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PROJECT GUIDE TO
CONTENT REQUIREMENTS AND AUDIENCE NEEDS

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CHIEF OF TECHNIQUES ENGINEERING DIVISION
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UNITED STATES AIR FORCE
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REVIEW AND APPROVAL


This technical report has been reviewed and is approved for publication.



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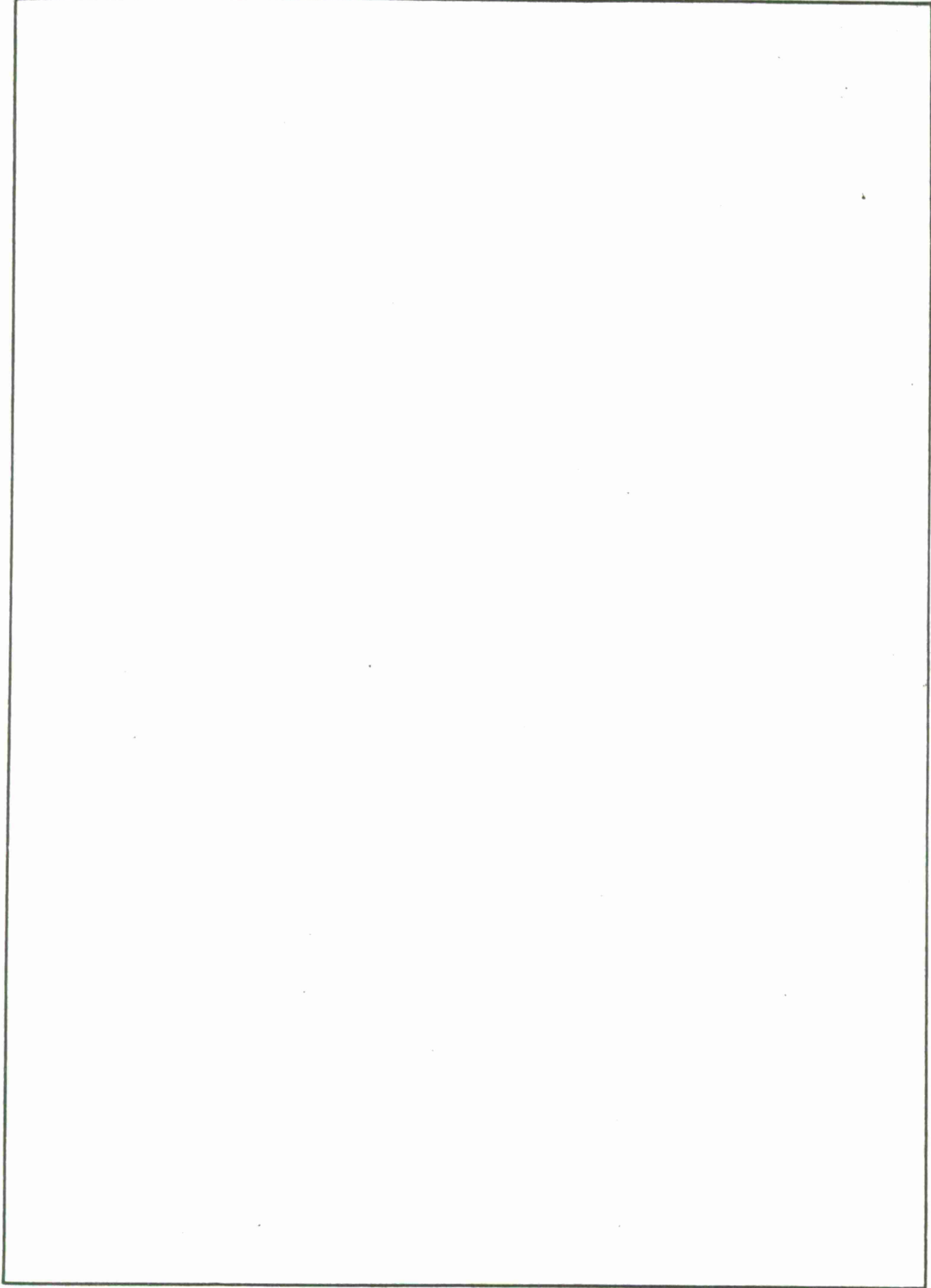
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FOREWORD

This report is one in a series of guidebooks intended to assist System Program Office personnel in software acquisition management. The contents of the guidebooks will be revised periodically to reflect changes in software acquisition policies and practices and as the result of feedback from users.

This series of guidebooks is being prepared under the direction of Electronic Systems Division (AFSC), Information Systems Technology Applications Office (MCI). Contributions were made by the following ESD/MCI personnel: Mr. P. Veckery, Major H. Eiden, Captain R. San Antonio, and Captain W. White (Project Officer).

The Software Acquisition Management Guidebook series is currently planned to cover the following topics:

1. Project Guide to Content Requirement and Audience Needs
2. Regulations, Specifications & Standards
3. Contracting for Software Acquisition
4. Measuring and Reporting Software Status
5. Statements of Work (SOW) and Requests for Proposal (RFP)
6. Reviews and Audits
7. Configuration Management
8. Requirements Specification
9. Computer Program Documentation Requirements
10. Verification
11. Validation and Certification
12. Management Reporting by Software Director
13. Computer Program Maintenance
14. Software Quality Assurance
15. Software Cost Estimating and Measuring

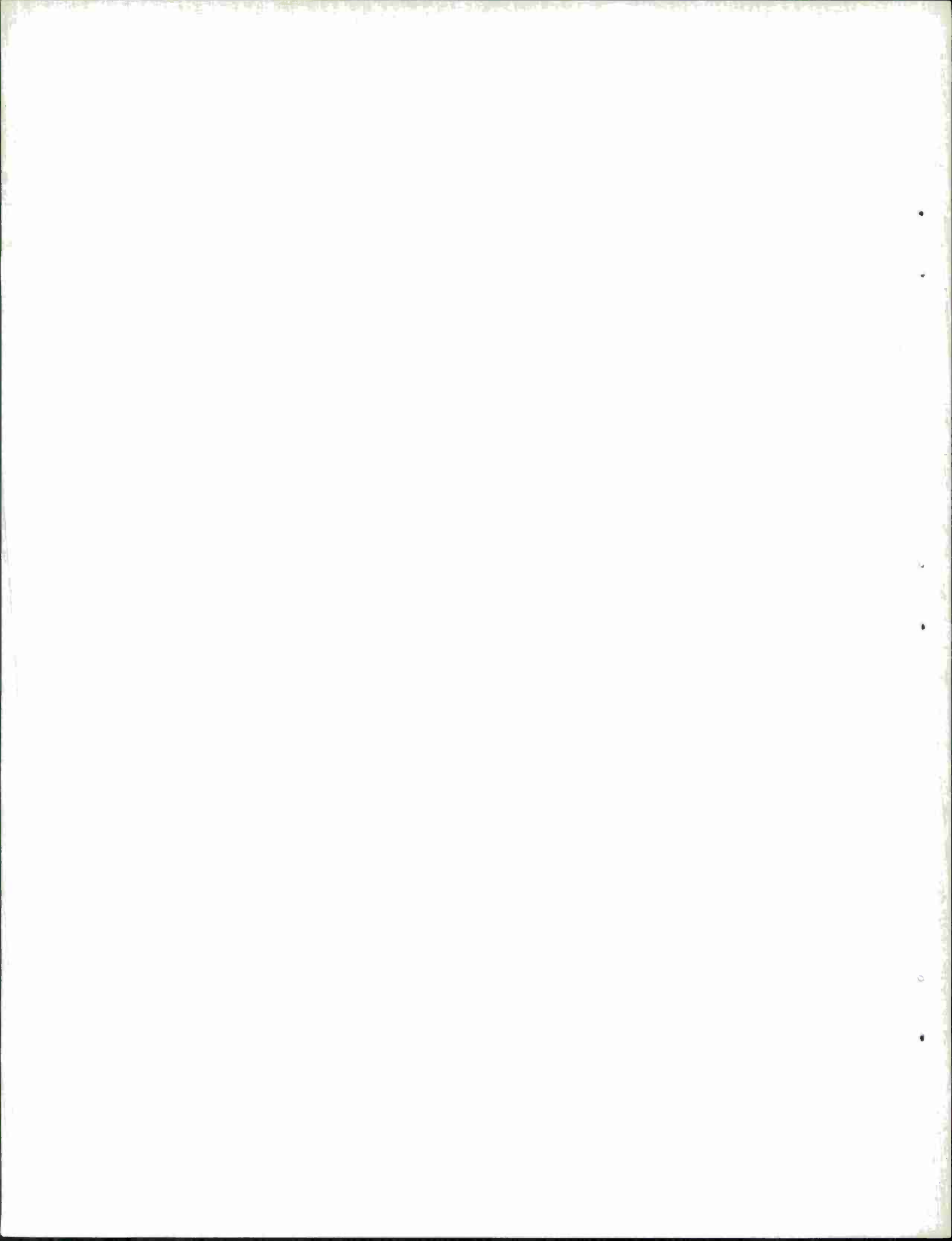


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SECTION I

INTRODUCTION

During the past year much has been written expressing deep concern about the problems of "Software Acquisition Management" (SAM): the management of software specification, procurement, integration, and maintenance as practiced within Air Force System Program Offices (SPO's).

Symptoms of SAM problems acknowledged to date include:

- Failure of software to meet the acquirer's and user's quality and performance expectations.
- Failure of software development efforts to meet projected schedules.
- Failure to anticipate accurately the resources needed to support and maintain software operating in the field.
- Failure to capture useful SAM experience in the form of coordinated standards and regulations.

Production of a series of SAM Guidebooks is one activity aimed at reducing these problems. Topics to be covered are:

1. Project Guide to Content Requirement and Audience Needs
2. Regulations, Specifications & Standards
3. Contracting For Software Acquisition
4. Measuring and Reporting Software Status
5. Statements of Work (SOW) and Requests for Proposal (RFP)
6. Reviews and Audits
7. Configuration Management
8. Requirements Specification
9. Computer Program Documentation Requirements
10. Verification

11. Validation and Certification
12. Management Reporting by Software Director
13. Computer Program Maintenance
14. Software Quality Assurance
15. Software Cost Estimating and Measuring

This technical report is the basis for the first volume, intended to serve as a guidebook writer's reference before and during the writing process in matters of guidebook planning, user profile, and expository and editorial style. (Of the remaining guidebooks, topics 2, 3, 4, 5, and 9 have been or are being developed).

Whatever its topic, each guidebook shares with the others a common responsibility to provide its ultimate user, the SPO's Software Director (SD), with three general classes of information:

- Reference and index lists which the SD can use to access the formal regulations, specifications, and standards relevant to the topic presented. These are to aid him in answering the question: What are my official management opportunities and constraints in dealing with this particular aspect of software acquisition?
- Explanations (lessons learned, common pitfalls, mistaken assumptions, etc.) which augment official guidance with useful experience. This kind of information will aid the guidebook user in answering the question: Given this mass of formal definition and procedure, how do I recognize the most significant and valuable pieces of guidance, how can I maneuver effectively and safely among sometimes conflicting sources of guidance, and are there any serious hidden implications within these sources?
- Checklists and descriptions of proven software acquisition management techniques which answer the question: What are the early symptoms of common SAM problems I might encounter in daily operations, and what tools have proven effective in the past in monitoring status, in identifying problem thresholds, and in re-creating and performing post-mortems on management decisions?

Based on his experience in the field, the SAM Guidebook writer should be able to anticipate his reader's natural questions, and he should tailor his guidebook organization and content accordingly. The major point here is that the guidebook writer holds all the editorial privileges and options: in matters of form he is initially constrained only by the nature of his material, which itself dictates a best form of presentation.

PROJECT GUIDE TO CONTENT REQUIREMENTS AND AUDIENCE NEEDS - IN PERSPECTIVE

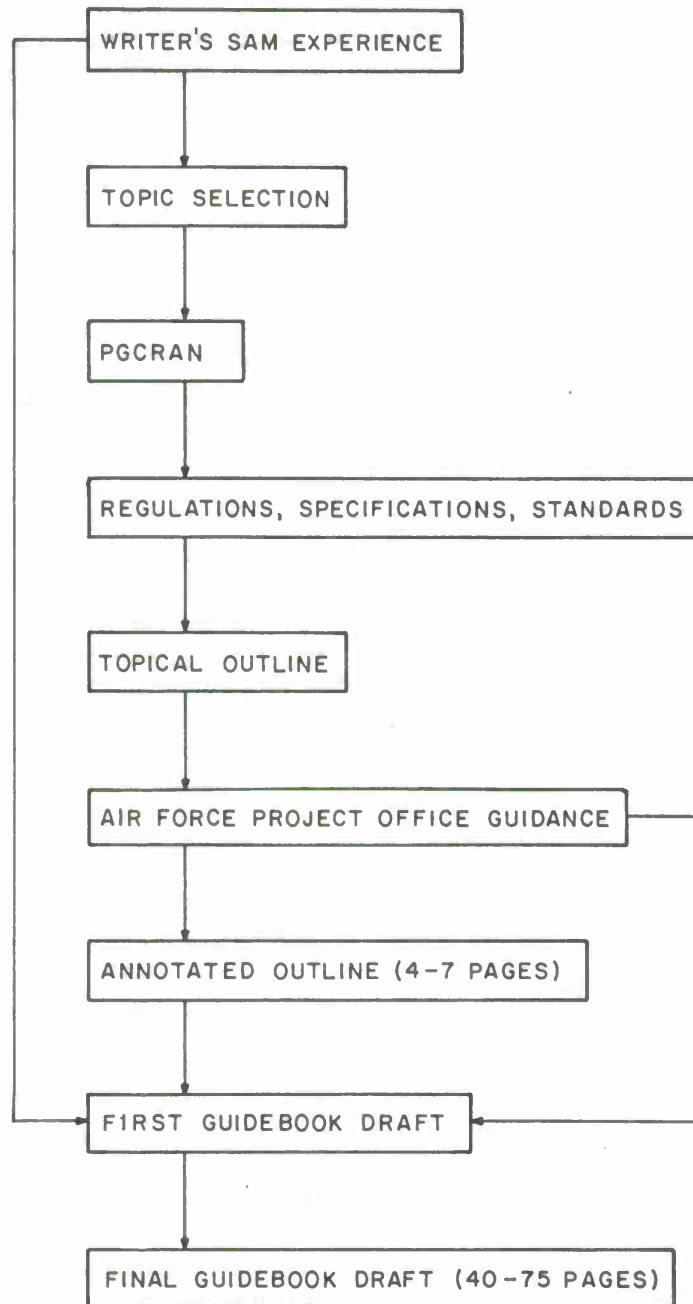
Figure 1 places the PGCRAN in its functional slot within the guidebook writing process. The activity flow shows the guidebook writer's SAM judgement and experience (hopefully) playing a part in the assignment of his topic. The working paper ISTAO-SAM-001 (extracts appended to this technical report) defines for the writer the boundaries of his topic, with its scope drawn in terms of subtopics and questions that each particular guidebook must answer. Given topical scope, the writer can dip into the body of SAM regulations, specifications, and standards and extract the formal guidance relevant to his topic. This formal guidance, plus the writer's experience with SAM tools and procedures plus the annotated outline for the document that has evolved during initial research comprise the raw data from which the finished guidebook will be constructed. How does the PGCRAN help the guidebook writer shape his material into the final product?

PGCRAN - CONTENT AND FUNCTION

The following section of this guide characterizes the SAM guidebook's audience in terms of probable background and software experience. This reader profile is essentially anonymous, and less useful to the writer than his own personal knowledge, if he has any, of the characteristics of SPO personnel.

With the guidebook target audience defined, the writer is concerned with methods at his disposal in communicating ideas and sharing experience. Sections III and IV draw a distinction between expository and editorial style and show by example how each can be used to achieve effective communication. Section V summarizes the guidebook writing process as a series of tasks from initial research to final review of the completed document.

This guide is neither a substitute for experience nor a set of editorial rules. We attempt here only to raise the writer's consciousness of his editorial freedom, and to suggest some proven techniques for expressing his ideas and experience in a readable way.



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Figure 1. Guidebook Writing Process

SECTION II

USER PROFILE AND NEEDS

The following sections describe the guidebooks' intended audience and their needs as guidebook users.

GUIDEBOOK USER'S PROFILE

The guidebook series is intended for use by System Program Office personnel, specifically the military officer or civilian assigned as Software Director. We assume the SD has the degree of Air Force management experience implied by the rank of Major, and that his systems engineering experience can range from basic to highly advanced. We can also assume that although the SD himself may have had little direct experience in software technology, he has at his disposal the technical training and experience of junior officers who may have done practical work in the field or studied computer science.

In tailoring his product for the intended audience, what kind of assumptions can the guidebook writer make about the SD's software background?

- The SD understands general differences in the roles of functional and non-functional software (executive versus applications programs).
- For the system whose development or maintenance he is managing, he is able to make the distinction between those functions performed by software and those performed by hardware (or firmware).
- He is aware of the characteristics of major inputs, outputs, and data bases processed by software.

Once outlined, this knowledge envelope provides some clear directions in the guidebook writer's choice of technical vocabulary. Because he knows basic EDP operations and reads the trade journals, the SD uses terms like:

- 1) compiler, sort program, data channel, main memory. He may be familiar with,

- 2) firmware, hardware diagnostics, program loaders. He will not deal with,
- 3) reentrant code, Polish notation, relocation dictionaries.

We sense immediately that, based on our arbitrary classifications, we can use Group 1 terms freely; we should provide definitions or glossary entries for Group 2 terms as required; we should avoid Group 3 to the extent possible. The SD must not be treated as a software beginner, nor should we draw him into a maze of detail, no matter how technically exciting.

USER'S NEEDS

For each guidebook, ISTAO-SAM-001 defines the user's needs for specific topical content, and repetition here would serve little purpose. In general, however, the SD does not need or want another set of regulations, nor an education in management or computer science. He can only reasonably expect any guidebook to provide him with the three basic kinds of information mentioned earlier: references to applicable regulations, specifications, and standards; advice on how to work within articles of official guidance; good advice on management techniques to be employed in response to common problems. And it is desirable, to the extent possible, to transmit these kinds of information in the form of concise checklists rather than masses of rambling narrative text.

To respond to these user needs appears to involve, at first inspection, the conventional kind of technical writing effort that's used to produce the SAM regulations, specifications, and standards themselves. More is required. If we really intend "to pass on experience" as we claim, then the guidebook writing task takes on some journalistic elements with the need to report past experiences and to take an editorial position.

This is a delicate point. Much of the experience we hope to pass on to the SD revolves around choices made and options exercised in the past with positive, neutral, or negative results. To advocate a particular choice in preference to others is to take a position, and in taking a position the writer obligates himself to reveal the reasons behind his position. The writers of regulations, specifications, and standards are under no similar obligation: RS&S documents say "do this," while the guidebook should say "we suggest doing this because...and here are the pro's, con's, advantages, and dangers in proceeding this way...."

At the same time, guidebook writers must beware of erring in the opposite direction by presenting overly detailed justifications and lengthy case studies for the following reasons:

- The best natural organization of a guidebook could be ruined if its material had to be warped around one or more case studies.
- It would be difficult to disguise the identity of actual programs. The intent is to pass on experience rather than implied criticism or gossip.
- Transition into and out of past tenses could be awkward and distracting to the reader.

Between the two extremes (checklists and case studies) lies the technique of presenting selected incidents which illustrate the reasons behind a position or recommendation. The following example is drawn from the U.S. Army Tactical Data Systems's "Software Acquisition Handbook," Fort Monmouth, 15 June 1973:

"Consider, for example, a test involving radar data. During the test, it is noticed that there is multiple registration of radar returns. The problem could be due to atmospheric conditions, radar set malfunction, noise on the communication lines bringing the radar message to the computer, incorrect adaptation for one or more radar sites, software error in the processing of the return, or a software error in displaying the return. Problems of this sort demand a great deal of data reduction during the diagnostic phase simply to pinpoint the malfunctioning subsystem. The acquirer may need to provide coordination between the software and hardware contractors to ensure complete diagnosis of the problem."

Persuasive advocacy often adds a desirable vitality to otherwise neutrally dry writing. An editorial point of view also gives the guidebook writer a sense of direction to use in getting started on any subtopic, and in subsequently shaping his material. The following two sections, covering narrative and editorial style, provide some guidelines to be used in the shaping process.

SECTION III
EXPOSITORY STYLE

DEFINITION

Although the term "style" as applied to the guidebook series to date is open to many interpretations, we make the arbitrary distinction here between expository and editorial style. Expository style refers to the manner of expression employed in communicating ideas to a reader. Editorial style refers to a set of structural formalisms and editorial conventions used in constructing a document, independent of conceptual content. (For example, one authority on editorial style, the U.S. Government Printing Office Style Manual, concerns itself with such conventions as standard heading labels and subordination, capitalization, abbreviations, footnote formats, type styles, and so forth.) Matters of editorial style are addressed in the following section. As discussed below, expository style is composed of mode of presentation and tone.

Mode

Ideas may be communicated to the guidebook reader using any of three general modes of presentation:

- Graphics - Those are pictures of all types: PERT Charts, flowcharts, histograms, etc.
- Lists - Lists may be ordered or unordered, composed of single words, sentence fragments, or entire paragraphs.
- Text - This is conventional narrative, organized arbitrarily into sections, subsections, paragraphs, or whatever units are dictated by the editorial style adopted.

The above is not presented simply for the sake of definition, but to help make a very important point: every idea, every concept that the guidebook writer wants to communicate to his reader has a best mode of presentation. The choice is the writer's, to be made free of any editorial conventions, based on the writer's intimate knowledge of his material and his immediate objectives in communicating it.

Editorial style conventions cannot govern choice of mode, only the structural formalisms applicable to the mode selected. To enforce modal standards, to require synchronization of content type with mode, inhibits effective communication. The writer who begins his guidebook development task by studying an editorial style manual has made the worst possible start. Editorial conventions are not a point of departure, and they do not set limits on effective communication of ideas.

Tone

Why do so many civilian and military managers prefer to receive information in the form of briefings, in preference to reading narrative text? Because the human voice can express shades of meaning which are very difficult to compress into reasonably sized sequences of written language, and because face-to-face communication is a natural function, a more interactive and satisfying experience than the scanning of a printed page.

But the use of dialogue is not appropriate to the guidebook series: we write narrative text, not quoted human speech. The very best narrative text, however, captures something of the tone of human speech in communicating even abstract ideas.

Given that we recognize tone or quality of human speech as a desirable feature of guidebook narrative text, we must choose the kind of tone likely to maximize the reader's absorption of the ideas we want to transmit. The very short list below bounds a tonal range that seems generally appropriate to the guidebook effort. (Naturally, each writer has his opinions and, in fact, tonal requirements change with the kind of material presented and the relative emphasis to be placed upon it.)

Writer

Should

Sound

in charge of his material
pleasant
persuasive

But

Not

commanding or condescending
chatty
contentious

The example below, drawn from the draft of the "Contracting" guidebook, fits nicely within this tonal envelope:

"The formal acquisition process sometimes gives the appearance of a maze of mysterious rules and regulations, understandable only by lawyers, which define in great detail what can't be

done. The software manager should not accept this appearance as the real situation. Instead, he should first decide what he wants to do and then insist that the acquisition experts figure out how to do this within the framework of the procurement regulations. The ASPR is surprisingly permissive in allowing the exercise of judgment and reason throughout the acquisition process."

Notice how the quotation above not only demonstrates attractive tonal features, but also takes an editorial position as suggested in Section II.

The following is another example drawn from the Army Tactical Data System's "Software Acquisition Handbook." Note that it is somewhat more formal in language but far from monotonal, since its punctuation creates some natural speech rhythms and inflections.

"Tradeoffs, of course, must be made relative to each candidate ECP. If its omission is such that the test cannot continue (due to a system loop or halt) or results are valueless, then there is no question but that it must be incorporated even if its installation and checkout delay the initiation or continuation of qualification testing. But some ECPs do not bear this importance - and their incorporation into the CPCI can await completion of the FQT."

The guidebook writer creates tone by making choices from among a multitude of options of mood, voice, punctuation, vocabulary, and sentence structure. One way of injecting tone is to invent, or adopt, a comprehensive set of rules governing usage of these language elements: "never use the passive voice," "use contractions where possible," "always underscore absolute or pivotal words like not, always, unless," "mix up usage of indicative, imperative, and subjunctive moods," etc. This approach, however, tends to produce a mechanical, cookbook writing process which stifles spontaneity of communication. There is another way.

Keeping a mental image of the intended reader's profile before him, the guidebook writer can visualize himself in an informal blackboard briefing situation and write in the relaxed verbal style he would use in explaining technical and management issues to an audience of one. This technique forces the writer to create appropriate tonal variations in spite of himself as verbal gestures are translated into narrative text. The more spontaneous and informal the process, the better: lapses in narrative construction, formality, and other elements are easily repaired later. The important point is to get moving with the story and to get its essentials down straight.

SECTION IV

EDITORIAL STYLE

This kind of style, as distinct from expository style, deals with conventions external to the idea content of the guidebook: it governs the packaging of the modes of presentation which carry the ideas. Because of the very large numbers of editorial style sources potentially available for review and evaluation, we are fortunate that the nature of the guidebook project dictates use of a single, unconstraining source: MIL-STD 847A.

THE STANDARD

"Format Requirements for Scientific and Technical Reports Prepared by or for the Department of Defense" (MIL-STD 847A) presents guidance of an extremely general nature. (The only mandatory contents of a technical report, for example, include a completed DD Form 1473 plus front and back covers.) Although the standard does not mandate a chapter/section/paragraph identification scheme, it does define a required sequence of sections by type when such sections are included:

(front matter)

- Front Cover
- Report Documentation Page, DD Form 1473
- Summary
- Preface
- Table of Contents
- List of Illustrations
- List of Tables

(body of report)

- Introduction
- Main Text
- Conclusions
- Recommendations

(reference material)

- References
- Bibliography
- Appendices
- Glossary of Terms
- List of Abbreviations, Acronyms, and Symbols
- Index

Distribution List
Back Cover

Beyond this, the standard specifies that headings and paragraphs need be numbered "only when needed for clarity." We may choose to adopt a numbering scheme such as the standard decimal progression (1.0, 1.1, 1.1.1, etc.) or one of many others. The decision can remain open to negotiation at this point since no great effort is involved in retrofitting a draft document with a numbering system.

THE OUTLINE

While the editorial style guide adopted ultimately provides a labeling and label subordination system for the guidebook's various units of information, it's the guidebook writer who defines the information contents and conceptual interrelationships of these units by means of an evolving outline.

The first stage requires preparation of a topical outline, an unordered list of subtopics which the writer feels are applicable to the guidebook topic and which he believes can be fleshed out reasonably using the materials at his disposal. Verifying his topical outline against his material and organizing subtopics into larger units as necessary, the writer creates an ordered list of sections together with a set of notes summarizing the content and objectives of each. This is termed an annotated outline, the point of departure of the writing process itself. The annotated outline must be delivered to the Air Force Project Office for formal review and concurrence.

Because the writer should be left free to organize his material in whatever fashion it best presents itself, restrictions and constraints on the outline process should be minimal. And, in fact, the guidebook outlines developed to date do show differing orientations, variously keyed to:

- the typical sequence of software acquisition management events,
- the relative magnitude of SAM tasks,
- the relative significance of SAM regulations, specifications, and standards.

AF pamphlet 10-1 "Guide for Air Force Writing," provides some excellent advice to the guidebook writer on the outlining process:

"NOTE: Don't let the making of an outline slow you down. The more complete you make it, the easier it will be for you to write from it later, but it doesn't have to be 'perfect.' Laboring over an outline until it details everything can be a waste of time and effort. It would be better to just jot your main ideas on paper and use them as a guide."

Beyond the desirable freedom to organize, there is a very small set of minimum mandatory content items which cut across all guidebook projects. These include a glossary of terms (see Section II), checklists of management guidance references and management procedures, a discussion of applicable Regulations, Specifications, and Standards and lessons drawn from experience.

SECTION V

WRITING THE GUIDEBOOK

Although each guidebook writer will have his own attitudes toward writing and his own personal methods of turning out copy, we can define (at a very high level) a set of production steps which seem to apply sensibly across all guidebook development projects. The sections below describe two preparatory steps and two writing and editing steps to be utilized in writing each guidebook.

ASSEMBLING AND ANALYZING MATERIALS

The writer analyzes content and boundaries of his topic as defined by ISTAO-SAM-001. He alters the boundaries as required in accordance with his experience and knowledge, negotiating such changes with the Air Force Project Office which must maintain centralized control of guidebook scope.

The writer identifies the portions of existing SAM regulations, specifications, and standards which are relevant to his topic and analyzes them, based on his experience, in terms of gaps, overlap, and conflict. To those sources of formal guidance he adds informal sources drawn from industry, government agencies, and interviews with experienced personnel including, if possible, those with System Program Office experience. Based on these materials, the writer develops reference lists of useful SAM tools and techniques.

In parallel with the above tasks, the writer works with an evolving guidebook outline. He is left free to rearrange his outline as his material develops inside or outside it, constrained only to organize the material in a way that seems natural for most effective presentation (as discussed in Section IV). This outline, first in topical then in annotated form, will be reviewed by the Air Force Project Office in accordance with the procedure outlined in Figure 1.

VERIFYING FEASIBILITY AND SCOPE

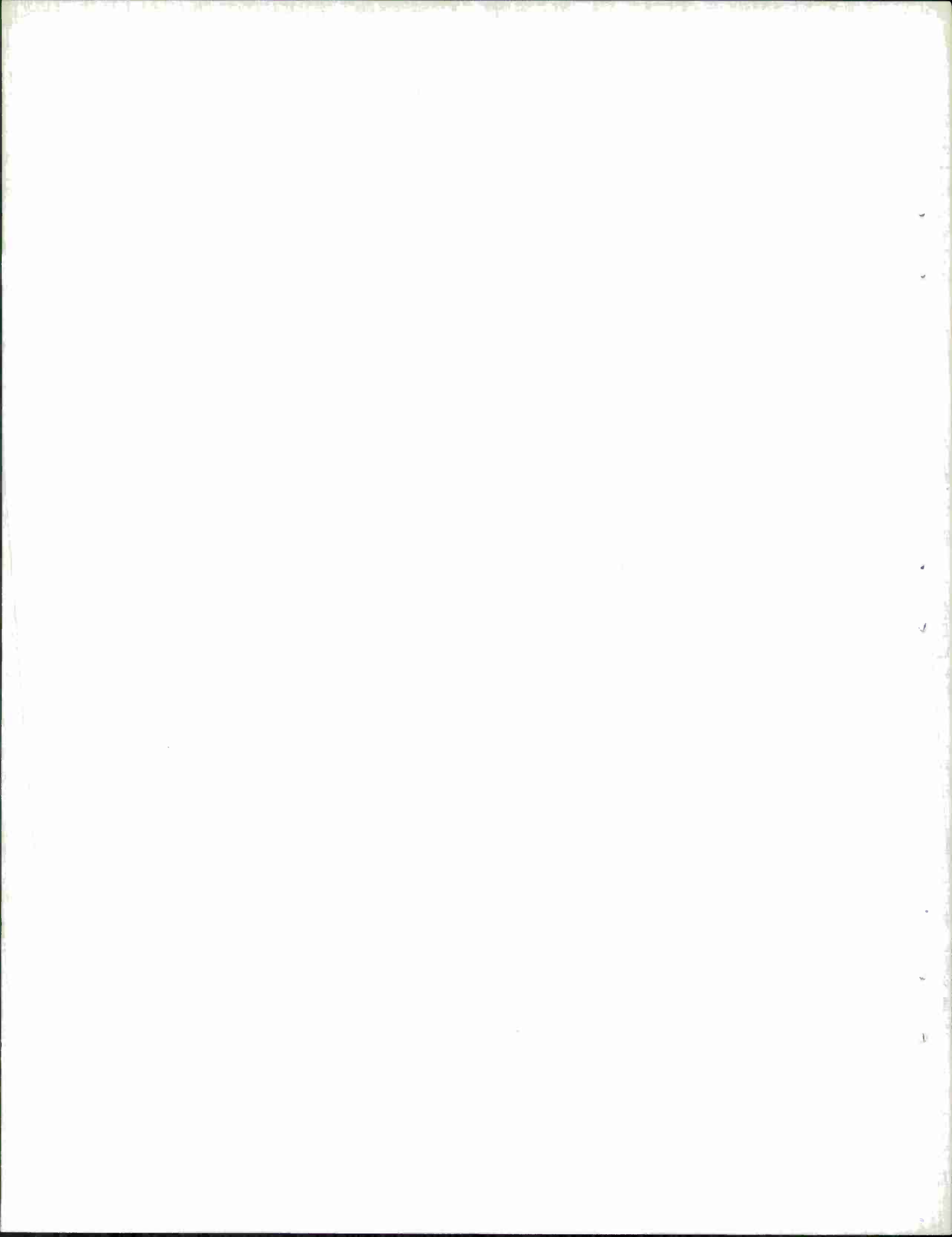
If a major overlap in topical boundaries is identified, the materials developed to this point (reference lists of management guidance and techniques) could be turned over to another guidebook whose scope would be adjusted accordingly. The object is to prevent heavy expenditures of manpower on a product whose content promises to add little in interpretation or experience to the basic official guidance. However, the Air Force Project Office must concur with this action.

WRITING AND EDITING

The writer reviews this guide once more and moves into the writing phase, producing text, lists, and graphics for each subtopic as fast as possible while striving for spontaneity of tone as suggested in Section III. The writer is careful not to begin with the guidebook introduction since he knows that effective introductory material can be written only after the content to be introduced is written and thoroughly understood. He also guards against an over-consciousness of the editorial style guidelines to be applied later.

With most of his guidebook content developed in piecemeal fashion, the writer must arrange his fragments in a natural best sequence (referencing his earlier intentions as reflected by his annotated outline). This done, he must label and link sections together by writing transitional material in accordance with the structural requirements of the editorial style adopted. An editing pass is then needed, driven by guidance from two sources: the editorial style conventions, and editing techniques drawn from the checklists published in any one of the many writing guides available. AF Pamphlet 10-1, Guide for Air Force Writing, is a useful document. One of the many checklists it contains is attached here as Appendix II.

With first draft written and edited, the guidebook draft is submitted to the Air Force Project Office for review. Gathering the comments thus generated, the guidebook writer produces the final draft for this guidebook (in the form of a 40-75 page technical report).



APPENDIX I

Extracts from ISTAO-SAM-001 which outline the topical boundaries of each of the proposed software acquisition management guidebooks.

GUIDE TO REGULATIONS, SPECIFICATIONS, AND STANDARDS

This guidebook will provide a topical index and description of regulations, specifications and standards that are pertinent to the management and development of software. Inconsistencies between regulations, specifications and standards will be identified to the extent possible. Where appropriate, it will provide a discussion of the impact and requirements that these documents impose on the software development cycle, and on the system acquisition life cycle (AFR 800-2). Appropriate matrices will be included to indicate: (1) the applicability of a particular regulation's specifications and standards to specific acquisition classes and (2) the applicability of a standard specification and standard at any point in the acquisition life cycle. Points covered by this volume are:

- How should regulations, specifications and standards (R, S, S) be used, and at what points in the life-cycle?
- What R, S, S are pertinent to software acquisition; how do they apply to areas covered in other sections of this guide?
- How can one resolve inconsistencies or conflicts in R, S, S?
- For each R, S, S, briefly summarize its contents.
- Provide a topic index to R, S, S's.

CONTRACTING FOR SOFTWARE ACQUISITION

This guidebook will address the contractual aspects of software procurement starting with advanced procurement planning and ranging to contract management. Topics include: contract type selection, contractor selection, proposal evaluation and contract management techniques. Questions answered by this guidebook are:

- What types of contracts deal exclusively with software or have software components?
- What contractual provisions do or should pertain especially to software?
- What are the pitfalls in software contracting and how can they be avoided?

- What provisions in the contract are required for protection of classified information?

MEASURING AND REPORTING SOFTWARE STATUS

The purpose of this guide is to describe available methods for assessing the status of the software development effort and to identify problem areas and shortcomings encountered in their use. It will tell the manager what information to look for, where to get it and how to use it to measure the progress of the development effort. Some of the questions for which guidance will be provided are:

- What methods are available for determining the status of developmental software?
- What types of reports or measuring devices should be imposed and what should they contain as data?
- How frequently should milestone or checkpoint reports be required?

STATEMENTS OF WORK AND REQUESTS FOR PROPOSAL

This guidebook describes the content and format of SOWs and RFPs. It identifies the organizational responsibility for their initial development and the process for initiating and controlling changes. Emphasis is placed on common pitfalls in SOW and RFP writing. Questions answered by the guidebook are:

How to Write a Software SOW or RFP

- What are appropriate contents?
- What regulations, specifications and standards should be identified?
- How can one determine the adequacy of each provision? What pitfalls are common?
- Where does a SOW or an RFP fit in the software life-cycle?
- What provisions should be made for software data rights?

What Can be Done if the SOW or RFP is Already Written and Inadequate?

- Formal amendment
- Other means for establishing agreement

REVIEWS AND AUDITS

This guide will list and describe design reviews and audits required by existing AF directives. It will indicate the organizational element responsible for conducting a design review or audit and describe when and how the review or audit will be conducted.

Typical reviews and audits required for software acquisition are:

- System Design Review
- Software Preliminary Design Review
- Software Critical Design Review
- Progress Reviews during Development and Programming
- Progress Reviews during Verification, Validation and Certification
- Functional Configuration Audit
- Physical Configuration Audit

The guidebook will answer the following questions for each review or audit listed above:

- What material should be available before each review or audit?
- What steps are involved?
- Who will or should be there?
- What documents should result?
- If corrective action is needed because of a review or audit, how is the action implemented?
- If previous reviews or audit have not occurred or have not been resolved, what alternatives are available for action?
- To what level of detail should a review or audit go?

- Who will use the results of the review or audit and what for?

CONFIGURATION MANAGEMENT

This guidebook will describe how the configuration baseline is established and controlled throughout the development life-cycle. Particular emphasis will be placed on techniques for enforcing sound configuration management procedures. Some of the questions addressed by this guidebook are:

- Baseline management - what is it?
- What establishes a baseline?
- What baselines are maintained, and when are they maintained?
- When is formal configuration control placed on the software development?
- When is informal (e.g., contractor's in-house configuration management) configuration control desirable?
- What type of organization is required to maintain control over the software configuration?
- Who participates?
- What does a typical configuration management plan look like?
- Changes and waivers - how does one make changes to baselines?

REQUIREMENTS SPECIFICATION

This guidebook describes the content of the functional requirements and functional specifications documents. It provides guidance on who prepares the requirements document, who reviews and approves them, and how they are to be used during subsequent phases of the acquisition life-cycle. Some of the questions to be answered by this guidebook are:

- Software requirements documents - what should they contain and what should be done if they don't?
- Who reads them, what does he do with them, and what does he need from them?
- What is the relation of software specifications and requirements documents to "system" specifications and other documents?
- How can software requirements best be stated (i.e., in what terms; to what detail)?
- What aids are available for stating requirements?
- From whose point of view should the requirements be stated?
- How are the software security requirements established?

COMPUTER PROGRAM DOCUMENTATION REQUIREMENTS

For each of the following documents, who is it intended for; who writes it; what are its appropriate contents; where are oversights frequently made; what documents describe their form and format; what is an appropriate level of detail; how does one re-create the document if it is missing or was improperly written; when is it unnecessary; how is it updated; how can one tell if it's any good; what are the corresponding data items (TD-3); what standards apply; how is a security classification determined?

- System Specification
- Computer Program Development Specification (Part I Spec)
- Computer Program Product Specification (Part II Spec)
- Lower Level Specification (Program module, subroutine)
- Programmer's Manual
- Operator's Manual
- User's Manual or Positional Handbook
- Program Catalogs and Listings

- Maintenance Documentation (set/used listings, change notices)
- Training Aids
- Data Base Document and Listings
- Interface Specifications
- Version Descriptions

VERIFICATION

Verification, in this context, is the process of determining equivalency between the different representations of the software that are products of the software development process. Verification tools and techniques are the means for accomplishing the goals and tasks that are identified in the formal review process (ref MIL-STD-1521). Using references as much as possible, this guide will describe the manual techniques employed for verifying requirements, specifications, and code. It will further identify automated aids that are available to assist the verification process. Emphasis will be placed on describing various strategies that can be employed by the software manager to obtain the necessary resources (tools, personnel, computer, etc.) to successfully accomplish verification (e.g. Independent Verification Contractor, Independent Air Force Agency, etc.) The guide will further identify the manner in which these resources should be organized, directed and controlled. Questions to be answered by this guidebook are:

- What software acquisition deliverables require verification?
- How are the verification criteria for a particular deliverable established and where are they specified?
- At what points in the acquisition life-cycle is verification accomplished?
- Who is responsible for accomplishing the verification?
- What tools are available for verifying software?
- What actions are taken if software products fail the verification?

VALIDATION AND CERTIFICATION

Software validation and certification are similar to software verification. They differ primarily in the span of software development activities to which the validation or certification process is applied. The validation process establishes whether or not the completed computer programs meet the system specification; certification establishes whether or not the completed computer programs satisfy the mission requirements. The guidebook will address the techniques for validating and certifying software and will cite pertinent standards, specifications and regulations related to the validation and certification process. Automated tools to facilitate validation and certification will be identified. Questions to be addressed in the guidebook are:

- What organizational element of the development activity is responsible for validation? For certification?
- Who provides the resources for certification and validation?
- What reports are provided to indicate the results of certification and validation?
- What actions are taken if the computer programs fail validation or certification?
- Who establishes the validation and certification plan and schedule?

MANAGEMENT REPORTING BY PROJECT DIRECTOR

This guidebook lists the formal reports required by directives governing the software acquisition process and the informal reports dictated by good management practices. Emphasis is placed on the need to provide meaningful, quantified, indications of where the project stands in relation to cost and schedules.

- What types of reports are required?
- By whom?
- What goes into a report? Where does one find the required information?

- What are the commonly accepted variables for assessing software status?
- How valid are they?
- How much flexibility does one have in preparing reports, how often must they be given, where does one look for additional direction (guidance)?

COMPUTER PROGRAM MAINTENANCE

This guidebook will emphasize the need for considering future maintenance of the software during each step of the development process. Appropriate Air Force and DoD directives specifying maintainability requirements will be cited. The following questions will be answered.

- What materials (documents, versions of programs, plans, facilities, etc.) must be available for maintenance?
- What is an appropriate organization for maintenance?
- What special procedures must be instituted for maintenance?
- How can one estimate the time and costs for maintenance?
- Who in the development organization is responsible for ensuring that end product maintenance provisions are adequate?

SOFTWARE QUALITY ASSURANCE

This guidebook will identify and define elements of software quality assurance, and provide guidelines for managing/conducting a quality assurance program. Topics will include: definition of software quality, methods of quality measurement, techniques (configuration management, test management, data management, requirements traceability, etc.), contractual aspects of quality assurance.

Questions to be answered by this guidebook include:

- What type of scheduled events or milestones should occur in a software quality assurance (SQA) program?

- Who should perform/use the SQA techniques (Air Force in-house, FCRC, prime software contractor, independent contractor)?
- What types of deliverables should be expected from an SQA program?
- What type of corrective action should occur if SQA program detects faulty design or coding?

SOFTWARE COST ESTIMATING AND SCHEDULING

This guidebook tells how software development cost and schedule estimates are established. Emphasis is placed on the techniques for measuring and controlling costs and schedule during the development life-cycle. Questions to be answered by this guidebook are:

- How can one estimate development costs, maintenance costs, life-cycle costs of software?
- What are the components of software development costs?
- How do cost analyses and predictions relate to work breakdown structures (MIL-STD-881)?
- What methods are available for measuring budget conformance?
- What methods are available for recovering from real or predicted budget overruns?

APPENDIX II
CHECKLIST FOR REVIEWING AND
EVALUATING WRITING

Technical Evaluation

1. Does it fulfill objectives?
2. Does it cover essential points?
3. Does the preface or introduction explain what is to come and in what order?
4. Are the proper acknowledgments and assumptions included?
5. Is the problem stated so that it agrees with the objectives?
6. Are the conclusions or recommendations significant, pertinent, and valid?
7. Are the findings supported by the data presented?
8. Does the main discussion or body describe the data, tests, procedures, etc., with completeness and accuracy?
9. Are specific sources given for all information?
10. Are all source materials in the public domain (for example, available through the National Technical Information Service)?
11. Is the information exact and accurate?

Writing Evaluation

1. Is the arrangement and order of presentation well-balanced?
2. Is there a suitable title page, table of contents, list of illustrations (if needed)?
3. Is the writing clear, unambiguous, precise, and readable?
4. Are the sections and subsections identified with accurate and interesting headings?
5. Are the typographical errors corrected or marked for correction?
6. Is the typing clean enough for the purpose for which the document is to be used?
7. Are the illustrations, charts, and tables (if any) accurately numbered for identification? Do they appear near the data they support? Are they referenced to the sections they support?
8. Is the level of language appropriate to the readers:
 - a. Too technical?
 - b. Too bureaucratic?
 - c. Too much jargon?
9. Are abbreviations and new terms explained?
10. Is the transition adequate from topic to topic, paragraph to paragraph, and sentence to sentence?