Operational Forecasters' Professional Development Series Training Program

A concept paper for an integrated approach to serving the professional development needs of operational forecasters

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for the

COMET® Process Definition Committee

March 3, 1997

Introduction

This concept paper describes and defines the components and elements of a process to develop educational and training materials that support and promote the professional development of operational forecasters. It describes an integrated approach that recognizes the distinct roles that various training centers and functions within the National Weather Service (NWS), the Air Weather Service (AWS), and the Naval Meteorology and Oceanography Command (NMOC) play in the professional development of operational forecasters. In particular, this paper describes how these training centers and functions will be able to utilize the instructional design, development, and presentation capabilities of the Cooperative Program for Operational Meteorology, Education and Training (COMET®) and, in turn how the COMET Program, working with these training centers and functions, will integrate the use of instructional technology to enhance and extend on-station training in the NWS, AWS, and NMOC.

A variety of instructional technologies are available for supporting on-station training and education in the weather services. Three major categories of these technologies are on-line instruction, teletraining, and CD-ROM-based instruction. Each of these afford different advantages and each also has peculiar limitations. Therefore the most complete form of on-station training and education will come from the integration of all three categories of instructional technologies. The process that will be outlined in this paper will account for how these categories of technology can be used to bring the operational forecaster to different levels of performance. Additionally, classroom-based instruction will be important for train-the-trainer in order to prepare SOOs or training officers to conduct effective on-station training.

Enhanced job performance is the ultimate goal of professional development. Within this context there will be educational activities as well as training activities. The former will be directed at instilling an operational understanding of scientific concepts and principles while the latter will be directed at mastering specific forecasting techniques and the use of forecasting tools. As is often the case, science and technology cannot be

separated but must be viewed as an integrated system. Before inferences can be made on the basis of scientific reasoning, prior and current conditions have to be assessed through observation, analysis, and synthesis through the use of advanced data sets such as satellite and radar imagery and model charts. The science and the tools needed to apply the science cannot be taught in isolation, so the focus of the described instructional development process will emphasize the full integration of these two areas.

An effective training and education program for professional development and job performance cannot be materialized out of the air, so to speak. It needs to emanate from what we expect professional job performers to be able to do. In an era of scarce human resources, both in the forecast offices and in the training organizations, there is no leeway for pursuing instructional activities that do not result in the maximum payoff. Besides determining what forecasters already know, there has to be a clear differentiation between that which is essential for them to know and that which is simply nice-to-know. For example, the first priority is for forecasters to know the relationships between the key atmospheric factors that determine an evolving weather situation. Secondarily, they may need to know how to characterize those factors as they attempt to synthesize a vast amount of information available from the observing systems and the numerical models. But, generally speaking, forecasters are limited by time and will not have the luxury of calculating their own parameters. They must rely on the tools provided to them to do the necessary calculations and then use their scientific understanding to evaluate the reasonableness of the results. Instructionally, a series of visualizations may be far more important then a series of computations even though those computations are the backbone of scientific verification and veracity. Emphasis should always be on providing the most parsimonious explanation needed to achieve understanding by the forecasters.

Establishing a Professional Development Series (PDS)

A Professional Development Series is derived from the service responsibilities of the weather services and their forecast offices. To have professional development that has impact, the training and education of a forecaster needs to be derived from the services being provided to the weather services' customers. PDSs need to be defined in terms of those services being provided and the types of products being delivered. This is illustrated in the following diagram. From the definition of forecast services to be provided and the required forecasting competencies to provide those services comes the determination of the basic training and educational units that have to exist. These units are referred to as Professional Competency Units or PCUs.

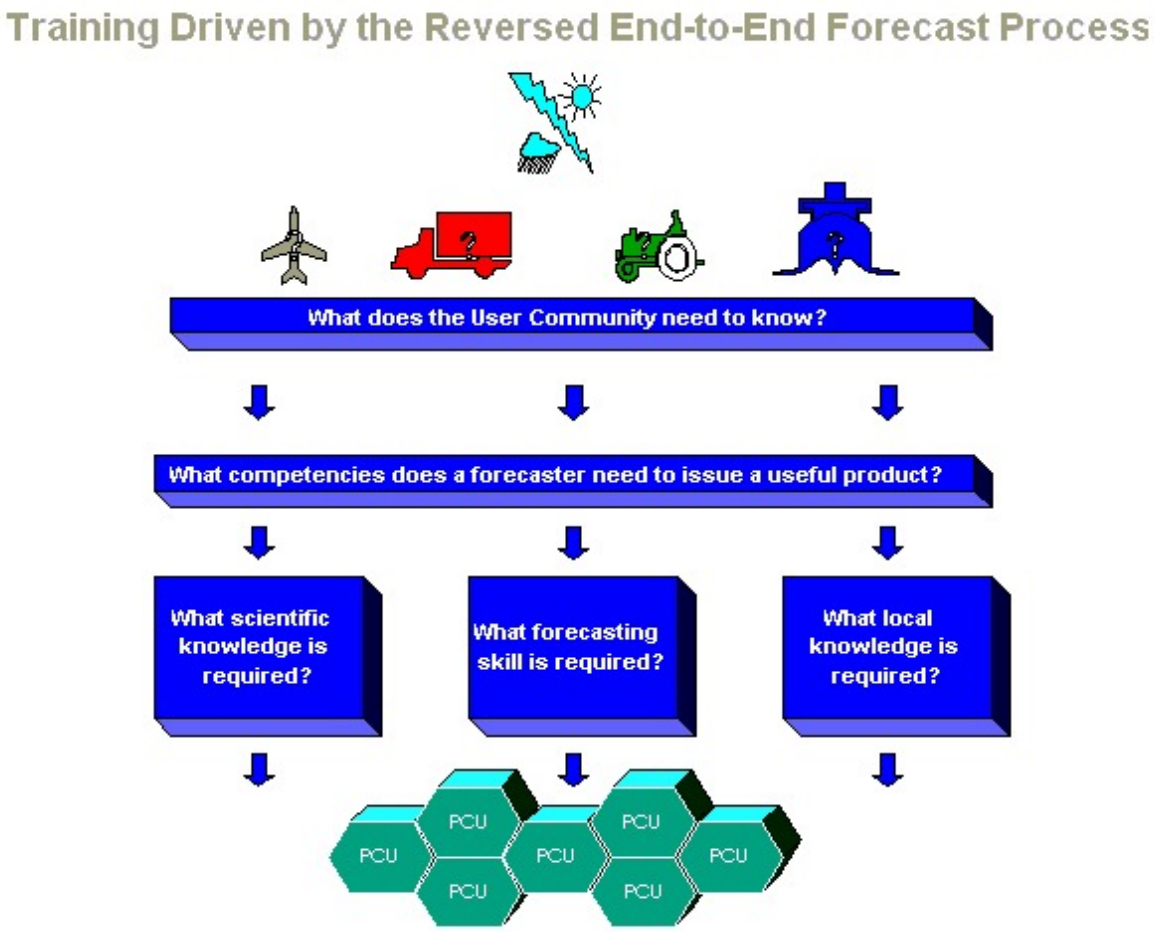

Figure 1: Determining a Professional Development Series

Following is a set of definitions that establishes the basis for the remaining discussion of the new professional development concept.

Definitions

Job Responsibility: Defines what gets accomplished by the forecaster. Job responsibilities are directly connected to the goals and objectives of the weather services. Since a major goal of the NWS is to preserve life and property, the issuance of watches and warnings are major areas of job responsibility. For the AWS or the NMOC, goals are derived from the military missions they are supporting. For example, an AWS

or NMOC forecaster responsibility would be to issue a visibility forecast for a target area.

Professional Development Series (PDS): This is a set of integrated instructional materials and presentations which taken together define the skills, knowledge, and abilities necessary for an operational forecaster to fulfill a major job responsibility. For example, a major new job responsibility for National Weather Service forecasters will be to issue convective watches for the WFO's area of forecast responsibility. A PDS for the responsibility of producing a convective watch would encompass all of the specific job duties and corresponding skills and knowledge necessary for a forecaster to be competent in producing a convective watch. In summary, a PDS should be focused on getting a person to a level of performance that enables him/her to meet their job responsibilities.

Job Duty: This is a set of work activities that produces an intermediate result or outcome leading to the fulfillment of the job responsibility. For example, using the issuance of a convective watch statement as our example job responsibility, a duty to be accomplished in meeting this responsibility is to assess the synoptic environment to determine the potential for convection.

Professional Competency Unit (PCU) : This is a unit of instruction within a PDS. When completed, a PCU prepares a forecaster to perform a specific job duty and/or job task. Completion of a PCU means that a forecaster can produce an outcome that can be observed and evaluated as to its effectiveness in fulfilling a job responsibility (e.g., issue a convective watch statement). A PCU typically will consist of a body of conceptual material, discussions and demonstrations, and performance exercises. Each of these are presented via the most appropriate instructional technology to maximize on-station training effectiveness and efficiency.

Job Tasks: Job tasks are stepping stones to the accomplishment of a job duty. They are discrete, observable activities with a measurable performance. A task involves the demonstration of skill and the application of knowledge. For example, determining vertical wind sheer is a job task. Determining CAPE and buoyancy is another. Establishing storm growth and direction given shear and CAPE inputs is still another. Task accomplishment often involves the use of a tool. Determining wind shear involves constructing and/or interpreting a hodograph. Determining CAPE and buoyancy requires interpreting a skew-T diagram. Tasks involve the use of skill and the application of knowledge.

Task Skill: Skill involves the ability to do something whether it is writing a coherent and meaningful forecast discussion or solving a forecast problem. For the forecaster, example skills are differentiating snow cover from low clouds in GOES imagery or identifying the outflow boundary in WSR-88D reflectivity data. Another skill would be identifying the low-level jet in an 850 mb or model forecast chart.

Task Knowledge: Knowledge is what, when, where, and how and involves the use of concepts, principles, and rules. Concepts are objects, events, or ideas that have common or differentiating characteristics. A super-cell thunderstorm is a concept. A principle explains why or how something works or comes about. A principle can be used to predict a future event or explain what happened. Coriolis force is a principle that helps explain wind direction. A rule establishes a relationship between two or more factors. The relationship can be causal or correlative but is operative in helping determine a future condition.

Sponsor: The organizational unit(s) within the weather services which explicitly agrees to support the development and implementation of a PCU. Such sponsorship includes stating that the developed PCU is desired, providing on-going access to forecasters to assist in the formative evaluation of materials as they are being developed, supporting the implementation of the PCU within offices when it becomes available, and participating in helping inform other offices on how to best implement and use the PCU as part of an office-level training plan or activity.

Instructional Component (IC): A PCU consists of an integrated set of instructional components. An instructional component is a form of instructional delivery (i.e., WEB, teletraining, CD-ROM, classroom) that focuses on acquiring and mastering task skills or acquiring and applying task knowledge. The form of instructional delivery is dependent on the nature of the skills and knowledge being acquired and mastered. Generally speaking, acquisition of meteorological concepts and principles can be managed via WEB-based instruction. Integration, synthesis, and demonstrated application of these concepts and principles will often come from either teletraining-based or classroom-based seminars. Practice in applying these concepts and principles will come from CD-ROM-based case exercises. The collection of ICs that make up a PCU constitute a learning environment

Job Structure Versus Training Structure

The terms that were just defined are parts of two individual structures-a job structure and a training structure. The training structure is a reflection of the job structure but is not a mirror image of it. Instead, the training structure is further elaborated so as to provide useful divisions of both content and learning activities that are reasonable for the forecaster to engage in during on-station training. This is reflected in Figure 2 below. In this figure, you can see that a job duty can have a one-to-many relationship with PCUs. ICs can have a one-to-many as well as a shared relationship with job tasks and knowledge.

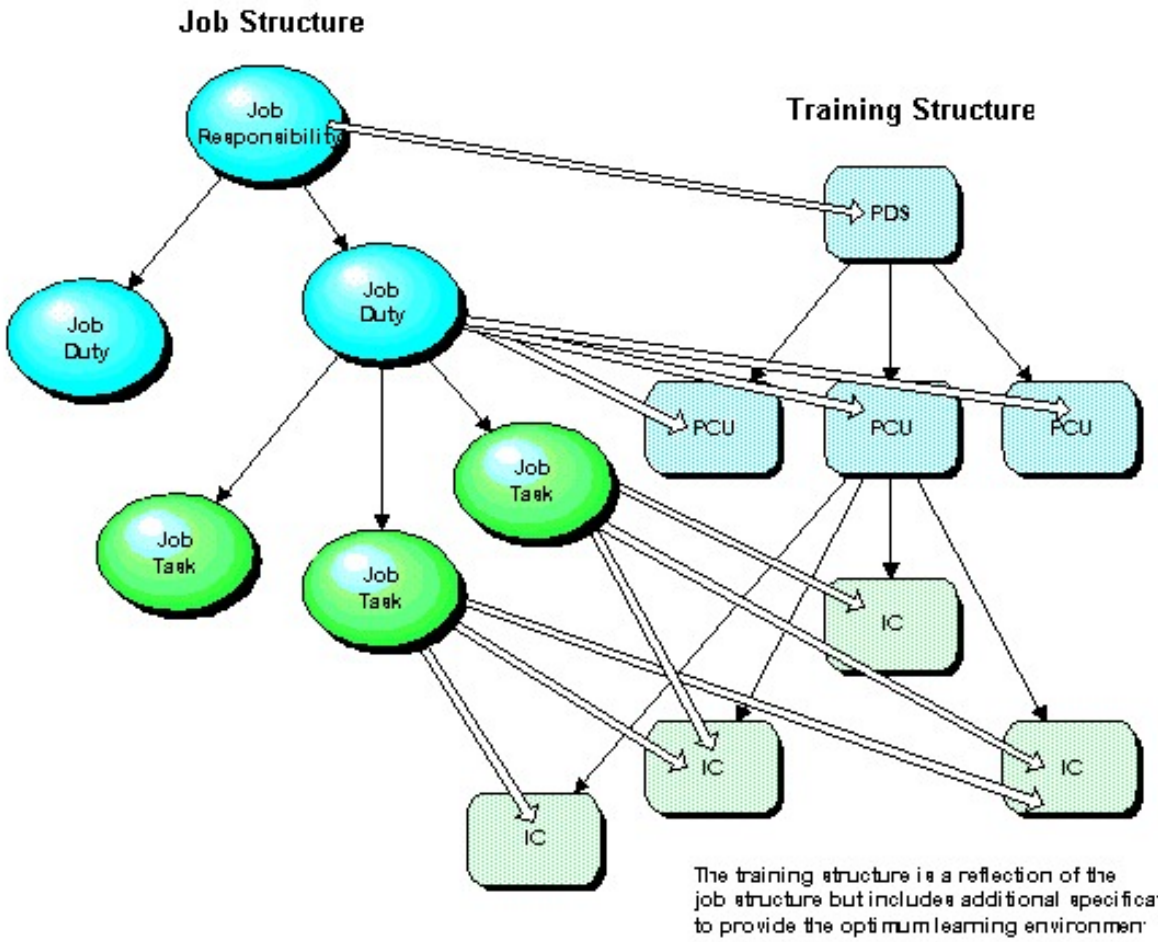

Figure 2: Relationship of Job Structure to Training Structure

In order to establish a PDS the following participants and their responsibilities are required

Weather Service Headquarters

- Establish a priority scheme for forecast services and define the expected job responsibilities for providing those services.

  This forms the basis upon which professional development (PD) priority decisions can be made. The forecast services to be delivered by the FOs directly determine the job responsibilities of the forecaster and in turn determine what should become a PDS. For example, the emphases of the NWS to move responsibility for convective watch statements from the SPC to the WFO constitutes the definition of a new job responsibility for the forecaster. Consequently it also defines a PDS. Likewise, providing quantitative precipitation forecasts (QPF) is another job responsibility that could warrant a PDS.

- Establish a support and evaluation system to ensure that forecasters have a reasonable opportunity to progress through a PDS.

Regional Centers

- Identify unique regional issues related to providing the prioritized forecast service and its corresponding job responsibilities.
- Sponsor Professional Competency Units that are appropriate for job duties common to all offices or forecasters in a region (including all Regional Centers or the majority of offices that may be within the region).
- Prepare and deliver region specific instructional content within the context of a PDS.

Forecast Offices

- Prepare a training plan for forecasters incorporating the PDS as a major element within the plan.
- Sponsor a PCU(s) appropriate for job duties that are unique to an office and the services it provides to its local communities
- Prepare and deliver office-specific instructional content within the context of a PCU. If necessary, provide preparatory training to enable forecasters to take an existing PCU.
- Assess accomplishment of PCUs and forecaster competency.

Training Centers

- Initiate a PDS in coordination with weather service headquarters and regional centers
- Structure PCUs into a learning or professional development path for operational forecasters.
- Identify and establish the means of delivery for all PCUs and the instructional elements that compose the PCU.
- Coordinate all on-line, teletraining, and CD-ROM-based instructional content necessary for a forecaster to progress through a PDS.
- Assign personnel to roles of executive producer, producer, and director.

Establishing Professional Competency Units (PCUs)

A Professional Competency Unit (PCU) is an integrated set of instructional content that taken together provides the job skills and job knowledge necessary for a forecaster to perform a job duty. The skills and knowledge include both scientific and technical areas of competency. For example, to perform the duty of assessing the synoptic environment to determine the potential for convection, scientific skills in analyzing wind-moisture fields are required in combination with technical skills in using tools such as SHARP (Skew-T/Hodograph Analysis and Research Program).

The integration of instructional content is represented in Figure 3.This figure shows an example of how a variety of instructional technologies come together to achieve completion of a PCU by the forecaster. Conceptual materials related to the development of specific task skills and task knowledge can be conveyed via on-line training materials. Teletraining seminars can be used to provide integration of the skill and knowledge elements by providing the forecaster an opportunity to discuss and see demonstrated various applications of scientific conceptual models and forecasting techniques. Finally, forecasters can measure their level of accomplishment by engaging in case-based exercises delivered via CD-ROM and evaluated by their SOO or training officer. Train-the-Trainer residence type instruction prepares SOOs and training officers to integrate the body of PCU materials in their own local training plans and supplement these materials with local examples and training discussions that fit the needs of a forecast office.

Caution: The specification of PCUs needs to be done with the idea of usefulness in mind. When it comes to defining job duties, there are really no hard and fast rules for setting up what the boundaries should be. PCUs need to be anchored to a job duty but they also need to meet a criteria for instructional usefulness. A PCU should provide a sense of accomplishment for the forecaster and not become too much of a seemingly endless enterprise. For example, given the job responsibility of issuing a convective watch, a job duty might be, "Assess the synoptic and mesoscale environments to determine the potential for convection." Rather than have one all encompassing PCU, instructionally it would be better perhaps to have three PCUs: 1) Assess the synoptic environment for determining the potential for convection, 2) Assess the mesoscale environment for determining the potential for convection, and 3) integrate synoptic and mesoscale perspectives in determining the potential for convection. This separation of perspectives on the job duty provide greater flexibility for the training officer or SOO to conduct an on-station training program. Because we are dealing with professional development, some forecasters may need more emphasis on the second PCU rather then the first, or they may need only the perspective of the third PCU.

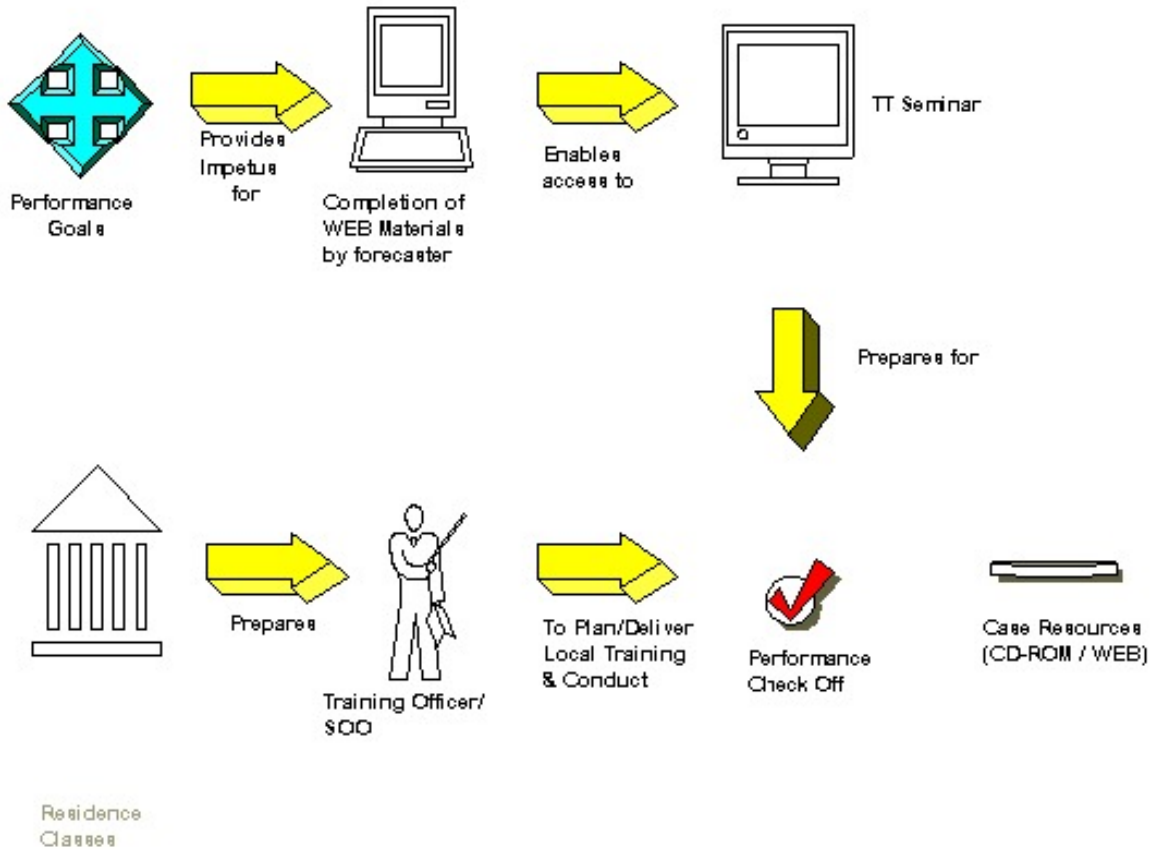

Figure 3: Integration of Instructional Resources in the PCU

A PCU is the building block of a PDS. It is also the framework within which a variety of training and educational activities can be conducted. These training and educational activities are not the exclusive domain of any one training center or organizational entity. Rather, a PCU is a coordinated set of learning activities involving resources from the training centers, the regions, and the forecast offices. PCUs may be suggested by any organizational level in the weather service but must fit within a particular PDS. Additionally, PCUs, before they are enacted, require explicit sponsorship by organizational elements who are willing to commit resources to not only the development of the PCU but also its implementation and utilization. To both ensure coordination and sponsorship of PCUs, a document called the PCU Charter will be used to initiate as well as document the "life" of a PCU.

It is important to note that generally both PDSs and PCUs are "living" entities. That is, a PDS can continually have PCUs added to it as new technologies, forecasting techniques, and scientific research result in expansion of job responsibility with the addition of new job duties. Likewise, PCUs can also have instructional elements added to them to address new task skills and knowledge that have to be acquired to maintain competency in a job duty.

Caution: There will always be more training and educational issues to be dealt with then there are resources to accomplish them. In specifying PDSs and PCUs, and then subsequently the instructional components that constitute a PCU, we need to avoid looking at things as "half empty," but instead be a bit more comfortable that things may be getting to be "half full." It is easy to see all the things that one is not covering especially in something as complex and involved as meteorology. But to do so can freeze one into inaction or efforts that never seem to get quite done. The main function of the PDS/PCU concept is to provide a context for the submission, discussion, and finally the selection of instructional materials that will receive the allocation and attention of development resources. To some degree, PDSs and PCUs may never be completely be finished.

The Roles of Producers and Directors

A PDS requires three positions that oversee, coordinate, and manage its development and implementation.. These positions are:

Executive Producer: The executive producer is the person responsible for establishing a PDS. This is accomplished by working with the sponsoring agencies to properly identify the job responsibility and its performance requirements that become the focus of the PDS. The executive producer secures charters for the PCUs that constitute a PDS as well as the budget and personnel resources to support the development and implementation of the PCUs. The executive producer also ensures the cohesiveness of the PDS by coordinating the development and implementation of PCUs across training centers. The executive producer may be from any one of these training centers. Generally speaking, the same executive producer maintains "ownership" of a PDS for its existence.

Producer: The producer is responsible for the development and implementation of a PCU. Each PCU will have a producer. The producer through the charter document ensures that the PCU has a specific audience and that the content and coverage of the PCU meets that audience's needs. The producer is responsible for gathering together the resources necessary for the development of the instructional components (ICs) that constitute a PCU. This means securing the scientific advisors, initial content script, relevant case data sets, and production resources.

The producer coordinates the scheduling and development of ICs so that implementation of the PCU provides forecasters with an ability to proceed with their professional development in an orderly and cohesive manner. If a PCU consists of WEB

ICs and teletraining ICs, for example, the producer is responsible for ensuring that these ICs complement and support each other. If the WEB ICs are prerequisite to the teletraining ICs, then the producer ensures the WEB ICs are available with sufficient time preceding the availability of the teletraining ICs. The producer also coordinates the implementation of the PCU. In summary, the producer ensures that everything in a PCU fits together and works to achieve the desired competency level. Also, in general, a producer maintains responsibility for a PCU until it is deemed complete.

Director: The director is responsible for the creation of one or more ICs. The director takes the resources gathered by the producer and gives life to an IC. The director ensures the appropriate use of both instructional strategies and media. The director is responsible for coordinating and managing the daily activities required to create an IC. The director ensures the instructional as well as content integrity of an PCC.

Depending on the scope of a PCU and the number of ICs that are required to achieve its implementation, the roles of producer and director may be occupied by the same individual. Likewise, various combinations of assignment of these roles to individuals is possible. An individual could be the producer for a PCU and also be the director for one of the ICs in the PCU. Another individual could be the director for the remaining two ICs specified for that same IC.

Summary

The purpose of the Professional Development Series concept is to provide a common vehicle for representing and coordinating training and educational development and delivery efforts of the training centers. This will first prevent unnecessary duplication of efforts but secondly it will provide a clear structure to convey what training is available for use within the forecast office. It will also provide a mechanism by which new training and educational components can be proposed, responsibility assigned for their development, and commitment be made for their use.

Because the instructional components that make up a PCU and in turn a PDS are clearly partitioned and defined and are available in the form of WEB pages, CD-ROM, or teletraining based seminars, great flexibility is afforded the SOO or training officer in composing a professional development program appropriate to their office and forecasters.