

Applying a Systematic Approach to making Training Requirement Decisions

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ABSTRACT

One requirement for major Department of Defense (DoD) acquisition programs is to develop a Human Systems Integration (HSI) plan early in the acquisition process to address a variety of human-related issues. One element of the HSI plan is the training plan. The training plan is a living document that is refined as the acquisition process moves forward. The purpose of this plan is to identify the high-level structure, staffing, and associated costs of the training system that is necessary to support the operation and maintenance of the hardware or software system being procured by Program. The most common method used to identify the training requirements is to conduct a formal Job Task Analysis (JTA) using the procedures specified by the lead procurement Service. The formal process may be very expensive and time consuming. The data obtained through the formal JTA process are more useful for making instructional design decisions than for making the training system design decisions that support cost determination in systems acquisition. The purpose of this paper is to present a simplified version of the more formal JTA process that is oriented towards program management issues, and produces the kind of information that is required to estimate the life-cycle training costs for the new or modified hardware or software system.

ABOUT THE AUTHORS

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INTRODUCTION

Department of Defense (DoD) Instruction 5000.2 requires an acquisition Program Manager (PM) to develop a Human System Integration (HSI) plan early in the acquisition process. The PM is directed by this instruction to “develop training system plans to maximize the use of new learning techniques, simulation technology, embedded training, and instrumentation systems that provide anytime, anyplace training and reduce the demand on the (existing) training establishment....For training programs that require training infrastructure modifications, the PM shall identify technology, schedule, and funding issues that impact program execution.”

Normally, the first step in any formal training analysis is to identify the details of the training tasks and to then determine prospective training requirements. This analysis can be very expensive and time consuming for a complex system, and the data collected may be inadequate to develop the HSI plan. A more detailed secondary analysis will usually be required to address specific instructional system design issues. However, detailed task information is often not available early in the acquisition process, so formal task analysis may be an inappropriate approach, and in fact may be completely unnecessary this early in the acquisition process.

The data that are required to develop cost estimates for HSI purposes are not as complex as those that are necessary to make decisions about the actual instructional design of the training program. So, a much less rigorous analysis can be performed to determine the potential impact that the new or upgraded system will have upon training system requirements. This becomes important if the analysis determines that the existing training infrastructure is inadequate.

At the most fundamental level, all that a PM needs to know for cost purposes is how long it is going to take to train personnel on the new hardware or software, how it is going to be delivered, and how many personnel are going to be trained and where it is planned. Each service has its own costing methodology that can then be applied to the training requirements to arrive at a “ball park” estimate of the life cycle cost of the new or modified training system.

Our belief is that a less rigorous and less formal process should be developed so that the PM can estimate the structure, and the associated life-cycle cost for the training system required to train personnel operation and maintenance of the new or upgraded hardware or software very early in the acquisition process when detailed task information is not available.

There are a number of methods and tools that are currently used to collect and analyze formal job task (JTA) information. This paper will discuss a few of those methods and tools that are widely used within the Department of Defense, describe how they are used, and how they should be used for system acquisition purposes. Then we will describe a modification of one of the JTA tools, and how it can help PMs to make “ball park” training system estimates more efficiently and early in the acquisition process.

DEVELOPMENT OF THE NEW METHODOLOGY

This work was begun under a U.S. Navy Science of Learning initiative and was initially funded by the U.S. Navy Human Performance Center. The original objective was to develop an automated algorithm that could be used to analyze JTA data that were being collected throughout the Navy, to determine the best method, at a systems level,

to train those tasks. It quickly became apparent to us that the traditional JTA process did not provide all of the necessary information, the data were overly complex from a systems level perspective, and the data were not in a format that a system manager would need to make high-level training system cost estimates. The strategy that we adopted was to reduce training cost by reducing formal, instructor-led, classroom training. The required our model push training out of the formal instructor-led classroom to as close to the job site as possible using computer-based training, formal on-the-job training, and performance aids.

In developing our new approach, we reviewed a number of government and commercially developed task training method and media selection models (e.g., Air Force Institute for Advanced Distributed Learning, 30 May 1998; Department of Defense, 31 August 2001). Specific methodology for the analysis of training requirements has been developed and promulgated separately by each of the Services. While the methods are similar, they are not exactly the same, and the steps and reports generated at step may be very different.

Formal JTA is the process of identifying the specific training tasks and associated training requirements. A task analysis should describe a task at an appropriate level of detail including how the task is performed in terms of actual performance steps, the conditions under which the task must be performed, such as in a garrison or field, and how well the individual must perform it in terms of performance standards. Some additional information such as the knowledge, tools, and references required to perform the task will also be identified to guide the design of the subsequent instruction.

The formal JTA process works best with "Subject Matter Experts" (SMEs) who are actually expert in performing the tasks that are being analyzed. It does not work as well with new systems or systems that have been significantly modified or with SMEs who are supervisors and not performers. In reality, there are no SMEs who can provide authoritative information about the new job task requirements. One common method that is used to ensure some reliability in the JTA process is to foster consensus among the SMEs about the task characteristics that are being rated by them during the task analysis.

The Defense Training Standards Working Group (DTSWGD), and inter-service advisory group, developed an instructional systems design guidance handbook in the Department of Defense Military Handbook 29612 series (DoD MIL-HDBK-29612) in five parts which describes out a methodology for developing military training content. It was an effort that was intended to bring together what is known about instructional systems design into a single document. Part 2A, "Instructional Systems Development/Systems Approach to Training and Education" (Department of Defense, 31 August 2001), deals with methods for conducting a formal training analysis. MIL-HDBK-29612-2A is not actually required to be used by the Services, and there are no data available about whether the handbook is widely used or not.

It is our opinion that this handbook is not appropriate for use by PMs to make high-level training system design or training delivery decisions for the purpose of estimating life-cycle training cost. One of the major problems with this handbook is that it is too complex to be used except by well-trained and experienced instructional designers. It is structured more like a reference guide than a process guide, and in places lacks sufficient technical detail about the topic being discussed. It is not a step-by-step tool that anyone can take and follow from A-Z to produce high quality instruction. And, because it's not a step-by-step tool, its usefulness in analyzing training requirements is somewhat limited from a PM's perspective.

However, each of the services uses some estimate of the task difficulty, criticality and frequency of performance as part of the analysis process. We adopted the Criticality, Difficulty, Importance, Frequency (CDIF) model, which estimates task criticality, difficulty to learn, importance of the task, and frequency of task performance, as the basic criteria to be used to develop our task selection model. We determined that it was necessary to simplify the traditional scales values, and the Service's analysis and classification processes to develop very rigid rules for selecting a small set of training delivery options based upon CDIF characteristics. One reason for selecting CDIF was to distinguish between combat-related and tasks that are not combat-related.

We simplified our CDIF scales by making them binary instead of using the traditional five-point scale for each characteristic. This gave us sixteen possible combinations for classification, and we developed one method and media rule for each possible combination. In order to test our simplified classification model, we applied the methodology to a sample of real JTA data collected during a formal analysis to determine whether there was any classification ambiguity.

In the initial study, we were easily able to classify all of the tasks into preferred delivery option categories without ambiguity. The result of the tryout is that we found only eight rules were necessary to define the form and function of the training system. In addition, we found that CDIF alone did not provide all of the information that we needed to select appropriate training methods and media. Therefore, we made some modifications to our original classification model.

TRAINING SYSTEM
METHOD/MEDIA
SELECTION MODEL

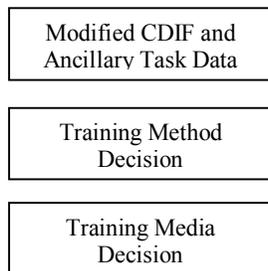


Figure 1. Simplified analytical process

MODIFIED CDIF

As previously mentioned, the key to making this process work for the PM was to simplify the CDIF scales and to develop rigid rules for linking CDIF data to training delivery options. In conjunction with the traditional CDIF information, additional data needed to be collected on each task to assist the PM in making decisions about training methods, training delivery options, and associated manpower requirements for costing purposes.

In addition to task criticality, importance, difficulty, and frequency for each task, it was necessary to estimate whether it was difficult to learn the task as well as difficult to perform the task, to estimate how long it takes to learn the task in training, estimate, to how long it takes to perform the task on the job, and to estimate what percentage of the learning process is devoted to learning information necessary to perform the task rather than actually learning to perform the task.

Criticality

The criticality of the task assesses the degree to which a task is essential to job performance even though the tasks may not be performed frequently. The consequences of inadequate performance on certain tasks could result in injury to personnel, loss of life, or damage to equipment, or the operator.

A task that is critical has one or more of these characteristics:

1. Must be performed as soon as the cues for performance are recognized
2. Improper performance will result in death or severe injury to personnel
3. Improper performance will result in severe damage to equipment
4. Improper performance will prevent mission accomplishment

A task that is not critical has one or more of these characteristics:

1. Need not be performed immediately after cues for performance are recognized
2. Injury or death of personnel is theoretically possible, but not very likely
3. Equipment could be damaged but it will not affect the mission

Importance

Importance is a measure of how significant the task is to the overall evaluation of job performance, excluding those things that make the task critical. A task might also be deemed important if it has command visibility or is part of an SOP. Failure to perform the task might affect other tasks from being performed. This factor is evaluated only if the task is not critical.

A task that is important has one or more of these characteristics:

1. Task has command visibility
2. Task is required by regulation or SOP
3. The unit's mission will be adversely affected if this task is not performed
4. You may be relieved or reprimanded if you fail to perform the task
5. Failure to perform the task prevents other tasks from being performed--i.e., bottleneck task

A task that is not important has one or more of these characteristics:

1. Almost nothing would happen if the task wasn't performed
2. Task can be performed at your convenience

Difficult to learn

Difficult in learning refers to the amount of time, the number of steps, the amount of prior knowledge, the amount of required information, and the analytical skills needed to learn the task.

A task that is difficult to learn has one or more of these characteristics:

1. Task requires frequent practice or performance to maintain proficiency
2. Task has more than seven steps
3. Task requires a lot of memorization
4. Task takes several days or more to learn
5. Task requires you to know a lot of information before you can perform it
6. Task requires a lot of decision making in order to perform
7. Task requires advanced language skills and or grammatical accuracy

A task that is not difficult to learn has one or more of these characteristics:

1. Task performance does not require formal training
2. Task can be easily memorized
3. The steps of the task are easy to perform
4. Task does not require refresher training
5. Task has fewer than seven steps
6. Task can be learned in few minutes

7. Task can be learned by reading the manual

Difficult to perform

Difficulty in performance refers to the time, effort, or assistance required by an individual to perform the task. Some tasks encountered in each job are so easy that they can be performed with little or no effort. At the other extreme, some tasks are so complicated because of the task conditions that it is difficult to perform them under optimal conditions. Other tasks lie somewhere in between these two extremes and require different levels of effort.

A task that is difficult to perform has one or more of the following characteristics:

1. Task requires a long time to perform
2. Task requires a lot of effort to perform
3. Task requires assistance to perform
4. Task is usually performed in the field
5. Task is part of a team or unit evolution
6. Task cannot be performed without using a manual or job aid
7. Task cannot be performed at the same time as another task

A task that is not difficult to perform has one or more of the following characteristics:

1. Task can be performed from memory in very short period of time
2. Task requires little effort to perform
3. Task requires no assistance
4. Task is not a team or unit task
5. Task can be performed at the same time as other tasks.

Frequency of performance

Frequency of performance is an indication of how often the task is performed on the job. A practical way to collect frequency of performance data on tasks is to rate their frequency of performance in the following manner:

Frequent

1. Performed more than once per hour
2. Performed once per day
3. Performed once per week
4. Performed once per month
5. Performed once per year

Not frequent

1. Performed less than once a month

Time to learn the task

This is a measure of how long it takes to learn the task if it takes any time at all.

1. No time
2. Minutes
3. Hours
4. Days
5. Weeks

Time to perform the task

This is a measure of how long it takes to perform the task if it takes any time at all.

1. No time
2. Minutes
3. Hours
4. Days
5. Weeks

FORMAL TRYOUT

The next step in our process development was to apply the methodology during a training situation analysis. For this step, we applied the methodology to the tasks associated with several courses at a U. S. Marine Corps formal school. Our task was to analyze the existing training, determine if the existing training could be more efficient and effective, make recommendations about the best methods to train each task, and provide a cost analysis for each recommendation. Additionally, we were tasked to perform a manpower impact analysis, a training aid analysis, and a facilities analysis.

We used existing task data from the Marine Corps master task list and the task statements from each course to provide a starting point for the analysis. We validated each task list using SMEs from each course track. The SME's rated each task on criticality, importance, difficulty to learn, frequency of performance, and an estimation of the time needed to train and perform each task. We applied our algorithm to the data generated by the SMEs. We determined whether the tasks needed to be trained or not trained, a selection of training delivery options if

formal training was required. We provided a cost analysis for each option.

Part of our tasking was to recommend options for training delivery. Currently, the school uses traditional formal schoolhouse training with in field practice and practical examinations. We determined which modules in each course could be adapted to alternative training methods such as computer based training (CBT). We also looked at the similarity of task statements and training modules in each of the course tracks with the possibility of leveraging any potential development costs across a number of courses.

CONCLUSIONS

The traditional JTA process for manpower and training provides the user with information that is often overly complex, unnecessary and is not in the necessary format to make training system design and delivery decisions for the purposes of determining life-cycle training cost early in the acquisition process. The PM is required to make "ball park" cost estimates for the form and function of the optimal training system for new or upgraded systems, often before there is a functioning hardware or software system. It is not a one step process though. The training plan is a living document. As the acquisition process proceeds, the plan can be revisited, and the original "ball park" estimate can be refined to reflect the new realities of the system.

Tools, such as the one discussed in this paper, should be developed and made available to the acquisition community to make it easier to estimate system costs early in the acquisition process. The advantages of the tool discussed in this paper lie in the fact that it is based upon standard practices of the training community, has good face validity, anchored definitions, simplified rating scale, specific rules for making decisions about the form of the training system, and is easily adapted for purposes other than what was originally intended.

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