

# THE ROLE OF THE TRAINING SYSTEM ANALYST IN COURSEWARE PRODUCTION<sup>1</sup>

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## Abstract

This paper will focus on the management tasks that should be performed to truly track the production of courseware for an aircrew training system. By the production phase, the training system design has been set and the proposed courseware structure is established. Once the foundation has been laid, what factors need to be monitored to ensure the courseware being created meets the designer's original intentions? Though each training system program requires solutions unique to that program, the similarity of problems and obstacles encountered during production across programs suggest activities which are predictable. The goal of this paper is to provide a discussion of these 20/20 hindsight activities.

## I. Introduction

Aircrew training in the Air Force is in the throes of a transformation. As Bills, Fakult, Brown, & Ahmed (1988) reported, the advent of the contracted aircrew training system transferred training responsibility directly to the contractor and created a need for a new type of technical specialist. The training system analyst is just such a specialist, able to support the acquisition of an integrated training program. One of the most newly recognized areas of jurisdiction for a training analyst is that of courseware. Courseware is the instructional information required to support a training system. It is possible to manage the production of this courseware effectively. Despite the nuances of particular programs, the similarity of problems encountered during production across programs

suggest predictable preventative measures. This paper provides a discussion of these measures a training analyst can take to ensure effective control of the actual production of lessons.

## II. Background

Five years ago, aircrew training acquisition consisted of one primary component -- simulators. The operational commands retained the responsibility for the support structure for those simulators. Instructors could not fully utilize the simulators without training scenarios and academic materials to go with them. These training scenarios and instructional materials that support training devices are referred to as courseware. Courseware usually resides on the following media; computer-based instruction, lectures, slide/tapes and/or workbooks. When aircrew training began to be acquired as a full system, courseware, as a part of that system, also became a player.

Once the Air Force saw the need for improved training effectiveness, the contracted aircrew training system arrived. As in other Air Force programs, limited resources and manpower drove training further and further into the contractor arena. Previously, the contractor produced only training devices. Now, in some cases, the contractor provides a guaranteed qualified student. This shifts the responsibility for the training system design and system integration from the buyer to the developer. Considerations of a simulator suite alone are now insufficient. The developer has to have a training system perspective when the intended product is a qualified student. Thus, the concept of a full life-cycle training system, where each element is integrated for systematic proficiency development, is born out of necessity.

<sup>1</sup> The opinions and views of the authors do not represent official policies of the Department of Defense.

The whole process of acquiring a complete system is still embryonic. There are few aircrew training system programs that have progressed beyond the initial design and development stage. As the acquisition process began to focus on the design of the training system, guidance on system specifications and training systems requirements analysis (including media selection) became available. However, since courseware, until recently, was not considered a prime factor in the acquisition of training, guidance on how to effectively manage its purchase went no further than design and development.

Courseware development and production benefits tremendously from the on-going trend towards an integrated training system perspective, particularly on the larger training programs. Though courseware is not considered a major factor and may be hard pressed to attain that status due to its chronically low dollar value and non-engineering nature, its existence is now acknowledged. In those smaller programs where the end product is still the training device/courseware suite, courseware is seen grudgingly as something that needs to be managed. It is now receiving attention, visibility, and process control similar to that of "software" twenty years ago (Bills, 1988).

Despite its recognized existence, the acquisition process is accepting the tracking and managing of courseware very slowly. Thus, courseware languishes unattended in the contractor's domain because it does not fit easily into the engineer's traditional jurisdiction (Fakult, Pfledderer, & Bills, 1988). However, as this paper points out -- this does not have to be the case. Courseware is an integral part of the training system.

Within the engineering acquisition community, a group of training analysts is learning to generate the contractual specifications and design characteristics of a fully integrated system. The analysts are managers with the ability to see how the pieces fit together. From their experiences with early training programs and standard engineering acquisitions come the existing pool of guidance on the technical management of design, development, and production of the system, including courseware.

Once the training requirements baseline analysis and the media selection are finished -- the assumption is that the hard part is over. However, just as a perfect automobile specification will not guarantee the assembly line product is without defects; similarly, production of courseware needs to be monitored and evaluated to ensure the quality of the final product.

### III. Discussion

The production of courseware can be split into three stages in which production activities take place; pre-production, full-scale production, and formative evaluation/terminal production. There are two basic functions for the training analyst in each stage. First, the analyst must always be thinking ahead -- making preparations for the next stage to run smoothly. This anticipation of what is needed to accomplish the next stage of production usually involves a thorough review of the developer's plan for that stage. Secondly, the manager must also track what is happening in the current stage -- ensuring that all is proceeding according to plans previously adopted.

#### A. Pre-Production

Pre-production refers to when the system specification, the training system requirements, and the media selection have all been completed and the production of lessons is imminent. Usually the developer begins creating prototype lessons before full-scale production of academics begins. It is critical that whatever forum exists for discussing courseware issues be used to establish the guidelines for the production rush to follow. Due to the newness of courseware as a training system player, it would not be unusual for a program to have no provisions for discussion of courseware issues.

The instructional developers creating the lessons should already know what is expected of them before they begin writing. If the contract calls for use of previously existing material, it is important that it be made clear if that material will be used as is, with changes to format, or with changes to technical accuracy. Without the conditions under which the material is to be used, the door will be open for the developer to constantly shift blame for instructional deficiencies to inadequate government furnished courseware; also, establish the technical documentation or Design Criteria List (DCL) to which the courseware developer is required to write the courseware. When an instructional developer sits down to write a lesson on Topic A, he/she has to know what to teach the subject about that topic. For instance, if the lesson topic is the aircraft radio, one of the things the lesson should include is how to turn on the radio. The source documentation that the instructional developer references to find out how to turn on the radio is what belongs on the DCL. This list is used during testing to establish that the lessons conform to the proper technical specifications.

The manager can ensure the full production process will run more smoothly by establishing the documentation flow during pre-production. Contract deliverables are not meant to hinder program progress but to provide time/phase data to inform management of developer progress toward a specific milestone. Sequencing the deliverables to match the program flow will make the tracking process natural. For example, the Lesson Format Guides and Lesson Specifications Report should be submitted before lesson production begins -- an obvious point but one that has been known to be overlooked.

This is also the stage for the formalization of the review process -- thinking ahead to document how the lessons will flow, how they will be monitored and evaluated, and to what point technical accuracy concurrent with the aircraft will be required. The Quality Control Report describes the overall process of the courseware review and the role of the players involved. It is the responsibility of both the buyer and the courseware developer to view the lessons for proper lesson design, correct application of the objective, and lesson development. By noting the problems early, they can be corrected and implemented into the lesson before the next incremental review is scheduled. By checking the quality control process before it is initiated, the purchasing agency can ensure the government is not expected to review lessons that have not already been through an in-house contractor review. This in-house process should include author peer review and instructional development team editor review. Throughout the lesson review, it is also important to track the lessons through their various stages of production. The proposed method of tracking the lessons and the vehicle for communicating production status should be covered in the Quality Control Report. Each program will have its own process but there are predictable stages that should occur across the board.

Format guidelines, lesson specifications, media presentation standardization -- the more of these that can be finalized now, the less reworking the lessons will need later. On both the lesson specifications and lesson format, terminology differs widely from program to program and developer to developer on how to refer to this information. In order to know what lessons to develop, a syllabus must exist. Certain elements like lesson length cannot be determined until the lessons are actually written but the basic flow of the training sequence should be in place. Before the instructional developers can begin writing, the lesson specifications must be approved. Basically, there are two areas of a lesson that need to be checked before it is actually written: format and content. The lesson specification is what will be covered in the lesson -- an overview of the lesson before it

is actually written. The key here seems obvious but has been overlooked before -- the lesson specifications should be approved before production begins. The format guidelines to be used across lessons must also be established in the Lesson Format Guide. All the lessons should be consistent in presentation. For example, two spaces after a period, begin lessons with a main menu, present the objective inside a box -- all are types of presentation guidelines. It is helpful to have this specification as a deliverable for use while reviewing lessons away from the development site. Once lesson format has been set and approved, lessons can be checked for conformance to this format throughout the review process.

The next stage of involvement is the storyboard. A storyboard is a frame by frame outline of a lesson. It is important that the acquiring agency see the outlined product before the lesson is committed to production. This way the lesson can be checked for the overall acceptableness of the instructional technique. The developer should have done an internal check of the storyboards in keeping with the process in the Quality Control Plan. The purchaser, on the other hand, should develop a process whereby both the user and the buyer have a chance to review the product. Then, whether by letter or phone, they should interact before transmittal of lesson comments to the courseware developer to ensure there are no conflicting directions. Depending on the program, any further stages of review should be conducted similarly with time built in for the buyer's review. The acquiring agency can check lessons for instructional technique, conformance with format guidelines, and feasibility of graphics -- things it is not necessary to be a user to see. This also provides an opportunity to ensure early on that the developer review process is not dampening creativity on the part of the instructional developers trying to create a lesson. Also, once the instructional developers are off and running in the creation of lessons, their appetite for technical information will be voracious. Now is the time to reestablish the roles of the Air Force Subject Matter Expert (SME) and the developer SME initiated in the design/development stage. Any delay by the buyer and patterns of interaction between the Air Force SME and the instructional developers will be cemented, making change difficult. The SMEs are likely to have been involved well before production but it is during the actual writing of lessons that the pitfalls of over-dependence on government SMEs can surface. It is not surprising that instructional developers writing lessons on topics they are unfamiliar with would seek verification from a SME on their lessons' accuracy. However, that is the role of the developer's SME. The Air Force SME looks at finished products and does not assist with actual development.

## B. Full-Scale Production

Once the Lesson Specifications, Lesson Format Guides, and any prototype lessons the contract calls for are completed, full-scale production of lessons begins. As lessons reach production milestones, the analyst can check the syllabus against realistic estimates of a lesson's length and changes in scope of individual lessons. The training system analyst must not only monitor progress on the integration of the whole sequence of lessons but also check the status of individual lessons. In order to truly monitor production progress, confirm that a representative sample of lessons are as far along in the production cycle as developer schedules indicate. Each lesson will have some sort of lesson tracking sheet that has checkpoints for milestones in its production. As the lesson progresses from outline to storyboard to initial draft to conditional SME acceptance to peer review and quality control, some indication will be made, manually or by computer, of the lesson's status on its tracking sheet.

The developer may communicate this progress in any number of forms -- usually lesson production status in percentage completion. It is the analyst's job to know the lesson production process well enough to convert those percentages back to raw data. He needs to understand, for example, that if Lesson A is 20% complete that this means its lesson tracking sheet will show it to have been through lesson outlining. The analyst needs independent confirmation of production status rather than relying entirely on developer figures. One step towards accomplishing this is taking a small, random sample of lessons and walking through its tracking sheets on-site. Next, visit the various departments involved at each checkpoint to understand the lesson's actual status. Check for simultaneous development of tests and quizzes that accompany the lesson. It is also important to ascertain if the media department is aware of the graphics or slides required for this lesson and make sure a vehicle is built into the production process for this sort of print-shop, media-shop, and instructional developer interaction. Look to see if the quality control process works as predicted. Who reviewed the lessons? Was anything missed? Does the quality control process look only for content or check also the actual quality of the media being produced, the reprint quality, etc.? To complete the picture, check each lesson for traceability back to its origins in the Training System Baseline Analysis. Ensure the lessons are being checked for human factors considerations that surface during production. At this point in production, the one person who has an inside view of production details is the Air Force SME. Encourage communication with him. Follow his lesson discrepancy reports through and ensure they are acted upon. It is the courseware analyst's responsibility to

ensure the SME's role as technical expert is not being abused by the developer in terms of overwork or participation in design activities for which the developer is being paid. The SME reviews what has been produced, as opposed to participating in the production.

The analyst must understand the purpose of each lesson and scenario in the total training system. Regular schedule updates and lesson listings are essential to understanding program status and problems that could arise. It is possible to identify problems of a non-SME nature like standardization, presentation problems, delivery format problems, unclear wording, typographical errors, and interaction problems. By looking at the lessons, the analyst can understand what is involved in their production. Knowing about requirements like media photo shoots facilitate their early on accomplishment. The developer should have provision for classified to be treated properly but still within conformance to format guidelines. The analyst should be aware of source data problems with certain lessons and either correct the situation, eliminate the lesson, or alter its projected complete date. The course map and syllabus should also be progressing. Remember to keep track of the overall picture. The analyst may or may not be able to have an awareness of the status of each lesson depending on program size. Nevertheless, the review process, if it executed properly, should enable the manager to verify for himself/herself the movement of the lesson through the storyboarding, programming, and finalization process.

A new aspect of academics and total training systems is the Training Management Information System (TMIS). TMIS provides a summary of students' performance as they progress through each lesson. This is a valuable tool for not only the students and academic instructors but also for the courseware developers. For students, it provides information on their performance of the material including grades and progress. Academic instructors use TMIS to identify trends in student and class performance. The TMIS can be set up to show what questions were asked of the student in each lesson, what the student answered, how many students answered correctly, and how long it took the students to complete the lesson. With all this data, instructors can locate deficiencies the students may have in learning the material. The TMIS is also a valuable tool for the courseware developers. The data collected, such as student performance and scores, can provide insight to the teaching effectiveness of the lesson and allow the developer to improve upon the questionable area in later lessons. Provisions can also be made for special user needs. Designed to track the student's process, TMIS can be configured to output almost any piece of data considered to be of statistical importance. Therefore, it is

necessary to isolate early on the user's delivery needs and ensure that TMIS produces its outputs and formats them in a useful manner. Even though this system cannot be fully tested until enough lessons have been written, it could be partially tested on existing courseware. As soon as possible, track the networking of the system and try to load to existing courseware and test the ability of the pieces of the system to interact.

At this point, lesson production is in full swing and the training analyst is staying abreast of production progress. It is now time to ensure the next stage, Formative Evaluation, is set up to run smoothly. The Quality Control Plan may or may not have gone into courseware test methods. If not, a test plan of some form for courseware should exist by now. Since lessons are written most effectively when the instructional developer can work on one until completion before starting another, lessons will be finalized sequentially and be ready for testing one by one. Thus, an analyst cannot wait until Formative Evaluation is upon him to consider test issues already underway. Formative evaluation begins with this plan for determining the training effectiveness of the lessons. Besides a theoretical discussion of how to accomplish this, the plan should also outline the details. Courseware testing is a long lead time endeavor. Here lines began to blur because testing can be arranged at such varied times in a given program. Even before a lesson is finalized, it should have been informally "tested" through peer reviews and individual try-outs. Group tryouts and reviews give the analyst an opportunity to present the lessons as a course and tests the training effectiveness of the lessons. In order to produce successful reviews and tests, the test plan should cover the requirements for subjects involved in testing; such as the number of students and background of students in order to obtain a useful representative sample. The number of evaluation periods to be held and the proposed method of dealing with the discrepancies from these evaluations must also be considered and included in the test plan.

Similarly, waiting until Formative Evaluation to consider delivery issues would give little room or time for discussion. This is the stage when the Implementation Report should be outlined. The analyst needs to ensure the issues of furniture, facilities and delivery format are considered well ahead of time. It is easy to get caught up in the production of individual lessons and forget the instructional materials must have facilities for presentation. The Implementation Report should address these issues. Since a lesson, once finalized, cannot be produced for delivery without precise formatting instructions -- documentation of what the user needs is essential. Delivery details as simple as three-ring binders, holes punched, and blank

pages for printing can become major contention points if not agreed upon early enough in the program. Well into the program it has already been established what the deliverables will be, but not their format. Begin with definitions of each deliverable -- understand what the items mean. For example, outline what a Student Guide is and what it will contain, as well as the packaging of the final product. The Implementation Report should point out these anticipated details of formal delivery format such as slide/tape numbering, blank pages between sections, requirements for cover sheets, and logo standardization. If there is a prime developer, it is important to identify the need for them to quality control their subdeveloper's delivery before it is passed to the Air Force. Appropriate provisions should be made for training schoolhouse delivery versus operational sites -- if the program has such distinctions. It should reiterate who has responsibility for courseware maintenance and draw the lines to establish which discrepancy reports, testing problems delivery problems, and lesson revisions will be fixed under which contract; production, or maintenance.

Finally, in this stage, ensure the existence of personnel trained in the interaction of the system with itself. An interesting situation can develop in courseware. The prime developer or hardware procurer is familiar with the computer system hardware being used. The instructional developers are familiar with the lessons they write. The authoring system could be an off-the-shelf language developed by some third party. The operating system that ties the system together could belong to any of these parties and, therefore, no one is familiar with the whole system. Before production is the time to identify this situation. The best lessons in the world are useless if the hardware will not play them or the operating system makes them inaccessible. Training personnel to handle the system integration is a long lead time item, but it is not difficult. The pitfall is in how easy it is not to realize this need exists.

#### C. Formative Evaluation and Terminal Production

At this point in production, most of the lessons will be nearing completion. Graphics are being inserted, typographical errors caught, and final quality control changes are being made. All the SME's technical comments have been resolved and the lessons stamped with conditional acceptance. The lessons will already have gone through the peer review process and examination by an independent contractor quality control department. It is now time for a pre-delivery testing by subjects with qualifications similar to those of the intended population. This initial testing is referred to as Small Group Tryouts (SGTOs) and conducted or monitored by the training analyst -- depending on the program.

SGTOs, using a group of subjects similar in qualifications to the students the system will be training, run through as much of the developed courseware as possible. This is an opportunity to simulate a true training class with a small group of students and at the same time collect the students' input on the quality of the courseware. Small group tryouts involve more than testing blocks of courseware; they include much planning and preparation in order to achieve a successful test. Initially, the purchaser and the user must select the appropriate population from which to choose a sample of students for testing. Students with various levels of experience are usually from the command which will be receiving the developed courseware. Once the students are selected and the test is scheduled, preparation for the SGTO begins. Selecting the courses to test is probably just as important as selecting the students. Instead of randomly selecting the various lessons, it might be beneficial to consider blocks of lessons which concentrate on one subject and, therefore, present a complete picture on one topic to the student. This will give the analyst the opportunity to see if the group of lessons were actually effective in teaching the students.

To begin, one must be assured that the furniture, hardware and software components are set-up at the testing site and ready to operate. This seems obvious, however testing courseware is infeasible without operating hardware and software. In order to measure the effectiveness of the lessons and collect student comments, questionnaires are developed. These questionnaires should cover such errors as comprehension of the objectives, instructional effectiveness, style or presentation of the material, and the human factors of how the lesson was presented. Questionnaires should be taken after each lesson is taken. Another way to collect student comments is to assign student monitors (individuals positioned behind the student) to record any comment the student may make on the courseware. If monitors are to be used, schedule them accordingly. At the actual tryouts, before testing begins, brief the procedures to be followed by the personnel involved. Take time to explain the importance of handouts, questionnaires, schedules and syllabi. Remember, the better the students understand their responsibilities, the more useful the comments. Inform students that collaboration on the comments is not permitted. Once testing begins, present the student with the lesson pretest. Pretests are taken before the lesson and later compared to the lesson posttest. Thus, by comparing the scores of these two tests, the teaching effectiveness of the lesson can be measured. Only conduct four to five test sessions per day to prevent student burnout. Meanwhile, check the networking of the system and compile comments during testing.

Finally, the week after tryouts should be the Courseware Review Board (CRB). The CRB reviews the test data provided by the students and suggest changes to the courseware by submitting test discrepancies (TDs) and assigning change priorities to those courseware changes. Test results are then summarized and fed back into the final production subphase. Some lessons will require only minor changes and others major rewrites. Thus, it is important that the manager makes it clear that production is not over until the lessons have been retested.

Though the primary purpose of this stage is initial testing of the courseware, production continues until all the SGTO test discrepancies have been corrected. Meanwhile, since not all lessons are involved in the first SGTO, production on non-tested material continues and then the untested material is scheduled to be looked at during the subsequent SGTO. So the cycle continues. Once production is well underway, as many lessons as possible are evaluated in predelivery SGTOs. Corrections are made to the material just tested, new lessons are prepared for subsequent testing, and SGTOs are conducted. All simultaneously for as long as the program's schedule and resources permit. Ideally, every newly developed lesson would be tested at the individual and SGTO level. That is not always feasible. Formative evaluation runs concurrently with final production just so it is possible to evaluate the caliber of lessons being produced while there is time to alter them.

Once formative evaluation and final production begin, the developer begins to look ahead to delivery. The delivery format specified in the Implementation Report should be upheld. Any last minute practical changes can be coordinated through all parties and documented. Since the guidelines for final delivery, DD250, and implementation were agreed to well before formative evaluation, all that remains is to ensure that the guidelines are being executed. The training analyst can forestall delivery difficulties by sampling the products to be used in SGTOs and ensuring they meet delivery format specifications.

By following these checkpoints and always thinking ahead to the next stage of the acquisition schedule, a training analyst should have little difficulty staying versed in program progress. At every stage of production, the analyst is involved. Without his/her suggested approval at the milestones of lesson specification, storyboard, conditional acceptance and formative evaluation -- program management could bring progress to a halt. It is also important to reiterate the training analyst should get involved in understanding the lesson production not by creating new work and data requirements to track lessons progress but rather using existing developer internal

processes. This is not intended to suggest problems will not develop; but by constantly staying abreast of production developments in each stage, the training analyst will definitely have time to see those production problems coming and work to forestall them.

#### IV. Summary and Conclusions:

There are many specific areas that can be controlled and managed within the production of courseware. This discussion intended to present the existence of predictable analyst functions at each stage of production. By being involved with lesson monitoring and thinking ahead to the requirements of the next phase, the training analyst is doing more than looking over the developer's shoulders; he/she is fulfilling the buyer's role of overall training system perspective without over-interference in the developer's work.

Guidance in the Air Force does exist for those people actually developing or designing courseware. These activities are meant to superimpose themselves over the existing guidelines as an outline for production. It is possible for the buyer to work with the developers in such a way as not to create work for them, but rather to provide an outsider's view of their progress. It is the training analyst's responsibility to look ahead and ensure the program proceeds smoothly.

This paper was also intended to bring courseware into the mainstream of training system acquisition by showing that courseware is not some unknown quantity. It can be dealt with by training system analysts who do not have to be courseware specialists. Courseware, like any other component of an acquisition, has its own vocabulary and once a training analyst has a grasp of that vocabulary, courseware should be just one more portion of his managerial jurisdiction.

If courseware is to be truly integrated with the total training system, guidance such as this paper should be available to the new training analyst. Courseware production does not belong in the hands of a few courseware specialists isolated from the rest of the training system. When courseware is truly considered just one more component of a system, then the Air Force's concept of an integrated training system will have taken one more step forward.

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