Using Department of Defense Architectural Framework (DODAF) to Identify Initial Training System Requirements

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ABSTRACT

Today's weapon systems are extremely sophisticated and as more advanced technology is incorporated into their design, they will be even more complicated. A significant amount of effort is expended into determining mission need requirements and designing a notional architecture for a new weapon system. However, associated training requirements are often oversimplified. Training related RFPs, proposals, and front end analyses (FEA) are often undertaken without a true understanding of methodologies used to determine actual training requirements. This paper describes a process that uses information from the Department of Defense Architectural Framework (DODAF), the Tactical Scenarios (TACSITs) derived from the Weapons System's Concept of Operations (CONOP) and the Mission Essential Task List (METL) to determine initial requirements that serve as a foundation for developing a total training system.

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INTRODUCTION

The design of a training program for a weapon system has become quite complex. It often involves the incorporation of various types of simulation media ranging from different levels of interactive courseware (ICW) to complex weapon systems trainers (WST). Ultimately, each "training medium" plays an integral part in supporting the overall goals of the training strategy. Thus each should be designed to satisfy training requirements that are needed for effective operation of the weapon system. The goal of this paper is to describe a process for conducting a Front End Analysis (FEA) to identify initial training system requirements for a new weapon system prior to the involvement of the traditional Instructional Systems Development (ISD) methodology. The approach briefly describes the major elements of a Top-Down Function Analysis (TDFA) – the mission analysis, function analysis and task analysis. More specifically, the paper provides information about how data are obtained from the Department of Defense Architecture Framework (DODAF) to undertake these analyses. This perspective is shown in Figure 1.

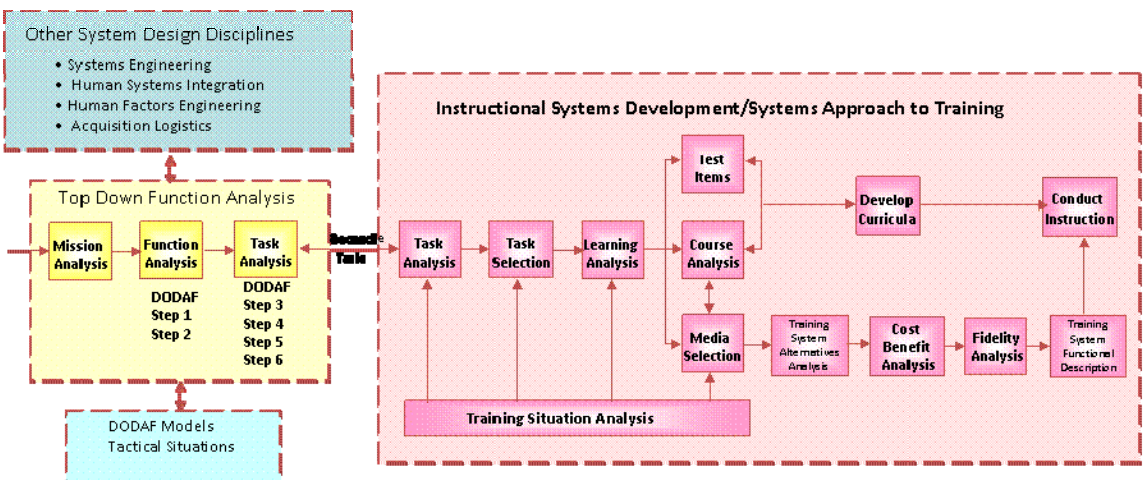

Figure 1 Relationship between TDFA and ISD

Many think of training system FEA as one of the major responsibilities of an Instructional Design specialist who uses the ISD model documented in MIL-PRF 29612. The ISD methodology does play a major role, however, there are also several other specialties that contribute significantly to the FEA process. Rather than just concentrating on ISD, it is suggested that an organization consider Design Layer Theory and assign individuals who have specific experience in Top Down Function Analysis (TDFA), Human Systems Integration (HSI), training systems engineering and logistics to the Training Integrated Process Team (IPT).

Design Layer Theory (DLT) requires the developer of the training system to break the initial design concept into various artifacts being designed rather than decomposing the problem into smaller design processes (Gibbons, Nelson & Richards, 2000). DLT can be illustrated by using an analogy of a new house. During the initial development of the blueprints for the building, the architect breaks down the structure into numerous subsystems such as foundation, basic frame structure, utility services, plumbing, et cetera. There must be total alignment among the different subsystems for a structure to pass strict building standards, thus, numerous interdependencies develop. The plumber installs his pipes so that they coexist with the wires installed by the electrician in the wall built by the carpenter. Each subsystem specialist (plumber, electrician, and carpenter) has their own tools, methodologies, specifications, vocabulary, and language to express meaning and intent for their specialty, but they interact with the other specialties in installing their required fixtures in the structure (see Hadley, Gibbons, & Richards, 2003). The same concept applies to the FEA effort. It is recommended the DLT concept be considered for the initial FEA effort.

TYPICAL APPROACH TO FRONT END ANALYSIS

Just as the various trade specialties have processes for installing their wares in a new building, acquisition professionals have unique methodologies that they use in procuring a weapon system as well as a training program for that weapon system. Systems engineering, logistics engineering, human factors engineering, and instructional systems development, all have detailed processes necessary to determine requirements needed by that particular discipline. Each are briefly described below.

Systems Engineering (SE) is an interdisciplinary engineering management process that examines initial technical design, considers system evolvement, and verifies system solutions that satisfy customer requirements. The Systems Engineering process described in ANSI/EIA 632, *Processes for Engineering a System*, provides a basic structure for ensuring the achievement of performance requirements. In the DODI 5000.2 system acquisition paradigm, those same needs are articulated as a means for satisfying joint war fighting capabilities. Both regulations were developed to insure that the various disciplines such as instructional systems, logistics, and human systems are also considered in the design process with engineering. Unfortunately rarely does this happen as planned.

Logistics engineers use another interdisciplinary management process that has implications for the FEA – the Logistics Support Analysis (LSA). LSA is an iterative process of identifying support requirements for a new system, especially in the early stages of system design. The main goals of LSA are to influence the design for supportability and affordability, define support requirements that are optimally related to the design and to each other, and define the required support during the operational phase. The LSA process considers four main goals. First, it influences system design by considering supportability requirements. Second, it identifies support problems and items that drive support costs early in the design process and works to resolve them early in order to reduce overall life-cycle support costs. Third, it determines the complete set of resources necessary to support the system over its lifecycle. Finally, it develops and uses a single database for use by all integrated logistics support (ILS) disciplines.

Human Systems Integration (HSI) is another interdisciplinary management process. There are several specialty areas which are included in this area to include manpower, personnel, training, environment, occupational health, safety, habitability, survivability and human factors engineering. They too have their unique processes for undertaking analyses in their domain. Human factors specialists use their knowledge of human capabilities and limitations to focus their analyses on the design of operator and maintainer interfaces that enable users to achieve mission objectives within a specified environment.

Finally, the Instructional Systems Development (ISD) process is still another interdisciplinary management process. The ISD process is comprised of five phases (Analysis, Design, Development, Implementation, and Evaluation) which identify activities required for the effective development of a curriculum to train individual operators or maintainers. The ISD process includes its own Analysis Phase which concentrates on "…procedures for defining what jobs are, breaking these down into statements of tasks, and using numerical techniques to …select tasks for training." (TRADOC 350-30 p. 4). While the ISD process may include similarities to the TDFA analyses described in this paper, the differences lie in the perspective. The ISD methodology concentrates on the individual job analyses related to training. This paper focuses on the process of identifying hardware, software and human tasks for a new weapon system prior to the determination of jobs. It is suggested that this information be used for the design and development of a training program for the weapon system.

PROBLEMS WITH CURRENT APPROACH

Unfortunately, each of the analyses described above often are done in a vacuum, using separate tools, customized databases, specialized terminology, and unique processes with little information sharing. Thus, there is limited coordination among the disciplines. There are several reasons for this. First, the analyses are done for different end customers, under different schedules. While there may be a high-level master program-integrated schedule that shows the touch points between the analyses, the specifics of the analysis vary widely by discipline. For example, the system engineers may start on the design of the radar system, the human factors engineers may start with the operation of the up-front display panels in the cockpit, logisticians may begin the LSA with the support requirements of the wing, and the ISD analysts may start with identifying the training requirements of the ground support crew. Furthermore, each specialist is usually only trained and/or experienced in his or her own discipline. It is rare to find a specialist who has had considerable experience and is considered highly proficient in more than one discipline. This means that specialists must learn to rely on each other more during the initial phases of the acquisition. They must be able to accurately communicate information about the types of data they required to solve problems in their disciplines – and they must know where to obtain the data.

For example, from a training perspective, the ISD process has often been criticized for being too time consuming. This is especially true in the analysis phase when determining specific characteristics for the high-end training devices such as weapons system trainers (WST) or weapons tactics trainers (WTT) that must be based upon training requirements. Complex training simulators need requirements specifications determined early to provide enough lead time for their acquisition. Training device engineers often "can't wait" for the ISD process to complete their analysis, so they design the device so that it accurately simulates the actual system, without a firm understanding of the true training requirements that are necessary to effectively use that device in the training curriculum.

Just like the craftsmen appreciate each others contribution to constructing a house, so too must Training IPT members join together in the analysis and design of a training system. The Training IPT must also work closely with weapon system designers to insure that the training program is designed to satisfy mission requirements. FEA efforts cannot concentrate exclusively on a training device, nor can it be concerned with courseware and curricula. They must learn to view their technical artifacts as pieces of a large puzzle – it is not completed until all the pieces are correctly assembled.

While there are a number of different types of analyses performed to determine the requirements necessary to design, build, and support today's modern weapons systems, there are also similarities. They all utilize some type of "Top Down" approach to decompose the various parts of the system into smaller and smaller activities according to their own domain. Additionally, they also all create some sort of task list that they use in their discipline to define human performance requirements.

RECOMMENDED APPROACH

In December 2008, DOD revised one of its primary acquisition regulations (DODI 5000.02) to stipulate that

> "…the PM shall take steps (e.g., prepare contract deliverables and establish Government/contractor IPT teams) to ensure ergonomics, human factors engineering, and cognitive engineering is employed during systems engineering over the life of the program to provide for effective human-machine interfaces and to meet HSI requirements. Where practicable and cost effective, system designs shall minimize or eliminate system characteristics that require excessive cognitive, physical, or sensory skills; entail extensive training or workload-intensive tasks; result in mission-critical errors; or produce safety or health hazards. The PM shall apply human systems integration to optimize total system performance (hardware, software, and human), operational effectiveness, and suitability, survivability, safety, and affordability" (DODI 5000.02 Enclosure 8).

Considering this emphasis, it is recommended that the DOD community carefully examine the FEA process and incorporate several often-disparate specialty areas of acquisition into a single integrated team assigned to identify initial training requirements for major weapon systems. A solution lies with undertaking the TDFA as a team effort using the integrated FEA process described below.

The TDFA Methodology

One of the initial activities undertaken by the integrated Training IPT during an initial FEA should involve a Top Down Function Analysis (TDFA). The TDFA methodology is a systems engineering approach that provides a comprehensive capability for ensuring that the human performance requirements are incorporated into the systems engineering process. The intent of the TDFA is to influence and refine system design of both the weapon system as well as its training program throughout the acquisition process. The full TDFA methodology involves ten phases or steps (Duke, Guptill, Hemenway, and Doddridge, 2006). Although each phase provides valuable information necessary to design a life cycle training program, this paper addresses only three phases that are directly applicable to identifying the initial training system requirements. They are the Mission Analysis Phase, the Function Analysis Phase, and the Task Analysis Phase. This is shown in Figure 2.

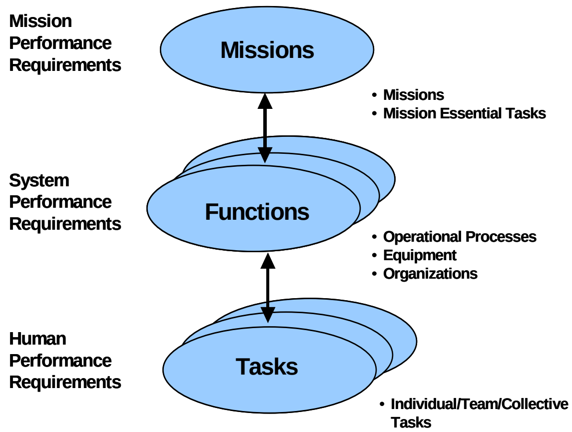

Figure 2 Mission, Function, Task Alignment

Mission Analysis Phase

The mission analysis is the first activity in the TDFA. Mission analysis serves to determine the overall purposes, objectives, or capabilities of the weapon system and to identify and document the mission requirements. Several things are identified during this initial phase. The Training IPT must first analyze and document the weapon system's primary and secondary missions. This is done by carefully reviewing acquisition related publications such as the Capability Development Document (CDD), the Initial Capabilities Document (ICD), and the Performance Based Specification (PBS). This identification process involves interviewing individuals who are familiar with high-level tactics and the type of mission scenarios in which the platform will be involved. The Training IPT must also identify system mission tasks. The Universal Navy Task list (UNTL), or other service task lists provide the basis for identifying the system mission tasks. Included in this analysis should be an alignment of Mission Essential Tasks (MET) with the primary and secondary weapon system missions. This system alignment creates an audit trail that correlates METs to platform missions, to system functions and collective and individual training tasks (see Allard, 2004).

Once the missions are identified, the Training IPT must accurately identify and document the *scope* of the weapon system and its boundaries because these will have a direct impact on the training program. For example, if dealing with the acquisition of a training system for a new aircraft, one must determine if the scope of the platform (system) includes a ground station. If so, then in addition to the aircraft platform, the FEA must consider the infrastructure and all logistics associated with the ground station as well as that of the platform.

The Training IPT must then identify and document any *system constraints* that could affect human performance, and may have a training impact. For example, some constraints may include a requirement to use a particular military specialty (Navy rate), a stipulation to use a minimum or maximum crew size, or a specific facility or environmental constraint. Any one of these may affect training. They may stipulate a certain Navy rate to operate or maintain weapon system equipment, thus limiting who could be trained. They could impose facility restrictions thus influencing the type of simulators (or other media) that can be acquired for training.

As a corollary to the missions, the Measures of Effectiveness (MOE) and Measures of Performance (MOP) must also be determined. This is important to the Training IPT because it will influence student performance measurement in the overall training curriculum. An MOE is a metric used to measure results achieved in the overall mission and execution of assigned tasks (CJCSI 3170.01C). MOEs are a measure of a system's ability to support the operational mission. They are defined in terms of operational results rather than technical performance, thus they are capability-oriented rather than being technically-oriented. The Training IPT must consider the platform MOEs when influencing the design of advanced training scenarios that will be played in a mission simulator. The method of evaluation of the crew's effectiveness in correctly interpreting the situation, utilizing all the tactics applicable to the situation and effectively performing all the collective and individual tasks related to the specific mission scenario must be determined and measured.[1] MOPs are derived from MOEs. They are the technical performance standards, which a system must achieve in order to satisfy the MOEs. The MOPs will have a direct influence on both individual and collective tasks in the curriculum development phase of ISD.

Function Analysis Phase

It is in the Function Analysis Phase where the foundation of the training FEA is built. Function analysis involves an identification and analysis of three areas: 1) the identification of all the necessary functions required to satisfy the primary and secondary missions of the weapon system; 2) the enumeration of the performance measures

[1] [1] In Naval aviation these are also evaluated by the Capability Based Matrix (CBM) –formally the Training and Readiness (T&R) Matrix which identifies crew standards for certain events that occur during mission sorties

for each function; and 3) the operational relationships between them. This information is obtained by carefully analyzing the functional architecture specifically created for the weapon system. The function analysis provides an identification of the functional characteristics the system must exhibit. For example, if a mission requirement for a weapon system is surveillance, then it is up to the mission system engineers to insure the aircraft is designed to perform the surveillance function with a radar system. It then becomes important for the Training IPT to concentrate on the activities required for successful operation and maintenance of this radar system. In order to develop an effective training program, the training IPT must be able to accurately analyze the functional architecture of the weapon system to not only determine if it meets the various components of the primary and secondary missions but also to identify areas of human performance that require training. These determinations are made as part of the functional analysis by carefully analyzing the weapon system hardware and software performance functions that are documented in specific DODAF views. More specifically, this functional determination is done in the first two steps in the six step process advocated by DODAF 2.0. These steps are briefly explained below.

Analyzing DODAF Views As Part of the Functional Analysis

DODAF defines a common approach for DOD architecture description, development, presentation, and integration for both warfighting operations and business operations and processes (DODAF Handbook 2004, p1-1). An architecture can be defined as "… the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution" (IEEE STD 1471, 2000). DODAF Version 2.0 advocates that the "…decision maker be actively involved in the architecture development process and support architectural description development" (DODAF Handbook Vol. 2.0, p.9).

The New DODAF 2.0 architecture is organized around data models and contains numerous integrated views that address various hardware and software components (not human) of a system. There are various models in DODAF 2.0, however only the views that provide the training decision maker with useful "data" to satisfy the "Fit-For-Purpose" intent are described in this paper. These data are found in views contained in the Operational Viewpoint (OV) and Systems Viewpoint (SV) models.

DODAF's OV models provide a description of the hardware/software tasks and activities, the operational elements of those activities, and information exchanges required to accomplish DOD missions. These views are the most important to the Training IPT. The SV models capture the information supporting automated systems, interconnectivity and functionality within the weapon system. The Training IPT typically works with the mission system engineers to understand how the DODAF SVs associate system resources to the OVs.

Data contained in the DODAF views are used create a foundation for the training system by using a 6 step process advocated by DODAF 2.0 (Figure 3).

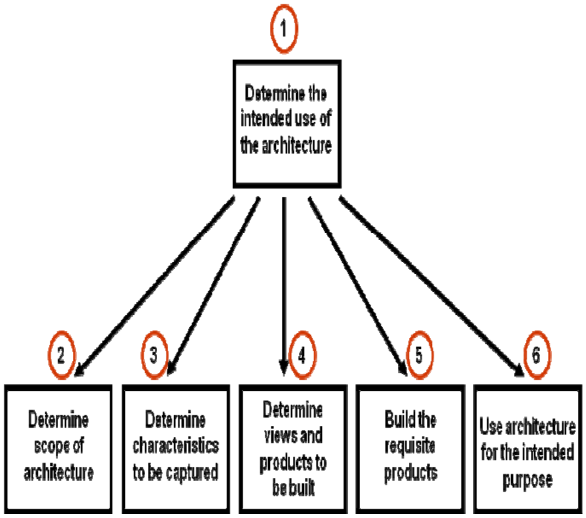

Figure 3. The 6 Step DODAF Process

The 6 STEP DODAF Development Process

DODAF Step 1- Define Architecture Purpose

In step 1 the Training IPT must identify the purpose and scope for the architecture, that is, they must be able to precisely define why they need specific information from the architecture. This is similar to the student undertaking a doctoral dissertation – the student should be able to ask certain research questions that support or reject their hypothesis. They should have a good idea of the type of data needed to support their hypotheses - before they start collecting data.

The Training IPT must be able to accurately communicate this information to the engineering architect and weapons systems development team using a vocabulary that everyone understands. Everyone should respect each other's discipline and be able to work concurrently to obtain and develop necessary data concepts needed for design in their specific area. The DODAF models that provide the Training IPT with useful data for determining training system requirements are the Operational Views, specifically the OV-1 (High-Level Operational Concept Graphic), OV-2 (Operational Node

Connectivity Description Model), and the OV-5 (Operational Activity Model). These data models provide information about the weapon system functional interconnectivity, which is extremely helpful to the training analyst in determining points of human interactivity.

In step 1 the Training IPT analyzes the CONOP (OV-1) to determine and document the primary and secondary mission requirements (Figure 4).

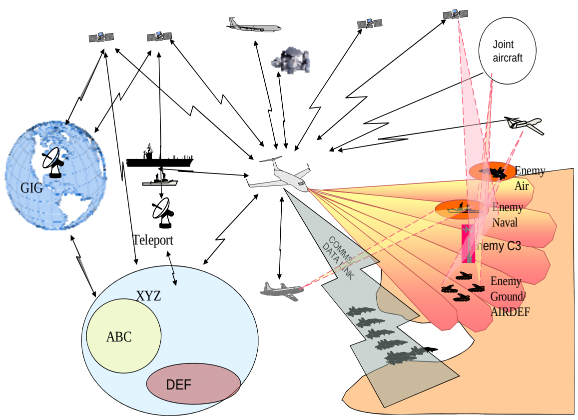

Figure 4 OV-1 Operational Concept

The OV-1 Operational Concept graphically depicts the Tactical Situations (TACSITS) and results in different scenarios that the training system must encompass. The Training IPT must understand what mission objectives must be achieved in particular situations and the tactics that will be employed to satisfy these objectives. This knowledge helps the Training IPT to formulate a training strategy for the weapon system.

Next, the IPT identifies and documents the functions of each of the systems that will be used to satisfy the mission objectives. This is done by concurrently analyzing the OV-1 and the OV-2 Node Connectivity Model (Figure 5) to determine how the systems interface. Note that up to this point the analysis is strictly from an engineering perspective – only missions and functions of the weapon system are examined.

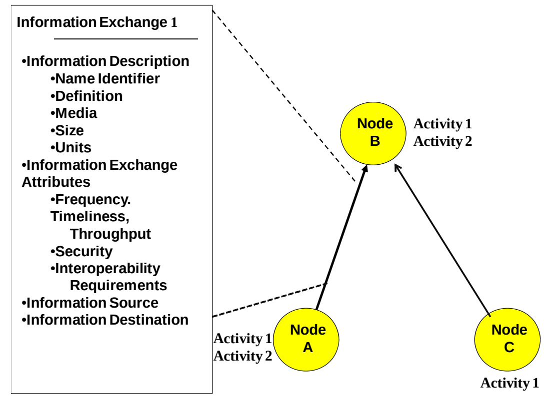

Figure 5. OV-2 Operational Node Connectivity Description

DODAF Step 2 – *Identify Architecture Scope*

In **Step 2** the Training IPT identifies the specific type of information that will be needed for the training requirements. Here the Training IPT, together with the mission system engineers, "scope out" all the systems that may serve to satisfy the functions necessary to meet the mission requirements.

For example, if the mission requirement requires surveillance, then the Training IPT and mission system engineers identify what components (equipment) of specific systems (i.e., radar) will be impacted and which will have human interface. This information will provide the Training Analyst an initial understanding of the human interfaces that may have a training component.

The IDEF0 (Information Definition Level 0) views comprising the OV-5 model provide notional system information that describe system capabilities, operational activities, input/output (I/O) flows between activities in the system and I/O flows to/from activities that are outside the architecture. An example of an IDEF view is shown in Figure 6.

It is the responsibility of the Training IPT to analyze the mission scenarios in order to determine the various capabilities (including human) required for each situation. Information obtained during this analysis effort provides data for the initial human task list.

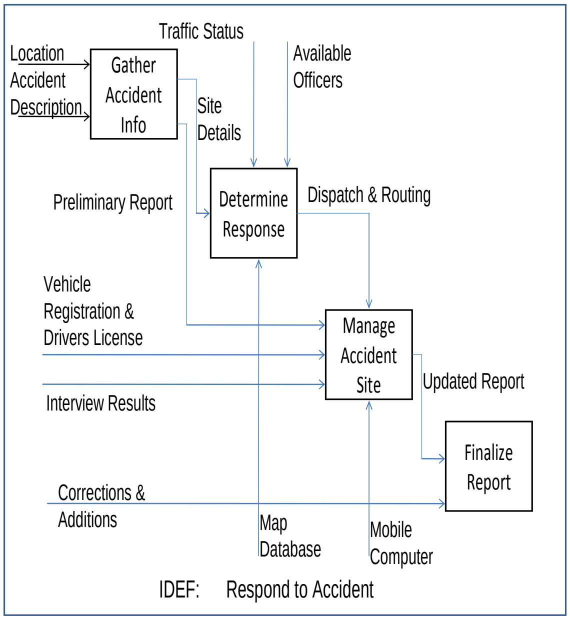

Figure 6. The OV-5 Operational Node Activity Model

Task Analysis

The TDFA Task Analysis is performed to obtain information that is used to develop tasks (hardware/software/human) that describe how system functions will be performed. Using the information obtained from the OV-1, OV-2 and OV-5 DODAF models, the Training IPT can now start to concentrate on defining the human tasks more precisely. It is important for the Training IPT to work with system SMEs and HSI experts to identify additional tasks necessary from the human perspective. As additional tasks are identified they should be added into the mission-function breakdown hierarchy (Figure 1) that will provide the traceability of all functions and tasks back to the operational missions. This traceability matrix enables the HSI analysts to complete usability analysis and to identify ways to improve the user interface with the system. The Task Analysis effort commences with DODAF Step 3.

DODAF Step 3 – *Task Data Requirements*

In **Step 3** The Training IPT determines the specific task data needed and where the data requirements will be obtained. This can be obtained from several sources. If available, data regarding human tasks may be obtained from a training task list done for a predecessor system or a task list from a similar weapon system that has similar capabilities (i.e., weapons systems that have similar radar systems). It is not unusual to use data developed or obtained by another IPT. For example, workload task analyses, performed by the HSI IPT can also be used for training purposes.

Data are also derived from use cases or tactical scenarios (TACSITS) along with their associated METs. The TACSITS provide specific mission requirements to be accomplished in specific areas (i.e., specific radar surveillance that will be done in the Straits of Hormuz). The METs provide notional measures necessary for effective mission performance (i.e., task will be accomplished in seconds, minutes, percentages) but they do not identify specifics. When the MET measure is associated with the TACSIT then a classified MOP as well as MOE will be able to be defined. For example, the operator will be able to recognize X target in 10 minutes (established standard for the operation) under XYZ conditions. This provides essential information for the Training IPT to determine performance requirements that the training system must support.

The actions, conditions, and standards necessary for successful mission accomplishment provide a gauge for how training should be designed. They also provide a basis for initial training objectives to be established. Additionally, the Training IPT must make an initial determination of what specific types of mission actions (involving human tasks) will need to be replicated for training and can they be considered legitimate candidates for training via a simulator. This is important from the training perspective because it must be remembered that the design and development of a training simulator is a long-lead item that often takes several years before it is ready for use in training curriculum. The desired requirements for simulator capabilities (what you want the simulator to do) must be correctly identified and documented in the design performance specifications. This becomes a part of the RFP sent to industry for bid.

DODAF Step 4 – Data Collection

In **Step 4** the Training IPT assists in collecting some of the data that will be required for training analysis. This is especially true for any unique data that are specifically associated with the training system, not necessarily the weapon system. For example, when the Training IPT collects initial training task data it is used not only for curriculum needs but also for making an initial determination of requirements for a training simulator. It is recommended that the Training IPT develop a custom use case scenario for this type of data collection. For example, the Training IPT could ask several SMEs to “sit down and tell a story” about the type of activity that would normally occur during a mission. A facilitator and recorder then captures details via a timeline for each position onboard the aircraft. A template similar to the one shown in Figure 7 can be used to collect this type of data.

TACSIT Title	Overall Goal Given a .... The student will... in a... environment.		
Summary Action	Short title for action	Short title for action	Short title for action
Aircrew Action	Aircrew activity of this section of the scenario	Aircrew activity of this section of the scenario	Aircrew activity of this section of the scenario
Timeline	T=0	T+30	T+50
Conditions ALT AOB/% Turn rate/dir HDG Pitch/% Environmental Sea State Weather			
Cues Includes entity behavior.			
Operator Tasks			
Standards			
Instructor Tasks			
Report Criteria			

Figure 7 Template for Collecting Scenario Data

From the type of data shown it can be seen that one of the responsibilities of the facilitator is to continually prod the SMEs to "fill in the details." If the Training IPT (in this case the facilitator) has an appreciation for what the end state is supposed to look like, then he will be able to act on getting the necessary data to support the desired conclusions. Unfortunately, Training IPTs often do not think through the situation enough in order to determine the specific data that is needed. The result is that important data is missing – and it is very difficult, often impossible to replicate the situation again in order to recapture the missing data.

Step 5 - *Verification*

In Step 5 as the architecture is being built**,** the Training IPT verifies that the information obtained from the DODAF models correlates with the information collected during the use case scenarios. There are several activities that take place in this step. For example, let us assume that a FEA is being done for a surveillance aircraft. One of the first things that must be verified is that the tactical scenarios used to collect data in step 4 actually represent the missions of the platform.

Second, the Training IPT must work with SMEs to determine if the scenario is realistic. For example, they must be able to recognize the numerous variables that the platform would normally encounter in the situation (i.e., typical types of potential images – pleasure boats, fishing boats, etc that would be found in the area of interest where the TACSIT would be taking place).

Third, the training analyst must work with the SMEs to understand exactly what functions must be performed by the platform in order to accomplish the objective (i.e., must be able to use a particular radar to locate a specific target as identified in the objective of the TACSIT) and insure that the function is satisfying the mission requirement.

Fourth, and perhaps most important, the training analyst must work with the training system engineer as well as the platform engineers in order to insure the technical DODAF data (found in OV-2, OV-5) correlates with the information obtained from the use case scenarios. Next, the analyst would examine the Mission Essential Tasks, which would have already been associated to the mission scenario, to determine the measures for satisfactory performance. He would use that as a guide to begin developing specific MOEs for a particular scenario. He could also begin to develop preliminary MOPs that are associated with the operational equipment and the human operator.

DODAF Step 6 – *Documentation of Results*

When all of the verification activities in step 5 are completed a human task list would be compiled. Tasks could now be written with an action (what an operator would be required to actually do on what piece of equipment), under what conditions (obtained from the TACSIT), to what standards (obtained in part from the MET as well as from any technical manual or instructor's guide).

This initial task list provides the foundation of the training program. This information is then used as the input to the more traditional ISD analysis process usually described in traditional ISD texts. The traditional ISD methodology concentrates on the individual and their interactions with the system. It usually involves undertaking a Job Task Analysis (JTA) to amplify the tasks required to perform an activity and identify the accompanying knowledge and skills that one must possess to successfully accomplish the tasks. In the ISD Analysis phase, a job is broken down into a series of duties and tasks. Duties are categories of work are performed on the job by the individual. Tasks are activities done to support the duty. A traditional DIF (Difficulty, Importance, and Frequency), analysis is usually done to provide an initial "Training Task Priority List." Each task selected for training can then be further decomposed into subtasks or steps. Accurately identifying these subtasks and steps help the training analyst determine the knowledge and skills necessary to perform the job. These knowledge and skills are then taught via a series of learning objectives.

Given the complexity of today's weapon systems a Cognitive Task Analysis approach which is an extension of a traditional task analysis technique should also be considered. Cognitive task analysis focuses on capturing a description of the knowledge required to perform complex tasks, which are defined as those tasks whose performance requires the integrated use of both controlled (conscious, conceptual) as well as automated (unconscious, procedural or strategic) knowledge to perform tasks that extend over a period of time (Clark, Feldon, vanMerrienboer, Yates & Early, 2006). Today's systems are highly automated, so the physical performance is largely automated, however the cognitive decisions and analyses that must be done can be highly complex.

Using techniques found in both traditional procedural task analysis as well as cognitive task analysis will aid the analyst in determining the knowledge and skills required to perform these tasks. These knowledge and skills statements provide the basis for the learning objective statements. So by combining system engineering concepts, HSI analyses, and traditional ISD job task analysis, the training analyst should have sufficient data to prepare initial learning objectives. Using this method insures a traceability of the Learning Objectives to the system design and more importantly to original mission requirements. This audit trail makes it easier to determine the training impact whenever the system design changes and matures.

CONCLUSION

Training FEA is often considered the sole responsibility of the instructional systems specialist. However, the process of identifying initial training requirements must involve specialists from numerous areas. This paper suggests a process to identify initial training system requirements prior to the traditional ISD involvement. This process is complex and involves obtaining and analyzing information from tools (databases) such as DODAF and the TDFA. However, Training IPTs must be familiar enough with the DODAF architecture to interpret and conceptually understand what the DODAF views represent. More specifically, they must know how the specific views will provide unique information to support training system requirements identification and development and how to query the database to obtain this information. This paper serves to illustrate that a Training IPT must have the right mix of individuals who possess the right experience, and understand their roles and responsibilities in the FEA process. Organizations that acknowledge this and take action at the onset of a program can prevent costly tactical decision errors in the acquisition process.

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