

AD-A213 163

# Ada 9X Project Report



## Ada 9X Project Requirements Development Plan

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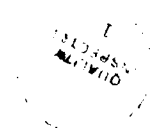
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## PREFACE

This document describes the plan for collecting, analyzing and synthesizing the requirements for the revision of ANSI/MIL-STD-1815A. The plan was developed by the Institute for Defense Analyses (IDA) under the sponsorship of the Ada Joint Program Office (AJPO). The IDA Program Manager is Ms. Audrey Hook (Computer and Software Engineering Division, 1801 N. Beauregard Street, Alexandria, Virginia 22311-1772). Other IDA staff that contributed to this document are Dr. Cy Ardoin, Dr. Joe Linn, and Ms. Catherine McDonald. The AJPO Program Manager is Ms. Chris Anderson, Ada 9X Project Manager (Air Force Armament Laboratory, Eglin Air Force Base, Florida 32542-5434).

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## CONTENTS

1. INTRODUCTION . . . . .	1
1.1 Objective of the Ada 9X Project Requirements Development Plan . . . . .	1
1.2 Operational Definition of a Requirement . . . . .	1
1.3 Requirements Criteria . . . . .	1
1.3.1 Consistency With Original Design Goals . . . . .	2
1.3.2 Positive Impact to a Wide Segment of the Existing Ada Community . . . . .	3
1.3.3 Implementability . . . . .	3
1.3.4 Upward Compatibility . . . . .	3
1.4 Structure of the Requirements Development Process . . . . .	3
1.4.1 Interaction with Other Revision Process Participants . . . . .	4
1.4.2 Visibility of the Requirements Development Process . . . . .	4
2. APPROACH . . . . .	5
2.1 Commentaries on Ada Language Issues . . . . .	5
2.2 Ada 9X Project Requirements Workshop . . . . .	5
2.3 Special Studies . . . . .	5
2.4 Revision Requests . . . . .	6
2.5 DoD Waiver Requests . . . . .	6
2.6 Requirements/Justification . . . . .	6
3. MANAGEMENT CONCEPT . . . . .	7
3.1 Key Participants . . . . .	7
3.2 Work Breakdown Structure and Deliverables . . . . .	8
3.3 Management Procedures . . . . .	11
4. SCHEDULE . . . . .	13
5. REFERENCES . . . . .	17
APPENDIX A: REQUIREMENTS TEAM . . . . .	18
APPENDIX B: DISTINGUISHED REVIEWERS . . . . .	19

LIST OF FIGURES

Figure 1. Active Participants in the Ada 9X Project Requirements Process . . . . . 9

Figure 2. Work Breakdown Structure for Ada 9X Project Requirement Team Areas of Responsibility . . . . . 10

Figure 3. Schedule: Ada 9X Requirement Development Process . . . . . 14

Figure 4. Requirements Team Schedule . . . . . 15

Figure 5. Schedule for Distinguished Reviewers . . . . . 16

# 1. INTRODUCTION

## 1.1 Objective of the Ada 9X Project Requirements Development Plan

The overall goal of the Ada 9X Project is to revise ANSI/MIL-STD-1815A to reflect current essential requirements with minimum negative impact and maximum positive impact to the Ada community. The Ada 9X Project Plan delineates three major activities within the revision process:

- 1) requirements development;
- 2) revision of the *Ada Language Reference Manual*; *Book*
- 3) implementation demonstrations .

This Plan is concerned with the first of these activities: Ada 9X requirements development.

The purpose of the Ada 9X Project Requirements Development Plan is to provide a detailed and organized approach to the process by which requirements for the revision of ANSI/MIL-STD-1815A will be collected, analyzed, and synthesized into justifiable requirements for change to the language. This document is organized as follows:

- A) Section 1 presents the objective of the Ada 9X Requirements Development Plan; the acceptance criteria for the Ada 9X requirements; and the structure of the Ada 9X requirements development process;
- B) Section 2 provides an overview of the approach to the Ada 9X requirements development process by discussing the activities which will lead to a final set of requirements for the revision of ANSI/MIL-STD-1815A;
- C) Section 3 provides the management structure for the Ada 9X Requirements Development process as it relates to the overall management and work breakdown structures of the Ada 9X Project;
- D) Section 4 provides the schedule for the Ada 9X requirements development; *AND*
- E) Section 5 provides a list of references which are referred to directly or indirectly in this document. *(CR) ←*

## 1.2 Operational Definition of a Requirement

A requirement is a language capability which should be present in Ada 9X so that applications and software tools can be more effectively implemented and maintained during the 1990's. Thus, an Ada 9X requirement is a need for programming support which remains unsatisfied by Ada 83.

## 1.3 Requirements Criteria

*Steelman* is the model for the Ada 9X Requirements process. The original goals of the revised language remain the same; additional capability may be added provided it is

consistent with these goals. The impact of revision on the Ada community, which was not a consideration during the development of Ada 83, is now a major consideration during the requirements development process. Accordingly, four criteria will be applied to the Ada 9X requirements developed for the Mapping/Revision Team's translation to language changes.

- A requirement must be consistent with the original design goals.
- A requirement must support the enhancement of Ada for a wide segment of the existing Ada community.
- A requirement must be implementable within current Ada compiler technology, preferably within existing compiler structures.
- Unless there is an overriding reason,<sup>1</sup> a requirement must result in upward compatibility.

Requirements which do not meet this criteria will be documented as study notes for consideration during a future revision.

### **1.3.1 Consistency With Original Design Goals**

It is expected that most requirements for revision will involve either a tightening or loosening of the constraints involving current language mechanisms. It is also anticipated that many of the issues which are seen as revision requirements by the Ada community will involve making a tradeoff among a number of generally desirable properties, such as:

- constrained generality
- reliability
- maintainability
- efficiency
- simplicity
- implementability
- machine independence (portability)
- complete definition

Much of the discussion involving requirements for language revision will center on these *Steelman* properties and their tradeoffs. For example, certain language constraints may be viewed as having too greatly compromised efficiency or portability for the sake of ease of maintenance; while other requirements may arise from the view that some restrictions result in reduced efficiency, reliability, and maintainability. In other cases, it may be necessary to determine what the requirement is, rather than to focus on how the language can be changed to emphasize a particularly desirable property.

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1. A revision requirement that does not meet the "upward capability" criteria will only be considered if it affects a very large portion of the Ada community and its absence in the revised standard has a serious negative impact on application development.

### **1.3.2 Positive Impact to a Wide Segment of the Existing Ada Community**

The Requirements Team will strive to attain a strategic balance between change and stability. Weighing the requested change against the other criteria and the needs of the community is difficult, but achievable. Requirements that support a large portion of the Ada community will obviously be weighted more heavily than those that affect very few.

### **1.3.3 Implementability**

The third criteria focuses on implementability: Can this requirement be satisfied within the ordinary structures of the existing Ada compiler base? The following criteria which was applied to the original language design also applies to the selection of requirements for this revision:

“No language can avoid the issue of efficiency. Languages that require over-elaborate compilers, or that lead to inefficient use of storage or execution time, force these inefficiencies on all machines and on all programs...Any proposed construct whose implementation is unclear or that requires excessive machine resources should be rejected.”

Specifically, no requirements will be included for which there is no known satisfactory realization that is deemed to be within the framework of current Ada compiler technology.

### **1.3.4 Upward Compatibility**

The expectation of economic benefits for using Ada is pervasive in the Ada community. DoD's sponsorship of the Ada language was motivated by the belief that focusing our resources on supporting one language and the associated tools for use in software development and maintenance would help improve the overall quality of software at lower costs. The investments in compilers, tools, and applications are beginning to produce an economic return which must continue unimpeded. The cost for implementing a requirement for the current revision must be justified by the long-term economic benefits it will produce. While some changes to compilers and tools will be needed, these changes should enhance the usability and reliability of applications and tools which are implemented after these changes are made.<sup>2</sup>

## **1.4 Structure of the Requirements Development Process**

The structure of Ada 9X requirements development process is analogous to the process by which requirements were developed for the design of the Ada language. Ada 9X revision requests will be collected from the Ada community during a prescribed period

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2. A revision requirement that does not meet the “upward capability” criteria will only be considered if it affects a very large portion of the Ada community and its absence in the revised standard has a serious negative impact on application development.

[October 1988–October 1989] and will be analyzed, synthesized, and restated as requirements for revision by a small team of Ada practitioners, hereafter called the Requirements Team [see Appendix A].

#### **1.4.1 Interaction with Other Revision Process Participants**

The Requirements Team will strive to resolve inconsistencies among revision requests and to provide a well justified set of requirements for the Ada 9X revision. There will be close interaction between the Requirements Team and the Distinguished Reviewers [see Appendix B] in an effort to build consensus on the essential properties of a requirement and its potential for realization as a revision to Ada 83. It is anticipated that as requirements are translated into language solutions by the Mapping Team and further evaluated by the Implementation Teams, additional trade-offs must be made among generally desirable properties and their costs.

#### **1.4.2 Visibility of the Requirements Development Process**

The revision requests or statements of requirements for revision submitted from the Ada community will be collected and made available to any interested party who accesses the Ada 9X electronic bulletin board (1-800Ada9X25). Substantive portions of the study notes and positions resulting from the dialogue between the Distinguished Reviewers and the Requirements Team will also be available as public information. When a consensus on the Requirements Document has been reached between the Requirements Team and the Distinguished Reviewers, the Requirements Document will be distributed to the Government Advisory Group, ISO WG9 and other interested parties for review and comment. It is anticipated that several revisions will be made to the Requirements Document based upon comments received from these participants, prior to public participation in the final review of the document. The Requirements Team will also prepare a document justifying the final requirements.



## 2. APPROACH

Analyses and synthesis of information from several sources will be performed by the Requirements Team as a preliminary step in the requirements development process.

### 2.1 Commentaries on Ada Language Issues

The Ada Language Issues (AIs) have been documented with commentary and resolutions as part of the on-going language maintenance activity of the AJPO and ISO WG9. Many important requirements and significant resolutions may be found in the AIs. Therefore, the Requirements Team will begin the process of requirements capture with an examination of the documents that have served as the basis for language maintenance since the standard was issued.

### 2.2 Ada 9X Project Requirements Workshop

Results from the Ada 9X Project Requirement Workshop in May 1989 will be carefully examined. Many revision requirements were developed during the Workshop in the following areas:

- Trusted Systems/Verification
- Software Engineering in the Large
- Real-Time Embedded Systems
- Parallel Systems
- Information Systems

### 2.3 Special Studies

During the past six years, several Ada related issues have persisted as topics for discussion among professional and standardization working groups. These issues include language impediments for real-time applications, lack of support for distributed processes, lack of formal proofs for trusted/secure systems, the need for standardized extensions or secondary standards for extra-lingual capabilities, and the facilitation of programming paradigms. Studies in these areas will be undertaken during the requirements development phase by various Project Teams. The findings from these studies will be considered by the Requirements Team as well as by the Mapping Team. These studies are:

- Complex Issues Study
  - exceptions and optimization
  - shared variables
  - fixed point
  - implementation-dependent pragmas and attributes
  - input/output
  - reuse
  - extended character set
  - user-controlled real-time scheduling
  - distributed processing
  - math library

- Formal Static Semantics Development Study
- Secondary/Supplementary Standards Study
- Programming Paradigms Study
  - stream-based functional programming
  - object-oriented programming
  - hooked-framework<sup>3</sup> programming

#### 2.4 Revision Requests

The Ada 9X Project Office has established a procedure for revision request submission. The primary job of the Requirements Team will be to ensure that the true requirement (if any) is extracted from each revision request so that the requirements can be consolidated with requirements from other sources for evaluation in accordance with the revision criteria.

#### 2.5 DoD Waiver Requests

In the US Department of Defense (DoD), Ada is required for almost all mission critical and information systems. However, if this requirement can not be met, the Project Manager can request a waiver. During the Ada 9X Project revision process, these waiver requests will be examined in order to uncover language-related problems.

#### 2.6 Requirements/Justification

The results of the studies/analysis tasks should provide the Requirements Team with a well founded view of the essential needs for Ada 9X revision requirements. The Requirements Team will apply the criteria [see section 1.3] to reduce the set of requirements derived through the studies/analysis tasks to produce the requirements and justification documents. These documents will be developed from team working papers, in which the requirements will be stated along with the assumptions and trade-off decisions made by the Requirements Team. The Distinguished Reviewers will give critical reviews on these working papers and assist the Requirements Team in settling disputes, discerning the requirements, properly justifying decisions, and correcting ill-formed assumptions or justifications. In all, the Distinguished Reviewers are an integral part of the requirements development process, providing quality control and assurance, completeness, and accuracy.

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3. A hooked-framework programming style is one where the individual components executing under the framework each register their semantics with the framework for execution at the appropriate time. A (virtually-) centralized dispatcher causes the semantic routines to be executed under the appropriate conditions, i.e. when a keystroke is entered with the mouse in the window associated with the semantic routine. These semantic routines are called *hooks*; hence, the name.

### 3. MANAGEMENT CONCEPT

The Ada 9X Project Plan identified the key participants in the Ada 9X Project management structure and provided a work breakdown structure for the entire project. The following identifies specific activities to be performed by these participants during the Requirements Development Process.

#### 3.1 Key Participants

- Ada 9X Project Office

The Ada 9X Project Manager is responsible for providing technical direction to all Ada 9X Project participants and for planning and implementing the Ada 9X Project activities.

- Requirements Team

The Requirements Team will develop the requirements and supporting justification based on the approved 197 Ada commentaries, the Ada 9X Project revision requests, and other sources of requirements information identified in this Requirements Development Plan. This team will develop the Requirements/Justification Document(s).

- Distinguished Reviewers

Distinguished Reviewers are a group of Ada experts who will review and comment on study findings and the requirements and justification resulting from the Requirements Team work. This group may be augmented, as needed, by special, volunteer reviewers who have expertise in particular subject areas.

- Government Advisory Group

The Government Advisory Group is composed of representatives from various government organizations spanning a wide range of user interests. This Group will be kept informed of the requirements development process and will provide comments as appropriate. They will also ensure that the technical issues/concerns of their respective organizations are reported to the Requirements Team.

- International Standards Organization (ISO)

The Convenor and several members of ISO Working Group (WG) 9 [Ada Language] will participate in the requirements development process as Distinguished Reviewers. The Ada 9X Project Manager and the Convenor will coordinate the dissemination of information between the Requirements Team and ISO WG9.

- Ada Community

The Ada community will provide input to the requirements development process during open meetings and via revision requests. The success of this process largely depends on the community's positive support for the development and refinement of requirements for Ada 9X.

Figure 1 identifies the active participants in the requirements phase of the Ada 9X project as shaded boxes within the overall Ada 9X Project Management Approach/Key Participants chart provided in the Ada 9X Project Plan.

### 3.2 Work Breakdown Structure and Deliverables

Figure 2 is the Ada 9X Project overall Work Breakdown Structure. The following identifies the elements of that structure which are performed by the Requirements Team.

- Management 1000
  - Planning 1200
    - 1201 Requirements Development Plan
  - Workshops 1300
    - 1301 Ada 9X Project Requirements Workshop  
International Requirements Workshop
  - Reviews 1400
    - 1401 Continuous Distinguished Reviewer interaction with the Requirements Team  
Public review of Requirements/Justification Document(s).
  - Public Relations 1500
    - 1501 Ada 9X Project Requirements Public Forum
- Revision Process 2000
  - Requirements/Justification 2300
    - 2301 Special Studies
      - Analysis of Complex Issues Study
      - Formal Static Semantics Study
      - Secondary/Supplementary Standards Study
      - Programming Paradigms Study
    - 2302 Ada 9X Requirements Document
    - 2303 Ada 9X Requirements/Justification Document

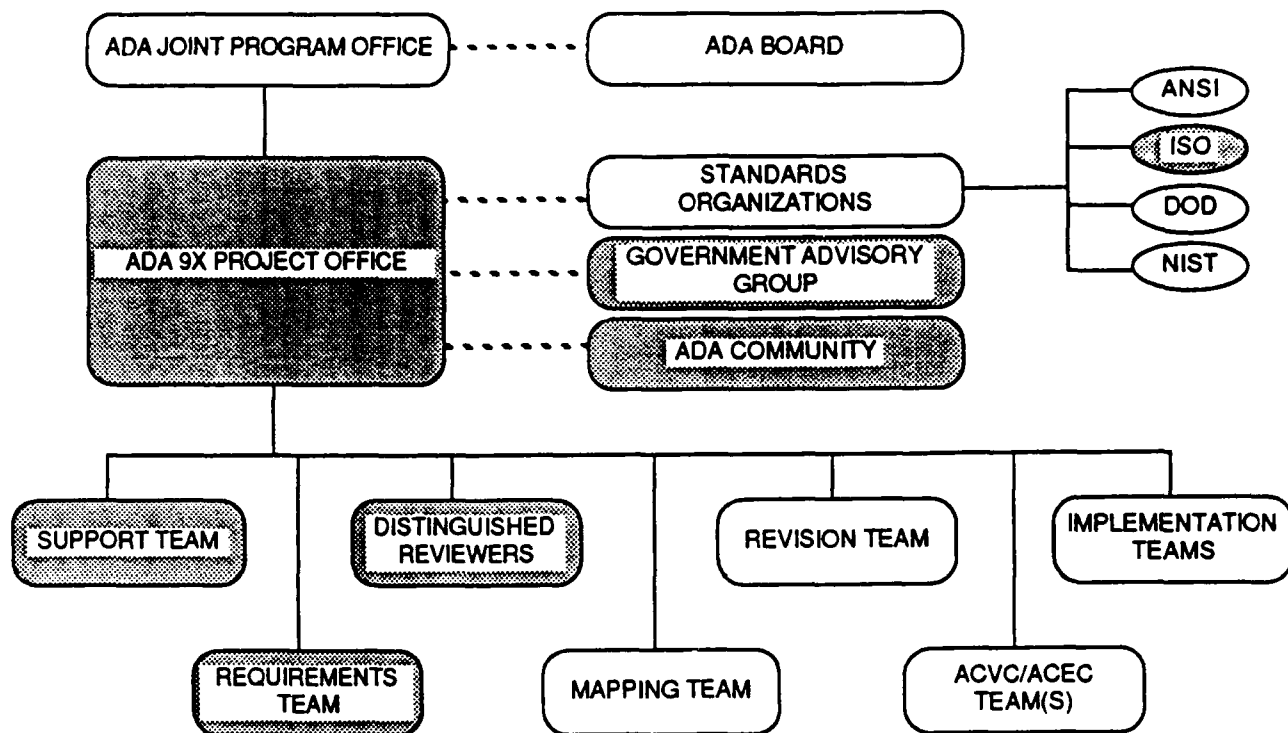
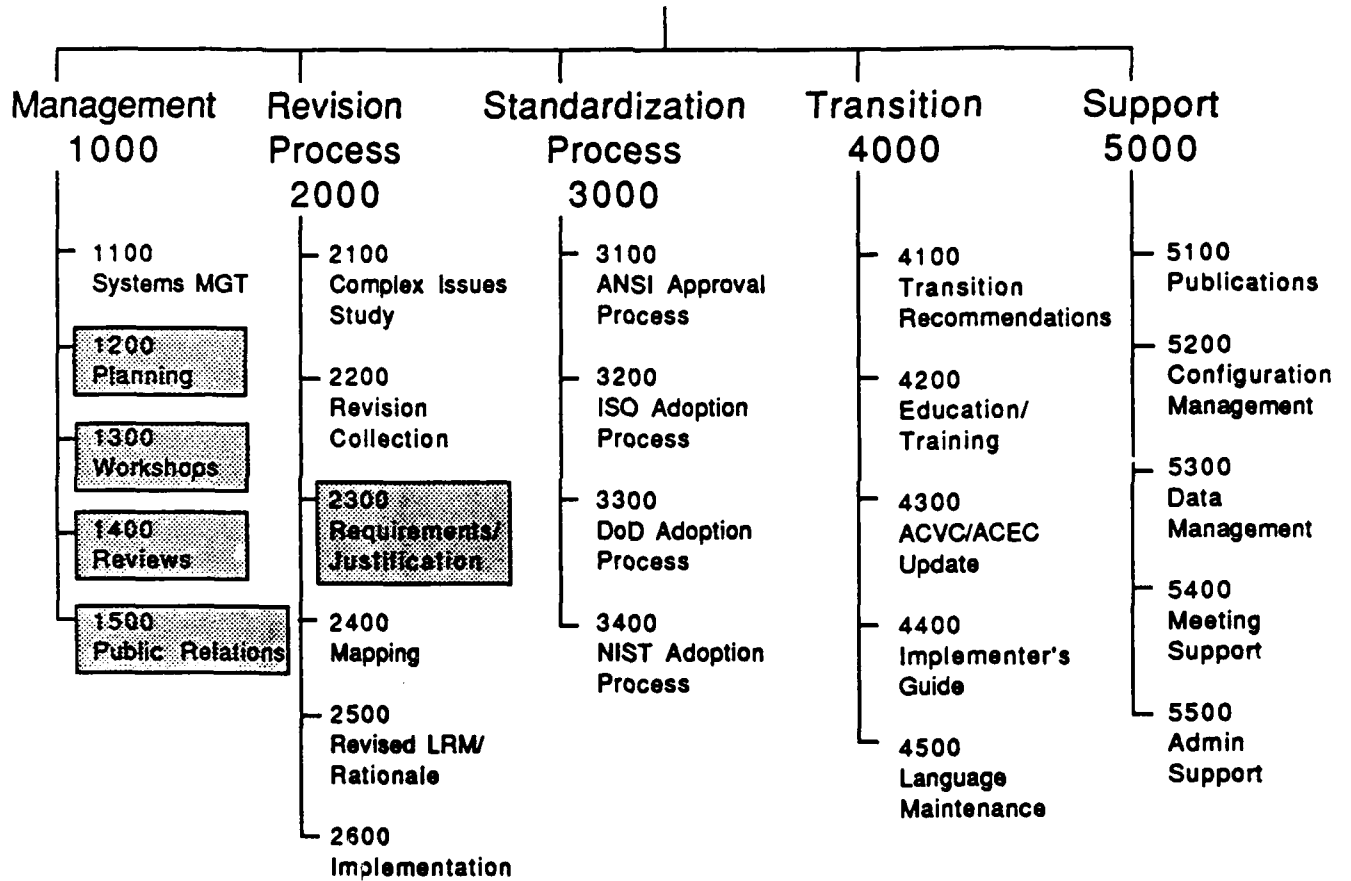


Figure 1. Active Participants in the Ada 9X Project Requirements Process (shaded areas)

# ADA 9X PROJECT



**Figure 2. Work Breakdown Structure for Ada 9X Project Requirement Team Areas of Responsibility (shaded)**

### **3.3 Management Procedures**

The Requirements Team will be located at the Institute for Defense Analyses (IDA) in Falls Church, Va. The four members of the Requirements Team, selected competitively, will be under contract to IDA as individual Ada experts. IDA will also supply Ada experts who are IDA Research Staff Members to contribute to the requirements development process. The IDA Task Leader for the Ada 9X requirements development task will make daily work assignments to the team members, prepare status reports, and coordinate with the Ada 9X Project Manager on schedules, products, reviews, tasking, and IDA practices.





#### **4. SCHEDULE**

The schedule includes the preliminary analytical/study tasks which facilitate the capture of requirements, the production of requirements and their justification, and reviews. Figure 3 depicts the schedule for the Ada 9X Requirements Development Process. Figure 4 is a schedule for Requirement Team documents. Figure 5 is a Distinguished Reviewer schedule for review of the Requirements Team documents.

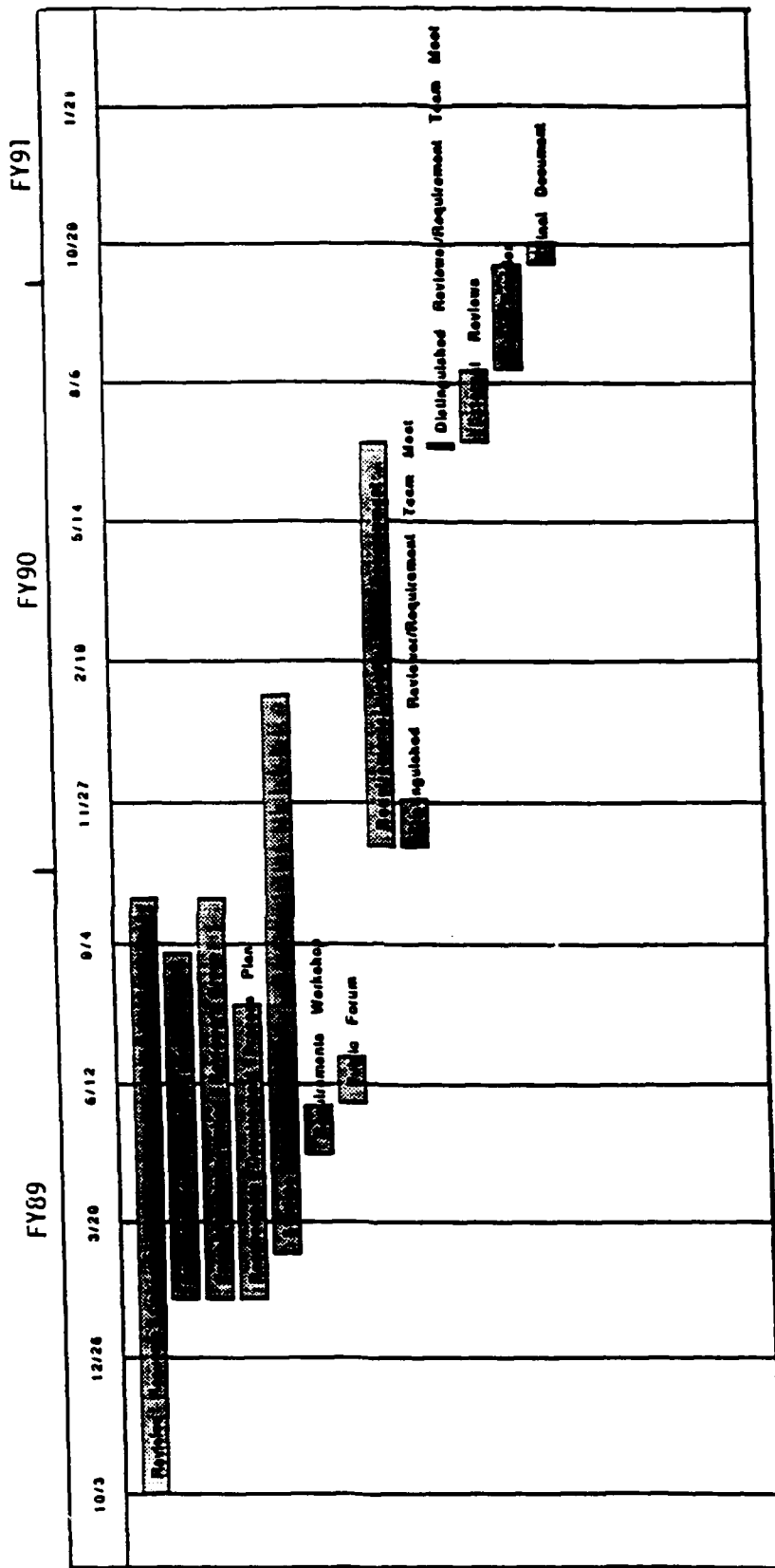


Figure 3. Schedule: Ada 9X Requirement Development Process

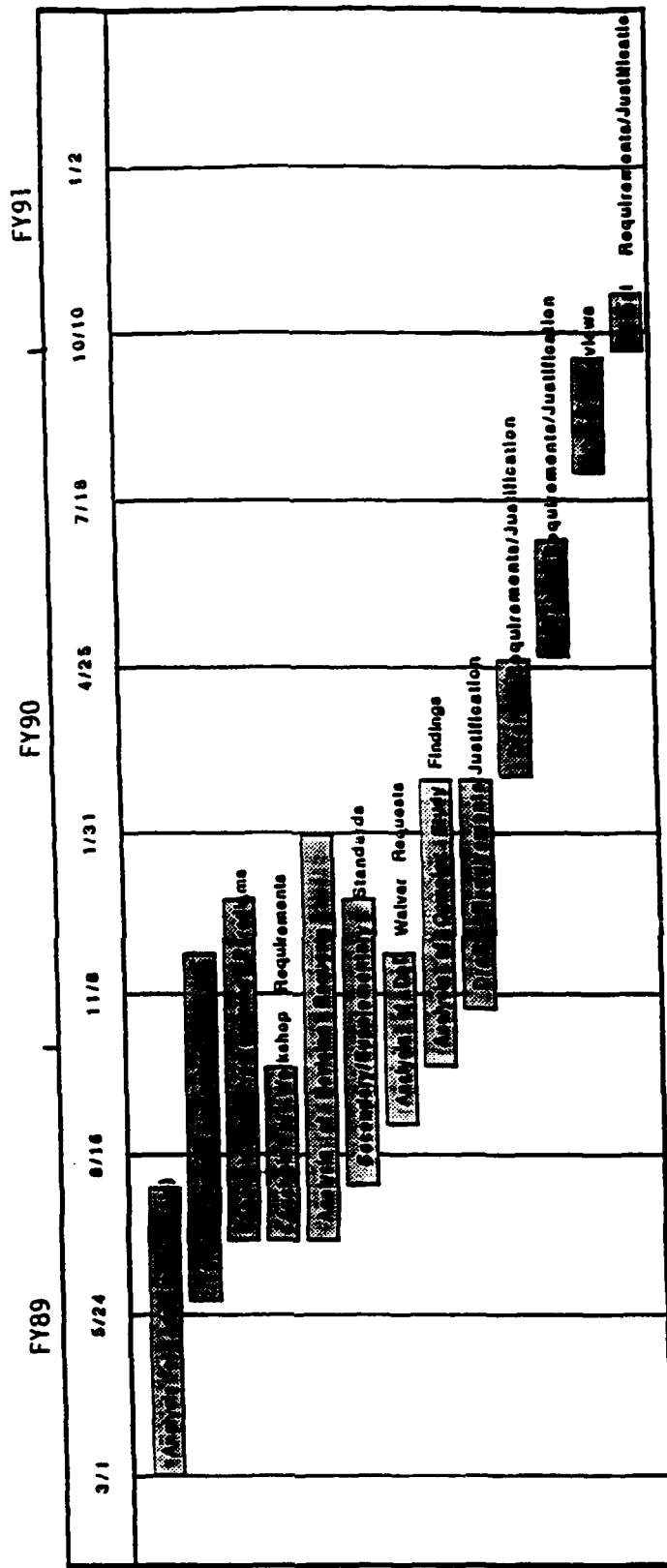


Figure 4. Requirements Team Schedule

### Schedule for Distinguished Reviewers

DR Review of Analysis of Ada Issues (AIs)	Sept. 1989
DR Review of Analysis of Workshop Requirements	Oct. 1989
DR Reviews of Formal Static Semantics	Aug.-Dec. 1989
DR Reviews of Secondary/Supplementary Standards	Nov. 1989 - Jan. 1990
DR Review of Analysis of DoD Waiver Requests	Dec. 1989
DR Review of Analysis of Programming Paradigms	Jan. 1990
DR Review of Analysis of Revision Requests	Feb. 1990
DR Review of Analysis of Complex Study Findings	Mar. 1990
DR Review of Draft Requirements/Justification	Mar. 1990
DR Review of Draft Requirements/Justification	May 1990
DR Review of Draft Requirements/Justification	Jun. 1990

Figure 5. Schedule for Distinguished Reviewers

## 5. REFERENCES

1. *Ada 9X Project Report: Requirements Workshop*, May 1989.
2. "The Ada Programming Language Reference Manual," ANSI/MIL-STD 1815A, US Department of Defense, U.S. Government Printing Office, 1983.
3. Christine M. Anderson, *Ada 9X Project Plan*, Office of the Under Secretary of Defense for Acquisition, Washington, D.C., February 1989.
4. Frederick P. Brooks, Jr., "No Silver Bullets: Essence and Accidents of Software Engineering," *Computer* 20:4, April 1987, pp. 10-20.
5. John B. Goodenough, *Ada 9X Revision Needs*, Software Engineering Institute, Carnegie-Mellon University, Pittsburgh, Pennsylvania, November 1988.
6. Department of Defense Requirements for High order Computer Programming Languages-"STEELMAN," June 1978.

## APPENDIX A: REQUIREMENTS TEAM

Cy Ardoin	Institute for Defense Analyses
Paul Baker	CTA, Inc.
Doug Dunlop	Intermetrics
Joe Linn	Institute for Defense Analyses
Steve Michell	Prior Data Sciences, Canada
Karl Nyberg	Grebyn Corp.

## APPENDIX B: DISTINGUISHED REVIEWERS

Jean Ichbiah	Emeritus Member, Alsys
Grady Booch	Rational
Ben Brosgol	Aisys
Norm Cohen	IBM
Robert Dewar	New York University
Gary Dismukes	TELESOFT
David Fisher	Incremental Systems
Anthony Gargaro	Computer Sciences Corp.
Mark Gerhardt	ESL
John Goodenough	Software Engineering Institute
Ernesto Guerrieri	SofTech
Tim Harrison	Software Productivity Consortium
Stephen Heilbrunner	IABG, Germany
Marlow Henne	Sverdrup
Paul Hilfinger	University of California at Berkley
Mike Kamrad	Unisys
Rudolf Landwehr	CCI, Germany
Kit Lester	Portsmouth Polytechnic, UK
Randal Leavitt	Prior Data Sciences, Canada
Lennart Mansson	TeleLogic, Sweden
Bob Mathis	Contel
Mike Mills	Air Force/ASD
Charlie Mitchell	Digital Equipment Corporation
Erhard Ploedereder	Tartan
David Pogge	Navy/NWC
Kent Power	Boeing
Olivier Roubine	Syseca, France
Tucker Taft	Intermetrics
Bill Taylor	Ferranti, UK
Eugen Vasilescu	GNV
Tom Wheeler	Army/CECOM