TRAIDEX NEEDS AND IMPLEMENTATION STUDY

SofTech, Incorporated

PREPARED FOR
Defense Advanced Research Projects Agency

14 May 1976

Final Report

TRAIDEX Needs and Implementation Study

Item Number 0002AB
Contract MDA903-75-C-0224

SofTech Contract Number 1020

1020-2

May 14, 1976

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the functional design of an information exchange system that will allow developers of military technical training courses to have access to an automated catalog of validated course units that are available for interservice sharing and reuse. The design, which is presented using the Structured Analysis and Design Technique (SADT), is based upon the information needs of technical course developers as revealed by a series of field interviews at over a dozen training

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headquarters, development sites, and research facilities in three services. The automated catalog allows inquirers to search for units of previously developed technical training courseware based on keyword descriptors, the content of formal learning objectives, the media used for presentation, and on many other descriptive fields. Additional descriptive information about validation methodology and result, entry qualifications, length of presentation, and other key areas are provided. The functions of required supporting organizations and activities are described, and the costs of implementing and operating the system at the INFOCEN information storage and retrieval facility, located at Wright-Patterson AFB, are estimated. The benefits that must accrue to course developers in order to allow the system to pay for itself are specified, and a plan for its development and integration are is presented.

ACKNOWLEDGEMENT

This study was directed by Carl J. Young; the members of the project staff were John W. Brackett, Reuben S. Jones, and Anita Nyyssonen.

Assistance in the collection and analysis of training course development information needs was provided under a separate ARPA contract (MDA 903-74-C-0290) by Len Swanson, Educational Testing Service, Princeton, N. J., and Lorraine T. Sinnott, Interuniversity Communications Council, Inc. (EDUCOM). Additional consulting services over the course of the project were provided by Thomas C. O'Sullivan of TRAC, Los Angeles, California.

The study also benefited greatly from the time devoted to it by a number of experienced members of the military training community whose cooperation in the information gathering task and in the evaluation of the TRAIDEX functional model was vital to our success. While the number of people who gave freely of their time and expertise is too great to allow individual acknowledgement, special thanks are due to the members of the Technical Training Committee of the Interservice Training Review Organization, and in particular to its chairman, Mr. W. E. Abel, CNETS, Pensacola, Florida, and to Mr. O. W. Sanders, NTEC, Orlando, Florida, and Dr. D. Meyer, HQ ATC/XPT, Randolph AFB, Texas.

In spite of all the assistance we received, SofTech is solely responsible for the contents and conclusions of this report.

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Section 1

MANAGEMENT SUMMARY

This section summarizes the findings of SofTech, Inc., with regard to the feasibility and cost effectiveness of the Training Resource, Applications and Information/Data Exchange (TRAIDEX) System. TRAIDEX is an information storage and retrieval system that has been designed to reduce the cost of developing technical training courses within the armed services by allowing developers to have timely access to a comprehensive, up-to-date catalog of well described and validated courseware. The information collection and analysis that forms the basis for these findings was performed during the period April 1975 through April 1976, by SofTech with the assistance of Educational Testing Service of Princeton, N. J. This information was gathered during a series of interviews at over twelve separate headquarters and training development locations, during which personnel ranging from senior headquarters and technical school staff through education and training specialists to course developers were interviewed. The functional design of an information exchange system that could fulfill the requirements that were uncovered by the information needs analysis was performed, and was reviewed by members of the Interservice Training Review Organization and by selected senior training staff personnel. Finally, two system implementation alternatives were designed and their costs estimated. The results of the study are summarized below.

1.1 Information Needs

The study indicates that the interservice sharing of validated technical course units can significantly decrease the time and cost required to produce courses for which identical or similar units must be developed. This view is supported both by qualified development personnel and by the experience of course developers who have actually reused course material from other services. The major obstacles that currently prevent this type of information sharing from taking place are:

- the lack of a catalog of up-to-date, descriptive information that identifies well-validated course material
- the lack of a uniform and responsive system for obtaining course material after it has been identified.

1.2 System Requirements

The TRAIDEX system that has been designed as part of this study addresses the information needs identified. Furthermore, the functional requirements of the system can be met by utilizing an existing hardware/software information processing system, INFOCEN, that is operated at Wright-Patterson Air Force Base in Dayton, Ohio. The implementation of TRAIDEX will therefore require no significant acquisition of computer hardware or software. The only additional hardware costs will include the purchase of low-speed typewriter terminals and the cost of using a packet switching communications network. These costs are described in detail in Section 6 and the appendices to this report.

The key to the successful implementation of TRAIDEX will be the provision of active support from the using services through the assignment of active, innovative operational staff and the visible backing of both headquarters and development site commands. The details of TRAIDEX staffing requirements are covered in Section 7.

1.3 System Costs

Two implementation options have been described for the TRAIDEX system. Based upon using the INFOCEN information storage and retrieval system as the host for the database, the first option takes advantage of the fact that INFOCEN is also the host for the Defense Audio Visual Archive (DAVA). The Director of DAVA has offered certain hardware cost and personnel support that places the five-year cumulative cost of implementing TRAIDEX at approximately $821 thousand. The second option also assumes the TRAIDEX system is implemented on the INFOCEN system, but does not assume DAVA assistance, for a five-year cumulative cost of approximately $1.9 million.

1.4 TRAIDEX Benefits

Based upon accepted estimates of technical course development costs, even the more costly TRAIDEX implementation option need reduce the development costs of the courses impacted by TRAIDEX by an average of only two percent in order to pay for itself in five years. This cost calculation is presented in Section 6.4. Furthermore, SofTech believes that other less quantifiable benefits, especially the production of higher quality courseware, will result from continued TRAIDEX usage.

Section 2

SCOPE OF THE TRAIDEX STUDY

2.1 Study Definition

This report describes the results of the information needs analysis and implementation study of the Training Resource, Applications and Information/Data Exchange (TRAIDEX) System. The TRAIDEX system has the general objectives of acquiring, maintaining, retrieving, disseminating, and exchanging documents, materials and information useful to the education and training activities of the four military services. It is a data exchange system, intended primarily for the use of training course analysts and developers in all services, that will allow them to obtain the benefits of common experience in the analysis, design, and development of military training programs.

The TRAIDEX study has been jointly funded by the Army, Navy, Air Force, and DARPA and has been conducted under the auspices of DARPA and the Interservice Training Review Board (ITRB) by two contractors: SofTech, Inc., of Waltham, Mass., and Educational Testing Service (ETS) of Princeton, N. J. The Interuniversity Communications Council, Inc. (EDUCOM) also provided substantial consulting support and assistance to ETS. The study was divided into four tasks, as follows:

- Conduct a cost/benefits/effectiveness analysis to identify the most feasible and attractive TRAIDEX features
- Conduct an information analysis to identify both needs for and sources of information in the military training community
- Define TRAIDEX concepts of operation
- Specify implementation options, costs, and a development plan

2.2 Study Background

In order to understand the underlying assumptions and definition of scope which guided the TRAIDEX study tasks, it is important to be aware of the evolution of the TRAIDEX concept prior to the start of this study. From the spring of 1974 to the spring of 1975, the potential definition of an information and data exchange system was still open-ended, and the TRAIDEX concept included many possible goals, benefits, and uses including:

- Making the curriculum developer more productive and effective
- Reducing course preparation effort
- Reducing inefficient, inappropriate application of training resources
- Identifying widespread research and development needs
- Maximizing the dissemination of new technical applications and innovations

The methods proposed for meeting these goals included the sharing of common course elements among the services and the sharing of evaluative information on media, resource applications, etc. The proposed user community included course developers, administrators of training curricula, headquarters planners and policy makers, and the training research community. Possible TRAIDEX application areas included technical training, flying training, general military training, human goals training, and the use of simulation devices, training devices and advanced training systems. Other possible areas of impact were research requirements, operational training, system maintenance, on-the-job training, career development, and support of the Instructional Systems Design (ISD) concept.

Realizing that the success of the initial study depended upon a well-defined scope, the Interservice Training Review Organization (ITRO), SofTech, and ETS agreed on several major points in the TRAIDEX definition. At the ITRO Training Technology Committee meeting in April 1975, SofTech and ETS were directed to emphasize training course design and development as opposed to training research or management, because personnel involved

in administration, plans, policy and research were recognized as having different information requirements from the developer. The most cost-effective benefits of a TRAIDEX system were projected to include:

- reduced duplication of effort during course development
- reduced use of personnel and resources during course development
- increased course effectiveness in attaining learning objectives
- increased course developer productivity

A second direction that evolved from the April meeting was that the study focus on technical training, because it has the following characteristics:

- it is characterized by high cost per student and high student volume
- course content is likely to possess a high degree of commonality across services
- rapidly changing weapons system technology base is causing the production of new courses and the modification of existing ones at a rapid rate

Primarily because it is characterized by very high dollar cost per student, flying training was also discussed as a potential study area. However, the flying training community is fairly small and close knit, and already operates with a high degree of interaction; therefore, flying training was not investigated. Other areas such as human goals and general military training were believed to possess a high degree of commonality, but the dollar costs per student for these programs are not as high as for technical training and they were de-emphasized during the information needs analysis. However, once the TRAIDEX system has been proven to be operationally and economically feasible, these areas can be added to the descriptive catalog by simply expanding the course screening criteria that are used to select the TRAIDEX course units. This is feasible because the basis for TRAIDEX unit descriptions (subject area keywords, learning objectives, test items, and so forth) is common for any category of training that has been developed using an ISD-like approach.

The final major directive resulting from the April meeting was that the study examine the possibility that TRAIDEX emphasize the use of a standardized training development process by directly supporting the ITRO ISD (Instructional Systems Development) model being developed by Florida State University.

In summary, the benefits projected for the potential TRAIDEX system at the beginning of the study were:

- Reduced course development effort and cost
- Increased productivity and effectiveness of the course developer
- Support of a standard instructional development methodology

2.3 Study Task Definition

2.3.1 Cost/Benefit Analysis: Task 1

At the start of the TRAIDEX study, it was intended that the potential cost of any proposed TRAIDEX function be compared to the expected benefit to be derived from it. This formal process would allow the study team to continually narrow its attention to only those areas where quantifiable benefits could be obtained through technically feasible means at a reasonable cost. Given the initial technical direction to concentrate on improving the efficiency of the course development process, it became clear that a key ingredient to the cost/benefit analysis would be the collection of design and development costs for each of the various stages of the instructional systems development process. However, as the information analysis task proceeded, it quickly became apparent that it would be impossible to obtain representative analysis, design, and development costs. The reasons for this lack of cost data are varied, but they can essentially be summarized as follows:

a) Personnel costs for learning material development are often not separated from costs incurred for instruction.

b) Estimates of the ratio of development to presentation time vary widely, and are heavily impacted by the introduction of new instructional technologies such as self-paced instruction in its various forms.

c) Development time is also strongly correlated with developer experience. Given the emerging state of newest (and presumably most effective) technologies and the relatively high rate of developer turnover, most developers have had relatively little experience in applying these technologies. We are therefore hesitant to accept the few development costs that were obtained as representative.

In spite of the problems cited above, the following general cost trends appear clear:

a) The same instructional technologies that are proving so effective in reducing the training time required to produce a qualified graduate are demanding an increasing investment in the learning material development phase.

b) As the trend toward more specialized course modules proceeds, the total number of course hours that must be developed is increasing.

As a result of this information deficiency, the study team has taken the following approach:

a) Design and specify an information exchange system that is functionally capable of providing the required course development assistance (see Section 5) and of handling the projected volume of stored information and data transactions (see Section 4).

b) Estimate the costs of developing, integrating, and operating this system, making maximum use of existing hardware and software systems, and translating these costs into the development resources that would have to be saved in order to have the system pay for itself. (See Section 6.)

2.3.2 Information Needs Analysis: Task 2

The analysis of training information needs was accomplished in the period May-August 1975 by interviewing a cross-section of training personnel in the four services and by surveying DoD and non-DoD information resources relevant to TRAIDEX information needs. SofTech and ETS cooperated in the interview tasks, and ETS/EDUCOM surveyed the relevant information resources. The objective of Task 2 was to provide a base for the remainder of the study by:

- Focusing the remainder of the study on the TRAIDEX functions with the greatest potential benefits

- Defining the information TRAIDEX must contain in order to provide those benefits
- Specifying the sources of existing information to be used and identifying information that must be created
- Evaluating the potential impact of TRAIDEX on inter-service training and development

A key issue in the information analysis task was the identification of the categories of information that should be handled within the TRAIDEX system. The specific categories of information that were selected for inclusion in TRAIDEX were culled from the kinds of information listed below. The scope and nature of the elements of this list indicates the breadth that the TRAIDEX concept possessed prior to the start of the study. At that point, TRAIDEX was expected to be able to handle:

- training resource material
  - simulation devices and part task trainers
  - technical training equipment
  - training aids
  - audio-visual materials
  - training literature
- job/skill analysis information
- training requirements analysis information
- new education/resource developments (techniques, materials, technology)
- applications, effectiveness and availability of training resources
- training facilities
  - instructors
  - existence of equipment
  - existence and configuration of laboratories
  - existence of classrooms
- course descriptions
- research requirements
  - completed
  - in process in laboratories
  - awaiting action
- operational training processes
- team training procedures

The very broad range of training activity and related information needs that is implied by the scope of this list was narrowed at the start of the study in order to focus on the areas of training course development that were believed to possess the greatest potential for cost reduction. It must be noted that the primary motivation for this reduction in scope was the decision taken by the ITRO Technical Training Committee to insure that the study was sufficiently well bounded, that it would result in a feasible and cost justifiable system and that it could provide tangible benefits within a realistic time frame. The decision to concentrate on the needs of the course developer, the discovery of other complementary information systems, and the decision to utilize the natural occurrence of objective-based descriptions has resulted in the definition of a system that is well-bounded, that will serve a specific need in the costly process of instructional systems development, and that will be relatively inexpensive to implement.

The results of the needs analysis conducted during Task 2 were documented in a SofTech report delivered to DARPA on September 15, 1975, entitled "TRAIDEX Study: Information Needs", the major contents of which are included in Section 3.

2.3.3 Concepts of Operation: Task 3

The concept definition effort was designed to define the functions that an operational TRAIDEX system must perform in order to meet the information needs identified during Task 2. Specifically, Task 3 was performed to define over-all procedures and capabilities in the following areas:

a) The content and form of TRAIDEX database elements, i.e., what information will be accessed through TRAIDEX, and in what form it will be provided to users.

b) The procedures to be followed in obtaining, updating, and preparing data for input to TRAIDEX, including procedures for indexing it appropriately.

c) User procedures for accessing TRAIDEX data, including methods of dealing with conflicts in indexing terms, limits on system response time, and other aspects of the user/system relationship supported by TRAIDEX.

d) The functional requirements that must be met by the organizations that support and manage the TRAIDEX system operation.

In short, this Task defined TRAIDEX concepts of operation, and provides the basis for the implementation options developed during Task 4. The task was approached from a viewpoint that consciously attempted to define the characteristics of the required functions without assuming the existence of a computer as a resource. The result is a functional design that is only minimally dependent upon the type of automatic data processing support that is available.

2.3.4 Implementation Options, Costs and Plan: Task 4

Given the functional requirements of the TRAIDEX system defined by Task 3, the goal of the final task has been to investigate and define feasible options for realizing the mechanisms required to perform those functions, to estimate the costs involved with implementation and operation, and to propose a plan for the integration of the system. It is worthwhile to point out at this time that the results of this task have indicated the complete feasibility of handling the technical requirements of TRAIDEX and the anticipated system data volumes within currently existing hardware and software systems. While the effective utilization of all appropriate, currently available resources has always been a stated objective of the ITRO, it was not until this task was complete that confirmation of the feasibility of a TRAIDEX implementation that did not require any large hardware/software procurement was established.

2.4 Report Definition

The remainder of the report has been divided into five sections that present the results of study tasks two through four. Section 3 describes the requirements, methodology, and results of the information analysis task, and concludes with a brief summary of the study team's conclusions concerning the utility of a TRAIDEX system. Section 4 contains the estimates of data and transaction volume that a system satisfying the needs identified in Section 3 would have to handle, and Section 5 presents the concepts of operation of such a system. Sections 6 and 7 present the steps required to implement and operate TRAIDEX, and provide estimated costs for each phase.

Section 3

TRAIDEX INFORMATION NEEDS

3.1 Task 2 Methodology

3.1.1 Background

The requirement that TRAIDEX be oriented primarily toward improving the technical training course development process implied that the information needs analysis task must gather at least the following basic data:

a) Descriptions (both qualitative and quantitative) of current course development practices

b) Descriptions of current information sources used by developers, and identification of those phases of the development process that would benefit most from the introduction of new sources

c) Estimates of the direction of future development in instructional technology, and their requirements for new information.

In addition, it was felt that verification of many of the fundamental assumptions about the utility of a TRAIDEX facility should be obtained from its potential end users. While much of this information could have been gathered via a mailed questionnaire that would have obtained broader coverage than an interview method, the latter approach was chosen for the following reasons:

a) TRAIDEX itself was and is an evolving concept; the interviewers could tailor the emphasis of their presentation both to a gradually more refined view of the system and to the outlook of their audience.

b) The sample base for information gathering covered a very wide range of personnel of varying rank in a variety of line and staff positions.

c) Most important, the fundamental aspect of TRAIDEX as a user-accessed, relatively passive information resource made it mandatory to evaluate at first hand the reaction of the proposed users, and to estimate the likelihood of their voluntary utilization of such a system.

After some experience in Task 2, information gathering, ETS evolved a set of questions that served as a base for information gathering throughout the rest of the task. A summary of the content of the questionnaire follows:

- course development process
  - describe the training process, management, and support, provided by your organization
  - what is the role of a formal ISD methodology in this process?
  - what is a typical ratio of course development time to course presentation time?
  - what are the most difficult or time consuming phases in the ISD process?
  - what are typical course development costs?
  - describe the inputs and outputs of the development process as practiced by your organization
- TRAIDEX information content and concept
  - what information would substantively aid the developer? How would the information be used, and how much would it help?
  - describe user to system interface requirements and possibilities, timeliness, indexing, form and format.
  - describe possible relevancy measures of TRAIDEX outputs.
- other information sources
  - what sources are currently used?
  - what sources would be used if access was available?

In addition, representatives of the training community were questioned regarding the assumptions behind TRAIDEX, such as the possibility of reducing development time and increasing developer efficiency, existence of a high degree of interservice commonality, etc. Hypotheses on the content, interface, and function of a possible TRAIDEX were continually tested. Finally, feedback on problems for an operational TRAIDEX were generally contributed with little need for formal questions or prompting from the study team.

3.1.2 Interview Sites

Interviews were arranged by phone and letter contact with members of the ITRO Technical Training Committee at each service training headquarters. With recommendations from these representatives and representatives at each succeeding level the interviewing proceeded from the headquarters down to the resident schools and course development sites. Figure 1 shows the distribution of interviews with locations and numbers of people interviewed.

Figure 1

Level	Air Force	Army	Navy
Headquarters	Air Training Command (ATC) 11	Training and Doctrine Command (TRADOC) 8 Combat Arms Training Board (CATB) 2	Chief of Naval Education and Training (CNET) 10
School Staff	Chanute AFB 7 Lowry AFB 16	Ft. Benning 2 Ft. Gordon 5	Chief of Naval Technical Training (CNTT) 6
Course Developer/ Instructor	Chanute AFB 9 Lowry AFB 25 Lackland AFB 4	Ft. Gordon 8	Memphis Naval Air Station 5

Not shown in Figure 1 were interviews with a representative of USMC Training Headquarters, two researchers from Florida State University (developers of the FSU ISD model) and several representatives of the DoD Directorate for Audiovisual Activities, as well as a visit to the Air Force Human Resources Laboratory installations at both Wright Patterson and Lowry Air Force Bases.

Given budgetary constraints, the necessity of visiting at least one technical school in each service and the desire to contact a cross-section of those involved in the course development process, the interview sample was small, and the results must rest on the careful evaluation of the informed opinions of key personnel. However, people in the major areas of the course development process that would have an impact on or would be impacted by TRAIDEX contributed to the study, and feedback was obtained from headquarters personnel, course development managers and course developers using various development methods including the Florida State University ISD model. Personnel involved in the future direction of training in the services were interviewed, including personnel supporting the newly formed Army Training Management Institute, the Air Training Command ISD Advisory Services section, and Navy Technical Training personnel involved in the establishment of the Memphis Computer Manage Instruction (CMI) complex. Since combat arms represents a large portio of the training concerns of the Army and Marine Corps, the study team contacted both the Infantry School and the Combat Arms Training Board. At the headquarters level interviews were held with those involved with advanced training support systems, planning, policy making, budgeting, and management as well as, technical training development and the use of simulation and advanced training aids. Information on databases was gathered at each visit with particularly relevant information coming from visits to the DoD Directorate for Audiovisual Activities and the Air Force Human Research Laboratory at Wright Patterson AFB, Dayton, Ohio.

3.1.3 Interview Methodology

Because the range of information sought was broad and because the experience, service background and level of responsibility of the potential sources was diverse, it became clear that a rigid questionnaire or highly structured interview guide would not be productive. Therefore, the information gathering methodology was built around a semi-structured interview. After briefly describing the nature of the study (without dwelling on the information retrieval aspects of TRAIDEX), interviewees were questioned in each of the general areas of the questionnaire. Depending upon the attitude and experience of the subject, certain areas were followed

up in greater detail. In general, lower level developers were interviewed in small groups and in the absence of their superiors.

As a separate subtask, ETS surveyed DoD and non-DoD databases and information resources such as reference materials, computer search services, periodicals, contacts, etc. The results of the information resource survey portion of Task 2 have been published by ETS in two documents:

1) "Information Resources for Training: A Survey of Non-military Sources", by Len Swanson and Lorraine T. Sinnot, Document MDA 903-74-C-0290-1, March 1975

2) "Military Sources of Training-Related Information", by Lorraine T. Sinnot, Document MDA 903-74-C-0290-2, September 1975

3.2 Interview Results

At the start of the study, the projected benefits of TRAIDEX had been focused upon reducing the course development effort and increasing the productivity and effectiveness of the course developer. Technical training was to be the primary study area because of large personnel and dollar costs, the judgment that a high degree of commonality existed in this area, and the assumption that rapidly changing technology caused much new course development and re-development. Support of the FSU-developed ISD model was a factor to be examined.

In order to present the results of a large number of interviews in a coherent manner, we have restated the original projected benefits and goals of TRAIDEX, along with some underlying assumptions about the nature of the technical training development process, as a set of ten hypothetical statements. These statements serve to formalize a set of requirements that must be shown to be realistic if TRAIDEX is to be a viable concept. The hypotheses are followed by a summary of interview responses both pro and con, and the study team's conclusion.

3.2.1 Hypothesis: Exchange of information will save course development time.

The most important point in the feedback on this issue is that a limited number of course developers have successfully borrowed course-

ware from another service and saved their own course development time as a result. For example, developers in the Department of Army Wide Training Support at the Signal School (Ft. Gordon) cited a case in which one month of development time was saved on a 3-4 month effort by using material borrowed from the Air Force; furthermore, this time was saved in spite of ostensible inter-service differences in maintenance and training philosophy. An interesting aspect of this particular development experience is that the developers tended to be technically oriented generalists who relied upon the assistance of subject matter experts, rather than subject matter experts with experience in a particular kind of course development.

However, the reuse of shared learning material is an infrequent occurrence, and how frequently sharing can be done and how much time can be saved is in doubt. A portion of those people interviewed felt that a lot of content duplication in course development exists, and that most developers would find it helpful to see what other developers with similar objectives have produced. Another portion felt that due to a variety of interservice differences, the interservice exchange of curriculum materials would seldom be worthwhile. And a third portion felt that, because of the time needed to understand and absorb another developer's material, the time savings would be minimal though the exchange would be helpful.

The possibility that the exchange and review of relevant learning materials might result in indirect reduction of effort became apparent as the study progressed. A number of developers interviewed felt that looking at the results of another's development effort would be a source of inspiration on presentation technique, format, and so on even though the material itself was not directly borrowed. Support for this point varies between the experienced and inexperienced developer, with the strongest support coming from those who are relatively inexperienced in applying a particular technology. The experience factor may be particularly critical in services where there is rapid introduction of new learning technology or a high rate of developer turnover.

Although estimates of potential development time savings varied widely, the TRAIDEX study team concluded that the exchange of course material will indeed save course development time; however, the quantification of this time savings is a separate and difficult issue. The savings appear to depend heavily upon the relative experience of the developer, his ability to submerge his own ego sufficiently to borrow relevant material, and the ability to quickly locate relevant and properly validated instructional material.

3.2.2 Hypothesis: Exchange of Information will increase course effectiveness.

This point depends upon the ability of the course developer to obtain (via TRAIDEX) material that may be more effective than he can produce within his time and budgetary constraints. A good many of those interviewed were concerned about the quality of material that TRAIDEX would cause to be shared, pointing out that automating mediocrity accomplishes nothing. A large percentage of the sample mentioned the use of professionally recognized validation methods as a criterion by which to judge the worth of learning material. In this case, the important validation is the internal validation to show that the course material is consistently successful in meeting the original learning objectives. This information has been specified as a requirement for inclusion in the TRAIDEX database. External validation showing feedback from the field is not a direct indication that stated objectives were or were not met, since failure in this area may be due to poor job analysis.

With respect to a developer obtaining more effective material than he might produce on his own, there will be a variance between those that are experienced and inexperienced in the application of a particular technology. In areas of the services with rapid turnover of course developers, one would expect the strongest positive effect. More important, perhaps, is the increase in effectiveness caused by the synergistic effects of the rapid dissemination of innovative resource and media applications that TRAIDEX would be able to accomplish.

3.2.3 Hypothesis: Perceived benefits can be cost analyzed.

Any model used to analyze the impact of a TRAIDEX on the course development process by cost/benefit assumes the existence of cost data for the various phases of the process. However, hard and comprehensive course development cost data could not be obtained from any site. In most cases development costs for a school were not separated from instruction costs. In one case development costs were merged for several courses. Factors such as the impact of the introduction of new instructional technology, such as self pacing, differences between initial and subsequent development of a course, developer time taken from other duties, experience of developer, etc., also made cost comparisons impossible.

Thus, conventional approaches to the costing of development activities could not be applied, because the necessary data is simply not being tracked. The closest we were able to come to real cost data was in the Air Force, where we were able to obtain some sampled data. Chanute AFB records fairly extensive data on the ISD process on a form called TC 200A. The table shown below summarizes this data for three sample self-paced courses. The problem with projecting from this data is that it is not comprehensive and therefore cannot provide a true picture of all course development activity, even at Chanute. Moreover, because of the difficulties inherent in tracking the time of instructors and part-time personnel, it is not clear that all of the personnel involved in the development process were tracked, or that their time was precisely allocated. It should be noted that the three sampled courses were not developed as part of the PLATO computer aided instruction (CAI) project at Chanute.

A similar problem occurs with the aggregate cost data collected by ATC (Forms 189A and 189B). These forms do provide a vehicle for tracking total development costs; however, the same cautions regarding the comprehensiveness and accuracy of this data also apply.

Rule of thumb estimates of the development ratio range from 30 hours (per hour of instruction) to 300 hours. A reasonable estimate for a comprehensive ISD effort within the Air Force is 100-150 hours. The

Naval Air Maintenance Training Group representative estimated development time at about 200 hours. At the instructor level we heard estimates of between 30 and 70 hours.

In the following table the phases correspond to four of five phases of the Air Force ISD process (Phase I - Analyze System Requirements, Phase II - Define Education and Training Requirements, Phase III - Develop Objectives and Tests, and Phase IV - Plan, Develop, and Validate Instruction). The ratio is the number of development hours to the number of contact hours.

Sample Course Development Costs
Chanute AFB

	Course		
	A	B	C
Contact Hrs.	232	231	384
Phase I:	594	80	534
Phase II:	721	16	13
Phase III:	531	1642	560
Phase IV:	9673	9477	3888
Total Hours	11519	11215	4995
Ratio:	36.7	48.5	13.0
Cost:	$58568	$47603	$22194

It is interesting that in these particular examples Phase IV (where TRAIDEX should be most useful) consumes approximately 80% of the development process. A few of those interviewed in relation to these cost figures estimated that TRAIDEX could save 25 - 50% of the production time (Phase IV). The important issues, however, are the rate of development and the number of courses for which TRAIDEX would be useful.

The cited development ratios may be compared to those stated for PLATO course development at the University of Illinois College of Veterinary Medicine at Urbana. A report on initial development costs (CERL Report X-43, George M. Grimes, author) states the coding time for an hour of PLATO instruction ranges from 37 to 82 hours with an average of 58 after two years of experience (the range early in development was 48 to 193). On the other hand, time to produce typical Instructor

based lockstep materials has been stated by typical instructor/developers to range from 2 to 10 hours per hour.

The implications are clear:

- As new and more sophisticated instructional methodologies are introduced, development time increases, particularly in the early stages of implementation.
- As development times increase, shared material may have greater impact on costs.

3.2.4 Hypothesis: Benefits of TRAIDEX are important because of a high rate of new course development and course modification

Most of those interviewed that supported the TRAIDEX concept agreed that benefits would be apparent in new course development. However, the benefits perceived for course modification were not as great. For example, course revisions to cover minor equipment changes are usually not major enough to warrant reuse of other than the original material. However, there are cases, such as the addition of a new subject or the conversion to a new type of training technology, (self-paced instruction, for example), when the ability to look at previously developed material is a real asset.

We received conflicting reports on the amount of new course development and the rate of revision involving a new training technology. The Navy has about 2000 full-time people involved in course development or redevelopment, the Air Force revises approximately 75,000 hours of instruction per year, and there are a few areas where major revisions using the ISD model are planned. However, at the school level in another service we were told that almost no new courses are being developed and in all services we heard that the most frequent types of revisions are not major. In conclusion, it appears that TRAIDEX must be justified primarily on the basis of new course development and major course revision. Given the economy to be gained in delivery costs via the introduction of self-paced courses, the advent of CAI and CMI, the realignment of MOS categories and the continual introduction of new weapon systems technologies, we should expect the development requirements to remain strong. Even if new development requirements only remain steady, a small percentage decrease in development cost should represent large dollar savings.

3.2.5 Hypothesis: Course development efforts with a high degree of commonality exist among the services

In every service at every level we encountered doubts as to the degree of course commonality among the services. Of course, some people had stror ; convictions that this commonality does exist, especially at the level of the basic or introductory technical course. However, these basic courses were also assumed to be fairly stable. If this is in fact the case, TRAIDEX potential use will be less than assumed. (Note, however, that in San Diego the Individualized Learning Development Group at the Service School Command is developing a basic electronics and electricity series (over 100 modules) to be used for all Basic Electricity and Electronics training in the Navy, and a similar program, Common Basic Electronics Training, was developed in the Army).

3.2.6 Hypothesis: The areas of the course development process most relevant to TRAIDEX are the search for existing courses or materials, media selection, and actual learning material development.

Using the numbering scheme of the FSU ISD model, the phases of the course development process to which TRAIDEX was originally thought to be most relevant were I.4 (analysis of existing courses), II.1 (development of objectives), II.2 (test development), III.2 (in the area of media selection), III.3 (review/selection of existing materials), and III.4 (development of instruction). The kind of TRAIDEX assistance expected for phase II.1 was not actual reuse of previously developed objectives but rather the examination of well constructed and (possibly unrelated) objectives for guidance by relatively inexperienced analysts. Through the interviews we sought feedback on these assumptions.

A nearly unanimous response to the question about the most difficult phases of the course development process (assuming use of a version of the instructional systems development model) was the conversion of job tasks to terminal learning objectives. Although this step is widely recognized as difficult and time-consuming, the only way that a TRAIDEX-like system could help is by offering samples of existing conversions for like tasks. It is assumed that jobs with parallel job tasks would be picked up by the Interservice Training Review Organization Curriculum Review

Committee effort. Furthermore, searching for a similar set of job tasks associated with a course in another service appears to be very difficult, primarily due to service specific terminology and function. However, the general feeling in the Army was that a large effort must be directed toward job and training task analysis before the resulting courses will have the quality necessary for beneficial sharing via TRAIDEX.

The use of TRAIDEX to assist in the media selection process was originally considered to be a viable application. Although media selection models do exist, several people interviewed felt that these are ineffective and that TRAIDEX could help by sharing evaluative information. However, the general response to the sharing of such evaluative information was negative. In many cases only a limited selection of media is available to the developer. Also, those interviewed felt that receiving unfiltered subjective media evaluations would not contribute to the development effort. Therefore, the idea of assisting the media selection phase, other than by showing what media is associated with a particular course and why that media was chosen, was rejected.

The TRAIDEX information system has therefore been designed to concentrate on the areas of:

- analysis of existing courses
- display of learning objectives
- review and selection of learning materials

that are common to all currently used development methodologies.

3.2.7 Hypothesis: TRAIDEX should be oriented around the Florida State U. Instructional Systems Development Model

From the point of view of TRAIDEX, the wide use of a single development model with standard terminology and fixed types of outputs would obviously be desirable. However, the interview process revealed that the support of the FSU ISD model was far less broad than had been assumed. Each service has its own version of an instructional systems development model; the FSU version does not have universal support, and those that are supportive feel that it is at least a few years away from widespread acceptance and implementation. Furthermore, the models currently in

effect are not always used as widely as intended. The key point, however, is that all development efforts currently center around the production of learning materials and tests that support formally stated, performance oriented learning objectives.

TRAIDEX data must be structured around a systematic course development process. This process does not have to be strictly the FSU ISD model, but we must assume some variant of ISD. At the absolute minimum, courses must have specified terminal learning objectives in the three-part form of action and condition, and standard when available. This assumption appears to be consistent with the future major role planned for ISD in the services.

3.2.8 Hypothesis: The potential for interchange of training development information is seldom achieved because current mechanisms are deficient

Section 3.2.1 stated that shared material has occasionally been used to save time in course development. The major question concerns the degree of sharing that currently takes place relative to the existing potential and the adequacy of mechanisms currently available to assist the process.

It must be noted that there exists a substantial body of opinion (particularly at higher staff and headquarters levels) that all possible sharing is currently done. For example, certain Army training personnel felt that within that service the system of subject-matter oriented "proponency" for certain types of courses maximizes information interchange by centralizing responsibility for a certain type of course at one resident school. It was also claimed that in and among the services there are a small number of schools dealing in any particular field, and that development personnel at these schools keep in touch to such a high degree that TRAIDEX wouldn't be able to substantially increase the level of communication. Other currently available sharing mechanisms include service-specific catalogs of programmed instruction materials, video tapes, and audi-visual systems that include the scope, objectives and student entry level of the material as well as a description of the means of accessing it. Libraries and advisory services are used for information

on training technology and in one service a TRAIDEX-like advisory service is provided at the training command headquarters level. For the future, the plans of the DoD Directorage for Audiovisual Activities should cut down the duplication and increase the exchange of audiovisuals through control and coordination; the Army hopes to benefit similarly through improved technical documentation of training aids.

In spite of the bright picture painted by this list of potential systems for courseware exchange, the majority of course developers felt that very little sharing is done. The problems that developers cited with regard to the currently available mechanisms for inter- and intra-service sharing of common development efforts may be summarized as follows:

a) Current sources of information are inaccurate, usually because the time required to compile, print, and distribute hard-copy catalogs is long compared to the rate of change of the courseware involved. This leads to very rapid obsolescence of the catalogs.

b) Current sources are incomplete, because they do not usually contain enough information to allow the potential user to accurately judge either the relevance of the material to his own objectives, or the quality of the instructional material in terms of its proven ability to achieve its own objectives.

c) Current sources are not always available at the level of the developer who might make use of them. While the ATC ISD Advisory Service has in the past reported a relatively high volume of inquiry, a majority of ATC course developers interviewed were unaware of its existence. A possible reason for this discrepancy is that the service was known to only a few "leading edge" developers who made extensive use of it.

While the sharing of audiovisuals and training aids is a partial solution to the problem that TRAIDEX addresses, there are no organized databases of training courseware. In conclusion, it seems certain that in relation to the interservice potential for sharing, there is a place for an effective, up-to-date, easily accessed database of information on courseware with built-in relevancy and validation measures.

3.2.9 Hypothesis: Current support for the concept of interservice exchange of training development information is centered around a few individuals.

Through the interview process it became apparent that general enthusiasm for interservice exchange was mild at best, and it became clear that a task associated with the future of TRAIDEX was that of eliciting more support at all levels for both its concept and its rationale. It was therefore surprising to discover the existence of ATC Regulation 52-34. To quote from the regulation -- "This regulation implements an Interservice Memorandum of Agreement which establishes policies and procedures for the exchange of training materials and training support services among the military services." While this regulation is an expression of existing support for the TRAIDEX concept, the fact that course catalogs are the only current means of implementing this regulation and since course developers have expressed the inadequacy of that means, TRAIDEX could become a means to facilitate the process of exchange as required.

3.2.10 Hypothesis: The TRAIDEX user will be the course developer or subject matter expert.

When the TRAIDEX effort focused on the course development process, the course developer or subject matter expert clearly became the end user. However, the necessary perspective and incentive for improving course effectiveness and the motivation for reducing development time does not always exist at this level. The TRAIDEX study team concluded that the knowledge of TRAIDEX system use and the ability to monitor courseware exchange should reside at the level of the course development advisor or staff level education or training specialist. The interviewing process demonstrated convincingly that it was at this particular level in the training hierarchy that the talented personnel with the most perspective on the training development problem coupled with daily contact with actual developers existed. Not only was the acceptance of the TRAIDEX concept greatest at this level, but the staff personnel in these positions generally have some type of review and approval rights over locally developed curricula.

3.3 TRAIDEX information content

The foregoing sections have reviewed the assumptions and hypotheses behind TRAIDEX. The remaining results represent feedback obtained on the form of the TRAIDEX system.

The information content as well as the concept and use of a proposed TRAIDEX is described in detail in Section 5. TRAIDEX information content is based upon responses to inquiries about shareable courseware and information that would significantly aid the course developer in locating and qualifying relevant, shareable courseware. Assuming access to a single instructional module below the level of a complete formal course, interviewee responses fell into the following categories:

- descriptive information that could be used to determine relevance
- pointers to sources of material
- course material to be used directly such as manuals
- course material to be used by instructors such as supervisor guides
- supporting courseware (for example, references)
- original course development files (for example, storyboard)

In relation to the timeliness of accessing TRAIDEX information course developers were consistent in stating a need for the relevant course material in a 2-4 week period from the time of seeking candidate material for reuse.

3.4 Information sources which provide related data

When the TRAIDEX study began it was assumed that a number of useful and relevant information resources already existed, both within and outside the military, and that these sources of information might be included in or accessed through TRAIDEX. Therefore one of the objectives of Task 2 was to identify and assess these information resources against the perceived needs of TRAIDEX users. This survey and assessment was conducted in two parts:

1) a survey of information resources outside the military
2) a survey of information resources developed or operated by the various agencies of the Department of Defense

The results of these investigations are reported in the companion reports cited in Section 3.1.3.

The surveys uncovered 31 information resources outside the military, and 6 information resources within the military, that provide information potentially of use to TRAIDEX users. The study team concluded that each of these information resources has intrinsic usefulness because of the way in which they could support a course development effort; discussions of how each resource might assist curriculum developers are provided in the detailed descriptions given in the separate reports. However, with the exception of some of the DoD resources, the interviews were unable to uncover any data supporting their inclusion in TRAIDEX. None of the active curriculum developers interviewed had any significant knowledge of or experience with most of these resources. As a result, they were simply unable to assess the potential impact of having access to such information. The exceptions to this are discussed in the reports.

Because we were unable to assess the potential benefit of providing access to these information resources through TRAIDEX, the study team recommends that the initial implementation of TRAIDEX not attempt to include these resources. However, many of them are likely to be important components in some future evaluation of TRAIDEX. Indeed, we strongly suspect that the need for many of them will become evident over time, and that TRAIDEX would provide a useful vehicle for interfacing these systems to the user community. To do so, TRAIDEX might contain pointers to (and detailed information about) these systems, so that in responding to a specific inquiry the user would be directed to an appropriate information resource from which he can obtain an answer to his question. It is felt that such a pointer system would be highly useful since an easy means of locating these information resources is presently lacking.

If TRAIDEX is established, a study should be undertaken to examine the potential utility of these information resources within the TRAIDEX community. This might be done by providing the TRAIDEX interface with access to certain of these systems, so that he could assess them against the kinds of questions posed by users under real conditions, and obtain feedback on the relevance of responses.

3.5 Conclusions based on interviews

Based on the results of Task 2 interviews, it appears likely that there is a need for an effective, timely method for the exchange of valid, relevant courseware. A system which implemented such a method would facilitate the observance of regulations on interservice cooperation and assist in new course development as well as the application of new types of training technology such as the ISD process. Such a system would reduce development time and increase the effectiveness and efficiency of the developer. The dollar cost savings or cost avoidance accomplished by this method depend upon:

- actual time savings
- increase in developer efficiency
- rate of new course development and revision
- rate of TRAIDEX use in ISD conversion
- degree of interservice commonality

A TRAIDEX system is feasible if based on the assumption that some form of the ISD process will be used and that learning objectives exist in the form of action, condition, and standard. The degree to which TRAIDEX could aid job-task analysts is not clear, but it can assist in the review of existing courses, review of existing materials, access to shareable materials, and by shared examples, spread new teaching technology.

A user community based on course developers in technical training is viable with a few exceptions. The needs of that segment of the Army involved in combat arms training and the needs of the relatively few groups in the three services involved in team training appear unique and the probability of their benefiting from TRAIDEX is small. In other areas of technical training the course development advisor at the local development site is the most appropriate interface to the TRAIDEX system while the end user remains the course material developer.

In conclusion, the study team feels that interservice sharing of relevant, validated courseware can significantly decrease the time and effort required to produce new technical training course modules. The effects of sharing will have the greatest leverage in situations where one or more of the following conditions is present:

- A new training requirement must be met
- New instructional technology is being introduced
- Course designer/developers are not subject matter experts
- The production cost per delivery hour is high, as in self-paced programmed texts, CAI programs, or multi-media presentations

This conclusion is based on a qualified evaluation of the interview responses, and upon the following observations:

- Personnel who agreed with the TRAIDEX concept were either currently involved or had previously been involved in situations similar to those described, and had or were attempting to share inter-service information. In several cases, these developers had successfully shared another service's development experience and/or courseware.
- Personnel who disagreed with the TRAIDEX concept did so primarily for 3 reasons:

  1) All potential sharing is already accomplished

     or

  2) The developer won't use shared information

     or

  3) Potentially shareable material cannot be identified short of actual examination of the product

- In fact, all three of these assumptions have proven to be erroneous. Developers are nearly unanimous in reporting that attempts to find shareable material are frustrated by the inadequate mechanisms available to them; only a few have developed the informal, "out of channels" contacts that allow them quick access to other developers. However, in the relatively few instances where inter-developer contact has been made, the success of sharing similar development efforts has been significant. Finally, a substantial number of course developers, curriculum review and advisory personnel, and education and training specialists in both military and civilian areas have agreed that a combination of the descriptors proposed for the TRAIDEX Database (learning objective, sample test items, media, validation data) are adequate to give the inquirer confidence in the relevance of the courseware described.

Section 4

TRAIDEX SYSTEM VOLUME ESTIMATES

4.1 Introduction

In order to select the mechanisms (computerized, manual, or a combination) that are required to implement the functions of a TRAIDEX system that will satisfy the information requirements presented in Section 3, the TRAIDEX study team estimated certain critical system volume parameters. These estimates were made and refined both during the information gathering process (Task 2) and during the concepts definition task (Task 3), and they serve both to determine certain functional requirements and as a basis for the operational cost estimates in Section 6. While all of the estimates below contain some measure of uncertainty, this uncertainty should not affect the final validity of the study results, for the following reasons:

1) The study team has consistently attempted to make the most conservative reasonable estimates. The estimated volumes and associated costs should therefore be on the high side in most cases.

2) It does not appear likely that any critical volume or rate estimate is in error by as much as a factor of two. The study team feels that any design or implementation effort whose success depends upon a closer estimation tolerance than this represents an unwarranted risk, especially because even the most conservative information volumes are well within the current state-of-the-art of information processing.

The TRAIDEX volume estimates fall into three key areas, as follows:

1) Number of course unit entries in the unit description catalog or database. This number helps determine the mechanism and associated cost to store the required data.

2) Rate of change of the unit description catalog. This rate determines the mechanisms suitable for updating (and therefore storing) the catalog, and the associated cost.

3) Rate of inquiry into the catalog. This estimate, couplied with the expected complexity of a typical inquiry and the required system response time, determines the nature of the required retrieval mechanism.

The means by which the above volumes were estimated and the resulting numbers are presented in the following subsections, and are summarized in Exhibit 4-1.

4.2 Unit Description Database Volume

The TRAIDEX catalog of technical training course units will contain a descriptive entry for each distinctly separable unit of courseware for each technical training course that is recorded. For the purpose of describing and retrieving this courseware, a unit is defined to be the smallest easily distinguished piece of learning material that, along with its associated descriptive information, supports at least one performance-oriented learning objective. The estimated volume of this database was determined by surveying the number of technical training courses listed in the service's formal (resident school) course catalogs and in the appropriate non-resident, correspondence, and career development course catalogs. Courses were screened by DoD occupational (subgroup) and those that fell into the following categories were omitted:

1) Medical technology
2) Human Goals (e.g., race relations, drug abuse)
3) Courses with little inter-service applicability (e.g., armor and amphibious)
4) Combat arms subjects

The result was the identification of 4200 technical courses with potential content for inclusion in TRAIDEX, broken down by service as shown in Exhibit 4-1.

In order to estimate course unit volume, the study team examined course catalogs and course unit material from each service. The actual number of units for courses for which this number was available (from documents such as POI's and curriculum outlines) was used to estimate the average number of units per course. Estimates across services were checked by consulting various members of the training community. The

resulting total of 82,000 course units is broken out as shown in Exhibit 4-1. This total appears to be reasonable; if a nominal 8 hours per course unit is assumed, the resulting 656,000 hours of instruction represents between half and two-thirds of all technical training presented, based upon informed estimates from within the training community.

4.3 Unit Description Update Volume

It was impossible for the study team to obtain exact estimates for the rates at which new courses are created and old courses are revised. However, it is the policy in at least one service to review each course at least once every three years. An examination of the Air Force Career Development Course Catalog indicated that about 200 of the 300 listed courses were scheduled for some type of revision, while the Army was scheduled to revise 300 of its 1400 courses. The study team has estimated that one-third of all course units will be examined for revision each year. This estimate, coupled with an estimated new course development rate of 10% of the revision effort, yields a total of 29,000 unit developments per year. Based upon an estimated 2,000 man-years of course development per year and the nominal 8-hour unit, this yields an average development time per unit-hour of about 17 hours, which, although low, is in line with current experience. In any case, it indicates that the update volume (and associated cost) is conservatively large.

4.4 Unit Description Inquiry Volume

This estimate is essentially driven by the estimated review and revision volume. The study team has assumed that since each development will not require a TRAIDEX Inquiry, an appropriate average inquiry volume will equal about one-half of the unit development and review rate, or about 14,600 inquiries per year.

Exhibit 4-1

TRAIDEX SYSTEM VOLUME SUMMARY

Item	Army	Navy	Air Force	Total
Current TRAIDEX Course Inventory	1400	1700	1100	4200
New Courses Developed/Year	20	57	37	114
Old Courses Revised/Year	470	570	370	1410
Average Number Units/Course	35	11	13	----
Total Course Units	49,000	18,700	14,300	82,000
Total New or Revised Units Per Year	17,000	6,900	5,300	29,200
Total Inquiries Per Year	8,500	3,450	2.650	14,600

Section 5

TRAIDEX CONCEPTS OF OPERATION

5.1 Overview

This section presents the results of the third task of the TRAIDEX study by defining the functions, activities, and mechanisms that are required to implement a TRAIDEX system capable of satisfying the information needs and volumes identified in Sections 3 and 4. The remainder of the section is composed of four subsections that cover the following topics:

a) Subsection 5.2 presents brief descriptions of the fundamental concepts that comprise the basic building blocks of the system, and the roles of those training personnel external to TRAIDEX who will be directly affected by it.

b) Subsection 5.3 is a summary of the key features of the functional design.

c) Subsection 5.4 contains the TRAIDEX Functional Design expressed as a Structured Analysis model. The model itself is preceded by a brief introduction to the Structured Analysis and Design Technique that was used to develop the design.

d) Subsection 5.5 summarizes the results of a design review during which members of the ITRO and of the technical training community critiqued the functional model.

A general overview of the functions of TRAIDEX can be quickly obtained by reading subsections 5.2 and 5.3. Those readers desiring a detailed insight into the system's functions, their various interfaces, and the issues surrounding their implementation should also read subsections 5.4 and 5.5.

5.2 Fundamental Concepts and Roles

5.2.1 Concepts Internal to the TRAIDEX Design

During the course of the information needs analysis and system design tasks, it became clear that any feasible implementation of TRAIDEX would encompass the following fundamental concepts as part of its basic framework:

a) There must exist a "database" (whether computerized of manual) of course unit descriptions.

b) There must exist some central organization whose function it is to control and support the daily operation of the information exchange system.

c) There must exist a trained "interface" person to whom the system's end user (the course developer) can turn for assistance with the details of system access and usage.

These concepts form the basic building blocks that are integrated into the final functional design, and their characteristics are summarized below.

5.2.1.1 The Unit Description Database

The information needs analysis task established that in order to enable the course developer to easily locate and obtain reusable course material the information that TRAIDEX manipulates must relate to a discrete unit within an entire course that can be determined by the developer to be relevant. Assuming that the development of learning objectives from training tasks leads to the development of separate and well-defined instructional units, the most useful indexable entity appears to be a course module that has been designed to achieve at least one major learning objective. This course module is referred to in the functional design as a course unit. It is important to note that, while course units are described in the TRAIDEX database, all of the units of a course are selected for sharing via TRAIDEX on the basis of the course level subject and objectives, not the individual unit objectives. The contents of an entry in the TRAIDEX unit description database are defined in Exhibit 5-1.

The projected volume of data in this database, coupled with the requirement for rapid search and retrieval of unit descriptions, justifies the premise that a computer oriented database system connected to keyboard terminals located at the user (course development) site is needed. The user's request to find relevant course units will usually consist of an iterative and interactive dialog with the descriptive database. A user will have to characterize his search criteria by more than one descriptive

word in order to reduce the number of course units selected to a reasonable number, and may need to alter the content of his request based on what he finds in the system. This need for more than one selection criterion and the requirement for dynamic modification of the search process makes the use of preprinted "key word in context" lists or similar non-automated methods cumbersome. The use of a mechanical selection method, such as edge punched cards, would require, at a minimum, one card per course unit. A preliminary estimate sets the number of course units to be considered at about 80,000. This would imply a possibility of having to search 80,000 cards, the equivalent in volume of 40 boxes of data processing punched cards. Further, unless the entire database, in whatever form, is located at each development site, a printed copy telecommunication system will be needed to meet the over-all response time requirement that was established in Task 2 to be on the order of a few hours to a day.

Exhibit 5-1

TRAIDEX DATABASE

Logical Record Contents

Field Name	Contents	Source
DESCRIPTOR. KEYS	Key words selected from the thesaurus	Course Title, Block or Module Title, Lesson Title, Equipment Type, Objective
COURSE. UNIT. ID	Code for Service, Course, Unit, and Subunit	POI, Curriculum outline
COURSE. TITLE	Formal name of course	POI, Curriculum outline
DEVELOPER	Name, address, autovon for cognizant developer	Local School Screening Committee
LEARNING. OBJECTIVE	Full text of terminal objective for course unit	POI, Curriculum outline
LEARNING. ACTION	Verb-object pairs	Selected by format process (Activity A22 on design model, Section 5.4.2)

Exhibit 5-1 (Continued)

TRAIDEX DATABASE

Logical Record Contents

Field Name	Contents	Source
LEARNING. CONDITION	Stimulus list	Selected by format process (Activity A22 on design model, Section 5.4.2)
LEARNING. STD	Completion criteria	same
PRESENTATION. TIME	Average or scheduled elapsed time to complete	POI, Curriculum outline
PRESENTATION. METHOD	Limited set of method-words	POI, Curriculum outline
DEVELOPMENT. DATE	Initial development date	Developer
SOURCE. UNITS	Course Unit ID's of units that were used in the development of this unit	Developer
PERSONNEL	Qualification of support personnel required	POI
TEST. QUESTIONS	Test questions selected from the unit test which further specify the unit content	Curriculum outline, local screening committee
MEDIA	This is a group of one or more composite fields where each member of the group describes one particular type of available courseware.	
MEDIA. CODE	One of a limited set of codes denoting the type of media: e.g., TV, PI text, sound/slide, etc.	POI, curriculum outline

Exhibit 5-1 (Continued)

TRAIDEX DATABASE

Logical Record Contents

Field Name	Contents	Source
MEDIA. ID	Full text name or title of media package that contains the unit and by which it should be ordered, including National Stock Number, if one exists	POI, curriculum outline
MEDIA. SOURCE	Locatior from which media can be ordered	Development site
MEDIA. PRICE	Price per package	Development site
MEDIA. PACKAGE	Brief description of package of which unit is a part	Development site
EQUIPMENT	Support equipment required	Development site
BIBLIOGRAPHY	References used to develop or as background enrichment material	Developer
VALIDATION. METHOD	Unit validation methodology used	Developer
VALIDATION. RESULT	Current status of application of validation method above	Develcper
ENTRY. REQUIREMENT	Reading level, prerequisite courses, aptitudes, etc.	POI, Curriculum outline, Development Site
JOB. TASK	Brief statement of task that is supported	Course Designer
or		
BASIC. SKILL	Le sson should support either a specific task or a basic skill	Course Designer
WHERE. USED. LIST	COURSE. UNIT. ID's of other lessons that were developed using this material	Course re-use indicator

5.2.1.2 TRAIDEX Central

There will exist a centralized organization of people, functions, and data, referred to in the design model as TRAIDEX Central. The TRAIDEX Central organization will have the primary responsibility for making the routine operation of TRAIDEX a success and will be responsible for the first level review and correction of TRAIDEX operation and policy.

TRAIDEX Central owns the unit description database. As a result of TRAIDEX activity, data input, unit searches by users, and shipment of course material, journals of each action are accumulated by TRAIDEX Central.

There will exist database management software for TRAIDEX use. Some of this software will be specialized for TRAIDEX while some general purpose software may be used to do common functions such as update and editing. Application software specific to TRAIDEX will be available for extracting reports and for providing a view of the data management system tailored specifically to the needs of TRAIDEX users.

The actual course unit material is not owned by TRAIDEX Central but remains the responsibility of the development site of the service where it was developed.

Also, during the course unit order and response cycle, the status of the order is maintained. This status file is also owned by TRAIDEX Central.

5.2.1.3 The TRAIDEX Interface

The TRAIDEX interface is one or more persons at the course development site who will help the course developer find and obtain relevant course units. The TRAIDEX Interface will have access to a terminal through which he can interact with the course unit description database.

In Section 3.2.10, it was stated that " ... the course developer or subject expert [is] clearly ... the end user. However, the necessary perspective and incentive for improving course effectiveness and the motivation for reducing development time does not always exist at this level. The TRAIDEX study team concluded that the knowledge of TRAIDEX system use and the ability to monitor courseware exchange should reside

at the level of the course development advisor or staff level education or training specialist." Thus, the primary function of the TRAIDEX interface is to make what help TRAIDEX can provide available to the developers, even if the developer is not motivated to seek out that help on his own.

Each TRAIDEX interface will be provided access to a terminal and instructions on how to connect the terminal to the computer holding the TRAIDEX database. From time to time, these persons will receive updates and further information on TRAIDEX operation such as list of new features added, notes on successful search strategies, and "alert reports" when descriptions of learning material with pre-specified attributes have been modified or added.

A key part of the TRAIDEX interface job is to know how to form effective searches for relevant course units. This will require a good knowledge of the restrictive and descriptive words used to describe course units. A copy of the thesaurus of all descriptive words will be provided to each TRAIDEX interface.

5.2.2 Roles of Persons and Organizations Affected by TRAIDEX

5.2.2.1 User Role

The primary end user of TRAIDEX system information is the training course developer. It is the course developer who must identify an initial need for development information on a particular technical topic, a specific instructional strategy, or the use of a particular development methodology. He will then discuss his needs with the TRAIDEX Interface person at his development site, and together they will decide on an appropriate set of descriptive information and an acceptable maximum volume of unit descriptions to be returned for examination by the developer. It should be noted that it is the TRAIDEX Interface, trained by TRAIDEX Central, who possesses the detailed knowledge of how to use the inquiry terminal and query language, the thesaurus of technical descriptors, and a knowledge of how to develop successful search strategies. The only formal training that the developer will receive will be a brief (1-2 hour) seminar at which the information content, potential uses, and response times of TRAIDEX will be described, and the local TRAIDEX Interface introduced and his role discussed.

After a particular developer's request has been structured and entered by the TRAIDEX Interface, the developer will be informed within (at most) a day whether or not material of potential interest exists within the system, and he will be provided with descriptive information about whatever learning materials have been cataloged. The developer may then decide on several options, including ordering specific items of material through the TRAIDEX Interface, or contacting the developers of relevant material directly in order to resolve specific questions on such things as media selection, validation, and so on. If the developer decides to order specific learning materials, the TRAIDEX Interface notifies TRAIDEX Central, and the developer receives his reply within a two to four-week time frame.

The developers at a site will be asked by the TRAIDEX Interface to evaluate the information received from the system, and to indicate (via a brief questionnaire enclosed with learning materials that are shipped) whether or not the materials were used or modified to become part of a new course unit.

The curriculum review function at the site will be required to inform the TRAIDEX Interface of changes to any locally developed course units that have been selected for inclusion in TRAIDEX that will affect their unit description entry. If the TRAIDEX Interface is attached to this curriculum review function, this activity should be quite easy to integrate into the normal review and approval cycle.

To summarize, it will be the user's responsibility to become aware of TRAIDEX and its potential use in assisting him in the solution of his development problems. He will not be required to become an expert in the use of an information retrieval system; however, he will be required to cooperate in its use. If user participation is low, it may be up to the TRAIDEX Interface, in conjunction with the curriculum review function, to inform and re-educate those involved in course development efforts on the ways that TRAIDEX can reduce their development costs.

5.2.2.2 Development Site Role

The local course development site must create the climate in which the TRAIDEX system can operate effectively. It must commit the resources of a trained, interested resource person as the local TRAIDEX interface, and it must support the TRAIDEX concept both directly by educating local curriculum design and development personnel, and indirectly by encouraging an atmosphere that lends prestige both to the use of TRAIDEX as a resource and to the contribution of potentially shareable material. Courses which contain units redeveloped from material obtained from TRAIDEX should be publicized, and other examples of TRAIDEX utility disseminated. The focus of much of this activity will be the TRAIDEX Interface, and the development site command must insure that the TRAIDEX Interface position is invested with sufficient prestige to make its operation effective. Based both on the nature of the curriculum review job and the characteristics of the personnel who occupy it, we feel that the most appropriate location for TRAIDEX interface is in this review and advisory position, rather than at the lowest development or instructional level.

The local development site must also commit the necessary facilities that will allow them to respond to requests from other sites for both direct developer contact and reproduction and shipment of shared material.

Finally, in order to judge the ultimate worth of the TRAIDEX concept, the time and cost accounting procedures that monitor actual development time and resources expended will have to be installed.

5.2.2.3 Training Command Headquarters Role

The Training Command Headquarters at the using services must assist in the establishment of the course screening criteria that are to be applied by each development site, and must establish the monitoring and follow-up functions that will insure that TRAIDEX input requirements and material shipment time limits will be met.

The commands will have access to the TRAIDEX database; while its primary user is still the course development specialist, the database will provide a considerable source of raw data about the state of training technology in a particular service. Although the focus of the database design has been to provide descriptive information to the developer, much of this information, particularly in an aggregate form that could be extracted by computer programs for special reports, will be of interest to headquarters personnel. For example, statistical summaries on the utilization of certain types of media and instructional strategies, course unit length, validation techniques and results can be readily collected.

5.3 TRAIDEX Functional Summary

5.3.1 System Overview

The overall function of the activities and data that make up the TRAIDEX system is to provide the mechanisms that will allow learning material developers to share information about, and the results of, development efforts with a common focus. The scope of the functional design of TRAIDEX is bounded by the following basic assumptions:

a) Units of learning material, and the activities that design, develop, validate, and present them are outside of the TRAIDEX System context. The units that result from development activities are examined by TRAIDEX, their descriptions are catalogued and distributed, and requests for their dissemination are accepted and monitored; however, the production and maintenance of the course unit inventory remains the responsibility of the development site.

b) The primary input to the system is the collection of learning materials, accompanied by descriptive information, developed by the military training community. The activity of the system is controlled primarily by requests from course developers to locate development information or relevant learning material. The primary outputs of the system are:

1) Responses to user requests, describing the characteristics and sources of relevant learning materials

2) Copies of specific course units requested by developers.

In order to accomplish its primary mission, the TRAIDEX system has been divided into four distinct functional areas, which are described in subsections 5.3.2 through 5.3.5. These functional summaries will stress the major operations performed by each functional area in terms of its important inputs and outputs, and the basic TRAIDEX mechanism(s) responsible for its operation. A more detailed and complete understanding of the inter-functional interfaces of the system can be obtained by reading the TRAIDEX Functional Design Model in subsection 5.4.

5.3.2 Initial Course Material Screening

Based on selection criteria established in conjunction with the TRAIDEX Central office and the appropriate Training Command Headquarters, each course development site will examine the course material and associated descriptive matter produced under its control, and will select some subset of courses to be cataloged by the TRAIDEX system. The description of each unit of a selected course will be extracted from the appropriate development documents (POI, curriculum outline, TAIS, etc.) and will be reviewed for conformity with TRAIDEX requirements (completeness, accuracy, format, etc.). The primary output of this process will be new course unit descriptions to be added to the unit description database. The screening activity will also be responsible for recognizing when changes have been made to locally developed units that have previously been cataloged. In this case, an updated unit description may have to be prepared. Records are kept that describe the results of the screening process, noting which courses have been selected and rejected. This screening history is used to modify the screening process as required.

5.3.3 Unit Description Database Maintenance

This activity receives the new and altered unit descriptions produced by the screening process, and creates the required updates to the

unit description database. For new unit descriptions, an important component of this process is the selection of the appropriate subject-area descriptive keywords from the thesaurus of technical training terms. The new and altered unit descriptions are created at the local development site that is responsible for the course material by clerical personnel under the direction and supervision of the local TRAIDEX Interface. Pending updates to the database are reviewed periodically by TRAIDEX Central for conformance to the database format rules, and are then added to the unit description database by the necessary update software. An important by-product of the update process is the creation of "alert" reports that allow the addition or alteration of specific types of material to be brought to the attention of interested personnel. The major outputs of the maintenance activity are the unit description database itself, and the thesaurus of descriptive terms which may need to be revised as new types of training are described and incorporated into the system.

5.3.4 Information Search and Retrieval

This is the central activity of the TRAIDEX system. Its functions are controlled primarily by requests from the training course developer to locate descriptions of course units that will aid the developer in producing a new unit of learning material. The requesting developer works with his local TRAIDEX Interface to formulate an appropriate list of search criteria for submission to the database search software. The search criteria will generally be composed of restrictive factors, such as maximum presentation time and minimum entry level, and descriptive words that are chosen from the thesaurus to describe subject area to some arbitrary depth of detail. The search criteria will be selected by the TRAIDEX Interface in conjunction with the developer, and will be based upon the developer's knowledge of his specific needs coupled with the TRAIDEX Interface's knowledge of the descriptive fields in the database and his experience with the application of other, successful search strategies. The developer and the TRAIDEX Interface will also agree upon the maximum number of acceptable unit descriptions that will constitute a successful search result.

The TRAIDEX Interface will then perform an interactive dialog with the system's database search software, expanding or contracting the contents of the search criteria list until either a suitable number of course unit descriptions have been located, or until the search has failed. It should be noted that a failure can occur either because no relevant entries can be located, or because the search criteria is so broad that too many units have been found. In the first case, further interaction between the developer and the Interface may result in a relaxtion of some of the restrictions, or it may be true that in fact no relevant material exists. In the latter case, the search must be further qualified by applying further restrictions, more detailed descriptors, or a combination of these strategies.

Once an acceptable list of course units has been located, the developer may request a full printout of the descriptive database entry for one or more of them. He may base any decision for further action (such as contacting the cognizant developers directly or ordering copies of the learning material through TRAIDEX) on his examination of such information as learning objectives, validation methodology and results, and so on.

5.3.5 Course Unit Distribution

If the developer decides to order samples of learning material for particular course units, he forwards his request (via the TRAIDEX Interface) to TRAIDEX Central. The request is logged for possible follow-up and is then routed to the proper development or storage site. Each development site must make whatever local arrangements seem to be most effective for storing copies of material that is cataloged by TRAIDEX. When a ship order is received, along with appropriate paperwork, the requested material is copied if necessary and shipped to the requesting developer. The system response time requirement for this activity is a maximum of two to four weeks. The shipped material is accompanied by a brief questionnaire (provided by TRAIDEX Central) that will be returned to the development site by the TRAIDEX Interface at the requesting site, indicating whether or not the requested material has been reused to develop a new unit of learning material.

5.4 TRAIDEX Design

5.4.1 Introduction to SADT

The functional design of the TRAIDEX system is portrayed as a Structured Analysis Model. The model itself is preceded by a brief description of the Structured Analysis and Design Technique (SADT)™ that was used to develop and specify the design.

5.4.1.1 Models of Systems

The Structured Analysis and Design Technique is a method for helping people to understand complex "systems" (defined as any combination of computer hardware and software, people and things, structured together to perform a function). The system may be a new system to be built or an existing system, and may be a combination of computers, people and things or may consist only of people and things. In all cases, the result of applying SADT is a "model" that shows, by a series of diagrams, the understanding of the system that the analyst has gained as a result of its application. For new system-building, SADT may be applied in planning, analysis, design, project management, or wherever a model is useful for system understanding.

The diagrams in a model are organized in a hierarchic and modular fashion, often called "top-down." That is, the scope of the system is established in a single overview diagram. The component parts shown in the overview are then detailed, each on another diagram. Each part shown on this detail diagram is again broken down, and so forth, until the system is described to any desired level of detail. Lower level diagrams, then, are detailed breakdowns of higher level diagrams. At each stage of breaking down the system the higher-level diagram is said to be a "parent" or overview of the lower level "detail" diagram.

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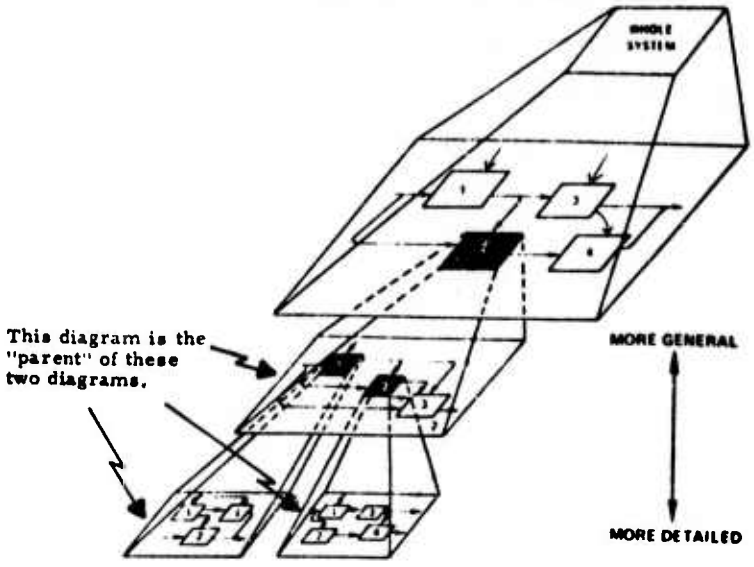
STRUCTURED DECOMPOSITION

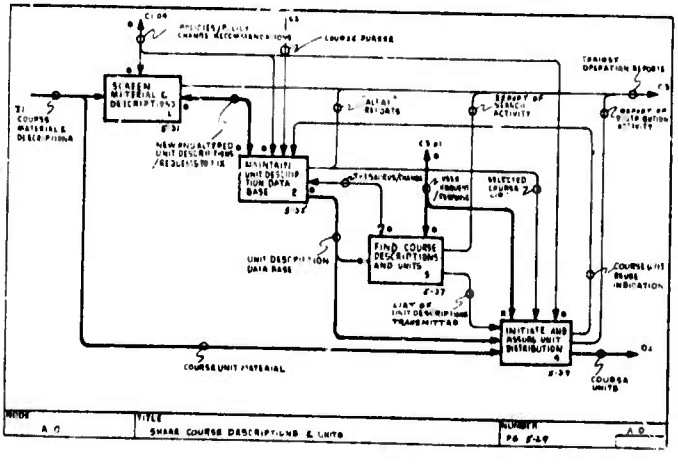


In an SADT diagram, the component parts are shown as numbered boxes. A diagram may have no more than six boxes. Each box is detailed in one diagram at the next lower level until a sufficient level of detail is reached.

5.4.1.2 Diagrams

SADT diagrams consist of boxes and arrows, and text describing them. The notation is kept simple, to permit easy reading with little special training.

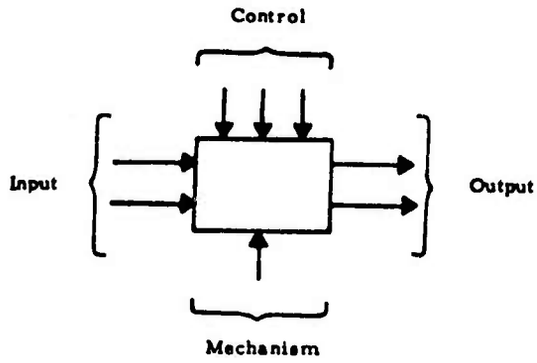
In SADT, boxes represent components in the breakdown, and arrows represent relationships between these components. Descriptive labels are written inside each box and along each arrow to describe their meaning. The following is a sample SADT diagram from the TRAIDEX model. The boxes represent activities, and arrows represent data or things which are interfaces between those activities.



SOFTECH

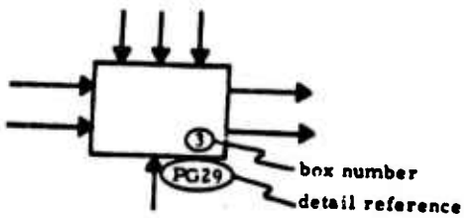
In SADT, boxes represent activities, and arrows represent data or things which are interfaces between those activities. Descriptive labels are written inside the box or along the arrow shank.

In addition to its label, the side at which an interface arrow enters or leaves a box shows its interface role as an input, control, output, or mechanism for the box.



The input data (on the left) are transformed into output data (on the right). Controls (on the top) govern the way the transformation is done. Mechanisms (on the bottom) indicate the means by which the function is performed. A "mechanism" might be a person, a committee, a machine, or a process.

The diagram's page number is written on the lower right corner of the diagram sheet. Box numbers appear in the lower-right corner of each box and "detail reference" appears just outside the box and below the box number. The detail reference identifies the page number of the detail diagram for the box. If it is omitted no further detail exists.

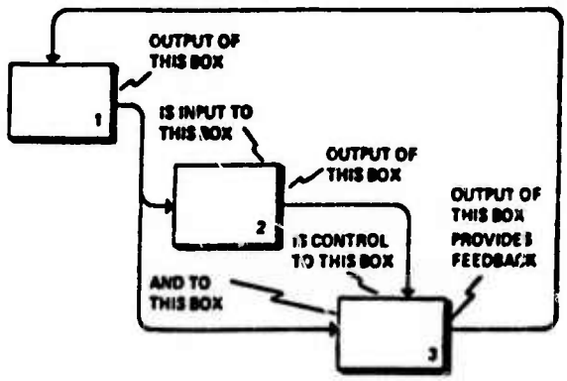


PG 16

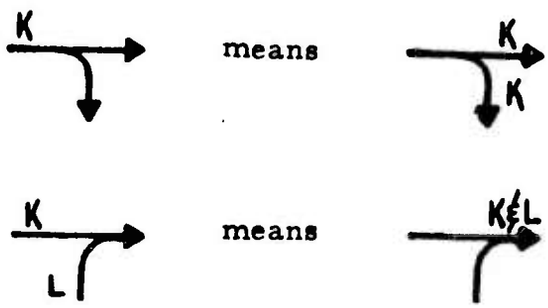
5.4.1.3 Interfaces between boxes

The arrow structure on an SADT diagram represents a constraint relationship among the boxes. It does not represent flow of control or sequence. The arrows entering a box show all that is needed by the box to perform its function. Therefore, the box is constrained by its input and control arrows.

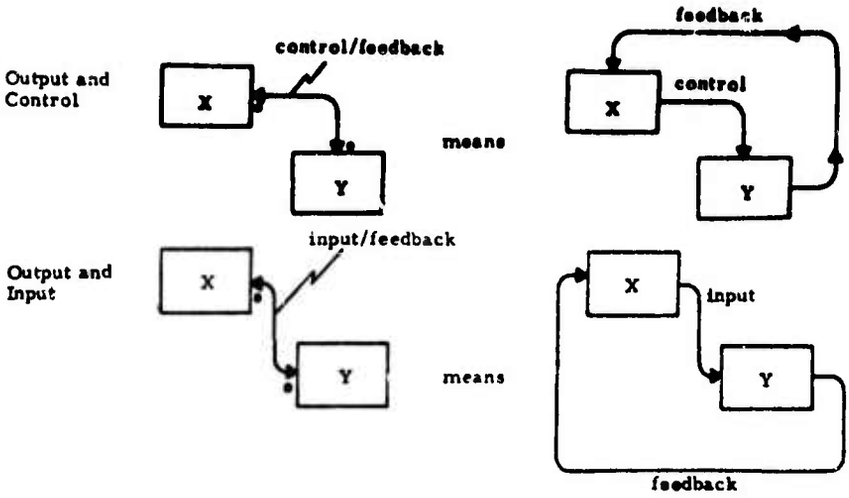
An output of one box may satisfy some or all of the input, control, or mechanism conditions required by one or more other boxes. It is not necessary that each and every box have input and control and output and mechanism. Also, several boxes can be active simultaneously.



The arrow label describes what the arrow represents. Arrows may branch or join. The branches may each represent the same thing, or different things of the same general type.

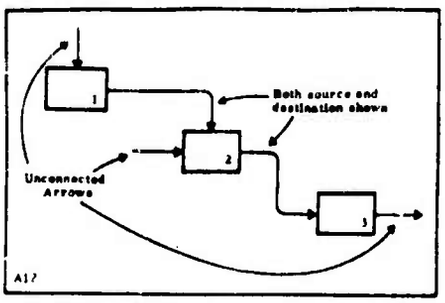


A two-way arrow (with an arrowhead and a dot at each end) is a shorthand way of indicating feedback. A double label, separated by a "/" identifies what is passed forward and backward along the arrow. If a single arrow label is used with no "/", the same thing is passed in both arrow directions.



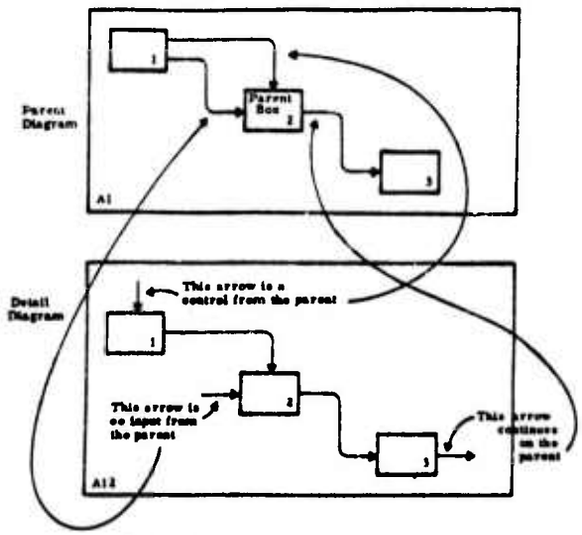
5.4.1.4 Interfaces between Parent and Detail Diagrams

Most arrows are connected at both ends to boxes on the same diagram. Other arrows leave one end unconnected. These unconnected arrows represent inputs, controls, and outputs of the parent box or of the parent diagram. The connections for these arrows can be found on the parent diagram. In order to make the diagrams complete and consistent, all such unconnected arrows must show their continuation on their parent.



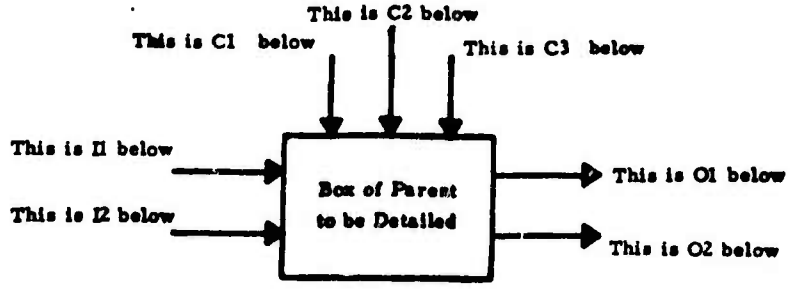
"UNCONNECTED" ARROWS ARE DERIVED FROM THE "PARENT"

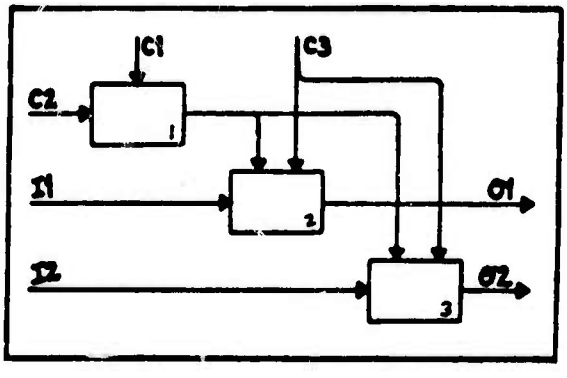
THE MATCH MUST BE COMPLETE AND CONSISTENT



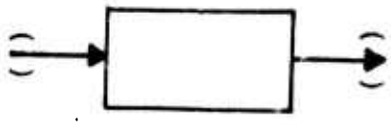
Although arrow connections from parent boxes to detail diagrams may be obvious from the labels, a special notation allows readers to do the match quickly. The letter I, C, O, or M is written near the unconnected end of the arrow on the detail diagram, to identify that the arrow is shown as an Input, Control, Output, or Mechanism on the parent box. To pinpoint the arrow more precisely, this letter is followed by a number giving the relative position at which the arrow is shown entering or leaving the parent box, numbering left to right and top to bottom. For example, "C3" written on an arrow in the detail diagram indicates that this arrow is shown as the third control arrow entering the parent box. These identifications are written on the matching arrows of the detail diagram.

Using this letter/number matching scheme, an arrow may have a different (but compatible) descriptive arrow label on the parent diagram and the detail diagram, if appropriate. Also, an arrow shown as control or as input on a parent diagram is not limited to the same role on a detail diagram (for example, C2 on the parent box appears as an input to box 1 on its detail diagram in the example below).



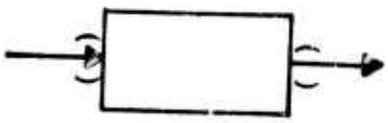


In a few cases, an unconnected arrow on a child diagram has no matching arrow on its parent. In this case, the unconnected arrow head or tail is shown enclosed in parentheses:



These arrows are not shown on the parent diagram.

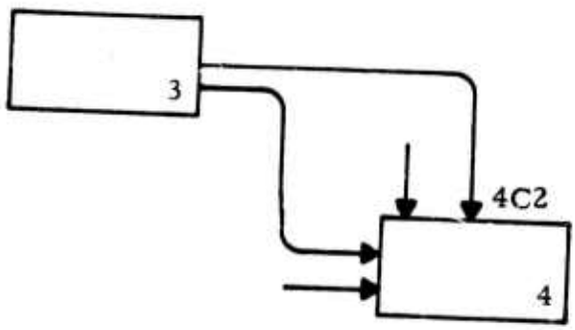
Also, arrows which will not be shown on a detail diagram are put in parentheses on the parent diagram.



These arrows are not to be shown on the detail diagram of this box.

5.4.1.5 Reference Notation

ICOM codes are also used as shorthand notation in the diagram text to refer to a particular item on a diagram. For example, in the diagram below "4C2" refers to the 2nd control entering box 4.



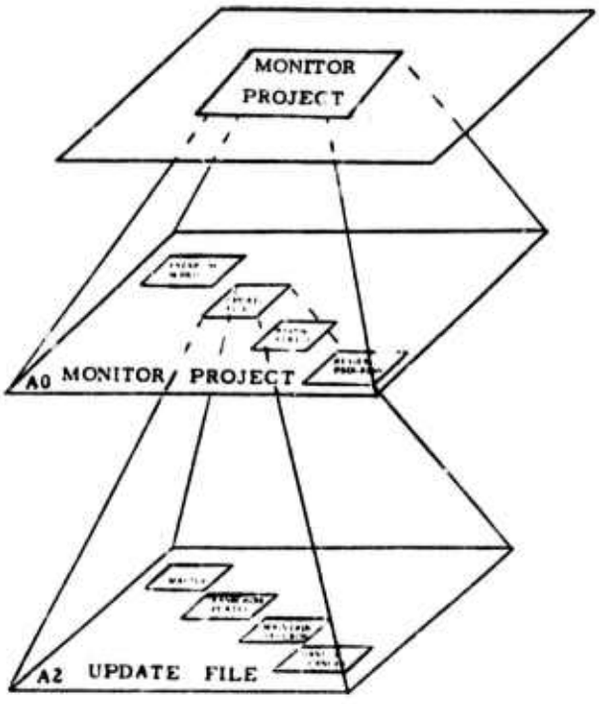
5.4.1.6 Indexing Diagrams

In an SADT diagram, the component parts are shown as numbered boxes. A diagram may have no more than six boxes. Each box is detailed in one diagram at the next lower level until a sufficient level of detail is reached.

The place of each diagram in a model is indicated by a "node number", derived from the numbering of boxes. For example, A21 is the diagram which details box 1 on the A2 diagram. Similarly, A2 details box 2 on the A0 diagram, which is the top diagram of the model. This hierarchy may be shown in an index of diagram names and their node numbers called a "node index". The node index serves as a table of contents for a model.

The example shown below says that the project monitoring function (A0) is broken down into four sub-functions, A1 through A4. File updating (A2) is further broken down into four, more detailed sub-functions, (A21, A22, A23, and A24).

Levels of Diagrams



Corresponding Node Index

A-0 Monitor Project (Top Level Context)
A0 Monitor Project
- A1 Establish Schedule
- A2 Update File
  - A21 Build Master
  - A22 Transcribe Updates
  - A23 Maintain Records
  - A24 Handle Changes
- A3 Report Status
- A4 Review Progress

5.4.1.7 How to Explore a Model

SADT models may be used as a reference, providing all details of a particular subject, or as a tutorial, providing an overview of the whole system. To read the model for its overview, use the node index to find all high-level diagrams. Disregard detail diagrams. For example, an overview is obtained as described above by studying A-0 and A0.

A-0 Share Course Units & Development Information-Scope

A0 Share Course Descriptions & Units

A1 Screen Material & Descriptions

A11 Set Course Selection Rules

A2 Maintain Unit Description Database

A3 Find Course Descriptions & Units

A4 Initiate & Assure Unit Distribution

A41 Log & Route Request

A43 Ship Course Material

To read the model for reference, use the index to find all diagrams detailing the subject of interest. Disregard unrelated diagrams. For example, to study the subject "Initiate and Assure Unit Distribution, examine the two diagrams A41 and A43 plus their parent, A4.

A-0 Share Course Units & Development Information-Scope

A0 Share Course Descriptions & Units

A1 Screen Material & Descriptions

A11 Set Course Selection Rules

A2 Maintain Unit Description Database

A3 Find Course Descriptions & Units

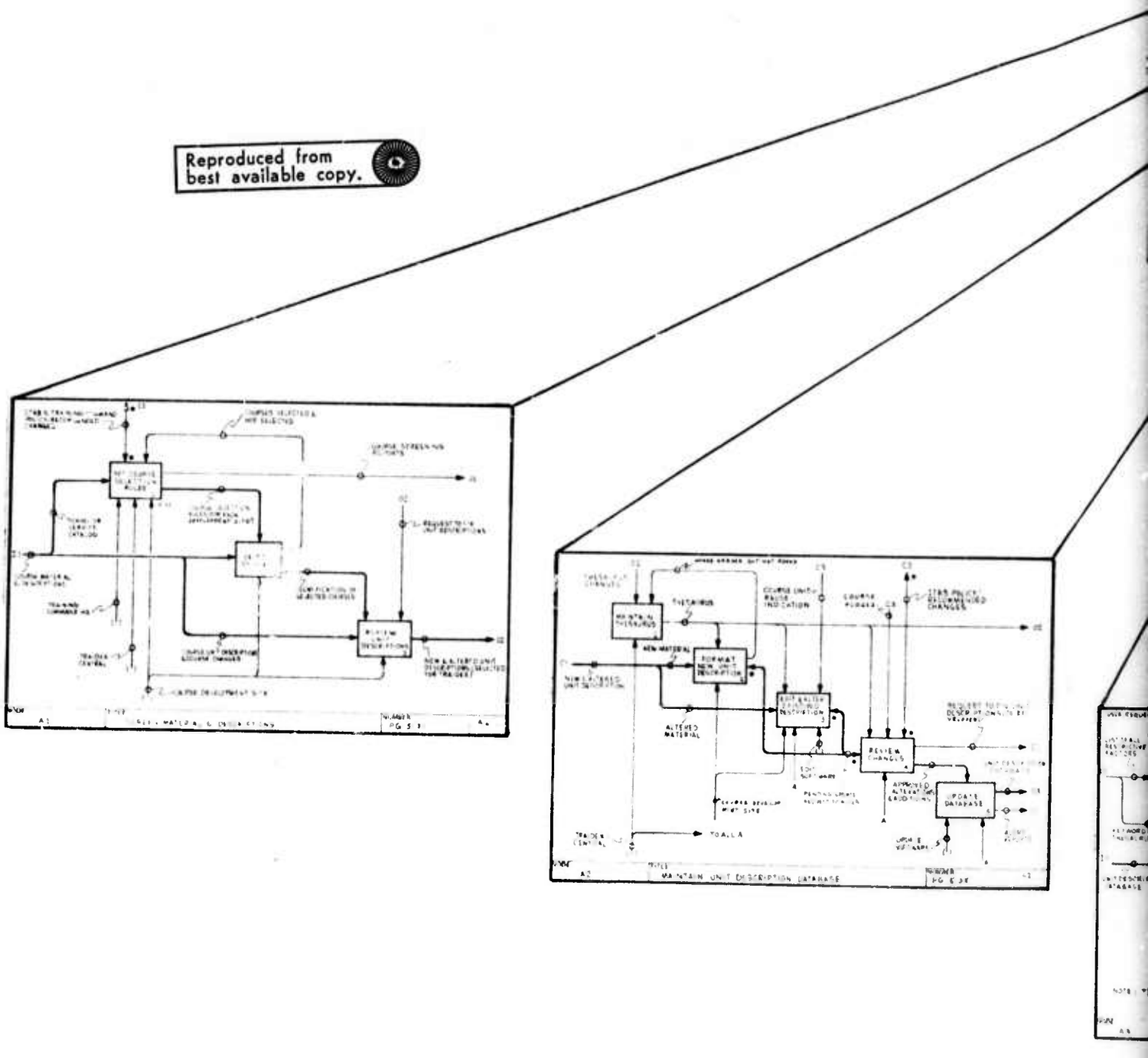
A4 Initiate & Assure Unit Distribution

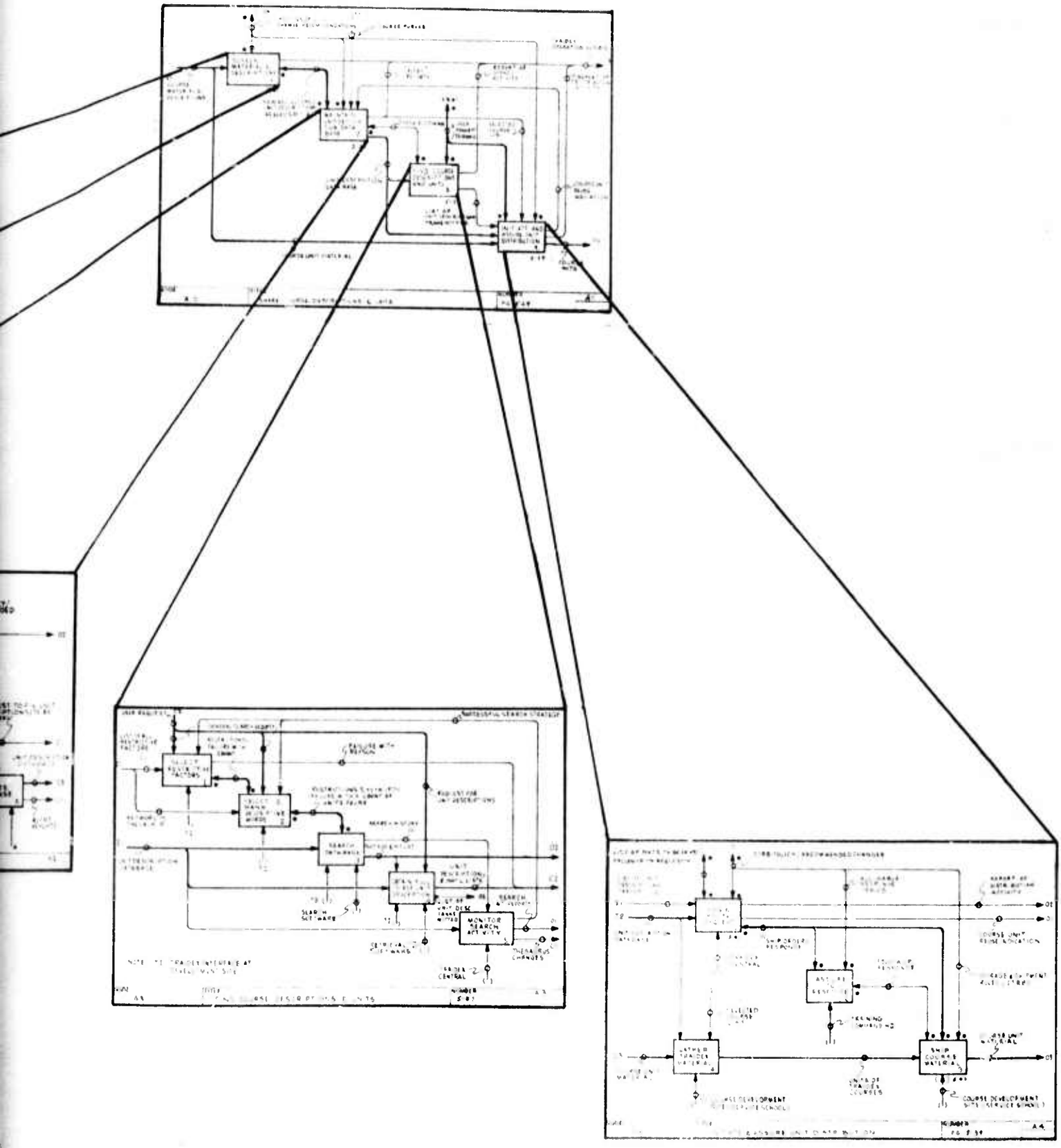
A41 Log & Route Request

A43 Ship Course Material

When published, the diagrams in a model are bound in "node number" order. That is, all detail diagrams relating to one box on an overview diagram are presented before the next overview diagram and details. This order places related diagrams together.

The figure on the following fold-out page illustrates how the model can be used to provide an overview. The figure shows the five SADT diagrams which provide a high-level view of TRAIDEX. The uppermost diagram "Share Course Descriptions and Units" is the most abstract diagram in the model. The four boxes on this diagram show the four most general activities of which TRAIDEX is composed. Each of the four boxes is decomposed into a set of sub-activities shown in one of the lower diagrams. Some of the boxes on the A1, A2, A3, and A4 diagrams are further detailed on additional diagrams.

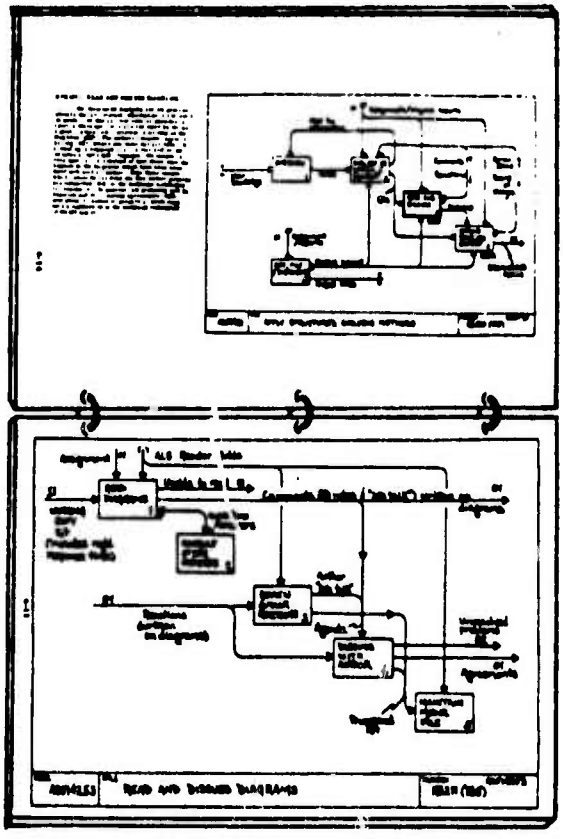




B

5.4.1.8 How to Read Diagrams

When published, each diagram is presented on a pair of facing pages. The diagram being considered is on the lower (right) page. It is identified by its node number, title, and a page reference number. Related text and a reduced version of its parent diagram are on the upper page.



The real information about a system is in the diagrams themselves, not in what the author says about them in the text. So, the following reading sequence is recommended:

1) Scan only the boxes of the current diagram to gain a first impression of the separate functions into which the parent has been broken.

2) Using the parent sketch as a guide, rethink the message of the parent. Note how the arrows feeding to and from the heavily outlined box in the parent sketch reappear in the current diagram.

3) Then, consider the internal arrows of the current diagram to see how it works in detail. Consider the boxes from upper left to lower right, and concentrate first on the heavy arrows that show the primary flow of data on the diagram.

4) Finally, read the text to complete your understanding.

This sequence becomes quite natural and ensures that the major features of each diagram receive attention. The reader should find that, with a little concentration, the diagrams are not difficult to read. The text will call attention to any salient aspects that the author wishes to emphasize.

5.4.2 The TRAIDEX Functional Design Model

The functional design of the TRAIDEX system encompasses those areas critical to the successful operation of TRAIDEX. For this reason, the scope is considerably larger than the computer database and telecommunication systems assumed to be part of the design. This scope is best understood by reading the diagram on page 5-27 and noting particularly the things and data considered to be inputs, whose sources are outside the system, and the outputs, whose destinations are also outside the system. After that, the names of the boxes on the diagram on page 5-29 should be read. These are the activities which are totally within the scope of the TRAIDEX system functional design.

This model, with only minor differences, is the material used in the design review that was conducted near the end of Task 3. The results of that review are reported in subsection 5.5.

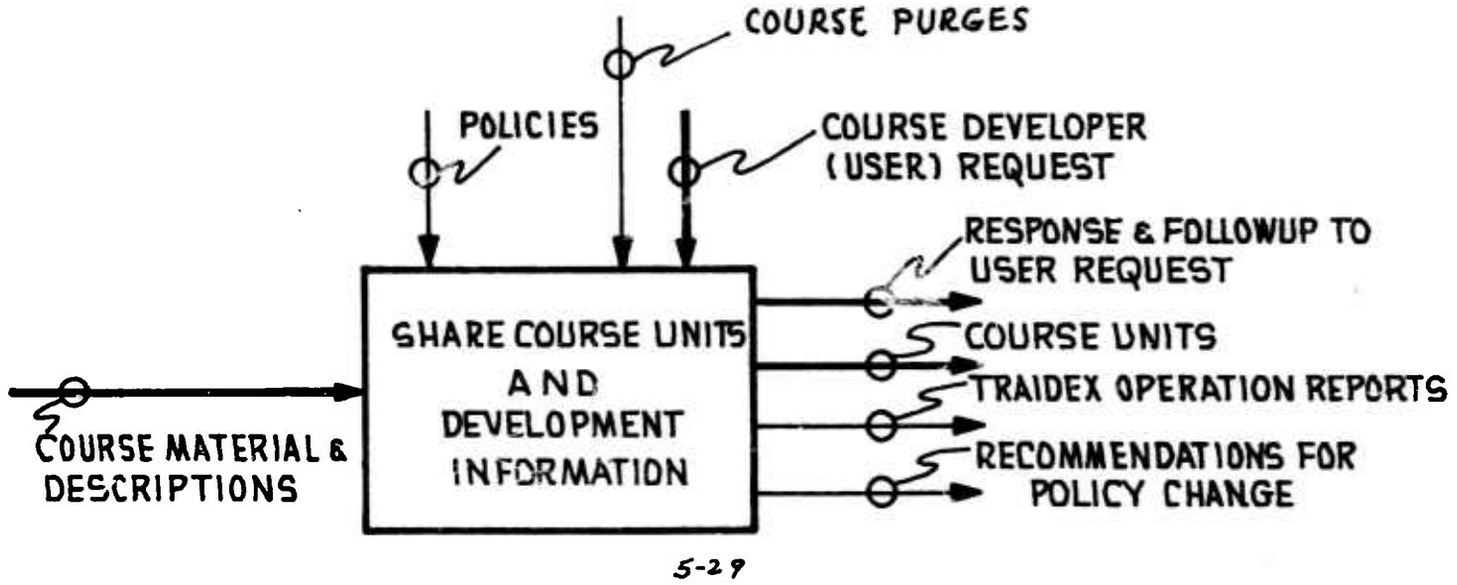
The areas of Screen Material & Descriptions and of Initiate & Assure Unit Distribution were described in more detail (nodes on the node index A11, A41, and A43) since these are the areas where the most implementation difficulties are expected to occur.

If there is difficulty in understanding a diagram, it is suggested that rereading the text (on the diagram's facing page) and a quick review of subsection 5.1 may be helpful.

A-0T. SHARE COURSE UNITS AND DEVELOPMENT INFORMATION

The scope of the TRAIDEX system design model is bounded by the input of course material and descriptions (I1), produced in the various service schools and other course development sites, and delivered as outputs (O2) to other course developers who wish to review the course units in depth in order to decide whether reuse is possible. This process is controlled by policies (C1) from the ITRB and the Training Commands, by directives from these groups and others to purge obsolete course material (C2), and by the Course Developer's request (C3) for material that he expects to reuse in his work. In order to assist the requesting user in his attempt to locate learning materials suitable for reuse, the system provides responses (O1) to his requests which allow him to examine descriptive material about selected course units and to make the final decisions on whether or not to request copies of specific learning materials. The system also provides information about its own operations (O3) and can make suggestions regarding beneficial changes in its operating policies (O4).

Note that the most important input, output, and control arrows have been emphasized by making them heavier than their companions.



NODE:	TITLE:	NUMBER:
A-0	SHARE COURSE UNITS AND DEVELOPMENT INFORMATION-SCOPE	PG 5-27

A-0

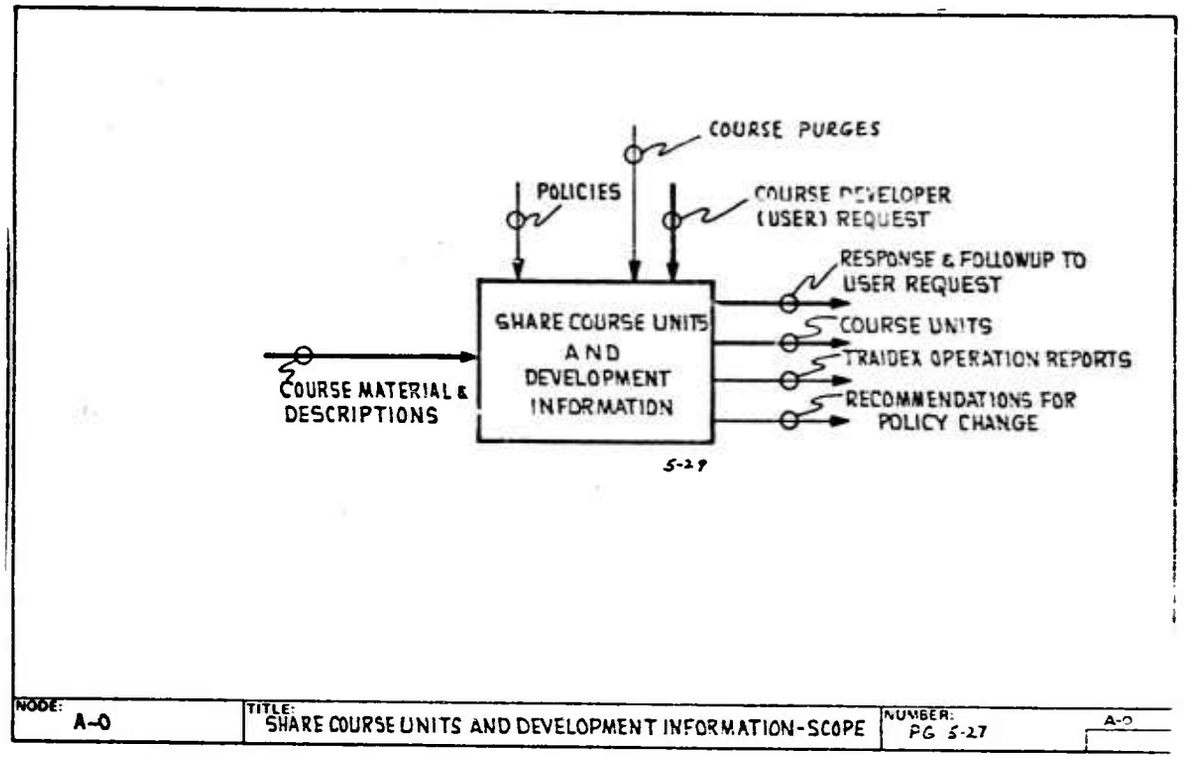
SOFTECH

A0T Share Course Descriptions and Units

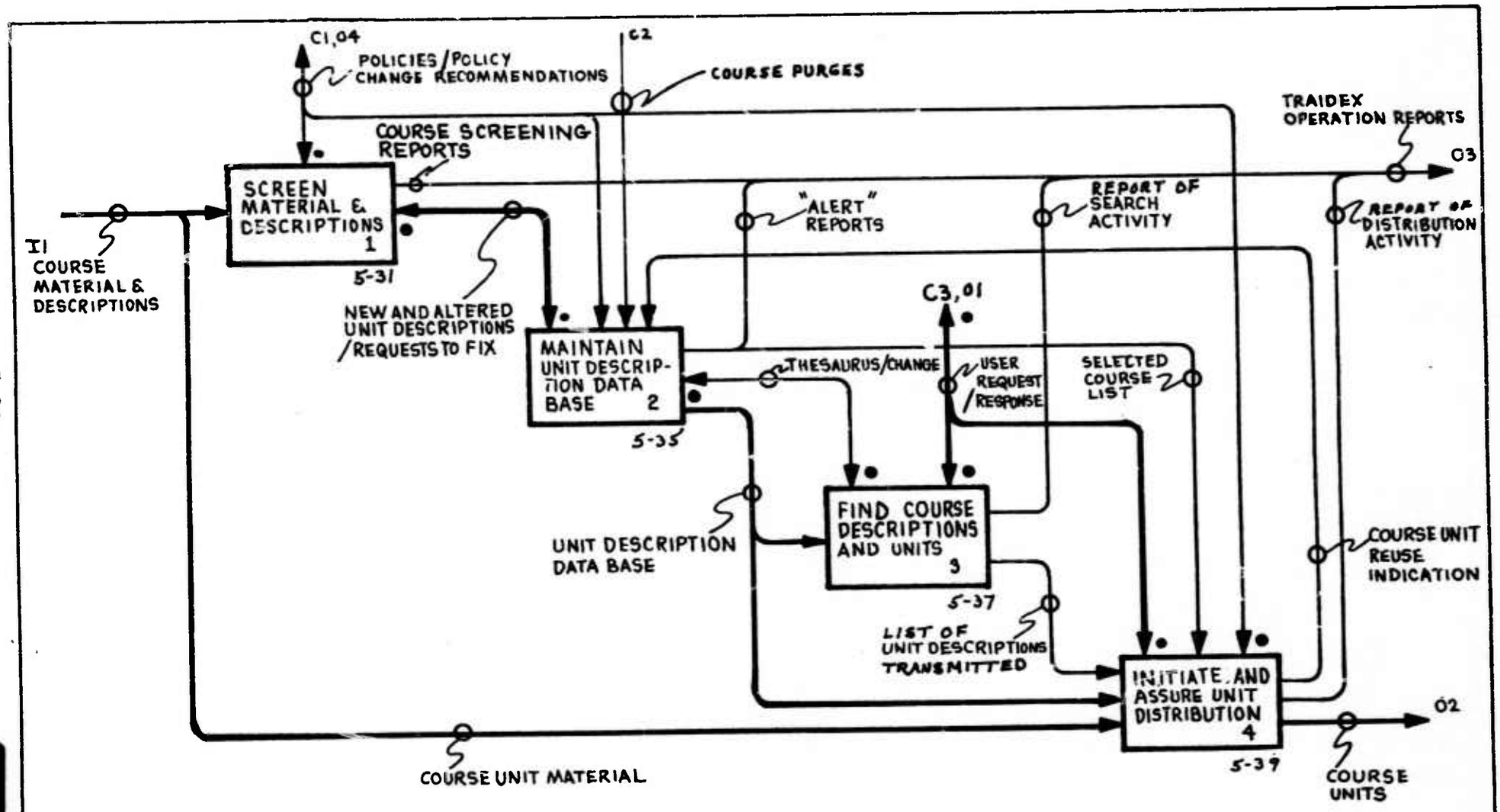
All learning materials developed for both formal school and correspondence courses (I1) are screened (box 1) to select that material made available for sharing through TRAIDEX. The selection is controlled by policies set by the Training Command the ITRB (both outside the scope of the system) and by requests to fix incomplete or incorrect unit descriptions (102). The outputs of the screening process are new course unit descriptions for courses selected for TRAIDEX sharing, and alterations to previously selected course units (1O2). Reports on the operation of the course selection activity (1O1) are produced.

The course unit descriptions (2C1) are maintained (box 2) in a unit description database (2O3). During the maintenance of the unit description database, new descriptive words (2O2) are added to the thesaurus (2O2), obsolete courses are purged (2C3), and the reuse of source units (2C4) is recorded in the database. New additions and alterations are reported to users (2O1) as "alert reports" and to the distribution activity (box 4) as a request to the development site to inventory the selected material for potential shipment.

The user request to find sharable course units (3C2) and the thesaurus of course unit content descriptive terms (3C1) are used to develop search criteria for finding course unit descriptions (box 3) in the unit description database 3I1). The result of the search (3C2) is returned to the user. Statistics on successful as well as unsuccessful searches are reported (3O1) and the need for additional descriptive key words in the thesaurus (3C1) is reported to the database maintenance activity (box 2). A list of the unit descriptions requested (3O2) are recorded by the distribution activity (box 4) for statistical reporting against material requested.



All course unit material (4I3) is culled based on the list of course units cataloged in the database (4C2), and is distributed (box 4) to users (4O3) when requested (4C1). The request is recorded and the order status is reported back to the user (4C1). Course units that are ordered for reuse are reported (4O1), and the re-use is noted in their unit description entry in the database (box 2). Lists of unit descriptions sent to the users (4I1) and statistical response time information generated within the distribution activity are used to report on the operation of the distribution activity. Names, addresses, and shipping instructions for shipment points are provided by the unit description database (4I2) and by ITRB and Training Command policies (4C3).



NODE:	TITLE:	NUMBER:
A 0	SHARE COURSE DESCRIPTIONS & UNITS	PG 5-29 A 0

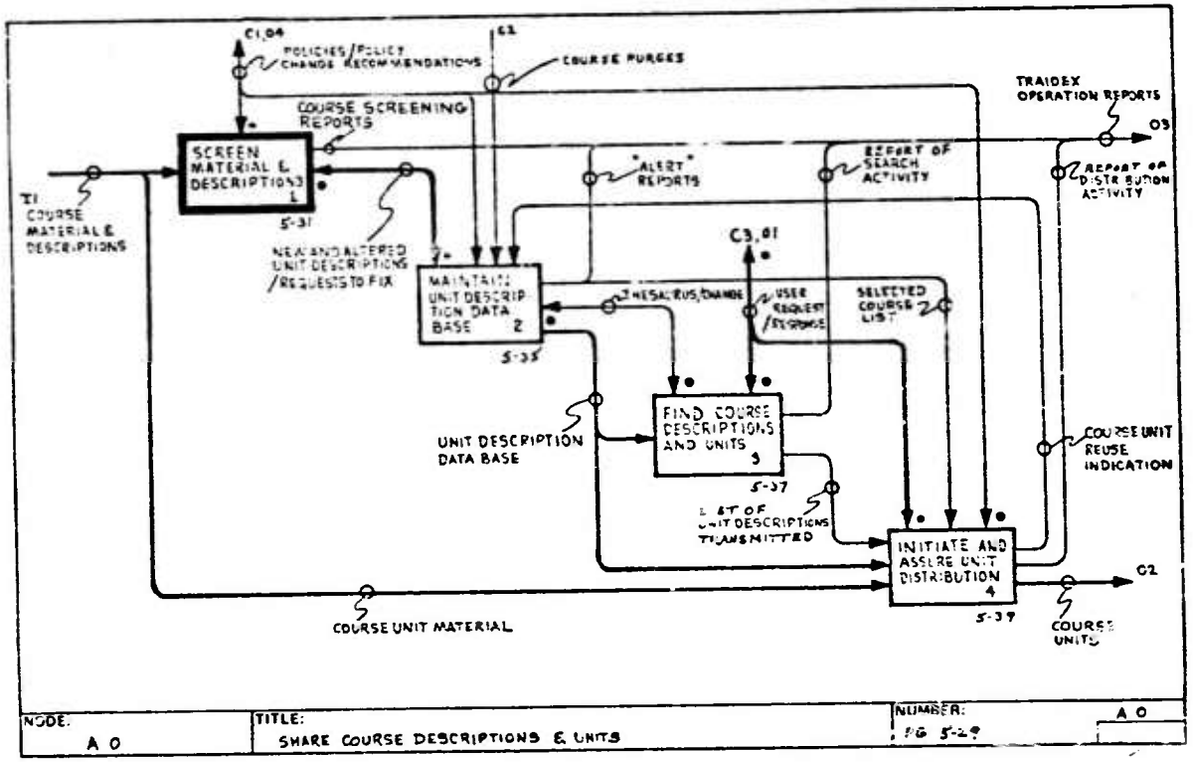
SOFTECH

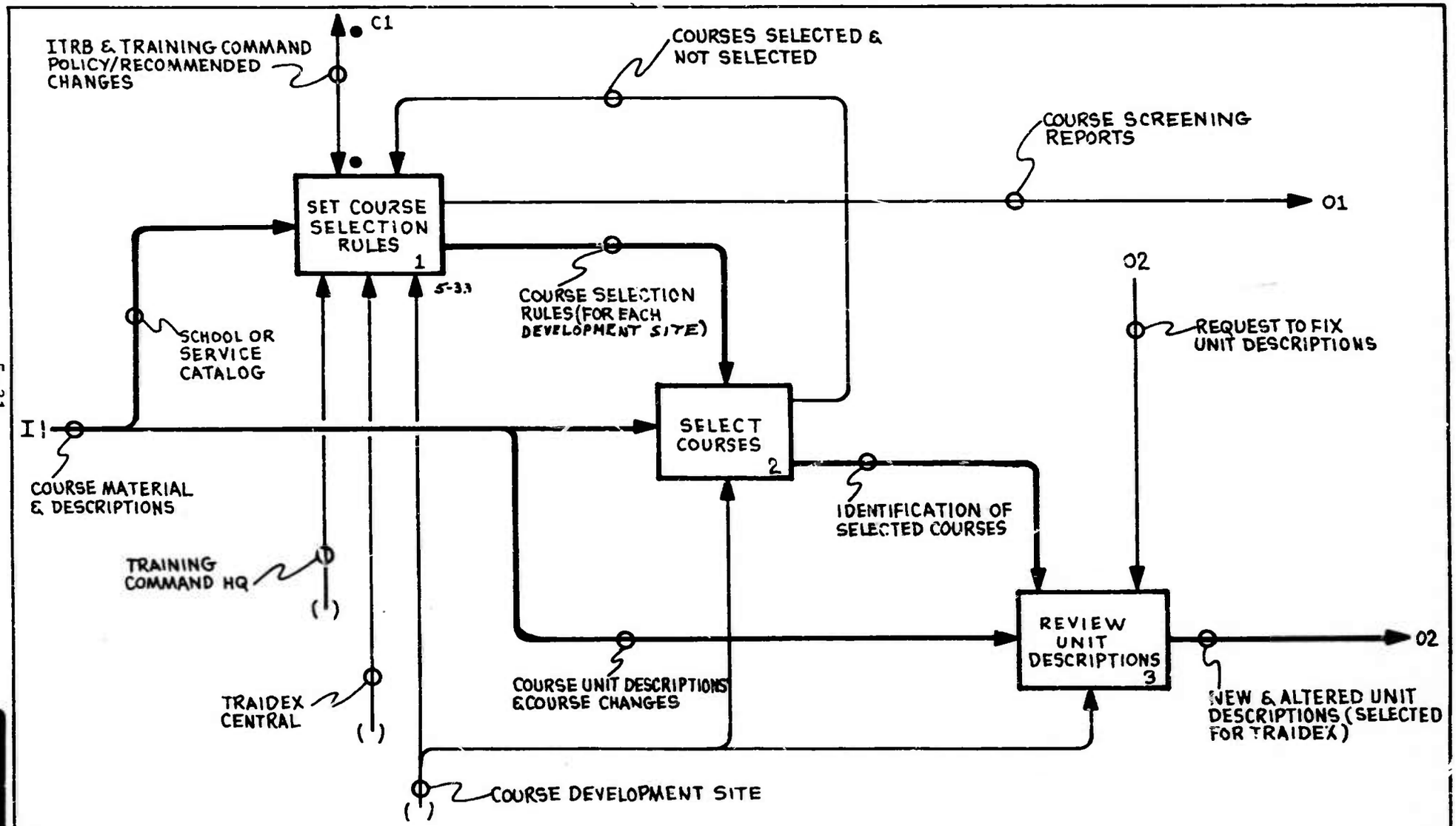
A1T Screen Material and Descriptions

Rules for course selection for TRAIDEX use are set (box 1) for each service and course development site. This activity is controlled by the Training Command and ITRB Policies (1C1). The rules may be modified based on experience (1C2) and a review of the service catalogs (1I1). This monitoring and resetting of the rules is reported (1O1) regularly. The work of setting the selection rules is done by the Training Command Headquarters for the respective service (1M1), the people who run TRAIDEX (1M2) and the course development site or school (1M3) affected.

All course material (2I1) is subjected to the selection process (box 2). The selection is controlled by the rules (2C1) set in box 1 and produces a list of courses selected (2O1). The selected/not selected status of each course is reported (2O1) for use in monitoring the effectiveness of the selection rules (box 1). The course selection is done at the course development site (2M1).

Once selected (3C1) for TRAIDEX use, the course unit descriptions (3I1) may be reviewed (box 3) by the developer or others at the development site (3M1) before they are sent to TRAIDEX (3O1). This review activity may be called upon to fix or change (3C2, 3I1) a previously submitted course unit description and to resubmit the description (3O1).





NODE:	TITLE:	NUMBER:
A1	SCREEN MATERIAL & DESCRIPTIONS	PG 5-31 A1

SOFTECH

A11T Set Course Selection Rules

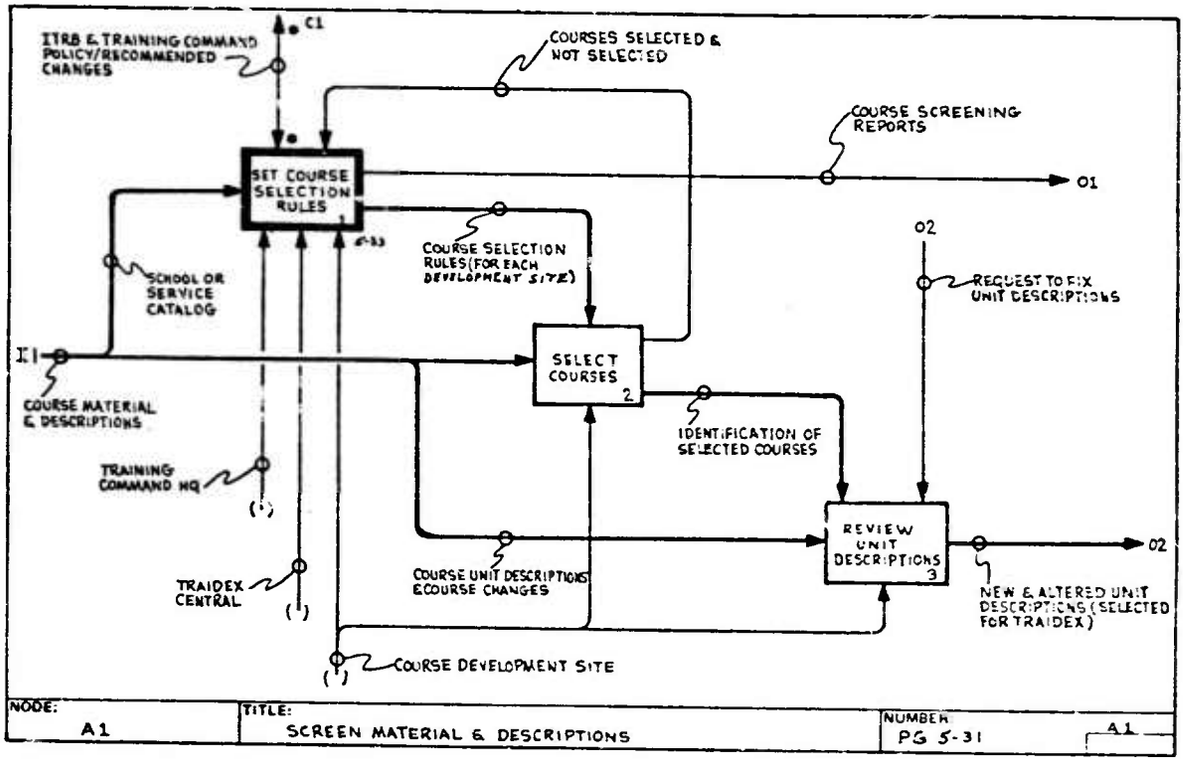
The basic screening techniques are created and revised (box 1) using ITRB Policy (1C1), reports on the effectiveness of the screening process (1C2), and specific technique and policy change recommendations (1C3). These basic techniques are in the form of a TRAIDEX course screening rule outline (1O1). Some policy change recommendations must be submitted to the ITRB or the Service Training Command (1O2). This work of creating course screening techniques is to be done by TRAIDEX personnel (1M1).

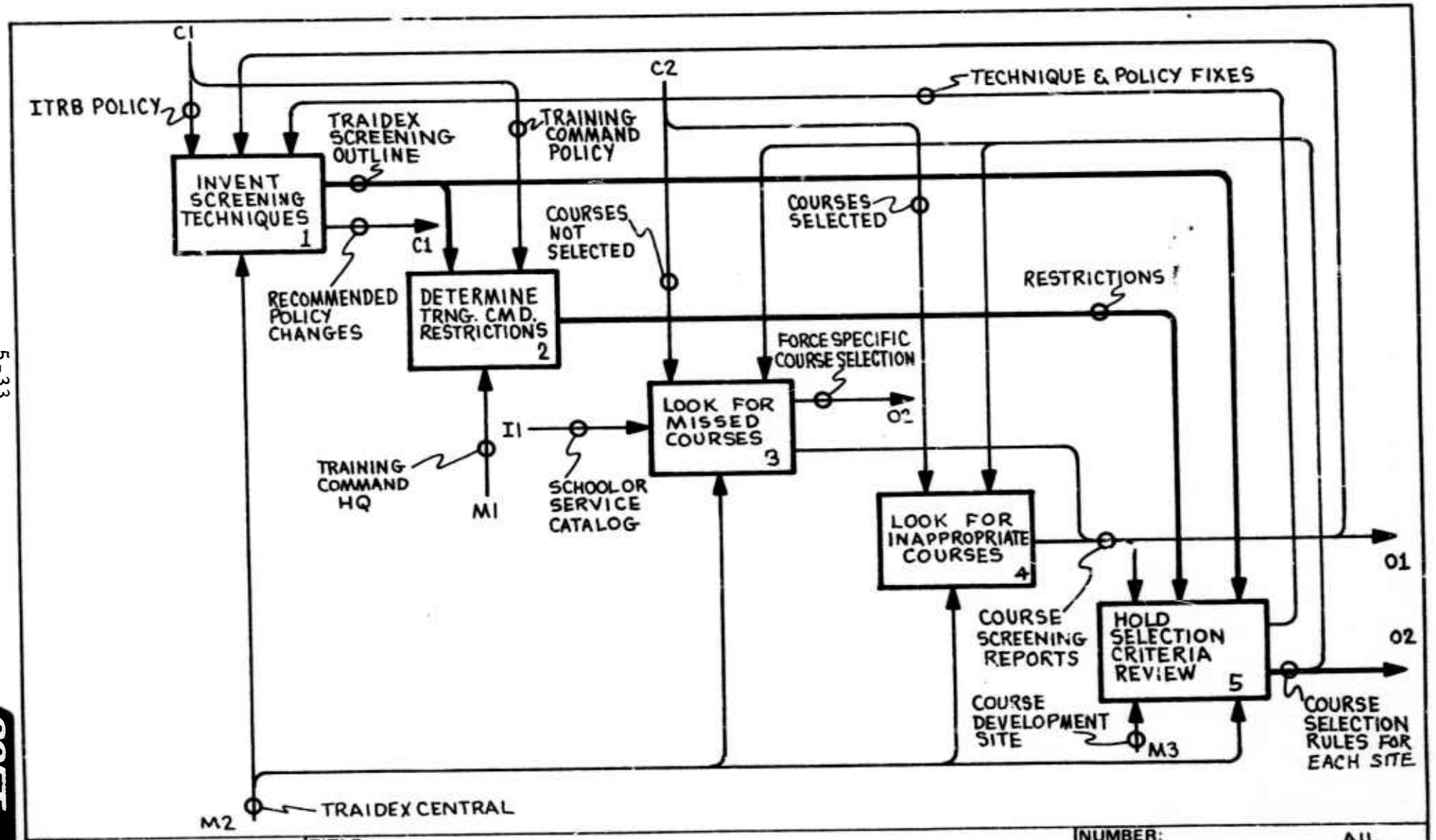
The Training Command Headquarters (2M1) will interpret (box 2) Training Command policy (2C2) with regard to course selection, using the Screening Outline (2C1) as a guide. This will appear as restrictions (2O1) on the courses which may be selected for TRAIDEX.

To determine the effectiveness of the selection rules (3C2), the TRAIDEX personnel (3M1) will periodically review (box 3) the service and school catalogs (3I1) for courses which should have been selected and were not selected (3C1). From this, a request for unit descriptions for specific courses (3O1) may be sent to the course development site. The success or failure of the rules (or development site) to select all relevant material is reported (3O2).

Courses selected (4C1) are checked against the rules (4C2) to determine if courses not conforming to the agreed upon rules have been selected. Inappropriate course selection is reported (4O1) for use in revising the selection rules (box 1 and box 5).

Personnel from the course development site for which the rules are being developed (5M1) and a representative from TRAIDEX (5M2) review (box 5) the current selection rules. This review takes into account the reported selection errors (5C1), the restrictions on course selection made at Headquarters level (5C2) and the latest selection techniques (5C3) which might be used. The results of this selection criteria review (box 5) are a revised set of selection rules for the particular development site or school (5O2) and recommendations for policy and selection technique changes (5O1).





NODE:	TITLE:	NUMBER:
A11	SET COURSE SELECTION RULES	PG 5-33 A11

SOFTECH

A2T Maintain Unit Description Database

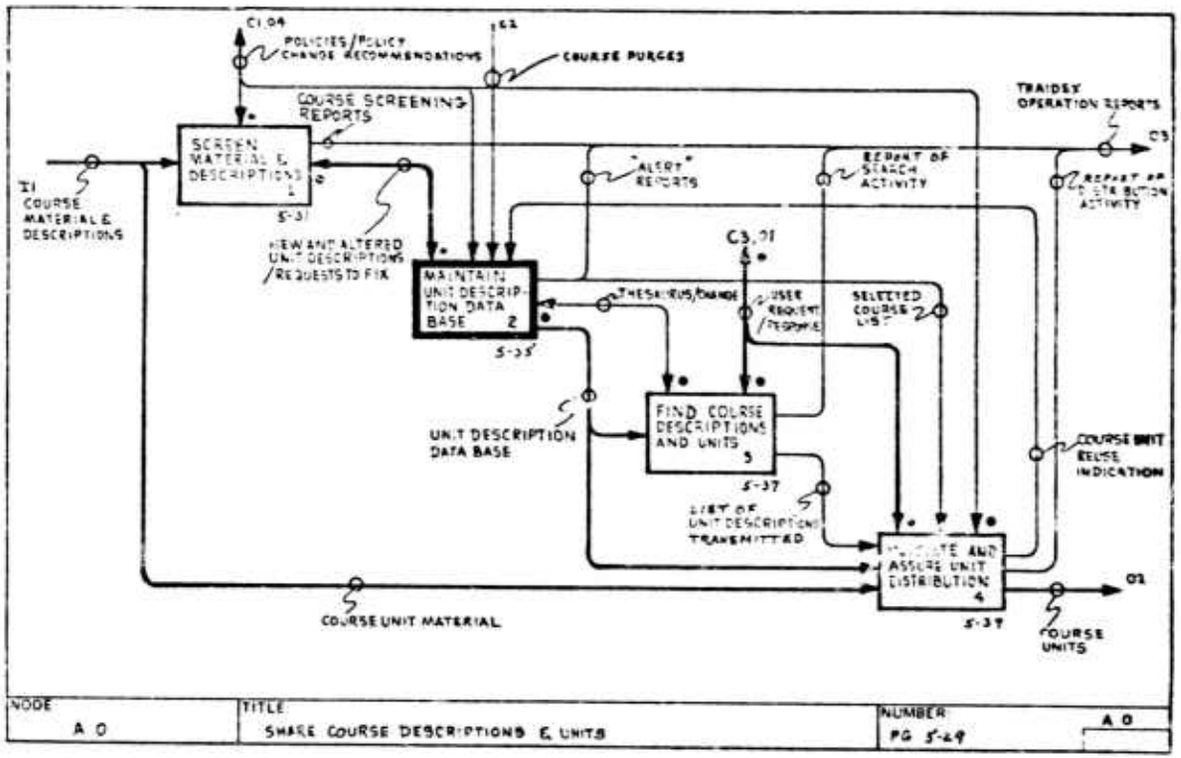
The thesaurus of descriptive words (1O1) is maintained (box 1) using change recommendations (1C1) and words needed to describe courses but which were not in the thesaurus (1C2). The thesaurus is maintained by TRAIDEX (1M1).

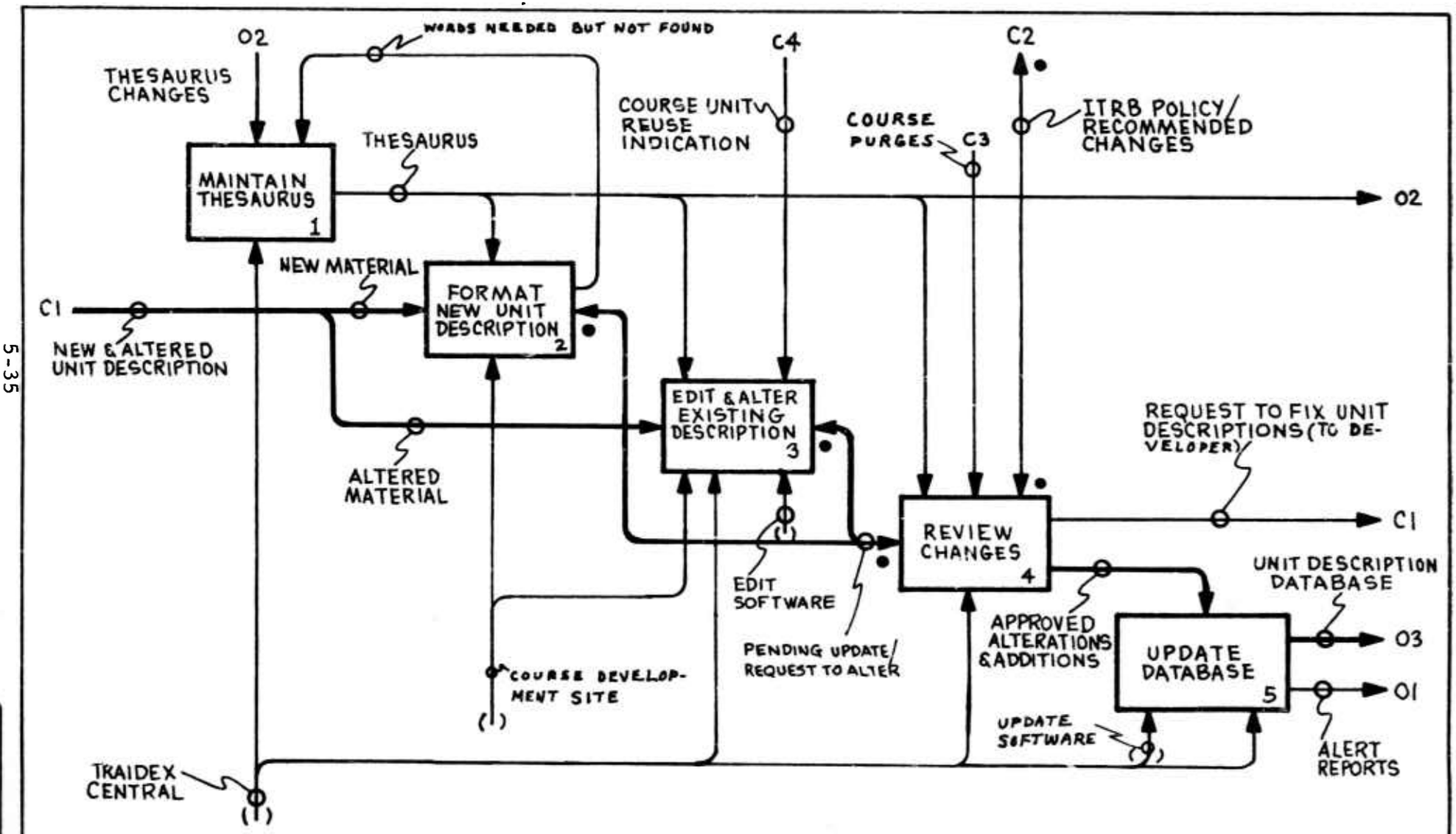
New unit descriptions (2I1) are formatted (box 2) and key words from the thesaurus (2C1) are selected to describe each course unit. Words needed but not found are reported (2O1) for thesaurus revision. The new TRAIDEX material (2O2) is now ready for final review (box 4). The formatting and assigning of key words (box 2) is done by the development site (2M1).

Changes to unit descriptions (3I1) already in the unit description database are used to prepare (box 3) pending changes (3O1) to the database. The course unit reuse (3C2) is noted at this point by TRAIDEX Central (3M2). Alterations (3O1) which arise from the review (box 4) are made and reentered as pending updates (3O1). The pending changes (3O1) are prepared by the development site using the local TRAIDEX terminal and a computerized text editor (3M3).

All changes to be made to the database (4I1 and 4C2) are reviewed (box 4) for correctness, consisteney (4C1) and conformance with ITRB policy (4C3) by TRAIDEX Central (4M1). This review results in either approved alterations and additions (4O2) or requests to fix incorrect descriptions. Depending upon the type of error detected, these requests are either sent to the unit developer (4O1) or returned to the editor format activities (4I1).

The unit description database (5O1) is updated by the database management software (5M1) at TRAIDEX Central (5M2) using the approved alterations and additions (5C1). During the update, the "alert" reports (5O2) showing new database additions and alterations are produced.





NODE:	TITLE:	NUMBER:
A2	MAINTAIN UNIT DESCRIPTION DATABASE	PG 5-35 A2

SOFTECH

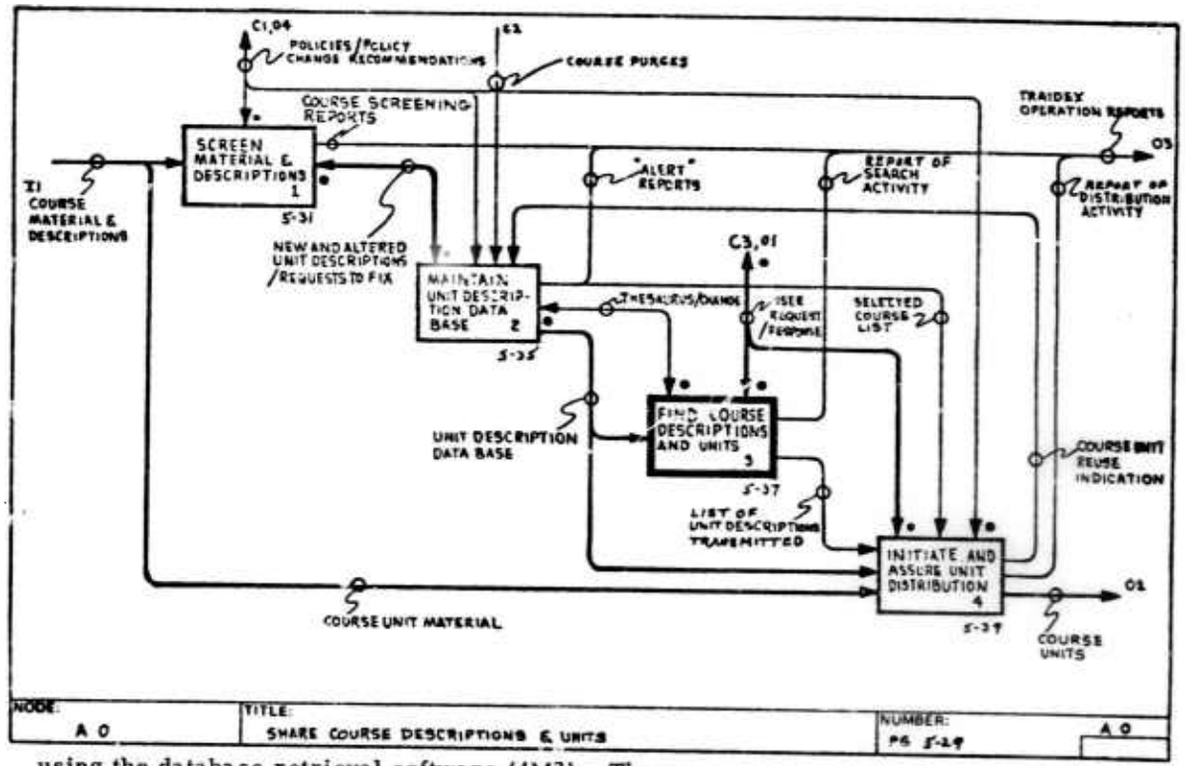
A3T Find Course Descriptions and Units

The TRAIDEX interface (1M1) works with the user request (1C1) to select (box 1) the restrictions (1O2) that will exclude from the possible responses those units which could not possibly be used (such as units requiring special equipment not available or units using teaching methods not appropriate to the course being developed). These restrictions are selected from all possible restrictive factors (1I1) supplied to the TRAIDEX interface as part of the thesaurus. Previously successful search strategies (1C2) are made available to help in formulating the restrictions. When no course units are available which meet the restrictions (1O2), the search failure with the reason for failure (1O1) is returned to the requester.

The restrictions (2C1) are then combined (box 2) with the descriptive words (2C2) that describe the required content of the course units to be found. These descriptive words (2O1) must be selected from those given in the thesaurus (2I1). This keyword selection (box 2) is done by the TRAIDEX interface (2M1) at the development site using the users request (2C2) and previously successful search strategies (2C3).

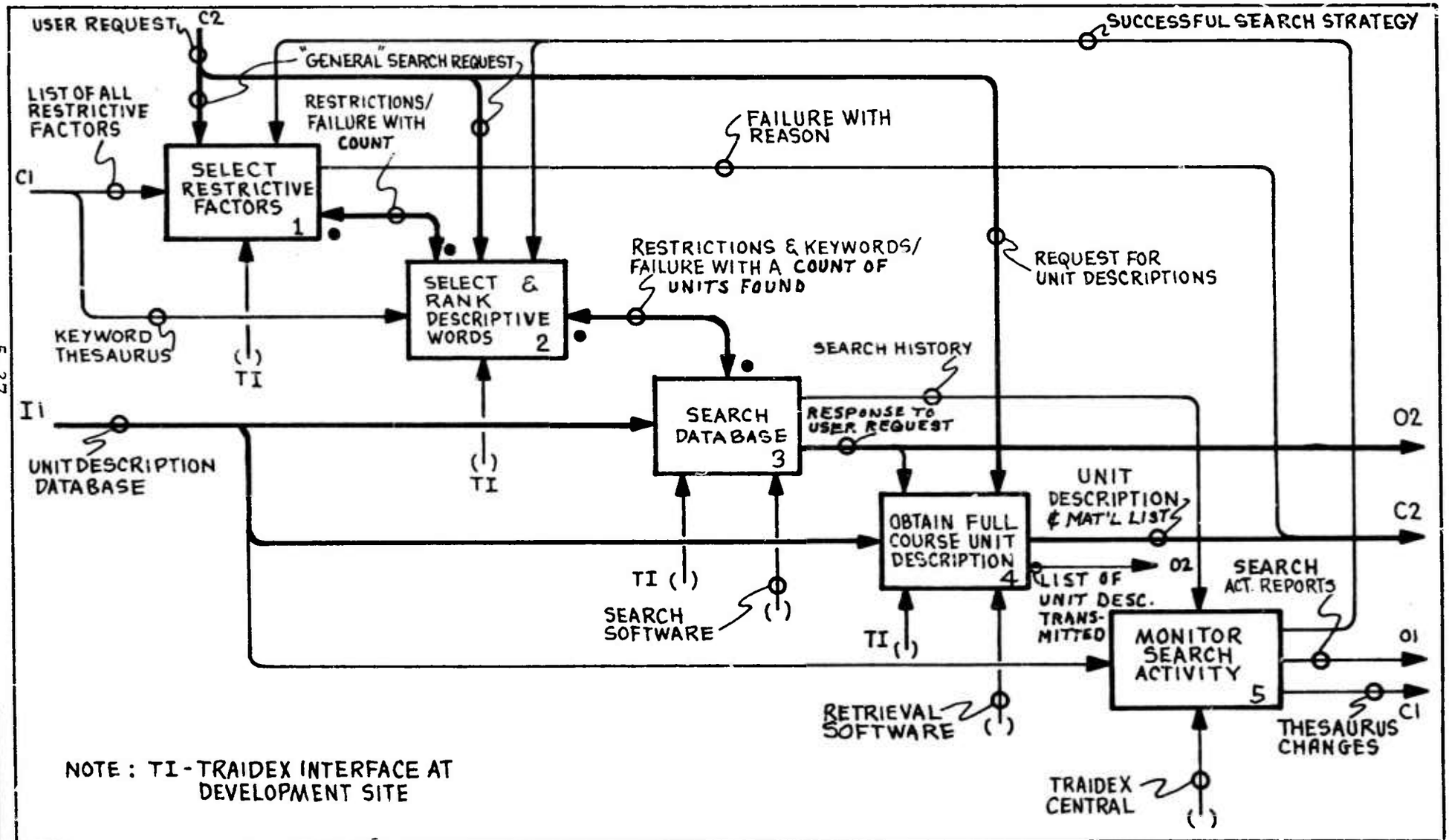
The TRAIDEX interface (3M1) then combines (box 3) the restrictive factors with the list of descriptive words and enters his search request (3C1). Search and retrieval programs (3M2) use the request to scan (box 3) the TRAIDEX unit description database (3I1). The search produces either a list of course units (3O2) or a failure notice (3C1) that indicates the number of unit descriptions that match the search request criteria. In the case of a failure, this number will either be zero or larger than the maximum number requested by the enquirer.

Once the relevant course units are located (4C1), the user may request (4C2) to see all or some part of the unit description (4O2) contained in the database (4I1). The list of course material (4O1) available (films, manuals, course notes, etc.) may also be obtained. Unit descriptions (4O1) may also be obtained by giving course number and unit number (4C2). These requests are made by the TRAIDEX interface (4M1) at the development site



using the database retrieval software (4M2). These unit descriptions (4O1) will be transmitted immediately to the terminal making the request and a list of unit descriptions actually requested and transmitted (4O2) is produced for TRAIDEX reporting purposes.

The list of keywords available in the thesaurus (5O3) will probably need to be enlarged as experience with TRAIDEX (5C1) is obtained (box 5). Also, some search strategies (5C1) may prove to be more successful than others and some material in the database (5I1) may never be searched for or retrieved. This experience is reported to those outside the user community (such as the ITRB) (5O2) and tc the various TRAIDEX interfaces at the development sites (5O1). This reporting activity (box 5) is done by the personnel assigned to TRAIDEX central (5M1).



NODE:	TITLE:	NUMBER:
A3	FIND COURSE DESCRIPTIONS & UNITS	5-37 A3

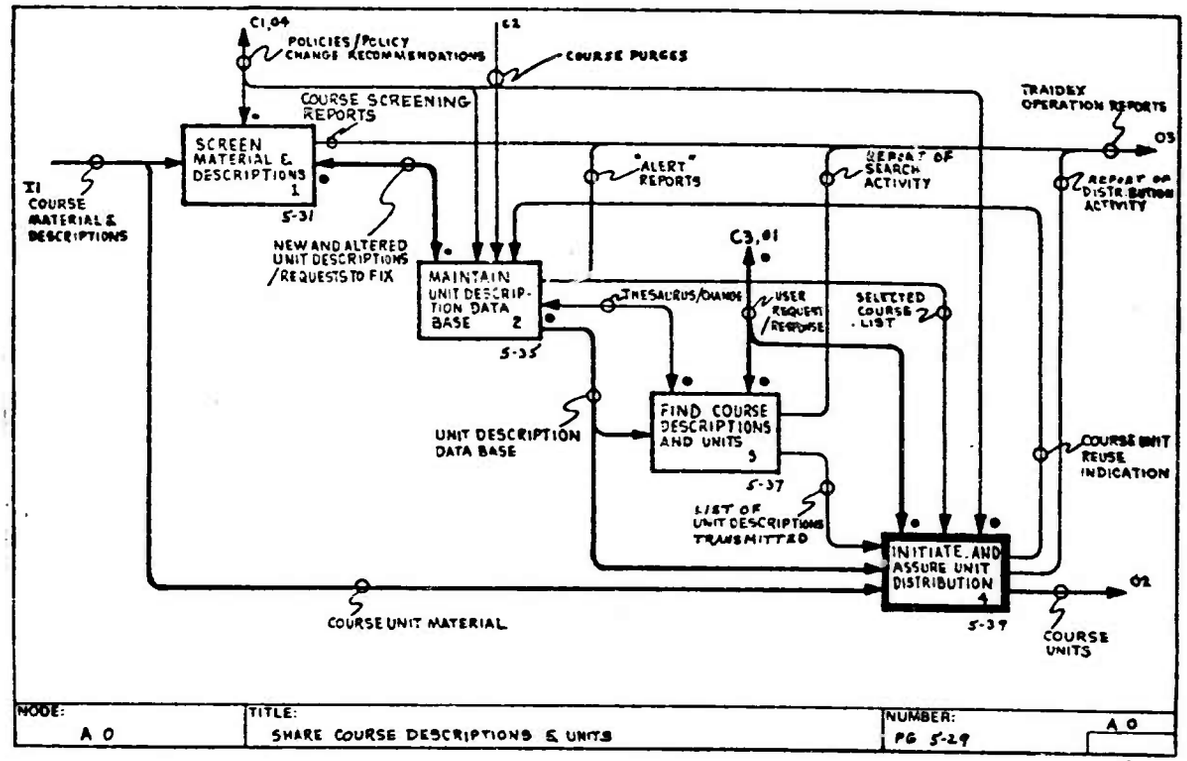
SOFTECH

A4T Initiate and Assure Unit Distribution

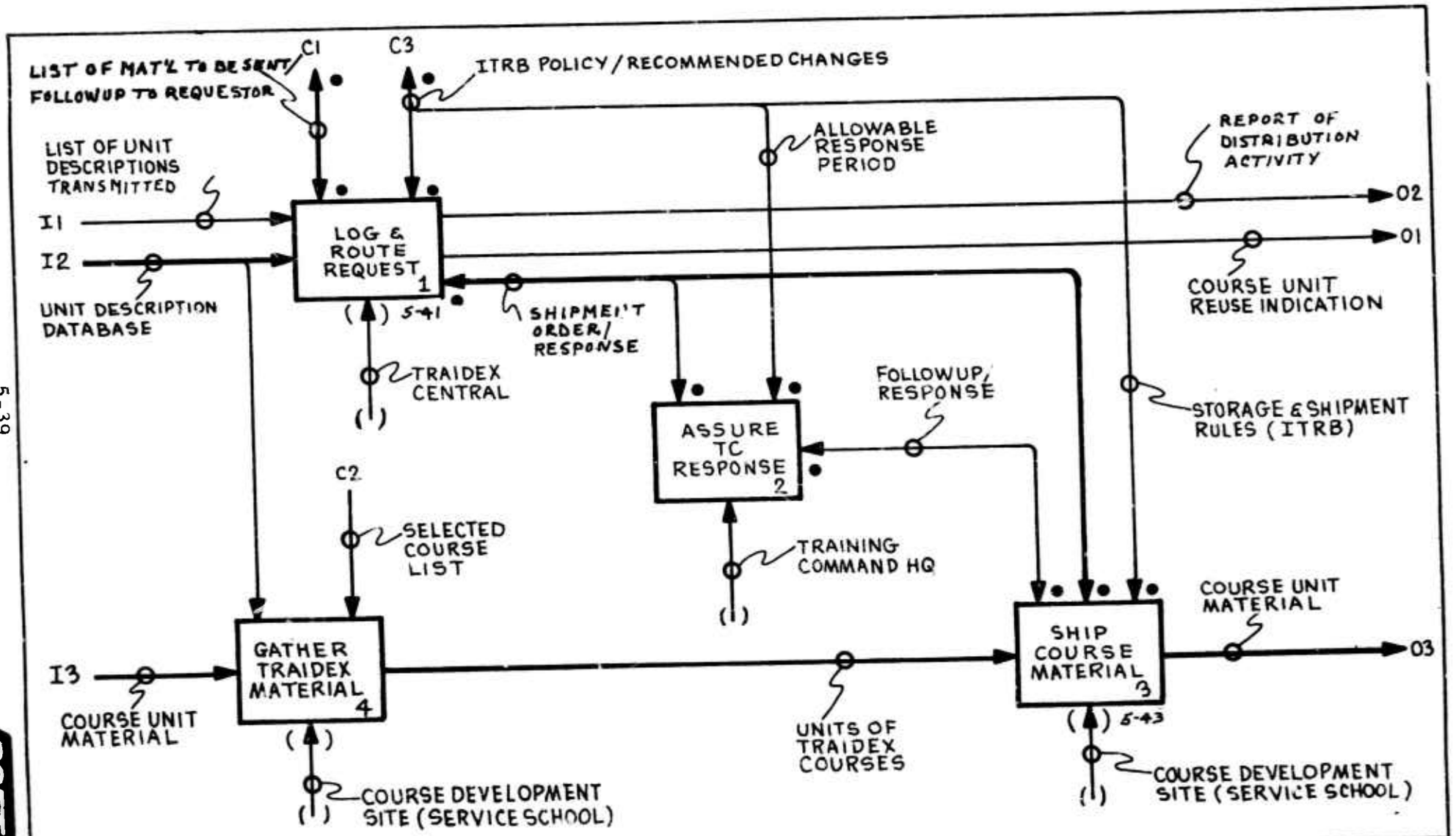
The user supplies a list of course units and the learning material to be sent for each unit (1C1). This request to send (1C1) is logged (box 1) by TRAIDEX central (1M1) and is routed (box 1) using the information about the source of the course units found in the unit description database (1I2). Each ship order is tracked (103) until the user indicates that he has received the material (1C1). If the Service development site or warehouse fails to notify TRAIDEX that the shipment has been made (103) in the time set by ITRB policy (1C2), a follow-up request (103) is sent to the responsible Command Headquarters (2M1) for follow-up (box 2) by the Training Command. The receipt notice for the material (1C1) received from the user (102) indicates whether the course unit has been reused in whole or part, and a notification of the course reuse (102) is created. If no receipt notice (1C1) is received from the user, then a follow-up (1C1) is sent to the user. Order activity vs unit descriptions transmitted (1I1) and order status are periodically reported (101). Recommended policy changes regarding response time and follow-up requirements (1C2) are formulated based on the order and shipping experience.

The Training Command (2M1) must be able to assure (box 2) that the material (201) is shipped (box 3). Therefore, the Training Command Headquarters is provided with the ship order (2C1), any follow-up notices sent from TRAIDEX central (2C1) and the allowable response time set by the ITRB (2C2). The Training Command may request changes to these times (2C2). The Training Command action is reported to TRAIDEX central (2C1).

The course units (3I1) are stored for shipment (box 3) by the Course Development Site which originally developed the material (3M1). The course unit material (301) is shipped (box 3) based on a ship order (3C2) and the shipment rules set up by the ITRB (3C3). When the shipment is made, a shipment notice (3C2) is sent. Follow-up by the Training Command (3C1) may also require a response (3C1). When needed, recommendations to change the ITRB policy on shipments may be made (3C3).



It may be necessary to select out, mark or specially package (box 4) the course unit material which was selected for TRAIDEX sharing (4C2) or which is still in the TRAIDEX database (4C1). This is done by the course development site (4M1) which developed the course material.



NODE:	TITLE:	NUMBER:
A4	INITIATE & ASSURE UNIT DISTRIBUTION	A4 PG 5-39

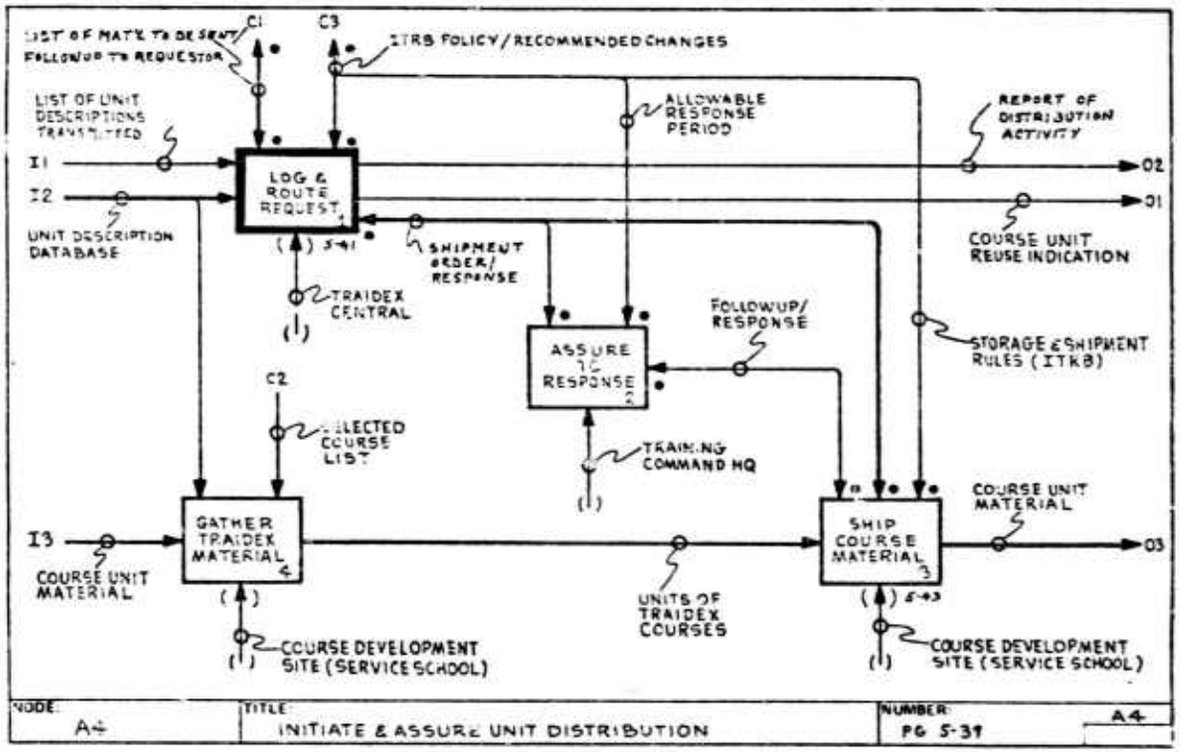
A41T Log and Route Request

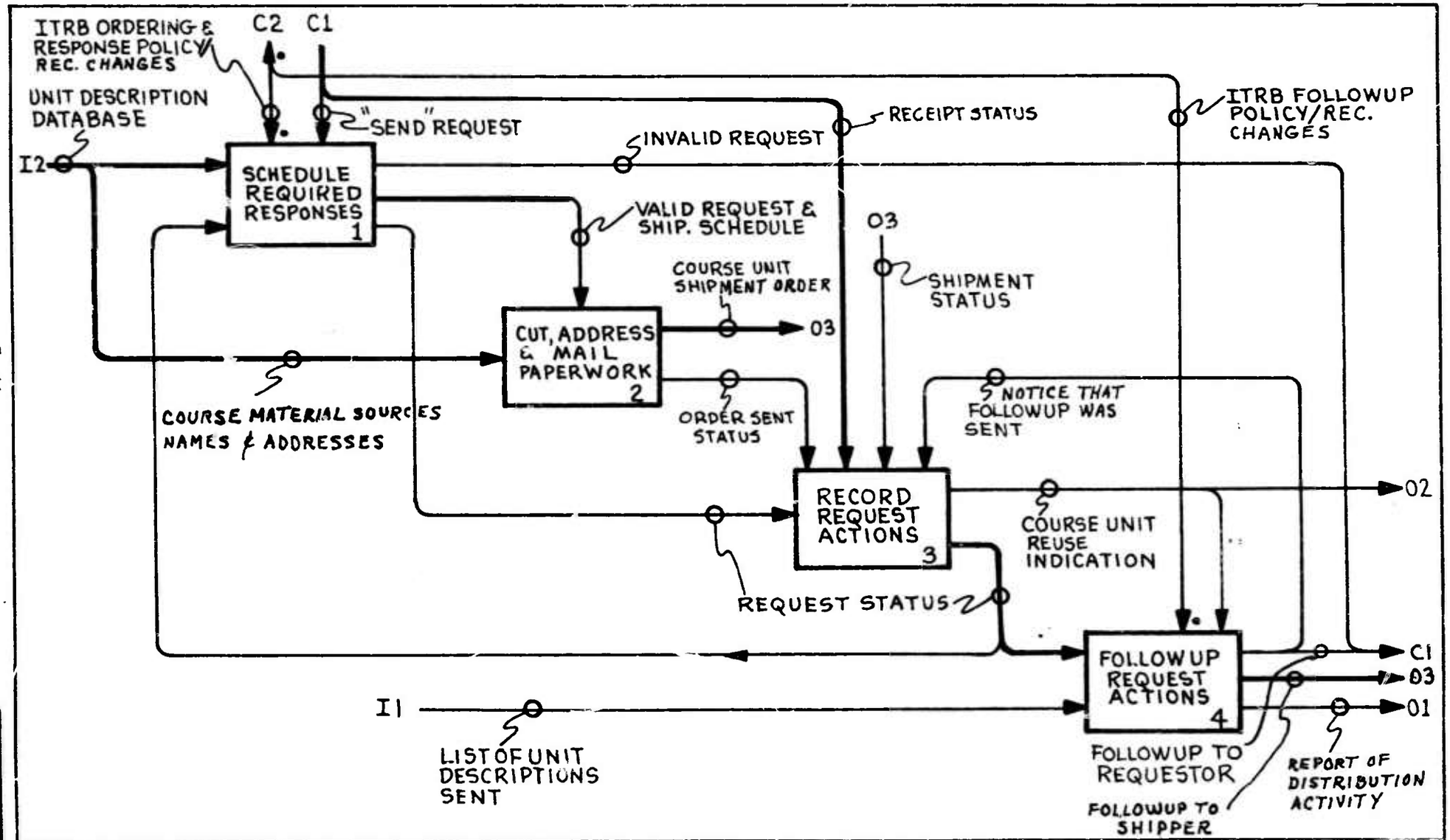
The required responses for each send request (1C2) are scheduled (box 1) and recorded in a request status file (1I2 and 1O3). The scheduling is done based on the ITRB ordering and response policy (1C1) and special instructions associated with particular course units (1I1). Invalid requests (1O1) are returned. Valid requests (1O2) are passed on to the paperwork activity (box 2) along with the shipment schedule (1O2).

The course unit shipment orders (2O1) contain the shipping instructions for all the materials ordered. This includes return mail forms to be included with the course unit material and mailed by the user when the material is received. The shipping instructions are printed (box 2) using the material sources, names and addresses in the unit description database (2I1) and the shipping schedule (2C1).

When the shipping orders (3C1) are sent, the order status (3I1 and 3O2) is updated (box 3) to show the orders have been sent. All receipts (3C2), material shipped (3C3), and follow-up sent (3C4) status notices are recorded (box 3) in the user request status file (3I1 and 3O2). When the material receipt is acknowledged by the user (3C2), the course unit reuse information he supplies is indicated (3O2).

Periodically, user request status (4I1) is reviewed against the shipment schedule (4I1) to determine if follow-up notices are needed either to the shipper (4O2) or to the requestor (4O1). The ordering history is reported (4O3) against the unit descriptions requested (4I2) and course reuse information (4C2) to determine how many of the selected course units were actually ordered and how many of those ordered are actually reused. The inprocess order statuses (4I1) are also reported (4O3).





NODE:	TITLE:	NUMBER:
A41	LOG & ROUTE REQUEST	PG. 5-41 A41

SOFTECH

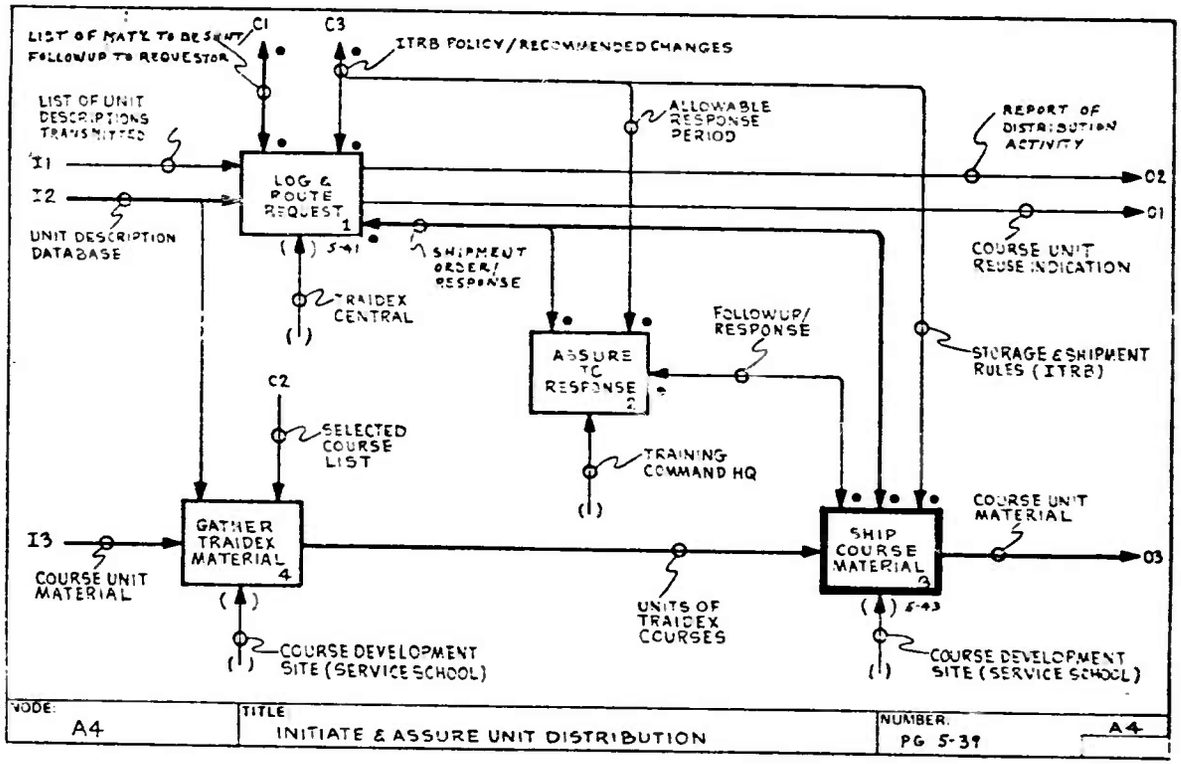
A43T Ship Course Material

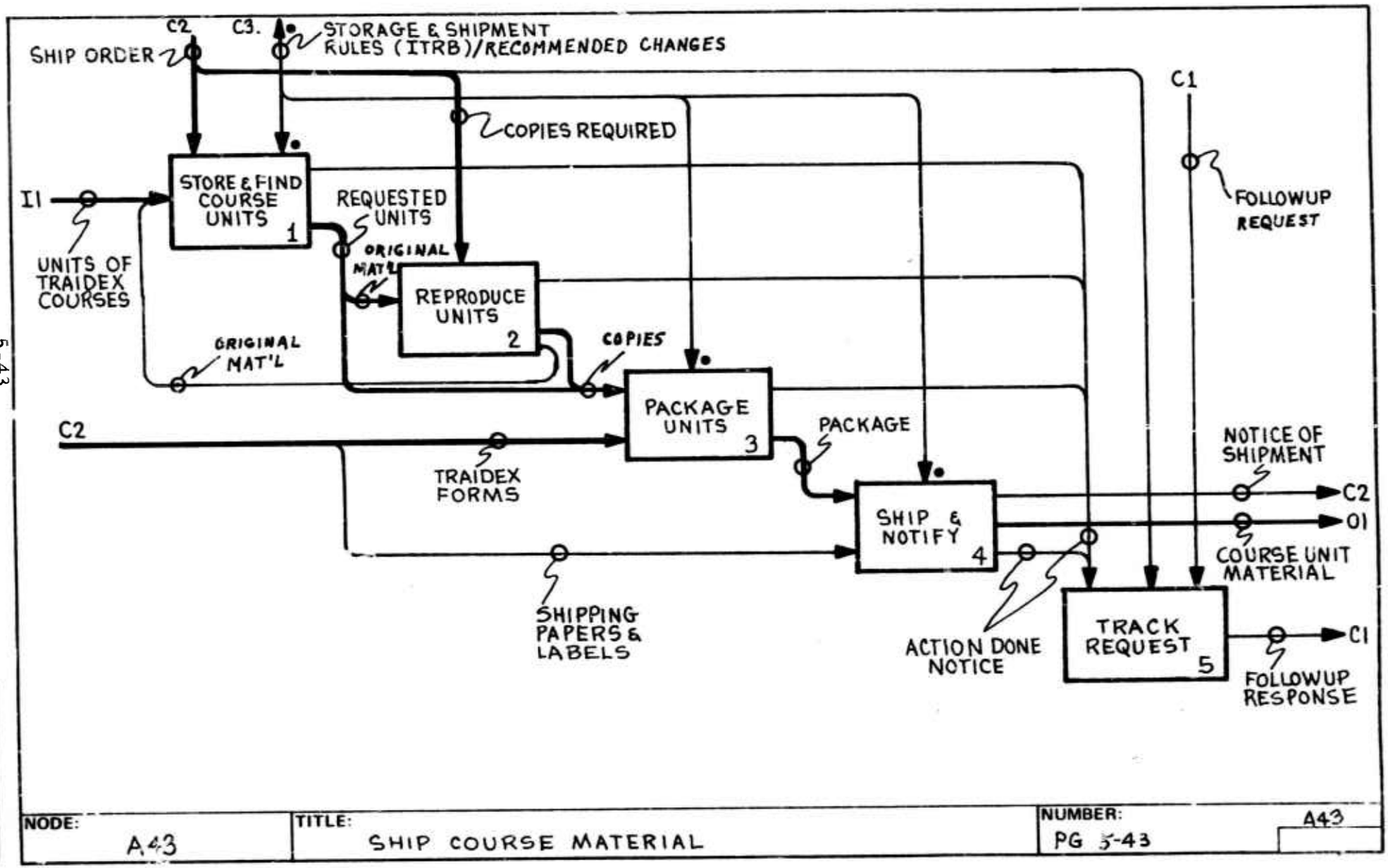
When the shipment order (1C1) is received, the course units requested are picked (box 1). The course units selected for TRAIDEX use (1I1) are stored in accordance with the ITRB storage rules (1C2). When the units that are requested (1C1) are found, they (1O2) are sent either to reproduction (box 2) or direct to the packaging activity (box 3). The fact that the units were found is noted (1O1).

If only the original of the material is available (2I1), copies (2O2) must be made (box 2 and 2C1). The original (2O3) is returned to storage and the completion of the reproduction is noted (2O1). Copies of course unit material (3I1) are packaged (box 3) along with the receipt and reuse return forms (3I2) provided with the shipment order. The completion of the packaging is noted (3O1).

The package (4I1 and 4O2) is shipped (box 4) using the labels and paper work supplied with the shipment order (4I2). Notice of shipment (4O1) is sent and the shipment completed action noted (4O3).

Each shipping action (5C1) is tracked (box 5) at the shipping site to assure local control on the order (5C2) and to answer (5O1) follow-up request (5C3).





NODE:	TITLE:	NUMBER:
A43	SHIP COURSE MATERIAL	PG 5-43 A43

SOFTECH

5.5 Design Review Results

5.5.1 Summary

This section presents a condensation of the comments that have been offered by those members of the various services' training establishments that have reviewed the TRAIDEX Functional Design Model. Where there has been disagreement or controversy on key issues, we have attempted to present a balanced discussion of both sides of the issues involved, and where appropriate we have added our own comments and conclusions.

A quick review of the comments recorded during the design walk-throughs shows that almost all of the key issues that were raised fall outside of the areas of computer or terminal hardware and software. An important benefit of the use of SADT has been to point out the large number of administrative problems that will have to be solved if TRAIDEX is to become a functioning reality. Most of the issues raised, however, are not insurmountable, and it can be stated with some assurance that the system will be viable and useful if (and only if) its end users and suppliers of data (the course development personnel) and the TRAIDEX Interface personnel that assist them are supportive and enthusiastic.

All issues which received substantial comment will be listed and discussed in the following sections; however, the areas of major interest to most reviewers were as follows:

1) Course material packaging and shipping. Most of those interviewed agreed that some adjustment in current methods of packaging, inventorying, and storing learning materials would have to be made.

2) Source data entry responsibility. There was some disagreement on where the primary responsibility for maintenance of the content of the course unit description database should lie.

3) Initial Database Build. There were several interesting suggestions provided concerning the staging and procedures required to build the initial database of course unit description information.

The issues summarized above will be explored, along with certain others, in the following sections. However, before proceeding with those more detailed explanations, it is worth noting that the need for and potential acceptance of a TRAIDEX is still strong. At one review site, the team was shown a request which had just been received by the local curriculum review department, asking for copies of over 100 programmed instruction texts that the requestor wished to review for possible inclusion in a course currently undergoing redevelopment. This anecdote illustrates three interesting points:

1) Given even minimal descriptive information (the service catalog), some people will still try to save development time by sharing other course development efforts.

2) Because sufficient information was not available to the inquirer, he created extra work both for himself and for the shipper.

3) The packaging and shipping problem already exists, and is already being addressed, at least in some ad hoc fashion.

5.5.2 Course Unit Description Database Maintenance

The major issue in this area of TRAIDEX operation concerns the focus of responsibility for the on-going maintenance (as opposed to initial entry at system start-up) of course unit descriptions. The functional design model, as initially created, showed the mechanism for accomplishing this function as TRAIDEX Central, using copies of new and altered unit descriptions provided by the course development site. The rationale for choosing TRAIDEX Central to perform this function centered primarily around the desire of the designers to keep the additional work load at the development site to a minimum. It was assumed that personnel at the TRAIDEX Central site could be trained to locate the database input information on the source documents provided; if they could not, a feedback arrow existed to prompt the development site for additional input.

This point of view was strongly supported by at least one reviewer, who felt that it was mandatory that TRAIDEX be imposed on the current development structure with as little additional required work as possible. However, there was a significant body of opinion that felt that giving effective local control over database content to the course development site responsible for the design and development of the units being catalogued held many advantages, the most important of which were as follows:

1) If each development site is directly responsible for entering and editing the new and revised unit descriptions, normal peer group pressure and professional pride in the content of widely visible material will tend to keep the quality and timeliness of the data high.

2) If the same interface is responsible both for inserting and changing descriptive data about locally developed courses and for locating and retrieving data about non-local courses for the use of local developers, simple and direct measurements of TRAIDEX effectiveness at any local site can be obtained by comparing time and resources spent entering data to those saved by re-use of shared material.

3) If the TRAIDEX interface is responsible for the assignment of descriptive keywords to locally developed unit descriptions as well as for using key words to locate potentially shareable material, he should become sensitized to the problems of the potential searcher, and use a corresponding degree of care to keep the quality of his own descriptions high.

4) Finally, local course or curriculum review personnel should be more aware of service-specific or even site-specific peculiarities in the format of source documents (and in alterations to those formats) than data entry clerks at TRAIDEX Central. This effectively shortens the error-correction feedback loop and minimizes the probability of its use.

If the four advantages cited above would in fact hold true in practice, they appear to be a strong argument in favor of local control over source data entry. Based on this argument, the current functional design model shows that the primary responsibility for entering changes to the unit description database is in the hands of the TRAIDEX interface at the local learning material development site (see diagram for node A2 on page 5-35).

Similar comments to these on data entry were received concerning the issue of screening and selecting courses whose units were to be described and catalogued in TRAIDEX. In this case, most reviewers agreed with original design model's allocation of the bulk of this work to the local course development site (see diagram for node A1, Page 5-31). Again, the same reviewer that cautioned against added developer workload felt that the review process should also not require additional work, a restriction that would be difficult to satisfy if the course screening were to take place locally. In spite of this, we feel that the benefits of local control and involvement with TRAIDEX content, coupled with obviously superior local knowledge of course content and quality, make local control of the screening and selection process mandatory. The additional workload imposed will have to be justified on the expected benefits to be received.

5.5.3 TRAIDEX Database Content Audit

In addition to workload issues, factors influencing the original design decision to place the complete database maintenance activity at TRAIDEX Central included the desire to enforce a reasonable degree of consistency on the format and content of database entries. If content and format control are delegated to the control of the TRAIDEX Interface at the local development site (as suggested in subsection 5.5.2), centralized periodic review of both the detailed contents of database entries and of the total content and utilization of the TRAIDEX database itself will be required. Field commentators have suggested that the normal inspector-general function be used to accomplish a formal audit of local site compliance with TRAIDEX input and format regulations, while the informal

pressures of professional pride and interservice rivalry should tend to keep the quality of this widely visible database at a relatively high level.

Culling unnecessary unit description entries from the database presents a somewhat more difficult problem. At this stage of design, it does not seem wise to attempt to provide an automatic purging mechanism by which the system itself can rid the database of deadwood. This conclusion is prompted by the observation that most of the "automatic" algorithms for unit deletion are in fact inappropriate. For example, deleting descriptions for the units of a course that is no longer taught could be a mistake, particularly if they were well validated and successful at reaching its objectives, and if it taught basic skills that could be easily reused. Other potential purging criteria such as the unit retrieval and re-use statistics produced by TRAIDEX operational reporting functions could be used as a basis for selecting units to be purged, but their interpretation will certainly require human intervention. For example, a unit description might fail to be retrieved or a unit fail to be reused because its database descriptors were erroneous or inadequate, while the unit itself was potentially reuseable. Our recommendation in this case is that an activity outside of the scope of the TRAIDEX system, such as the ITRB Curriculum Review Committee, periodically review the TRAIDEX database content and usage statistics, and order selective database purges. In any case, electromagnetic storage costs are becoming so low that purging should only become critical if frequently retrieved descriptions of inappropriate units are harming TRAIDEX inquiry operations.

5.5.4 Storing and Shipping Learning Materials

This area of TRAIDEX operation received more comment from reviewers than any other. The original functional design for this process (as detailed in the diagrams for nodes A4, A41, and A43, Pages 5-39, 5-41, and 5-43 makes the following basic assumptions:

1) The function of the TRAIDEX Central organization is to serve as a clearing-house for user requests and a monitor of the response that those requests receive.

2) The function of the local course development site is to store and inventory course units selected for inclusion in the TRAIDEX database, and to ship that material to requestors as directed by TRAIDEX Central.

The reasons behind this particular division of responsibility were primarily focused on avoiding the development of a large, potentially unresponsive central bureaucracy, and the feeling on the part of the analysts that, especially for relatively volatile material such as TV or audio tapes, learning material stored at the development site would be more likely to reflect the latest updates than would that stored at a central point. While several reviewers agreed with these basic assumptions, the following significant problems were pointed out:

1) The learning materials associated with particular course units are not usually packaged as separate entities. For example, units which support several objectives may be packaged into workbooks or texts which are grouped for convenience in distribution to a class of students and which cover several days worth of work. If a TRAIDEX inquirer orders only the materials associated with one unit, the standard package must either be broken apart, or the entire package shipped with instructions on how to locate the requested material. A third alternative, and one that would probably be used if a central storage and shipment site were selected, would be to maintain a separate, TRAIDEX-oriented inventory of material, broken down and inventoried by unit and arranged for easy duplication.

2) Learning materials, especially for multimedia presentations, may exist in many forms and may be available at varying costs. The inquirer should be allowed to order only those materials he requires, and the price and availability of those materials should be available to him in the unit description record.

3) Learning material may not be available at the development site. In fact, it may exist at several locations, possibly associated with a National Stock Number (NSN). However, the development notes associated with a particular course probably will not be stocked by NSN, and may only exist at the development site (if at all).

4) A strong argument in favor of centralizing material distribution is the potential lack of motivation for an individual school or development site to respond to TRAIDEX requests, particularly when local requirements compete for available resources.

In attempting to evaluate the issue of centralized versus local responsibility for learning material distribution, it is necessary to make a basic assumption about the operational characteristics and support that a functioning TRAIDEX would possess. While this assumption must, of necessity, contain some amount of uncertainty, it appears at this time to be generally sound.

The assumption concerns the motivation (or lack of it) for local development site personnel to cooperate in any way with the TRAIDEX system. While this quality is intangible, it is critical, because TRAIDEX cannot be successful in any of its phases if the development site personnel that are charged with screening, selecting, describing, and searching for course units must be forced to do their job. TRAIDEX must be accepted on its merits by the end users (the TRAIDEX interface) as a viable means to reduce development costs and improve quality, or it will be by-passed. Task 2 interviews continually showed that the key to the introduction of any new training development technology has been the existence of a cadre of highly motivated and well trained specialists in the area to be implemented. For example, the conversion of courseware from instructor-oriented to self-paced format, or the introduction of formal ISD procedures has been most successful when the concept has been implemented by dedicated professionals at the course development and local curriculum review level; where its installation has been legislated by headquarters or local school command without the support of trained and committed implementers, it has too frequently been allowed to become the object of paper exercises, and eventually to die out when upper command pressure shifted to other matters.

Fortunately, the same education and training specialists that have been acknowledged as the local leaders in the implementation of

innovative training techniques have also shown the greatest interest in and support of the TRAIDEX concept. Our assumption is that each development site will contain a few of these individuals; that they will constitute the primary interface to the TRAIDEX system for the remaining course designers and developers, and that they will be in a suitable position to assist and monitor the screening, database maintenance, description retrieval and unit distribution process. If this assumption is faulty, in the sense that the type of individual cited is not available, then the central versus local distribution problem becomes an academic question, since it is then doubtful whether TRAIDEX will receive sufficient usage to long survive.

Our recommendations, then, will continue to depend strongly upon local initiative to support routine operation of TRAIDEX. In terms of the specific courseware storage and distribution problem, the following approach seems most beneficial:

1) Each unit description database entry has been expanded to contain a description of each type of media (text, A-V, multimedia, workbook, lecture note, etc.) that is available to support a given unit. If the unit is packaged along with one or more others, that will be noted, and a description of the package given, including its price. TRAIDEX Central will keep a file containing the detailed ordering information for each unit, and would use this to produce and route a particular shipment request.

2) The individual development sites will be allowed to package individual units in the most convenient form. This may depend strongly on prevailing local conditions such as type of media to be reproduced, availability of storage space versus reproduction facilities, of storage space versus reproduction facilities, and volume and cost of the unit packages normally produced for local consumption. It does not seem unreasonable to expect the TRAIDEX inquirers to expend a small amount of extra effort to locate a unit in a package of related materials, particularly when the unit has already been precisely identified in the unit description database.

In addition to the assumption about the benefits and necessity of local control cited above, it also seems reasonable to suggest that in general, an evaluation of many unit descriptions in the database will lead to the actual ordering and shipment of a relatively small fraction over any given time period. In view of this, it seems prudent to place as little overhead as possible on the routine production of learning material, and to expend a little extra effort when a TRAIDEX shipment is requested. While there is no direct evidence to support the following assessment, it is not unreasonable to suspect that the TRAIDEX inventory usage will obey something akin to standard inventory utilization patterns, where around twenty percent of the items receive about eighty percent of the usage activity. If this does turn out to be true, any effort expended on pre-packaging the majority of units may be wasted.

Shipping from the location where course material is normally stored is the approach recommended. It is recognized, however, that material which has no normal in-service ordering route, such as course development notes, would present an unusual annoyance at the development site if this material were ordered frequently. When sufficient usage for a particular course unit is demonstrated, the material for that course might be inventoried and shipped from a centralized location under TRAIDEX Central control. This should be considered for demonstrated cases.

5.5.5 TRAIDEX Central

This organization will be responsible for the daily activity that keeps the unit description database up and online, maintains the technical keyword thesaurus, and operates course unit shipment clearing-house. Field interview response indicated that TRAIDEX Central should not be a DoD-level organization, but should probably be supported either by the ITRO or by a single service as an operating sponsor with financial support from the training commands. In any case, it seems certain that the staff should consist of members representative of each service, preferably personnel with a good technical training background and also some exposure to the administration of large database systems.

5.5.6 Initial Database Build

In the area of initial database construction, two interesting suggestions were made. Concerning the possible means of staging the database build, it was felt by some that it would be beneficial to quickly catalog a minimum amount of useful information about a wide variety of course units, and to flesh out these descriptions later. For example, initializing the data base content with relatively standard information such as unit identification (COURSE.UNIT.ID, COURSE.TITLE), learning objective supported ((LEARNING.OBJECTIVE), description key words (DESCRIPTOR.KEYS), and the necessary media ordering information could provide enough data to get the system off the ground. More sophisticated descriptive information could be added as it became available and as its need was felt. This appears to be an attractive approach, provided that the minimum information content of each record can be suitably defined. It was also suggested that the local development sites be given the largest possible degree of autonomy in scheduling their initial contribution to the database build, allowing them to time their input to correspond to local course development and re-work schedules.

The study team believes that stabilizing course unit description input and course material distribution early in the life of TRAIDEX is more important than the need to have available a high volume of unit descriptions. For this reason, the integration plan described in Section 7 recommends that a small initial load of high quality, highly shareable course units be loaded by TRAIDEX Central but that the loading of the bulk of the available course unit inventory be done when courses undergo periodic review and revision.

5.5.7 TRAIDEX Interface

Given our recommendations concerning the local control concept of TRAIDEX operation, it becomes obvious that the position of TRAIDEX Interface is the key to the success of the system. While we are confident that the type of personnel that the position requires can be located, it has been pointed out that the TRAIDEX Interface assignment should be sufficiently prestigious and the work content sufficiently demanding that

it does not constitute a lower grade job than the person would normally perform. It seems clear that the screening, search, and retrieval functions fall relatively naturally within the realm of development site curriculum review staff assignments as currently defined and practiced. The relatively straightforward clerical tasks that make up the data entry function can be performed by stenographic personnel, and their work can be proofread by the assigned TRAIDEX Interface.

While the prestige associated with the Interface job itself is somewhat intangible, it should be noted that the type of resource-person who would fit best into this type of job is likely to be highly motivated by the simple availability of the wealth of descriptive data that the unit description database represents. It seems likely that inventive and inquisitive users will quickly discover and begin to tap the reservoir of new data on learning objective construction, media usage, operative validation techniques, and so on, that are at their disposal via the TRAIDEX terminal.

Section 6

TRAIDEX COSTS AND BENEFITS

6.1 Overview

This section presents the TRAIDEX study team's conclusions concerning the most appropriate operational configuration for the TRAIDEX system, the costs required to build and operate that configuration, and an estimate of the amount of courseware development cost that would have to be saved in order to make TRAIDEX pay for itself by its fifth year of operation. The justification for using a five-year period in preparing this section is provided in Section 6.2.4.

This section has been divided into three major parts covering the following areas:

- A description of the operational components of TRAIDEX and the reasons for their selection.
- A definition of the cost categories to which TRAIDEX components have been assigned, and a summary of yearly and total costs in those categories.
- A description of the technique employed to estimate TRAIDEX benefits in the absence of hard courseware development cost data.

The main thrust of this section is the explanation of the configuration chosen and a summary of the attendant operational costs, while the details of hardware, software, and personnel cost estimates that support the summaries may be found in Appendices A through D.

6.2 TRAIDEX Operational Configuration

6.2.1 TRAIDEX Central Hardware and Software

Section 5 specified the reasons that a centrally maintained, remotely accessed database of unit descriptions was required to meet the complex retrieval requirements and relatively short response time requirements of the TRAIDEX system. In order to avoid the necessity of procuring computer hardware and/or developing new database software to support such a system, the study team investigated various currently available information storage and retrieval systems to determine the

feasibility of selecting one of them for the TRAIDEX database host site. In order to qualify as a candidate for the TRAIDEX Central site, it was determined that a system would have to possess the following functional and operational attributes:

1) Database Capacity: The system would have to have (or be expandable to) the capacity to store at least 100 million characters of descriptive information for on-line retrieval, plus the space required to hold whatever index files were required to support the database search.

2) Database Management: While the database need not be updated in real time, the software should accept remote input of updates that could be batched for offline update.

3) Information Retrieval: Due to the complex and flexible nature of TRAIDEX user inquiries, the system should permit the search for courseware unit descriptions to be controlled by arbitrarily complex combinations of search predicates connected by logical "AND", "OR", and "NOT" conditions that could be applied to any selected descriptive field in the database. The results of searches should be returned to the remote user quickly (within a reasonable time for a person waiting at a terminal) and should consist of the number of course units found which meet the search criteria. The search criteria (the selection of words or phrases to be matched, the field in which the search should occur, and the logical connectors) should be modifiable during the course of a search, and the user should be able to obtain, at his option, all or part of a unit description at his local terminal.

4) System Availability: The unit description database should be available for inquiry and the reception of remotely generated updates during the normal working day.

In addition to these fundamental requirements, it was considered desirable that the candidate systems support relatively inexpensive and available remote terminals, and that the capability to monitor the TRAIDEX database usage be present so that operational statistics could be obtained to assist in the analysis and evaluation of the system.

In view of the above rather demanding functional requirements and the parallel and competing requirement to keep costs at a minimum, the study team recommends that the TRAIDEX unit description database

be implemented on the INFOCEN information storage and retrieval system currently being operated by the U. S. Air Force Aeronatutical Systems Division at Wright-Patterson Air Force Base, Dayton, Ohio. Not only do the capabilities of this system meet the TRAIDEX functional and operational attributes listed above, but the costs required for data base inquiry and maintenance as detailed in Appendix D, are quite reasonable. Furthermore, the system is currently operational and is serving a wide variety of users across the country; its use, therefore, does not represent the risk and cost generally associated with the development of a new hardware/software system.

Finally, the INFOCEN facility is a particularly attractive site for TRAIDEX because it is already a host for three complementary training-related systems:

1) The Defense Audio Visual Archive (DAVA) is a catalogue of audio visual media and equipment covering all services. While it is organized primarily as an inventory of media and equipment elements, causing its coverage to be orthogonal to that of TRAIDEX, it could be an aid in many development situations where rapid access to a film or tape on a specific subject is required.

2) The Automated Database for Instructional Technology (ADIT) is a (currently) experimental collection of several thousand carefully indexed and evaluated abstracts of research articles in the field of instructional systems design and development. It provides a reference source on ISD technology and can be used to find new approaches to meeting training requirements that are not addressed by material in the TRAIDEX database.

3) The Catalog of Navy Training Courses (CANTRAC) is kept on line at the INFOCEN facility. While its purpose there is primarily to facilitate the maintenance and production of the hardcover edition, it could be made available for searching at the total course level. This might be particularly useful if a search of the TRAIDEX database turned up units of Navy Training courses for which the inquirer needed such information as presentation dates, locations, and application requirements.

No other government-operated information system which meets the functional and operational requirements is available to users outside the developing agency for use on a service bureau basis. The DIALOG system operated by Lockheed was investigated and it will meet all the functional and operational requirements. However, the costs of use were projected to be several times that of the INFOCEN System. Due to the cost factor, and the availability of other data bases of training interest on the INFOCEN system, the use of the DIALOG was not further investigated and is not included in the cost projections.

6.2.2 TRAIDEX Communication Requirements

Given the recommendation to install the TRAIDEX database on the INFOCEN facility, the choice of communication terminals and lines must obviously match those supported by that system. Fortunately, the hardware and software are compatible with the types of low-speed (15 to 30 characters per second) terminals that are considered to be most cost-effective for the TRAIDEX inquiry and data input functions. In addition, INFOCEN is serviced by a moderately priced packet-switching network whose hourly line charges are considerably cheaper than voice grade dial up or leased line connections. These facilities are already in use by the DAVA system. The details of the required line and terminal charges are contained in Appendix D. In addition, certain course development sites will have access to terminals that will be provided by DAVA; these terminals are potentially usable for TRAIDEX access and their locations are detailed in Appendix A.

6.2.3 TRAIDEX Staffing

As outlined in Section 5, the daily operation at TRAIDEX must be accomplished by a control and management operation that has been referred to as TRAIDEX Central. The detailed qualifications of the TRAIDEX Central staff are discussed both in Section 7 in terms of the personnel selection process that must take place during the system build and integration phases, and in terms of personnel categories and costs in Appendix B. In general, the staff will consist of four types of personnel:

1) The TRAIDEX Central director: a senior military or civilian member of the training community who can lend prestige, credibility, and innovation to the effort.

2) The TRAIDEX Service Representatives: a member from each service on duty at TRAIDEX Central to assist in handling particular needs and problems of his own service and to report on and evaluate TRAIDEX operations.

3) A Systems Analyst: a database and computer systems analyst either assigned from within DoD or obtained from a contractor to assist during the first year of operation in the initial database definition and in setting up TRAIDEX Central Office procedures.

4) Clerical assistance for initial database loading, secretarial and telephone services.

TRAIDEX is also "staffed" by Interface personnel at each development site. However, since their interaction with TRAIDEX is assumed to fall within the curriculum review responsibilities as currently defined, no additional labor costs are anticipated due to the use of TRAIDEX at a development site. The qualifications of the local development site TRAIDEX Interface are described in Section 7. The "staffing buildup" of local course developers and Interfaces is described in Appendix A.

6.2.4 TRAIDEX Database

Two concepts concerning the actual construction of the TRAIDEX Unit Description Database, whose contents are described in Section 5, are key to understanding the cost and benefit analysis that has been used in this report.

First, the study team recommends that the database of unit descriptions for the selected courses be loaded incrementally during the normal process of course review and revision at each course development site. This should result in the loading of about one-third of the basic inventory of course units in the second, third, and fourth year after TRAIDEX development begins. (See Exhibit 6-1). While this approach eases the data entry burden on the local development sites and should raise the over-all quality of the available descriptive learning objectives,

it does mean that the full potential benefits of TRAIDEX will not be realizable until five years after development begins. Therefore a five-year period has been used as the basis of the benefit calculations in Section 6.4.

Second, the TRAIDEX Integration Plan described in Section 7 recommends that a kernel of very high quality descriptions of broadly applicable courseware be entered into the database by TRAIDEX Central personnel in parallel with the installation of TRAIDEX capability at the local development sites. The reason for this approach is to provide early system users with a general base of high quality unit descriptions both for inquiry and as a model for their own data entry. The implication of this method is that there will in fact be some benefit even during the first year of TRAIDEX development; however, the study team has taken the conservative approach of ignoring these initial benefits in the benefits analysis.

The planned build-up of the database over the first five years is shown in Exhibit 6-1.

Exhibit 6-1

SIZE OF THE DATABASE AND SIZE OF UPDATE IN YEARS 1 THROUGH 5

Item	Year				
	1	2	3	4	5
The average percentage of the 82,000* course unit inventory which exists at sites which can access TRAIDEX. Taken to be the same as line 2, Exhibit A-2.	Small but not zero	70	90	95	100
The percentage of the 82,000 course unit descriptions which will have been loaded in the year shown:					
start of year	0	10	33	63	94
end of year	10	33	63	94	100
average for year	5	22	48	79	97
The average database size assuming 2000 characters per unit description (in millions of characters)	8	36	79	130	160
The number of input characters for update purposes assuming one input character generates 2 database characters (in millions of characters)	4	14	21	26	15

*From Exhibit 4-1, Section 4.2

6.3 TRAIDEX Cost Estimates

6.3.1 Cost Categories

Development and operational costs for the TRAIDEX system have been divided into three major categories. The costs that have been estimated are those that are required to support the actual operation of the system. Because no additional development site personnel are expected to be required with the introduction of the TRAIDEX system, no local site labor costs have been included.

The categories into which TRAIDEX operational costs have been divided are as follows:

1) TRAIDEX Central Labor and Travel Costs. These costs include the salaries and benefits of the TRAIDEX Central Director, the Service Representatives, clerical personnel and a computer systems analyst to assist in the initial system setup. Travel costs include both TRAIDEX Central Staff requirements and invitational orders for members of the three services covering policy-planning meetings.

2) TRAIDEX Central non-labor costs: These costs include all other TRAIDEX Central costs except for computer and telecommunications items, and are primarily restricted to costs for office space and equipment.

3) Computer and Telecommunications Costs. These costs include INFOCEN charges for set up and maintenance (updating) of the unit description database, access charges for TRAIDEX inquiries, and the costs for purchasing terminals and for using the packet switching communication network.

6.3.2 Costing Options

Given the fact that an INFOCEN-using organization is already in place (DAVA), the TRAIDEX study has investigated with the DAVA director the possibility of obtaining TRAIDEX cost reductions by utilizing DAVA personnel and equipment. Two costing options have been detailed in each of Appendices B through D, corresponding to either taking advantage of DAVA existence or providing a stand-alone TRAIDEX system.

The two approaches are summarized below:

1) DAVA will allow TRAIDEX to use their Washington, D.C., office space and will share personnel, travel budgets, and terminal equipment. DAVA will provide computer and telecommunication line charges at an incremental cost in excess of their existing budget.

2) A separate, stand-alone INFOCEN-based TRAIDEX facility will be established, purchasing all terminals and paying all computer and telecommunication charges.

For the first cost alternative, the cost figures given in this section have been reviewed with the director of the DAVA System. It should be noted that although the first costing approach will obviously provide the lowest implementation costs, a certain amount of operational autonomy must be sacrificed. Given the difference between the DAVA and TRAIDEX missions, alternative 2 may be warranted if the resulting TRAIDEX operation would thereby prove to be more responsive to the needs of the three services.

Exhibit 6-2 summarizes the estimated yearly TRAIDEX cost for the two costing alternatives described above. Over a five-year period merging TRAIDEX with DAVA is estimated to save $690,000. The largest project savings occur in the first two years of operation due to the sharing of labor costs while TRAIDEX is being set up and the ability of DAVA to absorb the computer and communication costs within its existing budget in the period before use begins at the training sites. Exhibit 6-3 provides data on computer and communication costs to support the cost summary in Exhibit 6-2. Further supporting details are provided in Appendices B through D.

Exhibit 6-2

SUMMARY OF YEARLY TRAIDEX COSTS

(in thousands of dollars)

Item	Year of Operation					5-Year Total
	1	2	3	4	5	
Alternative 1: TRAIDEX merged with DAVA						
Incremental Staff and Travel (Appendix B)	122	62	59	59	58	360
Incremental Non-labor Costs (Appendix C)	0	0	0	0	0	0
Incremental Computer and Telecommunication (Exhibit 6-5)	0	114	184	255	268	821
Total Alternative 1	122	176	243	314	326	1181
Alternative 2: Stand-alone TRAIDEX						
Staff & Travel (Appendix B)	183	156	150	150	150	789
Non-labor Office Costs (Appendix C)	15	15	15	15	15	75
Computer and Telecommunication (Exhibit 6-5)	104	166	204	267	267	1008
Total Alternative 2	301	337	369	432	432	1871
Savings by selecting Alternative 1	179	161	126	118	106	690

Exhibit 6-3

ESTIMATED TRAIDEX COMPUTER AND COMMUNICATION COSTS
(in thousands of dollars)

Item	Year of Operation					5-year Total
	1	2	3	4	5	
Alternative 1: TRAIDEX merged with DAVA						
Incremental terminal costs	0	0	0	8	0	8
Incremental line charges	0	46	59	62	64	231
Incremental computer costs	0	68	125	185	204	582
Total Alternative 1	0	114	184	255	268	821
Alternative 2: Stand-alone TRAIDEX						
terminal costs	58	52	20	20	0	150
line charges	22	46	59	62	64	253
computer costs	24	68	125	185	204	606
Total Alternative 2	104	166	204	267	268	1009

Note: For more detail, see Exhibit D-4 in Appendix D.

6.4 TRAIDEX Benefits Analysis

Given the lack of explicit course development cost data on which to base projected cost savings due to TRAIDEX use, the final justification of the system must be based on a judgment of the percentage of course development cost that could be saved by sharing relevant courseware. Therefore, we have developed an estimate of the total cost reduction for course development that must occur over the first five years of TRAIDEX operation in order for the system to pay for its own development and operational costs. This total cost saving, or "breakeven point", is then expressed as a percentage of the total development cost for technical training courses whose subject area is covered by the TRAIDEX database, and it is the judgment of whether or not this percentage reduction is attainable that should determine the economic feasibility of TRAIDEX. The total cost reduction, or breakeven point, is defined as follows:

> When the sum of all costs for startup and operation of TRAIDEX in each of the first five years
>
> EQUALS
>
> The sum of the cost savings realized in each of the first five years
>
> THEN
>
> TRAIDEX is defined to breakeven.

Because the percentage cost reduction depends upon both the course areas covered by TRAIDEX and the number of developers that have access to the system, the potential cost reductions vary from the first through the fifth year, after which they become constant. The annual savings are therefore different, and are defined to be:

> Percentage of development costs saved by TRAIDEX
>
> EQUALS
>
> Annual savings in development costs due to use of TRAIDEX
>
> DIVIDED BY
>
> Annual cost of course review, revision, and development in areas impacted by TRAIDEX

In order to obtain the breakeven percentage over the five-year installation period, the above formula must be rewritten as:

> Percentage of development costs saved by TRAIDEX over a five-year period
>
> EQUALS
>
> Sum of annual savings in development costs due to use of TRAIDEX over five-year period
>
> DIVIDED BY
>
> Sum of annual costs of course review, revision, and development in areas impacted by TRAIDEX over the five-year period.

In order to calculate the percentage of course development costs that must be saved for TRAIDEX to breakeven over the first five years of operation, the savings due to the use of TRAIDEX can be replaced in the above calculation by the costs of developing and operating TRAIDEX to yield

> Percentage of development costs which must be saved by TRAIDEX over a five-year period for breakeven to occur
>
> EQUALS
>
> Sum of annual costs to develop and operate TRAIDEX during the five-year period
>
> DIVIDED BY
>
> Sum of annual costs of course review, revision, and development in areas impacted by TRAIDEX over the five-year period.

Since the costs of TRAIDEX development and operation have been calculated in Section 6.3, the breakeven percentage can be calculated if the annual costs of course review, revision, and development in TRAIDEX-relevant areas can be estimated.

6.4.1 Estimation of TRAIDEX-Relevant Course Development Costs

In order to estimate the percentage of development costs that must be saved for TRAIDEX to breakeven, the key value is the total annual cost of course review, revision, and development in TRAIDEX-relevant areas. Knowledgeable people from the training community in the three services were asked to help in estimating the yearly course development costs of interest to TRAIDEX. This estimate was the product of two factors. First, it was determined that 2000 manyears per year of course

development time for courses in the categories of interest to TRAIDEX was a reasonable, and in fact conservative, estimate for the three services. Second, it was determined by this group that an overall cost of one man-year of development effort was about $20,000. This was confirmed later as the number being used by the Army in its own studies. In addition, the group agreed that the product of these two factors (2000 manyears X $20,000 per manyear) produced an estimate of the total yearly cost of technical course revision and new development, $40,000,000, that was determined to be reasonable.

When these development costs are used in the formula to calculate the percentage of development costs that must be saved by TRAIDEX over a five-year period for breakeven to occur, the percentage calculated is approximately two percent (based upon the $1.9 million dollar five-year cost of developing and operating a stand-alone TRAIDEX system, which represents the most conservative and costly approach).

6.4.2 Projection of Potential TRAIDEX Benefits

The percentage of course development costs which must be saved for TRAIDEX to breakeven appeared as realizable to the ITRO Training Technology Committee. Therefore, the potential savings which could be realized if larger percentage savings occurred have been calculated in this section. The potential savings have been calculated as

Annual net savings due to use of TRAIDEX

EQUALS THE DIFFERENCE OF

Annual cost of course review, revision, and development in areas impacted by the operation of TRAIDEX multiplied by the percentage of development costs saved by using TRAIDEX

AND

The annual cost of developing and using TRAIDEX

To calculate the first factor the development costs impacted by TRAIDEX in the first five years of operation must be estimated.

In order to be conservative in making this estimate, SofTech has assumed that the fraction of total course development costs in TRAIDEX-relevant areas impacted in each year is directly proportionate both to the number of developers doing TRAIDEX-relevant work with access to TRAIDEX and the extent to which the database of course units has been created. This assessment of the impact should be very conservative. If the initial 50 percent of the developers provided with access to TRAIDEX are primarily working on high-volume courses that are recognized to have significant potential for sharing, more than 50 percent of the development costs will be impacted. Similarly, if the database is created as recommended in the TRAIDEX integration plan presented in Section 7, high-quality courses with a large potential for sharing will be selected for early incorporation into the database. When 50 percent of the potential course units are available in the database, SofTech believes more than 50 percent of the benefits of having the database will be realizable. Therefore, the following method of estimating the annual cost of course review, revision, and development in areas impacted by TRAIDEX is believed to be quite conservative.

Annual cost of course review, revision, and development in areas impacted by the operation of TRAIDEX

EQUALS

Annual cost of course review, revision, and development in TRAIDEX-relevant areas

TIMES

Fraction of course developers doing the TRAIDEX-relevant development work with access to TRAIDEX

TIMES

Fraction of course units planned for incorporation which are actually described in the TRAIDEX database.

The product of the last two factors is referred to as the realization factor.

The realization factor is the fraction of the annual costs of course review, revision, and development in TRAIDEX-relevant areas which are impacted in a given year by the operation of TRAIDEX. Exhibit 6-4 summarizes the values of the realization factor for each of the first five years of TRAIDEX as well as the value of the two fractions which compare the

the realization factor. For example, in the third year of TRAIDEX operation 43 percent of the course development costs in TRAIDEX-relevant areas are estimated to be impacted by TRAIDEX. This estimate is based upon 90 percent of the potential course developers having access to TRAIDEX and 48% of the planned course unit inventory actually being in the database.

Exhibit 6-4

TRAIDEX REALIZATION FACTOR

Item	Year of TRAIDEX Operation				
	1	2	3	4	5
Realization Factor	0	.15	.43	.75	.97
Fraction of potential course developers with access to TRAIDEX	0	.70	.90	.95	1
Fraction of course units actually described	.05	.22	.48	.79	.97

Exhibit 6-5 shows the course development costs in TRAIDEX-relevant areas impacted in each of the first five years calculated using the annual course development costs (Section 6.4.1) and the realization factor (Section 6.4.2). The exhibit also includes the cumulative course development costs impacted since the beginning of TRAIDEX operation, and the

Exhibit 6-5

TRAIDEX COST IMPACTS

Costs (millions of dollars)	Year of TRAIDEX Operation				
	1	2	3	4	5
Course development cost impacted by TRAIDEX	0	6	17	30	39
Cumulative course development costs impacted by TRAIDEX	0	6	23	53	92
Cumulative costs of developing stand-alone TRAIDEX (Exhibit 6-2)	.3	.6	1.0	1.4	1.9

cumulative costs of developing TRAIDEX. Clearly a small saving in course development costs justifies the implementation of TRAIDEX. For example, the 43% realization factor for year three times $40 million yields a TRAIDEX cost impact area of $17 million. Added to the $6 million impact area of year two, the total cumulative development cost on which TRAIDEX had an effect by the end of year three is $23 million. Summing the yearly TRAIDEX development and operational costs for the most expensive configuration (alternative 2 on Figure 6-2), we find the cumulative costs in year three to be $1 million. Therefore, if TRAIDEX could save an average of 1/23 (or 4.3%) of development costs, it would break even at the end of year three.

Exhibit 6-6 has been prepared by assuming different values for the percentage of development costs which will be saved by TRAIDEX. The exhibit shows the cumulative savings achieved by the use of TRAIDEX after all development costs for a stand-alone system (alternative 2) have been deducted for four values of the percentage of course development costs to be saved (1%, 2%, 3%, and 6%). For example, it shows that if the saving in development costs by using TRAIDEX should be 3%, TRAIDEX will breakeven by the end of the fourth year of operation and will have a cumulative net savings of nearly $900,000 by the end of five years. If one believes a larger percentage of savings will be realized, the cumulative net savings can be quite substantial; for example, a savings of 6 percent will result in the breakeven period being under three years and will achieve a total savings of 3.6 million dollars in the first five years of TRAIDEX operation. In summary, a cost reduction of over 2 percent produces very high net savings when viewed against the risk and costs of implementing TRAIDEX.

Exhibit 6-7 was calculated assuming that TRAIDEX is merged with DAVA by using the cost data in Exhibit 6-2 for alternative 1. It shows that TRAIDEX would break even after five years if it provided only slightly more than a one percent cost reduction. If the two percent reduction required for alternative 2 were to be attained, the DAVA-supported system would have a net benefit of over $600 thousand.

Exhibit 6-6

CUMULATIVE NET COST SAVINGS VS YEAR OF OPERATION
FOR STAND-ALONE TRAIDEX SYSTEM

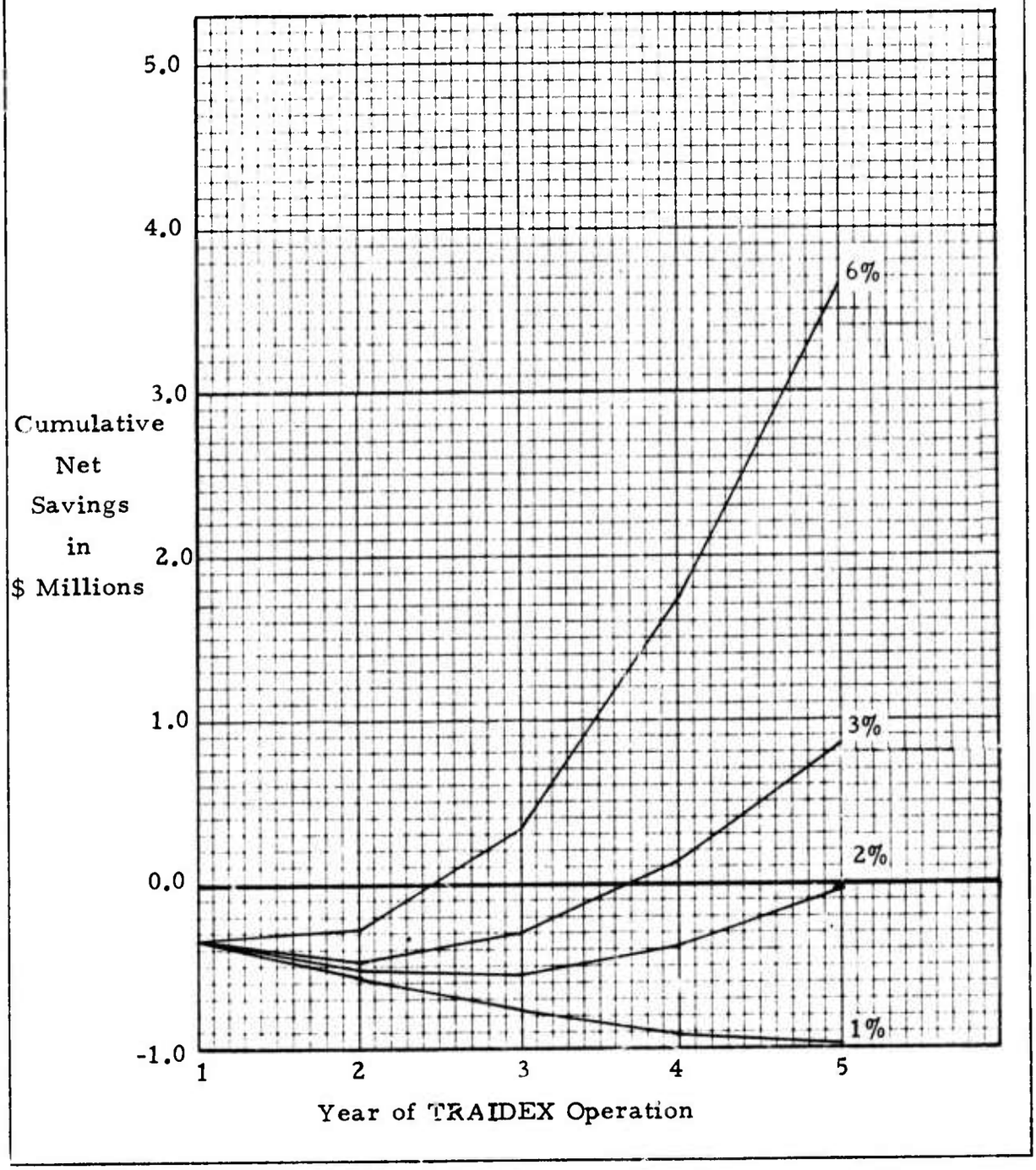
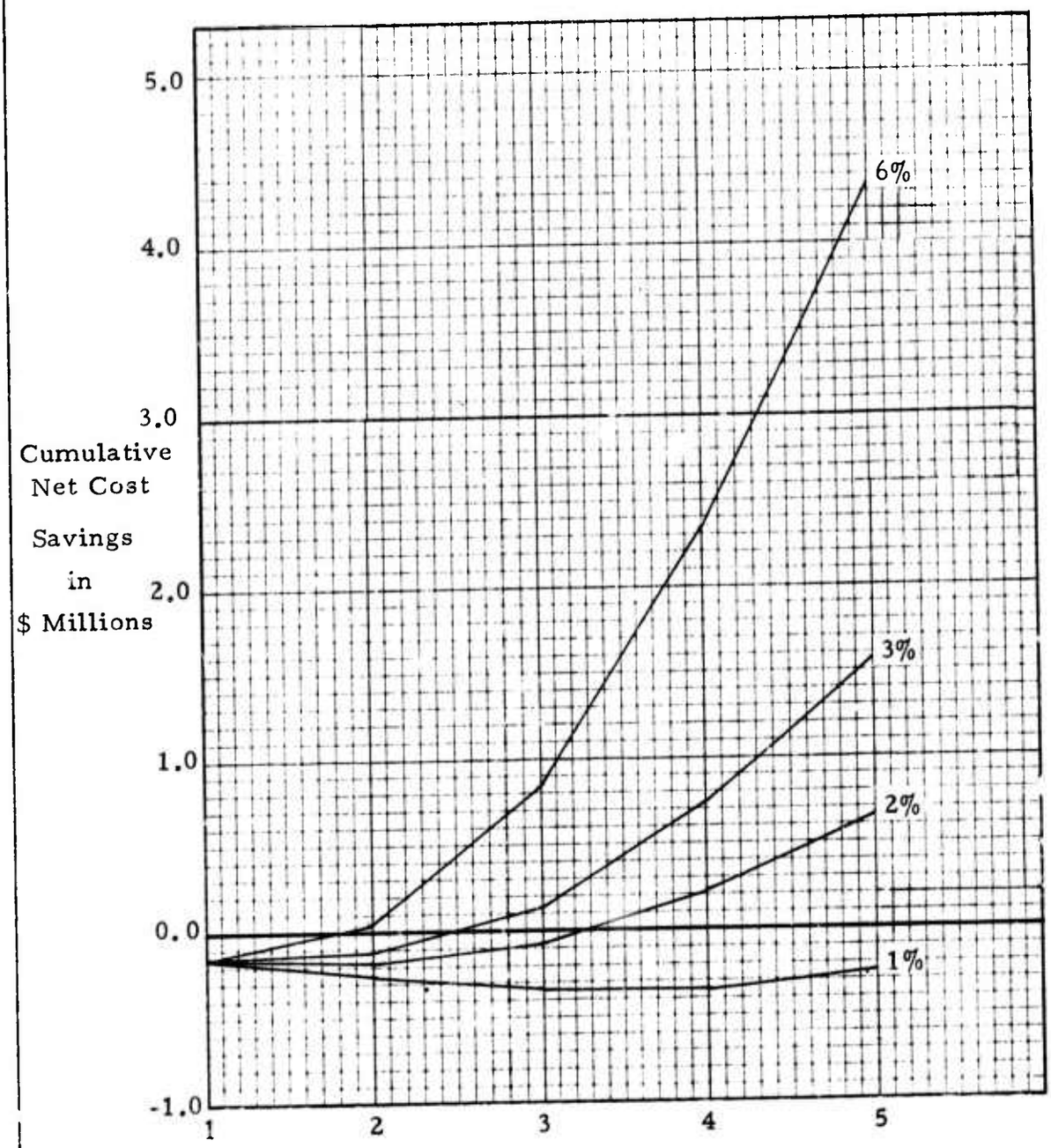


Exhibit 6-7

CUMULATIVE NET COST SAVINGS VS YEAR OF OPERATION
FOR TRAIDEX MERGED WITH DAVA



6.5 Summary of Cost and Benefit Estimates

The estimated costs of TRAIDEX development and operation over the first five years of system use total less than two million dollars for a stand-alone TRAIDEX system. By the end of the third year a majority of the potential TRAIDEX developers will have access to the system and it will contain approximately half the potential database. SofTech recommends that an in-depth evaluation of the utility of TRAIDEX to its intended audience, the course developers, be conducted at that time before a commitment is made to operate TRAIDEX on a permanent basis. To reach the point where this evaluation is carried out, based upon significant developer experience with the system, approximately one million dollars will have been invested in initial development and operation of TRAIDEX.

SofTech recommends that the ITRO proceed with the development of TRAIDEX up to the point of the evaluation if the ITRO is confident that:

1) The reduction in course development costs required for net savings to accrue is achievable, given the TRAIDEX capabilities described in previous sections of this report. A key issue in assessing the projected savings is the ITRO's confidence in the estimate of total course development costs ($40 million per year) provided in Section 6.4.1.

2) The training commands will actively support the TRAIDEX concept, especially in regard to the establishment of the TRAIDEX Interface positions as described in the Integration Plan.

SofTech believes other benefits, especially higher quality courses, will result from the development of TRAIDEX. However, these other benefits are not quantifiable and have not been included in the calculation presented in this section. However, these additional benefits provide significant further justification for developing TRAIDEX if the above conditions are met.

Section 7

TRAIDEX INTEGRATION PLAN

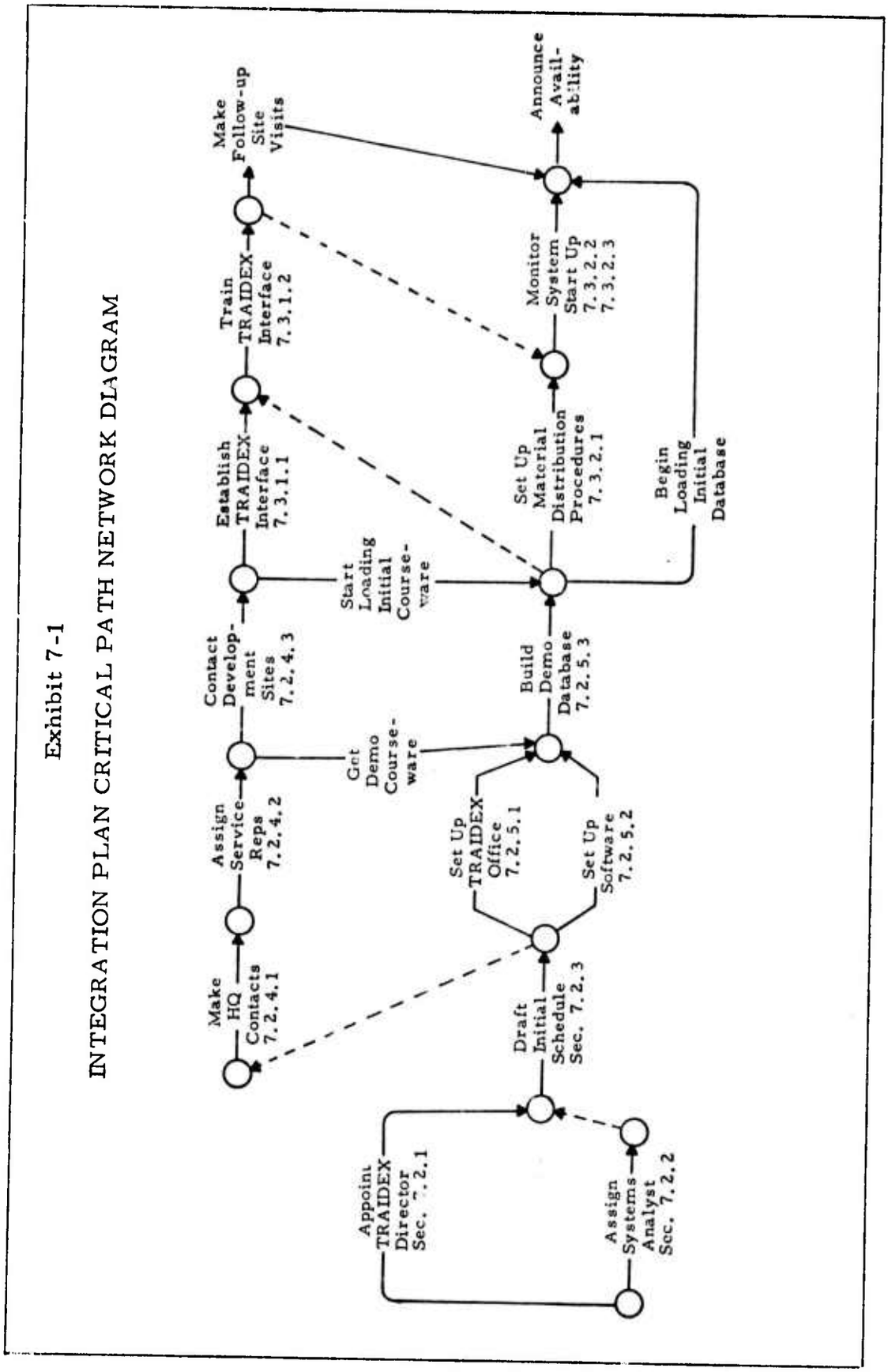
7.1 Overview

This section describes the steps that must be taken to establish an initial TRAIDEX capability, to make that capability available to the course development sites, and to accomplish the transition from start-up to full operational mode. A critical path network diagram of the integration plan is shown as Exhibit 7-1. The diagram expresses the activities to be accomplished as arrows and the critical milestone events as circles. Note that the diagram is composed of two essentially parallel paths connected by a few restrictive, non-activity arrows. The lower path is concerned with those activities that must be accomplished at the TRAIDEX Central site by the director, the staff analysts and the TRAIDEX Central representatives of the participating services. The upper path shows the activities that are executed at sites external to TRAIDEX Central (the Training Command Headquarters for each service and the local course development sites) by the TRAIDEX director and the service representatives. This upper path can actually be activated in parallel for each development site and each service; while it has been shown as a single path in Exhibit 7-1 for the sake of simplicity, the diagram used as a scheduling tool for the actual integration of TRAIDEX would show appropriate paths and nodes for each Training Headquarters and each development site.

The activities and events depicted upon the diagram are explained in Sections 7.2 through 7.4. However, before going into the details of each phase of TRAIDEX integration, the basic approach to the integration task itself must be described. There are two fundamentally different ways to approach the task of building TRAIDEX. On one hand, it would be feasible to mount a large scale, centralized effort to collect, describe, and catalog the majority of existing courseware. This approach has the advantage of creating a large TRAIDEX database in a relatively short time (approximately one year) and having that database available at

Exhibit 7-1

INTEGRATION PLAN CRITICAL PATH NETWORK DIAGRAM



the start of user operations. However, the manpower cost would be large, many of the data entry procedures would have to be designed with incomplete knowledge of the format and content of current descriptive documents, and most important, it would be very difficult to adequately control the quality of the catalogued courseware. Finally, such an effort might impose fairly large disruptions on the daily activities of the course development sites. Instead, the TRAIDEX study team recommends a staged build of the database that would occupy a three to four year time span. Except for the initial kernel consisting of a broad-based selection of about 200 high-quality, well-described courses, the initial TRAIDEX build would be accomplished in the normal course of reviewing, modifying, and updating current courses and during the production of new courses at those development sites at which TRAIDEX is operational. This staged approach, although requiring longer to capture all courseware of potential interest to TRAIDEX users, has the following advantages:

1) The quality of both the descriptive matter in the database and of the courseware itself should be high. As each course comes up for review and possible revision at the development site, both its content, presentation medium, descriptive objectives, and test items are reviewed for adequacy. Whether or not this review is a result of the application of an "ISD" program, a conversion to a new instructional methodology (self-paced instruction, CAI, etc.), or merely an every third year scheduled review, the result of driving the TRAIDEX database load from the output of the course review will be the capture of consistently higher quality courseware than any massive, one-time data load could guarantee.

2) Because the TRAIDEX unit description data is supplied as a by-product of an activity that must be performed in any case, the additional impact of formatting and inputting that data should be small and essentially clerical in nature. Therefore, TRAIDEX will be able to maintain a low-cost, non-threatening profile to both local course development site command and to course development personnel.

3) Because the total database load is staged over a relatively long time, the development of data input procedures, course screening, the development of

effective search and retrieval methods, and the installation of adequate course material inventory and dissemination procedures for response to course unit shipment requests can evolve while the data volume is relatively low.

The staged integration of TRAIDEX is described in the following subsections. The activities of the critical path diagram have been divided into three phases: initial planning, system startup, and operational cutover. Within each phase, the applicable section describes the activities of both TRAIDEX Central and the Training Command Headquarters and local development sites. The diagram indicates clearly which activities in each phase can occur in parallel.

7.2 Phase I - Initial Planning

This phase covers the selection and assignment of the key TRAIDEX Central Operating cadre, including the director, the service representatives, and a systems analyst assigned for the duration of the first two phases of the Integration project.

7.2.1 Appoint TRAIDEX Central Director

The proper selection of this individual will have a major effect on the success of this program. Because the TRAIDEX concept itself must in fact be "sold" to the training command headquarters and especially to the development sites, the TRAIDEX Central Director must possess the following qualifications:

1) Above all he must be enthusiastic and committed to the success of the project. Because of the experimental nature of several aspects of the system, he must expect and be prepared to handle a multitude of political, administrative, and operational problems as the system is brought on the air. This is not a job for a caretaker or a paper pusher - the director must be committed, active, and innovative.

2) Because he must be able to command the respect of relatively high-level civilian and military personnel throughout all services, he should currently have an established career within the military training community.

3) Although TRAIDEX is a computer based system, his data processing credentials are considerably less important than his training experience primarily because he will have the full time assistance of a systems analyst, and because there are no extensive computer hardware or software acquisitions required.

4) Finally, while it probably does not matter whether the director is a military or civilian employee, he should be able to commit to at least a three-year assignment with possible relocation and should be prepared to travel heavily during the first two years of his assignment.

7.2.2 Select TRAIDEX Systems Analyst

At the same time that the ITRB or other cognizant authority selects the TRAIDEX Central Director, it should also select and assign a qualified systems analyst, whose major task will be to design, implement, and check out the manual procedures (of the TRAIDEX Central Office procedures), the detailed database design, and the manual and automated procedures that will be required to interface with INFOCEN software in order to allow access to and maintenance of the TRAIDEX unit description database. Ideally, this analyst would possess the following qualifications:

1) Familiarity with the theory and operation of large scale information storage and retrieval systems such as INFOCEN. Actual experience in the succesful implementation of application subsystems on a similar database would be very desirable. The analyst should be thoroughly familiar with the functional requirements of on-line text editing software, file back-up and archiving procedures, and should be capable of interfacing existing INFOCEN database software to required statistical packages and report generation programs.

2) Some exposure to military technical training, at least to the point where the analyst understands the external environment of TRAIDEX user and the place in the instructional systems development process that TRAIDEX is intended to occupy. This familiarity should be sufficiently deep that he can be responsible for the initial build of the kernel demonstration database and thesaurus with minimal guidance from the TRAIDEX director and service representatives.

This systems analyst need not be assigned as permanent member of the TRAIDEX Central staff. His services are required only while designing and checking out detailed TRAIDEX Central Procedures during the planning and startup phases. The required analyst could be drawn from an organization like DAVA, or could be obtained from a contractor who could supply a variety of personnel with particular talent or experience as the job required them. In any case, he must be capable of working closely with the TRAIDEX Director and staff of service representatives as well as with the INFOCEN technical support staff, and must be able to troubleshoot and solve the typical user problems that inevitably crop up in a new online system.

7.2.3 Draft Initial Schedule

This is a brief, kickoff activity at which the initial TRAIDEX Central skeleton staff of the Director and Systems Analyst set up the initial schedule for the design of central office procedures, the load of the demonstration database, and the initial specification of any required enhancements to the INFOCEN software interfaces. Since the new TRAIDEX Director will soon begin to spend a great deal of time traveling to various headquarters and development site locations, it is this plan that will guide the initial TRAIDEX Central activities and that will allow the central and field work to proceed in parallel.

The remainder of activities in Phase I are covered in subsections 7.2.4 and 7.2.5. Subsection 7.2.4 describes activities that are carried out by the TRAIDEX Central staff at external locations such as the training command headquarters and the course development sites, while subsection 7.2.5 describes the parallel activities that will take place at TRAIDEX Central.

7.2.4 External TRAIDEX Activities

7.2.4.1 Make Initial Headquarters Contacts

The TRAIDEX Central Director must make contact with each training command headquarters, probably via the services ITRO representative. He should arrange a briefing that will cover TRAIDEX objectives,

current funding and manpower allocations, and current implementation plan. He should then enlist the headquarters in identifying and assigning that service's TRAIDEX Central representative. The TRAIDEX Director should help the headquarters command to identify potential candidates who have had significant exposure to current course development practices in their services, who are familiar with ISD, and who will be able to work well with local development site personnel. The TRAIDEX Director should insure that a firm schedule has been set for the appointment of the service representative.

7.2.4.2 Assign TRAIDEX Central Service Representatives

After a particular training command has selected its TRAIDEX representative, the director and representative meet at the Training Command Headquarters to initiate that service's TRAIDEX involvement. At least the following tasks should be accomplished at that meeting:

1) Identify initial development sites to be contacted for TRAIDEX set-up.

2) Start preparation of development site briefing to be given by director and service representative. This briefing must include information on how the development site will select the local TRAIDEX Interface, what the local site requirements will be for data input,courseware storage and retrieval, and what resources can be made available by the service training command headquarters.

3) Establish an initial cut at the course screening requirements for the service. This should take into account the first development sites to be visited, so that any special local requirements can be addressed prior to the local briefing.

4) Identify the training command headquarters liaison to TRAIDEX, and establish his (relatively limited) duties, which will include monitoring of the screening reports for that service.

5) Identify high quality, well described courseware for entry into the initial demonstration database, and initiate procedures to obtain this material and and its supporting documentation for shipment to TRAIDEX Central.

The TRAIDEX service representative will be responsible for preparing the development site briefing, making initial contact with the selected sites, and arranging the first briefing at each development site. Note that it is not necessary for the new service representative to relocate immediately to TRAIDEX Central; however, he should plan to move there by the time the first development site in his service is using TRAIDEX.

7.2.4.3 Make Initial Development Site Contacts

These are the final external activities in Phase I, and consist of a briefing by the TRAIDEX Central director and the appropriate service representative to the commanding officer and curriculum review staff at the selected course development sites. This briefing is preceded by written and phone contact to the site by both the service representative and the training command headquarters, outlining the purpose of the briefing and emphasizing headquarters support for the system.

The initial site briefings should be low profile and non-threatening, and should spell out the support that will be provided from both headquarters and TRAIDEX Central for the installation of a TRAIDEX capability at the site. The briefing should clearly convey the required qualifications of the TRAIDEX Interface, and the director should obtain agreement on a reasonable schedule for local TRAIDEX Interface designation. This briefing should make it clear that a prime qualification of the TRAIDEX Interface appointee be that the functions of review of course unit content (media, method) and description (objectives) be a part of his normal function, and that the responsibilities of developer review and assistance already be a part of his normal duties. In this way, the existence of TRAIDEX will be seen to be a tool to assist the Interface rather than an additional burden on his time.

It may also be appropriate for the service representative to spend some extra time at the site evaluating locally developed courseware candidates for entry into the initial demonstration database, and investigating the local courseware storage and distribution situation.

7.2.5 TRAIDEX Central Activities

The activities in this section can take place in parallel with the external activities described in subsection 7.2.4. While the details of these tasks will be defined by the initial schedule as described in subsection 7.2.3, the key items that must be accomplished are summarized below.

7.2.5.1 Set Up TRAIDEX Central Office

The TRAIDEX systems analyst must translate the functional requirements and the TRAIDEX Design Model defined in Section 5 into the detailed files and procedures that must be handled by the TRAIDEX Central Office staff. This task includes the definition of the order status files required to track courseware shipment requests, the set-up of chronological correspondence files, the definition of the paperwork to be sent along with course unit orders (including an appropriate courseware reuse questionnaire), and so on. Since the TRAIDEX director will be spending a great deal of time in Phase I "on the road", the analyst will also be responsible for coordinating the details of setting up physical office space, equipment, and local terminal interfaces to the INFOCEN computer.

7.2.5.2 Set Up Operational Software

An important job of the analyst will be to work with INFOCEN technical support personnel to establish the detailed design of the unit description database, to set up the initial loading and updating procedures, to establish the required accounting and security procedures, and to insure that the INFOCEN system will be ready to accept the initial demonstration database load and will be available to serve as demonstration tool for TRAIDEX Interface training. Two important tasks that must be accomplished during this activity are:

1) The investigation of the functional characteristics of available on-line text editors to be used for unit description database entry input and modification. The candidates to be evaluted include the INFOCEN text editing software, and independent editors such as WYLBUR.

2) The identification and specification of any required data collection points in the TRAIDEX access software that will be required to monitor TRAIDEX system usage, including identification of the users who send or receive TRAIDEX data, number of search requests per user, size of the database, and so on.

7.2.5.3 Build Initial Demonstration Database

The final TRAIDEX Central activity to be accomplished during Phase I is the loading of the demonstration database and construction of the initial TRAIDEX system thesaurus. This activity depends both upon the operational software set up work described in Section 7.2.5.2 and on receipt of the "model" courseware and descriptions received from the TRAIDEX director, the service representatives, and as a result of initial contacts with the development sites. The TRAIDEX system analyst and the service representatives will format the unit description database entries, construct an initial thesaurus of descriptive terms, and load the demonstration database into the INFOCEN system.

7.3 Phase II - Operational Startup

This phase begins with the appointment and training of the TRAIDEX Interfaces at the initial development sites and covers the activities required to make the local development sites effective users of TRAIDEX as inquirers, providers of data, and shippers of course units to requesters at other sites. Subsection 7.3.1 describes the activities that will take place at the development sites, while Subsection 7.3.2 covers the tasks that must be accomplished at TRAIDEX Central.

7.3.1 Install TRAIDEX Capability at Course Development Sites

7.3.1.1 Establish TRAIDEX Interface

After the initial development site briefings described in subsection 7.2.4.3, the appropriate TRAIDEX Central service representatives should monitor the site to ensure that the local TRAIDEX Interface is selected

according to the agreed-upon schedule. In the meantime, the installation of a terminal should be coordinated through the TRAIDEX Central systems analyst.

7.3.1.2 Train TRAIDEX Interface

As each development site informs TRAIDEX Central that it has assigned its TRAIDEX Interface, the TRAIDEX Central Director and the appropriate service representative schedule a second site visit. The purpose of this week-long session is to familiarize the new TRAIDEX Interface with the TRAIDEX facility and its operation, to teach him the details of accessing the INFOCEN system, and in general to get the local TRAIDEX operation off to a good start. The tasks that will be performed during this training and orientation session are as follows:

1) Assist the local TRAIDEX Interface in the preparation and delivery of briefings to the local course developers. TRAIDEX Central should provide general visual aids and assistance with preparation and tailoring of the narrative to local development subjects and problem areas.

2) Train the new Interface to use the INFOCEN system by helping him develop a suitable demonstration of the system's capabilities. This "demo" should be made a part of the briefing to developers, and should include access and display of TRAIDEX database elements and possibly use of ADIT, DAVA, and CANTRAC, if appropriate. The demonstration session should be carefully tailored to appeal to the interests of local developers, and the TRAIDEX director and service representative should take care to insure that the TRAIDEX Interface is obtaining a good grasp of the fundamentals of data search and retrieval.

After the initial Training sessions and briefings have taken place, the TRAIDEX Central director will leave the service representative to spend the remainder of the week establishing a preliminary schedule for courseware loading, setting up a brief training session for data entry clerical personnel, and establishing the local course screening procedures and courseware inventory methods. The service representative should also obtain any locally developed courseware appropriate for indexing by TRAIDEX Central for inclusion in the kernel demonstration database.

At this point, the local development site should be prepared to be an active TRAIDEX inquirer and should have a firm schedule for providing locally developed courseware descriptions. In addition, the service representative should have a sufficiently detailed picture of the local site's plans that he can predict that site's input rates for building the database and its likely inquiry usage. It will be necessary to monitor the local site's activity to insure that TRAIDEX in fact remains "alive and well" at the development site after the TRAIDEX Central representatives have completed the installation.

7.3.2 Control Operational Start-up at TRAIDEX Central

7.3.2.1 Set Up Material Distribution Procedures

As TRAIDEX begins to operate, courses are entered and inquiries made, this activity will begin to produce a small number of requests for course material. These early requests for material must be used to set up and test workable material distribution and monitoring procedures at TRAIDEX Central. During the field review of the Concepts of Operation part of the study, it became clear that these manual procedures would be critical to the success of TRAIDEX, since a course developer would be easily discouraged from using TRAIDEX if material, when ordered, never arrived.

7.3.2.2 Control Database Load

As local course development sites begin to submit course unit descriptions to be placed in the TRAIDEX unit description database, the analyst and service representatives will have to be particularly careful to closely edit the unit descriptions for appropriate keyword assignment, format and completeness of descriptions and so on. Interaction with the TRAIDEX Interface personnel who are responsible for the submission of material from each site should be carefully handled and should always be done in a constructive and non-threatening manner.

In addition, the rate of input for new unit descriptions and the rate of TRAIDEX inquiry usage at each site should be monitored for conformance to the schedule established during the TRAIDEX installation visit.

This is particularly critical for the first course unit descriptions submitted, since slippages may indicate operational problems which, if not corrected early, may severely damage TRAIDEX's credibility at the site.

7.3.2.3 Monitor Course Screening

Particular attention must be paid to the early course screening reports from new course development sites in order to insure that the ITRO selection policy and specific service guidelines are being accurately followed. It will be very important to be sure that course units are not being "screened out" for reasons that are incompatible with TRAIDEX requirements.

7.4 Operational Cutover

After approximately half of the course development sites have been brought on line with trained TRAIDEX Interfaces, the TRAIDEX Central staff should make brief follow-up visits to each installed site to straighten out any outstanding data entry, inquiry, or unit distribution problems. After making any required adjustments in screening, entry, searching, or ordering procedures and seeing that these changes are reflected not only in the standing TRAIDEX operational regulations but in the TRAIDEX Interface briefings and training programs, the general availability of TRAIDEX should be announced, and the remaining sites brought on line.

An important part of the ongoing operation of the TRAIDEX system will consist of the evaluation of its usefulness to the user community. This evaluation will consist both of quantitative measures of the number of new and redeveloped course units that use course units located through TRAIDEX as primary source material, and qualitative judgments obtained from development site staff, TRAIDEX interface personnel and course developers by TRAIDEX Central service representatives.

Appendix A

COURSE DEVELOPMENT SITES

There are 35 Course Development Sites that are expected to use the TRAIDEX database to locate potentially shareable course units and to supply course units to the TRAIDEX database. These sites are listed with appropriate notes in Exhibit A-1.

There are 22 Army sites that are expected to use TRAIDEX since they perform some technical training development, although that is not their principal function. Not included in these are DoD-wide schools such as the Defense Intelligence School, Washington, D. C., and schools believed to have specialized course development responsibilities such as the Judge Advocate General's School at the University of Virginia.

The Air Force teaches the same course at several sites but the course development is done at only one site for the schools teaching that course. Therefore, there are only 7 Air Force course development sites shown on Exhibit A-1 although training takes place at some 18 locations. There are six Navy Training Centers listed in Exhibit A-1. While not all of the course development sites are expected to use TRAIDEX immediately, it is expected that 70% of the developers will have access to the TRAIDEX system by the end of the first year. This will be accomplished by selecting the larger development sites for the installation of TRAIDEX capability in the first year, so that less than half the sites need actually be using TRAIDEX in order to reach 70% of the developers.

The expected pattern of the build up of sites on the TRAIDEX system by year and the resulting percentage of the courses and developers covered in those years is given in Exhibit A-2. The first year shows TRAIDEX capability installed at 12 sites. The critical issue with regard to TRAIDEX success is not whether this number is 12 or 20 but whether an average of 70% of the course developers have access to TRAIDEX during the second year.

Exhibit A-1

LIST OF COURSE DEVELOPMENT SITES
WHICH ARE EXPECTED TO USE TRAIDEX

	Note
ARMY:	
U. S. Army Air Defense School, Ft. Bliss, TX 79916 El Paso, Texas	4
U. S. Army Armor School, Ft. Knox, KY 40121 Louisville, Kentucky	4
U. S. Army Aviation School, Ft. Rucker, AL 36360 Ozark, Alabama	4
U. S. Army Command and General Staff College, Ft. Leavenworth, KS 66027 Leavenworth, Kansas	4
U. S. Army Engineer School, Ft. Belvoir, VA 22060 Newington, Virginia	4
U. S. Army Field Artillery School, Ft. Sill, OK 73503 Ft. Sill, Oklahoma	4
U. S. Army Infantry School, Ft. Benning, GA 31905 Columbus, Georgia	4
U. S. Army Institute of Administration, Ft. Benjamin Harrison, IN 46216 Indianapolis, Indiana	
U. S. Army Institute for Military Assistance, Ft. Bragg, NC 28307 Fayetteville, North Carolina	
U. S. Army Intelligence Center and School, Ft. Huachuca, AZ 85613 Tucson, Arizona	4
U. S. Army Logistics Management Center, Ft. Lee, VA 23801 Petersburg, Virginia	2, 4
U. S. Army Military Police School, Ft. McClellan AL 36201 Anniston, Alabama	1, 4
U. S. Army Missile and Munitions Center and School, Redstone Arsenal, AL 35809 Huntsville, Alabama	3, 4

Exhibit A-1 (Continued)

LIST OF COURSE DEVELOPMENT SITES

WHICH ARE EXPECTED TO USE TRAIDEX

	Note
ARMY: (Continued)	
U. S. Army Ordnance Center and School, Aberdeen Proving Ground, MD 21005 Aberdeen, Maryland	4
U. S. Army Quartermaster School, Ft. Lee, VA 23801 Petersburg, Virginia	2, 4
U. S. Army Security Agency School, Ft. Devens, MA 01433 Ayer, Massachusetts	4
U. S. Army Sergeants Major Academy, Ft. Blixx, TX 79918 El Paso, Texas	4
U. S. Army Signal School, Ft. Gordon, GA 30905 Augusta, Georgia	4
U. S. Army Transportation School, Ft. Eustis, VA 23604 Lee Hall, Virginia	3
U. S. Army War College, Carlisle Barracks, PA 17013 Harrisburg, Pennsylvania	4
U. S. Military Academy, West Point, NY 10996 West Point, New York	4
U. S. Women's Army Corps School, Ft. McClellan, AL 36201 Anniston, Alabama	1, 4
NAVY:	
Chief of Naval Education and Training Support, Pensacola, FLA 32509	3
Chief of Naval Technical Training, Naval Education and Training Support Detachment, Naval Air Station Memphis, Millington, TN 38054	4
Naval Education and Training Support Center, San Diego CA 92106	3

Exhibit A-1 (Continued)

LIST OF COURSE DEVELOPMENT SITES
WHICH ARE EXPECTED TO USE TRAIDEX

	Note
NAVY: (Continued)	
Naval Education and Training Support Center, Norfolk, VA 23511	4
Naval Education and Training Support Detachment Naval Training Center, Great Lakes, IL 60088	4
Naval Training Equipment Center, Orlando, FLA 32813	3
AIR FORCE:	
Chanute AFB, IL 61866 Rantoul, Illinois	4
Keesler AFB, MS 39534 Biloxi, Mississippi	4
Lackland AFB, TX 68236 San Antonio, Texas	4
Lowry AFB, CO 80230 Denver, Colorado	4
Mather AFB, CA 95655 Sacramento, California	4
Randolph AFB, TX 78148 San Antonio, Texas	3
Sheppard AFB, TX 76311 Wichita Falls, Texas	4

Explanation of Notes on right margin:

1. One terminal is to be placed at Ft. McClellan to retrieve information on Audio Visual material from the DAVA system. This terminal is to be used for both the Military Police School and the Women's Army Corps School course developers. This terminal is considered to be usable for TRAIDEX retrievals by both schools.

2. One terminal is to be placed at Ft. Lee for use with the DAVA Audio Visual Materials System. This terminal will be used by both the Logistics Management Center and the Army Quartermaster School. This terminal is considered to be usable by both schools for TRAIDEX retrievals.

Exhibit A-1 (Continued)

LIST OF COURSE DEVELOPMENT SITES
WHICH ARE EXPECTED TO USE TRAIDEX

Explanation of Notes on right margin: (Continued)

3. These sites have Defense Audio Visual Archive (DAVA) terminals at the time of this report.

4. Terminals for use with the DAVA system are expected to be installed at these locations prior to the beginning of the 1979 Fiscal Year. These terminals will be available for use with the TRAIDEX system.

Exhibit A-2

PLANNED BUILD UP OF THE NUMBER OF COURSE DEVELOPMENT SITES USING TRAIDEX OVER THE FIRST FIVE YEARS OF TRAIDEX OPERATION

Item	Year of TRAIDEX Operation				
	1	2	3	4	5
The number of Development Sites with access to TRAIDEX at year end	12	25	30	35	35
The average percentage for that year of course developers with access to TRAIDEX*	small but not zero	70	90	95	100

*The number of courses for which a site is responsible is assumed to be proportional to the number of developers at that site.

Appendix B

TRAIDEX CENTRAL STAFFING

B.1 Staffing Requirements

The two criteria for staffing TRAIDEX Central are as follows: first, the staff must be capable of performing the functions described in the functional design model (as specified in Section 5) that are shown to be done by TRAIDEX Central, and must be capable of executing the planning and integration functions described in Section 7. Second, the personnel at TRAIDEX Central will be expected to make TRAIDEX a success at the development sites by their enthusiasm and quick response to problems. The staff must therefore be able to do their prescribed work and to gain the confidence of the TRAIDEX Interfaces, developers, and development site staff as well. The on-going operation and the first year start-up needs will be best served by staffing TRAIDEX Central with at least one uniformed representative from each service who has had some course development experience. These service representatives will go to each development site in their respective service when the initial briefings are given, when the TRAIDEX Interface is trained and on the follow-up visits. They will also participate in the course selection rules meetings (Activity A115 in the functional model) and in solving distribution problems (Activity A41). Their primary function during the on-going operation of TRAIDEX will be to encourage use of TRAIDEX and help in course material searches (Activity A35).

The TRAIDEX system will require the services of a full-time director during the first year of its setup and operation. In subsequent years this director might also be responsible for other training assistance systems which would be co-located with TRAIDEX Central. During the first year, the director will participate in all the Training Command Briefings and in selected Development Site briefings. He should be seen at the development sites on at least one of the subsequent visits during the startup year.

In the following years the director will visit the development sites as needed but probably not less than every two years. His primary function is to insure a smooth operation of TRAIDEX Central and to direct the service representatives in their dealings with the individual development sites.

In addition to the TRAIDEX Director and the three service representatives, a secretary will be needed to handle normal correspondence and to manage the course material order and shipment function, including the maintenance of order status files. The study team has avoided estimating the number of course material shipment orders that will result from the TRAIDEX system because of a lack of clear feelings in the training community of the volume of course material sharing to expect. It is not possible to know the work load involved in this filing but while additional clerical help may be needed, it should not be added until the need is demonstrated by actual order volume.

Computer related staffing should be kept to a minimum, and a permanent programming staff is not needed. Although some reports will be required, these reports should be produced using standard report generation facilities where possible and should be set up by part-time or borrowed personnel from INFOCEN or by a contractor. It might be possible to arrange a standing contract with a systems and program service that can be called upon as needed. In this way the programming service would be available when needed but each report would have to be clearly cost justified.

While a full-time programming staff is not needed, it will be necessary to have available during the first year manpower and skills, possibly supplied by a contractor for setting up the database and the course unit description entries. In addition toward the end of the first year and subsequently, a run coordinator will be needed to supervise the database updates and prepare special runs such as those required for backup and recovery. If borrowing or contracting for report programming is not acceptable, this position could be upgraded to be a programmer or analyst. Exhibit B-1 gives a summary of the personnel needed in the first and continuing years at TRAIDEX Central.

Exhibit B-1

SUMMARY OF POSITIONS NEEDED AT TRAIDEX CENTRAL

Position	Primary Functions
TRAIDEX Director	Assure the smooth operation of TRAIDEX Central and supervise the Development Site assistance being given by the Service Representatives.
One representative from each Service	Assist the TRAIDEX Interfaces with course material searches, solve course material material distribution problems, participate in the course selection rules meetings, and visit sites twice yearly.
Secretary	Type correspondence, maintain order status file, distribute orders for course material to the correct distribution point when a request to ship is received, and follow-up on orders.
Run coordinator	Prepare database update runs using material entered at the development sites and at TRAIDEX Central, maintain the database integrity, draw reports as needed.

Total full-time people at TRAIDEX Central = 6

B.2 Staffing Alternatives

These TRAIDEX Central functions can be provided in two ways. First, TRAIDEX Central can become part of an existing (or proposed) organization which has similar needs to deal with the training community across the three services. This approach corresponds to costing alternative 1 described in Section 6.4.2. Second, TRAIDEX Central can be a stand-alone organization with responsibility only for running TRAIDEX and making it a success, corresponding to alternatives 2 and 3. The staffing costs for these two alternatives are given in Exhibits B-2 and B-3. The first alternative is obviously less costly if the trips concerning TRAIDEX and trips of the existing organization are to the same development sites and the existing work is with the same people who would use TRAIDEX at those sites. Further, some expertise sharing could be realized if the computer and software facilities were essentially the same. If the objective of the existing organization was to assist the course developers in reducing course development effort, then there is not likely to be a conflict of interest between the existing organization's work and the work needed to make TRAIDEX a success. However, potential cost savings gained by having TRAIDEX operated by another organization might be more than offset by the fact that its impact and effectiveness would be somewhat less than that of a stand-alone operation.

The DAVA (Defense Audio-visual Archive) organization has been selected as the candidate organization which might absorb the TRAIDEX Central functions. Their staff contains one or more representatives from each of the three Services. They have established offices and are using the INFOCEN database facility for the DAVA database. DAVA personnel often travel to the service's course development sites to train course developers and others in the use of the DAVA system for sharing Audio Visual Material. However, DAVA, being a DoD-level function, is not perceived as having as its main objective the reduction of course development effort.

A representative of the DAVA organization was interviewed by the study team to determine the incremental costs that he felt would be needed to absorb TRAIDEX and provide the first year introduction of TRAIDEX. These costs are shown in Exhibit B-2.

One clerical person and one systems analyst are the minimum, full-time personnel needed over and above the existing DAVA staff. The provision for initial database and procedures setup is the same for both staffing alternatives as is the provision for part-time clerical help to create the demonstration database.

The Travel estimates for the TRAIDEX Central staff shown on Exhibit B-2 were obtained by estimating the travel needs of a stand-alone organization (that shown on Exhibit B-3) and then assuming that half of that travel could be shared with existing travel needs in the DAVA organization. The TRAIDEX Central staff Travel estimates for a stand-alone organization uses $300 per trip. The number of trips is estimated assuming that two people will make three trips to each development site coming on-line in that year (see Appendix A, Exhibit A-2). In addition, $5000 for other travel is estimated in years 1 through 4. In years 3 and 4 one person is assumed to return to each of the sites already on-line from previous years and in year 5 two persons are assumed to travel to each site once during the year. The travel for the ITRO coordinating committee is the same for both alternatives (Exhibit B-2 and B-3). This travel is expected to be a TRAIDEX Central cost because it was felt among the training representatives consulted, that proper and supportive oversight of the TRAIDEX operation would not occur if each committee member was required to obtain travel money for work not essential to his respective local organization. This coordinating committee is the primary means of providing the policy direction shown as "Policies on the A0 diagram in the functional model. The Committee is assumed to meet four times per year. Invitational orders are to be issued for six service representatives, two from each service, and one other person. This amounts to 28 trips at $300 each or about $8,00 per year.

Exhibit B-2

INCREMENTAL STAFFING COSTS ASSOCIATED WITH ABSORBING THE TRAIDEX CENTRAL WORK LOAD INTO THE DAVA ORGANIZATION

Costing Alternative 1

Item	Year 1	2	3	4	5
One clerical person for work as described in Exhibit B-1	$ 20,000*	← Same →			
One systems analyst, to fill the role of run co-ordinator and programmer	$ 20,000*	← Same →			
Initial database and procedure setup (probably contracted)	$ 50,000	0	0	0	0
Part-time clerical help for load of demonstration and initial databases	$ 10,000	0	0	0	0
Travel:					
TRAIDEX Central Staff	$ 14,000	$14,000	$11,000	$11,000	$10,000
Coordinating Committee	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Total TRAIDEX Central staffing and travel costs	$122,000	$62,000	$59,000	$59,000	$58,000

TRAIDEX Central Staffing costs for first 5 years of operation = $360,000

*The average costs of persons on the staff is taken as $20,000 per year.

Exhibit B-3

STAFFING COSTS ASSOCIATED WITH A STAND-ALONE TRAIDEX CENTRAL ORGANIZATION

Costing Alternative 2

Item	Year				
	1	2	3	4	5
Six full-time persons as shown in Exhibit B-1	$ 88,000*	$120,000	$120,000	$120,000	$120,000
Initial database and procedure setup (probably contracted)	$ 50,000	0	0	0	0
Part-time clerical help for load of demonstration and initial databases	$ 10,000	0	0	0	0
Travel:					
TRAIDEX Central Staff	$ 27,000	$ 28,000	$ 22,000	$ 22,000	$ 21,000
Supervisory Committee	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Total TRAIDEX Central and staffing costs	$183,000	$156,000	$150,000	$150,000	$149,000

TRAIDEX Central Staffing costs for first 5 years of operation = $788,000

*The average costs of a staff member per year is $20,000. In the first year, three quarters of the costs are assumed because of inevitable delays in staffing these positions.

Appendix C

TRAIDEX CENTRAL OFFICE FACILITIES

Office facilities may be provided for the exclusive use of persons responsible for TRAIDEX or, like people and travel, be shared with an existing (or proposed) organization.

The DAVA (Defense Audio Visual Archive) organization is the candidate organization selected for evaluating the TRAIDEX Central costs for the case where TRAIDEX Central is merged with an existing organization. This approach corresponds to costing Alternative 1 discussed in Section 6.4.2. A representative of the DAVA organization was consulted and given that under this costing alternative only two additional people are planned, he could not identify any additional costs for office facilities over those already available for DAVA use. While using zero incremental costs for office facilities seems optimistic, the costs of providing all TRAIDEX Central office facilities shown in Exhibit C-1 is only $15,000 per year. Therefore, any error in this incremental cost estimate will not be significant in the overall costs of TRAIDEX. The incremental office facilities cost for costing alternative 1 is therefore estimated to be zero.

The costs of providing stand-alone office facilities is given in Exhibit C-1. This corresponds to costing alternatives 2 and 3 discussed in Section 6.4.2 and with the staffing for those alternatives given in Appendix B. The yearly costs of providing TRAIDEX Central stand-alone office facilities is estimated at $15,000 and the first 5 years of operation are estimated to cost $75,000 in total.

Exhibit C-1

TRAIDEX CENTRAL OFFICE SPACE AND EQUIPMENT

Item	Initial Purchase costs	OR	Yearly Lease
5 desks for the director, the service representatives, and the run coordinator	$2,000		$ 480
2 clerical desks (one extra for first year data entry clerk part time)	$ 800		$ 192
5 five-drawer file cabinets (3 for ordering information and 2 for status file and other)	$ 800		$ 192
1 desk for first year contractor or systems analyst	$ 400		$ 96
2 typewriters	$1,600		$ 384
copier with supplies	-		$ 1,800
Telephones	-		$ 2,400
Supplies	-		$ 1,000
1080 square feet of office space including an 8x10 room for storage of mailables and terminal use	-		$ 7,236
Other	-		$ 1,220
Total yearly costs of office space and equipment			$15,000 *

* The yearly lease costs are used for costs estimating since all space and equipment is likely to be leased from some military service or DoD agency. Lease costs are computed at 2% of the purchase costs per month for items shown above with initial purchase costs.

Appendix D

TRAIDEX COMPUTER AND TELECOMMUNICATION COSTS ESTIMATES

Computer and telecommunication costs are made up of the following elements:

- Costs to bu[illegible]minals for use by the TRAIDEX Interface at [illegible] development sites and for use by the TRAIDEX Central Staff.
- Telecommunication line charges to connect these terminals to the computer housing the TRAIDEX database.
- Computer costs associated with connecting these terminals to the computer.
- Computer time needed to search the database.
- Costs of storage to maintain the database on-line and available for immediate access.
- Costs associated with updating the database.

The basis for estimating the cost of each element is explained below. The estimates for each cost element for the first 5 years of TRAIDEX operation are given in Exhibits D-3a and b, corresponding to the two costing alternatives discussed in Section 6.

Telecommunication Terminals

The terminals needed are commonly available for use with commercial time sharing systems and operate at 15 or 30 characters/second. Faster terminals are not required since the volume of material to be printed at the development site is not expected to be large. For example, the response to a typical successful search request should consist of ten or fewer course unit descriptions, comprising about three pages of printed output. Also, the higher speed terminals require more costly telecommunication lines. While existing video terminals should be used if they are already available at the development site, it is not recommended that new video terminals be purchased for this application unless hard copy attachments are also provided because reference to hard copy after the terminal session is likely to be important when the TRAIDEX Interface is conferring with the course developer.

A highly portable terminal that would provide adequate hard copy, is light,and can be used on the desk of the TRAIDEX Interface is made by Computer Devices, Inc. It can be connected to a standard telephone handset and requires no special installation. When there is more than one TRAIDEX Interface at a site, this terminal could be used by persons in separate buildings since it is highly portable. The CDI Terminal costs $3,100 and rents for $119/month.

A less portable terminal such as the Anderson Jacobson is better than the CDI for extensive input and editing work. It has a longer carriage, uses an impact printer that produces better hard copy, and may be used efficiently by an experienced typist. It is mounted on a stand with rollers, and can be rolled from office to office but is not easily moved from building to building. This type of terminal is as noisy as a typewriter and should not be used in locations where it would disturb others. This terminal also connects to a standard telephone without special installation, costs $4,274, and rents for $185/month.

Terminals originally purchased or placed at the development site for other purposes probably could be used for TRAIDEX. For example, six of the development sites listed in Exhibit A-1 now have terminals for use with the DAVA (Defense Audio Visual Archive) system. These terminals may be used to access the TRAIDEX database. In fact, all but two of the sites listed are planned to have DAVA terminals by fiscal year 1979.

For the purposes of estimating the costs of purchasing terminals, $4,000 per terminal has been used.

Costing Alternative 1 takes maximum advantage of any existing or planned terminals that will be available at the development sites. There are only two development sites listed in Exhibit A-1 that will not have a terminal available. These two sites are assumed to be in the last group of sites brought on to TRAIDEX, and $8,000 is shown in the fourth year for purchase of their terminals.

Costing Alternative 2 takes no advantage of the existing DAVA organization for TRAIDEX Central needs. Without co-location of the DAVA

and TRAIDEX Central offices, the cost of two terminals for staff use must be borne in the first year. Due to the relatively large input requirements the more elaborate terminals will be needed and the estimated cost in the first year is $10,000. In addition, the costs of all terminals used at the development sites must be included, since terminals that were purchased for use with other systems are to be used for connection to the TRAIDEX database. The cost of purchasing these terminals is spread over the first five years of TRAIDEX operation according to the plan for bringing course development sites onto TRAIDEX shown in Exhibit A-2, Appendix A. The average cost of these terminals is $4,000.

Telecommunication Line Charges

It is recommended that one of the Packet Switching Networks described in Exhibit D-1 be used to connect the terminals at the Development Site to the TRAIDEX Central database. The costs of these networks is very low compared to long distance voice telephone charges and the user is charged only for time used regardless of distance from the development site to the computer handling the TRAIDEX database. The terminal and packet network operates in the following way:

> The lines will appear to the TRAIDEX Interface to be dial-up switched network lines similar to those used for voice telephone. However, rather than basing the charges on AT&T long-distance voice rates, a computer switched private network will actually be used. This network appears as a local phone number in 55 cities. The terminal user simply dials this local number on his desk telephone, places the handset in the cradle provided as part of the terminal and he is ready to use TRAIDEX. His terminal is connected to the TRAIDEX computer via the private network behind this local number.

Charges for packet switching services were obtained from two companies providing this service. These estimates are given in Exhibit D-1:

It should be noted that the local telephone number will be in one of the 53 cities shown below. Line charges to one of these cities are not included in the line charges shown in Exhibit D-1. These local or long-distance charges can be eliminated if the development site maintains tie lines to one of these major cities, or they can be considerably reduced by purchasing a private line to one of the 53 cities. The list of cities for the Tymnet network is given below.

TYMNET Services is Available in These Cities

The locations currently being served by TYMNET are as follows: (Those with an asterisk are planned for future installation.)

Alabama
*Birmingham

Arizona
Phoenix

California
Inglewood
Los Angeles
Oakland
Orange County
Oxnard
Palo Alto
Riverside
Sacramento
San Diego
San Francisco
San Jose

Connecticut
Darien
Hartford

Colorado
Denver

District of Columbia
Washington

Florida
*Miami
St. Petersburg

Georgia
Atlanta

Illinois
Chicago
Freeport

Iowa
*Des Moines

Kansas
*Wichita

Louisiana
Baton Rouge
New Orleans

Maryland
Baltimore

Massachusetts
Boston

Michigan
Detroit

Minnesota
Minneapolis

Missouri
Kansas City
St. Louis

New Jersey
Englewood Cliffs
Union

New York
Buffalo
New York City
Rochester
Syracuse

North Carolina
Chapel Hill
Durham
Raleigh

Ohio
*Cincinnati
*Cleveland
Columbus

Oklahoma
Oklahoma City

Oregon
Portland

Pennsylvania
Philadelphia
Pittsburgh

Texas
Dallas
Houston
Midland
San Antonio

Utah
*Salt Lake City

Washington
Seattle

Wisconsin
Milwaukee

Exhibit D-1

LINE CHARGES FOR TWO COMMONLY AVAILABLE PACKET SWITCHING NETWORKS

Item	TYMNET	TELENET
Basic line charges:		
• major metropolitan areas	$1.00/hr	$1.40/hr
• other metropolitan areas (1)	$4.00/hr	$2.40/hr
Character transmission charges	$0.10/1000 chars	$0.60/1000 packets (packet equals a line)
Estimated char rate	$1.00/hr	$1.00/hr
Rate for estimating purposes	$3.00/hr (2)	

Notes:

(1) The terminal user must make a local or long-distance (regular voice network) telephone call to the node nearest his terminal. By December 1976, there will be 42 nodes for the TELENET Network and 55 nodes planned for the TYMNET network. The major metropolitan rates apply to: San Francisco, New York, Los Angeles, Washington, D.C., Chicago, Boston, Detroit, and Philadelphia.

(2) When large-volume contracts exist and the line charges for TRAIDEX can be placed within this existing contract, a lower rate can be obtained. The TRAIDEX System could operate within the existing contract between TYMNET and the National Library of Medicine. The DAVA System uses this contract and they have experienced charges of $2.50 to $3.00 per hour. The rates without this contract ride are estimated to be no more than $4.00 per hour.

The line charge estimate is the product of the estimated rate given in Exhibit D-1, $3.00 per hour, and the estimated number of hours per year of terminal connect time. The terminal connect time is estimated as follows:

1) Each time a course is developed or revised that contains subject matter for TRAIDEX sharing, this course development or revision is assumed to generate TRAIDEX inquiry activity. Because not all course units are revised during the review, it is further assumed that there will be one inquiry for every two units. From Exhibit 1, 29,200 course units could be expected to be revised or developed per year. Thus, the number of inquiries for course unit material is assumed at about 14,600 per year. While this may seem high, the total course development effort in the three services exceeds 4,000 manyears per year. If half of these manyears are spent on courses of interest to TRAIDEX, then these 2000 manyears would revise or develop about 7 course units per manyear. This does not seem to be too high a rate of development and revision.

2) Each course with subject matter of interest to TRAIDEX that is revised or developed will be loaded at the development site mostly during the years 2 through 4. All course units of courses being revised are entered initially. Thereafter, only revised units are entered. The data entry load for new and revised courses is 29,200 course units per year during years when whole courses are being entered and half of this or 14,600 units per year thereafter.

3) Ten course unit descriptions printed at the development site terminal will take about 6 minutes. While some searches will require many iterations, some will be very simple and require little interactive time. After

getting some experience with making inquiries, the TRAIDEX Interface is not likely to take more than 1 hour of terminal time on even the most difficult inquiry, yet even the simplest inquiry will probably require 15 minutes of terminal time. The study team decided to assume 30 minutes per inquiry after subjectively evaluating these factors.

4) The data entry rate for new and revised course units was estimated by assuming that the material for single course units would be entered on a low-volume, irregular basis by an experienced typist. SofTech Programming Secretaries who enter programs and program corrections into online database systems were consulted, and taking the irregularity of the data entry into account, they estimated that each course unit would require about 30 minutes to enter, although this estimate would be smaller if the volume were higher and the arrival rate more regular. For terminal time estimates, 30 minutes will be allowed for each new or revised course unit entered.

The terminal and line time can be reduced by using cassette-equipped terminals which allow typing and editing of the input data off-line and transmission of the edited data at communication line speed (30 characters per second, or 4 to 6 times faster than typing speed). This option was not considered, however, since such terminals are more expensive and not as readily available. In the future, this possible cost savings could be considered.

The estimated terminal connect time for the first five years of TRAIDEX operation is given in Exhibit D-2. The connect time for the first year was estimated at 1/3 of that estimated for a year where all sites were on-line and the initial database build was still going on. The terminal time for each of the years 2 through 4 were estimated at 7,300 hours for inquiry and 14,600 for data entry if all sites were on-line. These estimates were modified in each year to reflect that only some of

the developers and courses will be exposed in these early years to TRAIDEX. The factors reflecting this correction are taken from Exhibit A-2, line 2, in Appendix A. The 5th year estimate contains the time needed to re-input those units revised in that year which had been entered in earlier years and the costs of entering course units missed in years 2 through 4 because of not having all sites on-line.

Exhibit D-2

ESTIMATED TERMINAL CONNECT TIME IN EACH OF THE FIRST FIVE YEARS OF TRAIDEX OPERATION

Item	Year 1	2	3	4	5
Connect time for inquiries (hours)	2433	5110	6570	6935	7300
Connect time for course unit description input (hours)	4867	10220	13140	13870	14033*
Total terminal connect time (hours)	7300	15330	19710	20805	21333

*The connect time for course unit description input drops to 7300 hours in year 6 and beyond.

Computer connection and time charges associated with terminal use

Charges associated with the INFOCEN facility at WPAFB will be used for cost estimating purposes.

The computer usage charges are based on two parameters. First, because each terminal actually connected to the computer uses some computer memory and some fraction of the telecommunication connection facility, the charge at INFOCEN for being connected to the computer is 3 cents per minute. Therefore, the terminal connect charges are $36,000 per year for a fully operational year. The second parameter affecting computer usage costs is the amount of computer processing time required to perform a database search; this cost is estimated at $10,000 for a fully

operational year. These dollar figures represent 35 development sites encompassing all the developers and all the course units in the current inventory. The build-up of sites, and therefore of the number of developers and courses exposed to TRAIDEX, is less than 100% in some years. The average percentage of the course units and developers exposed to TRAIDEX, in a given year is shown on line 2 of Exhibit A-2. This build-up is taken into account in the costs shown in Exhibit D-3a and 3b.

For costing Alternative 1, the first-year INFOCEN computer charges are absorbed by the DAVA organization. Otherwise, the computer time and connection charges are the same for both costing alternatives.

Costs to update the database

The costs to update the database are based on the number of characters of new data to be added to the database and the size of the database at the time of the update. The INFOCEN charges are $170 per million characters of new data to be added to the database and $10 per million characters of data already in the database. The database build up will occur as courses are reviewed. This review rate has been assumed to 1/3 of the course inventory each year. The build-up also includes the new courses developed in that year; however, not all of the courses being reviewed are reviewed at sites on-line to TRAIDEX. The estimates of database and update sizes resulting from the combination of these factors are shown in Exhibit 6-1, Section 6.

It is more expensive to update more often because the cost of each update has a fixed cost element that is dependent upon the database size. The study team decided to allow for one update per week so that material entered during one week by the development site would be visible in the database no more than one week later. This was felt to be necessary to maintain and encourage the course unit entry by the development sites. A database update more often does not seem to be cost justified, since the effectiveness of the database for finding course material is impaired by less than one percent when the update is delayed for a week. The update charges will be greatest in the 4th year. The database is expected

to reach 160 million characters in the 4th year (see Exhibit 6-1, Section 6 for build-up) and the number of characters to be added in the 4th year is 26 million. The 4th year update charges are estimated at $85,000.

For Costing Alternative 1, the first-year INFOCEN update charges are absorbed by the DAVA organization. Otherwise, the update costs for the both costing alternatives are the same.

Exhibit D-3a

SUMMARY OF COMPUTER RELATED COSTS

FOR COSTING ALTERNATIVE 1

Taking full advantage of existing DAVA organization and equipment

(In thousands of dollars)

Item	Year 1	2	3	4	5	5-Year Total
Telecommunication Costs:						
Terminal purchase costs:						
for development sites	0	0	0	8	0	8
for TRAIDEX Central	0	0	0	0	0	0
Line Charges	0	46	59	62	64	231
Total Telecommunication Costs	0	46	59	70	64	239
Computer Costs (INFOCEN):						
Connect time charge	0	18	24	25	16	83
Computing time charge	0	7	9	10	6	32
Data storage charges	0	22	47	78	96	243
Update charges:						
Update size charge	0	2	4	4	3	13
Database size charge	0	19	41	68	83	211
Total Computer Costs	0	68	125	185	204	582
Total Telecommunication and computer costs	0	114	184	185	268	821

Exhibit D-3b

SUMMARY OF COMPUTER RELATED COSTS

FOR COSTING ALTERNATIVE 3

A complete stand-alone TRAIDEX facility

(In thousands of dollars)

Item	Year 1	2	3	4	5	5-Year Total
Telecommunication Costs:						
Terminal purchase costs:						
for development sites	48	52	20	20	0	140
for TRAIDEX Central	10	0	0	0	0	10
Line Charges	22	46	59	62	64	253
Total Telecommunication Costs	80	98	79	82	64	403
Computer Costs (INFOCEN):						
Connect time charge	9	18	24	25	16	92
Computing time charge	5	7	9	10	6	37
Data storage charges	5	22	47	78	96	248
Update charges:						
Update size charge	1	2	4	4	3	14
Database size charge	4	19	41	68	83	215
Total Computer Costs	24	68	125	185	204	606
Total Telecommunication and computer costs	104	166	204	267	268	1009