Research Report 1241

ARMY TRAINING TECHNOLOGY TRANSFER: A SYSTEMS MODEL

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MANPOWER AND EDUCATIONAL SYSTEMS TECHNICAL AREA

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Innovations in training technology must be transferred from the researcher to the user to be effective. This system concept paper presents a framework for the establishment of an Army training technology transfer program, as well as suggestions to improve the acceptance and use of training research products.

Training technology transfer is defined as the process by which research results become implements of useful change in operational training. The user

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can be civilian or military, functionally involved at levels from high-level review to the trainer in the field. The systems model developed here uses a linear approach to describe the four steps of technology transfer in the Army: (a) analysis of requirements; (b) research, development, test, and evaluation (RDT&E) of solutions; (c) dissemination of findings; and (d) institutionalization. Within these steps, specific issues include assessment of military needs, consideration of the appropriateness of current RDT&E funding, user acceptance of new products, and the transition from innovation to policy, as well as prediction methodology and recommendations for ongoing monitoring, evaluation, and feedback. Recurring throughout the transfer process are issues of sponsorship and the self-renewal capability of the research product.

A bibliography on training transfer is organized in terms of specific activities within the model.

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FOREWORD

The Manpower and Educational Systems Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) is concerned with improving individual and unit training through research in the design, methodology, and implementation of instructional delivery systems. One aspect of this research is to develop procedures for improving the acceptance and use of these training systems by Army personnel. This report summarizes a systems model and relevant issues to be used on initial steps in understanding the transfer of training technology from the researcher to the Army user. As a 6.2 effort, this research was initiated to predict the outcome of the transfer of game-based learning innovations to the operational environment. Work on this effort was accomplished under Army Project 2Q162717A764, FY 1979, "Evaluation and Assessment of Training Technology." Technical assistance was received from Mr. Jim Baker, Dr. Leon Nawrocki, Dr. Harry O'Neil, Dr. Halim Ozkaptan, and Dr. Joyce Shields.

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ARMY TRAINING TECHNOLOGY TRANSFER: A SYSTEMS MODEL

BRIEF

Requirement:

To improve individual and unit proficiency of Army personnel by developing a systems model for effective transfer of training technology from researchers to Army users.

Procedure:

Technology transfer of Army training products was defined through analyses of military and nonmilitary literature and data. The background and history leading up to the current interest of the Army in training technology transfer were presented in relation to pertinent data and critical events.

A systems model of training technology transfer from both military and nonmilitary sources was described, along with the specific stages within each activity of the model. The presence or absence of relevant stages in the Army human resources research, development, test, and evaluation (RDT&E) program relative to the systems model was emphasized. Discussion and suggestions to improve Army training technology transfer followed.

Findings:

Development of the systems model revealed that several issues need to be addressed in Army training technology transfer. These issues are categorized under general, specific, and recurrent topics. Under the general category, definitional, modeling, and transfer issues need attention. Under specifics, the issues that appear to need work include an assessment of needs; RDT&E funding; information dissemination; institutionalization; and prediction, monitoring, evaluation, and feedback. Recurrent issues needing attention are sponsorship and a self-renewal capability.

Utilization of Findings:

This paper presents a conceptual view of the current situation of Army training technology transfer. Application of this systems model may allow Army decisionmakers to set priorities for addressing specific activities or issues related to the utilization of training products.

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OVERVIEW

Operational Problem

Parallel with the demand for new, costly, and complex Army materiel systems is the requirement for insuring parity in the level of training necessary to operate and maintain these systems. This need for improved Army training has led to the research, development, test, and evaluation (RDT&E) of new training products. However, informal comments and anecdotal evidence (Appendix A) suggest that significant numbers of recently fielded training products have not been integrated sufficiently nor used effectively to improve individual and unit proficiency within the Army's materiel systems (Drucker, 1977; Shields, 1976). One aspect of the problem concerns the manner in which new training technology is transferred from researchers and developers to users. The emphasis on training technology transfer is based on the assumption that the strategies and procedures used in introducing new training products in the field determine their acceptance and use.

Research Objective

The objective of a successful training technology transfer program in the Army is the improvement of individual and unit proficiency in materiel systems. One means of achieving this objective is the provision of discussion and suggestions for improving training technology transfer.

Scope

The Department of Defense (DOD) Technology Transfer Consortium was established in July 1971 as a result of congressional scrutiny of the extent of spinoff benefits from RDT&E, similar to benefits from the NASA space program (NASA, 1973; Tempest & Van Rooy, 1975). The consortium's purpose was to transfer military R&D results to solutions of civilian problems (between-agency transfer) rather than to concentrate solely on military problems (within-agency transfer).

This paper focuses on the transfer of training technology from the Army human resources (HR) RDT&E community to the Army field user; consequently, the transfer of training technology from the Army to agencies outside the Army or DOD is not discussed.[1] Emphasis is on the role of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) in providing accepted and useful HR RDT&E products to the user, as well as on a systems

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[1]For discussion of "between- versus within-agency transfer," see Jolly & Creighton, 1975; Millburn, 1979; Montanarelli, Jolly, & Creighton, 1977; Office of Technology Assessment, 1978; and Teich & Whartnaby, 1978.

model describing nonsystem, advanced RDT&E with reference to basic and exploratory development when relevant.

Approach

To present information about technology transfer from which Army decisionmakers can formulate a training technology transfer program, the following format is used:

1. Background history of critical events leading up to the current interest of the Army in training technology transfer;

2. Description of a systems model of training technology transfer, from both military and nonmilitary sources;

3. Description of specific stages within each activity of the systems model, emphasizing the presence or absence of relevant stages in the current Army HR RDT&E program relative to the systems model; and

4. Discussion and suggestions to improve Army training technology transfer.

Definitions

In general, technology transfer can be defined as a process by which existing research knowledge is transferred operationally into useful processes, products, or programs that fulfill actual or potential public or private needs (Federal Council for Science and Technology, 1975). Key words in the literature used to describe technology transfer are change process, diffusion of innovations, innovation dissemination/transfer, knowledge sharing/transfer, product utilization, research dissemination/utilization, and technology assessment/sharing/utilization.

The user is an individual and/or agency who (a) expresses or implies a need/requirement for a training product or (b) must approve, or transmit information of, the training product prior to its acceptance and use in the field. The researcher is an individual and/or agency involved in the RDT&E of a training product in response to an expressed or implied user need. The training product is a research-derived set of procedures and/or devices designed to improve individual or unit proficiency in specified materiel systems. These three terms are described more fully in Appendix B. For the purposes of this paper, Army training technology transfer is defined as a process by which the HR RDT&E community produces an accepted and useful training product that fulfills the expressed or implicit requirements of the Army user; the main point is that successful training technology transfer results in a research product designed to produce a change. The research community may view this change in the way the user applies the training product; the user may view this change in terms of produced results within the user's operational environment (Table 1).

Table 1

Differences in Researcher and User Meanings of "Use of Research Product"[a]

Researchers	Users
Operational use of product	Improved effectiveness
Change-mission performance	Cost-effective improvements
Incorporation of product	Usable information
Application of knowledge	Benefit to decisionmaking
Adoption of results	User requirements provided
Minimum translation	Saving of money
Options for development solution	Application of operational evidence

[a]Based on a survey of 67 Army, Navy, Air Force, and contractor researchers and product users (Drucker, 1977).

Since the most visible result of training technology transfer is the training product, interest has been focused on the dissemination and eventual use of the training product. However, this report shows that the training technology transfer process involves both formulating the training product and introducing it to the Army user. This system concept document, in a "top-down" framework, supports the establishment of an Army training technology transfer program and presents a conceptual view of the current situation of training technology transfer in the Army and other areas. The "big picture" of the training technology transfer process will allow Army decisionmakers to determine which specific activities in the program may need improvement.

BACKGROUND

DOD Involvement

During the past two decades, research and development (R&D) of major materiel systems and associated training products have become increasingly specialized. This specialization has brought a greater emphasis on the interdependence between the R&D community and the user community (Clarkin, 1978). For example, in 1966, President Johnson stated that

> Presidents . . . need to show more interest in what the specific results of research are in their lifetime, and in their administration. A great deal of basic research has been done . . . but I think the time has come to zero in on the targets--by trying to get our knowledge fully applied. . . . We must make sure that no life-saving discovery is locked up in the laboratory. (Comroe & Dripps, 1975)

This statement forecasted the Federal attitude toward a greater emphasis on the usefulness and applicability of research products.

The Department of Defense conducted a study, "Project Hindsight," in 1966 to track the use of specific military R&D products (Comroe & Dripps, 1975). The study analyzed retrospectively the development process of 20 weapon systems (e.g., Polaris and Minuteman missiles, M102 Howitzer). Some of the study's conclusions were that (a) contributions of basic, scientific research were minimal; (b) scientists contributed most effectively when their effort was mission-oriented; and (c) the time lag between initial discovery and final application was shortest when the scientist worked in areas targeted by the sponsor. Although this study focused on hardware products (e.g., materiel, weapon systems) rather than on software products (e.g., training programs), it indicated initial military involvement in evaluating the usefulness and relevancy of its research products. During this time, new terms were popularized in the general R&D community to reflect this trend: targeted research, mission-oriented research, programmatic research, commission-initiated research, contract-support research, and payoff research. Congress and the Office of Management and Budget reacted accordingly with an increase in NIH-supported contract research and commission-initiated research (Comroe & Dripps, 1975). Thus, during the 1960's, the trend was set for justifying applied research in terms of user needs, stated in terms of goals, targets, etc.

In the late 1960's and early 1970's, Congress showed an increased interest in the relevancy of R&D products. For example, the Mansfield Amendment to an early 1970 appropriations bill stated that all defense R&D must have a direct and apparent relationship to the DOD mission. This relationship apparently emphasized the overall DOD mission, in the development of hardware, weapon systems or subsystems, or in the maintenance of combat readiness through better training, better personnel management, or better manpower management (Taylor, 1978). In response to this amendment, each of the military services reviewed their R&D programs based on categories which had (a) both a direct and apparent relationship, (b) an apparent relationship, or (c) neither a direct nor an apparent relationship to the overall DOD mission. This intraservice review resulted in a restructuring of the military R&D program from the standpoint of both relevancy and emphasis (Taylor, 1978).

In 1971, the Ginnesburg Management Report recommended an increase in R&D expenditures in the behavioral and social sciences and improvement of the management in these areas. Some of the findings of the report were (a) a lack of communication between policy decisionmakers and researchers; (b) too much control of research by the hardware community; (c) too much research originating from the bottom up, rather than from the top down; (d) lack of involvement and control by those responsible for the program; (e) lack of responsiveness to the needs of the client; and (f) too much concentration on research in the hands of particular groups (here, the Ginnesburg report focused on psychologists and the lack of involvement of a wide variety of disciplines (Rostker, 1978)).

The next major historical point was the House Appropriations Committee's review and report on the 1976 fiscal budget request (Taylor, 1978). The committee recommended a 50% reduction (from $40 million to $20 million) within human resources R&D due to the lack of demonstrated utility of research products in this area. However, the Senate restored half of the $20 million reduction, and the House acceded to the Senate's position (Taylor, 1978). Consequently, the budget for human resources R&D was kept intact, but Congress caught the attention of the R&D community. Since that time, there has been an effort within the R&D management community and within certain segments of the user community to clarify the use of human resources R&D (Taylor, 1978).

In November 1975, following the final authorization of the FY 1976 budget, the Chairman of the House Appropriations Committee requested that the General Accounting Office (GAO) conduct a detailed review of the military human resources R&D program so that a more thorough analysis of the FY 1977 defense budget request could be completed (Reusse, 1976; Taylor, 1978). On April 22, 1977, the GAO report entitled "Human Resources Research and Development Results Can Be Better Managed" was published.

The GAO conducted its evaluation over a period of about 18 months. They developed an audit trail of human resources research, using the technical report as a basic source to audit. They visited eight organizations within DOD and identified 374 reports that contained results which the research community deemed ready for immediate use. To complete the audit trail, the GAO contacted users both by survey and personal interviews to determine which R&D results were used and which were not used. They found that (by their criteria) 56% of the results had been used and 38% had not been used, with 6% considered for possible use. The GAO emphasis was on immediate use and did not consider results relating to the decisionmaking process (Taylor, 1978). Some of the reasons that the GAO report found for nonuse were that (a) users believed that results were for information only; (b) users had not seen the reports or were unaware of the reported results; and (c) the research community questioned the results, or they believed them to be unusable (Taylor, 1978).

As a result of this study, GAO submitted to DOD four recommendations intended to improve the management of research utilization:

1. Develop criteria to identify R&D results with immediate (i.e., near-term) use potential. The GAO used three criteria for determining use potential of a given research project, i.e., research intended to support change in education or training; equipment; or regulations, order, policy, doctrine, or manuals. One idea is to require that each published technical report in the human resources area provide a statement concerning the intended user or user community and the suggested use of any product or findings.

2. Improve communication between researchers and users. Some ideas are periodic utilization reports; user involvement through technology process; collocation of researchers with users; conferences; and linkage agents serving as intermediaries between R&D and user communities.

3. Establish a monitoring and feedback system for tracking utilization.

4. Develop a management mechanism for resolution of issues between the researcher and the user (Reusse, 1976; Taylor, 1978).

Similar recommendations were put forth by the 1976 Defense Science Board Task Force on Training Technology (Alluisi, 1977) and the Laboratory Utilization Report (White & Taylor, 1976), with the additional recommendations of the need for (a) cost-benefit and performance-effectiveness analysis relating to research utilization; (b) resolution of conflict of interest between researcher and user; and (c) emphasis on the whole R&D process, from requirements to utilization (Taylor, 1978).

A major response by the DOD human resources RDT&E communities to the growing Federal concern over the use of research products was the convening of the National Symposium of the Military Services on Utilization of People-Related RDT&E in June 1977 (Sands & Glaser, 1978). The purpose of the symposium was to assess the problems of human resources RDT&E, principally within the military establishment, and to formulate recommendations for improving utilization strategies of RDT&E. Recommendations from this symposium emphasized improvement and/or increased activity in the following areas: (a) use of research products, (b) interaction between researchers and user communities, (c) accountability and responsibility affecting the use of research products, (d) relevancy to R&D requirements, (e) implementation planning, and (f) reporting and dissemination of research findings.

Army Involvement

In December 1972, the Military Requirements and Product Utilization Office was formed within ARI to assist in cooperative efforts between the research technical areas and the sponsor-users of the results of ARI research. The staff consisted of military officers who performed liaison functions. The purposes of the office were to help define needs and problems and to promote the adoption and effective use of the research products (Uhlaner, 1977). This office was subsumed eventually under the Plans, Programs, and Operations Office in ARI. A major contribution of this office was to heighten those activities concerned with promoting the use of ARI research products, e.g., the Technical Advisory Service, the Tri-Service Utilization Service, the draft research utilization plan, and a task force to study the use of research products.

Dusek (1974) traced the history of technology transfer in Army human resources R&D. Although Dusek's review emphasized between-agency transfer, this historical survey is important because it provides an accounting of significant contributions developed by the Army human resource RDT&E community.

Two major Army regulations defining doctrinal and procedural aspects of personnel performance and training RDT&E were AR 70-1 (1975) and AR 70-8 (1976). These regulations defined the extent of ARI responsibilities in performing RDT&E, the program formulation and approval process, the RDT&E categories, and the implementation of RDT&E fundings. Major research funding categories were delineated within ARI's purview, namely basic (6.1), exploratory (6.2), and nonsystem advanced development (6.3A). This last category focuses primarily on non-material-oriented technology (e.g., for training products) which has potential application to a variety of systems rather than to one specific system.

In May 1976, ARI research scientists participated in the Potomac Chapter of the Human Factors Society annual symposium on training technology transfer, which addressed research and policy problems in education and training. This meeting produced the explanation and tracing of training from the RDT&E phase through the process of translating the resultant technology into implementation policy to the impact of policy in training.

Drucker (1977) presented the results of a survey on military research product utilization to the Military Psychology Division of the American Psychological Association in September 1976. Major findings from this survey were (a) that researchers and users have different meanings for the term "research product utilization," (b) a breakdown of different descriptions of users, (c) factors influencing the acceptance and use of a research product, and (d) discussion of evaluation criteria for product utilization. Shields (1976) discussed the process of technology transfer in relation to the Army's need for improved (and timely) training products. Her review presented deficiencies in existing models of technology transfer (e.g., implementation, timeliness), factors to be considered in an Army model of training technology transfer (e.g., incentive system, organizational structure), and current status and future trends within the Army. Shields' review provided the framework from which an Army model of training technology transfer could be developed.

In summary, both DOD and Army involvement in training technology transfer has focused on the ways to insure the acceptance and usefulness of the training research product. Although a consensus had developed as to this goal, the particular means or sequence of activities necessary and sufficient to achieve the goal had not been delineated. Based on a literature review, this report describes important activities in promoting the acceptance and usefulness of a training product. Deficiency in any one of these activities may result in unsuccessful implementation of the product.

SYSTEMS MODEL

Based on a review of the literature on technology transfer and of Army regulations pertaining to HR RDT&E, four major sequential activities were considered to be sufficiently characteristic of the Army training technology transfer process (Figure 1). The activities are defined and their associated key words presented in Table 2. References are categorized by the primary activity emphasized (Appendix C). The model was developed in accord with the following considerations.

1. The overall intent of the model was primarily prescriptive, i.e., informing the reader what is done, as exemplified in the major activities and their stages. Subsequent discussion and suggestions were designed to be predictive, i.e., informing the reader of alternative methodologies that may improve certain activities.

2. Primary focus was on describing the appropriate sequence of activities involving the initial formulation of a proposed researchable

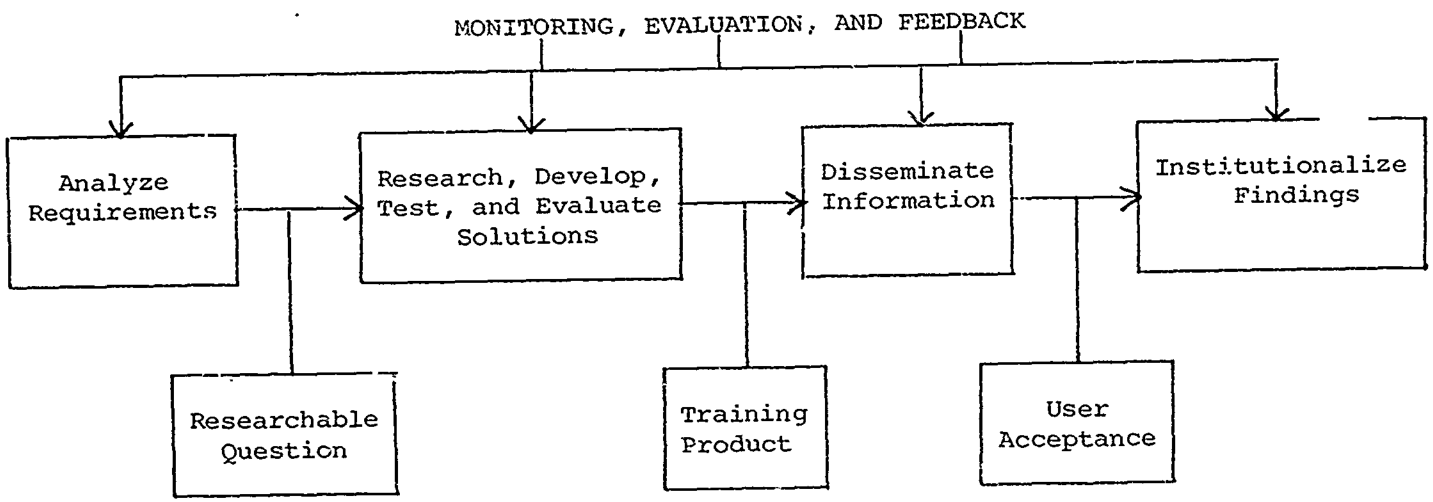


Figure 1. Army training technology transfer model.

Table 2

Description and Key Words of Each Activity in the Model

Activity	Description	Key Words
Analyze requirements	A systematic effort by the researcher and the user to determine the goals, objectives, or alternatives for the basis of a productive effort at applied research technical assistance or organizational improvement (Hambrick, 1978). Requirements analysis may be viewed as a discrepancy analysis between "What is" (current condition; baseline activity level) and "What should be" (required or desired condition). A problem may then be defined as a documented discrepancy selected for resolution (Kaufman, 1972). Techniques to assess requirements must yield information that attempts to represent the two polar conditions of "What is" and "What should be." The result of a researcher-user requirements analysis is a researchable question, directed by the user's needs, and adapted technically by the researcher's experience.	Baseline Definition phase Discrepancy analysis Forecasting Front-end analysis Needs analysis/assessment/identification Organizational diagnosis Planning stage Problem analysis/definition/diagnosis/identification Program analysis/formulation Project formulation Social & behavioral indicators
Research, develop, test, and evaluate solutions	A systematic effort to establish a scientific knowledge base (6.1) for potential solutions to specific military problem areas (6.2) and to apply this knowledge in solving a researchable question directed, in part, by a military sponsor's need and/or directive (6.3A). The procedures describing Army HR RDT&E are the most documented (by regulation and doctrine) relative to the other activities in the model. The end result of this activity is a training product that satisfies a sponsor's requirement.	Applied research[a] Assessment of casualty Basic research[b] Design, development Factor identification/manipulation Innovation/invention stage Technology application/utilization

Table 2 (Continued)

Activity	Description	Key Words
Research, develop, test, and evaluate solutions (Continued)		Prototype model/breadboard mockup Variable relationships Field testing and evaluation Validation and feedback
Disseminate information	The dispensing of information about RDT&E products to users at various distances from the points of origin of the R&D product (Shields, 1976). An ARI scientist can relay information about a particular training product to the military sponsor(s) who originally requested a need for the product, describing the product designed in response to the user's need, demonstrating its operation, providing assistance in training "front-line" users to operate the product, and turning over the whole package to the users for their own purposes. The ARI scientist can also inform other units, commands, agencies, etc., about this product, thereby broadly diffusing the findings to potential users remote from the initial application of the training product. Individuals who promote the acceptance of the training product into their/other organization(s) are called change agents or linkage agents, and the process whereby disseminated findings are convincingly demonstrated to, and by, the change agents (and other users) is called linkage or change agentry. Indicators of the dissemination of information to the user are observed in (a) professional publications, technical reports, briefings, and meetings with the sponsor/user; and (b) use of the Army Research and Development Information System	Change agentry Communication Confirmation Decision Demonstration Diffusion Exchange/feedback Flow of information Knowledge flow Linkage Reception/rejection Retrieval/memory bank Transmission

Table 2 (Continued)

Activity	Description	Key Words
Disseminate information (Continued)	(ARDIS) via its two subsystems: The Management Information System (ARDIS-MIS; provides management type information to DCSRDA and information and guidance to ODCSRDA and other Army R&D managers), and the Scientific and Technical Information Program (S&TI; supported by the DDC data bank). The end result of this activity is the user's acceptance of the training product.	
Institutionalize the findings	Following user acceptance, the time period during which the training product is incorporated and used effectively by the Army user. Ultimately, the training product becomes a stable and regular part of Army organizational procedures and user behavior.	Adaption Adoption Application Assimilation Diffusion Distribution Implementation Policy Routinization Utilization
Perform monitoring, evaluation, and feedback	A systematic effort to monitor and evaluate the technology transfer process of a training product, and to provide feedback to the researcher and user concerning changes and new requirements in the formulation and introduction of current and subsequent training technology.	Assessing the level of product use Evaluation study Implementation study Predictive model of technology transfer Project monitoring Program evaluation

[a] Also known as commission-initiated research, contract-supported research, directed-research, mission-oriented research, payoff research, targeted research, research in the service of man, technology.

[b] Also known as contracted/grant research, fundamental research, nontargeted research, undirected research, science research.

question, the translation and development of this question into a prototype training product, and the communication of the results of this product to the user for subsequent implementation. This approach is essentially a linear sequence model for explanatory purposes, although in practical terms the flow of activities may be circular at any one point within the model. For example, a training product may be disseminated to the sponsor-user who initially requested the RDT&E of the product, and the information about the training product may be presented to other interested military agencies who may in turn use this information to formulate requirements for RDT&E of a training product specific to their needs. Another example is the monitoring, evaluating, and providing of feedback throughout all four activities of the model. The researcher(s) and/or user(s) may provide critical review of the progress being made in the development/fielding of the training product. This review can result in a modification of the activity based on the agreements set forth by both the researcher and the sponsor-user.

3. The result of each activity (researchable question, training product, and user acceptance; see Figure 1) also represents the basis from which the subsequent activity is directed. For example, the researchable question is the basis for RDT&E where the result is a training product. Thus, the basis and results of an activity, as presented here, act as conceptual markers that indicate the point of progress through the Army training technology transfer model. These conceptual markers, in a top-down approach, can be translated subsequently into official documentation.

Analyze Requirements

Analysis of requirements involves the formulation of a research plan prior to development of the training product. The goal is a researchable question that is a well-conceived alternative and that guides the RDT&E activity in a direction responsive to user needs. The literature review revealed four major stages constituting analysis of requirements (see Figure 2). Each of these stages is explained more fully in Appendix D. These stages describe the procedures conducted to formulate a RDT&E effort. Moreover, current Army procedures are identified in relation to each of these stages. The Army indicators (official documentation and/or activities) of the analysis of requirements are Human Resource Needs (HRN) statements, Scientific Technical Objective Guides (STOG), DOD-approved programs, Military Themes, and the Qualitative Requirements Information (QRI) (see Army Regulations 70-8 and 70-35).

One stage in analysis of requirements is identifying problems for subsequent solutions. An example of requirements of analysis in Army training was conducted by the Board for Dynamic Training in 1971 by direction of the Army Chief of Staff. The Board identified the discrepancies between what the Army required in its training system and what it was then doing in the system. As a result of this effort, the U.S. Army Combat Arms Training Board (CATB) was formed to manage the implementation of significant new training programs. Among these newly formed programs were (a) the Training Extension Course (TEC) program; (b) lasers and subcaliber devices; (c) career-long, integrated

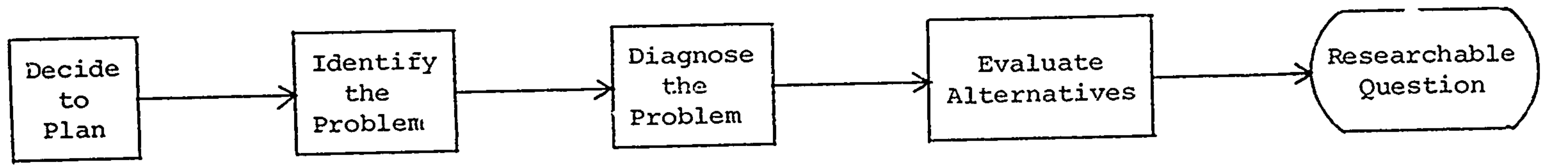


Figure 2. Analysis of requirements.

personnel management and training system for soldiers; (d) techniques in training literature; and (e) a network for exchanging ideas and requirements between operational units and the training base responsible for providing instructional materials and resources (Roberts, Daubek, & Johnston, 1977).

Four years later, a symposium was held at Fort Eustis, Va., to identify problems in instructional services provided by Army schools (Roberts et al., 1977). The 1975 Instructional Technology Symposium report specified solution strategies that were applied Army-wide to create a new agency, the Training Development Institute (TDI) of the U.S. Army Training and Doctrine Command (TRADOC). The solution strategies specified by the 1975 report essentially consisted of two programs: (a) expert instructional technology consultation and services to Army schools, and (b) comprehensive staff and faculty training programs. These programs have had an impact on other Army training development programs, such as self-paced instruction and the Integrated Technical Documentation and Training (ITDT) program; the latter is a program to change technical publications from merely reference manuals into training resources for soldiers (see also Army Research, Development, and Acquisition Magazine, 1978).

Research, Develop, Test, and Evaluate Solutions

The stages of the RDT&E solutions activity are detailed in Army Regulations 70-1 and 70-8. Figure 3 presents a general outline of the research funding efforts' impact on non-system-advanced development (6.3A). A more elaborate breakdown of the training RDT&E effort was described by the Training Development Working Group of ARI (1977). This group applied the framework of the Life Cycle System Management Model (LCSMM) (DA Pamphlet No. 11-25, 1975) of Army materiel system RDT&E to the training RDT&E effort. As Figure 4 shows, this model primarily emphasizes what the present paper subsumes under the RDT&E solutions activity. The major contribution of the LCSMM training model appears to be as procedural markers or guidelines in conjunction with the policy statements in Army Regulations 70-1 and 70-8. The major theme throughout the RDT&E solution activity is that a well-defined researchable question should be systematically investigated and developed into an evaluated training product, guided by researcher-user involvement.

Disseminate Information

Dissemination of information about a training product may proceed along two main paths. The first path is one in which communication is directed to persons other than the user who initially requested the RDT&E of the training product. The purposes here are primarily to inform and secondarily to persuade. Such activities can be found currently in the Army Research and Development Information System (ARDIS), which includes management information for DCSRDA (MIS), and scientific and technical information for scientists and other interested individuals (S&TI). Also, ARI scientists publish technical reports, provide technical advisory service, and administer the U.S. Army Human Factors Research and Development Conference in this regard. The second path is concerned with both informing and persuading the user to accept the training product. Here, briefings and informal dialogs are just as relevant as organizational sponsorship and budgetary considerations. The stages for information dissemination are presented in Figure 5.

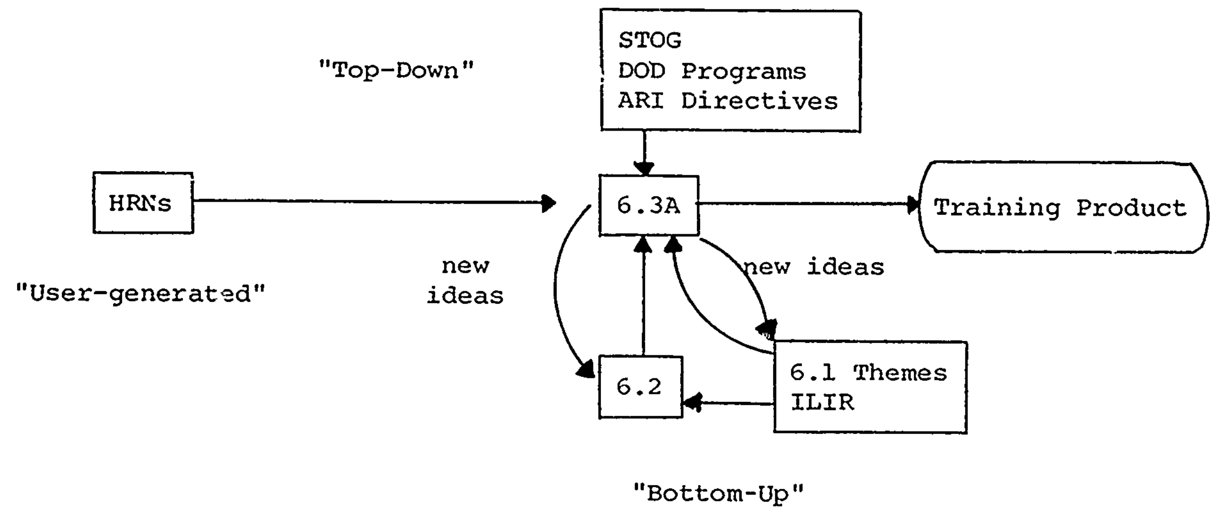


Figure 3. Activities impacting on RDT&E solutions in 6.3A research.

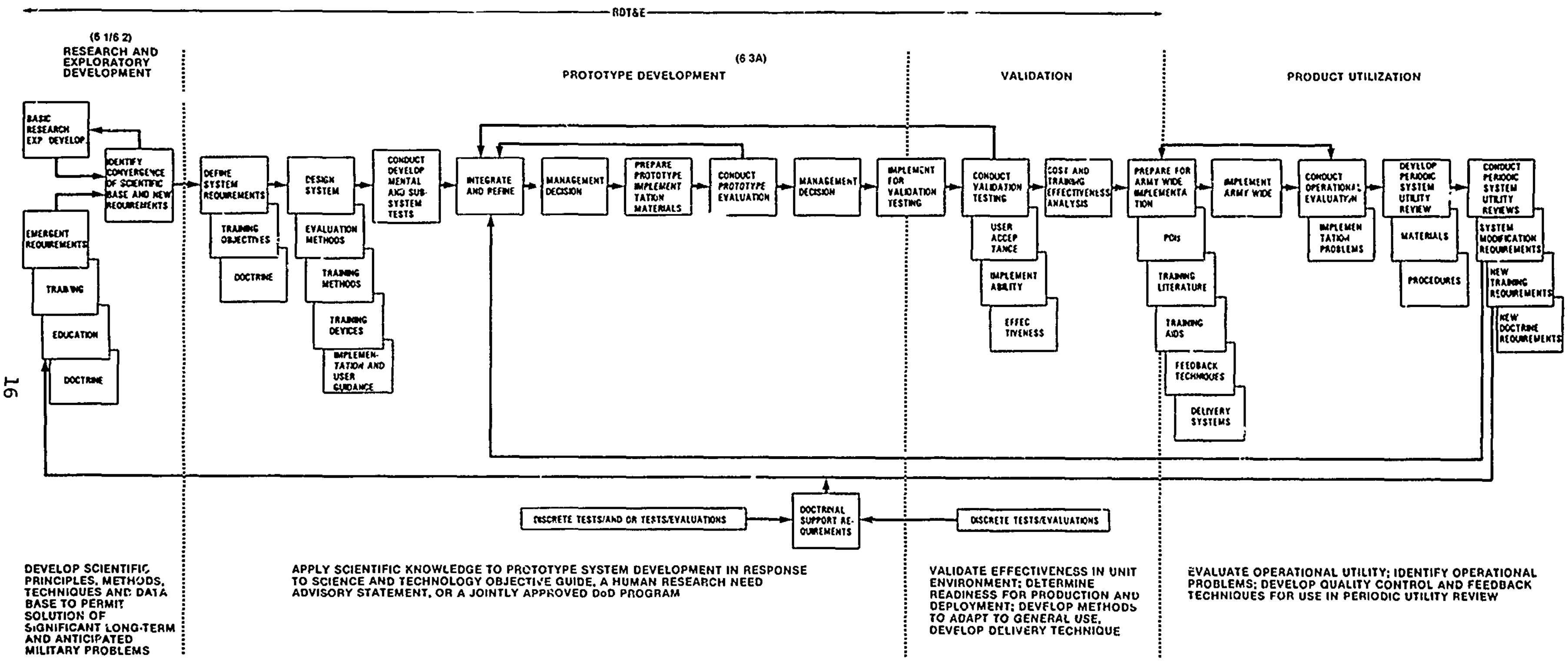


FIGURE 4 RDT&E MODEL OF ARMY UNIT TRAINING AND EVALUATION PROGRAM BASED ON THE LIFE CYCLE SYSTEM MANAGEMENT MODEL. (THIS IS A DRAFT MODEL DESIGNED BY THE ARI TRAINING DEVELOPMENT WORKING GROUP. CERTAIN TERMS HAVE BEEN ADDED BY THE AUTHOR FOR EXPLANATORY PURPOSES)

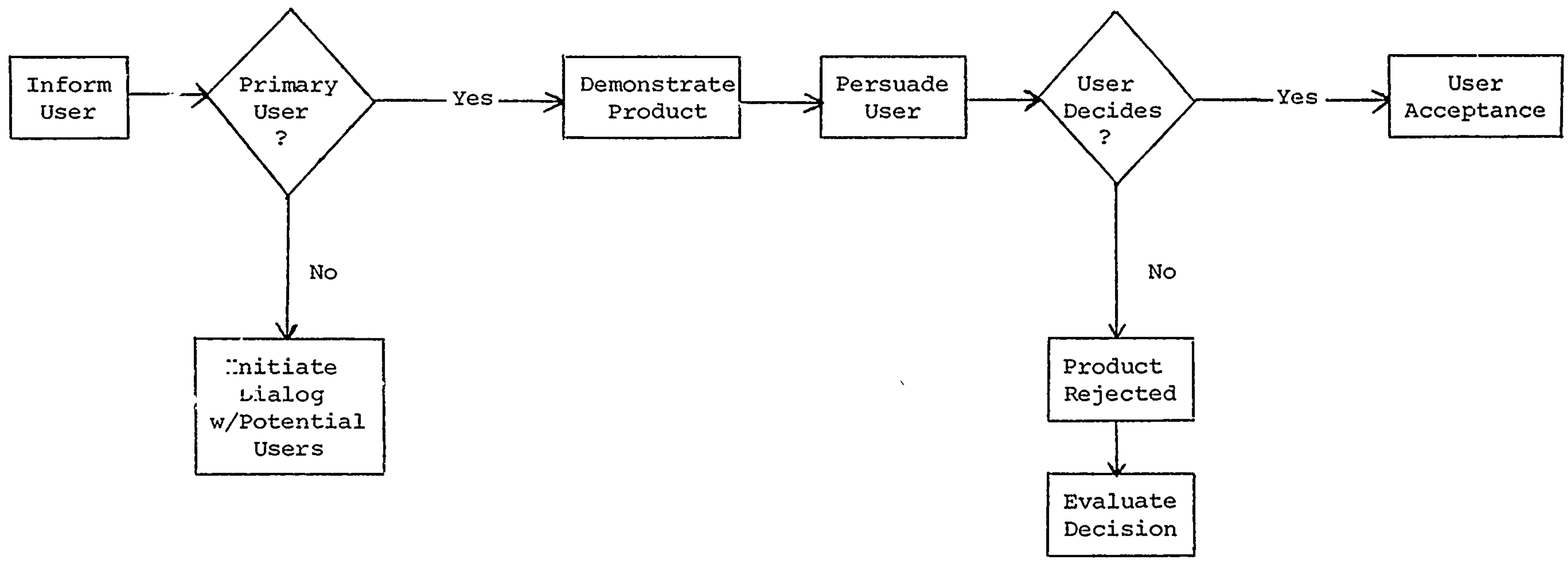


Figure 5. Disseminate information.

A significant amount of research has been conducted to develop models predictive of user acceptance through the process of dissemination of information about the training product. Thus, research has focused on variables influential in this process. As noted in Appendix B, the level of involvement of the user to which communication is directed is an important variable. Moreover, consideration of relevant factors influencing this process have been cataloged in the literature (see references in overviews and models section for more detail). For example, Table 3 presents a representative list of relevant factors underlying the success of the dissemination of information for eventual user acceptance of the training product (Shields, 1976). These factors could be applied as a checklist indicating either the presence or absence of these factors during training technology transfer, or rated along a dimension of visibility, such as completely absent, somewhat visible, completely present.

Another use of these factors has been more quantitative and predictive in purpose. This approach attempts to translate qualitative, descriptive factors deemed important for technology transfer into quantitative, numerical values which can be incorporated in a mathematical equation, whose result would provide an index representative of the predicted success/failure of the acceptance or use of a training product by the user. An example of this approach is provided by the Linker Model of Jolly and Creighton (1977) presented in Table 4. The Linker concept is used in this model as a term for effective technology transfer. The linking mechanism necessary to achieve effective technology transfer is described by identifying the factors that contribute to predicting the movement of technology from the source of knowledge (researcher) to the use of knowledge (user/receiver). The nine factors influential in the dissemination process are divided into two classes, formal and informal factors. Formal factors consist of procedures for dissemination of stor , indexing, and retrieval of knowledge. These procedures may consist of different types of informative reports designed for specific levels of uses, data banks, and/or user feedback/input documentation which influences the RDT&E of the training product. Formal factors are generally visible and easy to catalog and measure. Informal factors involve interpersonal communications and contacts; personal beliefs and feelings about a knowledge source; and perceptions about one's organization, supervisors, and peers. Informal factors are essentially behavioral in nature, measured by subjective reports that attempt to scale attitudes and response evaluations of training technology transfer. These factors are listed and described below.

Formal Factors

1. Method of Information Documentation: Refers to how the technical information is recorded; rated by the format used, organization of material, complexity of the language, ease of indexing and retrieval (e.g., ARDIS, MIS systems, executive summary style).

2. The Distribution System: Refers to the physical channel through which information flows (e.g., formal distribution lists, publications in journals, symposia presentations and conferences, informal meetings).

Table 3

Factors Within Each of the Major Categories of Variables Which May Influence Technology Transfer in the Army[a]

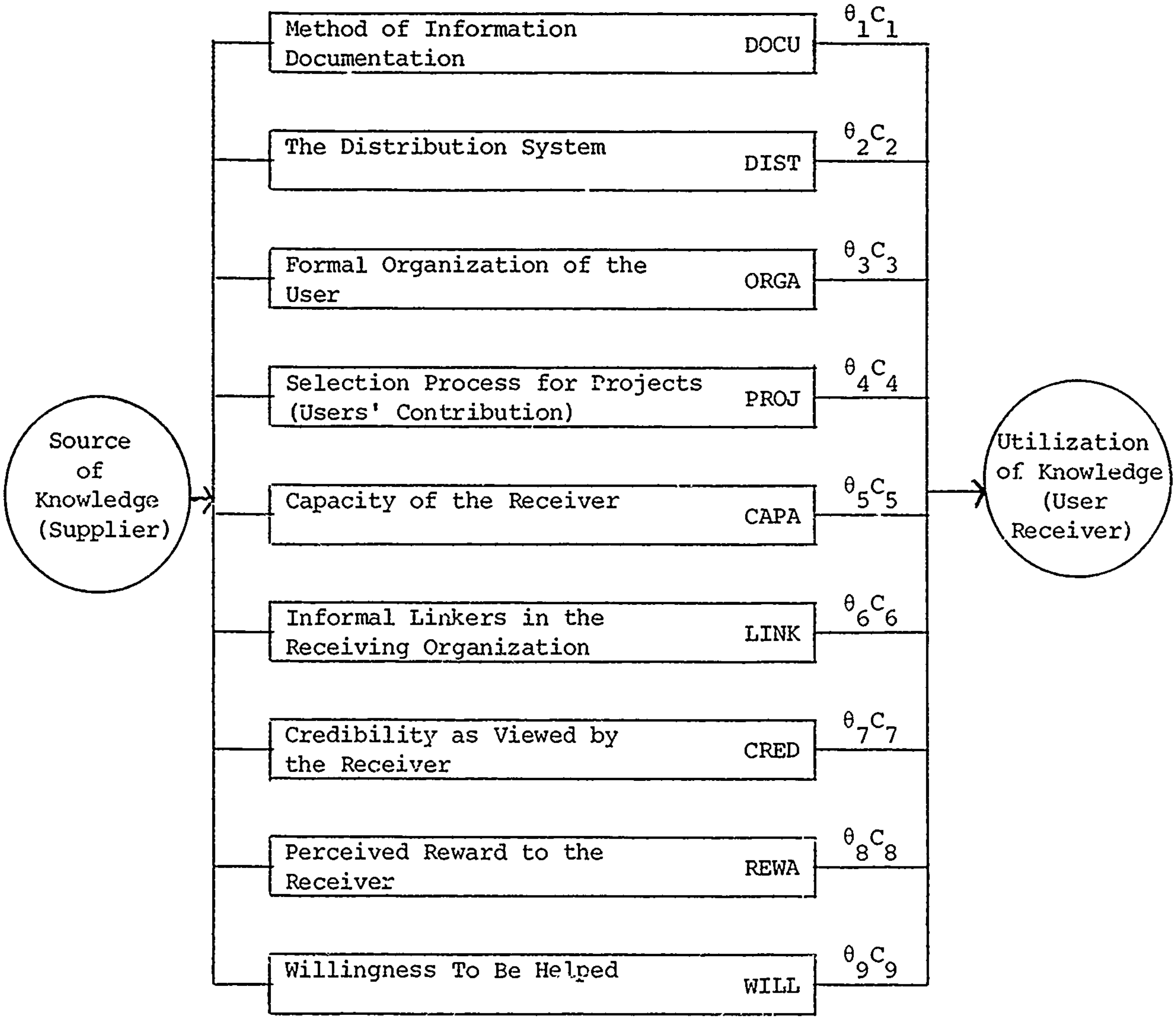
Innovation Factors	Organizational Factors	Individual Factors
Type of innovation (hard vs. soft)	Size	Education/training
Source of innovation	Formal structure	Intellectual level
Match with operating environment, capabilities of human operators and other elements of the system	Informal structure	Status in group
Reliability	Attitude toward authority	Alternatives
Complexity	Goals, values, customs	Attitude toward change
Effectiveness	Cohesiveness	Attitude toward change agent
Documentation	Communication patterns	Attitude toward authority
Ease of use	Communication with change agent	Self-esteem
Capital, personnel, and time requirements	Organizational interdependency	Satisfaction with intrinsic motivators
Visibility	Resources	Cosmopolitanism
Adaptability		Exposure to outside attitudes
		Attitude toward present equipment/system
		Attitude toward innovation
		Resources

Implementation Factors	External Factors--Milieu
Presence of a change agent	General social conditions in society
Communication channels used	General political conditions
Vigor of the communications effort	Critical events, crises, and revolutions
Form of communications (content)	Acting on the adopting organization
Characteristics of the change agent	
The supplier	
Completeness of innovation package	
Implementation delays	
Prior need	
Command support	
User participation	
User training	

[a]Shields, 1976.

Table 4

Predictive Model of Technology Transfer (The Linker Model of Jolly and Creighton, 1977)



The model may be expressed in equation form such that:

$$L_i = \Sigma\theta_1 C_1 + \theta_2 C_2 \div + + \theta_j C_k$$

Where

L_i = Linker index for an organization i
θ_j = A measure of factor utilization, θ_j range $0 \rightarrow 1$
C_k = A measure of the factor contribution, $\Sigma C_k = 1$

Note: The linking mechanism necessary to achieve effective technology transfer is described by identifying the factors that contribute to movement of technology from the source of knowledge (supplier) to the utilization of knowledge (user/receiver).

3. Formal Organization of the User: Refers to the user's perception of his/her formal organization's influence on the use of technical information; consider infrastructure elements, such as the power structure, the nature of the business, the management style, the resources available, management's attitudes, the amount of bureaucratic procedures, and the stability of the organization (e.g., dependent on levels of users).

4. Selection Process for Projects (User's Contribution): Refers to the user's input to the selection of the R&D project (e.g., feedback, HRNs).

Informal Factors

5. Capacity of the Receiver (User): Refers to the individual characteristics associated with the extent of use of a training product (e.g., traits, attitudes of a person, such as leadership qualities, educational experience, age, social status, rank, etc.).

6. Information Linkers in the Receiving Organization: The person or persons who promote technology transfer process (e.g., see Appendix B, such as sponsor's representative, commandant, front-line user, congressional staffer).

7. Credibility as Viewed by the Receiver: Refers to the user's perception (assessment) of the reliability and accuracy of the information (associated with the training product). Credibility is a function of the perceived reliability and accuracy of both the source and the channel through which the information flows. The extent of use and the rate of adopting research output correlates with the credibility of the available technology.

8. Perceived Reward to the User: Refers to the perceived and actual recognition of using an innovative product in the organization of which the user is a member; can be divided into two broad categories: (a) intrinsic--opportunity to use skills, to gain new knowledge, to deal with challenging problems, and to have freedom to follow up one's own ideas (akin to self-growth in competence tendency); (b) extrinsic--monetary reward, increased administrative authority, association with top executives, etc. (It is suggested later that technology transfer in the Army has relied more on the intrinsic reward system than on the extrinsic reward system.)

9. Willingness To Be Helped: Awareness, or familiarization, of an innovative product is not sufficient to insure acceptance and use of the product (e.g., Freda & Shields, 1979). There must be a self-interest (internal motivation) to improve one's operational setting via the use of new training procedures.

The Linker Model's main contribution is the recognition of both procedural (formal) and behavioral (informal) factors influencing successful dissemination of information about a training product. Jolly (1975) measured these factors by studying the responses selected organizations made to questions designed to describe each factor. Organizations were found to differ statistically on several of these factors--organizations defined as having employed effective technology transfer beforehand differed in these responses, relative to those organizations that were not effective. The significance of this research is that it is a first, but essential, step in predicting the success of technology transfer. One issue that needs to be resolved with this prediction technique is the development of a reference standard (baseline) against which to judge technology transfer based on the aforementioned factors in the model.

Institutionalize the Findings

After user acceptance, it is important to note the differences between the initial utilization and subsequent implementation of the training product (Drucker, 1977). Utilization refers to cooperative efforts between the researcher and user to incorporate the training product within the operational setting. This stage can involve 6.1 and 6.2 efforts to support 6.3A success. Implementation involves further use, operational adaptation, and expansion of the use of the training product. This activity is generally performed by the users above, following 6.3A efforts, and it is not generally a formal function of human resources RDT&E.

The current RDT&E funding categories present a "Catch-22" situation for the HR RDT&E community. On the one hand, congressional scrutiny of military training budgets forces the research community to justify its existence by demonstrating effective use of its training products. On a research level, this goal is translated into developing objective measures of users' benefits. On the other hand, the fiscal control lent to the HR RDT&E community officially stops at the 6.3A funding category (nonsystem advanced development), and further control of the training product is taken over or dispersed by other agencies from the 6.4 (engineering development) to 6.7 (operational system development) funding categories. This procedure carries over from weapon-systems development practice, in which software (e.g., training) development is made equivalent to the hardware (e.g., materiel system) development process. [One aspect of this analogy is the difference in visibility, for justification purposes, between a software (nontangible) product and a hardware (tangible) product.] Therefore, if the HR RDT&E community is to be held accountable for the acceptance and effective use of their training products, it would appear reasonable to allocate to that community a significant amount of budgetary control over the dissemination, utilization, and implementation of their training products. At present, Congress is asking the HR RDT&E community to be responsible for the operational effectiveness of their training products, over which that community has no formal budgetary control.

An example of institutionalization (Drucker, 1977) is a personnel test that is critically validated (utilization) and, after the user receives it, is subsequently standardized on a larger scale (implementation). Another example is a prototype training course developed for a particular training manager (utilization) which is then used by the training manager for widespread application in a number of training locations (implementation). The final stage is policy, which is not a formal part of the HR RDT&E effort. During the policy stage, use of the training product has become standard practice, defined and supported by Army regulations. When this happens, use of the training product has become "routinized" (Yin, Quick, Bateman, & Marks, 1978). The stages of the institutionalization of findings are presented in Figure 6.

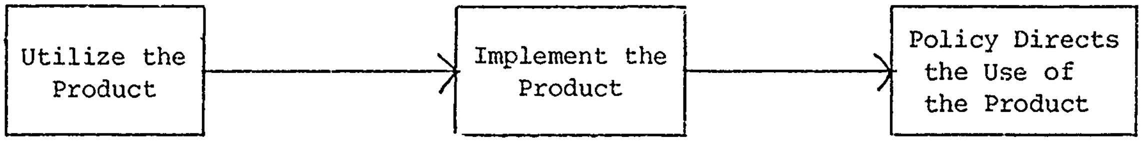


Figure 6. Institutionalize the findings.

Yin et al. (1978) have attempted to quantify and measure the stages of the institutionalization of an innovative product. They contend that an emphasis on this activity is lacking in the current RDT&E approach to technology transfer. To facilitate the analysis of the institutionalization process, the process of eventual routinization is viewed as a composite of both passages and cycles. A passage occurs when a formal transition from one organizational state to another has been accomplished. For example, establishing new procedures for instructional development constitutes a passage. A passage reflects increased organizational support for an innovative product, generally occurs only once, and is indicative of its having become a more integral part of the organization. In general, the more passages that have been achieved, the more routinized a product may be regarded. A cycle, on the other hand, is an organizational event that occurs repeatedly during the lifetime of an organization. In general, the more cycles that an innovation survives, the more routinized it is. Thus, "cycle" applies to repeated events that occur as part of an organization's operations and that may affect an innovative product.

Table 5 presents Yin's breakdown of routinization in terms of resources and operations specific to passages and cycles. Observation or use of these resources/operation occurs during particular stages of the routinization process. Similar to the stages of the institutionalization process are the stages of the "life histories" process underlying routinization. These stages are improvisation (utilization), expansion (implementation), and disappearance (policy). The improvisation stage is the initial period, following user acceptance, during which the product is used, and no significant passages or cycles need occur during this stage. The main goal here is to use the product at some meaningful level/frequency for some specified period of time. The expansion stage is characterized by the growing use of the product and the achievement of several passages and cycles. Finally, the disappearance stage involves the completion of the remaining passages and cycles. During this stage, the product continues to be used but eventually loses its recognition as an innovative product--i.e., it achieves the status of standard agency practice (policy).

Table 6 organizes the occurrence of passages and cycles, along with their respective resources/operations, into specific stages of the life history of an innovative product. Table 7 presents 10 factors associated

Table 5

Organizational Passages and Cycles Related to Routinization

Type of resource or operation	Passages	Cycles
1. Budget	Innovation supports changes from soft to hard money (2)[a]	Survives annual budget cycles
2. Personnel		
Jobs	Functions become part of job descriptions or prerequisites (5)	--
Incumbent turnover	--	Survives introduction of new personnel (9) Survives promotion of key personnel (8)
3. Training		
Pre-practice	Skills become part of professional standards, professional school curriculum (7)	--
In-service	--	Skills taught during many training cycles
4. Organizational Governance	Establishment of appropriate organizational status (3) Use of innovation becomes part of statute, regulation, manual, etc. (6)	Attainment of widespread use (10)
5. Supply and Maintenance	Supply and maintenance provided by agency or on long-term (contract) basis (4)	Survives equipment turnover (1)

[a]Numbers refer to 10 passages and cycles studied in actual life histories (Yin et al., 1978).

Table 6

Summary of Passages and Cycles in an Innovation's Life History

Passage or cycle number	Life history stage	Number of case studies achieving each passage or cycle
	Improvisation stage	
	(no necessary passages or cycles)	
	Expansion stage	
1	Equipment turnover	13
2	Transition to support by local funds	18
3	Establishment of appropriate organizational status	14
4	Establishment of stable arrangement for supply and maintenance	15
5	Establishment of personnel classifications or certification	12
	Disappearance stage	
6	Changes in organizational governance	7
7	Internalization of training program	6
8	Promotion of personnel acquainted with the innovation	6
9	Turnover in key personnel	7
10	Attainment of widespread use	10

Source: Yin et al., 1978.

Table 7

Factors Associated with the Facilitation of the Routinization of an Innovative Product

1. Core application in an agency's activities
   - Determine by observing if innovative product has displaced some significant function
2. Minimal competition for resources among different applications
3. Service payoffs; should include
   - Specific nature
   - Perceived by many people
   - Consensus that payoff exists
4. Prior need for innovative product
5. Client support
6. Community support
7. Top administrative support within the agency
8. Practitioner support within the agency
9. Active innovator support
10. No adversary group that specifically opposes the innovative product

Source: Yin et al., 1978.

Note: Factors 5, 6, 7, and 8 can be used in relation to the different levels of users presented in Appendix B.

with the facilitation of routinization of an innovative product (Yin et al., 1978).

Table 8 displays the extent of influence these 10 factors had on routinization in various locations using different innovations. The routinization process is graphically portrayed in Figure 7.

The relevance of Yin's approach to Army training technology transfer resides in the use of organizational indicators to define the extent that a training product is successfully incorporated within an operational setting. Within this framework, reliance upon indicators such as utilization reports (AR 70-8) provides only a partial picture of where the product stands in the way of incorporation. Other indicators could be modified and incorporated by Army decisionmakers into an "institutionalization checklist," which would provide a documented metric of product utilization.

Monitoring, Evaluation, and Feedback

This activity is ongoing throughout all the main activities of the model. For example, during requirements analysis, emergent requirements from the field or policy makers can be evaluated and possibly incorporated into the formulation of ongoing RDT&E efforts. During RDT&E, user-researcher dialog can result in review of training design respecification for possible incorporation into ongoing R&D efforts. During dissemination and institutionalization, researcher and user feedback can provide information to guide the acceptance and effective use of a training product. Models predictive of technology transfer are also used to measure the extent of successful incorporation of a training product during institutionalization. Methodologies employed in this activity consist of multivariate prediction models, on-site interviews, and monitoring and user feedback reports. A major point of emphasis is that this activity should be continuous, even during the institutionalization process. Once a training product is defined as standard practice (policy or routinization), monitoring and evaluation of this practice can result in a new emergent requirement, which in turn initiates the training technology transfer process. Notice that, as previously mentioned, the training technology transfer process is cyclical in nature, and only linear for explanatory purposes.

DISCUSSION AND SUGGESTIONS

The following topics present discussions of the aforementioned model, and suggestions to improve Army training technology transfer.

Organization of Regulations and Procedures

The procedures defining certain aspects of Army training technology transfer are in several documents. It is suggested that an ARI regulation could consolidate relevant sections of Army regulations in accordance with the model presented in this paper. A general outline is presented in Table 9 to help in this endeavor.

Table 8

Presence of 10 Factors Hypothesized to Facilitate Routinization (Case Studies)

Degree of routinization/site[b]	Type of innovation	Ten factors hypothesized to facilitate routinization[a]									
						Strong support for innovation by:					
		Core application	Minimal competition	Payoffs[c]	Prior need	Clients	Community	Adminis-trators	Practi-tioners	Active innovator	No adversary group
High											
Indianapolis (10)	PC	+	+	+	+		+	+	+	+	+
Birmingham (9)	MICU	+	+	+	+	+	+	+	+	+	
Dallas (9)	CAI	+				+		+	+	+	+
San Diego (9)	CAI	+		+			+	+	+	+	+
Nashville (8)	PC	+	+	+		+			+	+	
Miami (7)	PC	+	+		+		+	+		+	+
Boston (7)	PC		+	+				+		+	
Cincinnati (7)	BT	+	+	+	+			+	+	+	+
Moderate											
Akron (5)	BT	+	+	+	+	+		+	+	+	+
Dallas (6)	MICU	+	+	+	+	+	+		+	+	
Rochester (6)	J-A		+	+				+		+	+
Omaha (5)	J-A		+	+	+			+		+	+
Tampa (5)	CAI									+	+
Memphis (4)	BT	+	+	+		+			+	+	+
Portland (4)	CCTV		+							+	+
Marginal											
Oakland (2)	CAI		+								
Omaha (2)	CCTV		+			+				+	+
Rochester (2)	CCTV		+					+			
Denver (0)	MICU		+	+			+			+	

Source: Yin et al., 1978.

[a]The presence of these factors is indicated by a plus (+) symbol in the table.

[b]The routinization score for each site is shown in parentheses.

[c]"Perceived" payoffs, not the result of any evaluation.

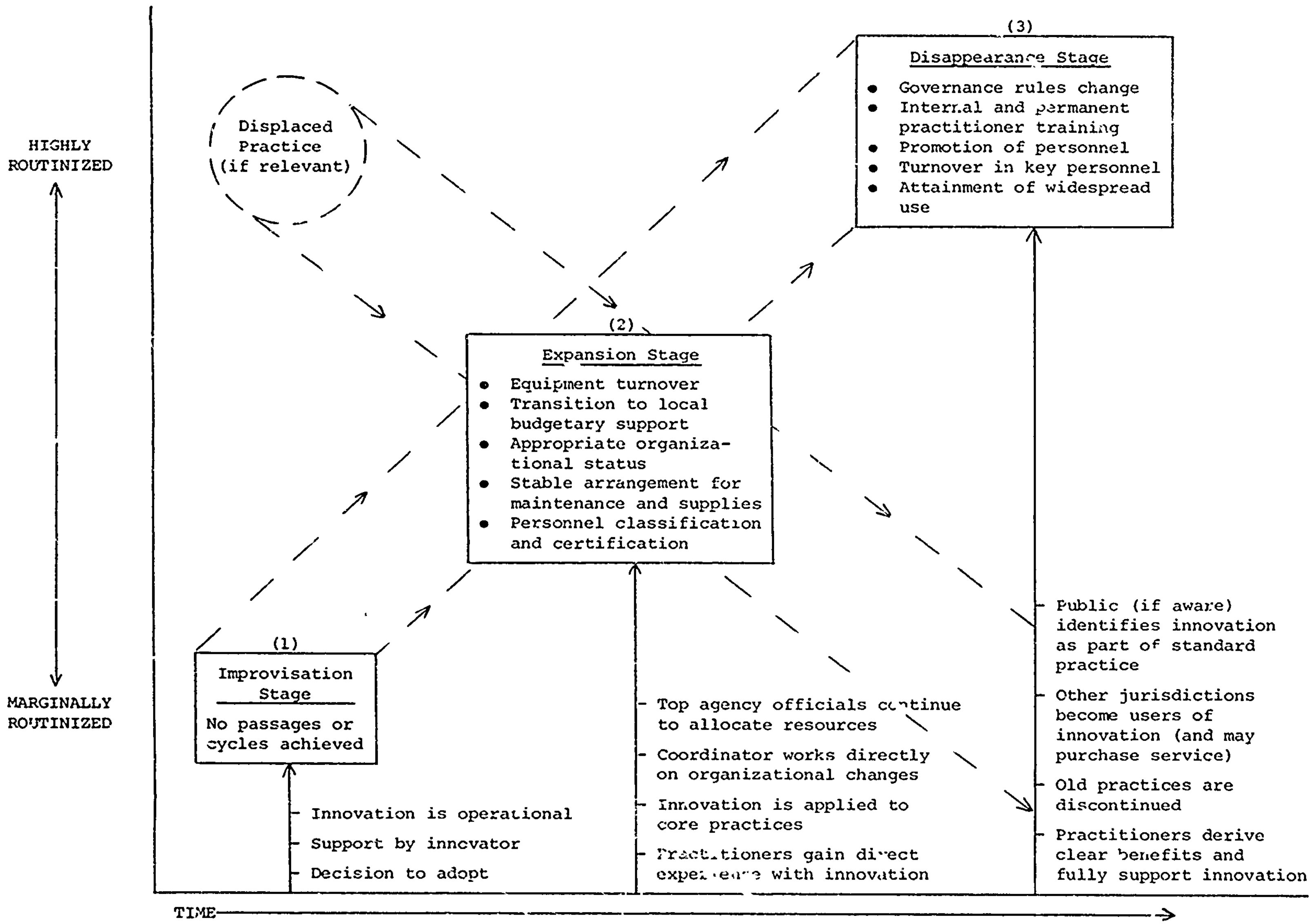


Figure 7. Routinization process (Yin et al., 1978).

Table 9

Relationship of Army Regulations to Model Activities

Activities	Analysis of requirements	Research, develop, test, & evaluate solutions	Disseminate information	Institutionalize the findings
Indicators	HRN STOG DoD Program (AR 70-8) TAS QRI/QRRI (AR 70-35)	Progress Reports (AR 70-1) Meetings (AR 70-8)	ARDIS S&TI (AR 70-45) MIS (AR 70-1) TAS (AR 70-8) HFRDC (AR 70-26)	Utilization Report (AR 70-8)
Agencies Involved	ARI Contractor DCSRDA DCSPER FORSCOM/USAEUR TRADOC Sponsor	ARI Contractor DARCOM Sponsor	ARI DCSRDA DARCOM Sponsor	Sponsor
Oversight/ Audit Boards	Scientific Advisory Board & GAO			

Essentially, one regulation could serve as a system concept document whose sections are defined in terms of the activities of the model. Specific parts of the current Army regulations can be incorporated within each activity of the model. The indicators are presented in Table 9 for that purpose. It is assumed that, if the general flow of the model is accepted as reasonable, then Army decisionmakers will be able to clarify problems in training technology transfer.

A Comprehensive Requirements Analysis

Shields (1976) discussed how current models of technology transfer do not provide adequate information (a) to insure the success (or improve the chances of success) of the implementation process, (b) to promote the timeliness of technology transfer (i.e., turnaround time from what is wanted to what is produced), and (c) to incorporate a wider range of influential factors, such as economic, organizational, and political considerations. One way to achieve these objectives is to weigh systematically and exhaustively the range of effect (positive and negative outcomes) of a proposed training product during the analysis of requirements stage. Such a procedure is presently lacking in training technology transfer. An attempt to accomplish this task has been initiated by the Navy Training Analysis and Evaluation Group (TAEG) with a contract to IBM to develop a comprehensive educational technology assessment model (ETAM; see references in the Analyses of Requirements section of Appendix C). The ETAM can be viewed as a set of procedures to evaluate whether a proposed training innovation is worth the subsequent RDT&E effort. Details combining an overview and steps in ETAM are presented in Figure 8 and Appendix E. The ultimate goal of ETAM is a computer-based system which contains (a) taxonomic information of major classes of training products, (b) input and retrieval capabilities to compare/contrast the proposed innovation with those already contained in the data base, and (c) interactive routines of cost-benefit analyses using both qualitative and quantitative weighting factors to estimate the worth of the training product. The relevance of ETAM to the Army training technology transfer process resides in its structure for a comprehensive requirements analysis. Army decisionmakers might find ETAM's flow of activities helpful in defining the decision stages of user-researcher interaction so as to facilitate the clarity of user needs, translated into a researchable question. The main point here is the emphasis on clarity of problem definition.

A Methodology for the Dissemination of Information

There is at present no set of procedures outlining a sequence of steps to promote the acceptance and use of a training product. Welsh (1977) has developed a methodology which may resolve some of the problems associated with the dissemination of information. This methodology is designed to satisfy user requirements through the systematic dissemination of products.

The methodology consists of 10 primary steps:

1. Planning,

2. Product modification,

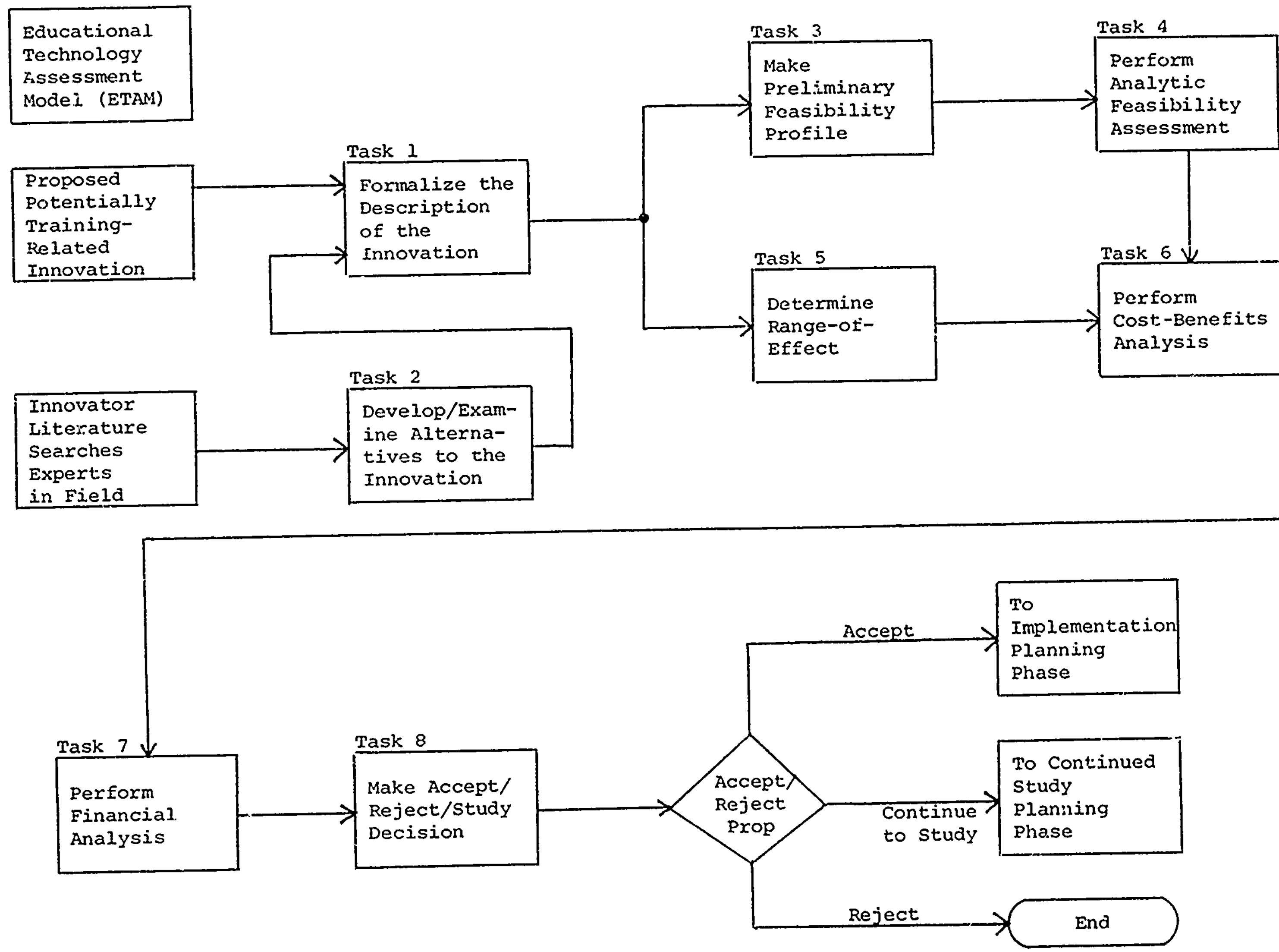


Figure 8. ETAM procedural sequence.

3. Identifying appropriate diffusion strategies/tactics,

4. Conducting needs assessments,

5. Focusing upon specific target audiences,

6. Identifying early adopters and opinion leaders within targets audience,

7. Setting forth procedures for contacting early adopters and opinion leaders,

8. Utilizing early adopters and opinion leaders to sustain diffusion plan,

9. Systematically evaluating effects of a product upon targeted settings, and

10. Systematically evaluating diffusion strategies/tactics in relation to product impact upon targeted audiences.

Steps 1, 4, and 9 pertain to conditions for change; step 2 pertains to characteristics of the innovation; steps 5, 6, and 7 pertain to characteristics of the target audience; and steps 3, 7, and 8 pertain to linkage systems. Only characteristics of the innovator are not addressed by the methodology (see Wolf, 1977, for description of linkage agents' training program). Appendix F describes Welsh's methodology in more detail.

The importance of this methodology for Army training technology transfer is the specificity of guidelines to promote user acceptance of training products. It is plausible that Army decisionmakers could consider the use or modification of this methodology as a first step in understanding the dissemination process.

Documenting the Institutionalization of a Training Product

Although current funding control of Army training technology transfer stops at the 6.3A level (user acceptance), congressional concern still focuses on the accountability of human resources RDT&E to develop and produce objective measures of user benefits. One aspect of this concern is to document the flow of activities during the institutionalization of a training product. It is suggested that one way to do this is to use or modify the passage and cycle framework developed by Yin et al. (1978). By documenting those passages and cycles that occur during the utilization, implementation, and policy stages, Army decisionmakers can determine the extent of incorporation of a successful or unsuccessful training product. Table 10 presents a proposed classification scheme to document activities during the institutionalization of a training product. This scheme could be incorporated into an ARI regulation, consolidating information with respect to Army training technology transfer.

Table 10

Proposed Classification Scheme to Document Activities During the Institutionalization of a Training Product[a]

	Utilization	Implementation	Policy
Passages	End of 6.3A support Utilization Reports	Transition to support by local agency funds Establishing of appropriate organizational status Supply and maintenance provided by agency Training product functions become part of job description or prerequisites	Use of training product becomes part of regulation, manual, etc. In-house training program develops skills to use training product, which becomes part of professional standards and curriculum
Cycles		Survives equipment turnover	Promotion of personnel acquainted with the training product Turnover in key personnel Attainment of widespread use (standard practice)

[a]Based on the work of Yin et al., 1978.

Recurrent Factors to Consider During Training Technology Transfer

Two major classes of factors recurrent throughout the whole training technology transfer process are sponsorship and self-renewal capability.

Sponsorship. The authoritative support and/or active proponent of a training product and necessary considerations influencing the successful incorporation of an innovation sponsorship may be viewed on two levels.

1. User. Initially, highly authoritative policy makers are needed to promote the technology transfer process. Researcher interaction with all levels of users should follow, however, to insure the endurance of this process to completion (i.e., acceptance and effective use of the training product by the user). That is, successful incorporation of the training product will depend more on within-unit sponsorship as the technology transfer process proceeds. At the outset of a project, active proponents should be sought and encouraged, such as a sponsor's representative who would work closely with the researcher throughout all the activities of the training technology transfer process. This linkage agent role for the user would help to minimize current and subsequent resistance from the eventual "front-line" user (i.e., those at the implementation and receiver levels of users). For example, the sponsor's representative could be given a temporary-duty status or assigned "contact" days to work and consult "in-house" with the researcher. During this arrangement, the representative could deliver or arrange seminars designed to explain the training product to prospective user agencies. Pros and cons could be discussed at these meetings, details negotiated, and feedback provided for incorporation into the RDT&E activity. Thus, user resistance encountered during these sessions would be recognized, discussed, and perhaps resolved prior to full-scale dissemination of the training product. Therefore, the sponsor's representative would act as a coordinating influence, translating "front-line" user concerns into useful RDT&E considerations.

2. Researcher. It is the researcher's responsibility to determine the technical feasibility of satisfying the user's requirements. Sponsorship within this framework focuses on the RDT&E support given to a training product. Collocation of researchers with users, such as ARI field units, is one way in which this support can be perceived more quickly by the user. It is suggested, however, that the role of field units be expanded to include responsiveness to regional (vs. local) Army needs, with major and minor research efforts allocated jointly by the field unit and ARI Headquarters. Similar efforts have been demonstrated by the Navy's Field Engineering Offices, which have resulted in greater timeliness in response to user requests for innovations. It is realized that, in the extreme, collocation could result in parochialism and unresponsiveness to the global needs of the Army (Sands & Glaser, 1978). However, with these considerations in mind, the lag in implementation of training technology R&D findings has been shortened when RDT&E has been collocated with the user (Alluisi, 1977).

Self-Renewal Capability. This factor refers to those variables which help the user to incorporate and maintain the training product after researcher intervention. Several variables are relevant here:

1. Training. Introduction to and on-the-job training in the use of the training product for both administration and implementation levels of users should be initiated no later than the dissemination of information activity. Effective training programs should be coordinated with the researcher and user (i.e., at this stage, the training schools would be considered a "user" also), with the ultimate goal of within-agency (in-house) training programs that would prepare subsequent new personnel for using the training product. In-house training programs, thus, promote both initial competency as well as endurance of the use of the training product.

2. Resistance. As implied earlier, resistance to a novel training product is a normal phenomenon. However, resistance may also be viewed as an indication of a lack of researcher-user cooperation to prepare "front-line" users for the outcomes of the training product. Resistance can be lessened by (a) early researcher-user involvement in the training technology transfer process, (b) the sponsor's representative serving in an active linkage agent role (i.e., marketing and persuading prospective agency users), and (c) suitable training prior to the incorporation of the training product within a unit.

3. Money. Budgetary considerations should be planned and evaluated during the analysis of requirements activity. Fiscal obligation for supporting the institutionalization of the training product requires strong sponsorship at the policy and administration levels of the user. There is no use in directing efforts toward user acceptance if subsequent institutionalization of the training product will not be funded.

4. Personnel Turnover. This concern is important in the Army because of frequent tour-of-duty changes (every 2 to 4 years). As mentioned earlier, a good in-house training program should lessen personnel turnover problems in maintaining the use and incorporation of a training product. Also suggested is an extended tour of duty for those key personnel involved in the initial utilization of a high-priority training product. Such an extension may provide the necessary foundation for the subsequent implementation and standardization of the training product within the unit.

5. Reward (Incentive) System. A set of procedures (regulations) should be instituted that provides incentives for researcher-user efforts in training technology transfer. For example, both implementation and receiver levels of the user could be given official recognition/awards, cited in their personnel records for promoting/using the training product in an effective manner. Both policy and administrative levels of the user could be given more budgetary and policy leeway to promote training technology transfer (i.e., such as being allowed to spend money saved in implementing the training product, in other areas given high priority by the local user agency). Other possible incentives are accelerated promotions and/or seniority, choice of tour of duty, choice of training programs, or monetary bonuses.

Possibilities for an Evaluation Scheme

As presented earlier, monitoring, evaluating, and feedback occur throughout the entire training technology transfer process. These activities may be in the form of emergent requirements, changes in specifications during the

RDT&E effort, validation feedback reports, or research utilization prediction models. If given the funding controls, follow-up feedback evaluations should also be conducted by the researcher (outside-agency) on an annual basis, while the user (within-agency) should conduct in-house evaluations more frequently (i.e., semiannually). The specific ways of conducting such an evaluation are lacking; however, the following format is suggested for use.

To answer definitively the question of how many training products are in fact used, a systematic approach must be formulated. First, the types of training products to be evaluated must be defined. One could start by using the classification scheme reported by Drucker (1977). Second, the events that accompany the acceptance and use of a training product must be clarified and documented for data collection purposes. The passages and cycles classified under the stages of the institutionalization activity (Yin et al., 1978) could serve initially as the critical "utilization" events. Both of these suggestions are presented together in matrix format in Table 11.

If this scheme is used, certain passages and/or cycles may not be appropriate to certain training products, and thus, modifications will have to be made on an individual basis. This kind of approach would provide systematically obtained information on whether or not a utilization problem exists, and, if so, the degree to which this problem extends into the institutionalization activity, and for what products. Additional information needed to address this problem is proposed in Appendix G.

A Proposed Modification of Current RDT&E Funding Categories

As mentioned previously, materiel system RDT&E categories are used in training research RDT&E. These categories essentially direct the flow of, and diffuse responsibility for, training technology transfer. Unfortunately, neither near-term nor long-term training R&D efforts can be isolated into discrete operational control afforded by the current RDT&E categories. Even well-planned training research involves (within-category) serendipitous findings which promote reflection on and modification of ongoing research efforts. It is suggested, therefore, that it would be desirable to modify the present funding categories. The objective of this proposal is twofold: (a) to provide some degree of fiscal and operational control by the research community over the institutionalization of training products, thus providing the research community with the capability of sharing the accountability for the acceptance and effective use of the training product, and (b) to provide timely and well-planned training research programs that support Army decisionmakers for both near-term and long-term problems.

Specifically, this proposal suggests an incorporation of 6.1-6.7 funding categories into two research funding activities administered by ARI. This suggestion is outlined in Table 12. The primary proposed modification to the present RDT&E funding system, as stated above, is the full-scale operational and budgetary control inherent in the Programmed Fund. This control promotes acceptance and effective use of a training product. The Programmed Fund is designed to provide a well-planned effort to improve training technology transfer. This effort is realized in an "Implementation Plan" which

Table 11

Proposed Classification Scheme To Measure "Product Utilization"

Classification	Utilization	Implementation	Policy
Research findings (data)			
Tests and other measurement instruments	End 6.3A support (P)[a]	Transition to local funds (P)	Regulation promulgated (P)
Research tool	Utilization reports (P)	Appropriate organ. status (P)	Training program estab. (P)
Training program		Agency maintenance (P)	Promotions (C)
Training literature (manuals, circulars, instructions)		Training product job descriptions (P)	Turnover (C)
Set of guidelines		Survives equipment turnover (C)	Widespread use (C)
Recommendations for change in doctrine			
New technological information			
Handbook			
Report suitable for publication in professional journal			
Any project report			
Data banks			
Technical manual			
Recommendation for change in policy			
Job aid, information			
SCP (Standing Operating Procedure)			
Policy manual			
Research material for university-level education			
Making the researcher an expert			

Note: Training product descriptions extracted from Drucker, 1977.

[a] P = passages, C = cycles; specific descriptions extracted from Yin et al., 1978.

Table 12

Proposed ARI Research Funding Activities

Analytic fund	Programmed fund
(30% - 35% budget)	(65% - 75% budget)
1. Combines previous 6.1 and most 6.2 monies	1. Combines some 6.2, all 6.3A, and adds (as appropriate) 6.4-6.7 money for extending operational control to institutionalization
2. Research directed toward providing input for both near-term and long-term problems	2. Research directed toward solving mainly near-term problems (5 years)
3. Research initiated or provided by: (a) spinoff ideas from programmed fund, (b) contracts (basic research), (c) in-house generation (ILIR), and (d) in-house problem definition research for Army training (some previous 6.2 work).	3. Research initiated from the top down (by management), or laterally (from the field). Research funding requires an "Implementation Plan," in which researchers and users document the accountability, audit trails, and evaluation schemes for each of the following activities: (a) requirements analysis, (b) RDT&E solutions, (c) dissemination of information, and (d) institutionalization.

constitutes much "front-end" analysis prior to RDT&E activity. If prior consideration is given to, and allowed for, dissemination and institutionalization problems (given adequate funding control), increased likelihood of the acceptance and use of the training products may result. Appendix H provides a suggested format for an implementation plan to guide RDT&E efforts in the Programmed Fund. Finally, the Analytic Fund would provide both the technical data base and problem-definition guidance for supporting research planning in the Programmed Fund. Whereas the Programmed Fund would see a training research project through the requirements analysis, RDT&E, dissemination, and institutionalization activities, the Analytic Fund would operate primarily within the RDT&E domain. It is hoped that this type of funding framework will provide greater researcher involvement in the control over the acceptance and use of a training product. Given the funding authority, the researcher may then feel somewhat more justified in being held accountable for obtaining objective measures of user benefits.

SYNOPSIS OF ISSUES IN TECHNOLOGY TRANSFER

Definitional Issues in General

1. Technology transfer is a process by which existing research knowledge is transferred operationally into useful processes, products, or programs that fulfill actual or potential public or private needs. The user can be defined in two dimensions: organizational sector (civilian and military), and the functional level of involvement in the Army technology transfer process (scientific/informative review, policy, administration, implementation, and receiver). These dimensions are depicted in a User Identification Matrix (see Appendix B).

Modeling and Transfer in General

1. Development of a systems model and organization of regulations to reflect the flow of technology transfer within an agency. Four major activities constitute or define human resources technology transfer in the Army:

- Analysis of requirements (e.g., needs assessment, resulting in a researchable question);
- Research, development, testing, and evaluation of solutions (RDT&E, resulting in a research product);
- Dissemination of findings (can result in user acceptance); and
- Institutionalization (starts with the utilization of the product by the user and eventually is incorporated within the user's agency as a policy matter).

2. Between- Versus Within-Technology Transfer (see Chapter 1).

Specific Needs Assessment

1. Lack of systematic methodology to assess the needs of the military user prior to the initiation of R&D. Needs assessment should consider (a) researcher-user interaction to arrive at a consensually defined researchable question, (b) program analysis techniques to define and weigh alternating research approaches, (c) cost-benefit analysis to include subjective estimates of utility of a particular research proposal, and (d) individual, innovation, organizational, political, and economic variables which would influence the formulation of an R&D plan.

2. The extent to which dissemination and R&D implementation plans should be incorporated in needs assessment. Assuming that future funding for a particular R&D product is predictable, one could plan, prior to RDT&E, how to disseminate information about the R&D plan, as well as how to transfer responsibility from the researcher to the user in line with the shift of operational funding control during institutionalization of the R&D product (e.g., shifting from 6.3 to 6.4-6.7 funds). The analogy is planned comparisons rather than post hoc analysis.

Specific RDT&E

How appropriate are the current funding categories/processes (e.g., 6.1-6.7) for human resources R&D activity? It may be desirable to consider modification of the present funding categories. Specifically, this proposal suggests an incorporation of 6.1-6.7 funding categories into two research funding activities (see Table 12).

Dissemination

1. Procedures and factors involved in dissemination of information about a research product. Dissemination occurs after RDT&E and ends in user acceptance.

2. Classification and documentation of the events surrounding the transition between researcher responsibility and user institutionalization of a research product. Congressional scrutinizing of military training budgets makes the research community justify their existence by demonstrating effective use of their training products by the target user. On a research level, this goal is translated into developing objective measures of user's benefits. On the other hand, however, the amount of fiscal control lent to the human resources R&D community generally stops at the 6.3 funding category officially, and further control of the research product is taken over or dispersed by other agencies from the 6.4 to the 6.7 funding categories. This procedure is a carry over from weapon-systems' development practice in which software (e.g., training) development is made equivalent to the hardware (e.g., materiel system) development process. Therefore, if the human resources R&D community is to be held accountable for the acceptance and effective use of their training products, a significant amount of budgetary control over the dissemination, utilization, and implementation of their training products should be allocated to the HR RDT&E community. At present Congress is asking the HR RDT&E community to be responsible for the operational

effectiveness of their training products over which the human resources R&D community has no formal budgetary control.

3. Linkage agents and change agentry effects on user acceptance of research products. A linkage agent role of the sponsor's representative would help to minimize current and subsequent resistance from the eventual "front-line" user--those at the implementation and receiver levels of users (e.g., trainers and students).

Institutionalization

1. Documentation of the critical events during the institutionalization of a research product.

2. Determining the "time line" of a research product's incorporation by a military user.

Prediction, Monitoring, Evaluation, and Feedback

1. Predicting the successful incorporation of a research product by the user. Several models have been developed to predict the outcome of a research product; this approach attempts to translate descriptive factors into numerical values that can be incorporated into a mathematical equation, whose result would provide an index representative of the predicted success/failure of the acceptance/use of a research product by the user. The Linker Model's main contribution is the recognition of both procedural (formal) and behavioral (informal) factors influencing successful dissemination of information about a research product.

2. Developing a prediction methodology in-house. To answer definitively the question of how many research products are actually used, a systematic approach must be formulated (see Appendix G).

3. Interorganizational/agency involvement. The information depicting those DOD agencies that spend RDT&E funds, and the types of RDT&E funds used is a matrix consisting of 6.1 through 6.7 funds listed along one dimension, and the names of the agencies along the other dimension. The question of interest is from-whom-to-whom are funds handed off during the transition of RDT&E funding control of the research product. This information would indicate the extent of desirable interaction with specific agencies involved in the handoff of budgetary and operational control of the research product. (For example, one could see how many agencies spend/use funds during the 6.3-6.4 interval.) This matrix would serve as a "funding flow" chart consisting of clusters of agencies which may be correlated with organizational events critical to the outcome of the research product.

4. Determining baseline success rates. Success rates of research product utilization would help to guide subsequent funding and research directions. Determining the baseline rate has not been addressed empirically. The definition issue could be resolved by using both objective and subjective sources of information, as mentioned previously. Then the scope, to be addressed, could be limited up to 6.3 (user acceptance), or could include the transition period (6.3-6.4 interval) of budgetary and operational control.

5. Monitoring, evaluation, and feedback. This activity goes on during all the main activities of the model. Once a research product is defined as standard practice (policy or routinization), monitoring and evaluation of this practice can result in a new emergent requirement, which in turn initiates the training technology transfer process.

Recurrent Issues

Recurrent throughout the training technology transfer process are sponsorship and self-renewal capability; incorporation of an innovation sponsorship may be viewed on two levels: user and researcher.

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APPENDIX A

DOCUMENTATION OF INFORMAL COMMENTS AND ANECDOTAL EVIDENCE

Document 1 (Shields, 1976)

1. In one unit, in the FORCES COMMAND (FORSCOM) SCOPES (an engagement simulation system for the infantry) was introduced, briefly used, and for the past year has simply sat idle.

2. The Training Aids and Audiovisual Support Services Organization (TASO) at another FORSCOM installation indicated that a game designed to assist tankers in learning combat tactics had not been checked out since its arrival.

3. A tank-driver trainer-simulator was found sitting in a warehouse--simply occupying a great deal of space--not training.

Document 2 (Sands & Glaser, 1978)

1. Army Case Study--The Value of Stereoscopic Viewing in Image Interpretation

The research objective was to assess the usefulness of stereoscopic viewing within serial surveillance systems in terms of quality of information obtained and the rate at which it is extracted. Both tactical and strategic types of interpretations were used in setting up performance measures which were administered to two matched groups of image interpreters. For each measure, stereo pairs were provided to one of the two groups and nonstereo photographs to the other. Data were analyzed by comparing mean scores through t-tests and analysis of variance.

Stereo viewing and nonstereo viewing of the tactical and strategic photographs were found to be equivalent in terms of the quality of information provided and confidence expressed by interpreters in the information they extracted. Accuracy and number of targets identified under the two methods of viewing were similar; that is, no statistically significant differences were found.

This research was suggested by Army researchers after they had been called in by the Air Force to consult on a similar problem. Findings in the Army research then suggested strongly that the value of stereo viewing should not be taken for granted, and, in fact, led Army researchers to suggest that the need for the stereo capability should be clearly demonstrated before new display equipment with stereo capability is developed for use of interpreters in detecting and identifying militarily significant objects. Several other research efforts by other organizations corroborated these findings.

But Army researchers found a strong existing conviction in favor of stereo and a system already highly geared up for obtaining and interpreting stereo imagery. The research had little impact on decisions to build more stereo capability, despite consistent replication of the above and the conduct of several projects on overlapping imagery (60% is needed for stereo) that indicated conditions of nonoverlap (except the small percent needed to insure 100% coverage) to be superior in time to interpret and no different in terms of accuracy or completeness of interpretation.

The practical aspects of stereo coverage argue strongly against it. In addition to the extra 30% to 40% in time required for stereo viewing by the interpreter mentioned above, there are several severe systems costs involved. It takes twice as many photographs (and processing) to cover a given area using stereo. Dollar cost as a function of the number of systems using stereo is readily derived. It also means that twice as many reconnaissance missions need to be flown (again one can compute dollar costs) and twice as many planes and lives risked.

And still systems users have persisted in using stereo.

2. Army Case Study--REALTRAIN

REALTRAIN is an improved, low-cost training and evaluation technique for use in Army tactical training exercises for combat units. Realistic, two-sided free-play tactical training employing recognized principles of learning is achieved through simulated combat engagements.

Originally this research sought to develop a method for evaluating individual tactical performance under simulated battlefield conditions. It was felt necessary first to construct job situations that would demand that a man act as he would be expected to act on a battlefield. It was, in retrospect, not surprising that the environment developed for testing became a powerful vehicle for training. The rationale which provided the basis for the initial development of methods for simulating the combat environment with a high degree of psychological fidelity led directly to the REALTRAIN method for tactical training.

Before a research organization recommends implementation of a new training method it is accepted practice to determine empirically whether the new method works and how well it works (the degree to which training objectives are achieved, the nature of the skill acquisition curve) and to compare the new method with the method it was designed to replace. This was not done with REALTRAIN. The decision was made by the Training and Doctrine Command (TRADOC) to implement the method before the standard validation procedures had been conducted.

The reasons for TRADOC's decision were (a) the heavy cost of conducting an evaluation of a new unit training technique in the field, (b) the rapid and enthusiastic acceptance of the method by troops and commanders, (c) the overwhelming face validity, and (d) the fact that no technique for realistic tactical training had previously existed.

The REALTRAIN training method was implemented by a TRADOC Mobile Training Team (MTT) during the period 3 November 1975 to 5 March 1976 at four divisional training sites throughout the U.S. Army Europe (USAREUR). The implementation in USAREUR afforded an opportunity to conduct research which could be used to improve tactical training and evaluation techniques further in an engagement simulation context, specifically providing a valuable empirical base and data source for the analysis of tactical performance by participants in the exercise, participant and controller reactions to this new method, and the cost of conducting such exercises.

That implementation by TRADOC involved a cost of several million dollars. REALTRAIN is still not being effectively utilized today for a number of reasons:

1. REALTRAIN has entailed very significant--even revolutionary--changes from the ways of past training and it was almost too big a challenge to do it well.

2. One specific resource requirement that has given heartburn has been the requirement for controllers who are required for conduct of an exercise, though controllers learn as much as the trainees.

3. Young, inexperienced officers don't like to conduct exercises and lose badly, as many of them do, even though the learning experiences are invaluable. By the same token, to be a participant casualty through inappropriate performance in the exercise is also stigmatic. To help solve the young officer problem, a leader board game has been devised to get the officers better prepared for the exercises.

4. Logistical requirements are overwhelming--training ammo is expensive, tactical radios to support control of the exercise are hard to get.

TRADOC officials have been much aware that initial successful utilization of REALTRAIN may rest critically upon keeping researchers involved in the handing-off process to help solve some of the problems of utilization. The purpose of a new program is to do just that--have researchers assist in preparing a method for implementation and observe problems of utilization and help make refinements, periodically return to reassess utilization procedures.

Comment: Normally the early grabbing of a research product for implementation before the completion of research is considered in the nature of eating the bean sprouts, intended for planting to ease famine. In this instance, however, researchers did not consider that harm had been done to the ultimate utilization of this product, especially in view of the fact that implementation aided research.

3. Army Case Study--Armor School

The Armor School, in conjunction with Naval Training Equipment Center (NTEC), contracted with General Dynamics to develop a Miniature Armor

Battlefield (MAB). The MAB had radio-controlled tanks on a miniature (6') field, with TV sensors in the tanks and hit/kill sensors; it was intended for the simulation of platoon versus platoon engagements. Development cost was approximately $1 million.

The Armor School asked HumRRO to evaluate the system and to work out training procedures. The research group had been working on a simplified version of the system which eliminated some problems encountered with the TV sensors on the General Dynamics device. The evaluation was performed with a 24-hour field exercise as the performance criterion; the system was shown to be effective for training tank crews. A follow-up in Europe using commanders' ratings as a criterion resulted in higher ratings for the system than for conventional training techniques.

The Armor School recommended that the MAB and another research product, the Armor Combat Decisions Game (CDG), be developed by TRADOC. Regulations were published governing the use of these training devices. NTEC was to have action on obtaining the devices, in simplified form, per recommendations of HumRRO. NTEC tried, however, to improve the tank model further but encountered problems with miniaturization of electronic components. A contractor could not be found to build the devices to specifications; a later attempt by the Training and Doctrine Command, Deputy Chief of Staff for Training to get the devices built through Naval Training Device Center (NTDC) failed as well.

At present the CDG is in use by the Canadian Army in their own version, successfully. The MAB has not yet been produced as a training device. Another product, a map board which was part of project RECON for Armor training, was given to NTDC, formerly NTEC, for development. It is currently confined in use to the Ohio National Guard.

4. Army Case Study--ASVAB

In February 1966, the Assistant Secretary of Defense for Manpower and Reserve Affairs requested research on a common aptitude battery that could be used by all the services in the high school testing program. The Army was designated lead service to determine to what extent the aptitude tests of the several services were interchangeable and to develop an appropriate test battery. The Armed Services Vocational Aptitude Battery (ASVAB), consisting of a common core of abbreviated forms of tests found to be interchangeable, was a first product of this endeavor and was put into use to test potential recruits in the last year of high school.

As the original research called only for the development of tests for the high school program, only those tests common across all services were considered. Thus, the service with the smallest set drove the system. From School Year 1968/1969 ASVAB Form 1 was used in high school testing; in 1972 Forms 2 and 3 were developed for high school testing, and they also became the operational batteries of the Air Force and Marine Corps. Army bowed out as Executive Agent for ASVAB research and Air Force took over.

In the middle of 1974, the ASD (M&RA) decided that as of 1 January 1976 there would be a single classification battery, ASVAB, to serve the primary selection and classification purposes of all the services, as well as for high school testing. The new requirement represented an important change of concept. To produce one selection and classification battery to serve needs of all services, the service with the largest set of requirements drove the system, and thus, a 13-test battery was necessary.

The battery was fielded 1 January 1976, but with the short lead time available, it was done with no validation, a fact which some Army observers believe contributed heavily to the large attrition rates in TRADOC schools. In addition, norms have had to be adjusted and are still being questioned in the Army, Navy, and Marine Corps.

This case study depicts the development of a product for which sponsor interest, enthusiasm, and impatience are factors that have to be dealt with to delay (rather than hasten) utilization, so that the product will have a reasonable chance to be effective in operation.

APPENDIX B

DEFINITIONS OF USER, RESEARCHER, AND TRAINING PRODUCT

User Definition

The user is defined in two dimensions: organizational sector (civilian and military), and the functional level of involvement in the Army training technology transfer process (scientific/informative review, policy, administration, implementation, and receiver). These dimensions are depicted in the User Identification Matrix, which follows. Note that the matrix is not all inclusive. It serves as a starting point to help determine what strategy is needed to facilitate training technology transfer based on the user's level of involvement and sector in the process. For example, attitudes and factors related to the training product, special group processes, and the organizational structure are important variables influencing the acceptance of an innovation (e.g., Havelock, 1976; HIRI, 1976). Knowing where a particular user is located in terms of sector and level of involvement will provide information on the user's perspective on attitudes and factors related to the aforementioned variables. If one were interested in congressional subcommittee support, then the user's perspective may be couched in terms of cost-effectiveness of the training product, political liaison, and organizational contact via a congressional staffer. Or a sponsor's representative may be interested in the ability of the training product to satisfy the sponsor's specific requirements, would be in contact with the researcher on an information and interactive basis with the researcher, and would function as an organizational link to promote change agentry with the organization to which the training product is directed. It is realized that there may be some degree of overlap when categorizing users into levels and sectors, thus the user rate within this matrix represents an emphasis other than an inclusive/exclusive classification.

Sources	Key Words
Drucker, 1977	Adoption agency
Havelock, 1976	Change agent*
	Client
	Customer
	Linkage agent*
	Receiver
	Sponsor

*I have narrowed the definition of these terms to the user only (see Havelock for expanded definition).

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User Identification Matrix

Sector	Levels				
	Scientific/ informative review[a]	Policy[b]	Administration[c]	Implementation[d]	Receiver[e]
Civilian	Members of scientific community	Congressional subcommittees			
	Project manager	SECDEF SECArmy			
Military	ARI Other DOD scientists	DCSRDA DCSPER TRADOC FORSCOM USAEUR	Sponsor's representative Training manager Commandant	Instructor Trainer Operations NCO	Student Trainee Soldier

[a]Uses information for professional review.

[b]Creates doctrine and budget levels.

[c]Executes doctrine and uses the budget.

[d]Manages, operates, and/or maintains the research product.

[e]Uses the product as a beneficiary.

Researcher Definition

The researcher is defined in two dimensions: organizational sector (civilian and military), and the functional level of involvement in the RDT&E of the training product (application and characteristics). These dimensions are depicted in a Researcher Identification Matrix, which follows. This matrix represents the primary functions of the researcher(s) in response to user requirements. An application function would involve translation of user mode into a researchable question and the monitoring of the RDT&E activity to insure that a solution is found. Characteristics functions underlie the actual RDT&E effort to produce the training product.

Sources

Drucker, 1977
Havelock, 1976

Key Words

Contract/grant monitor
Contractor/grantee
Developing agency
In-house research director
Program/project director
Researcher/bench scientist
R&D manager

Researcher Identification Matrix

	Levels	
Sector	Application[a]	Characteristics[b]
Civilian		Contractor
Military	Developing agency ARI	ARI

[a]Monitoring and evaluation of RDT&E activity to insure fulfillment of user requirements.

[b]Conduct "hands-on" research activity to find solution to researchable question.

Training Product Definition

There is a strong agreement (r = .82) between researchers and users in what they consider to be a research product, although a greater percentage of researchers (72%) check more items qualifying as research products than do users (54%) (Drucker, 1977). Of those items considered, an average of 77% of both researchers and users classify training products as research products. While a large percentage of both researchers (71%) and users (74%) consider training programs and devices as examples of training products, there is disagreement with respect to classifying training literature (e.g., manuals, circulars, instructions). That is, 85% of the researchers, and only 53% of the users, consider training literature as a research product (Drucker, 1977). Based on these data, Drucker (1977) states that "... the user does not give enough credit to research in helping him with his implementation of policy changes or may not accept that the researcher makes a contribution with such products as handbooks and manuals." It is suggested that in order for a training product to be used effectively, the user must be shown (convinced) how the product can be integrated, used, and/or maintained within one's operational setting. Training programs and devices possess considerable "face-value" structure which users can appreciate initially in fulfilling their training needs. However, training literature, as a "stand-alone" product, lacks sufficient integration to solve training needs from the users' point of view. Optimally, a training product is developed to effect a change. Differences in viewpoints as to what specific products accomplish this objective can be lessened if the researcher and user form a continuous, critical dialog during the training technology transfer process.

APPENDIX C

REFERENCES EMPHASIZING SEPARATE ASPECTS OF THE SYSTEMS MODEL

Overviews and Models of Technology Transfer

Military

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APPENDIX D

ANALYSIS OF REQUIREMENTS ACTIVITY

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
1. Decide to plan • Identify <u>users</u> and their <u>functions</u> • For proposed training products, consider following questions: a. Will proposed product or change in system reduce costs? b. Will product result in better results? c. Is the problem urgent? d. Will "management" be receptive to proposed undertaking? e. How large is the project and how long will it take to implement? Will the results be lasting? f. Can product effort and conversion costs be justified? g. Is the current staff capable of executing this project? Will additional personnel be required? h. Is product feasible with existing hardware/software?	a. Group decision of users b. Group presentation/consensus c. Representative panels based on users involvement/authority d. Interviews	(6.1, 6.2: DCSPER reviews/approves annually the 6.1, 6.2 portions of the Science & Technology program submi ted by ARI; also, as in AR 70-1, 6.1 known as Single Program Funding (SPF); work units known as Scientific areas; 6.2 known as Single Program Element Funding (SPEF); work units known as Technical Areas) DCSPER: Coordinates troop support requirements between appropriate major commands; distributes ARI 5-year plan annually to staff agencies and major commands. FORSCOM/USAERU: Sponsor RDT&E projects in consonance with their responsibility for unit readiness. TRADOC: Defines immediate and long-range training objectives, combat developments, and strategies which require advanced development.

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
2. Identify problem--sponsoring agency • Access the utility of the requirements analysis a. Obtain authorization to participate in requirements analysis b. Obtain organizational chart to determine functional level of users c. Conduct interviews/attend meetings to obtain necessary information d. Confine interviews and meetings to middle and higher management e. Review current systems documentation to the extent necessary to understand the operations of the current system f. Correlate information from relevant users g. Decide to continue or drop investigation	a. Review reports of incidents that have occurred recently in training context b. Review in-house statistics of agency c. Review current documentation and operating forms d. Record personal observations e. Interview relevant levels of users f. Meet and discuss issues with users and higher management	DCSPER: Reviews/approves annually the ARI 6.3A portion of the program following a presentation of the proposed program to sponsors and other interested agencies at which time sponsors review the program and reconfirm needs and priorities as required. 6.3A expended in response to a user requirements as stated in: a. Science & Technical Objectives Guide (STOG) b. Human Research Need (HRN) advisory statement c. Jointly approved DOD program ARI: In preparing a plan for the advanced development portion of the program, ARI will identify the work with a DA- and/or DOD-approved project. HRNs which support a procurement action will be included as supporting background documentation with the total package when processing Determinations and Findings (D&F).
• Identify domain/limitations for planning, e.g., trainee, team, field-use, etc. • Identify and select techniques for requirements analysis	a. Group participation of all levels of users as possible/feasible Guidelines: I. Outcomes of requirements analysis are stated in measurable performance terms; including all the criteria used in any measurable objective:	

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
	• Criteria usually associated with training objectives are useful here • Assessment objectives should include outcomes for at least the receiver, implementer, administrator, and policymaker, and should list objectives within each of these levels. II. Insure all "partners" in training process are involved in selection and decision. III. Do not select techniques that affix blame or could be used to do so.	
3. Diagnose the problem • Determine the existing condition for all partners ("what is") a. User levels: Receiver Implementer Administrator Policymaker b. Context: Organization Social-interactive Resources (budget, personnel, etc.) c. Insure existing conditions stated in measurable terms of performance	a. Re values of users: • Rucker's (1969) value analysis b. Re starting concerns/parameters • Sweigert's (1969) concerns analysis • Stufflebeam's (1968) CIPP analysis • Flanagan's (1954) critical incidents • Kaufman et al. (1954) utility criteria • Key Informant Approach (Hagedorn et al., 1976) • Group forum • Structured workshops	ARI: Will arrange for meetings of the principal investigator and sponsor's representative initially to coordinate RDT&E objectives and later to facilitate execution of the RDT&E effort. Technical Advisory Service (TAS): Formulate limited ad hoc consultative advice provided by Army scientists or contract consultants of the developing agencies to assist users/sponsors in formulating operational requirements in terms amenable to RDT&E treatment.

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
• Determine the required condition a. Obtain consensus information from users b. Goals/objectives in "indicator" format/Milestones Chart c. See Table D-1 d. Researcher should be aware of state-of-art assessment in training to insure required conditions are realistic within given time-frame	a. All techniques under b. in stage 3 above b. Delphi method (Dalkey, 1970) c. Bracketing method (similar to Delphi, but without a category defining requirements provided initially) [see La Bay & Peckenpaugh, 1974].	

Comments on Stage 3:

These steps essentially involve translating needs into researchable questions. Zaltman's (1978) Victory Model delineates the following factors which the researcher should be aware of when involved in Stage 3:

- Ability to communicate among the users
- Reward structure of the organization
- Availability of resources for solutions
- Time-lag for formulating solutions
- Different user levels may result in different user perceptions of problems
- Types of resistance:
  - Semantic: difficult in communication
  - Operational: imprecision in identification of problems
  - Attitudinal: organization-specific problems in information flow among users and researchers (see Zimbardo & Ebbeson (1970) for information on how to change attitudes)

• Reconcile discrepancies among users' viewpoints	Select techniques from steps in Stage 3	

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
4. Evaluate alternatives • Place priorities among the discrepancies and select a. Consider two questions when making priorities: What does it cost to meet the need? What does it cost to ignore the need? b. Objectives c. Review milestone plan d. Consideration of project magnitude • Estimating totality of meeting requirements • Budgeting • Personnel • Support manpower • Interaction with other agencies • Innovation characteristics • Sociopolitical trends	a. Representative panel Delphi Bracketing b. Large group ballot c. Face-face consensus building/ranking	For each approved project, the developer will provide milestones, man-year estimates for accomplishing the effort, and resource requirements needed for the conduct of RDT&E.
• Insure requirements analysis is a continuing process • Types of changes to consider Requirements Design Technological Social/political Personnel/manpower Corrections	a. Planning/evaluation set up within organization b. Stated in policy that requirements analysis will be updated and corrected periodically	Annually, ODCSRDA updates STOG; ARI updates its 5-year 6.3A program.

Stage	Technique	Army analog (all references to AR 70-8 unless otherwise noted)
One can attempt to control change, not eliminate it. Estimate importance of change on project costs and delivery dates. If user(s) still want change incorporated, negotiate contract modification, issue formal change notice, and proceed with R&D.		

Table D-1

Requirements Analysis Summary Table[a]

Level	User sector	Identification	Discrepancy: Current condition	Discrepancy: Required condition
Policy	Civilian	Congress DOD Secretary		
	Military	TRADOC		
Administration	Civilian	DOD Army		
	Military	FORSCOM/Staff		
Implementation	Civilian	X X X X X		
	Military	Trainer		
Receiver	Civilian	X X X X X		
	Military	Trainee		

[a]This table provides a guide for documenting what is needed if the user at each level of involvement in the training technology transfer process (see Kaufman, 1972). The table, when filled in, displays in graphic format the differences needed to be overcome for successful RDT&E of the training product. Strategies could then be developed to lessen these differences by focusing on specific levels of users.

APPENDIX E

TAEG REPORT NO. 40 (DUFFY, MILLER, & STALEY, 1970(b))

Section I

Introduction

Background

The benefits, costs, and risks associated with introducing technical innovations in education and training can invoke large commitments of resources. The rational assessment of payoffs and penalties for investing in changes therefore deserves technical attention with the objective of arriving at sound decisions to accept or reject. In essence, this means making an analysis of the full potential range of applicability of the proposed innovation in terms of benefits, liabilities, and risks, including financial analysis of costs, and synthesizing the mass of resulting data into a decision-making presentation. Key judgmental operations should, of course, be retained by humans. Explicitness in procedure and in the expression of human judgment is a key factor in rationality. The Educational Technology Assessment Model (ETAM) is a set of comprehensive procedures and variables for this analysis, synthesis, and decisionmaking. Although the content of this structure, or "model," is directed specifically toward education and training, the structure itself is applicable to any rational, decision-making context.

An innovation is broadly defined. In ETAM it is "a relatively constant or enduring change in the procedures, objects or functions used in any aspect of the instructional process which may be viewed as a benefit (or a liability) and has associated costs." Thus, an innovation may be a technical invention or it may be a structural change in the setting of instruction, such as from shore-based to ship-based training. In summary, innovations range across content of instruction, instructional procedure, student selection, and generation and implementation of training requirements.*

The initial ETAM study developed a complete set of manual procedures, parameters, and formats for all analysis, synthesis, and decision. A comprehensive, descriptive taxonomy of educational technology was generated. Its purpose was to enable any proposed innovation to be described in a standardized terminology for determining the full range of potential effect in the Navy: students, courses, jobs, instructional devices, instructional development, as areas of relevance. An equivalent effort was spent in developing or adapting analytic cost models applicable to the Navy's training environments.

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*For additional reference to educational innovations see: Miller, Robert B., and Duffy, Larry R., 1975. Design of Training Systems Phase II-A Final Report. TAEG Report No. 12-3, Training Analysis and Evaluation Group, Orlando, Fla. Chapter III.

The procedural model also included return on investment analysis, sensitivity analysis, and scaling procedures for translating subjective evaluations of relative worth into utility values. These utility expressions became inputs to formal decision tree models to be presented to the executive decisionmaker. A logical flow of information is maintained from one procedural step to the next, so that the assessor can readily review the sources of benefits data, cost data, judgments, and assumptions leading up to the final presentation of evaluation decision alternatives. The decisionmaker can change the input values to the sensitive parameters in the model and determine the effect on the decision alternatives. The decisionmaker is not restricted to working only from the formal outcomes of staff evaluations.

Assumptions About Using the Model

Some assumptions that were stated in the initial ETAM study should be repeated here.

1. The primary user of ETAM will be the assessor of the innovation. He (or the assessing team) have expertise in the subject matter of the particular innovation to be evaluated. He has mastered the ETAM classification structure, at least to the level of being able to reference its content. Furthermore, he will have had at least several dozen hours of preliminary practice in applying the procedures manually (except for calculational problems) and can "walk his way through" the major ETAM tasks. He will also have background in the operational aspects of Navy training courses, instructional devices and media, Navy jobs, and/or the developmental stages of training; at least he will be familiar with those aspects of these operations relevant to the innovation. This assumption recognizes that humans will provide the information inputs and judgments, whereas the model merely structures, guides, and within defined limits processes them.

2. The secondary user of ETAM will be the executive decisionmaker. He makes the decision to commit, deny, or commute the resource for implementing the decision. He may question the constituent or summary judgments, evaluations, data sources, and predictions of the assessor embodied in the final evaluative recommendation. He can "peel back" the various layers of data and judgments entering into the final calculations. ETAM documentation should facilitate this normal relationship between the executive and his advisory staff work. The service of the computer should aid rather than hinder this inspection.

   A key factor is the ability to identify the factors most sensitive to the decision outcome, and test the range of this sensitivity across the limit where a recommended decision choice A changes to a decision choice B.

3. The assessor will make the final judgments as to whether the innovation is or is not applicable to an entity such as a given training course, a given instruction vehicle, a given job or job-task. The

range-of-effect search operations, including the indexing of the innovation and indexing the data base content, and automatic searches on data bases, will facilitate those judgments, but not replace them.

4. The user is not compelled to apply the procedures beyond any stage where common sense shows that the outcome will be hopelessly negative. The model is segmented into stages so as to help this kind of efficient termination come about. It is easy to become disengaged from the model with a sensibly completed piece of work. The assessor is also encouraged to examine the outcome of each stage of work for being within the bounds of reasonableness.

Objectives for ETAM

The design phase of ETAM led to the specification of a set of manual procedures for assessing a proposed innovation or change in Navy training. A proper follow-on objective was adapting computerized aids for reducing the large burdens of manual activities and supplementing rather than replacing or interfering with human judgmental processes. The scaling operations leading to expressions of utility in decision models were so important that they deserved intensive study of theory and practice in behavioral utility models before adopting and standardizing on any given procedure. Another key issue was the practicability of the ETAM classification structure to the indexing and searching of the content in Navy data bases dealing with training courses, jobs, and job-tasks, instructional vehicles, and media. These issues were the basis for the next phase of ETAM.

The following tasks summarize the initial ETAM objectives:

1. A study to determine appropriate scaling techniques which would increase the expected reliability and validity of subjective estimates required within the ETAM procedures.*

2. A study to define indexing methods to provide equivalence between the ETAM range-of-effect taxonomic elements and data base descriptors for the purpose of achieving effective data search and retrieval operations.**

3. A major report presenting a comprehensive overview of the innovations in concepts, methods, and practices that have shaped and are currently influencing modern instructional technology. The purpose was to give the intelligent layman an overview of the effects of innovation upon training. Such a document would aid high-ranking military officers and business executives in making decisions on applying proposed innovative techniques and/or technologies to

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*Miller, Robert B., and Duffy, Larry R., 1975. Design of Training Systems, The Development of Scaling Techniques. TAEG Report No. 32, Training Analysis and Evaluation Group, Orlando, Fla.

**Refer to Appendix A of this report, TAEG Report No. 40.

their training system. There are parallels, but few direct equivalents, of the content of the initial ETAM report (TAEG Report No. 12-3). It would be an appropriate orienting background to the ETAM report for those using its content.

4. Computerization of the ETAM logic so that an assessor can interactively arrive at an accept/reject conclusion using various utility, probability, cost, and benefit data as model inputs. Standard program documentation and a user's guide will be produced as an output of this task.

Section II

ETAM Functional Requirements

This section of the report has two components. The first deals with the procedures arising from the steps in the operational sequence of ETAM. Each of these steps has a set of defined information inputs, processing activities, and defined information outputs. This procedural definition was presented in the initial ETAM report, but subject to modification by the results of the studies on scaling and on indexing procedures. The second component of the functional requirement is the design requirement for computer support to the procedures.

Procedural Requirements

The ETAM procedures consist of eight major tasks. The following descriptions will focus on the data management components of these tasks rather than on how they are performed since these aspects are most relevant to the functions of computerized data storage, processing, and retrieval.

Figure II-1 is a schematic of these steps.

Task 1--Formalize the Description of the Innovation. A project file is initiated to serve as a data base for Innovation X. The innovator identifies the objectives of the innovation as he conceived them, target applications, and the results of empirical studies, if any, made from the innovation, or cited as relevant to the innovation. With the assistance of a staff "assessor" with ETAM background, the prose description of the innovation is indexed according to the taxonomic classification descriptors in ETAM. The indexed innovation as a set of descriptors will be used as a search specification against data bases in Task 5--determination of range-of-effect. The information in prose form will be retained in a Task 1 file.

Task 2--Develop/Examine Alternatives to the Innovation. In this task the innovator (or other expert) is requested to consider possible alternatives to the proposed innovation which may require a lesser level of investment funding, and possibly be more cost effective. Any outcome of Task 2 will be treated procedurally like Task 1 and the outcomes of Task 1. The ultimate result will be to create a decision that compares Innovation X with the alternative Innovation XX. The profile of descriptors that indexes

Innovation XX may, or may not, be identical to the index of Innovation X. Innovation XX will generate its own file with a direct associative link to Innovation X.

Task 3--Make Preliminary Feasibility Profile. The formal assessment procedure begins at this point with a questionnaire about potential risks in the implementation, acceptance, and application of the innovation. The issues deal with organizational incompatibilities, goal/policies incompatibilities, technical support requirements, funding constraints, and problems in attitudinal acceptance by users. A format is available for entering risk estimates and comments on each of the key risk variables.

If the risks are high, risk reduction projects are formulated. Their costs are roughly estimated and the consequent risk reduction is also estimated. If the overall risks still seem excessively high, the decision to reject the innovation from further consideration may be made at this point.

A format for collecting these data is contained in Appendix B of this report (Figure B-1). The content becomes part of the Project File. It will be used in Task 4 and appear as essential data in Task 8.

Task 4--Perform Analytic Feasibility Assessment. The results of Task 3 are analyzed in greater depth and risk reduction studies and projects are further defined and costed. A preliminary decision tree is structured for providing initial guidance as to whether the innovation should be accepted outright, accepted with the additional expenditures for the risk reduction projects, or rejected. Presumably, a definitive range-of-effect study of potential benefits has not yet been justified, or a sample of already known target applications for the innovation is a sufficient working basis for this stage of assessment.

Project descriptions are prepared for each R&D effort with supporting data about resource requirements, cost analysis, and time schedules. These projects are grouped into packages, each of which is intended to reduce the overall risk to a reasonable level. A format for collecting cost/saving data is shown in Appendix B (Figure B-2).

Decision trees are developed from estimated benefits data, cost data associated with various supplemental projects, and risk estimations. Refer to Appendix B (Figures B-3 and B-4).

Note that at this stage, the range-of-effect and cost analysis has been only grossly estimated rather than derived from a full scale analysis. But even on these bases, the differences among the decision alternatives may be so large and, based on sensitivity analysis, appear so reliable, that a decision may be justified without further analysis.

If analysis proceeds further, the risk estimations and risk reduction project data are fed into Task 6.

Task 5--Determine Range-of-Effect. The prior tasks have been concerned with the assessment of the innovation over a limited range of application. Initially, it was the target applications identified by the innovator; in Task 4 a preliminary extended range-of-application was considered. Task 5 enables the assessor to apply both the formal descriptors applied to indexing the innovation and the contextual knowledge about the innovation to the full range of the Navy's inventory of training courses, instruction vehicles, and job-tasks.

ETAM stipulates that entities--training courses, job-tasks, instructional vehicles--subject to range-of-effect analysis may be indexed according to the rules of the descriptor taxonomy in ETAM formulated in Appendix A of this report. These indexed entities comprise a data base. This data base can be searched by search arguments composed of the descriptors that uniquely identify the relevant properties of the innovation.

Thus, the indexed description of the innovation that was made in Task 1 becomes an input into range-of-effect search. When the search arguments reveal hits in the data base, the assessor examines contextual information about the entity (a course, a job-task, or an instructional vehicle) and makes a judgment of relevance or irrelevance. When matches between the innovation's properties and the entity's properties are made, the assessor estimates the kind and proportional magnitude of benefit/liability that is likely to be contributed by the innovation. A method from the initial ETAM study for describing a benefit (or liability) is shown in Appendix B (Figure B-5). Ordinarily, there will be a number of benefit variables and liability variables that make up a pattern or profile applicable to the innivation's promise. The identification of affected entities (courses, etc.) is input to cost-benefits analysis, Task 6.

Task 6--Perform Cost-Benefits Analysis. The decision tree developed in Task 4 is refined to include more precise costs and savings derived from processing the tangible benefits through the model. Thus, if the innovation has been estimated to enable an average reduction of 20% for learning the content of Course A to criterion, the cost model determines how frequently the course is taught, how many students take the course and, from its base of cost data about Course A, computes in dollars the actual projected savings. In addition, the assessor uses utility scaling techniques for analyzing intangible benefits so that they are expressed in "equivalent dollars," thus enabling them to be combined into a single continuum of worth or value. Equivalent dollars is a utility expression rather than a literal dollar value. Probabilities of implementation success and user acceptance with and without the risk reduction projects are refined and the decision variables are recalculated.

The procedural model described in the ETAM Phase II-B report, "Design of Training Systems, The Development of Scaling Procedures," is the structure whereby the assessor generates multivariate utilities for outcomes in the decision tree.

The model permits sensitivity analysis of variables that could reasonably change enough to affect the choice of a decision alternative.

The output of this Task goes into Task 7, and subsequently to the decisionmaker in Task 8.

Task 7--Perform Financial Analysis. This task is concerned with assessing the tangible benefits and liabilities (those expressible in real dollars) in terms of certain economic measures. The investment costs and the annual costs and savings are calculated over a planning period extending a number of years into the future. Rates-of-return on the invested dollars are determined for the incremental effect of each alternative compared to the primary project. Alternatives consist of the proposed innovation, the existing system, and any other approaches defined in Task 2 which were considered reasonable candidates for further assessment. This assessment process provides a separate, distinct view of the value of the innovation from that gained from the decision tree assessment in Task 6. Both are inputs to the decisionmaker.

The model enables sensitivity analysis. The purpose is to give the assessor insight into the variables that could cause a change in the decision if they were to vary over a reasonably expected range.

Task 8--Make the Accept/Reject/Study Decision. The immediate bases for the making of the decision are the financial analysis, plus sensitivity analysis, from Task 7, and the decision tree data, plus sensitivity analysis, from Task 6.

However, the organized content of the data base files of the assessment project enables the decisionmaker to examine any of the constituent elements beneath the summary presentation made to him. He may substitute his own evaluations of worth, probability of outcomes, importance of intangibles, estimates of benefits or liabilities. He may "peel back" the data in each of the seven tasks by selectively accessing the files on each of these tasks. He could examine samples of range-of-effect entities contained in computer files and retrieved interactively.

The executive is thus in a position to put probes behind the facade of conclusions presented to him. He is therefore capable of reassurance in the results or direct participation in changing them according to his own values and store of information.

Comment. The preceding description is merely a synoptic outline of the ETAM procedure. It is neither a substitute nor replacement for the full description, including stipulations, assumptions, and caveats, that are contained in the source, the initial ETAM report, TAEG Report No. 12-3.

APPENDIX [illegible]

WELSH'S DISSEMINATION METHODOLOGY

Chapter III

Rationale for the Purpose and Steps of the Methodology

3.1 Introduction

The purpose of this chapter is to provide a detailed justification for the purpose and each of the steps in the methodology. Literature from such sources as rural, medical, and general sociology; economics and marketing; and education will be cited in support of the steps included.

Actually, the bulk of research reported in knowledge diffusion and utilization is concentrated in sociclogy and anthropology. Some work has been done in marketing research, although this is a much newer field. Relatively little dissemination research has been completed in education. The methodology represents an attempt to synthesize the best available knowledge from the various disciplines mentioned.

In the following pages, the purpose, and all the steps of Draft I of the dissemination methodology will be listed. This will be followed in turn by the justification of the purpose and the rationale for including each of the ten major steps.

3.2 Dissemination Methodology: Draft I

Purpose: To meet needs through the dissemination of products.

Case I: The disseminator is working for a product developer (a special case--the disseminator is the product developer)

Case II: The disseminator is working as an independent change agent (i.e., his/her remuneration would come from something like a university salary; dissemination is not his/her only major concern; rather, one of a number of interests)

Case III: The disseminator is working for a funded agency whose function is to disseminate products (for example, the Far West Laboratory for Educational Research & Development)

Case IV: The disseminator is working for a consumer or group of consumers (e.g., a school system)

I: Negotiate a contract with a product developer interested in dissemination

A. Explain each major step in the methodology to the product developer

B. Identify the product to be disseminated

C. Identify the resources available for the dissemination effort

D. Prepare the contract and secure the product developer's final approval

II: Plan the implementation of the remaining steps in the methodology

III: Have the product developer design--or adapt, if the product is already designed--the product to be as amenable to dissemination as possible, without changing the character of the product

A. Determine the resources available for this step

B. Make an initial judgment as to what general populations benefit from the adoption of the product

C. Make the product as compatible with the potential adopter's values, culture, and/or traditions as possible

1. Determine the values, culture, and/or traditions of the potential adopters

2. Determine the adaptability of the product

3. Adapt the product to the values, culture and/or traditions of the potential adopters

D. Keep the cost of the product as low as possible

1. If product costs nothing or almost nothing (e.g., a research report advocating some variety of behavior change), move to Step III.E.

2. Break the product down into component parts if possible

3. Determine which of the components are essential to the product if it is to accomplish the purpose for which it was designed

4. Eliminate those components found to be nonessential in Step 3

5. Continue to break down the components until it is relatively easy to determine the lowest possible cost for each. The total will then be the lowest possible cost for the product

6. Document cost information for use in Step V

E. Reduce the complexity of the product as much as possible

1. Steps III.D.2. through III.D.4. will have yielded components of the product. If the components are broken down as far as possible, go to Step 3

2. Break down the components into their most basic subcomponents

3. If necessary, provide explanation of the final list of components of the product

4. Document complexity information for use in Step V

F. Make the product "divisible," so that it can be tried initially on a small scale

1. Determine whether the product is divisible or can be made divisible without sacrificing its ability to accomplish its purpose. If it is not, or cannot be made divisible, go to Step III.G.

2. Determine how the product can be tried on a limited basis

   a. Determine whether only part of the product need be tried

   b. Determine whether only a part of the adopting population (given that it is made up of more than one person) needs to try the product to give it a fair trial

   c. Document all possible ways the product can be made divisible for use in Step V

G. Make the product observable, if possible, so that a potential adopter can see it in operation before he makes his decision

1. Determine whether any institutions already use the product

2. Determine whether the product developer or the disseminator can demonstrate the product

3. Document observability for use in Step V

H. Devise appropriate support services which the adopter may avail himself of after adoption of the product

1. Determine potential difficulties adopters can encounter when using the product

2. Determine which of these can be eliminated, or at least reduced, by providing support services to the adopter

3. Plan specifically support services to reduce problems identified in Step 2

IV: Identify general populations that will benefit from the adoption of the product (potential adopters)

A. Determine the resources available for this step

B. Identify general populations that have a need for the product

1. Determine all populations that could possibly have a need for the product

a. Read the relevant literature

b. Talk with people whose work is in related areas

c. Brainstorm all possible general populations

2. Determine if the general populations identified in Step IV.B.1 actually need the product

a. Read relevant literature on these populations

b. Talk with experts on these populations

c. Sample opinions from the populations themselves

d. Conduct relevant research on these populations

3. Compile a list of populations that are identified as needing the product

C. Among these populations, identify those sub-populations for whom the product fills a high-priority need

1. Implement the needs analysis methodology, using at least a sample of the target sub-population

2. Determine whether or not the need the product fills has a sufficiently high priority on the needs of the population; if it does, go to Step IV.D.; if not, select another sub-population and implement needs analysis again

D. Of these, identify, as far as possible, those sub-populations on whom the product would have seriously detrimental side effects, and leave them out of the dissemination effort

1. If the resources are relatively small, make judgment from existing relevant knowledge

a. Brainstorm possible side effects

b. Talk to people knowledgeable about those sub-populations

c. Read relevant literature on those sub-populations

d. Sample opinions from the sub-populations

E. The above steps will result in a set of potential adopters who will be the target population; if it is different from the group identified in Step III.B., consider whether or not you need to recycle from Step III.C. on

V. Identify, among the designated potential adopters, those subgroups most likely to react favorably to the product and focus communication upon them

A. Determine the resources available for this step

B. Determine those in the population who are the early adopters

1. Decide on definition of "early adopter"

2. Identify products used by the target population similar to the product to be disseminated

3. Determine those in target population who have a record of early adoption of those products

a. Examine available records of adoption of those products

b. Talk with those who use those products

c. Talk with those connected with the adoption of those products

4. Compile a list of those identified as "early adopters"

C. If resources are relatively large, and if there are a relatively large number of early adopters, determine the opinion leaders among the early adopters. If not, go to Step V.D.

1. Use other sociometric devices to identify opinion leaders (e.g., questionnaires that ask, "name the three colleagues from whom you would be most apt to seek advice with regard to (whatever the nature of the product is)")

2. If the disseminator has insufficient expertise in interpreting sociometric devices (if sophisticated sociometric devices are in fact used), employ an appropriate consultant

3. Compile a final list of those members of the target population to be the first at whom dissemination efforts will be directed

D. Develop a professional level (as opposed to friendship level) of rapport with the potential adopter identified in Step V.B.4. or Step V.C.3.

1. Observe common rules of courtesy carefully (punctuality, politeness, etc.)

2. Remain honest and as objective as possible at all times

3. Be aware of the potential adopter's professional activities, or the activities of his/her institution

4. Make your interest (if genuine) in his/her activities or those of his/her institution known to the potential adopter

5. Explain clearly to the potential adopter that your intent is to disseminate the product only to meet needs. If he/she does not see that it meets a need, you are not interested in disseminating the product to him/her

6. Explain fully your role in disseminating the product

7. Be able to explain readily any aspect of the product

E. Explain the product fully, and describe how it will meet the potential adopter's needs

1. Explain your perception of the potential adopter's needs (or the needs of his/her system). If the potential adopter's diagnosis, and if the potential adopter and the disseminator cannot reach an agreement on needs, go to another potential adopter. Otherwise, proceed to Step 2

2. Explain your perception of what the total impact of the product will be on the potential adopter's system

   a. Explain how you think it will meet need(s)

   b. Explain what negative effects may result

3. Explain the characteristics of the product that were determined/developed in Step IV

   a. Explain the cost of the product

   b. Explain how the product can be observed in use (if it can)

   c. Explain how the product can be tried on a limited basis (if it can)

   d. Explain its compatibility with the cultures, values, and traditions of the potential adopter (if it is, in fact, compatible)

   e. Explain the support services available for use if the product is adopted

VI: <u>If the potential adopter(s) decide(s) to adopt, make the product available to him/her as soon as possible, including all available support services if they are desired</u>

VII: <u>If resources for this step remain, implement the "2-step model" i.e., help the opinion leaders disseminate the product to others in the population</u>

A. Determine whether the opinion leader wants to help in the dissemination effort

B. Determine whether the opinion leader is to be trusted with the resources available for this step. If not, go to Step VIII

C. Determine how much and what kinds of resources the opinion leader needs

D. Make the resources available to the opinion leader

VIII: <u>Evaluate the results of the adoption/rejection</u>

A. The Fortune-Hutchinson evaluation methodology is recommended with the product developer as the decisionmaker

B. If adopted, evaluate its acceptance, use, and impact, including unintended outcomes

1. If it meets the adopter's need, proceed with other potential adopters in the same manner--i.e., return to Step IV

2. If it does not meet the need, or for some other reason causes trouble for the adopter, return to Step III

C. If rejected, evaluate reason(s) for rejection and return to Step III or IV, as the product developer decides (i.e., he may choose either to redesign his product or to aim the existing product at a different target population)

IX: <u>Proceed through Steps IV-VIII until the product is completely disseminated, or until resources run out</u>

X: <u>Evaluate the success of the methodology and revise where appropriate</u>

APPENDIX G

SUPPLEMENTAL INFORMATION NEEDED FOR EVALUATION

To broaden the scope of the evaluation of technology transfer in the Army, supplemental information should be obtained. The types of information needed are suggested below:

1. Within ARI, one could evaluate research products in general (of which training products form a subset). An initial step here is to categorize those products with which ARI is involved. For example, one could subjectively "factor analyze" the research products reported by Drucker (1977) into four major areas, based on their purpose (see Table G.1). Then, within each category, one could focus interest on completed products and those in the process of being completed (i.e., handed off from 6.3 to 6.4 budgetary and operational control). Within each of the completed products, determine successful (S) versus nonsuccessful (N) products. Success can be determined by objective sources (e.g., training effectiveness data, usage in terms of frequency counts) and by subjective sources (e.g., obtaining statements from different levels of users). Within the process products, select products that have a very high probability of being successful (+) and those that may or may not be successful (?). Finally, track (rate) all the products in terms of the organizational events based on Yin et al. (1978) approach (e.g., incorporation and maintenance of products over time). The completed products' outcomes will be predictive markers for the process products' outcomes. That is, if the completed S and N products cluster discriminately on Yin's organizational events, then this institutionalization approach may be used to predict the outcome of the process + and ? products. The relevance of this approach is that it may help to highlight the processes that occur during the handoff of ARI products to the user from 6.3 to 6.4 RDT&E funding and operational control. If the "6.3-6.4" interval is critical for technology transfer, then perhaps application of Yin's "routinization" approach may help to correlate organizational events with S and N products. This proposed analysis is schematized in Table G.2.

It is realized that this proposed analysis takes ARI out of its formal RDT&E boundary (past 6.3), but if ARI focuses only on the "6.3 handoff" (user acceptance) while still being held accountable for its institutionalization (6.4-6.7), events influencing this accountability (i.e., effecting the outcome of the S and N of products) may be unnoticed during the 6.3-6.4 interval. A major implication of previous assignment of accountability to the HR RDT&E community (see Note 2) is that the handling of research products through the 6.4 to 6.7 phases does not cause significant transformations on the eventual outcomes associated with the use of the product. Therefore, serious consideration should be given to studying those events that not only correlate with later incorporation (6.4 to 6.7), but also those during the 6.3-6.4 interval (i.e., the utilization stage of the institutionalization activity).

2. Supplemental to the first suggestion would be information depicting those Army/DOD agencies that use (e.g., spend) RDT&E funds, and the types of RDT&E funds used. This suggestions is a matrix consisting of 6.1 through 6.7 funds listed along one dimension, and the names of the agencies along the

Table G.1

Proposed Categories of ARI Research Products

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1. Informative-Explanatory ("What is")

   Data banks
   Job aid, information
   Making the researcher an expert
   New technological information
   Project report
   Report suitable for publication in professional journal (Scientific Report)
   Research findings (data)
   Research material for university-level education

2. Informative-Procedural ("How to")

   Guidelines
   Handbook
   Policy manual
   SOP (Standing operating procedures)
   Technical manual
   Training literature (manuals, circulars, instructions)

3. Recommendations (this is a subset of both 1 and 2 above, depending on its purpose)

   Recommendations for change in doctrine
   Recommendations for change in policy

4. Research Methodology

   Research tool
   Tests and measurement instruments

5. Training Products

   Training literature (also listed under 2)
   Training device
   Training program

Source: Based on Drucker, 1977.

Table G.2

Tracking the Outcome of Selected Research Products

Research products	History	Outcome
Informative-explanatory	Completed	Success / Nonsuccess
	Process	+ / ?
Informative-procedural	Completed	S / N
	Process	+ / ?
Research methodology	Completed	S / N
	Process	+ / ?
Training product	Completed	S / N
	Process	+ / ?

Note: Document (rate) products on the organizational events during institutionalization as listed by Yin et al. (1978).

other dimension. One could look at agencies involved in HR RDT&E research products in general, or one could delimit the field of interest to training products. The question of interest is from-whom-to-whom are funds handed off during the transition of RDT&E funding control of the research product. This information would indicate how much interaction one should have with specific agencies who are involved in the handoff of budgetary and operational control of the research product. For example, one could see how many agencies spend/use funds during the 6.3-6.4 interval. This matrix would serve as a "funding flow" chart consisting of clusters of agencies which may be correlated with organizational events critical to the outcome of the research product.

3. An a priori baseline of success rates of research product utilization would help to guide subsequent funding and research directions. Determining the baseline rate has not been addressed empirically. First, there is a definition issue. This could be resolved by using both objective and subjective sources of information, as mentioned previously. Then the scope must be addressed. The scope could be limited up to 6.3 (user acceptance), or could include the transition period (6.3-6.4 interval) of budgetary and operational control. Also, a within-Army standard could be referenced from the "hardware" RDT&E community (e.g., the Harry Diamond Labs), using their "success" rates for comparison with those of "software" RDT&E products.

It is suggested that the above-mentioned supplemental information, as well as the proposed evaluation scheme, may be incorporated with the product utilization activity of the Plans, Programs, and Operations (PPO) office of ARI. The above-mentioned suggestions might provide a conceptual framework from which the PPO office could decide future evaluative efforts on research product utilization.

APPENDIX H

FORMAT FOR AN IMPLEMENTATION PLAN*

Requirements Analysis

1. General Nature of the Problem

    a. Description of current training problem
    b. What operational problems exist

2. Reasons for Attention at This Time

    a. Congressional concern
    b. Budgetary reasons
    c. Military readiness
    d. As appropriate

3. Objectives Related to the Problem

    a. Use established statement of objectives, or, where necessary, a version of it specially tailored to the operational problem.

    b. Three essential components

        (1) Good effect or result intended to be achieved
        (2) For whom
        (3) By what means

4. Measure of Effectiveness (MOE's) Related to the Objective

    a. If the plan relates to a particular training program, use the established MOE's supplemented as necessary by others more directly related to the hypothesis being tested.

    b. Attempt to use quantitative indicators of objectives results.

    c. Don't confuse MOE's with activity levels.

5. Target Groups - Receiver Level of User

    a. Present level of training effectiveness
    b. Estimated potential level of training effectiveness

6. Beneficiary Group - Any/All Level(s) of User

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*Extracted and modified from Keller (1979).

7. Programs Related to or Affected by this Problem

   a. Local agency
   b. Command
   c. As appropriate

8. Alternative Considered

Dissemination and Institutionalization

9. How the Approved Alternative Will Operate (the detailed operational plan)

   a. Staffing
   b. Organization
   c. Relations with other organizations
   d. Policies
   e. Method of operating

      (1) Chronological account of a typical operation
      (2) Special techniques used

10. Estimated Effectiveness of the Approved Alternative

   a. Refer back to the MOE's in 4, above.
   b. Refer back to the discussion in the General Nature of the Problem in 1, above.

11. Estimated Costs of the Approved Alternative

   a. Investment

      (1) R&D
      (2) Facilities
      (3) Equipment
      (4) Initial training

      } As applicable

   b. Operating

      (1) Personnel
      (2) Minor equipment
      (3) Supplies
      (4) Direct services
      (5) Contracted services

   c. Totals--Annual
      Totals--10 year

      (1) Indicate whether the costs are in constant or current dollars.
      (2) Indicate whether present value discounting has been done.

12. Spillover Effects

a. Refer to the public agencies listed in 7, above.
b. Other spillovers
c. Coordination problems between levels of users

13. Other Considerations

a. Resistance
b. Constraints on operations
c. Linkage agent role for sponsor's representative
d. Training
e. Continued fiscal backing

<u>RDT&E Concerns</u>

14. Proposed Method of Evaluating the Approved Alternative

a. In drawing up an evaluation scheme (or research design), one must allow for certain basic concerns, to make judgments subsequently about the overall validity of the evaluation. These include

(1) The nature of the questions to be answered or the decisions to to be made.

(2) What will constitute a "success" or a "failure."

(3) The basic methodology to be employed, including consideration of the bases of comparison and the adequacy and power of the specific techniques to be used.

(4) The level of confidence which can be attached to the conclusions.

(5) The generalizability of the conclusions.

b. In dealing with these basic concerns the following more specific procedures and questions should be dealt with in full detail:

(1) What are the hypotheses to be tested?

(a) How do they relate to the stated objectives?

(b) What are the logical linkages between the overall good effect and the immediately testable good effects?

(c) Are there assumptions which can or should be converted to testable hypotheses?

(2) What measures of effectiveness are related to the hypotheses to be tested?

(a) Are these direct measures of effectiveness or are they proxy measures?

(b) If they are proxy measures, what is the basis in evidence for the presumed relationship between the proxy measure and the direct measure?

(3) Data on what other measurable consequences and items of evaluative interest need to be collected?

(4) How frequently are data on the measures of effectiveness, other measurable consequences, and other items of evaluative interest to be gathered?

(5) For how long will each category of data be collected?

(6) How, exactly, will all of these data be collected?

(a) By whom; and will they need any special training in data collection procedures? What opportunities for bias are there among the data collectors?

(b) What procedures will be followed in collecting the data? Do they create the possibility of bias creeping in?

(c) What forms will be used to collect the data? Are they clear enough? Will Privacy Act requirements inhibit the data collection effort?

(7) With respect to the experimental group:

(a) What criteria will be used to select subjects into the experimental group?

(b) How will the sample be stratified?

(c) What will be the maximum and minimum usable sample sizes?

(d) What methods or mechanisms will be used for actually selecting subjects in accordance with the criteria specified in a, b, and c, above?

(e) To what degree can the Hawthorne Effect be eliminated?

(8) With respect to the control group used as a basis of comparison with the experimental group:

(a) What exactly will be the form of comparison?

(b) How will points 7a, b, c, and d, above, be dealt with for the control group?

(c) Are there ethical or legal problems involved in choosing or using the control group?

(9) Exactly what calculations will be made using the data to be gathered?

(a) Are the statistical or other techniques to be used appropriate to the problem?

(b) Are they sufficiently powerful to produce the desired results?

(c) Have all of the data required to drive the computational models been identified?

(d) Have provisions been made to assure the availability of all of these data?

(e) If some of the data cannot be collected at all, or with sufficient reliability, what fall-back computational procedures can be used?

(10) Meeting what criteria, or ranges of values which result from the calculations, will be considered as constituting a "success"? an "indeterminate result"? a "failure"?

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