Reconsidering the Role of ISD

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ABSTRACT

Two decades of military experience with ISD have yielded mixed results. Depending on one's perspective, "doing ISD" may still be considered essential to the development of effective, efficient training systems or it may be regarded as a resource-consuming chore to be avoided to the extent possible. Both perspectives and numerous variations have merit. This paper examines some of the problems associated with ISD models and their applications and discusses potential solutions, including redefining ISD's role. The problems with ISD, the acquisition process, and Navy training in general are not simple, and filling the knowledge gaps, streamlining processes, and producing better-equipped ISD practitioners are only partial solutions. Although the paper focuses on naval aviation, it is applicable to other naval activities and military services.

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INTRODUCTION

The acquisition and fielding of a large-scale training system in parallel with a weapon system can involve years of effort, thousands of tasks, hundreds of people, and a paper trail that extends for miles. Managers and performing agencies juggle the demands of budget, schedule, and reporting requirements while undoing and redoing training system efforts in response to changes in the parent weapon system. High-cost items, regardless of the role they will ultimately play within the training system, typically consume the major share of resources and attention. Weeks or months can be spent negotiating compromises and changes. Resolution of one problem may create others, and the cycle of compromising, undoing and redoing starts again. It doesn't take long for an effort to derail, and it's easy to lose sight of the overall objectives.

Still, training systems get developed and fielded--not necessarily within budget, on schedule, or in a form that remotely resembles the original design, but fielded nonetheless. And, over time, most military people learn to perform their jobs reasonably well. How this happens may have little to do with Instructional Systems Development (ISD). To some, "doing ISD" is considered essential to the development of effective, efficient training systems. To others, it is a resource-consuming chore to be avoided to the extent possible. Both perspectives and numerous variations have merit. This paper examines some of the problems associated with ISD and makes a case for redefining its role in the acquisition of Navy training systems. Simulators and other training devices will still be purchased, academic courses will still be developed, and people will still be trained with or without the time and expense of ISD. "Why do ISD?" turns out to be an interesting question. This paper focuses on naval aviation, but it is also applicable to other naval activities and military services.

THE MILITARY TRAINING ENVIRONMENT

Military training systems are rarely static, and their modification usually continues throughout the life cycle of the parent system. Within naval aviation, as a result of aircraft Engineering Change Proposals (ECPs), new tactics, or the identification of training deficiencies, new requirements evolve and training system elements may be introduced or modified. Especially within fleet aviation, training programs must be adaptable--both to the projected needs of the next deployment and to the constant ebb and flow of training resources. When a simulator is down for modification, bombs aren't available, or range time is limited, workarounds are implemented. Today's base closures, force draw-downs and realignments also require training workarounds and training system modifications. The required flexibility is an inherent part of the military environment.

Training programs must also be adaptable to changes in preceding or follow-on courses of instruction. For example, with the (potential) introduction of the T-45 to replace the T-2 and TA-4 in the undergraduate advanced jet training program, adjustments may be required both in the T-34 syllabus and in follow-on Fleet

Readiness Squadron (FRS) syllabi. Similarly, the introduction of the Joint Primary Aircraft Training System (JPATS) or other system to replace the T-34 may impact the T-45 syllabus and others.

It should be obvious to anyone who works on maintaining the training continuum within one or more pipelines that the changes made in one course of instruction to accommodate changes in another course are not necessarily made to improve or maintain training effectiveness. Being able to afford one change may mean making other changes for cost-savings purposes. The potential impact on training effectiveness usually isn't ignored--some kind of analysis is done to demonstrate that the change probably won't hurt or may even enhance training.

It was to this environment, in part, that ISD was introduced approximately 20 years ago. Neither the concept of a systems approach to training nor the procedures that became part of the ISD model were new. However, the first application within naval aviation of the "new" ISD model can be dated to 1974 and to some of the aircraft that are still being flown, e.g., the EA-6B, E-2C, and A-6E.[1] Then--as now--reactions to ISD varied. The words of McClelland, writing in 1978 about the previous 25 years' experience with the systems approach to training, still apply: "Today.....the full potential of applying the systems approach to training has not been realized."[2]

It is worth remembering that the basic objective of any training system is to enable people to develop the capabilities required to proficiently and reliably perform their jobs. The precise components that make up a system can vary considerably--even to meet the same training objectives--and people will still learn. An effective system is simply one that works. Even very inefficient training programs can help people develop the skills required to perform their missions--but at a higher cost and over a longer period than necessary. Clearly, in the resource-constrained military environment, training system development efforts must maintain a focus on both effectiveness and efficiency.

THE ROLE OF ISD: IN THEORY

On paper, the role of ISD in the development of a new training system is straightforward: ISD provides the logical framework and procedures for systematically identifying training system requirements and then translating these requirements into actual instructional materials, devices, courses, etc.

ISD consists of a series of interrelated activities, each of which is intended to provide part of the data required to produce an effective training program. This series of activities is generally divided into five phases: analysis, design, development, implementation, and evaluation (or quality control). The analysis phase entails the determination of tasks that must be performed to operate or maintain the parent system, entry-level skills of the future system operators and maintainers, and, based on those two sources of information, training requirements. During the design phase, the various training system elements (courses, trainers, etc.) will be planned. The development phase entails the actual production and tryout of training materials. The implementation phase involves putting the new or modified system in place in the field. The final phase, evaluation, is intended to ensure that the system continues to function as required throughout its use.

Also on paper, ISD is an iterative process that provides for the systematic refinement of training requirements and materials as more and more information becomes available. During the development of a new weapon system, changes in engineering specifications or, initially, limitations in available data may impact the identification of training requirements. More than one report (or other product) may have to be updated simply as the result of changing a single operator or maintenance task. This is not unusual, and provisions are generally made for the revision of ISD reports as required to reflect these changes. It is rarely the case that each report is done once and only once without updates. Automated systems simplify the tasks of managing developmental data, reports and courseware.

ISD also plays a role in the modification of existing systems. Typically on a smaller scale, the same sequence of activities that results in identification of training needs and resource requirements for a new system is repeated for an existing system. The cycle of analysis, modification as required, and evaluation will

continue (in some form or another) throughout the life cycle of the system.

Since the early 1970s, various ISD procedural models have been developed, and numerous handbooks, standards, and specifications have been published. Both within and across military services, different models are employed. For example, the Navy has typically used one approach for the development of aircrew training programs and another for aviation maintenance training. Despite methodological differences, the objective is the same: systematically identify and meet training requirements.

To ISD practitioners, the question "Why do ISD?" may at first seem incredible. But even the enthusiasts (most of them anyway) will agree that ISD in theory sometimes bears little resemblance to ISD in practice.

ISD IN PRACTICE: THE PROBLEMS

ISD is labor-intensive, time-consuming, and costly, but so is the process of acquiring a training system without the use of ISD, so these factors are hardly critical determinants of its worth. More importantly, the application of ISD to a training development effort provides no guarantee that an effective, efficient training program will result. Numerous factors may combine to limit both ISD's role and impact. Some of these factors are discussed below.

Lack of Expertise

For the most part, application of ISD requires the use of both training development specialists and specialists in the system being developed. The training development specialists, knowledgeable about training technologies, instructional strategies, and human behavior, set the pace for ISD efforts. The term subject matter experts (SMEs) applies to the aircrew and maintenance personnel who fulfill the role of system specialists. Some SMEs will be former military personnel hired by a contractor involved in the ISD effort, and others will be active-duty military who may be available at various points in the process to assist in the development effort. For example, the formation of an Instructional Systems Advisory Team (ISAT), which entails on-site availability of military personnel, provides regular opportunities for informal (and formal) fleet involvement in the ISD process. Members of the Fleet Project Team (FPT) can also play an essential role not only in the development of trainers but in the development of curricula.

SMEs are not required to be experts in ISD to perform their jobs well. They bring other qualifications (and problems) to a design effort and do not share responsibility for lack of expertise in ISD. It's the inexperienced, unskilled other specialists on the ISD team--the training system designers and developers--who pose major problems for ISD efforts. ISD is not an objective approach to training system development, and although ISD cookbooks exist, none would permit the inexperienced developer to (intentionally) construct a good program.

Decisions at each step in the ISD process entail combining knowledge of learning and instructional techniques with best judgment and best guesses. In the hands of inexperienced designers, the resulting training programs may be inefficient and of limited effectiveness. Unfortunately, technically competent, skilled, experienced developers sometimes seem to be in short supply. Unless they are also familiar with the military environment, their recommendations, sound as they may be, can be met by incredulous stares or simply ignored.

Insufficient/Excessive Procedural Guidance

MIL-STD-1379D (*Military Training Programs*) and many other ISD documents provide guidance for the experienced instructional systems developer on what should be done, but they do not describe the how. And the "how" can usually be approached in a variety of ways--none necessarily entirely satisfactory. For example, the specification of tasks to be trained seems like a simple enough undertaking. In practice, there are a variety of ways to construct task listings and numerous theoretical arguments over which is preferred and why. The experienced developer (if allowed) simply applies what will seemingly work best in the current project. Others must resort to whatever guidance they can find. Attempts to provide this guidance have often resulted in overproceduralization of ISD steps, with the same unsatisfactory results.

Form Over Function

In the absence of sufficient procedural guidance, performing agencies and/or government representatives may resort to microscopic

examination of what is available to glean enough information to make decisions. A carelessly constructed sentence in the Statement of Work (SOW) or Data Item Description (DID) or a sentence that usually but not always applies to an ISD effort is taken literally by one or both parties. The result is overemphasis on the form of a deliverable and insufficient attention to the purpose. To continue the example of the task listing, regardless of the structure used, not all human endeavors will fit neatly into the categories. So force-fitting is employed to meet the SOW or DID requirement, and the intent of various task statements or objectives may be distorted in the process. Since most ISD activities are interrelated, what is done at one point will impact what is done at the next, and inaccuracies or inconsistencies may be compounded as time goes on.

Force-fitting may also be employed unintentionally. Cookbooks, developed to fill the *gap caused by insufficient procedural guidance* and a short supply of trained developers, may provide step-by-step procedures for completing various tasks. These steps are themselves simplifications, and reliance on them again results in overemphasis on form.

Incomplete Applications

Inadequate and incomplete ISD efforts stem from several factors including inexperienced personnel. Even with strong team members, available resources are almost always inadequate to permit unconstrained design, development, and evaluations of training systems. As a result, the concept of a training "system" may still not be fully realized.

In addition, training system managers differ in their understanding of or willingness to apply ISD. To some, doing ISD means designing and developing the paper-based instructional material to be used to support classroom instruction. They are perfectly content to leave that to the "experts" while they manage the more critical elements of the system - facilities, training devices, and other hardware. Even believers in the ISD concept may be reluctant to apply the results of analyses if the results suggest some "new" approach to training or a "new" piece of training equipment.

Poor Timing

Many ISD efforts have failed to achieve the desired results because they have not been initiated at the proper point in the acquisition cycle nor synchronized with "real world" requirements. For example, trainer specifications may be developed well before the ISD effort is off the ground. Although the contractor may still be responsible for completing the required ISD steps--including media specification and development of trainer functional characteristics --the exercise is usually pointless. Similarly, the training system manager must plan for facilities requirements and other high-cost or long lead-time items. The number of classrooms and number and type of computers for computer-based training may well be decided long before the media selection process indicates such a system should or should not be employed.

Lack of Responsiveness

As suggested in the previous section, lack of *responsiveness of ISD to the training system* manager's requirements is in part related to ineffectual timing of the ISD effort. The manager must make decisions when acquisition milestones or other reporting requirements dictate, and the absence of ISD data doesn't change that.

Descriptions of the ISD process, for example in MIL-STD-1379D, typically do not explicitly relate ISD products to acquisition reporting requirements, and the instructional system developers may not know when decisions that will impact the shape and substance of the training program will be made. Even if they do know, someone on the team (not necessarily the instructional developer) may insist on rigid adherence to one or another set of ISD procedures, the timing will still be off, and the manager still won't get the data.

WHAT'S RIGHT WITH ISD?

It should be fairly obvious that the problems with ISD are only partly due to inherent deficiencies. ISD models are simply that - models or frameworks for instilling logic and order to a complex, sometimes very disorderly process. Applied knowledgeably, the ISD framework will always result in some improvement in the process. Whether the model is called ISD or SAT (systems approach to training) or anything

else, yes, some sort of systematic approach to identifying and meeting training requirements is essential to a sound acquisition program.

The development of effective, efficient training systems is art and science - just like flying, the practice of medicine, or diagnosing equipment failures. The experienced instructional designer, who brings to the team a large body of theoretical and applied research on learning, is an irreplaceable element in the design and development process. Despite gaps in the base of knowledge about human performance, enough evidence is available to predict for many tasks the effects of altering basic variables like time allotted to learn, amount and distribution of practice, and instructional methods and media. These variables can be intentionally manipulated to improve the fit between training needs and the demands that the military environment places on training programs, e.g., frequent turnovers of personnel; the requirement to schedule training in a way that personnel availability can be predicted; the need for a series of courses; the requirement to train large groups of people with widely varying backgrounds and skills; the need for flexibility, etc. Best guesses are still required, and the competent developer is not easily replaced.

TRAINING EFFECTIVENESS REVISITED

As indicated earlier, an effective training system is simply one that works, and many people might argue successfully that, in general, military training systems do work. Even a casual observer would have little difficulty distinguishing between the student pilot and the third-tour fleet aviator. The smooth, seemingly effortless performance of the proficient aviator bears little resemblance to the erratic performance of the novice who may be overextended initially even by the basic task of flight control.

Obviously people learn, but "how well", "compared to what", and "at what cost" are questions with no simple answers. The contribution of the formal training system to skill development--or of any single element of the system--is not easily measured. Although the Navy collects a variety of data that can be used to infer the effectiveness or efficiency of training systems, formal training system evaluations are rarely done. When they are done, the results are sometimes difficult to interpret or not used to impact future design efforts.

Even without precise measures of effectiveness or efficiency, it's not difficult to find evidence of an uneasy fit between training systems delivered to the field and the needs of the users. One doesn't have to look far for training materials that are shelved almost as soon as they are delivered, device design features or entire devices that are ignored, and unused or underutilized computer-based training systems. (Although there are a variety of reasons for these uneasy fits--including some good ones--many are not related to ISD and aren't the focus of this paper.)

Most people who have been through any kind of Navy or other DoD training pipeline need not look beyond their own experience to understand that people who are motivated to learn will do what they can to learn--in spite of the system. Students compensate for unprepared and ill-equipped instructors by conferring among themselves about the meaning of this concept or that, wading through texts, or asking other instructors. They also employ self-teaching of the trial and error variety on almost every piece of equipment in the inventory. Fortunately, more often than not, they and the equipment survive. But mishap rates and equipment repairs and replacements attest to the high costs of some of these experiments. Discussions in the ready room, around the coffee mess, chief to new sailor (or Ensign), sea stories, and so on also typically play a part in Navy training, sometimes compensating, in some sense, for the lack of transfer of information and skills through other channels.

Information about the successes and failures in training system acquisition may be only informally collected and not fed back into a new design effort. As a result, past mistakes tend to be repeated, and the basis time and again for some design decisions is simply: "It worked before (I think), so it must be okay to do it this way."

SOLVING PART OF THE PROBLEM

The problems with ISD (and the acquisition process in general and Navy training) are not

simple and won't be easily resolved. Although efforts to fill the gaps, streamline the process, and produce better-equipped practitioners continue, they'll take time. The implementation in 1990 of the new standard, MIL-STD-1379D, may have also introduced new problems, in part because of the lack of readily available guidance on its use. An additional problem stems from trying to integrate individual service/activity and program requirements into a standard. Current joint-service efforts to refine the standard and develop common data element descriptions will resolve some of the difficulties.

A partial remedy for inadequate ISD efforts is ensuring that qualified teams - both within and outside of the government - are available to work on the projects. And "qualified" means far more than having a string of degrees or "x" number of years of fleet experience. Another fix entails shifting our approach to the use of ISD.

RECONSIDERING THE ROLE OF ISD

It's perhaps worth repeating that the purpose of a training system is to help people develop the capabilities required to perform their missions. The ever-present resource constraints, the sometimes large pools and lengthy waits for additional training, insufficient knowledge or technology to always provide the best training solution, and the sometimes arbitrary decisions that negatively impact training systems all provide good obstacles to learning; it's hardly necessary to create more.

It is also worth remembering that all training system components are simply tools to facilitate the learning process or improve the efficiency with which training can be delivered. Training devices, books, instructors or other elements are the means for providing instruction and opportunities to practice developing skills. Some people argue that too much energy is dedicated to the hardware and software components of the system and not enough energy to the message. Although it's true that training device acquisition projects can take on a life of their own, the energy devoted to the cause is laudable.

Perhaps it's more appropriate to say that not enough attention also goes into integrating and shaping training devices and other components to ensure that the resulting training system will serve its intended purpose. The myriad of design decisions (and compromises) made during a development effort that impact the capabilities of a training device also impact the rest of the system. Where more or fewer capabilities than planned are the result of these decisions, more, fewer or different capabilities (not necessarily in a one-to-one relationship) must be considered for other system components.

Purposeful design requires maintaining a constant focus on what it is the system is intended to accomplish. This means identifying the training requirements beforehand (difficult as that sometimes may be) and applying what we know about learning and performance not only to the design of the curriculum but to hardware and software components as well. Center stage belongs mostly to training requirements, partly to issues of training efficiency, and only rarely to technology.

It is easy to lose sight of the overall objectives--especially if system design efforts follow device design efforts. Training objectives, a preliminary syllabus, the plan for other training tools, reasons for incorporating device design features, and concern for the ultimate users must precede, parallel, and shape the design and development of training devices.

Knowledgeable application of ISD--at the right time and in a way that meets the needs of the acquisition process--will require some adjustments to the way we do business. To effectively serve as it should, as a framework and road map for the system design effort, ISD must be responsive to the very real demands of budget, schedule, and reporting requirements and to the needs of various players for information in different forms. As an example, the revised Air Force ISD model represents a step towards addressing the different information requirements of different agencies by the inclusion of a series of guides for different user communities.[3] Training system managers do not need to know the difference between Miller's taxonomy of human tasks and Gagne's, but they do need to be able to ask the right questions of the ISD team. They, along with every other team member, also must be willing to suspend belief in what they know about training at least long enough to weigh the available evidence. The training development specialist must be

prepared to explain why one approach is preferred over another and to identify what constitutes best judgment, best guess, or empirically or theoretically sound design concepts. It's then up to the program manager to make the hard decisions.

Knowledgeable application of ISD also means recognizing the essential role played by potential users of the training system in the development effort. No, the users don't always know the best way to meet their own needs, but they provide insight into system and human considerations that others may overlook. Just as surely as motivated people will do what they can to learn, so, too, will they defy--to the extent that they can--all efforts to make them use what they don't want. User acceptance is a requirement in any design effort, and attempts to explain, demonstrate, and persuade should precede design decisions. When these attempts don't work, it's usually far better to reconsider the design approach than to expect that the impasse will eventually be resolved in favor of system or component use.

CONCLUSIONS

There are no technological solutions to the problems with ISD. Automated design and development tools, improved configuration management systems, and better integration of data from ISD analyses, logistic support analyses, and other sources will improve the products and streamline the process, but they will not ameliorate the inherent weaknesses in the ISD model. Nor are there substitutes within the discipline for the experienced ISD practitioner--who has an appreciation for both the art and science of systems analysis--or for the involvement of end users and subject matter experts.

The value of ISD stems in large part from its application as a framework and road map for the training system design effort. Without top level commitment to this concept and its execution, ISD may well be a resource-consuming chore.

Implications for Training System Managers

"Doing ISD" as if it were simply one other acquisition requirement--apart from facilities planning, device designing, and other major system design considerations--will ensure its limited utility. The systems approach to training encompasses all training system elements, including devices, and sound design decisions must stem from both an analysis (beforehand) of training requirements and an understanding of the interplay among the system elements being developed. Training system managers can help ensure the success of training system development and modification projects both by committing to the application of ISD as a road map (nothing less) and by insisting that the effort be responsive to the demands of budget, schedule, and reporting requirements. ISD is an iterative process--not a set of specific procedures that must be performed in only one way and completed in its own time. It is designed to assist the decision-maker, especially in instances of uncertainty, e.g., when available data from the system under development are limited. If the effort isn't doing this, then the team isn't doing ISD.

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