsibilities if the positions are filled by contractor personnel. ILS staff are likely to be supplied by either the software support or PSTA contract, although potential organizational conflicts might be avoided if the ILS support staff and software support staff are from the same organization. For this reason it is recommended that the software support contractor supply ILS staff, to be administratively (monthly report input, personnel issues, company policy, etc.) managed by the Software Support Task Manager . ILS staffing levels below the Project Manager will be dictated by activity, future directions, facilities and funding limitations.

One key area of interaction for ILS staff will be direct contact with outside organizations who are evaluating MIDAS technology or are under consideration by FLI/YBI for collaborative work. Examples of common interactions include: 1) support Project Manager during preliminary interactions with outside organizations, 2) support Project Manager and FLI/YBI during in-house demonstrations of MIDAS, 3) follow up on technical issues surrounding possible collaborative efforts or technology transfer 4) serve as the focal point for support of visiting staff who are evaluating MIDAS technology and 5) instigate dissemination of software and documentation following the necessary approvals.

It will be the responsibility of ILS staff to be intimately familiar with the principles, functionality, limitations, and certain implementation aspects of MIDAS software components. Close interaction with software support staff will be necessary to achieve this and maintain current knowledge of development status.

ILS staff who are responsible for investigating and understanding the range of relevant design tools and techniques employed outside FLI/YBI will also be required to convey this information clearly and concisely to development staff members. The nature and regularity of these interactions will be dictated by FLI/YBI and ILS management.

ILS staff will also work closely with PSTA staff in areas such as configuration management, quality assurance and maintainability. ILS staff will assist with development and implementation of standards, policy and procedures in these areas. Familiarity with documentation and reporting standards which may by mandated by FLI/YBI through PSTA staff is required.

To anticipate future technology transfer requirements, other staff interactions may include 1) consultation with Chief Scientists regarding ongoing and future research areas and 2) interaction with researchers outside FLI on topics of immediate interest to the Branch.

3.3 Responsibilities

This section describes in general terms some of the key responsibilities of the ILS collectively. Assignment may be distributed across several staff member and overlap in many instances. The staffing section contains a more complete and specific breakdown of skills and responsibilities of individual ILS staff members.

3.3.1 Technology Assessment

ILS staff will continuously survey other government sites, industry and academic institutions to assess the state of design aiding tools and techniques applicable to the MIDAS approach. Examinations may include systems and techniques ranging from highly mature and functional products to laboratory-base prototype systems inspired by recent research. ILS management and staff will study this technology and generate summary reports and recommendations as outlined in the Reporting Section below.

3.3.2 Technology Transfer

One of the most important functions of the ILS is to facilitate the transfer of technology from FLI/YBI to other government sites and industry, and to encourage collaborative agreements with outside organizations who have something of value to contribute to A^3I. Policy and procedures for dissemination of software as outlined in the Policy and Procedures Section will be the responsibility of ILS staff.

As part of the overall technology transfer effort, ILS staff will be responsible for preparing and tracking software submissions to NASA COSMIC. This represents an important step for organizations who wish to utilize MIDAS software without necessitating a collaborative or other contractual arrangement. Since the typical cycle period for software submissions is several months from submission to availability, proper preparation and scheduling of submission will minimize rework and delays.

3.3.3 Liaison

Closely related to the function of technology transfer is the more general responsibility of liaison with outside organizations. This type of activity will generally encompass both visits to other sites and hosting visitors within FLI/YBI for the purpose of encouraging cooperative work arrangements, transfer of technology, information gathering or perhaps political objectives. In-house responsibilities will include ongoing end-of-phase demonstrations and other briefings supported by the Project Manager and ILS staff as required by FLI/YBI. These types of interactions may include briefings before or after a demonstration and narration during the demonstrations.

In addition to direct contact with outside specialists, ILS staff will remain cognizant of industry and government techniques and tools through publications. ILS staff will monitor technical publications and other relevant documents for indications of trends, state-of-the-art and breakthroughs in technology or techniques.

Although liaison with outside organizations has been emphasized, the importance of maintaining good relations and effective communications with management and in-house staff cannot be underestimated. The information collected, summarized and disseminated by the ILS is virtually useless if it does not reach the proper personnel or if it is considered of no value by the recipients. Consequently, there must be a clear communications path between the ILS and development staff, coupled with clear support for ILS activities from the FLI/YBI or Program Office level.

Other liaison-type activities such as liaison with NASA TU, legal offices and public relations were mentioned previously in the interaction sections.

3.3.4 Planning

Offsite: The A^3I Program holds a yearly offsite meeting to evaluate the results of a previous development phase and plan the subsequent one. This meeting typically spans several days and includes participation by project management, development staff, support staff, contractors and invited experts whose perspective is considered of value in planning the next development phase. Planning, conducting and summarizing these offsite meetings is a considerable task which has traditionally benefited from participation by individuals outside the immediate development, management and support staff. The ILS will be responsible for recommending to the offsite planning team industry and other government participants for the eminent offsite meeting. Upon acceptance by the planning team, the ILS will be responsible for issuing invitations and following up with accepted individuals. Other support for the offsite may be provided by the ILS as necessary

3.3.4.1 Phase Planning

The user community will play an increasingly large role in the direction of future A^3I development phases. Since the ILS is most closely tied with this group, technical planning for each development phase will require participation by ILS staff.

3.3.4.1 Budget Planning

The yearly budget plan prepared by PSTA staff may in future phases include funding contributions or projected contributions from industry and other government agencies. The ILS will keep PSTA staff apprised of the status of any existing or pending agreements which may affect budget planning.

3.3.5 Demonstrations

Yearly end-of-phase demonstrations are conducted to apprise the user community, potential funding sources, management, technical specialists and other interested personnel of the status of MIDAS. Demonstrations represent a sizable time investment and detract significantly from development, but are essential to continued funding for R&D type programs. Nonetheless, considerable efficiency, effectiveness and improved development staff morale could be achieved by offloading the major portion of demonstration support to ILS staff. The reasoning is that software engineers are most effective developing software, while ILS staff (probably composed of managers, human factors specialists and engineers who appreciate the opportunity to discuss problem solving techniques) have been recruited to perform liaison functions that require refined communications skills. Other benefits include:

- More global picture
- More cohesive presentation
- Less likelihood of centering too heavily on implementation details
- Sensitivity to real problems
- Examples of real-world MIDAS applications

The vast majority of demonstrations could be supported by ILS staff. In cases where a particular domain expert is required or implementation details are of primary concern, one-on-one interactions could be individually scheduled so that unrelated development efforts are not affected.

3.3.6 Reporting

An important product of technology transfer and liaison activities within the ILS will be the generation and distribution of status and summary reports. The reports will be used by FLI/YBI and Program Management to maintain up to date knowledge of 1) outside research and development, 2) areas and level of interest in FLI/YBI products, 3) status of ongoing cooperative agreements and 4) MIDAS user feedback. This information may be subsequently used by management to assess the current and future directions of research and development in FLI/YBI. A more detailed breakdown of ILS reporting requirements is contained in the Documentation subsection of Policy and Procedures.

3.3.7 Staffing and Startup

The Project Manager will be responsible for implementation of the ILS under the direction of FLI/YBI management. This document will serve as a preliminary guide, but is expected to evolve as the needs of the ILS change. The Project Manager's duties will initially encompass the entire spectrum of tasks outlined in this document, although prioritized as necessary and subject to the immediate requirements of FLI/YBI.

3.3.8 Other

Additional responsibilities of the ILS will be determined by Code FLI/YBI and A^3I Program Management. These may include periodic support for special in-house events, participation in professional conferences and other direct support activities.

4.0 POLICY AND PROCEDURES

4.1 Configuration Management

Since A^3I is primarily a research oriented Program, numerous organizational and technical barriers exist at this time which affect efficient flow of software technology into and from the ongoing A^3I Program development effort. One major area of concern for the ILS with regard to technology transfer is software configuration management. Generally, configuration management for research projects is significantly less structured and policies loosely enforced due to the prototypical nature of most developments. However, as code becomes more stable and interest increases outside the A^3I, it becomes critical that some form of configuration management be implemented and followed.

4.1.1 Definitions

Baseline: A collection of software and corresponding documentation formally designated and fixed at a specific time during a Configuration Item's life cycle. Baselines, plus approved changes, constitute the current configuration.

Configuration Control: The systematic evaluation, coordination, approval or disapproval, and implementation of all approved changes in the configuration of a CI after formal establishment of its baseline.

Configuration Item (CI): An aggregation of hardware/software, or any of its discrete portions, which satisfies an end use function and is designated for configuration management.

Configuration Management (CM): A discipline applying technical and administrative direction and surveillance to (a) identify and documenting the functional and physical characteristics of a Configuration Item (CI), (b) control changes to those characteristics, and (c) record and report change processing and implementation status.

Discrepancy: A note showing variance between what exists and what is documented to exist or considered acceptable.

4.1.2 Problem Description

The complexity of large scale, long-lived software development efforts such as A^3I increases in a roughly exponential manner with time as the overall size of the system grows. This tendency stems from a number of well known software engineering factors, including: a growth in the number of functions, components, and interfaces; the expansion of old routines for uses beyond their original design; the problem of new developers implementing parts of the system before they fully understand how it works; and a loss of institutional memory as original developers leave. These types of problems are compounded in a distributed environment where mismatches in old and new software can occur on individual systems, or new software (operating system, framework applications, etc,) releases can introduce inconsistencies.

The growing complexity in the Man-Machine Integration Design and Analysis System (MIDAS) cannot be stopped. However, software development practices can be adopted that slow the rate of growth to an acceptable level. A critical element of these practices is a software source control system to manage the introduction of new versions of software applications and a configuration management plan to control the distribution of software.

The software configuration related tasks encountered by the A^3I Program in controlling software versions and providing application programs developed in-house to outside organizations are likely to include the following activities:

Maintenance and Bug Fixes
Technical Phone Consultation
Non-Technical (user) Phone Consultation
Distribution Tape Generation
Configuration Tracking
Release Logging and Tracking
Release Notes Generation
Software Update Distribution
Software/Hardware Configuration Documentation
User's & Programmer's Documentation
Documentation Updates
Testing and Verification
Government Tech Transfer Requirements

Many of the above tasks could be eliminated by the issuing organization if code is provided on an "as is" basis, without support. However, close collaborative working relationships are often desirable and cannot work effectively under such circumstances. Consequently, some form of configuration management must be implemented that is compatible with the development methodologies (incremental software development, rapid prototyping, etc.) that are presently in use by A^3I designers. The CM system must also address version control of the wealth and variety of existing software systems in a manner that does not adversely affect new development or limit exploratory work.

This section is intended to serve as an outline for a portion of an overall configuration management plan that is tailored for the A^3I Program and similar research and development programs. Initial emphasis will be placed on the details and characteristics of each major software component that comprises MIDAS, followed by specific software CM tool recommendations that may be utilized immediately to begin version control. This document is not intended to serve as a comprehensive CM plan, since its focus is primarily on CM issues as they affect technology transfer.

4.1.3 A^{3}I Software Application Programs

The A^{3}I Program to date has produced or funded the development of nine major software components that are presently an integral part of MIDAS, and about three stand alone or support programs. Individual components are called Computer Software Configuration Items (CSCI). Since the products under development by A^{3}I are primarily software applications, CSCIs may be referred to as simply Configuration Items (CI). The CIs are listed in Appendix A, including brief descriptions, native language and hardware platforms, versions, documentation, any configuration management systems that may be used at this time and the level of interest known or projected to exist outside A^{3}I. Some information is missing such as dynamic memory requirements.

4.1.4 CM Recommendations

4.1.4.1 Planning

The A^{3}I Program's consideration of production issues for certain mature software application areas will require a simple, effective plan which is recognized by all staff levels, especially software development personnel, as important. This plan outline is proposed as a platform for discussion among Program and support staff management, to be followed by consultation with remaining staff. The goal is to converge on an approach that satisfies the need to control software configurations without adding a level of bureaucracy that excessively hinders development progress or discourages innovative thinking.

4.1.4.2 Organization

The existing A^{3}I organizational structure is sufficient to plan, implement and adapt an initial set of CM policies and procedures that is appropriate for the A^{3}I Program and like efforts. However, as the A^{3}I Program reaches the final phases of exploratory development, it will be desirable to add full time staff to perform CM and software maintenance functions.

4.1.4.3 Responsibilities

It is recommended that implementation of configuration management policy and procedures be the responsibility of the Programmatic Support and Technical Assistance (PSTA) contractor, with input from the ILS and A^{3}I Program Office. PSTA will provide status reports to the Program Office on a regular basis initially, and an as-needed basis after CM procedures have been sufficiently adopted. Provisions will be made to allow modification and adaptation of policy and procedures as the needs of A^{3}I change.

It will be the responsibility of the cognizant ILS staff member to understand current procedures and interact the the System Administrator as necessary to maintain an up to date understanding of the status of both hardware and software configurations for all major software components of MIDAS. The ILS staff member will understand the variations of hardware platforms and software configurations which may affect the suitability of potential user's hardware and software for installation and execution of MIDAS components. A sample form is included below to aid the ILS staff member in documenting and tracking configurations of MIDAS software.

Software Configuration Table

Software Module	Release Version	Current Version	Platform
Jack			
Mission Spec./Task Decomp.			
Pilot Model			
Training Assessment			
Cockpit Editor/Views			
Communications			
Aero/Guidance			
Volumetric FOV			
Visibility			
Visual Modeler			
Icon Editor			
Modeler			

Figure 3. Software Configuration Table.

The ILS will be responsible for assessing the suitability of any adopted CM policy and procedures for technology transfer activities that are part of ILS' charter. Close interaction with the PSTA contractor will be necessary to ensure initial CM policy and procedures, as well as modifications and adaptations, are compatible with the needs of the ILS.

The A^{3}I Program Office will oversee the development and implementation of CM policy and procedures. Final decisions regarding alteration of established CM policy will be made by the Program Office. Staffing requirements beyond the current complement will be evaluated by the Program Office to determine if additional CM personnel are warranted.

A^{3}I software development and support staff will be responsible for 1) participating in the initial development of CM policy and procedures, 2) adhering to the established procedures and 3) providing feedback to PSTA and ILS management on the effectiveness or applicability of those procedure currently in effect.

4.1.4.4 Policy Directives

The A^3I Program Office will delegate authority to the PSTA contractor to develop, enforce and modify CM policy and procedures. PSTA staff involved with CM will consult with ILS staff and software development staff to promote development of a CM system that is compatible with A^3I's goals and objectives.

The ILS will be responsible for reporting to the PSTA the effectiveness of CM with regard to technology transfer activities.

4.1.4.5 CM Implementation

The following section may be used as an outline for developing a more complete implementation plan for A^3I configuration management. It provides a minimal set of operating procedures that can be used as interim measures until a comprehensive plan can be developed and exercised.

4.1.4.5.1 Base Line Identification

Each major A^3I software development cycle is called a Phase, typically covering from 6 months to 1 year. At the end of each Phase, demonstrations are conducted, comments assimilated and planning meetings conducted to ascertain the scope of the next Phase. Software applications developed over the course of any Phase consist of numerous integrated CIs that are collectively referred to as MIDAS. The completion of a development Phase represents an appropriate juncture to establish a baseline, since the MIDAS configuration is generally frozen at that time.

Individual MIDAS CIs are presently referenced by name (see A^3I Software Application Programs Section), although early development phases also correlated module names with work breakdown structure (WBS) numbers. A WBS or CI numbering scheme is recommended for identifying and tracking individual MIDAS application programs and their constituents.

At the completion of each development Phase, a baseline will be established consisting of all MIDAS CIs as well as ancillary or support programs. The CIs will be identified by WBS or CI number and will include a minimum of the information identified in the A^3I Software Application Programs Section above. Individual CIs will be baselined as well as the integrated MIDAS product.

4.1.4.5.2 Configuration Changes

Changes to any CI or MIDAS baseline may be precipitated by software or hardware bugs, operating system upgrades, application program upgrades, hardware changes, critical software functionality improvements or other factors that make it impractical or undesirable to maintain the existing baseline. The final approval or denial of baseline configuration changes and the classification of these changes will be through the PSTA contractor, however, the PSTA contractor must obtain concurrence from both the ILS manager and an A^3I Program Office designee prior to initiating any change. Changes which require CM action may classified as 1) minor and 2) major releases.

Minor: Minor changes are enhancements, upgrades, bug fixes and other evolutionary alterations of the MIDAS configuration or individual CIs that occur during a development phase subsequent to the established baseline. Minor changes typically have not been documented, and do not affect the baseline. CM action regarding minor changes involves primarily logging these changes and reporting status to management, although incremental documentation of minor changes will reduce the effort required for major releases.

Major Releases: Major releases provide an intermediate opportunity to upgrade the baseline configuration without necessitating the completion and acceptance of a development Phase. A major release is generally an accumulation of minor changes to an extent that significant functionality and performance improvement has been gained. The major release configuration becomes the new baseline.

Major releases primarily benefit outside organizations who are using MIDAS in some capacity, in addition to a diminished in-house documentation effort at the end of a development Phase. PSTA management and staff will be responsible for projecting major release dates.

All major releases will be preceded by a complete archiving of the current MIDAS software configuration prior to implementation of changes (probably already performed as part of the completion of the previous Phase, or the most recent major release). The archiving will be accomplished by computer systems administration staff, presently under the direction of the PSTA contract manager. All documentation will be checked for currency to ensure it matches the archived configuration. Previously archived baselines will be evaluated at this time by PSTA, ILS and A^3I Program management to determine if it is appropriate to continue maintaining these versions.

Documentation will be updated upon major releases. Documentation requirements are likely to be less rigorous than end-of-phase requirements, and may be satisfied by "release note" addendum to SDDDs. Release notes will indicate the rationale and implementation details of any changes to the end-of-Phase baseline.

4.1.4.5.3 Status Accounting

All changes to the baseline configuration will be documented and reported. A data base will be established that contains all information deemed appropriate for completely documenting baseline configuration. The A^3I Software Application Programs Section may contain sufficient information for an initial implementation of the CM data base. Future additions are likely as requirements evolve. The data base will be maintained on Macintosh personal computers, since these systems are most widely available and contain a broad range of tools to aid in the creation and maintenance of data bases. Communications applications are also available to allow direct transfer of data between Macintosh computers and software development minicomputers.

Changes to the baseline configuration, including minor changes that do not alter the baseline, will be summarized by PSTA staff and distributed in a suitable form (printed, floppy disk, etc.) to all A^3I management personnel.

4.1.4.5.4 Outside Software

The A^3I MIDAS software configuration is composed of numerous software modules that have been wholly developed or modified by sources outside the in-house development team. Currently, MIDAS contains software developed 1) in-house, 2) under subcontract (Bolt, Beranek and Newman, Sarnoff Labs, Expert EASE Systems, Analytical Mechanics Associates, etc.), 3) as part of a NASA Grant (University of Pennsylvania, New York Center for the Blind, etc.), 4) through collaborative agreements (McDonnell Douglas Helicopter, Software Systems, etc.) and 5) as commercial off-the-shelf products (Inference Corp. Art, Software System MultiGen, etc.). Other sources are likely to provide code for inclusion in MIDAS in the future (BRL CAD, Georgia Tech. Research Institute GEST, etc.). As the number and size of these modules increases, the task of controlling the integrated MIDAS configuration will become unmanageable without some type of CM.

Because it would be inappropriately restrictive to devise a blanket CM policy that applies to all code developed outside A^3I, it is recommended that the following characteristics be examined as part of any agreement which may ultimately result in new MIDAS code. The characteristics are presented as a set of questions that might be considered in the process of evaluating a software application.

CM policy.
- Any CM used?
- If so, what system?
- If not, how is released software controlled?

Updates.
- How are updates provided?
- How often?
- Corresponding documentation updates?

Support.
- Hotline?
- Single technical point of contact?
- More than one technically cognizant?
- Any motivation to be responsive?

Stability.
- How mature is product?
- How stable is sponsoring organization?

Software.
- Cost?
- Bug free?
- Source provided?
- Well commented?
- Standard C and LISP constructs (i.e. portable)?
- Compatibility with existing hardware (i.e. memory requirements, etc.)?
- Compatibility with existing software systems?

Documentation.

User documentation?
Programmer documentation?
Quality and currency of documentation?
Release notes and other updates?

License/Distribution

Any contractual restrictions?
Number of CPUs code permitted on?
A^3I distribution rights?

Each application should be individually evaluated in terms of these considerations, where some considerations are of greater consequence than others. For example, software that is available in executable only form is generally disqualified. Licensed software is also avoided, but has been used at times where there are no alternatives to supply critical functional capabilities.

4.1.4.5.5 New Software Recommendations

Since commercial and contracted software represents a sizable percentage of all A^3I CIs, it is appropriate to adopt some minimum CM requirements for any system under evaluation for inclusion in MIDAS. To serve this purpose, CM will be considered from the perspective of the development platform, i.e. UNIX hosts and LISP machines. It is assumed that source code is available for any A^3I CI.

CIs obtained externally for use under the UNIX operating system (Silicon Graphics workstations) should use the UNIX Revision Control System (RCS, see 5.3). Ideally, the developing organization will implement and maintain code under RCS, although it may be necessary for the cognizant technical lead within the A^3I in-house staff to perform this function. Similarly, code written for LISP machines should use the Symbolics System Construction Tools (SCT).

New contracts (procurement contracts, grants, collaborative agreements, etc) should be written to include use of RCS or Symbolics Systems with any software provided to A^3I. This does not require much additional effort by the developer, particularly if it is new software, so the cost impact should be minimal. User documentation must be provided as part of the deliverable. Since A^3I will pay for this one way or another, it is most cost effective to have the developing organization produce this documentation, even if it increases the contract cost. The cost/benefit of contractually requiring programmer's documentation should be analyzed on a case by case basis.

4.1.4.5.6 Existing External Software

Software developed externally for A^3I that is still undergoing development by outside organizations represents an area where some CM compromises may be necessary to minimize A^3I in-house developer workload. Examples of CIs that fit this classification include Jack, the Volumetric Field of View Vision Model and the Visibility Vision Model. In these and similar instances that may arise in the future, the preferred course of action is to require the sponsoring organization to use RCS or Symbolics Systems. Failing this avenue, distribution of current releases of these applications must be the responsibility of the originating organization, since the A^3I development team has no means of controlling or tracking changes without devoting staff to the lower priority tasks of software update and maintenance.

4.1.4.5.7 Software Released to COSMIC

The Computer Software Management and Information Center (COSMIC) is NASA's clearing house for Government developed software that is of widespread applicability. All A^3I applications which qualify for submission to COSMIC (see Software Technology Transfer Contractor Report, August, 1989) will ultimately become available publicly via COSMIC. However, COSMIC is able to provide only the submitted version and accompanying documentation, since no mechanism exists (except another complete submission cycle) for providing updates. Consequently, it is likely that requests for upgrades may be handled directly by A^3I for recipients of COSMIC software.

4.1.4.6 Controls

To ensure the planning and implementation of CM policy and procedures continues to serve the changing needs of A^3I, suitable controls are necessary. These controls, however, should not interfere with the objective of the A^3I Program; exploratory development. The system of controls would be counterproductive if it in any way discourages developers from making improvements or fixing known software deficiencies. At the same time, staff must understand the importance and long term benefits of adopting and consistently using software CM.

There are two primary development platforms presently used by A^3I software engineers: 1) UNIX-based processors and 2) LISP machines. Both platforms have built-in tools to document and control configurations of large software systems.

4.1.4.6.1 UNIX Configuration Tools

The two most common UNIX CM tools are the Source Code Control System (SCCS) and the Revision Control System (RCS). SCCS is a source management system that originated at the University of California at Berkeley and is available on 4.x BSD variations of UNIX systems. It maintains a record of versions of a system, including what changes, why they were made, who made them and when. RCS is a similar system that originated in the Department of Computer Sciences at Purdue University. Because RCS is considered a more powerful and general purpose software management system, it is recommended as the preferred tool for use with UNIX systems and will be described in greater detail.

RCS: The following description is taken from the UNIX Programmer's Supplementary Documents, Volume 1, Section 13.

The Revision Control System (RCS) manages multiple revisions of text files. RCS automates the storing, retrieval, logging, identification, and merging of revisions. RCS is useful for text that is revised frequently, for example programs, documentation, graphics, papers, form letter, etc. It greatly increases programmer productivity by providing the following functions.

1. RCS stores and retrieves multiple revision of programs and other text. Thus, one can maintain one or more releases while developing the next release, with a minimum of space overhead. Changes no longer destroy the original -- previous revision remain accessible.
a. Maintains each module as a tree of revisions.
b. Project libraries can be organized centrally, decentralized, or any way you like.
c. RCS works for any type of text: programs, documentation, memos, papers, graphics, VLSI layouts, form letters, etc.
2. RCS maintains a complete history of changes. Thus, one can find out what happened to a module easily and quickly, without having to compare source listings or having to track down colleagues.
a. RCS performs automatic record keeping
b. RCS logs all changes automatically.
c. RCS guarantees project continuity.
3. RCS manages multiple lines of development.
4. RCS can merge multiple lines of development. Thus, when several parallel lines of development must be consolidated into one line, the merging of changes is automatic.
5. RCS flags coding conflicts. If tow or more lines of development modify the same section of code, RCS can alert programmers about overlapping changes.
6. RCS resolves assess conflicts. When two or more programmers wish to modify the same revision, RCS alerts the programmers and makes sure that one change will not wipe out the other one.
7. RCS provides high-level retrieval functions. Revision can be retrieved according to ranges of revision numbers, symbolic names, dates, authors, and states.
8. RCS provides release and configuration control. Revision can be marked as released, stable, experimental, etc. Configuration of modules can be described simply and directly.
9. RCS performs automatic identification of modules with name, revision number, creation time, author, etc. This, it is always possible to determine which revision of which modules make up a given configuration.
10. Provides high-level management visibility. His, it is easy to track the status of a software project
a. RCS provides a complete change history.
b. RCS records who did what when to which revision of which module.
11. RCS is fully compatible with existing software development tools. RCS is unobtrusive -- its interface to the file system is such that all your existing software tools can be used as before.
12. RCS' basic user interface is extremely simple. The novice only needs to learn two commands. Its more sophisticated features have been tuned towards advanced software development environments and the experienced software professional.
13. RCS simplifies software distribution if customers also maintain sources with RCS. This technique assures proper identification of version and configurations, and tracking of customer changes. Customer changes can be merged into distributed version locally or by the development group.
14. RCS needs little extra space for the revisions (only the differences). If intermediate revisions are deleted, the corresponding differences are compressed into the shortest possible form.

4.1.4.6.2 LISP Machine Tools

The Symbolics LISP machines used by A^{3}I software developers include a utility known as the System Construction Tool (SCT) that is designed for building and maintaining applications composed of a large number of source and executable files.

Symbolics System Construction Tool

Symbolics software developers can define a "system" as any set of files, rules and procedures that define the relations among these files. A system can include LISP source files as well as files written in other languages such as FORTRAN or PASCAL. A system is defined using an SCT defsystem special form that is called a system declaration.

The system declaration specifies the names of the source files (or modules), the desired operation (compile, load, both) for each file and any dependencies. After a system has been defined, executing the command Load System <sysname> causes the operating system to automatically load into dynamic memory the proper executable files in the proper sequence. Any necessary update such as a recompile and load of a changed file is automatically performed, also resulting in the necessary updates to any changed file version numbers that comprise the system.

Incremental changes to the system are easily provided by the patch facility. The patch facility allows software developers to avoid recompiling or reloading an entire system after changes have been made by maintaining a directory of incremental file changes. It is also makes it possible to maintain multiple versions of the same system.

Many A^3I applications residing on Symbolics hardware are presently using a manual variation of the SCT which requires the developer to construct a text file (generally called a "loadfile") that contains the name and explicit executable version number of each file in a system. The loadfile does not contain implicit dependencies (executable files are loaded in the order listed) or facilities to automatically compile and load changed files. It is the responsibility of the software developer to update the loadfile after any change has been made to the system. While this method has proven efficient for relatively small, prototypical applications, it is not recommended that this approach be utilized with large, relatively stable systems that may be distributed outside A^3I due to the maintenance and tracking difficulties.

It is highly recommended that the Symbolics System Construction Tools be utilized for all major software applications that execute on Symbolics equipment. Systems ultimately save a considerable amount of time for applications composed of numerous different files with complex file dependencies. Several examples exist on A^3I hardware which may be used as patterns for new systems.

4.1.4.7 Verification

It may be desirable to encourage adherence to CM policy and procedures by periodically conducting audits and reviews to verify the status of any current or previous MIDAS configuration. An audit of any major software component should require no more than 2 hours to verify the type of information listed under the A^3I Software Application Programs Section. It will be necessary, nonetheless, to impact the work schedule of the cognizant software engineer or engineers for this relatively brief period of time. The verification will be conducted by the PSTA manager or designee. Results of the verification will be reported by the PSTA contractor either as a discrepancy report or conformance statement. A sample Software Configuration Audit form is provided (Figure 4).

SOFTWARE CONFIGURATION AUDIT

Auditor ______________________________ Date ______________

Software Engr. ______________________________

Software Name		
WBS Number		
Applications & Version		
Language(s)		
Hardware Platform(s)		
OS Version in Use		
Latest Hardware OS Version		
Baseline Version & Date		
Major Release Version & Date		
Development Software Version		
Last Minor Update		
Documentation		
Configuration Management		

Another forum for verification of MIDAS configuration data is the regularly scheduled technical status reviews required by the Program Office. These reviews represent an effective mechanism for CM verification, provided there is advance notice of the topic and attendees have an opportunity to prepare.

4.1.4.8 CM Summary

As the A^3I Program continues to grow and transition to mature, production stages of development for certain elements, software related tasks will change from development to maintenance and rapid prototyping to highly structured methods under strict configuration management. A comprehensive plan for configuration management would include treatment of engineering change proposals, deviations, waivers, priorities, change control board, quality assurance provisions, critical component identification, audits, configuration status accounting and configuration traceability to name a few. A large amount of published material is available on "standard" CM within the Government that may be referenced when the A^3I Program reaches the stage where rigorous CM is required. Until that time, it is nonetheless desirable to devise and implement an appropriate subset of CM practices that are compatible with the present emphasis of A^3I.

The A^3I Program is composed of a number of support organizations whose responsibilities vary from software development to budget planning. For example, the software engineering and PSTA staff are not from the same contractor organization. This situation represents a potential conflict in the area of CM, since the PSTA contractor will in effect be "managing" another contractor by conducting audits and requiring compliance with CM. The key to making CM work for A^3I is adopting sensible policies and procedures that are recognized as valuable, and that in the long run reduce *developer* workload. CM for the sake of CM will not work for a program like A^3I unless there is a shift in emphasis from development to production.

4.2 Reliability

The primary issue with regard to reliability is operational reliability of application software, since hardware is off-the-shelf and generally under commercial maintenance contract to ensure continuous operation. The nature of R&D efforts necessitates secondary emphasis on reliability of prototypical software. Because the Branch's activities are exclusively R&D, reliability issues are not generally addressed and no formal policy exists for disposition of known failure risks. However, it is recommended that the ILS take a lead role in conjunction with the System Administrator in proposing reliability policy and procedures. Minimally, known reliability risks should be documented and logged.

The cognizant ILS staff member will coordinate with the System Administrator regarding hardware and software issues which may affect the reliability of existing software configurations. These include hardware upgrades, operating system revisions, application software updates and other changes to stable hardware-software configurations.

4.3 Quality Assurance & Maintainability

Quality assurance and maintainability policies, like reliability, are typically nonexistent in an R&D environment. Nonetheless, it is feasible to develop guidelines for software engineers to consider whenever new software is generated or existing software is modified. Several broad guidelines are suggested here:

Liberally Commented Source Code: Provide header comments (name, date, description, any restrictions, etc.), procedure/function description, variable meanings throughout source files.
Style: Proper indentation.
Appropriate Variable Scoping: Minimize the use of global variables.
Modularity: Break code into manageable subparts, < 2k lines per file.
Minimize Hardware Dependent Optimizations: Applies especially to graphics code.

The tradeoff decisions inherent in development versus pilot or production coding must be dictated at the Branch or Program level, but recommendations and implications may be passed from the programming staff to these levels via the Task Manager. The ILS may provide input to the Branch or Program level from the user's perspective.

While these recommendations are largely applicable to MIDAS software engineers developing code, it is important for ILS technical staff to have an awareness of these issues while evaluating outside software for possible collaborative arrangements. A thorough analysis of existing code's suitability for integration in MIDAS should include quality assurance and maintainability considerations.

4.4 Joint Development

Throughout the previous 4 years of directed software development for the A^3I Program, the software engineering team and contracted staff have produced a considerable amount of code in the process for the current generation of MIDAS. Some of the code has resulted in relatively mature application programs, which have often been of interest to outside organizations who wish to make use of A^3I developments as part of their own design aiding tools. This section discusses the methods by which user modifications to, and joint development of prototype A^3I software can be accommodated, shared, and controlled to mutually benefit both A^3I and the using community. The section will also propose guidelines for negotiating the exchange of software, equipment, documentation and ideas between A^3I and potential users, for those applications which are not addressed by the provisions of COSMIC.

4.4.1 Mechanisms

This section covers the methods and mechanisms currently available to the A^3I Program for use in establishing and maintaining joint development agreements with both users and co-developers of MIDAS and MIDAS-like products. Joint development involves a commitment from both parties to supply manpower and equipment resources toward the development of application or support software for human-machine system design and analysis. Each category of user/developer (i.e. Government, Industry, University) is unique in terms of the most effective and appropriate methods that may be utilized, consequently, they will be covered separately.

The report does not cover unilateral agreements where the Government supplies software to another organization without compensation (i.e. through COSMIC or Freedom of Information) or the Government acquires software from an outside organization through procurement contracts, Grants or SBIR awards. It also does not address Joint Endeavor Agreements, which are designed primarily for space ventures involving Shuttle experiments. The orientation is toward joint development agreements and user evaluations that do not involve the exchange of funds and are applicable to A^3I research and development activities.

4.4.1.1 Government

The A^3I Program to date has been supported entirely by Federal Government (DoD) R&D funding. This fact makes exchange of products with other Government organizations generally the easiest and quickest form of technology transfer available for software products that have no distribution restrictions imposed. As described in the Software Technology Transfer Contractor Report (STTCR), there are several mechanisms that can be used for Government-Government cooperative agreements:

1) Memorandum of Agreement (MOA)
2) Memorandum of Understanding (MOU)
3) Interagency Agreement (IAA)

Other mechanisms require the exchange of funds (Procurement Contract, Grant) are specific to space-related work (JEA) or involve universities (Joint Enterprise, University Consortium). Those involving universities will be treated in the Universities Section. JEAs and Cooperative agreements are typically employed when dealing with organizations outside the government, and will be addressed in the Industry Section.

The Memorandum of Agreement is a Space Act agreement that has been used successfully within a single agency or branch of the Government when an expeditious, informal agreement is desired that can be generally covered by brief descriptions. The sample MOA in Appendix B was designed for collaboration between the A^3I Program Office and a NASA/Ames branch. Approval was granted at both the Division and participating branch levels, although complete execution of the agreement requires review by legal and approval at the director level. It is recommended that the MOA be utilized for any collaborative efforts with NASA/Ames or collocated Army organizations.

Another informal mechanism is the MOU, which primarily outlines and establishes that A^3I and a particular organization wish to enter a relationship with the intent of negotiating a complete agreement at some point in the future, although a subsequent formal agreement is not required. MOUs are bilateral Space Act Agreements designed for use with industry, universities and nonprofit organizations. MOUs are typically implemented through the TU Office (if technology transfer is involved), reviewed by the patent counsel and approved by the Center Director. A^3I approval has historically been granted at the Army (Code Y) and NASA (Code F) Directorate Levels prior to legal review. A sample MOU is provided in Appendix C. The use of MOU-type agreements is recommended for any collaboration where informal, flexible terms are suitable for both participating organizations, and a MOA is not applicable. This will typically occur when an informal agreement is desired between two Government organizations that are not located at the same geographic site.

IAAs are designed to facilitate collaboration between Government entities. As with MOUs, MOAs and other Space Act agreements, there is no exchange of funds. IAAs are likely to be used when a more specific and binding agreement than an MOA or MOU is desired between two Government organizations. An IAA would be an appropriate mechanism to utilize when a cooperative agreement is desired between A^3I and the FAA, DOE, or other branch of the Government where there has not been prior activity.

When developing MOA, MOUs or IAAs, it is important to realize that distribution rights may be an issue that should be explicitly addressed with regard to newly developing and existing software. The Joint Development Guidelines Section treats this issue in more detail.

4.4.1.2 Industry

1) Memorandum of Understanding (MOU)
2) Technical Exchange Agreement (TEA)
3) Cooperative Agreement

Although MOUs have been applied largely to Government-Government relationships, it is permissible to establish MOUs with profit-making entities as well, provided there is no exchange of funds.

TEAs involve relatively specific and formal terms between two organizations and include the transfer of technology between the participating organizations. TEAs must be routed through the TU Office and approved by the NASA Patent Counsel and Center Director. A TEA should be utilized in cases where either party prefers a less open-ended approach than an MOU. Large aerospace firms are likely to require the TEA mechanism due to corporate restrictions or management policy. A sample TEA is provided in Appendix D.

Cooperative agreements are one of 3 federally standardized methods (contract, grant, cooperative agreement) to carry out procurement activities. Cooperative agreements permit Government agencies to provide compensation in both monetary and non monetary form for efforts that require close working relationships. Cooperative agreements within NASA have traditionally been for research projects with universities, and must be approved at Ames by the Acquisition Division University Affairs Branch. This mechanism is likely to require the most effort and time to complete the approval cycle.

4.4.1.3 University

1) Ames University Consortium Program
2) Ames Joint Enterprise
3) Cooperative Agreement

The University Consortium Program is a mechanism that allows university faculty and students to work with Ames personnel on short-term research projects. The participating university must be one of about 136 approved universities. This mechanism is recommended both as a means of evaluating potential staff and of acquiring short-term support for development efforts. It also serves as a useful means of infusing new ideas and approaches into the Program and establishing outside contact and visibility.

Unique to Ames, the Joint Enterprise for Aerospace Research & Technology Transfer is a tripartite R&D agreement whereby the resources of Government, industry and university combine to transfer technology to commercial applications while simultaneously leveraging federal R&D resources and university research. Funding to sponsor university research and support Joint Enterprise (a non-profit organization administering the agreement) are normally supplied by either NASA or industry, and paid directly to the Joint Enterprise for dissemination. Each agreement is negotiated uniquely in terms of resources and rights (intellectual property, patents, etc.).

Cooperative agreements are as described in the Industry Section.

4.4.2 Joint Development Recommendations

This section describes the two most common collaborative interactions between A^3I and outside organizations, 1) Joint Development and 2) User Evaluations. Guidelines and considerations will be proposed for negotiating agreements in each instance. It is assumed that the desired mechanism (MOA, MOU, TEA, etc.) has been selected, and that the terms and content of the agreement are the main concern.

4.4.2.1 Joint Development

Joint development agreements involve the modification or generation of MIDAS elements, including activities contributing to integration of MIDAS components. Joint development requires the commitment of software engineering resources by both organizations toward the common goal of developing state-of-the-art man-machine interface design and analysis systems. Some of the more critical issues to be considered in a cooperative development agreement are described in the following section.

4.4.2.1.1 Agreement Guidelines

Term: Generally, a period of at least 1 year is sufficient to justify the effort to implement a formal agreement, but short enough that a long term commitment doesn't result if for some reason the relationship does not develop as desired. If a long term relationship is anticipated, the agreement should be written such that renewal at the end of each year is a relatively simple process (signature memo, etc.).

Technical Suitability: In evaluating the suitability of an organization, some obvious characteristics include technical knowledge and available resources. The availability of proposed resources and any contingencies should be understood since R&D efforts or non revenue producing activities often receive lower priority when resources are scarce.

It may at times be appropriate to enter into a cooperative agreement with an organization because it is politically suitable, but no recommendations are provided for these cases since the Program Office will have the greatest insight into the benefits and pitfalls.

Scope: In defining the scope of work to be performed, be realistic. Although it is sometimes better to ask for more than one expects to receive, this same strategy can at times yield no results at all if each element is integrally tied. It is perhaps best if both parties know fairly explicitly what is required from each organization as part of the agreement. Schedules are desirable as well to avoid 80% of the work performed in the last 20% of the agreement period. If possible, decompose the work to be performed into separable, "deliverable" elements that can be incrementally evaluated and integrated.

Less rigidly defined agreements may be appropriate when the objective is primarily exchange of existing software, rather than new code development. In these cases, it would be desirable to build in a considerable amount of flexibility to cover the possibility of follow-on agreements.

Rights: The A^3I Program must have the right to distribute code resulting from any cooperative agreement in at least binary form. Submission of executable code to COSMIC must be permitted.

Sensitive or proprietary material should be clearly identified and noted in the agreement.

Participating organizations should have the right to distribute approved code developed at Government expense throughout the organization's site, but not throughout the Agency or Corporation without permission from the A^3I Program Office. These restrictions are consistent with NASA COSMIC and Freedom of Information Act mandates.

Version Control: Any new software developed by outside organizations as part of a cooperative effort must adhere to A^3I software configuration management procedures for UNIX and LISP machine code development. Namely, RCS must be used with applications developed for UNIX hosts and Symbolics System Construction Tools must be used with LISP hosts. These requirements may be waived if the amount of code is deemed sufficiently small.

Conventions: Some form of coding convention that is consistent with other MIDAS software would be desirable when new software is to be developed. For example, software written for UNIX hosts should include prefix identifiers for global variables and functions that allows other programmers to determine the associated module. Software Systems' guidelines would be a reasonable starting point for C code. LISP applications or routines may be assigned their own Symbolics "package" to reduce the risk of variable conflict.

Source Code: Any new software developed for MIDAS by an outside organization must be provided to A^3I with source code. If the source constitutes a non-separable element (doesn't execute stand-alone), A^3I must also have the right to provide source code to outside organizations as part of cooperative efforts, evaluations or applicable submissions to COSMIC.

Documentation: Minimally, user documentation must be provided. Where source code is developed, liberal use of comments throughout the code is desirable to enable software engineers integrating or modifying the software in the future to efficiently study and understand the design.

Integration Support: Unless the interfaces have been clearly defined and documented (seldom the case with rapid prototyping efforts), some level of integration support must be provided. It is suggested that integration support be provided in at least 2 instances: at the midpoint of development and upon completion of the agreement. Integration support implies software engineering staff familiar with the code who travel to Ames to assist with integration until the software is fully functional within the MIDAS framework.

Progress Reporting: 1 page progress reports should be exchanged each month. Regular progress reports serve have both political and technical advantages, since management can identify successes in technology transfer while developers remain on top of progress and are able to better anticipate problems.

Evaluation: As part of a cooperative development effort, it is desirable to solicit user-type feedback at the same time development progresses. It should be recognized, however, that the depth and quality of these evaluations is unlikely to match what would be achieved by an agreement designed specifically for that purpose. It may be desirable, nonetheless, to include this element as part of the agreement.

Acknowledgements: Both organizations are likely to benefit from the visibility of cooperative development. There should be no restrictions on publicizing a cooperative agreement in general terms to the extent that no proprietary information is released. To the appropriate extent, all presentations, briefings, announcements, publications and other disseminations relating to the cooperative agreement shall properly acknowledge both A^3I and the participating organization with regard to their respective contributions.

Approvals: The approvals required by A^3I are dictated by the type of agreement as outlined in the Mechanisms Section. In addition, agreements that include the release of Government-developed software may under some circumstances require notification of NASA TU or NASA Headquarters per NMI 2210.2A. Refer to the STTCR for details pertaining to criteria for notification. Dissemination of proprietary or restricted release software must meet the requirements of the appropriate organization as well.

4.4.2.2 User Evaluations

The prototype MIDAS has reached a stage where it is sufficiently complete to allow the user community to begin use and evaluation. "Alpha" or "beta" versions of MIDAS or MIDAS stand alone components will be provided to suitable organizations for use and critical evaluation so that the A^3I development team can receive valuable feedback on the effectiveness of their products from a user's perspective. To facilitate the dissemination of software to participating sites in the most expedient and efficient manner, a cooperative agreement is required. An MOU-type format is recommended for all agreements involving short-term (less than 6 months) evaluation of software.

4.4.2.2 Agreement Guidelines

Term: 1-6 month evaluations are recommended since MIDAS continues to change at a relatively rapid pace. Terms of longer than 6 months are not advised in general since a reasonable amount of time and effort is required to distribute software updates and documentation to beta sites.

Scope: An evaluation agreement is a commitment to use and critique the applications that have been supplied. Sample problems are encouraged, the results of which should be provided to A^3I as part of the agreement so that they may be used in-house for demonstration purposes. The areas of emphasis in the evaluation include 1) usability and 2) suitability. Usability will reflect the application program's user interfaces, while suitability will measure how well the application(s) are able to solve real problems.

Feedback: Feedback should be in the form of written, monthly reports, although other forms of communication (site visits, telephone consultation, etc.) in addition to these reports should be encouraged. Feedback will be provided in the two areas of usability and suitability.

Summaries: In addition to regular, monthly feedback, summary reports identified as part of the agreement may be desirable. If a sample problem format is possible, a summary report should be prepared describing the problem and detailing the performance of A^3I applications in solving the problem.

Rights: Applications provided for the purpose of evaluation are supplied in executable only form and may not be reproduced or distributed unless otherwise noted. Generally, software is made available for installation on a single CPU or suite of processors in the same geographic location. Proper acknowledgments are required when software is demonstrated or discussed outside the recipient organization. Use of supplied software exclusively for commercial gain or to obtain competitive advantage is strongly discouraged until the availability of MIDAS products is more widely known.

Software and all documentation must be returned to A^3I following the evaluation period. All code must be permanently removed from recipient equipment and archived copies destroyed as part of the agreement.

Approvals: Since evaluation agreements are likely to be largely MOUs, Branch and Directorate level approvals are generally required. Additional approvals or notifications may be required as noted previously when restricted or proprietary software is involved.

Protection: It is recommended that some form of "time bomb" routine be integrated with software released for evaluation to ensure that software does not proliferate. This will help to control the number and variety of MIDAS and MIDAS component versions floating around outside A^3I. This is an important consideration until the MIDAS configuration becomes relatively stable and mature.

4.4.2.3 General Recommendations

Number of Joint Efforts: Initially, it is recommended that a maximum of one joint development and two user evaluation agreement be active at any given time. Since it is assumed that the user evaluation agreements will result in little additional load to ongoing A^3I activities (ILS should handle the majority of this work), the joint development effort will require the most attention. After the first joint development agreement has been implemented and in progress for a reasonable period of time, the degree of interaction, additional workload, coordination and other aspects will be more apparent. At that time it should be possible to make a relatively accurate assessment of the optimum number of joint efforts to conduct. The most desirable number of user evaluations may be adjusted at this point as well.

Updates: Since the duration of joint development agreements will generally be one year, it is recommended that updates to the baseline be considered quarterly. At least one update (preferably the final one) should coincide with the completion of an A^3I development Phase.

It may be appropriate to evaluate each quarterly update with regard to updating the baseline and make the baseline change discretionary rather than mandatory. However, at least one update of the established baseline should occur over the 1 year agreement term.

Scope: It seems both impractical and unnecessary to attempt joint development that covers the entire MIDAS suite of applications. User needs surveys suggest that the majority of organizations are most interested in select aspect of MIDAS capabilities such as anthropometric or vision analysis, rather than the entire integration framework. This fact should not preclude providing the integrated MIDAS capability to organizations, but it may limit the degree of participation that can be expected in the area of developing the overall framework itself.

Site Visits: It is reasonable to coordinate site visits with quarterly releases of updates to the jointly developed software. These visits could be alternated so that each organization must travel on 2 instances (or more, if desired) to the other site to install, integrate and receive software and documentation.

POC: It is critical that each participating organization have a primary point of contact. The POC should be intimately familiar with details of the joint development agreement and should probably be the most technically cognizant staff member regarding details of the joint development effort (i.e. the programmer). The Software Support Contractor Task Manager or someone from the A^3I Program Office should be the alternate POC. Serving as the A^3I focal point for a particular joint development agreement should not be a full time position. If the load on the POC becomes excessive, this may be a signal that the balance of contributions is inappropriately tilted.

4.5 Documentation

4.5.1 User's Guides

Documentation relating to MIDAS elements produced by the A^3I Program is almost exclusively programmer's documentation describing implementation details of a particular software module. The format has been standardized, and includes a short user's guide section. Responsibility for generation of these documents lies with the software development staff, who update existing documentation on a yearly basis (approximately) to account for changes made during the preceding design phase.

While programmer's documentation is sufficient for developers who intend to modify or integrate MIDAS source code, there is insufficient documentation available for the designer who wishes to simply use the system. Since ILS staff are theoretically more closely tied to the user community than the software development staff, it is appropriate for ILS staff to be involved with the generation of user documentation. It is proposed that the PSTA Manager will have responsibility for writing and maintaining user documentation (Technical Writer Position under PSTA), with support from the development staff and input from the ILS. The initial draft of user documentation should be produced by the cognizant software staff member, with subsequent revisions provided by the PSTA Technical Writer with input from the ILS.

4.5.2 Programmer's Documentation

Cognizant ILS staff will be responsible for reproduction and dissemination of programmer's documentation. Programmers documentation will be generated and maintained by the software development staff.

4.5.3 Papers, Plans, Summaries, etc.

Throughout the course of the A^{3}I program a number of papers have been generated which are generally available for release, including executive summaries, technical papers, budget plans, contractor reports and other relevant material. In addition, numerous related publications, whitepapers, technical reports and other documents have been collected and compiled as part of the A^{3}I library. It is the responsibility of designated ILS staff to be familiar with the content of the A^{3}I library (except books, technical documentation and periodicals) and to process outside requests for copies. The designated ILS staff should be sufficiently familiar with library contents to recognized and recommend information which may be of value to collaborating organizations. ILS staff should be familiar with NASA reproduction services and utilize A^{3}I secretarial support as necessary to accommodate requests for information.

4.5.4 Hardware/Software Configurations

The ILS will maintain a listing of available hardware/software configurations for each separable MIDAS component. A suggested format is provided in Figure 3, although this format should be expanded to include hardware and software options.

4.5.5 Agreements

The ILS will compile and maintain a collection of all active and inactive agreements involving the transfer of technology. These include but are not limited to 1) procurement contracts, 2) grants, 3) cooperative agreements, 4) memorandum of understanding (MOU), 5) Ames university consortium, 6) Ames joint enterprise for aerospace research and technology transfer, 7) technical exchange agreements (TEA), 8) joint endeavor agreements (JEA), 9) Small Business Innovative Research (SBIR) and 10) interagency agreements (IAA).

4.5.6 Reports

4.5.6.1 Releases & Tracking

The ILS will generate and update a listing of all releases of software outside the Branch. Included in each release summary will be a minimum of the following information:

Recipient Organization
Point of Contact & Mailing Address
Telephone Number of Point of Contact
Purpose
Reciprocal Deliverable (e.g. what does the government get in return?)
Applicable Agreement (i.e. MOU, TEA, contract, evaluation, etc.)

Release Date
Target Hardware
    Model & Options
    Operating System & Version
Released Software
    Name
    Version
    Source Releases:
        Source Files
    Executable Releases:
        Duration of Evaluation
Documentation Provided
Release Approvals:
    Branch
    Center Technology Utilization
    Letter to NASA Headquarters
    Other Approvals (licensed software, proprietary restrictions, acknowledgements, etc.)
Forms Provided:
    Software Bug Report
    User Survey
Status

The status section of the release summary may be used to periodically document the state of any agreement involving release of products. This section may provide some key insights into the effectiveness of various agreements which may be used to avoid potential pitfalls in future ones. It also serves to collectively document Branch contributions to outside organizations.

4.5.6.2 ILS Status

The role of technology transfer in R&D projects like A^3I is expected increase significantly as programs reach more mature stages where fully functional products are available for use. ILS activity should eventually play a significant part in the continued development and evolution of MIDAS due to the contributions of outside organizations. As activity increases, it is appropriate to explicitly document the accomplishments of the ILS and status of work in progress as separate and distinct from development efforts. This emphasis is rationalized by NASA's charter to transfer technology coupled with the probability that some funding for future phases of development may be contributed by industry or other government agencies.

4.5.6.3 Software Discrepancy

An important part of any development effort is establishing a consistent, responsive and accurate feedback channel for reporting software bugs and discrepancies. Cognizant ILS staff will be responsible for providing copies of software discrepancy reports to recipients of software and encouraging both users and software engineers to thoroughly test code and document any bugs.

Bug reports will be collected and summarized for both the both Program Management and Software Development Task Management in the form of recommendations as outlined in the next section. A sample discrepancy report form is included below in Figure 5.

DISCREPANCY REPORT

No. ____________

Name ______________________________ Date ____________

Software Name ______________________ Version __________ Site __________

Task/function being performed:

Problem:

File(s) being worked on:

Stack dump (4/5 lines) if applicable:

Process duplicatable? (yes/no)
If yes, please state steps:

For A3I Use:
Cause of problem:

Action taken (in version): ________

Programmer ______________________ Date ______________________

Accepted by ______________________ Date ______________________

Figure 5. Software Discrepancy Report.

4.5.6.4 Recommendation Reports

The ILS will be responsible for developing, administering and summarizing user questionnaires for any products released. The surveys will be issued by the ILS as a prerequisite to releasing any code. It will be the responsibility of cognizant ILS staff to follow up with the recipient organization to ensure that feedback is provided.

Information contained in user reports and bug reports will be summarized in recommendation reports. These reports may also contain any insight gathered as a result of site visits, telephone conversations, demonstrations or any other contact with recipient organizations. Ideally, the recommendations are to be based on equally weighted collective feedback from all organizations utilizing MIDAS products in an effort to avoid favoring a particular user and their specific requirements. It is important that the ILS remain sensitive to this issue and avoid appropriating resources to unique user problems which may result in a competitive advantage for any singular organization.

4.6 Release of Code and Documentation

One primary purpose of the ILS is to aid in the dissemination of R&D products and services for use outside the developing organization. Although nearly all unclassified computer programs developed by NASA or NASA contractors can be made available to interested domestic parties, there are established guidelines and procedures to be followed by both the requestor and supplier of computer code. Initially, ILS staff must become familiar with overall NASA software distribution policy (Army policy is the same) as well as policies and procedures pertaining to specific software modules targeted for release. A NASA/Ames Contractor Report titled Software Technology Transfer (August, 1989) summarizes NASA policy and procedures for software distribution. An attachment to this report is available from the A^3I Program which discusses each major MIDAS software module and the procedures necessary for release. It is suggested that ILS staff become familiar with the content of the Contractor Report and attachment.

It will be the responsibility of the ILS to ensure the procedures for distribution of government-developed software are followed, all applicable criteria are met, approvals obtained and reports generated prior to release of any code. The Project Manager will interact closely with Program Management during the approval cycle. Following approval, documentation will be assembled and software loaded on an appropriate distribution medium (generally cartridge tape). It may be necessary for ILS staff to request the assistance of software development staff in the generation of distribution tapes.

4.7 Modifications

As ILS activities gain momentum there will be an increasing number of opportunities to enhance, correct, adapt or otherwise modify FLI/YBI software to suit outside organizations. Although the ILS implementation plan requires the ILS to have the capability to make modifications to development code, it is inevitable that some burden will be passed to code authors or developers most familiar with the code. The degree to which this impedes development progress, or conversely, inhibits outside interactions through the ILS, will ultimately be determined by the priorities of FLI/YBI and the sense of cooperation among affected staff members. Some initial guidelines are proposed that may at least illuminate the potential for conflict and the need to evolve some specific policies and procedures.

1) Clear statement of current mission from FLI/YBI and Program Management: Development and support staff must understand the primary purpose of any development effort at any given point in time, since most long term efforts are dynamic in this regard. In the 6 years of FLI/YBI development, the "mission" has included basic research, research and development, fund raising, public relations/promotion, production for end users, and perhaps may others.

2) Intermediate Change Process: FLI/YBI development phases are planned and implemented on the basis of yearly offsite meetings immediately following the completion of a development phase and demonstrations. Once development begins, there are no formal mechanisms or provisions for departures from the established plan. While this approach is most efficient in a close environment, it will be difficult to be responsive to outside organizations under these circumstances. It is recommended that some formal means of intermediate design review and status planning be perfomed to accommodate ILS activities. The impact on development staff should be minimized, but it is important that there is an appropriate level of technical representation.

3) Closed Loop Paper Trail: One important tangible product of ILS activities are reports and recommendations submitted to management. To ensure some priority and emphasis is placed on these documents, a closed loop method of routing should be implemented whereby products from the ILS eventually are returned to the ILS staff with comments from reviewers. Comments may include simple acknowledgement of receipt, technical feasibility assessment, schedule impact, budget impact, resource impact, priority and any other factors deemed appropriate.

4.8 Other Issues

4.8.1 Source Code

A decision was made during the early phases of the A^3I Program to prohibit incorporation of any software in the prototype MIDAS which did not include source code. This policy has proven to be critical to the successful integration of MIDAS components, and will continue to apply to future developments. The policy has significance to the ILS since it is expected that a variety of cooperative agreements will be negotiated whereby code is to be exchanged. The software received by FLI/YBI must include source if it is to be considered for incorporation in MIDAS.

4.8.2 Proprietary Software

The A^3I Program and others likely to emerge as part of Code FLI/YBI's future activities are portions of NASA's overall policy to conduct its activities to contribute to the preservation of the role of the United States as leader in aeronautical and space sciences and their applications. An essential element of this policy is the ability to transfer new technology outside the Agency in an efficient and timely manner. Although the A^3I Program's early objectives were to develop a proof-of-concept prototype in the most expeditious, economical manner (i.e. using commercial off-the-shelf software in some instances), later phases have seen an increased emphasis on transfer of technology. One obstacle the A^3I Program has encountered to achieving this element is commercially licensed, proprietary software embedded in certain MIDAS components. Consequently, it is recommended that ILS staff carefully evaluate the implications of incorporating proprietary software in MIDAS that may subsequently restrict the availability of MIDAS components.

5.0 STAFFING

5.1 Approach

The ILS staffing approach was to first identify a relatively comprehensive set of skills and responsibilities for the overall ILS. The next step was to outline a phased plan, with suitable skills and responsibilities at each stage of staffing. The final step was to develop position descriptions in a generic format compatible with NASA APM 48 (REV. OCT 88), Vacancy Announcement, or other typical job description formats. The position descriptions appear in Appendix E.

5.2 Skills & Responsibilities

The following is a collection of grouped skills and responsibilities identified for a particular "requirement" which may be combined to form ILS staff position descriptions. Some attempt has been made to prioritize those requirements that were identified, although it is recognized that these priorities are subject to change due to management emphasis, economic outlook, research objectives and other factors. Highest priority skills are listed first. Desired characteristics are provided as additional criteria which may be used to supplement an evaluation of candidate knowledge and skills, but are not considered disqualifying requirements if not satisfied.

Requirement: Liaison

- Knowledge/Skills:
  - Human Factors/Human Performance
  - Professional Level Publications
  - Public Speaking
- Responsibilities:
  - Understand & Promote MIDAS Concept
  - Understand Functional Limitations and Weaknesses
  - Author and Present Technical Papers
  - Emphasize Problem Solving Capabilities Available Today
  - Identify & Cultivate Candidates for MIDAS Technology
  - Supporting Planning Activities
- Characteristics:
  - Persuasive
  - Team Oriented
  - Views Consistent w/Program Office
  - Enthusiastic
  - Positive Attitude

Requirement: Designer

- Knowledge/Skills:
  - Prior Man-Machine System Design Experience
  - Understanding of Typical Design Problems
  - Contacts in Government & Industry
- Responsibilities:
  - Maintain Technical Liaison w/Outside
  - Study Technology of Like Efforts
  - Disseminate New Data to Development Staff

Report as Necessary
Generate & Document Technical Recommendations

Characteristics:

Bright & Quick Learner
Self Starter

Requirement: Facilities Coordination

Knowledge/Skills:

Systems Management on Unix & Symbolics Workstations
Configuration Management Procedures
Documentation Standards
Familiarity w/Software QA

Responsibilities:

Documentation Maintenance (User & Programmer)
Software Submissions to COSMIC
Guest Logistics (badging, orientation, setup, etc.)
Distribution of Documentation, Reprints, Code, etc.
Document Usability/User Interface Feedback
Surveys
Summary Reports & Functional Recommendations

Characteristics:

Junior Level

Requirement: Software Engineering

Knowledge/Skills:

C and LISP Programming Languages
Systems Integration

Responsibilities:

MIDAS Implementation Details
Technical Recommendation Priority Scheme
Assist Visiting Staff w/MIDAS Mods as Needed

Characteristics:

Ability to Work w/Others

Requirement: Management

Knowledge/Skills:

Technical Staff Management
Research Environments
Technology Transfer Requirements

Responsibilities:

Contracts/Agreements
Demonstrations
Interact with Program Office
Program Representative as Required
Liaison w/Technology Utilization Office & NASA/HQ

Characteristics:

Leadership
Initiative

Team Oriented

While it may be argued that each of the above requirements represents a staff position, the practical limitations necessitate staffing strategies which optimize the use of manpower by combining, distributing and in some cases eliminating lower priority skills or responsibilities. Secondly, a phased approached to staffing is anticipated, beginning with a single senior-level position and peaking at a level of 3-4 individuals. Three position descriptions, 1) ILS Manager, 2) Technical Lead and 3) Technical Support are provided (Appendix E) under the assumption that the ILS Manager position will be filled initially, followed by the Technical Lead and lastly the Technical Support position. Figure 6 is a proposed phasing plan.

There will be some overlap in the position descriptions due to the phased approach. Initial ILS staff will likely perform most of the duties of the Section, probably at a reduced level. As staff are added, responsibilities may be distributed optimally and a greater number of duties performed at a higher level of completeness, efficiency and effectiveness.

In the event a phased approach is not necessary and several staff members may be assigned to the ILS at the same point in time, redundant duties and responsibilities across the position descriptions may be removed and perhaps replaced with other duties from the requirements listing above. Position descriptions for an alternate staffing approach are provided where the ILS Manager is hired first, followed by two additional staff members simultaneously at a later date.

Position	1990												1991								
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Option 1- Manager		Δ																			
Tech. Lead				Δ																	
Tech. Sup.										Δ											
TBD														Δ							
Option 2- Manager		Δ																			
Tech. Lead							Δ														
Tech. Sup							Δ														
TBD														Δ							

Figure 6. Proposed ILS Staffing Schedule

6.0 FACILITIES

6.1 Rationale

The move to more actively foster inter-Government and Government-industry cooperative development has precipitated a requirement to provide government facilities at Ames to visiting staff from participating organizations. Ames is the most appropriate location to conduct joint activities because the staff expertise and equipment are available at Ames, while some of the products developed by FLI/YBI contain components that are proprietary or have restricted release which presently limits distribution outside Ames. Proposed facilities include furnished office space, computer equipment space with properly conditioned power and cooling, and access to existing FLI computer equipment.

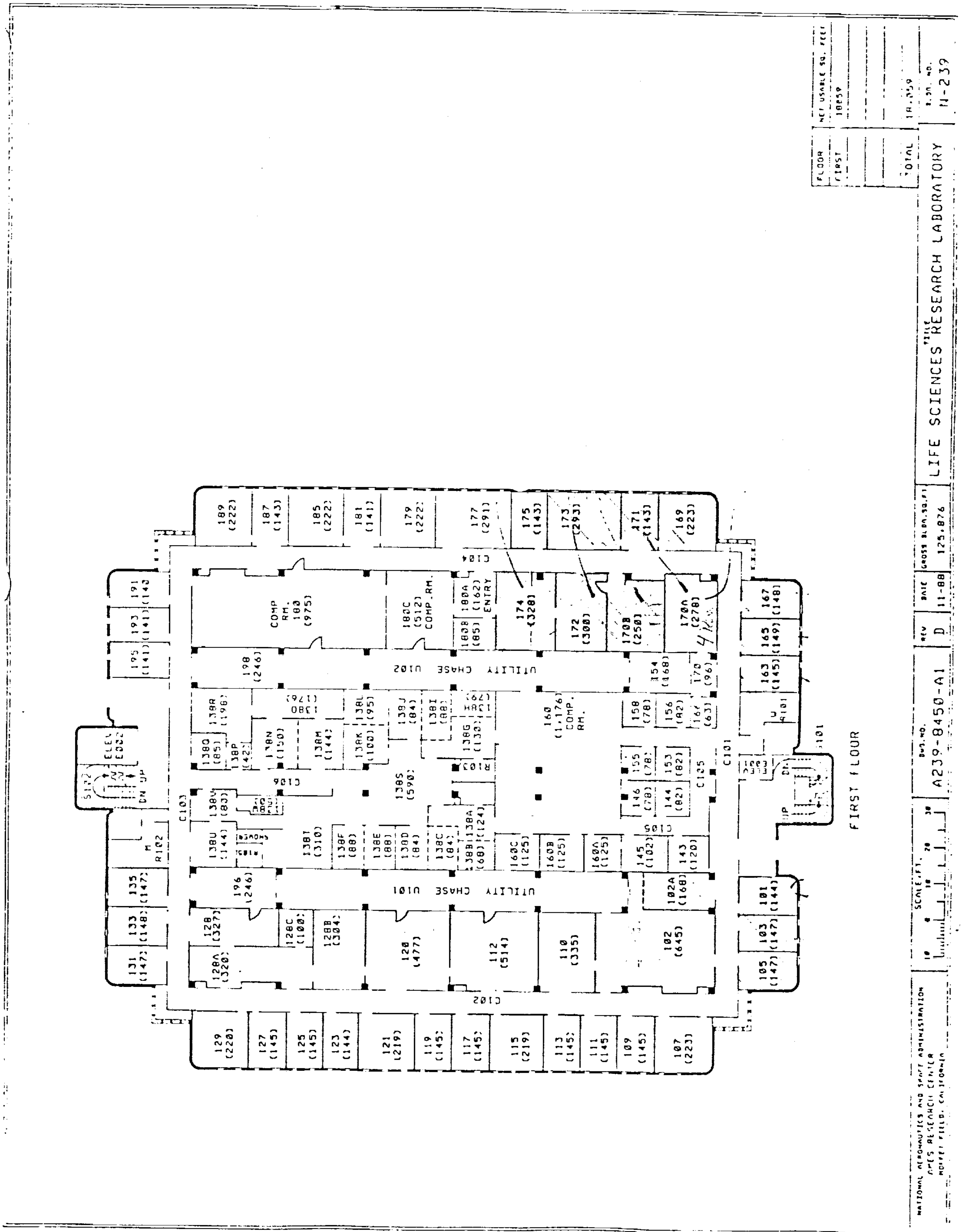
Previous cooperative arrangements have been primarily staff oriented, whereby representatives from Boeing, Sikorsky, Lockheed, etc. work directly with in-house software engineering staff at Ames for periods ranging from 2 weeks to several months. FLI/YBI software engineers typically instruct visiting staff on procedural issue in using the software and technical details of its implementation so that these developers may make any necessary modifications to suit their specific problems.

Other relationships may involve temporary or permanent integration of additional hardware into the prototype HF/CAE workstation suite from cooperating organizations in exchange for access to the workstation, software support and training.

6.2 Proposed Office Facilities

Upon completion of the new Human Performance Research Laboratory and occupation in March, 1990, there will be a reorganization and allocation of office space to those branches which remain in building N239, namely the Crew Research and Space Human Factors Branch and the Computation Human Engineering Research Office. The proposed allocation of space for FLI/YBI is depicted in the shaded areas of Figure 7, representing about 30% of available space. The remaining space is allocated to the Crew Research and Space Human Factors Branch. Given this configuration, the present plan calls for the following assignments:

Room 174	Lab Computer Equipment
Room 173	PSTA Manager + 2 staff
Room 172	Lab
Room 171	Branch Secretary
Room 170B	ILS Visiting Staff Offices
Room 170A	4 Software Engineers
Room 169	Branch Chief
Room 167	Software Support Task Manager
Room 165	Principal Scientist
Room 163	2 Software Development Group Leaders
Room 101	A^3I Deputy & ILS Manager
Room 103	2 Software Engineers
Room 105	2 Software Engineers



ORIGINAL PAGE IS
OF POOR QUALITY

The current allocation of space is already insufficient, since the present A^3I Program staff complement alone fills the available space with no room for 5 currently unfilled staff positions (2 ILS, 3 programmer). Furthermore, it is highly likely that the Computational Human Engineering Research Office will grow in the near future to include other projects in addition to A^3I. Some resolution is necessary to avoid the expense and inefficiency of placing contract staff in trailers. The above allocation of space appears to be deficient by approximately 4-7 "desks" in meeting the current and near future needs of FLI/YBI.

6.3 Requirements

The anticipated facilities requirements are outlined below.

Office Space. It is expected that from 1 to 3 individuals from each organization will work at Ames, while 1 or 2 organizations may be represented at any time. Since industry tends to be proprietary in the presence of perceived competition, it is important to provide at least two relatively isolated (enclosed area with doors) office areas so that developers may work uninhibited when there are two industry organizations present simultaneously. Two 10' by 12' areas would likely be sufficient to accommodate the maximum number of persons expected (3) per area. Area lighting should be fluorescent. Task lighting may be included for use near the furnished areas.

Furniture. The requirements for each 10' by 12' area include 2 desks, 3 chairs, a 2-drawer (minimum) file cabinet, 2 bookcases and a table.

Conditioned Power. Power supplied to theses areas should be conditioned in the event that participating organizations bring additional computer equipment to the site, or equipment is moved to these areas for use by visiting staff.

Equipment. Ideally, 1 Silicon Graphics Personal IRIS, 1 Symbolics 3620 or MacIvory and two ASCII terminals would be available as pool resources beyond the core equipment currently utilized by FLI development staff. This equipment would be dedicated to visiting staff as the first priority, and other FLI staff on an "as available" basis.

Access to Existing Facilities. Both electronic and physical access should be provided to allow free communication between visiting staff and FLI staff. It should be convenient to move between the office space and the FLI development laboratory. Cabling between existing equipment and future installations for use by visiting staff should be provided via raised floor or concealed cable runs.

Safety. Smoke detectors tied to the master building system should be provided. A minimum of two egress routes from each office area should be available in the event of a fire or other hazard.

6.4 Projected Costs

Structural Modifications (NASA SR)	$	5,000.00
Lighting (NASA SR)	$	2,000.00
Furniture (NASA/Army PR)	$	10,000.00
Personal IRIS Graphics Computer (NASA PR)	$	35,000.00
Symbolics 3620 (NASA PR)	$	30,000.00
2-ASCII Terminals (Task ODC)	$	2,000.00
TOTAL	$	84,000.00

7.0 FUTURE DIRECTIONS

7.1 Research

Code FLI/YBI is a research office and as such will continue to facilitate and perform computational human factors research activities. Prior to the completion of A^3I as a research project it is anticipated that certain aspects of A^3I will be formally designated "research" in nature and detached from production requirements and the pull of the user community. The ILS will remain cognizant of these eminent divisions and serve to inform the user community of the status of ongoing research developments. ILS staff will make clear the distinction between research and pilot or production developments, and identify each major MIDAS component as belonging to one of these classifications.

7.2 Production

The A^3I Program is rapidly reaching maturity as an exploratory research program, and will likely begin transitioning to development and production phases in the near future. This transition requires skills and procedures that are often in conflict with the goals and objectives of fundamental research activities. Consequently, provisions must be made for a smooth transition which minimizes resource and organizational conflict.

More significantly, it is important to establish clear boundaries between research and production elements to facilitate the acquisition of funding from the widest possible range of government and industry sources.

7.3 Commercialization

Many of the products and services developed by FLI/YBI staff and support personnel are suitable for commercialization. Several mechanisms exist that enable the government to benefit from commercialization of products developed with government funding. Benefits include professional recognition, royalties, patent rights, copyrights and other negotiable advantages. ILS staff are positioned to anticipate commercialization of FLI/YBI products based on outside demand, and may assist with laying the foundation for implementing commercialization or joint endeavor agreements.

7.4 Funding

Trends in FLI/YBI funding over the life of the A^3I Program have been unfavorable due to sizable cuts in defense spending for R&D. As a result, innovative and creative approaches to accomplishing necessary development have been increasingly entertained. These approaches have primarily centered around cooperative or collaborative agreements where code is provided in exchange for funding from another government agency. An optimistic viewpoint would contend that serious interest from industry in mature MIDAS products will be accompanied by funding. While additional funding is certainly desirable, some caution is necessary for reasons of competitive advantage previously mentioned. The ILS will play a major role in identifying and ascertaining the suitability of any organization outside the government for supplying FLI/YBI with funding.

8.0 CONCERNS

8.1 Startup & Staffing

The crucial step in building an effective ILS will be the selection and orientation of the Project Manager. The qualifications of this individual have been outlined, but the criticality of this position has not been adequately addressed. The importance of this initial position (it is assumed that the manager position will be filled first) is largely dictated by the fact that it is likely the Project Manager will be performing the duties of the entire ILS for an indefinite period of time. The period of time may simply be contingent on the success or failure of the Manager to generate sufficient tangible interest outside FLI/YBI in the form of cooperative agreements, requests for software or funding. Overall effectiveness is also determined by the ability of the Manager to interact with all factions of the Program from Management and Chief Scientists to software engineers. In short, the ILS Manager must be successful and team oriented if the ILS concept is to gain acceptance and momentum.

8.2 Facilities

The proposed N239 office facilities are barely adequate for even the existing staff level, which is presently under complement by 5 unfilled positions. Little or no space has been provided for expansion, which is inevitable given the available positions, the mission of Code FLI/YBI (research) and the apparent direction of many aspects of A^3I (production).

8.3 Organizational Conflict

FLI/YBI and support staff represent a unique and sometimes complex mixture of NASA, Army, grantee, contractor and subcontractor staff. The A^3I Program has enjoyed an unprecedented degree of success managing this diverse collection of capabilities because all participants could generally be focused on a single goal (completion of phase of development) with minimal competing objectives. As FLI/YBI grows and expands into research domains, and as staff are added who may be matrixed across several responsibilities, the task of motivating and managing will become significantly more difficult. The ILS may find itself wedged in the middle of this complexity because toplevel direction and approval is provided at the Office level, but implementation of ILS objectives is heavily dependent on the degree of cooperation between ILS staff and both support and development staff. There is no simple organizational solution to this complexity, however ILS staff members who must function effectively in this environment should be selected with some sensitivity to their communications skills and the ability to work well with a variety of professionals.

A more radical proposal than careful staff selections would be to place the ILS as a support function within the FLI/YBI Office in the same manner as PSTA. While this would not guarantee success, it would increase the visibility of ILS and provide additional authority. However, since the ILS is a new and evolving area, it is recommended that the current structure be implemented initially until the purpose and priority of ILS activities become more clearly defined.

8.4 Technical Issues

Early A^3I development phases emphasized incremental software development, rapid prototyping, object-oriented programming techniques and language/operating system standardization as the preferred tools and techniques to be employed in all software development. While it was acknowledged indirectly that some of these techniques facilitate portability, there has been a reduced emphasis on this issue in recent phases. The ILS is in a position to heighten sensitivity to software portability by virtue of its influence on reliability, quality assurance and configuration management policy. These policies and procedures should be developed with an appropriate level of consideration to the portability issue.

Appendix A. A^3I Software Modules and Configuration Data (including Distribution Status)

Jack

Interactive application program to display and manipulate articulated geometric figures. Used by A^3I to analyze human reach and fit, comfort, etc. in advanced helicopter cockpits. Integrated by A^3I staff with 3D environment construction tools (CDE/VIEWS).

Name	Jack
WBS/CI Number	
Language(s)	C
Hardware Platform(s)	All Silicon Graphics
Minimum Configuration	?? MB RAM ?? MB Mass Storage ?? Bit Planes 19 in. Monitor
A^3I OS Version	3000 Series: 3.6 4D Series: 3.1D GTX: 3.1D
Latest OS Version	3000 Series: 3.6 4D Series: 3.2.1 GTX: 3.2.1
Baseline Version & Date	Version 3.10, February, 1989
OS Compatibility	3000 Series: 3.5 - 3.6 binary compat. 4D Series: 3.1C - 3.2 binary compat. 3000->4D: Recompile required
Major Release Version & Date	Version 3.10, February, 1989
Development Software Version	4.0
Last Minor Update	September, 1989
Documentation	Jack User's Guide, Version 2.0, September 12, 1988 & 2.1, November 11, 1988, Computer Graphics Research Laboratory, Dept. of Computer and Information Sciences, University of Pennsylvania.
Configuration Management	
Outside Interest	McDonnell Douglas Helicopter (Longbow) Patuxent River Naval Air Station Boeing Commercial Airplanes Douglas Aircraft Company TACOM

Distribution Status: UPenn has given permission for release of binaries only, provided UPenn is notified of who receives the code. UPenn must be contacted directly regarding release of source code.

Acquisition Options:

1) Request code from COSMIC after it is submitted by A^3I and becomes available. Binaries only will be submitted, provided COSMIC has a mechanism for tracking and reporting who receives the code. Cost is unknown at this time.
2) Executable code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements

are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.

3) UPenn may be contacted directly (Dr. Norman Badler).

Mission Specification/Task Decomposition

Initial implementation was Mission Decomposition Methodology, an object-oriented framework for creating discrete time simulations of hierarchical human-machine task interactions. The Mission Decomposition Methodology was separated into mission, pilot and vehicle components for independent development.

Name	Mission Specification/Task Decomposition
WBS/CI Number	
Language(s)	Symbolics Common LISP
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	Genera 7.2
Latest OS Version	Genera 7.2
OS Compatibility	Genera 7.0->Genera 7.2
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	Phase III Symbolic Modeling SDDD, December, 1988, Jerry Murray, Sterling Software. BBN Report No. 6431, December, 1986
Configuration Management	
Outside Interest	Boeing Commercial Airplanes

Distribution Status: BBN has granted approval for the release of the software, provided appropriate acknowledgements to both BBN and NASA are given. This software is classified as "pilot" code and may be submitted to NASA COSMIC.

Acquisition Options:

1) Request code from COSMIC after it is submitted by A^3I and becomes available. Source will be available (LISP). Cost is unknown at this time.
2) Code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.

Symbolic Pilot Model

Symbolic pilot model initially existed as an integrated component of the task decomposition methodology. Subsequently separated and enhanced in by in-house development staff to allow independent development and exploration of computational human performance models. The current VACP resource model is being extended to include context sensitivity and multiple resource theory. A constraint-based, dynamic, adaptive, opportunistic scheduler is also being designed. Symbolic pilot model is separate and distinct from "analytical" pilot models such as Jack, and attempts to model more cognitive and qualitative aspects of human behavior and performance.

Name	SymbolicPilot Model
WBS/CI Number	
Language(s)	Symbolics Common LISP
Applications	GEST 3.0 (Georgia Tech Research Institute) SOAR V5 (CMU)
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	Genera 7.2
Latest OS Version	Genera 7.2
OS Compatibility	Genera 7.0->Genera 7.2
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	Part of Phase III Symbolic Modeling SDDD, December, 1988, Jerry Murray, Sterling Software. BBN Report No. 6431, December, 1986
Configuration Management	
Outside Interest	

Distribution Status: This software is classified as development, and is not appropriate for submission to COSMIC.

Acquisition Options:

1) Code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.
2) Portions of the code which do not exceed $ 50,000 in development cost may be directly released by A^3I, with acknowledgments.

Training Assessment Module

The Training Assessment Module was designed to 1) give equipment designers early feedback about the training implications of design decisions, and 2) provide training program designers with training requirement prediction information that may be used to develop appropriate instructional approaches. Software was developed entirely by A^3I software development staff (Sterling Software), although the methodology was based on Logicon, Incorporated's Training Analysis Support Computer System (TASCS).

Name	Training Assessment Module
WBS/CI Number	None
Language(s)	Symbolics Common LISP (I/O functions)
Applications	Inference Corp. Automated Reasoning Tool (ART), Version 3.2
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM

	?? MB Mass Storage
A^3I OS Version	Genera 7.2
Latest OS Version	Genera 7.2
OS Compatibility	Genera 7.0->Genera 7.2
Application Compatibility	ART V?->ART V3.2
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	Phase III Training Assessment SDDD, December, 1988, Carolyn Banda, Sterling Software.
Configuration Management	None
Outside Interest	AAAV Program Office NTSC (AAAV Program Office) NASA/Marshall Space Center

Distribution Status: Code is considered pilot or production and is appropriate for submission to to NASA COSMIC.

Acquisition Options:

1) ART is required. Request code from COSMIC after it is submitted by A^3I and becomes available. Source will be available (LISP). Cost is unknown at this time.
2) ART is required. Code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.

Cockpit Display Editor and Views

A tool designed to construct and animate 3D graphical representations of helicopter cockpits and simulated environments for human factors analysis. The application is an A^3I-modified version of commercial software (MultiGen) designed for visual system data base modeling.

Name	Cockpit Display Editor and Views
WBS/CI Number	
Language(s)	C
Application	Software Systems' MultiGen Kernel Version 3.0, 8/12/88 Flight DBL Version 4.0, 7/88
Hardware Platform(s)	All Silicon Graphics
Minimum Configuration	8 MB RAM 100 MB Mass Storage for development 10 MB Mass Storage for execute only 24 Bit Planes 19 in. Monitor
A^3I OS Version	3000 Series: 3.6 4D Series: 3.1D GTX: 3.1D
Latest OS Version	3000 Series: 3.6 4D Series: 3.2.1 GTX: 3.1D
OS Compatibility	3000 Series: 3.5 - 3.6 binary compat.

	4D Series: 3.1C - 3.2 binary compat.
	3000->4D: Recompile required
Application Compatibility	No compat. w/newer versions
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	MultiGen Programmer's and User's Documentation, November, 1988, Software Systems. Phase III Cockpit Design Editor SDDD, December, 1988, Teh-Ming Hsieh, Sterling Software. Phase III Views SDDD, December, 1988, Andrew Lui, Sterling Software.
Configuration Management	MultiGen: RCS CDE/Views: None
Outside Interest	Patuxent River Naval Air Station McDonnell Douglas Helicopter Lockheed Missiles and Space NTSC (AAAV Program Office) FAA Aviation Safety and Automation Program Trimble Navigation Systems Douglas Aircraft Company TACOM

Distribution Status: CDE and Views may not be distributed directly by NASA due to the proprietary restrictions of the basis code, MultiGen.

Acquisition Options:

1) Executable licenses are available from Coryphaeus Software, Monte Sereno, CA (408-395-4537) for $ 30,000. Price includes software on cartridge tape, installation, user training, documentation and limited support. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release of Government-developed code. Source is available, fees negotiable.
2) Executable licenses are available from Software Systems, San Jose, CA (408-995-0689) for $ 25,000 without documentation or support. A^3I is responsible for necessary approvals, distribution and support.
3) Portions of the code which do not exceed $ 50,000 in development cost may be directly released by A^3I, with acknowledgments.

Communications

Application software used to transfer math model output data to the graphic display application soft re in a scaled time simulation. Software developed entirely by A^3I software development staff.

Name	Communications
WBS/CI Number	
Language(s)	C, LISP
Hardware Platform(s)	All Silicon Graphics All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage

A^3I OS Version	3000 Series: 3.6 4D Series: 3.1D GTX: 3.1D Symbolics Genera 7.2
Latest OS Version	3000 Series: 3.6 4D Series: 3.2.1 GTX: 3.2.1 Symbolics Genera 7.2
OS Compatibility	3000 Series: 3.5 - 3.6 binary compat. 4D Series: 3.1C - 3.2 binary compat. 3000->4D: Recompile required Symbolics: Genera 7.0->Genera 7.2
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	Phase III Communications SDDD, December, 1988, Alex Chiu, Sterling Software.
Configuration Management	None
Outside Interest	Lockheed Missile and Space

Distribution Status: Code does not meet the criteria for submission to NASA COSMIC, but may be released directly by A^3I. Source (C and LISP) is available.

Acquisition Options:

1) Request code from A^3I Program Office. Acknowledgements are required.

Aero/Guidance

Existing application software developed for man-in-the loop simulation which was adapted by A^3I to compute linear, uncoupled, 6 degree-of-freedom helicopter dynamics. The algorithms were adapted under subcontract, while implementation, integration and modifications were performed in-house.

Name	Aero/Guidance
WBS/CI Number	
Language(s)	C, FORTRAN IV
Hardware Platform(s)	All Silicon Graphics
Minimum Configuration	minimal RAM minimal Mass Storage
A^3I OS Version	3000 Series: 3.6 4D Series: 3.1D GTX: 3.1D
Latest OS Version	3000 Series: 3.6 4D Series: 3.2.1 GTX: 3.2.1
OS Compatibility	3000 Series: 3.5 - 3.6 binary compat. 4D Series: 3.1C - 3.2 binary compat. 3000->4D: Recompile required
Baseline Version & Date	Phase III, December, 1988
Major Release Version & Date	

Development Software Version	
Last Minor Update	
Documentation	Phase III Aero/Guidance SDDD, December, 1988, Alex Chiu, Sterling Software. Analytical Mechanics Associates Contractor Report
Configuration Management	
Outside Interest	

Distribution Status: Code is considered pilot or production and is appropriate for submission to NASA COSMIC.

Acquisition Options:

1) Request code from COSMIC after it is submitted by A^3I and becomes available. Source (FORTRAN) will be available. Cost is unknown at this time.
2) Code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.
3) Contact NASA/Ames Software Lending Library manager (Sterling Software) for policy regarding distribution of original TMAN program.

Volumetric Field-of-View Vision Model

3D volumetric projection of the pilot's field-of-view developed under NASA Grant to the New York Association for the Blind.

Name	Volumetric Field-of-View Vision Model
WBS/CI Number	None
Language(s)	C
Applications	Jack Version 3.10 (display environment)
Hardware Platform(s)	All Silicon Graphics
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	3000 Series: 3.6 4D Series: 3.1D GTX: 3.1D
Latest OS Version	3000 Series: 3.6 4D Series: 3.2.1 GTX: 3.2.1
OS Compatibility	3000 Series: 3.5 - 3.6 binary compat. 4D Series: 3.1C - 3.2 binary compat. 3000->4D: Recompile required
Application Compatibility	Jack V3.1->Jack V4.0
Baseline Version & Date	
Major Release Version & Date	
Development Software Version	
Last Minor Update	August, 1989
Documentation	
Configuration Management	
Outside Interest	AFHRL Douglas Aircraft Company

Distribution Status: Aries Ardidit has granted permission to distribute the volumetric field of view software in binary form, with acknowledgements. Code is considered pilot or production and is appropriate for submission to to NASA COSMIC.

Acquisition Options:

1) Request code from COSMIC after it is submitted by A^3I and becomes available. Binaries only will be submitted, provided COSMIC has a mechanism for tracking and reporting who receives the code. Cost is unknown at this time.
2) Code may be directly released by A^3I if a cooperative/contractual agreement exists between the A^3I Program and the recipient. Acknowledgements are required, and approvals must be obtained at NASA/Ames and NASA/HQ prior to release. Recipient may not subsequently distribute software received under this provision.
3) Contact the New York Association for the Blind directly.

Visibility Vision Model

Developed under contract with David Sarnoff Research Center as part of ongoing development at Sarnoff. Analytical model to predict legibility of specific information under particular environmental conditions such as lighting, sun angle, equipment location and emissive characteristics. The application is image-based (vs. polygon/geometry-based) and requires photographic quality image input. It is also projected to execute on SUN Microsystems hardware.

Name	Visibility Vision Model
WBS/CI Number	
Language(s)	C
Hardware Platform(s)	Sun Microsystems
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	TBD
Latest OS Version	TBD
Major Release Version & Date	
Development Software Version	
Last Minor Update	
Documentation	
Configuration Management	
Outside Interest	AFHRL Douglas Aircraft Company

Distribution Status: It is expected that Sarnoff Labs will give permission for release of binaries only under the same conditions as UPenn and N.Y. Association for the Blind software. A formal position has not been issued at this time.

Acquisition Options:

1) Expected to be the same as New York Association for the Blind, but currently unverified

Visual Modeler

A prototype application designed to allow graphical creation of math models that was developed under subcontract to Expert EASE Systems. Uses data flow simulation methods. Not currently integrated with MIDAS.

Name	Visual Modeler
WBS/CI Number	
Language(s)	Symbolics Common LISP
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	Genera 7.0
Latest OS Version	Genera 7.2
Major Release Version & Date	Phase II, July, 1987
Development Software Version	
Last Minor Update	
Documentation	Expert EASE Contractor Report
Configuration Management	
Outside Interest	

Icon Editor

Application to allow non-programmers to create and connect various 2D display types to simulation variables for display (tap probes) or to interact with the displays to alter values of simulation variables (tap sets). Extracted from STEAMER application developed by BBN for Navy Personnel Research and Development Center for interactive training devices. Not used in Phase III.

Name	Icon Editor
WBS/CI Number	
Language(s)	Symbolics LISP
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage Color Monitor (will work in B&W)
A^3I OS Version	Genera 7.0
Latest OS Version	Genera 7.2
Major Release Version & Date	Phase II, July, 1987
Development Software Version	
Last Minor Update	
Documentation	Phase II SDDD
Configuration Management	
Outside Interest	

Modeler

Application used in Phase II to control overall execution of the A^3I simulation and provide an integrated environment of constructing simulations. Based initially on STEAMER executive due to ability to handle variable resolution and rate math models. Not used in Phase III.

Name	Icon Editor
WBS/CI Number	

Language(s)	Symbolics LISP
Hardware Platform(s)	All Symbolics
Minimum Configuration	?? MB RAM ?? MB Mass Storage
A^3I OS Version	Genera 7.0
Latest OS Version	Genera 7.2
Major Release Version & Date	Phase II, July, 1987
Development Software Version	
Last Minor Update	
Documentation	Phase II SDDD
Configuration Management	
Outside Interest	

Appendix B. Sample Memorandum of Agreement

MEMORANDUM OF AGREEMENT

Between Army-NASA Aircrew/Aircraft Integration Program Office

and the NASA/Ames Information Sciences Office

This agreement between the Army-NASA Aircrew/Aircraft Integration Program Office within the Aerospace Human Factors Research Division (FL) and the Information Sciences Office (ISO) at NASA/Ames Research Center defines the support ISO will provide the A^3I Program.

The A^3I Program is a joint Army-NASA research and development undertaking requiring expertise from a variety of disciplines such as engineering, computer science, artificial intelligence, human performance modeling, cognitive sciences, training, operations, reliability and quality assurance, safety, and manufacturing. Many centers of excellence exist throughout the U.S. that specialize in one or a number of these areas, for example MIT, Stanford and Carnegie-Mellon Universities in select areas of artificial intelligence.

The approach adopted by the A^3I Program for achieving the specified goals,involves coordinating an effort which utilizes as its foundation, the findings of various centers of excellence. The Information Sciences Office at NASA/Ames is considered one such center.

It is agreed that the following tasks will be performed by ISO for the A^3I Program:

(1) Develop a (brief) functional specification describing the training issues and proposed implementations within the overall A^3I designers workstation.

(2) Develop an expert system consistent with other A^3I hardware and software structures which implements the concepts described in (1).

(3) Provide support for integration of the training expert system component of the overall workstation structure.

(4) Support scheduled demonstrations as required by the Program Office.

(5) Provide progress reports to the Program Office as needed.

(6) Establish and maintain contact with other Program participants that are providing relevant expertise or deliverables.

The preliminary schedule indicates required completion dates for specified tasks.

TASK PROGRAM YEAR

86 87 88 89 90 91

Functional Specification X----X

Expert System Development X---------------------------------X

Demonstration X X X X

Integration X-------------------X

The A^3I Program will provide funds to support the ISO task elements. These funds shall be consistent with overall program resources and will be negotiated anually dependent on progress and needs.

The A^3I Program point of contact will be E. J. Hartzell (415-694- 5743, MS 239-21 Room 119).

CONCURRENCE
date

C. Thomas Snyder - Director, Aerospace Systems

CONCURRENCE
date

David C. Nagel - Chief, Aerospace Human Factors Research Div.

CONCURRENCE
date

Victor L. Peterson - Director, Astronautics

CONCURRENCE
date

Henry Lum, Jr. - Chief, Information Sciences Office

Appendix C. Sample Interagency Agreement

A MEMORANDUM OF AGREEMENT BETWEEN THE ARMY AVIATION RESEARCH AND TECHNOLOGY ACTIVITY (AVSCOM) AND THE AMES RESEARCH CENTER(NASA)

FOR THE JOINT ARMY/NASA AIRCREW AIRCRAFT INTEGRATION PROGRAM

The Aviation Research and Technology Activity (ARTA-AVSCOM) and the Ames Research Center (NASA) are presently engaged in joint research activities aimed at improving the working environment of the modern helicopter pilot and of the ability of this man-machine system to perform the missions assigned. These activities reflect the recognition that a crew-performance/workload/training problem exists in today's civil and tactical military helicopters that can contribute to mission failure or loss of aircraft or crew. There is a need to develop predictive computational methods to be able to design efficient cockpits and to train aircrews to assure a symbiotic relationship between the man and the machine. The objective of both agencies is to develop an interactive computer-based design and analysis system that incorporates models for system simulation, human behavior and performance models, graphics, expert systems, and other tools for use by designers and planners of cockpits and training devices for future advanced technology rotorcraft.

The focus from the Army's point of view is the single-seat scout/attack rotorcraft with a capability to perform its mission at night, in adverse weather, and operating in the nap-of-the- earth environment. From the NASA perspective, the focus is the highly automated helicopter with full capability for single pilot IMC operation.

This program is to establish reliable predictive computational methods that will enable:

1. Engineers to design helicopter controls, and automated systems displays, with assurance that the consequent man-machine system will accomplish its mission with satisfactory performance, acceptable workload, and reasonable cost.

2. Users to develop rotorcraft training systems and devices that will support the required level of aviator capability at acceptable cost.

The program will be jointly managed and funded by the Army and the NASA. The particular organizations responsible for managing the program are the Aeroflightdynamics Directorate of the Aviation Research and Technology Activity (AVSCOM) and the Aerospace Systems Directorate of the NASA Ames Research Center, both of which will be active in all elements of the program. The Program Office will be located within the Aerospace Human Factors Research Division at Ames and will report to the Chief of that Division. It is expected that there will be active participation by the Avionics R&D Activity (AVSCOM); the Applied Technology Directorate (ARTA-AVSCOM); the Army Research Institute for Behavioral and Social Sciences; the Army Human Engineering Laboratory; the Directorate for Training and Doctrine (USAAVNC) in those portions of the program that are relevant to the interests and activities of the respective organizations. The NASA Ames Research Center's Information Sciences Office will play an important role in the program as will other related Center organizations.

The program is established under the auspices of and pursuant to the terms of the "Agreement between the National Aeronautics and Space Administration and the Army Materiel Command for Joint Participation in Aeronautical Technology Related to Army Aviation", dated November 12, 1969, and "An Agreement between the National Aeronautics and Space Administration and the United States Army Materiel Development and Readiness Command for Joint Participation in Aeronautical

Technology at the Ames Research Center, Moffett Field, California", revision dated 18 February, 1983. In accordance with the concepts of operation of these agreements, each agency will provide funding, support, and personnel as these resources are available, but generally in accordance with the program plan to achieve a major objective within five years.

The Directors of Aeroflightdynamics, ARTA, and of Aerospace Systems of NASA-Ames, or their designated representatives, will establish procedures in a manner responsive to the needs of their respective agencies for periodic review of the Army/NASA Aircrew Aircraft Integration Program to ensure proper direction of effort and to determine the technical, administrative, fiscal, and personnel adequacy of the program.

The provisions of this agreement are subject to modification or termination of the NASA/Army agreement dated November 12, 1969 (NASA NMI 1052.123).

date date

Director Director
NASA Ames Research Center Aviation Research and
Technology Activity

date date

Director Director
Aerospace Systems Aeroflightdynamics

Appendix D: Sample Technical Exchange Agreement

TECHNICAL EXCHANGE AGREEMENT

BETWEEN THE
ARMY/NASA AIRCREW-AIRCRAFT INTEGRATION PROGRAM OFFICE
AND
<ORGANIZATION>

IN THE AREA OF GRAPHICAL PROTOTYPING TOOLS
FOR
COMPUTATIONAL HUMAN ENGINEERING ANALYSIS

The National Aeronautics and Space Administration, by virtue of the National Aeronautics and Space Act of 1958, is directed to conduct its activities so as to contribute to the preservation of the role of the United States as a leader in aeronautical and space science and technology, and their applications. NASA recognizes that technical exchanges between the Agency and industrial organizations will accelerate understanding of the use of graphical prototyping techniques in developing computational human engineering principles and methodologies. <Organization> recognizes that NASA has developed prototype tools which can enhance the firm's ability to meet the aerospace industry's needs for graphical design tools.

Accordingly, effective when signed by the last signatory to this Agreement, the National Aeronautics and Space Administration (hereafter NASA), Washington D.C. 20546 and <Organization>, having a principal place of business at <address>, agree as follows:

ARTICLE I - PURPOSE, SCOPE, AND CONSIDERATION

1.01 For the purpose of investigating the usage of graphical techniques for prototyping and subsequent analysis of man-machine interfaces, NASA and <Organization> agree to exchange technical information and to consult on the development of a flexible design environment for rapidly prototyping and animating cockpit displays and controls (hereafter SUBJECTS). This technology is currently under development within the NASA/Ames Computational Human Engineering Branch (Code FLI) as part of the Army/NASA Aircrew-Aircraft Integration (A^3I) Program.

1.02 Both parties shall exert their best efforts and cooperate in good faith to achieve the purpose of this Agreement. All work done by either party in conjunction with or related to this Agreement is at the sole discretion and expense of that party. There will be no exchange of funds under this Agreement, the sole consideration residing in the cost-free exchange of information and data on the SUBJECTS. The parties recognize that NASA's ability to perform its obligations hereunder is subject to the availability of appropriated funds.

ARTICLE II - RESPONSIBILITIES

2.01 <Organization> shall contribute the following to the Agreement, valued at <$ value>

i) design, code and test a series of functional enhancements to the set of existing NASA prototype tools currently used by the A^3I Program for studying the human factors implications of helicopter cockpit designs. The enhancements are listed below in order of development priority, based on an assessment of needed capabilities at the time of this agreement, but do not represent a rigid commitment to generate the identified capabilities. The composition and priorities of the list are likely to change over the term of this agreement subject to NASA and <Organization> requirements.

Projected Functional Enhancements to NASA Graphic Prototyping Tools

1) Perspective Display Editor
2) Improved User Interface
3) Display/Control Library
4) Interfaces to SGI "Personal Visualizer" Rendering Package
5) On-Line Display/Control Design Aiding (heuristic)
6) HUD Editor
7) HMD Editor
8) Raster Fonts on Multi-Function Displays
9) Extendible Simulation Variable Interface

ii) collaborate with NASA and NASA contractors on the integration of functional enhancements i) above;

iii) advise NASA on areas where functional capabilities not currently supported by the existing set of tools or functional enhancements above is lacking and provide inputs to any development which NASA may consider or conduct;

iv) collaborate with NASA and NASA contractors on the development of interfaces between the graphical prototyping tools and both existing and potential analysis tools;

v) develop complete user documentation for NASA graphical prototyping tools;

vi) provide demonstrations, temporary evaluation copies of executable code, documentation, training and other user support to organizations designated by NASA (the A^3I Program Office) relating to the graphical prototyping tools. Obtain necessary approval from the cognizant NASA Technology Utilization Office and generate appropriate summaries for NASA Headquarters in cases where NASA graphical prototyping software is to be released to another organization.

2.02 NASA shall contribute the following to the Agreement:

i) source code for the current versions of the graphical prototyping tools on cartridge tape distribution medium;

ii) text source (Macintosh file in Microsoft Word format) of current graphical prototyping tool documentation;

iii) access to source code of any analysis tools to be used (or considered for use) in conjunction with graphical prototyping tools;

iv) integration of the tools developed by <Organization> in 2.01i) with existing tools utilized by NASA;

v) collaborate with <Organization> on the development of interfaces between the graphical prototyping tools and both existing and potential analysis tools;

2.03 Each party will appoint a person to serve as an official contact and to coordinate the activities of each party in carrying out this Agreement. The appointees of each party are:

<Organization>: <name/title>
NASA: E. James Hartzell/Chief, Code FLI

2.04 Each party shall have sole discretion with respect to implementation of the work done by it. Each party's use of the advice and comments offered by the other party is at the using party's sole discretion and risk.

2.05 In performance of activities pursuant to this Agreement, it is contemplated that <Organization> and NASA personnel will visit and confer at the other's facilities, and therefore each party agrees to observe the safety, security and facility operating rules while on the other's property.

2.06 Title to any personal property furnished by one of the parties to the other under this Agreement shall remain in the party furnishing the same. The parties agree to exercise due care in handling such property; however, each of the parties agrees to be responsible for any damage to its property suffered in the performance of this Agreement and to waive any claim against the other party for such damage, whether arising through negligence or otherwise.

2.07 No member of or delegate to the United States Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this Agreement if made with a corporation for its general benefit.

ARTICLE III - DATA

3.01 Data as used in this Agreement is defined to encompass information relating to the SUBJECTS which is in writing, on computer magnetic storage medium or proper other recorded or tangible form. Orally disclosed information is included only to the extent that the information, and any restrictions on disclosure of the same pursuant to this Agreement, are identified at the time of disclosure and later reduced to writing and transmitted by the disclosing party to the recipient party within one (1) month of the oral disclosure.

3.02 Except for limitations expressly stated in this Article, all data exchanged pursuant to this Agreement may be used or disclosed by the receiving party without restriction. The parties agree to use the data responsibly and to give credit to each other where appropriate in any publications. Although reasonable efforts will be made by the parties to minimize such occurrence, it may be necessary for <Organization>, within its sole discretion, to furnish or otherwise disclose to NASA certain previously existing (relative to the date of this Agreement) data which constitutes <Organization> trade secrets. In order to enable <Organization> to maintain its trade secret rights in such data, the following Notice shall be affixed to the data and NASA will thereafter treat the data in accordance with the conditions of the Notice.

NOTICE

This data is a trade secret of <Organization> and is submitted in confidence to NASA under Technical Exchange. It may be used, reproduced and disclosed by NASA only for the purpose of carrying out its responsibilities thereunder, with the express limitation that it will not, without prior written permission of <Organization>, be disclosed outside NASA. This Notice shall be marked on any reproduction of this data in whole or in part.

Upon termination or expiration of this Agreement, NASA agrees to return all copies of trade secret data bearing such Notice to <Organization> or to destroy the same at the option of <Organization>.

3.03 As to data newly developed by <Organization> pursuant to this Agreement and identified by <Organization> at the time of transmitting the same to NASA as related to an invention for which <Organization> wishes to seek patent protection, NASA shall, to the extent permitted by law, withhold such data from public disclosure for a reasonable period not to exceed one (1) year from the data of receipt thereof by NASA. Any such data and unrestricted data contained in the same document therewith shall be clearly designated by <Organization> with appropriate markings.

3.04 No rights are granted to NASA by this Agreement in any <Organization> patent rights covering inventions disclosed in previously existing or newly developed data or other <Organization> information disclosed to NASA by <Organization> pursuant to this Agreement.

3.05 Data newly developed by NASA pursuant to this Agreement and identified by NASA at the time of transmitting the same to <Organization> as related to an invention for which NASA wishes to seek foreign patent protection shall be withheld from public disclosure by <Organization> for a reasonable period not to exceed one (1) year. Newly developed NASA data shall also be subject to withholding from public disclosure by <Organization> in order to preserve first publication rights in the NASA employee investigator(s) who originated the data. Any such data and any unrestricted data contained in the same document shall be clearly designated by NASA with appropriate markings.

3.06 Each of the parties shall have the right to disclose to third parties for purposes consistent with the purpose of this Agreement as define in Section 1.01, data originated by the other party, providing such third parties before receiving data shall agree in writing to be subject to the same restrictions on use and disclosure of data as are imposed on the party disclosing the data to the third party.

ARTICLE IV - TERM OF AGREEMENT

4.01 The term of this Agreement shall be for one (1) year from the effective data of this Agreement.

4.02 This Agreement may be extended beyond its term pursuant to Section 4.01 by mutual written Agreement to the parties..

4.03 Either party may unilaterally terminate this Agreement prior to its expiration specified in Section 4.01 by giving written notice to the other party two (2) weeks prior to the desired termination date. Neither party shall be entitled to any compensation, or other form of consideration due to such termination, and neither party will be required to transfer any data, information, patents or other results of the work accomplished or in progress except as otherwise expressly provided in this Agreement.

4.04 The obligations of each party pursuant to Article 2.06 and Article III survive (a) the expiration of this Agreement pursuant to Section 4.01 or (b) the termination of this Agreement pursuant to Section 4.03.

4.05 The parties hereby execute this Agreement as of the date set forth below.

<ORGANIZATION>	NASA
By: ______________________________	By: ______________________________
Title: ____________________________	Title: ____________________________
Dated: ___________________________	Dated: ___________________________

Appendix E. ILS Position Descriptions

POSITION: ILS MANAGER
(Option 1)

Industry Liaison Section
Computation Human Engineering Office (Code FLI)
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The ILS Manager will initially serve as the only staff member in the ILS. Consequently, the ILS Manager must function in the capacity of liaison, technical lead and technical support until additional staff may be added. The ILS Manager's primary duties will be to establish contacts outside the Code FLI Office and promote collaborative relationships whereby information and technology may be optimally transferred between the FLI Office and other Government organizations, industry and academia. The ILS Manager will also be responsible for refining the ILS charter, subsequent staffing and conduct of ILS policy and procedures.

DUTIES AND RESPONSIBILITIES

Identify & Cultivate Candidates for MIDAS Technology
Understand & Promote MIDAS Concept
Understand Functional Limitations and Weaknesses
Emphasize Problem Solving Capabilities Available Today
Author and Present Technical Papers
Disseminate New Data to Development Staff
Generate & Document Technical Recommendations
Produce Summary Reports & Functional Recommendations
Provide Demonstrations as Required
Interact with Program Office
Serve as Program Office Representative as Required
Develop and Track Contracts and Collaborative Agreements
Establish and Maintain Contacts in Government, Industry and Academia
Understand Technology Transfer Requirements
Maintain Liaison w/Technology Utilization Office & NASA/HQ
Develop and Refine ILS Policy and Procedures
Staff or Assist with Staffing ILS as Required
Enhance Public Relations

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in Technical Field
Understanding of Man-Machine System Design Issues
Strong Communication Skills
Relevant Contacts in Government, Industry and Academia
Technical Writing Skills
Willingness to Travel
Ability to Define Goals and Develop Work Plans

DESIRED:

Familiarity with Programming
Understanding of Specific Man-Machine System Design Problems
Ability to Accomplish Work through Others
Previous Visibility Outside NASA

POSITION: ILS TECHNICAL LEAD
(Option 1)

Industry Liaison Section
Computation Human Engineering Office
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The ILS Technical Lead will be the point of contact for all MIDAS technical and implementation details. The Technical Lead will be responsible for technically assessing the suitability of MIDAS technology for specific user problems, and assisting users and potential users in the application of MIDAS to particular problem domains. The technical lead will also evaluate the applicability to MIDAS of existing or emerging technology outside Code FLI and will often be required to visit Government, industry or academia sites to study the technical details of their capabilities as well as their problems. The Technical Lead will initially be responsible for offloading the ILS Manager of detailed technical responsibilities to free the Manager to concentrate on exploring and developing collaborative arrangements. The Technical Lead will also perform critical technical support functions until the position is filled, and may assist the Manager in recruiting additional ILS staff as required.

DUTIES AND RESPONSIBILITIES

Maintain Technical Liaison w/Outside
Study Technology of Like Efforts
Disseminate New Technical Data to Development Staff
Report Findings and Status as Necessary
Generate & Document Technical Recommendations
Configuration Management Procedures
Maintain User & Programmer Documentation
Software Submissions to COSMIC
Guest Logistics (badging, orientation, setup, etc.)
Distribution of Documentation, Reprints, Code, etc.
Document MIDAS Usability/User Interface Feedback from Users
Conduct User Surveys
Thorough Understanding of MIDAS Implementation Details
Devise Technical Recommendation Ranking Scheme
Assist Visiting Staff w/MIDAS Modifications as Needed

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in CS or Engineering
Minimum 2 Years Industry Experience
C and LISP Programming Languages, Minimum 2 yr.
Communication Skills
Willingness to Travel

DESIRED:

Applications Experience with Silicon Graphics and/or Symbolics Computers
Prior Man-Machine System Design Experience
Understanding of Typical Design Problems
Technical Writing Skills
Motivated, Self Starter
Ability to Work with Others

POSITION: TECHNICAL SUPPORT
(Option 1)

Industry Liaison Section
Computation Human Engineering Office
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The Technical Support specialist will be responsible for ensuring all ILS software configurations and documentation are maintained. Temporary staff who are utilizing ILS MIDAS equipment will be the responsibility of the Technical Support specialist in terms of NASA badging, orientation and access to necessary working facilities. The Technical Support specialist will be responsible for configuration management and distribution of products outside Code FLI, including obtaining the necessary approvals prior to release. The Technical Support specialist will also serve as the bridge between users of MIDAS and the development staff by conducting and summarizing user surveys. Functional and/or technical recommendations may be provided as a product of such surveys, in cooperation with input from the Technical Lead.

DUTIES AND RESPONSIBILITIES

Maintain Configuration Management Procedures for Release Software & Documentation
Recommend and Implement Documentation Standards
Research and Implement Appropriate Software QA Practices
Maintain User and Programmer Documentation
Software Submissions to COSMIC
Guest Logistics (badging, orientation, setup, etc.)
Distribution of Documentation, Reprints, Code, etc.
Document Usability/User Interface Feedback from Users
Conduct and Compile Surveys
Produce Summary Reports & Functional Recommendations
Assist Visiting Staff w/MIDAS Modifications as Needed

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in Technical Field
Systems Administration on UNIX and LISP Hardware
Technical Writing Skills
Ability to Take Direction from Others

DESIRED:

Applications Experience with Silicon Graphics and/or Symbolics Computers
Oral Communication Skills
C and LISP Programming Languages, Minimum 1 yr.

POSITION: ILS MANAGER
(Option 2)

Industry Liaison Section
Computation Human Engineering Office (Code FLI)
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The ILS Manager will initially serve as the only staff member in the ILS. Consequently, the ILS Manager must function in the capacity of liaison, technical lead and technical support until additional staff may be added. The ILS Manager's primary duties will be to establish contacts outside the Code FLI Office and promote collaborative relationships whereby information and technology may be optimally transferred between the FLI Office and other Government organizations, industry and academia. The ILS Manager will also be responsible for refining the ILS charter, subsequent staffing and conduct of ILS policy and procedures.

DUTIES AND RESPONSIBILITIES

Identify & Cultivate Candidates for MIDAS Technology
Understand & Promote MIDAS Concept
Understand Functional Limitations and Weaknesses
Emphasize Problem Solving Capabilities Available Today
Author and Present Technical Papers
Disseminate New Data to Development Staff
Generate & Document Technical Recommendations
Produce Summary Reports & Functional Recommendations
Provide Demonstrations as Required
Interact with Program Office
Serve as Program Office Representative as Required
Develop and Track Contracts and Collaborative Agreements
Establish and Maintain Contacts in Government, Industry and Academia
Understand Technology Transfer Requirements
Maintain Liaison w/Technology Utilization Office & NASA/HQ
Develop and Refine ILS Policy and Procedures
Staff or Assist with Staffing ILS as Required
Enhance Public Relations

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in Technical Field
Understanding of Man-Machine System Design Issues
Strong Communication Skills
Relevant Contacts in Government, Industry and Academia
Technical Writing Skills
Willingness to Travel
Ability to Define Goals and Develop Work Plans

DESIRED:

Familiarity with Programming
Understanding of Specific Man-Machine System Design Problems
Ability to Accomplish Work through Others
Previous Visibility Outside NASA

POSITION: ILS TECHNICAL LEAD
(Option 2)

Industry Liaison Section
Computation Human Engineering Office
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The ILS Technical Lead will be the point of contact for all MIDAS technical and implementation details. The Technical Lead will be responsible for technically assessing the suitability of MIDAS technology for specific user problems, and assisting users and potential users in the application of MIDAS to particular problem domains. The technical lead will also evaluate the applicability to MIDAS of existing or emerging technology outside Code FLI and will often be required to visit Government, industry or academia sites to study the technical details of their capabilities as well as their problems. The Technical Lead will be responsible for offloading the ILS Manager of detailed technical responsibilities to free the Manager to concentrate on exploring and developing collaborative arrangements. The Technical Lead may also assist the ILS Manager in recruiting additional ILS staff as required.

DUTIES AND RESPONSIBILITIES

Maintain Technical Liaison w/Outside
Study Technology of Like Efforts
Disseminate New Technical Data to Development Staff
Report Findings and Status as Necessary
Generate & Document Technical Recommendations
Document MIDAS Usability/User Interface Feedback from Users
Conduct Technical Surveys as Necessary
Thorough Understanding of MIDAS Implementation Details
Devise Technical Recommendation Ranking Scheme
Assist Visiting Staff w/MIDAS Modifications as Needed
Assist Development Staff w/MIDAS Modifications as Time Permits

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in CS or Engineering
Minimum 2 Years Industry Experience
C and LISP Programming Languages, Minimum 2 yr.
Communication Skills
Willingness to Travel

DESIRED:

Applications Experience with Silicon Graphics and/or Symbolics Computers
Prior Man-Machine System Design Experience
Understanding of Typical Design Problems
Technical Writing Skills

Motivated, Self Starter
Ability to Work with Others

POSITION: TECHNICAL SUPPORT
(Option 2)

Industry Liaison Section
Computation Human Engineering Office
Aerospace Human Factors Research Division
NASA/Ames Research Center

SUMMARY:

The Technical Support specialist will be responsible for ensuring all ILS software configurations and documentation are maintained. Temporary staff who are utilizing ILS MIDAS equipment will be the responsibility of the Technical Support specialist in terms of NASA badging, orientation and access to necessary working facilities. The Technical Support specialist will be responsible for configuration management and distribution of products outside Code FLI, including obtaining the necessary approvals prior to release. The Technical Support specialist will also serve as the bridge between users of MIDAS and the development staff by conducting and summarizing user surveys. Functional and/or technical recommendations may be provided as a product of such surveys, in cooperation with input from the Technical Lead.

DUTIES AND RESPONSIBILITIES

Maintain Configuration Management Procedures for Release Software & Documentation
Recommend and Implement Documentation Standards
Research and Implement Appropriate Software QA Practices
Maintain User and Programmer Documentation
Software Submissions to COSMIC
Guest Logistics (badging, orientation, setup, etc.)
Distribution of Documentation, Reprints, Code, etc.
Document Usability/User Interface Feedback from Users
Conduct and Compile Surveys
Produce Summary Reports & Functional Recommendations
Assist Visiting Staff w/MIDAS Modifications as Needed

QUALIFICATIONS

REQUIREMENTS:

Minimum BS in Technical Field
Systems Administration on UNIX and LISP Hardware
Technical Writing Skills
Ability to Take Direction from Others

DESIRED:

Applications Experience with Silicon Graphics and/or Symbolics Computers
Oral Communication Skills
C and LISP Programming Languages, Minimum 1 yr.

REFERENCES

A^3I Computer Equipment Property Record, October, 1989.

A^3I Program Library Listing, April 11, 1988.

Army/NASA Aircrew-Aircraft Integration Program Office, A^3I Program Executive Summary, NASA/Ames Research Center, April 15, 1986.

Army/NASA Aircrew-Aircraft Integration Program Office, A^3I Research, Development and FY '90 Budget Plan, NASA/Ames Research Center, August 21, 1989.

Computer Systems Research Group, University of California, *UNIX Programmer's Supplementary Documents Volume 1 (PS1)*, pp. 13-1 - 14-15, April, 1986.

Coryphaeus Software, *Software Technology Transfer Contractor Report*, August, 1989.

NASA Contractor Report, Software Technology Transfer, NASA/Ames Research Center, August, 1989.

NASA/Ames Research Center Technology Utilization Office, Ames Research Center Legal Mechanisms.

NASA Computer Software Management and Information Center, COSMIC Software Submittal Guidelines, University of Georgia Computer Services Annex, January, 1987.

NASA Management Instruction 2210.2A, Distribution of NASA Computer Programs, December 23, 1982.

Symbolics Programmer Documentation Volume 4, *Program Development Utilities*, August 1986.

Sterling Federal Systems, Inc., *Army-NASA Aircrew/Aircraft Integration Program Software Detailed Design Document: Phase III*, August, 1989.

Report Documentation Page

NASA
National Aeronautics and Space Administration

1. Report No. NASA CR-177569	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Industry Liaison Section Implementation Plan		5. Report Date September 1990 6. Performing Organization Code
7. Author(s) Stephen Lakowske		8. Performing Organization Report No. A-90303 10. Work Unit No. 505-61-51
9. Performing Organization Name and Address Sterling Federal Systems, Inc. 1121 San Antonio Road Palo Alto, CA 94303-4380		11. Contract or Grant No. NAS2-11555 13. Type of Report and Period Covered Contractor Report
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546-0001		14. Sponsoring Agency Code

15. Supplementary Notes

Point of Contact: Robert A. Carlson, Ames Research Center, MS 233-15, Moffett Field, CA 94035-1000, (415) 604-6036 or FTS 464-6036

16. Abstract

The Industry Liaison Section is a new function of the Army/NASA Aircrew-Aircraft Integration Program that is intended to bridge an existing gap between Government developers (including contractors) and outside organizations who are potential users of products and services developed by the A^{3}I Program. Currently in its sixth year, the Program is experiencing considerable pull from industry and other government organizations to disseminate products. Since the A^{3}I Program's charter is exploratory and research in nature, and satisfying proper dissemination requirements is in conflict with the rapid prototyping approach utilized by the design team, the A^{3}I Program has elected to create an Industry Liaison Section to serve as the Program's technology transfer focal point. This report describes the process by which the Industry Liaison Section (ILS) may be established, organized and managed, including the baseline organizational structure, duties, functions, authority, responsibilities, relationships and policies and procedures relevant to the conduct of the ILS.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Liaison, Army/NASA Aircrew-Aircraft Integration Program (A^{3}I), Technology transfer, Software technology transfer	Unclassified-Unlimited Subject Category - 05

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	82	A05

NASA FORM 1626 OCT 86

For sale by the National Technical Information Service, Springfield, Virginia 22161