Applications Research in Instructional Systems Development

Robert K. Branson
Director, Center for Educational Technology
Florida State University
Tallahassee, FL 32306

Abstract. The Interservice Procedures for Instructional Systems Development project (IPISD, 1973–1976), which the author directed, brought instructional systems development (ISD) to the training schools of the U.S. armed forces. This article recounts the history of that project, emphasizing the problems faced, the choices made, the focus chosen, the difficulties encountered, the product that resulted, and the outcomes of the project. The author draws conclusions from this large-scale military ISD project that are applicable to applications research projects in other organizations.

This article describes the development of a large-scale instructional technology project in the military training system and some lessons learned from it. The Interservice Instructional Systems Development project was undertaken by the author and a number of associates at the Center for Educational Technology (CET) at Florida State University between 1973 and 1976. The center's mission is to take the findings of educational research out of the laboratory into the real world and to devise ways of applying those findings to produce educational results that are more economical and more effective than the alternatives. For the most part, we work with large organizations and institutions.

To carry out that mission, the center engages in applications research in a variety of related areas. Here, applications research may be defined as: the study of the processes, techniques, and variables that affect the relative success of institutionalization of research-based approaches to training technology.

Applications research cannot be conducted in a laboratory; it must be conducted in the target institutions and organizations. Consequently, it will be a long time before applications research becomes a science, or, for that matter, even an accomplished technology. Although the aim is clearly an attempt to isolate and apply valid knowledge through a systematic developmental approach within existing institutions, the majority of our operations and conclusions are based principally on observational, impressionistic, reactive, and anecdotal data. Rather than repeatedly reapplying a narrow specialty, CET has sought out a progression of assignments that give us the experience to tackle problems of increasing depth, scope, and difficulty. Currently—in preparation for some as yet unknown application—we are conducting independent research into the problems and potential of videodisc players interfaced with microcomputers.

CET has been able to carry out a wide range of projects through the use of a general systems approach to educational technology. It was our experience with the general systems approach that enabled us to analyze and deal with the project described in this article. This approach has been used in even larger scale development projects by others (Morgan & Chadwick, 1971). See particularly Morgan's (1979) article on the Korean Educational Development Institute.

The same systematic approach used here with the Army project has been used previously by the author in a variety of instructional settings, including:

- Oakland Community College, where an entire curriculum was orchestrated through a systematic approach to audiotutorial instruction (Manilla, 1971)
- The Parks Job Corps Center in California, a residential vocational school for high school dropouts (Branson & Wilkey, 1969)
- The United States Naval Academy, which served as the host institution to an applications project sponsored jointly by the Navy and the United States Office of Education (Branson, Note 1)
- The Karlsruhe American Elementary School, operated by the Department of Defense for children of government employees in Germany (Moncrief, 1973; Sands, 1972).

Although each of these projects had its own objectives, organization, curriculum, and problems, we used essentially the same systems approach for each project. The experience gained allowed us to expand systematic approaches beyond their previous limits. It was with this background that we approached the Army's training program.

The Army School System

The Army school organization resembles a typical state multiversity consisting of 23 schools, each serving a limited number of occupations. The Army's chief training officer, a two-star general in the Training and Doctrine Command (TRADOC), is charged with the design and delivery of effective training. Each of the major schools, essentially equivalent to individual universities, is headed by a general of equal rank who has a high degree of autonomy in day-to-day school operations.

Our efforts were cosponsored by the Chief of Naval Education and Training, the senior training officer in the United States Navy. Although somewhat smaller than the Army's, the Navy school system is organized similarly (Scanland, 1978).

Most of the work on the interservice instructional systems development (ISD) project was done in the Army training system. Here, the distinction between "education" and "training" lies in the degree to which one can predict the proximate occupation of the trainee. The Army trains for a highly predictable environment and exerts a considerable effort to ensure the content validity of its training programs.

The Initial Survey

In the spring of 1973, my associates and I concluded an extended series of visits to Army schools to provide an assessment of Army training. What we found in that initial survey absolutely staggered our imaginations. First, we were overwhelmed with the scope of the problem. Second, we discovered that within those schools existed some of the best and the worst examples of training we had ever observed. Third, we found that the Army had made such a faithful copy of a general academic environment, that it had even copied the lack of a quality control or quality assurance system.

We reviewed critically the way different schools evaluated trainees, trainers, managers, and training, and concluded that a major improvement in the evaluation system would cause improvement in the entire training system. Based almost entirely on norm-referenced models, the existing system required that about 5% of any class be designated as honor graduates and an equal number as failures or repeaters.

Not surprisingly, we found that most instruction followed a rigid fixed-process-variable-result instructional management model (see Figure 1). At that time, the "all volunteer Army" was just becoming a reality and a gradual decline in the aptitude and ability scores was observed. The decline in aptitude among recruits, combined with the increasingly complex nature of warfare, threatened to produce a serious shortage of well trained, skilled, and capable soldiers.

As we critiqued its schools, we also became increasingly aware of the Army's basic strengths. One of these was the ability to manage skillfully a variety of large training programs. We soon became convinced that the Army would be able to execute any innovations we might suggest (see Roberts, 1978).

		INSTRUCTIONAL TIME: fixed	INSTRUCTIONAL TIME: variable
INSTRUCTIONAL PROCESS	fixed	• Block schedule • Lockstep	• Recycling (partial) • Complete repetition
	variable	• Grouping ability achievement • Multiple tracking	• Self-pacing • Alternate paths • Prescriptive • Diagnostic assignment

FIGURE 1. One way to view the possible approaches to instruction. The Army has traditionally followed the fixed-time/fixed-process model.

As part of our review, we interviewed those who receive the graduates of the training: the field commanders. Their responses raised a number of questions regarding the quality and appropriateness of the recruits' training. These reports indicated that Army trainees were deficient in a number of areas, and, in particular, there often appeared to be a mismatch between training content and job requirements. We were later to discover that this mismatch was both serious and well documented. Its elimination remains one of the more challenging problems the Army faces.

Army Regulations

We analyzed the regulations and guidance documents, finding substantial discrepancies between what the regulations required and what was actually being done (Ricketson, Schulz, & Wright, 1970). For example, in 1968 the Army issued a regulation, *The Systems Engineering of Training* (Department of the Army, Note 2), which called for the faithful application of a systematic approach to the design, development, execution, and quality control of training programs.

When the regulation was issued in the spring of 1968, it required schools to report by July 15 of that year the number of courses that had been "systems engineered" in conformance with the regulation. In the schools we visited, the only way they could respond in so short a time to the regulation was to short-circuit the critical steps and, instead, apply a makeshift systems engineering process to existing courses, rather than doing a valid front-end analysis as the regulation required. Only by using existing and out-of-date job information could they report "progress" between the issuance of the regulation and the required report date.

This tight schedule created a wave of hostility and frustration toward the entire systems-approach-to-training process within the Army schools. Having studied the regulation at some length, it was clear to us that the only honest answer to the question, "How many courses were systems engineered by July 15th?" would have been "zero." A valid application of the process was prevented by unrealistic management-reporting requirements, not by any inherent fault in the regulation.

Staffing Formulas

The Army's training productivity guide resembles the standard formula used in state universities, where full-time equivalent positions are allocated according to the number of credit hours generated in each department (Department of the Army, Note 3). Staffing in Army schools was directly based on platform hours of instruction delivered. Thus, any effort to develop more effective instruction had to come from time invested by the department head sponsoring the program (Wager & Branson, Note 4). The regulation required the systems engineering of training, yet the staffing guide penalized anything but standard, stand-up platform instruction. In the Army, as in most institutions, when a conflict arises between program and budget, budget inevitably wins. Once established. budget stays fixed while program quality varies.

Instructor Training

We examined the training program that prepared regular and noncommissioned officers to conduct instruction in the schools. The teaching method used was, for the most part, standard platform-delivered instruction. Although this instruction was of a high quality, this teaching method was the implicit model for all future Army instructors. Regardless of its appropriateness to instructional requirements, the model remained fixed. By the time the officers and noncommissioned officers had gone through 12 years of elementary and secondary school, with many attending 4 years of a university, the implicit model was well established. It is within this context that change was attempted.

Evaluation of Results

Finally, we examined the quality control and quality assurance programs, required by regulation, and found them to be totally deficient. The students were rank-ordered and the instructors rated, but no attempt was made to evaluate the instruction or the outcomes, making it impossible to isolate problems associated with poor students, poor instruction, and poor evaluation.

In Lessinger's (1976) distinction, quality control ensures that students are taught well. Quality assurance, on the other hand, ensures that they are taught the right material—content that enables them to perform their jobs, content that could be developed correctly only through the complete front-end analysis required by the regulation. A thorough review of the Army's quality assurance program showed it to be based mainly on hearsay and anecdotal evidence passed back and forth in a sort of "teachers' lounge" environment. Because they are based on gossip instead of measurements, such evaluations may be the greatest deterrent to the improvement of education and training.

Based on these initial extensive observations as well as on a thorough document analysis conducted prior to the site visits, we recommended fundamental and thorough corrective action (Branson, Stone, Hannum, & Rayner, 1973). The recommendations were briefed to a number of key general officers in the spring of 1973; the final report was published later that year.

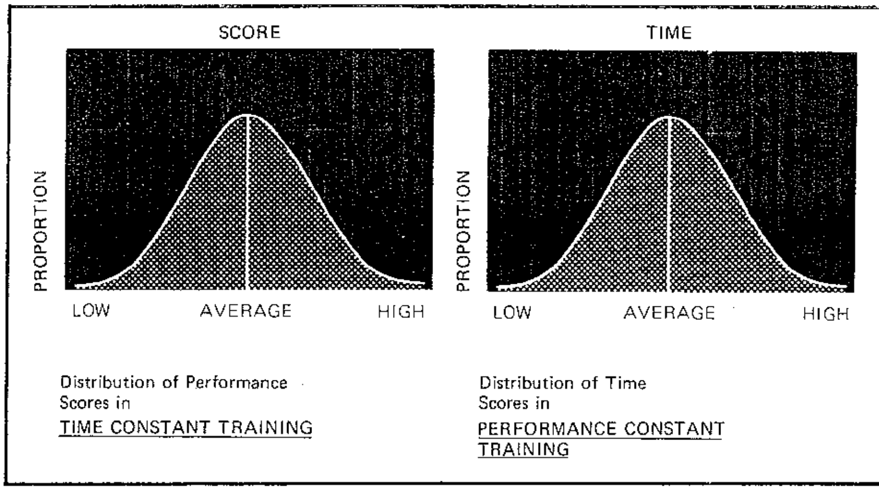

FIGURE 2. The distribution on the left represents the hypothetical results of time-constant training yielding variable results, and the distribution on the right represents performance-constant results with variable time.

The Systems Approach to Training

There were two major considerations in the design approach: (a) the general theory and practices of the systems approach to training and (b) the specific data collected during the analysis phase of the Army project.

Whether the procedures are called the systems approach to training, systems engineering of training, or instructional systems development (ISD) they all follow a similar path toward a common goal: providing more competent workers through better training. The key concept in all these approaches is planning, which involves:

- accurate identification of job requirements and problems
- setting specific performance objectives
- application of analysis techniques to the problem
- regular measurement of job performance and training results
- comparison of results to plans.

When we began our project, there already were isolated examples of well designed and delivered systematic instruction in Army schools. Though there were these impressive exceptions, the Army had traditionally followed a block-scheduled model that required a fixed-time and a fixed-training process, yielding variable results.

More recent developments in instruction strive for a greater uniformity of results through the use of variable-process, variable-time instruction including, but not limited to, self-paced instruction. In many traditional approaches (such as the Army's), the processes of training are kept constant although the results vary. One class may be about trucks and another about communication, but both are taught alike. In ISD, outcomes are identified and held constant, but the learning processes are varied in order to develop the best training to meet those outcomes. Figure 2 indicates the basic choices available to instructional designers, either fixed-time/variable-result or fixed-result/variable-time.

Design Objectives

The first design objective was to provide for adequate quality control and quality assurance. The initial step in quality control was to replace a significant amount of norm-referenced testing with criterion-referenced performance tests. The objective in quality assurance was to provide a constant check on the validity of course content. This may seem an obvious step, but in a recent article Andrews and Goodson (1980) indicated that even now a large number of published models for the systems approach to instructional design and development totally lack internal and external validity checks. At the time of this project, new technologies were emerging that permitted for the first time the collection, analysis, and utilization of huge amounts of occupational information in the Army (Berger &

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Hawkins, 1979). Prior to these new computer-based methodologies—called the Comprehensive Occupational Data Analysis Programs (CODAP)—it was impossible to identify all the tasks that composed soldiers' jobs in their various assignments. Without that knowledge it was impossible to design efficient training (Christal, Note 5).

The second design objective was to provide an empirical procedure for selecting media, learning events, and activities for each category of learning. Our surveys had shown us that existing training programs seldom recognized that different categories of learning existed.

Because the number of tasks performed in many Army jobs is so vast, there is no possible way they could all be learned during the short time spent in school. The third design objective was, therefore, to provide a decision-making model to select which tasks should be taught in schools and which in on-the-job training programs. This decision-making procedure proved to be quite complex.

A fourth design objective was to promote the use of appropriate cost models to aid in the design and management of training programs.

The establishing of valid measures of job performance was a fifth objective. The testing methods used at that time to evaluate soldiers were coming more and more under question from equal employment opportunity administrators and other legal sources; they were also a source of great frustration among soldiers who could perform the tasks well, but who could not pass the pencil and paper promotion tests.

Finally, since we hoped to introduce several new kinds of learning formats (including, where appropriate, self-paced instruction), our last objective was to establish a training program for the instructors and supervisors who would be in charge of these classes. We hoped that the military would adopt our overall program as a model for designing future courses.

Design Constraints

In any large project, there are always design constraints; some real, some imagined. In this case, time was the true critical constraint, because we had to implement the project before the sponsors were reassigned to other duty. Because virtually all the impetus in the Army for this study came from individual officers bound for promotion and transfer, it was absolutely essential to avoid getting caught by the changing of the guard.

In the Navy, on the other hand, the single strongest proponent for the ISD system was a senior civilian who was likely to be around for a long time. Many academic instructional developers have faced this same problem when the faculty member for whom they were developing an innovative course accepted a job at another university, and the new professor proved totally uninterested in improved instruction.

A second significant design constraint required that the model and procedures be acceptable to key opinion makers and potential blockers within the schools. The purpose of the project was to produce a methodology that would cause individuals in the schools to do their jobs differently and, we hoped, better. Any time one tries to change people's established daily work habits, friction is inevitable. Dealing with that friction was a critical part of the project.

A third design constraint, which proved to be virtually insurmountable, was that of designing the materials so that they could be used by untrained junior officers and noncommissioned officers. Although there are ways this can be done, the implementation process is long and cumbersome. It is not difficult to train people to be effective entry-level employees in well supervised instructional development departments where there already exists a storehouse of knowledge in the state-of-the-art. In that situation the experienced people can bring the apprentice along at an appropriate pace. Where there are not well trained and experienced managers and technical staff in a department, the conversion problem is much more difficult (Montemerlo & Tennyson, Note 6).

A related constraint had to do with the efficient training of new instructors, because each person assigned to an Army school as an instructor is transferred within 3 years. The Army cannot devote a large percentage of those 3 years just to getting the instructors ready to produce. And the problem is not just to provide instructors with training, but to train them to teach in new ways, requiring them to overcome the burdens of their prior experience and modeling from their early school observations.

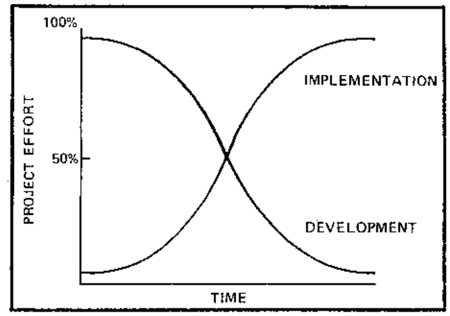

FIGURE 3. The integrated development-implementation model for curricular change. The sum of the effort at any point on the x-axis is 100%, showing the desired division of effort between development and implementation. (After Burkman, Note 7).

Development and Implementation

The methodology for producing systematically developed products is generally well known and will not be discussed in depth here. There were, however, two particular principles that we were trying to follow simultaneously. The first of these, the integration of implementation with design and development, is illustrated in Figure 3, where 100% of the total project effort is represented by summing the two curves at any point on the x-axis. The first principle requires devoting some effort to implementation from the very beginning of design and development. It further implies that the relative amount of effort devoted to development should fall dramatically after the initial draft of the product is achieved. And, as the project develops, most of the time should be spent on implementation and only a little in development, to revise and fine tune (Burkman, 1974, Note 7).

The second major principle was to get a general framework and complete first draft of the intended product distributed before attempting to adjust its various parts. We believe that strategy provided for the maximum ability to revise and allowed us to make significant revisions at the latest possible time. Although these have been referred to as principles of applications research, they are, more simply, lessons forced upon us by past failures.

Early Implementation Efforts

During the initial survey of Army

schools, we tried to locate staff members who were competent in ISD in order to build a wide base of support for future activities and to establish a resource pool to whom we could pose questions of importance. On every possible occasion we visited, consulted with, and tried to extract products or commitments from the key opinion makers, some of whom became substantial contributors. We identified active and passive blockers. Active blockers spend time and effort directly opposing the project, and passive blockers are unwilling to take any positive steps to support the project—perhaps because they have no opinion on the matter or because they have little ability or power to act.

A third stage in the development was the convening of a number of advisory committees to whom early draft documents could be circulated. It was during this step that we discovered a new pool of talented contributors without whom the project could not have been successful (see Burkman, 1974).

Project Chronology

At the same time we began the project, and independent of it, a committee with representatives of the four military services was established to produce a common glossary of training terminology. When the chair of that committee became aware of our efforts, he approached our sponsor, the president of the Army Combat Arms Training Board, and asked for the interservice committee's participation. Subsequent to that meeting, the Interservice Committee for Instructional Systems Development became the official sponsor for the project. The major project events are listed in Table 1.

The chronology is not unusual in major instructional development projects. Table 1 contains a long list of project review procedures and meetings. These meetings were not intended primarily to improve the quality of the product; rather, they were intended to broaden the base of support and to identify the potential facilitators and blockers. The tryouts and revisions of the workshop materials were intended to improve quality.

Probably the most remarkable entries in Table 1 are the last two. As indicated, the version now used in the field is the "second draft" version. The initial project plan called for the issuance of that draft to the field, and, after a period of 1 year's use, the final revision was to be made. Had the final version been published, it would have been based on actual field usage data. It appears that changes both in personnel and in priorities have delayed the final revision of the material. As a result, the version now in existence is the "second draft," lacking a final revision.

TABLE 1. The major milestones and events in the development and implementation of the Interservice Procedures for Instructional Systems Development, 1973–1976.

Event	Date	Comment
Contract award, initial survey	1/15/73	Initial problem analysis
General officer briefing	4/1/73	Recommended actions
Contract award	4/29/73	Development of ISD Model
Interservice committee	7/25/73	Representatives of all four services agreed to sponsor project
Meetings and review	various	Committee reviewed all materials and procedures developed
First staffing review		Army personnel asked to participate and contribute
Phases I and II individual trials	Summer 1974	Workshop materials used with individual members of target population
Phases I and II group trials	November 1974	A group of 40 people at Ft. Benning spend 1 week going through material
Phases I-V group trials	February 1975	In San Diego 30 people go through complete workshop
Major revisions	February-August 1975	First draft major revisions
First draft printing	August 1975	Published in limited quantities for full staffing in all services
Staffing revisions	August-December 1975	Cleanup of editorial, technical problems; artwork
Air Force authorization	September 1978	Air Force regulation adopts Interservice version for optional use
Contractor's plea for final revision	February 1979	Decision not to issue a revised first edition

Results

The contract called only for the delivery of the materials specified in Table 2 and nothing else. No mention was made of any kind of implementation strategy or staffing policies. One result of the project was the actual publication and issuance of the materials to the Army and Navy training communities.

The essence of our project, the IPISD Model, is presented in Figure 4, and the manuals referenced in Table 2 are available from the National Technical Information Service (Branson, Rayner, Cox, Furman, King, & Hannum, 1975).

The model and procedures produced in this project were approved as the official procedures for *interservice* training. Following that, each service on its own decided to use or not to use the materials. The Army and Navy adopted the materials essentially as they were produced. Three years later the Air Force adopted the materials by issuing a regulation making them optional. To this date, the Marine Corps has not adopted the materials. One of the recommendations made at the time of final delivery was that each service adapt the materials by inserting its own examples, form numbers, and references to regulations as well as other supporting literature.

Although the direct results of the project are relatively straightforward, we believe the unanticipated results are more important. One early indirect result was a substantial reorganization of individual Army schools to provide an organizational entity responsible for each of the functions called for in the IPISD model. In that revision, called School Model '76 (Department of the Army, Note 3) the first three phases of the model were assigned to a single department (see Figure 5). The fourth phase, implementation of training, was assigned to a second department, and the fifth phase, quality control, was assigned to the evaluation directorate.

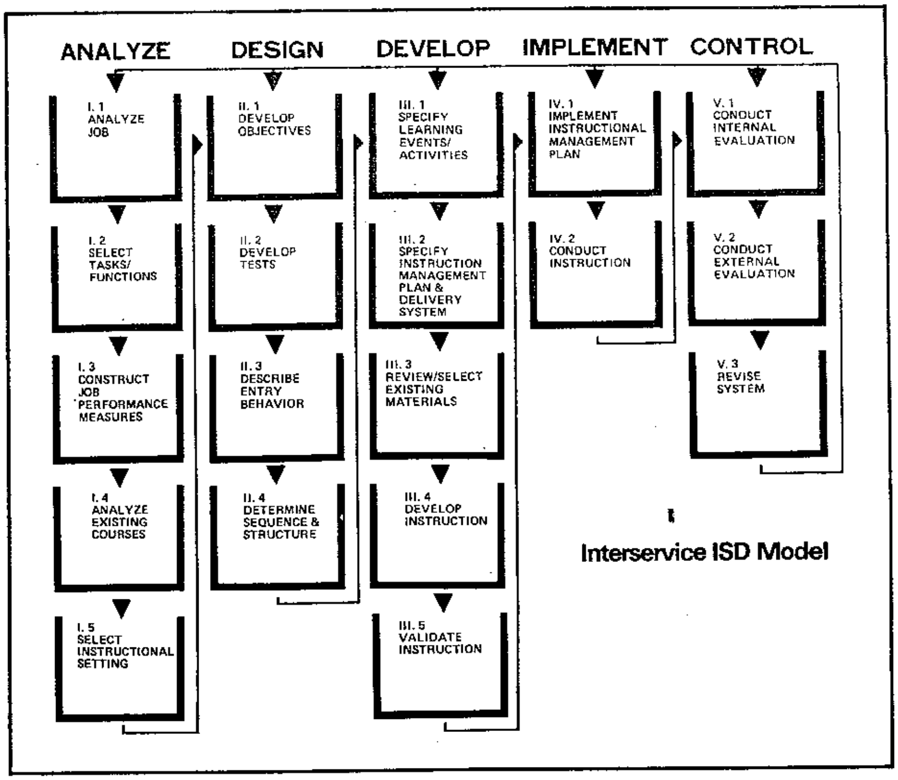

FIGURE 4. The model for the Interservice Procedures for Instructional Systems Development.

TABLE 2. The titles and approximate page lengths of the major documents delivered to the Army in the Interservice ISD project 1973-1976.

Interservice Procedures for Instructional Systems Development	
1. Executive Summary	185
2. Phase I: Analyze	313
3. Phase II: Design	105
4. Phase IV: Implement Phase V: Control	161
5. Technical Workshop Modules	96
6. Technical Workshop (Director's Guide)	183
7. Managers Workshop (Readings)	127
8. Managers Workshop (Director's Guide)	85

Document numbers and ordering information available.

A second indirect result of the project was the requirement for Army contractors to use the IPISD materials in developing the training and technical documentation for new hardware systems. We think this was a major and significant breakthrough into the materiel procurement area. In the past, the Army, as did most other military and industrial organizations, accepted delivery of new systems and hardware without first receiving technical manuals or valid training material to support them.

Although the Center for Educational Technology staff did develop the IPISD model, we modestly refrain from taking the credit (or blame) for the Army's decision to impose it on the contracting community.

Conclusions and Observations

In an attempt to advance the field of applications research, we have tried to derive a number of tentative conclusions and observations based on the experience of this project. First, the fact that we were dealing in a military environment does not make the project essentially different from others of its kind in other environments. The military, to a great extent, resembles any other large bureaucratic organization. Many people believe, erroneously, that anything can be done in the military simply by having the commanders issue an order. That is exactly what happened in April 1968, when the systems engineering regulation was first issued. Although there were outward signs of compliance, our investigation revealed (and others confirmed) that the situation simply had been set up so that true positive results could not be achieved.

There are many similar instances in universities and community colleges in which instructional design and development projects have not realized their full potential benefit. Most often, these failures are not caused by a shortfall in the product, but by faulty implementation procedures. The most common of these is the failure of the designer to analyze the project in the context of the system in which it must operate. We once tried to install a self-paced criterion-referenced physics course at the U.S. Naval Academy (Branson, Note

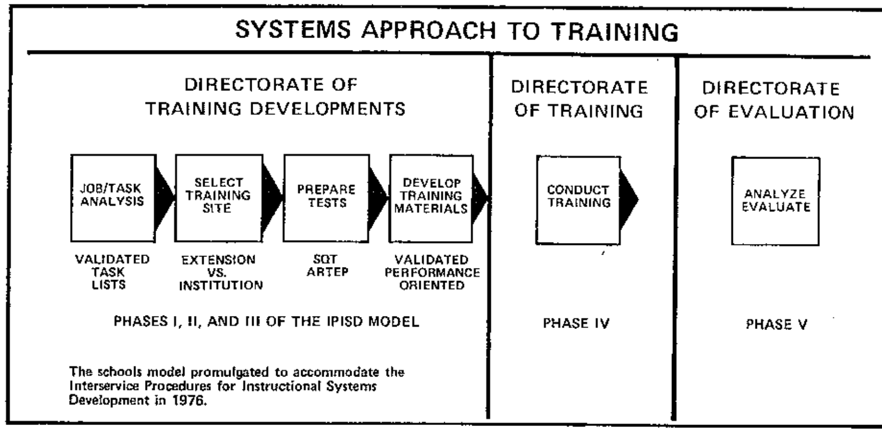

FIGURE 5. The functional organization of Army schools adopted to implement the Interservice Procedures for Instructional Systems Development.

1). The course was a complete success from the independent standpoint of instructional design and a complete disaster from the standpoint of the Academy. Because class standing was so important to them, the midshipmen strongly resented a course in which they were required to meet an absolute criterion. They wanted to be graded only on the curve so that they, and not the faculty, could decide how much time and effort to put into the course.

As a general rule, in large-scale training projects, the true discriminator is whether or not the trainees are paid. If the trainees are paid, their salaries usually account for most of the cost of training. Hence there is tremendous pressure to reduce the cost by reducing the time spent in training. If trainees or students are not paid, priorities are completely different. Schools and universities have no true interest in instructional efficiency if they must invest resources to achieve it (see Braby, Henry, Parrish, & Swope, Note 8).

Third, we want to emphasize that a systems approach model for any institution must be tailor-made for that particular institution, even though it may be based on well known generic systems models. If such a specific application is not made, the people who utilize the material will be forced to make their own assumptions and translations, and these may have low fidelity. We have commented previously on the essential part that a quality control-quality assurance program plays in the implementation of any systematic approach to training. The IPISD calls for both an extensive internal evaluation and, in order to validate the training system, a considerable external evaluation as well. The primary intent of trying to ensure the collection of evaluation data is that once the data are collected and organized to provide the basis for reasonable conclusions, *they can often serve as a forcing function to require its use.*

Because the IPISD system is designed to be revised on the basis of empirical data, a considerable amount of management attention must be focused on data collection in order to achieve the full payoff from the training system. Technically, this is a fairly simple matter, but technology does not achieve results, managers do. And, it is formidably difficult to get managers to make data-based decisions when they have been accustomed to making decisions by generalizing their limited experience. We believe that we have helped the Army move a step closer to that goal.

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