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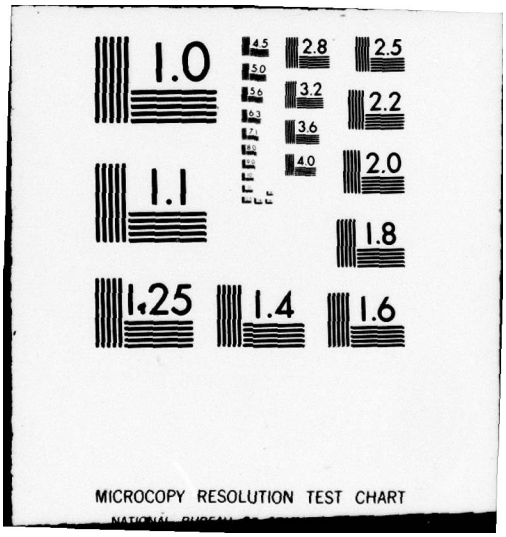
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Technical Report: NAVTRAEQUIPCEN IH-314

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PROBLEM ANALYSIS AND THE PROGRAM MASTER PLAN: KEY ELEMENTS IN THE INSTRUCTION SYSTEM DEVELOPMENT PROCESS

July 1979

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Technical Report NAVTRAEQUIPCEN IH-314

PROBLEM ANALYSIS AND THE PROGRAM MASTER PLAN: KEY ELEMENTS IN THE INSTRUCTION SYSTEM DEVELOPMENT PROCESS

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FINAL REPORT

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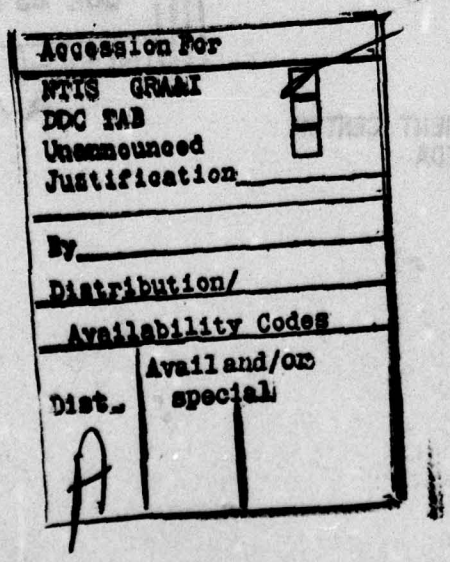

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Training systems evaluation is an important aspect of the instructional development process as it is carried out in Naval aviation. Whether applied to an existing training system in need or revision, or to a newly emerging weapon system in need of a complete training program, an evaluative process designated as problem analysis is conducted in order to determine the nature of the instructional development that will be required to produce a cost/effective training system. Thisreport describes the evaluative process from problem analysis through planning of the instructional development project, the major emphasis

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being concentrated on a description of the informational contents contained in the Problem Analysis Report, e.g., evaluations of training program goals, instructional organization, student population, student throughput, performance criteria, curricula, behavioral objectives, and instructional resources. This information constitutes a primary input to project planning and the resulting Program Master Plan, the instrument that directs and coordinates development of the revised or new training system. Consequently, a section of this report is devoted to the objectives of the program plan and their relationship to the contents of the problem analysis.

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SECTION I

INTRODUCTION

TRAINING SYSTEMS EVALUATION

Although the methodology that is now employed throughout Naval aviation for instructional systems development (ISD) has become sufficiently advanced to assume the integrated format of a systematic model, [1,2] the closely allied methodology of training systems evaluation has not been formulated comparably. Until recently, such evaluation was regarded as merely preparatory activities necessary to justify initiation of an ISD project. Experience gained through numerous applications of the ISD process, however, has clearly dispelled this view. It is now apparent that both the direction and scope of an ISD application depend heavily on the data, assessments, and plans that result from an appropriately conducted training system evaluation.

The training systems evaluation process developed at the Naval Training Equipment Center is currently required as a prerequisite to initiation of any ISD project. The process is divided into two main spheres of effort -- problem analysis and project planning. Each area of activity and its output is described generally in the introductory paragraphs that follow, and in greater detail in subsequent sections of this report.

OBJECTIVES OF PROBLEM ANALYSIS

While the extensiveness of any given problem analysis (PA) may vary according to the complexity and seriousness of the training problem it addresses, the overall purpose of the PA is always to establish an evaluative foundation upon which can be built a plan of action to solve a training problem. Whether solution of the problem requires remedial enhancement of an existing training program (TP), or original development of a new TP, it is the PA which provides the data-base and analytical framework that governs the specific direction taken.

Four primary PA objectives may be distinguished. They are:

a. To collect, organize, and analyze all factual information necessary to document the nature of the training problem, its origins, and the factors that sustain it.

b. To evaluate the training problem in terms of modern instructional systems development (ISD) methodology as a means of determining the training, managerial, and resource requirements that will be needed to carry out any new TP development or enhancement.

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1. _____ (October, 1977) "Training Requirements for Aviation Weapon Systems," NAVTRAEQUIPCEN Specification MIL-T-29053, draft.

2. Courseware, Inc. (June, 1977) "Fleet Aviation Instructional Systems Development Model", Courseware Technical Report, Vols. I-VII.

c. To access the feasibility of alternative approaches to solution of the training problem considering the resources available for TP development, implementation, and continued operation as compared with the constraints, costs, and utility inherent in each approach.

d. To anticipate problem areas and support requirements that are likely to arise at some future time during the life-cycle of the revised or newly developed training program.

PRELIMINARIES TO PROBLEM ANALYSIS

The events preceding initiation of a problem analysis must achieve three main goals:

a. Authentication of the existence of an identified training problem.

b. Justification of funding for the proposed problem analysis.

c. Establishment of lines of communication and responsibility among the major participants in the project.

The preliminary process may be initiated by the identification of a training problem existing within an on-going training program, or by the emergence of a new weapon system (or system component) which imposes training support requirements not present in the fleet.

Assuming the training problem arises within the context of an existing weapon system, the general flow of inputs and actions through the Navy hierarchy is as follows. After a training problem has been formally identified by a Navy command (squadron, wing, type commander (TYCOM), Chief Naval Operations (CNO), Naval Air Systems Command (NAVAIRSYSCOM), or a Navy laboratory), the usual procedure is for the CNO to task the TYCOM to conduct an Initial Problem Identification (IPI) and to prepare an IPI report. This report tentatively documents the nature, scope, and criticality of the problem. If a significant training problem (one which is likely to require a substantial expenditure of resources to analyze and correct) is found to exist, an Operational Requirement for Revision of Existing Training System (OR) is generated either by the CNO, NAVAIRSYSCOM, or NAVTRAEQUIPCEN. This OR serves as the basis for justifying the funding necessary to study the training problem in depth.

On approval of the OR by the CNO, he then tasks the NAVAIRSYSCOM to conduct a detailed Problem Analysis (PA) and to develop a Program Master (PMP). The TYCOM and NAVTRAEQUIPCEN are informed of this tasking so that they may prepare to participate fully in the effort. Eventually, NAVTRAEQUIPCEN is tasked to plan the PA and PMP, and communication begins among the various concerned Navy organizations and independent contractors. The ensuing communication system serves to inform the fleet participants of the nature of the PA, to delineate the respective roles of each participant in the PA effort, and to coordinate the resources necessary for the PA process.

Once the lines of communication have been established, a coordination meeting is scheduled for the participants. This corresponds in time with the completion of the Problem Analysis Plan Report by NAVTRAEQUIPCEN and its approval by NAVAIRSYSCOM. This plan will guide the management and coordination system necessary to carry out the PA. Also, by now the funding requirements for the PA will have been established and approved by NAVAIRSYSCOM. Collection of the data (usually by an independent contractor with expertise in instructional systems development) needed for an evaluation of the training problem is then begun. Upon completion of data collection and analysis, the complete Problem Analysis Report is prepared and submitted to NAVAIRSYSCOM for review.

OVERVIEW OF THE PROBLEM ANALYSIS PROCESS

The extensiveness of the PA process is largely determined by the nature of the training program (TP), if one exists, in which the problem of concern has arisen. That the PA process should be keyed more directly to the program than to the problem is but an extension of the principles implicit in a system approach to instructional development. From this point of view, a TP is a functioning system and the outputs are complex products of the interactions among all the system's components. A training problem arising within an existing TP is regarded as a kind of system failure or malfunction where the origins can be discovered most satisfactorily by an analysis of the interdependent contributions of component processes to the operations of the system as a whole. Hence, it is the conditions responsible for the training problem that the PA seeks to determine, and it is the nature of these conditions the governs the degree to which the analysis must be carried.

The PA may be performed either on an existing TP in need of revision, or on an emerging weapon system for which no TP has yet been developed. In the latter case, the PA will be a mini ISD project aimed at an identification of the major tasks required for operation and/or maintenance of the new system. Since competent performance of these tasks is what, ultimately, the TP must be designed to produce, the tasks will define the primary goals to be achieved by the TP. Once the task-oriented goals of the program have been established, the next stage of the PA process is to determine the nature of the ISD project needed to generate a TP that will attain most effectively the stated goals. The various steps that will be required to carry out the ISD project may now be enumerated, and from these are determined the personnel, facilities, equipment, time, and funding requirements necessary for the instructional development project. These are the main elements of the PA process as it is applied to the problem of a newly emerging weapon system for which no previous TP has been developed.

In the case of an existing training program, the extensiveness of the PA usually will depend on whether the TP was originally designed according to the basic principles intrinsic in ISD, and whether the original TP has been systematically reevaluated and updated since the time of its implementation. Should both of these conditions be satisfied, the PA would be a straightforward, if not routine, review of data pertaining to any problematic aspects of the program, or to any newly required program changes. However, the usual state of affairs necessitating a PA probably would be a training program that has been neither updated in keeping with weapon system changes, nor originally designed in accordance with the principles of ISD. In this instance,

a full-scale PA effort would be needed in order to adequately assess the problematic nature of the existing TP, and to provide the data necessary for development of a program master plan (PMP), the basic work plan which guides and coordinates development of the revised instructional system.

A full-scale PA of an existing training program involves extensive interviews with cognizant Navy personnel, surveys of relevant technical publications, etc., and first-hand examinations of all training facilities, materials, and procedures. Aspects of the existing TP that are specifically examined include the purpose and scope of the program, its management structure and instructor profile, the student entry-levels, flow-rates, and evaluation techniques; the training schedule, syllabi, media, equipment, and aircraft; as well as training facilities (classrooms, student learning centers, etc.) and any other supporting resources. Throughout this program review, an attempt is made to identify any problem areas (training deficiencies, resource inadequacies, etc.) and factors requiring program changes (weapons system changes, new mission requirements, revised student flow-rate, etc.) that are likely to impact upon subsequent application of the ISD process to TP enhancement or revision. These data not only define the nature of the training problem, but they also form the necessary basis for ISD project procurement.

FROM ANALYSIS TO PROGRAM MASTER PLAN (PMP)

Now that the nature of the training problem, the conditions giving rise to it, and the resource requirements needed to meet the desired training goals have been identified in the PA and reviewed for feasibility by NAVAIRSYSCOM, the stage has been set for development of the PMP, the plan which will control all subsequent ISD efforts. The major items of information contained in the PMP are:

a. A detailed listing of the resources necessary for support of the ISD project, as well as their resources.

b. A statement of the specific objectives to be achieved by the ISD project.

c. An enumeration of the main tasks to be performed during the ISD project, their time-phasing and scheduling into the major milestones to be reached throughout the project, and the method to be used in tracking progress toward their completion.

d. A delineation of the roles, areas of responsibility, management systems and channels of communication that will exist among participating Navy organizations and independent contractors during the project.

e. A statement of the procurement strategy options and instruments that may be selected for use, given the availability of funding, for each activity and material requirements encompassed by the project.

The primary foundation upon which the above PMP contents are based is the PA and its data and assessments of the training problem. However,

in order to transform these results of analysis into a practical, workable plan of action, additional sources of information must be utilized. Foremost among these is the NAVAIR/NAVTRAEQUIPCEN ISD model[3] which provides specifications of the ISD tasks to be accomplished, their sequencing, and the end products to be delivered at each major milestone throughout the project. Essentially, the model may be viewed as a management control system utilized by the NAVTRAEQUIPCEN to insure that all technical, instructional, and logistical requirements will be accomplished in a timely coordinated manner. Other sources of information that are incorporated into the PMP include the latest funding analyses available, and cost data (Navy and contractor) from previous ISD projects. Hence, the PMP is a document which consolidates the analytical information contained in the PA with the decisions for action derived therefrom, integrates this dynamically transformed informational core with inputs from all other pertinent sources, and projects a path for ISD action that is consistent with the NAVAIR/NAVTRAEQUIPCEN model, which may be used as the primary management tool for directing a large-scale ISD project. If the PMP is approved by NAVAIRSYSCOM, and the necessary funding is secured, Phase I of the ISD project may be initiated.

3. Funaro, J. F. and Mulligan, B. E. (July 1978),"Instructional Systems Design: The NAVAIR/NAVTRAEQUIPCEN Model," NAVTRAEQUIPCEN Report No. IH-304.

SECTION II

PROBLEM ANALYSIS

THE PROBLEM ANALYSIS REPORT

The contents and points of emphasis in a PA report may differ depending on both the nature and status of the training program. The following paragraphs cover the main items of concern in the evaluation of an existing training program and the situation in which the PA is most often applied. Although the orientation of a PA aimed at determining the training needs for a newly emerging weapon system may not coincide exactly with a PA directed at assessing the need for a revision or enhancement of an existing TP, both are responsible for providing the data necessary to formulate a plan for TP development. The items of information described in the following paragraphs should, therefore, generally represent the contents of a typical PA report.

THE TRAINING PROGRAM

REASONS THE PA WAS CARRIED OUT. To develop a characterization of the training problem which may be viewed from two perspectives, that existing prior to the PA, as documented in the IPI, (see p. 4), and that existing after completion of the PA. While the former constitutes the review of the problem that ultimately led to the PA, a summary of both views may not only provide an informative introduction to the PA report, but it may indicate the gain in understanding of the problem acquired from the PA. In any case, a concise statement of the characteristics of the training problem, whether based on PA data alone or combined with the earlier IPI data, should serve as an introduction to the subject of central concern in the PA report.

THE PROGRAM PURPOSE

REASONS THE TRAINING PROGRAM WAS ORIGINALLY INSTITUTED. A brief historical review of the conditions and situational constraints that existed at the time of the original development of the TP in question, particularly those factors that constituted the rationale for developing and instituting the TP. This section will be especially important if the original TP goals (see section below) were not stated explicitly, or if they cannot be obtained from available documentation. The information sought here is not to be a replication of that contained in above section, the objective of which is to describe the nature of the problem that arose after the TP was implemented. The present section is concerned with the context and factors that led to the original development of the training program. This historical summary should not only provide a picture of the background against which the training problem may be viewed most appropriately, but also it may indicate what the TP was originally designed to accomplish.

THE PROGRAM GOALS

WHAT THE TRAINING WAS DESIGNED TO ACCOMPLISH. This section should contain a complete statement of the TP goals including any revisions and additions to the original goals. In the absence of any available documents containing

goal statements, it may be necessary for the analyst to deduce the program goals from interviews with instructional personnel and course syllabi. Even if documentation of goals is available, the analyst should confirm their accuracy.

There are several rules which apply in the evaluation of training goals. First, for each position to be trained there should be at least one goal statement. Second, each goal statement should be derived from an analysis of the task to be performed upon completion of training, and should indicate the level of proficiency that will be expected in the operational environment, as well as the entry-level proficiencies, of new trainees. Third, the goal statements for a given position should be such that they imply, and are consistent with, the behavioral objectives for every course of instruction applicable to that position (see CURRICULUM ORGANIZATION). Fourth, for each position, there should be a goal statement summarizing the duration of training from entry to exit and the program's student through-put capacity (see page 12).

A generalized goal statement might read as follows: for BLANK operator position, this training program is designed to take in BLANK number of trainees that meet BLANK entry-level requirements and to train them in the areas of BLANK, BLANK, BLANK such that, at the end of BLANK weeks, graduates will display BLANK attitudes and exhibit BLANK proficiencies in the performance of BLANK tasks under BLANK operational conditions. In the foregoing, the word BLANK indicates the required data. A complete enumeration of the program goals for a particular position will probably require several sentences. In any case, these statements should make explicit what the training program was designed to accomplish, as opposed to what the training program actually does accomplish.

PROGRAM GOALS STATUS

EVALUATION OF GOALS AGAINST CURRENT AND ANTICIPATED NEEDS. Make an appraisal of training program goals in effect at the time the PA was conducted, considering the appropriateness of each goal in light of current and projected fleet needs and training support availability. Goals may require updating to reflect alterations in operational system components, changes in expected graduate proficiency levels, stepped-up levels of demand for program graduates (or the inverse of this), the supply of students meeting entry-level requirements, etc. Also, goals may be out of line with the availability of training facilities, funds, competent instructors, etc. If any of these factors represent permanent constraints upon the TP, then they should lead to a new goal statement. This goal statement differs from that of the preceding section since, here, it is the current and anticipated needs for training that are of primary concern rather than the needs that existed at the time the original TP was designed.

Essentially, then, this section should contain a comprehensive set of explicitly formulated revisions to the training program goals. Since these goals will best represent what the TP can and should accomplish, they will serve as the criteria for assessing the conceptual (design, direction, scope, etc.) and organizational (management, quality control, support systems, etc.) deficiencies in the existing TP, as well as its validity.

PROGRAM ORGANIZATION

RELATIONSHIP AMONG, AND RESPONSIBILITIES OF, ALL PARTICIPATING UNITS. An organizational chart that delineates the formal lines of authority flowing from the highest level of identifiable responsibility down to the unit(s) responsible for TP implementation. In the case of two, or more, implementing units having no direct organizational ties other than their respective contributions to the TP, the structure of the flow chart may project as high as the Chief of Naval Operations (CNO) level before merging. This overall organizational structure should be supplemented by an itemization of the major responsibilities assumed by each command identified in the chart. Statements of responsibiliy areas should make clear the mutual commitments for TP support (funds, facilities, manpower, materials) and coordination among all participating units.

TRAINING SQUADRON ORGANIZATION

FLEET REPLACEMENT SQUADRON (FRS) POSITIONS AND DUTIES. An organizational chart that identifies the formal lines of authority within each squadron responsible for implementing any aspect of the TP. The chart should begin with the commanding officer of each FRS and then break out all authorized subordinate positions of responsibility. This detailed organizational structure should be supplemented by complete statements of both primary and collateral duties assigned to each position. Examples of duty areas include: administration, personnel management, resources management, record maintenance reporting, instruction, instructor training, training device instruction, support management, human relations, safety, and recreation. If more than one squadron is responsible for implementing the TP, then the respected parts of the TP (courses, parts of courses, etc.) assigned to each should be identified, and any organizational mechanism used to coordinate activities of participating squadrons should be described.

PROGRAM ORGANIZATIONAL STATUS

EVALUATION OF STRUCTURAL AND FUNCTIONAL ASPECTS OF THE TRAINING ORGANIZATION. Conduct examination of both the supporting and training organizations to establish their adequacy for achieving program goals. Questions of interest regarding the overall organization are: Is the organization formally adequate to provide the necessary training support and coordination? Is the organization functioning as intended? Is there a more efficient organizational structure that is feasible? What constraining factors would limit structural reorganization? What organizational changes would be beneficial and/or required in order to institute changes in the TP? Questions of interest regarding the training squadron(s) are: Is the formal organization of each training squadron adequate for successful implementation of all aspects of the TP? Have the duties of FRS personnel been specified in sufficient detail to insure their performance and to permit in sufficient detail to insure their performance and to permit their evaluation? Is the FRS organization functioning as intended? Will changes in the TP benefit by and/or require reorganization of the FRS? Does the FRS contain a training management and quality control system?

POST-GRADUATE COMMANDS

THE OPERATIONAL SQUADRONS THAT RECEIVED TP GRADUATES. Identify fleet squadrons to which graduates of the TP are assigned. A description of the initial positions and duties assumed by TP graduates should be given for each fleet squadron. Questions of interest regarding post-graduate commands are: Are the jobs to which graduates are assigned initially in operational squadrons commensurate with the training they received in the FRS? Are there additional squadrons in the fleet that could utilize FRS graduates, especially if the TP was enhanced? What directions of TP enhancement would expand utilization of graduates whether within the present user squadrons or within new squadrons?

INSTRUCTORS

QUALIFICATIONS AND AVAILABILITY OF PERSONNEL RESPONSIBLE FOR TRAINING. Conduct a summary of FRS personnel's capability to carry out instructional requirements of the TP. The two areas of prime importance to assess personnel's capability are instructors' qualifications and availability, as they exist in the FRS. Instructors' qualifications should be documented in the following categories: previous experience (operational, instructional, etc.) that is required; rank or rating requirements; normative selection criteria (relative test performance); instructors' training program requirements and certifications; instructors' evaluations (types, dimensions, and frequency). Instructors' availability should be documented in the following categories: the number of qualified instructors present in the FRS for each area (position) of training designated in the TP syllabus; the retainability of instructors in terms of the normal tour of duty as a FRS instructor; the number of non-instructional personnel in the FRS that are qualified to serve as instructors on an "as-needed" basis; the instructional work loads (number of classes per day, class duration, etc.) assigned to instructors; the non-instructional work loads (administration, handout preparation, equipment inventory and checkout, watch duties, etc.) assigned to instructors; the use of non-FRS personnel as instructors.

STUDENT POPULATION

PIPELINE SOURCES AND ENTRY-LEVEL REQUIREMENTS. Conduct analysis of student origins, qualifications, and program entry-level requirements for each position to be trained. Identify the sequential flow of students through the various command units (pipeline) that ultimately feed into the TP to provide data on the previous training received and qualifications attained by students, as well as the data necessary to assess problems related to quota control. Likewise, any entry-level requirements (prerequisite training programs, prior aircraft experience, NATOPS qualifications, service group rating, security clearance, etc.) that are operative in the selection of students for admission to the TP should be listed for each position to be trained. These data not only help to define the general characteristics of the student population for which the TP presumably was designed, but they may also enumerate detailed characteristics of the student population that exert a selective influence on the success of the TP, e.g., specific student readiness deficiencies.

Questions of interest regarding composition of the student population are: Does the TP require training in any area for which entering students are unprepared, improperly prepared (proactive inhibition), or already fully competent? In the case of essential entry-level skills and/or knowledges that are either lacking or at variance with those to be required in the present TP, will special media (trainers, computer programs, etc.) or additions to the syllabus be required in order to remedy these deficiencies? If special media are required, will they have to be developed, or can they be made available through arrangements with other commands? Can entry-level deficiencies be eliminated by a reorganization of the pipeline? Do entry-level deficiencies contribute to poor student motivation and attitudes, if such exists? Can entry-level requirements of the TP be revised so as to reduce entry-level deficiencies?

STUDENT THROUGH-PUT

CLASS LOADS, PROGRAM CAPACITY, AND STUDENT FLOW. Make analysis of student through-put and program capacity for each position to be trained, and each category (courses, etc.) and phase of the annual program cycle. The data may be summarized conveniently in terms of a yearly schedule of classes. Such a schedule would identify each class by its proper designator and start-completion dates, and thus provide a framework in which student through-put data may be entered. The actual number of students processed and the maximum number of students that can be effectively processed are the two data items that should be given for each offering of each class. The first datum should be a matter of record. The second should be estimated on the basis of the following:

a. Availability of adequate training facilities (see PHYSICAL RESOURCES)

b. Availability of proper instructional materials and media (see PHYSICAL RESOURCES)

c. Instructor-to-student ratio (see INSTRUCTORS).

The maximum number of students that can be effectively processed per class can be taken as an index of the effective capacity of each class offered. This schedule analysis may be supplemented by an overall flow diagram which would show the paths (training tracks) specified in the syllabus for all positions.

Questions of interest regarding student through-put are: What is the magnitude of the TP in terms of actual numbers? Does actual through-put exceed or fall short of the program's effective capacity in any area of training? Is effective capacity too low in any area of the TP due to a lack of facilities, materials, media, and/or instructors? If through-put exceeds effective capacity in a given area, what are the consequences of this in terms of student performance? Has through-put fallen below the original TP goals (see PROGRAM GOALS) in some program area as a result of a low effective capacity? Have student attrition rates been excessive in any particular program area? Is the effective capacity in all areas of the program sufficient to meet newly evolved TP goals? Is the flow of students through

the syllabus consistent with the hierarchy of behavioral objectives so that the objectives intermediate between entry-level and final task performance and students are trained in the proper progression? Are "hand-on" experiences programmed so as to reenforce academic training? In the case of tasks specified for "deferred training," are provisions for this adequate to achieve the necessary training at the post-FRS duty stations? If the TP does not operate on a scheduled basis with regular start-completion dates, is the TP offered on some other basis, e.g., "as-needed"? Is this basis adequate to meet program goals? Are any alterations of, or additions to the syllabus required (see CURRICULUM ORGANIZATION)? Can syllabus changes be avoided by reducing either the rate of student through-put (e.g., an increase in course duration), or the magnitude of through-put relative to program effective capacity?

STUDENTS PROGRESS

PERFORMANCE, MOTIVATION, AND ATTITUDES OF STUDENTS TRACKED THROUGH THE TP. Conduct analysis aimed at determining the degree to which the instructional objectives are being achieved. It is here that the instructional effectiveness of the TP is assessed. The data to be collected should, if it is available, answer the following question: Does student performance change after exposure to the TP such that expected program achievement levels are met? The answer to this question should be documented not only in terms of performance relative to criterion-referenced measures for behavioral objective encompassed by the TP, but also in terms of motivation and attitude measures.

In order to assure that observed changes in the various student measures are attributable solely to the instructional effects of the TP, several precautions will be helpful.

Assuming that performance, etc., is tracked from just before training begins (pre-test), throughout training (lesson tests), and finally to completion of training (possibly an "on-the-job" test), the analyst must account for any events that may occur between tests (a change in the grading system, instrumentation breakdown, pay increase, etc.) that may account for the observed change in test performance. In addition to specific events, the analyst should look for temporal trends in test performance that may be the result of such gradual influences as time away from family, boredom, and experience in the training setting (e.g., habitual distracting features). Further, the analyst should make sure that a general trend toward improved test performance is not due to experience gained on successive tests, a cumulative effect unrelated to instruction.

In the case of programs that allow students to progress from one stage to another only if their performance exceeds some high cutoff level, there is a non-instructional effect which may result in an apparent decrease in performance on the test at the next stage. This is known as statistical regression toward the mean, and it is the result of selecting students to advance only if they score above some cutoff at the extreme end of the performance distribution. The reverse effect may occur as a result of attrition, i.e., if low-scoring students drop out of the program, then

performance on subsequent tests by students who continue in the program may appear to improve.

By taking these factors into account, the analyst will help to insure that non-instructional effects are not attributed erroneously to instruction. This pitfall may be avoided more substantially by means of a control group that is treated in exactly the same way as the student group in all respects except that the control group does not participate in the TP and, hence, cannot benefit from it. If the control group approach is feasible, care should be taken to insure that both the students and controls were drawn from the same population. An optimal procedure is to match individuals on all parameters of importance, and then to assign them randomly to each group. Although a control group will probably not be possible in most established situations, it may be possible to obtain some comparable data relating student performance in the TP under consideration with that of individuals trained under a different program. This data will probably be "on-the-job" performance evaluations and considerable caution should be exercised in drawing conclusions from such comparisons.

A related area of concern involves programs that originally were subjected to a tryout-revision process. If the TP effectiveness is found to fall short of the expectations established during tryouts, the analyst should determine whether this is due to such forces as differences between the current student population and the population used as a source of tryout personnel, differences between the tryout situation and the training situation, and differences between the treatments (higher levels of motivation, etc.) received by individuals who participated in tryouts as opposed to those in the TP.

The foregoing is based on the assumption that the TP has identifiable, if not specifically stated, behavioral objectives that not only stipulate the actions to be performed, but also the conditions of performance and the standards below which performance is judged to be unacceptable. In the absence of such objectives, the analyst will have little basis for determining appropriate performance criteria, and hence for evaluating the instructional effectiveness of the training program. In the case of a TP with no stated behavioral objectives, the analyst should attempt to deduce the actual criteria implied in performance tests and to determine whether they provide a valid and unbiased estimate of the performance to be expected on-the-job. A TP cannot be considered effective if it does not result in an improved job performance, even if it does succeed in improving performance on tests that are invalid. In any case, the analyst should consider in detail both the methods of testing (test type) and the methods of evaluating test results, as well as the subject matter tested, the testing schedule, the system for providing test results to students, the system employed for recording and storing test results, and the procedures used in tracking and evaluating student progress. It is also important to determine whether the scope and depth of the information actually taught is adequately represented in tests. Further, the manner in which test results are consolidated and used to establish final evaluations of student performance should be carefully examined.

CURRICULUM ORGANIZATION

TRAINING TRACKS, COURSE SYLLABI, AND BEHAVIORAL OBJECTIVES. An analysis of the sequential organization of courses and course contents. It is convenient to divide this analysis into two parts: (1) training tracks, and (2) course syllabi and objectives. The former is a comprehensive map which shows the ordinal arrangement of courses for each position to be trained (see STUDENT THROUGH-PUT). The latter is a breakdown of each course into its component units, lessons, segments, and "hands-on" exercises with statements of the behavioral objectives to be achieved within each component part.

The map illustrating program tracks provides an overall view of the organization of instructional content. For each position to be trained, the order in which a student successively encounters each general content area may be traced from program entry to exit. The general cohesiveness of the content organization within tracks may be made visible by means of such a map. Also, courses that are common to more than one track, and which may have been duplicated, or even ommitted, may be identified. Further, such a map can show the points in the instructional program where coordination of instructional inputs to the program from other squadrons should occur in cases where more than one unit is responsible for training.

The second part of this analysis is an assessment of the instructional contents of courses in light of program goals and course objectives. Theoretically, if all the behavioral objectives for every course of instruction that are included in the training track for a given position are combined, they should provide a complete and accurate specification of the program's instructional goals for that position. While this theoretically ideal situation might never be found to exist, it indicates the kind of relationship that should exist between program goals and course objectives. If the program goals for a given position have been formulated to accurately encompass the tasks to be performed, then these goals may serve as a basis for evaluating course objectives. If the behavioral objectives for all courses in a training track are found to be incomplete relative to the goals of the program, then it is likely that either course enhancement or addition is required. However, if the behavioral objectives are found to be excessive relative to program goals, it is probable that either course revision or deletion is needed. An analogous comparison should be made between course objectives and lesson objectives.

The foregoing analysis establishes the completeness and appropriateness of course contents, but it does not access the integral nature of the contents. A well-designed sequence of instructional divisions (courses, units, lessons, lesson segments, and "hands-on" exercises) insures that students possess just those requisite skills and knowledges at each stage of training that are necessary for them to move successfully on to the next stage. This is usually accomplished by sequencing elemental objectives before more advanced ones. A careful examination of the syllabus for each course should reveal any gaps or sequential misalignments of course contents. As a general rule, the following organization of course contents has been found to be the most useful.

Entry-levels are taken as indicators of how elementary the first objectives must be. These are divided into segments which are then grouped to form lessons that are followed by tests (see STUDENT PROGRESS). Lessons are organized into instructional units which are followed by "hands-on" exercises that allow students to practice that which has been learned at each stage before they move on to other subject matter, whether it be elemental or more advanced. The syllabus may cycle students between a number of elementary academic units and corresponding "hands-on" exercises before proceeding to the next level of training. However, instructional units should be formed so as to permit practice and application of principles before they are forgotten or confused with others. As the units become progressively more advanced, the exercises thar are required should also increase in difficulty, but without exceeding that which has been learned academically. Initial "hands-on" exercises may be at the familarizational level, while subsequent exercises involve practice in simulators and, eventually, in the operational environment.

The data that is necessary to perform a curriculum analysis consists of complete syllabi for all courses and exercises (trainers, equipment, and aircraft). It will be convenient to attach these documents, if they are available, as appendices to the PA report. From these documents, as well as other sources, the analyst may abstract the training track map, the program goals, the course objectives from units down to lesson segments, and the sequential organization of instructional divisions within each course. From this data base, it should be possible to evaluate the organizational structure of the curriculum as well as the instructional completeness and integrity of individual courses. Also, it should be possible to determine whether courses are designed to meet program goals and, additionally, to identify missing, weak, duplicated, or misdirected courses. This data also may cast light on the source of curriculum problems, e.g., students required by logistical constraints to deal with subject matter at a level for which they lack the requisite skills.

PHYSICAL RESOURCES

INVENTORY AND EVALUATION OF INSTRUCTIONAL MEDIA AND FACILITIES. Make analysis of the physical capacity of the TP to fulfill course objectives. An inventory of instructional media and facilities for each area of training is necessary to establish the existing availability of resources, but this inventory alone will not indicate the need for certain media and facilities that may exist in any particular training category. Both availability and need should be documented in detail and, from this data, a physical resources requirement be determined. Specific media and facility needs should be established for each course and training track taking into account student through-put data and the nature of instruction indicated in the behavioral objectives for each lesson and exercise (see CURRICULUM ORGANIZATION). The following media and facilities categories should be inventoried for both availability and need.

a. Media:

(1) Training equipment (projectors, recorders, screens, etc.)

(2) Maintenance and production equipment, tools, and supplies

(3) Media software (slides, workbooks, tests, etc.)

(4) Trainers

(5) Aircraft (aircraft per sortie)

b. Facilities:

(1) Classrooms (number, dimensions, lighting, acoustics, etc.)

(2) Office space for instructors and staff

(3) Furniture (classroom, office, etc.)

(4) Space for media storage, maintenance, and production

(5) Student learning center and study areas

(6) Computer terminal area

(7) Avionics test bench areas

(8) Ramp and hanger spaces.

Questions of interest are: What media are needed to achieve the behavioral objectives for each course? Do available media meet specifications derived from course objectives? Are all available media operational? Are facilities and equipment in the training squadron adequate to keep media in good repair througout the lifetime of the program? If not, are there other units available for maintenance activities? Does the training squadron possess the equipment, facilities, and expertise for updating, revising, and producing new media software? If not, do alternative strategies exist that may be employed for this service? Are media hardware compatible with software? Do trainers and available aircraft possess the necessary systems for training? Are classrooms adequate to meet student needs and program schedules? Are study areas, individualized instruction areas, etc., adequate? Is space available for a properly managed media library? Is the office space available to instructors and program managers adequate? Are there other facilities that may be converted to use of the training squadron? Are there any items of equipment, etc., on order which are not reflected in the inventory? Are all facilities located within an area sufficiently small to permit easy movement from one place to another? If not, are there scheduling problems, transportation problems, etc., that exert a detrimental influence on the success of instruction?

CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF MAJOR FINDINGS NECESSARY FOR PROJECT PLANNING. The contents of the PA report serve as the primary data source for development of the project master plan (PMP). Whether a revision, an enhancement, or an entirely new TP is required, the PMP is the plan that will govern the

necessary managerial and technical aspects of TP development, production, implementation, and long-term support. The success of this plan is heavily dependent upon the completeness and utilizability of the information provided in the PA report. Assuming that the analyses indicated in previous sections have been carried out fully, attention should now be directed to a summary organization of this information that will make it maximally usable during project planning. The precise nature of the training problem should be delineated together with recommendations for its remedy. The planners should be able to see which aspects of the existing TP contribute to the problem and be able to understand the overall context in which the problem is manifest. Alternative strategies for solving the various components of the problem should be offered whenever possible. In brief, the conclusions and recommendations called for in this section are those that will be essential to the development of a plan to alleviate the training problem.

SECTION III

PROJECT MASTER PLAN

This is the primary work plan which will guide and coordinate development of the new training program, or the revisions to be incorporated into an existing TP. Utilizing the information provided in the PA, together with other inputs such as ISD specifications (MIL-T-29053) and associated Data Item Descriptions (DIDs), the NAVTRAEQUIPCEN initiates a course of action which ultimately results in the PMP. This plan coordinates every aspect of the project including its development, production, implementation, and long-term support. The PMP must insure efficient utilization of available resources, adequate support throughout the life-cycle of the TP, and continued instructional effectiveness and technical currency through a system of monitored performance and quality control.

PMP OBJECTIVES

Considering the diversity of organizations, technical expertise, and resources required to successfully deliver and put into operation training systems of the magnitude and complexity of those current in Naval aviation, it is evident that a plan to accomplish this will have to be correspondingly broad in scope. Essentially, such a plan must be a management tool that coordinates the contributions of all participants to the project and which monitors the timeliness and quality of each contribution. A plan that possesses these characteristics will have to achieve the following objectives:

a. Review training program goals, establish current training deficiencies and projected needs, and specify the training materials, media, facilities, and management systems to be developed within the arena of this project.

b. Identify the organizations, agencies, and offices that will support development of the training system, and define the roles, responsibilities, and resource commitments of each group.

c. Identify the committees and teams that will provide either professional or technical support for development of the training system, and determine for each group the tasks to be performed and the products to be delivered.

d. Establish a system for liaison, coordination, and communication among all groups and organizations participating in the training system development.

e. Construct a time-based schedule of project activities that specify the start and completion dates for major tasks, the delivery dates for training products, and the time periods that will be available for review and evaluation of deliverables.

f. Given funding, resources, and time constraints, develop training system specifications (ISD specifications, training device specifications, etc.) and procurement procedures that will insure the acquisition of an efficient and cost/effective training system and its successful implementation.

PA INPUTS TO PROJECT PLAN

It would seem logical to assume that, for purposes of developing the project master plan, the essential information contained in the PA report would be the characterization of the existing training problem (see TRAINING PROGRAM). While this information undoubtedly serves to focus the planner's attention on the more troublesome aspects of the program, an examination of the PMP objectives indicates that the entire contents of the PA report will be necessary in order to achieve these objectives. The sections dealing with training goals, curricula, and physical resources provide the primary information necessary to meet Objective I, although important data that also relate to this objective are contained in other sections. Objectives II, III, and IV depend heavily on the sections concerned with program organization, training squadron organization, and post-graduate commands. To meet Objective VI, planners must utilize the information contained in the section on physical resources, but they must also consult the sections on student population, and student through-put. For all objectives, planners require information from sources other than the PA report (ISD specifications, funding analyses, equipment specifications, procurement procedures, etc.), especially in the case of Objective V. However, it is the PA report that provides the informational core upon which the planning process is based, and this core is presented in summary form in the section devoted to conclusions and recommendations.

POST PMP USES OF THE PA REPORT

In addition to its value as a data source, the PA report is also an evaluative document. Throughout its various sections, the PA report contains both detailed analyses and evaluations of specific aspects of the training program. Consequently, if the PMP calls for ISD revision of the training system, much of the work will have been completed already in the PA. The task analysis stage of ISD may be bypassed and the appropriate part of the PA substituted in its place. Likewise, the analyses that would otherwise have been necessary to determine program goals, entry-levels, behavioral objectives, media and facilities requirements, etc., may be considerably reduced. Especially important in the case of programs to be revised or enhanced are the requirements that need to be met to insure that the newly developed components of the training and management system will dovetail with the unchanged parts of the existing program. These requirements would have been evident from the outset in the PA report.

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