The National Weather Service Clustered Peer Concept of Operations Prototype Plan

Fiscal Years 2007-2009

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Table of Contents

1.0 EXECUTIVE SUMMARY 3

2.0 BACKGROUND 6

2.1 CONCEPT OF OPERATIONS TIGER TEAMS 6
2.2 PROTOTYPE SELECTION PROCESS 7
2.3 LABORATORY 9

3.0 PROTOTYPE INTRODUCTION 12

3.1 PROTOTYPE PHILOSOPHY AND GOALS 12
3.2 PRINCIPLES 12
3.3 CONSTRAINTS 12
3.4 RISKS 13

4.0 PROTOTYPE STRATEGY 14

4.1 PROTOTYPE OVERVIEW 14
4.2 PROTOTYPE DEFINITIONS 15
4.3 PROTOTYPE TRAINING 17
4.4 PHASE 1 19
4.5 PHASE 2 20
4.6 PHASE 3 22

5.0 CONOPS PROTOTYPE EVALUATION PROCESS 25

6.0 CONOPS PROTOTYPE REPORT 27

APPENDIX A: OPERATIONS AND SERVICE IMPROVEMENT PROCESS 28

APPENDIX B: CONOPS LABORATORY FINDINGS AND RECOMMENDATIONS 29

APPENDIX C: PROTOTYPE RISKS 35

APPENDIX D: CLUSTER PLAYBOOK OPERATIONAL STRATEGY PAGE EXAMPLE 38

APPENDIX E: PROTOTYPE TRAINING 39

APPENDIX F: MEETINGS AND EXERCISES 43

APPENDIX G: PRELIMINARY PROTOTYPE GANTT CHART 45

1.0 Executive Summary

Early in CY2006, the NWS Corporate Board agreed in principle with the recommendation from the Initiative Team that the Clustered Peer Concept of Operations (CONOPS) be used as the CONOPS of the future. This CONOPS is fueled by a number of key shifts from the way the National Weather Service currently operates. The Concept of Operations Prototype Team was chartered to provide the Corporate Board with a Prototype Plan of the CONOPS that was sufficient for Impact and Implementation (I and I) negotiations with the National Weather Service Employees Organization (NWSEO).

As part of the Prototype Plan development process the team identified WFO clusters that will take part in the prototype demonstration and designed a laboratory process that tested the technologies necessary to support the CONOPS. The Corporate Board approved four clusters (Pacific Northwest, Great Plains, Great Lakes, and the Southeast U.S.) and the funding for the Earth System Research Laboratory/Global System Division (ESRL/GSD) to support the laboratory. The laboratory exercise (referred to as Lab #1) began on September 11 and concluded on October 6. Based on findings from Lab #1, it has been determined that the original cluster size grid point criterion (120,000) is too large and adversely affects system performance. Additionally, it has been determined that without tracking software, clusters of more than 4 offices create an unacceptable level of complexity during the Resource Allocation Process (ReAP). Based on this information, the CONOPS Prototype demonstration has been designed to provide maximum information for decision makers with a minimum risk to operations.

The CONOPS Prototype Team recommends a measured, three phased approach. Phase 1 begins with the decision by the Corporate Board to proceed with the prototype demonstration. During this phase, Impact and Implementation negotiations with NWSEO will be accomplished, training and GFE software upgrades necessary to support the prototype process will be developed, and Cluster Management Teams decide on rules of engagement, common tools, and common forecast methodologies. As part of the test and evaluation of the upgraded software needed to support the prototype effort, the team recommends that WFO Boulder and WFO Pueblo be identified as a prototype test bed pair. This is consistent with WFO Boulder's designation as an Experimental Forecast Center and will provide a rapid feedback process to the software developers. Another risk-reduction effort the team recommends is that the CONOPS version of the Graphical Forecast Editor (GFE) be placed on a non-baseline processor. This will allow cluster offices to retain the baseline version of GFE in AWIPS while significantly reducing the complexity of the prototype related to secondary service-backup capability.

With Corporate Board approval, Phase 2 will begin after a second laboratory (Lab #2) validates that software upgrades and hardware additions to support expanded domain operations and enhanced collaboration are operationally ready. Only WFOs who are currently service-backup pairs within the original 4 clusters will participate. This will reduce the number of prototype offices from 25 to 20. These two-office clusters will

develop a capability to operate as a team under the Clustered Peer concept of operations. Using a Resource Allocation Process (ReAP) based on close collaboration, work will be transferred to the partner office to focus on high impact events and create capacity that can be used to focus on the impact-based forecast concept and increase support to decision makers. While some training will be required, the development of forecasting skill and familiarization will be less for existing service-backup pairs.

Assuming that the expanded domain capability can be successfully demonstrated in Phase 2, the option exists to expand this capability nationwide as early as July 2008 with the release of AWIPS Operational Build 8.3. This represents a significant improvement over the current service backup protocol and will allow more offices to participate in an environment that supports culture change and service evolution. This option lies outside of the scope of the CONOPS Prototype, but represents a substantial early success and a tangible dividend on our investment.

Lab #3 will precede Phase 3 of the CONOPS Prototype Demonstration. Software necessary to support four-office clusters of less than 100,000 grid points will be validated in Lab #3. Results of this lab will be presented to the Corporate Board for approval prior to launching into Phase 3. During Phase 3, four-office clusters will develop the capability to operate as a multi-office team utilizing the Clustered Peer concept of operations. It should be noted that not all two office clusters created in Phase 2 will be able to migrate to four office clusters because of domain size limitations. WFOs will be able to share workload and create capacity (time) for forecasters to learn how to forecast for areas larger than their own County Warning Area (CWA). Operational Strategy (OS) pages in the cluster playbook will identify the duties and expanded capabilities of each WFO in the cluster. The four-office clusters will fully utilize the ReAP to allow focus on high-impact events by shifting routine forecast duties to cluster teammates. The ReAP will also be used to gain capacity on a frequent basis to provide time for WFOs to work with other NOAA line offices, assess impacts of weather events, and develop methods to provide increased decision support to our partners, particularly the emergency managers and first responders. These activities will yield improved performance in future high impact events as well as expand the role of the NWS into other areas of earth system science.

It is expected that at the conclusion of Phase 3, the Corporate Board will have sufficient information to decide on the viability of the Clustered Peer concept of operations for national implementation. It will be necessary to conduct further testing on the new AWIPS platform with the re-architected GFE to determine the optimum number of offices in a cluster, cluster size, and the national cluster configuration.

The CONOPS Prototype Team Charter states that the Prototype demonstration should conclude at the end of FY08. Based on the recommended three phase approach, the prototype demonstration should continue into FY09 in order to allow the Corporate Board to have access to information gathered in all seasons of the year during Phase 3. It is further recommended that the evaluation of the prototype be the responsibility of an independent private entity, but with support from the ESRL/GSD for data gathering. The

final report will be provided to the Corporate Board late in the third quarter of FY09 for a decision on whether to proceed to a national implementation of the Clustered Peer CONOPS.

Two associated plans must be written in order to successfully accomplish the prototype demonstrations.

- A Management Plan that details the organizational structure that will oversee the prototype demonstration is crucial to a well organized effort. The team believes that the existing organizational hierarchy must take ownership of the move to the Clustered Peer CONOPS and therefore should be responsible for the management of the prototype demonstration. An Integrated Work Team is well-positioned to assess the progress of the demonstration and offer recommendations for course corrections but not to manage such a large project.
- A Funding Plan that provides significant detail on the costs associated with the Prototype Demonstration for FY07, FY08 and FY09 must also be developed.

Moving forward in order to remain relevant and effective in the Nation's ever-changing weather enterprise is the steering component of the Clustered Peer CONOPS. It will allow the NWS and NOAA to meet society's diverse and expanding needs for environmental information and to improve the quality of our prediction capabilities and services.

2.0 Background

2.1 Concept of Operations Tiger Teams

In August, 2005, the NWS Director chartered an NWS Concept of Operations Initiative Team to develop an NWS-wide concept of operations (CONOPS) for the digital era. The CONOPS provides a path into a future state where the NWS is flexible, adaptable, and agile.

At its January, 2006, meeting, the NWS Corporate Board agreed the CONOPS proposed by the initiative team be further investigated by way of a prototype demonstration. The Board chartered a second team, the CONOPS Prototype Team, to plan and implement a prototype of the "Clustered Peer" concept of operations. A "Clustered Peer" is a group of equal offices that can readily realign resources to collaborate with each other, as well as other offices, to deliver products and services. The NWS wants to determine if a group of clustered offices, operating as one large unit, can be more effective and efficient than each office on its own. A prototype will help answer questions about whether the NWS can achieve multiple goals of 1) improving service by providing a greater focus on high-impact events; 2) finding more efficient ways of operating; 3) maintaining local expertise; 4) taking on additional environmental information service responsibilities; and 5) increasing the quality of work life for employees. There will be a number of key shifts that must occur to move the agency from today's Concept of Operations to tomorrow's Cluster Peer CONOPS:

- From producers of our forecasts to customers of our own expertise
  In today's NWS, forecasts are produced to support our customer's decisions. In the future, the NWS will continue to provide these forecasts to our customers, but use our own forecast information to make internal resource decisions
- From Static Resource Allocation to Dynamic Resource Allocation
  In today's NWS, operational resource decisions are made within the WFO. In the future, WFOs in the cluster will collaborate to dynamically allocate resources. By sharing work with their cluster teammates, the WFOs will be able to dedicate more time and focus to high impact services, partnerships with other NOAA entities, understanding impacts of weather events, training, and decision support outreach
- From Phenomenon Based Forecasts to Impact Based Forecasts
  Today the NWS forecasts the weather with limited consideration of the impacts to our partners and customers. In the future, our forecasters will require a much greater knowledge of the effects of weather events and use that knowledge to provide decision support to emergency managers and other partners. Obtaining this information and providing training to the forecasters will take time. This time will be made available through the dynamic allocation of resources within the cluster environment
- From Product Based Services to Decision Support Services
  Today we provide products to partners and customers and they base their

decisions on those products. In the future we will not only provide a stream of information to our customers and partners, but we will be providing them decision support services through the interpretation of this information stream with impact-based advice. The support may be through telephone, internet, remote display, on-site services, or some future telecommunications capability.

- From Coordination to Collaboration between WFOs
  Today WFOs primarily coordinate with one another on the forecast and on resource decisions. In the future, WFOs within the cluster will collaborate forecast and resource decisions. This means that WFOs will have to "share space" rather than operate as independent entities. This is done today within the WFO; in the future it will be critical that it is done between WFOs in the spirit of teamwork.
- From Weather-centric to a larger Earth System Science viewpoint
  This will move the NWS from primarily a provider of weather information to a provider of an integrated information service consistent with the vision and goals of NOAA. Through the hiring of applicants from a broader range of scientific backgrounds and with a robust training program for current staff, the NWS staffs will gain the necessary expertise.
- From Deterministic Forecasts to Probabilistic Forecasts
  Today the NWS provides the best possible forecast for each weather element (i.e. the high temperature today will be 81 degrees) for all times in all places. In the future, the forecast information will provide the most likely solution and other probabilistic solutions for a particular weather element at a particular time and place. This is a dramatic change in the type of service that the NWS provides and will require a substantial investment in education and training for our customers and partners. The time needed to accomplish this will come in part from the dynamic sharing of resources between WFOs within the cluster environment.

2.2 Prototype Selection Process

Following the first meeting of the CONOPS Prototype Team in late February, 2006, a request for input was submitted to NWS Regional Directors, National Center Directors, Office Directors, MICs, and HICs. These individuals were asked to rank initial cluster criteria in relative importance to their office. They could also identify additional cluster criteria they felt important to consider. The CONOPS Prototype Team identified six initial candidate cluster criteria as follows:

- Common Forecast Challenge
- Physiographic Boundaries
- Transportation
- Economy
- Population
- Partnership Opportunities

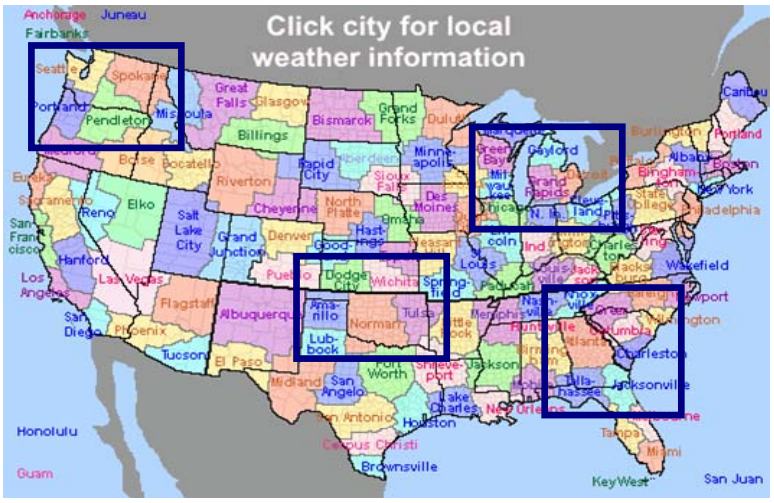
Furthermore, each MIC and HIC was asked to identify, from his/her perspective, the

NWS offices that should be included in a cluster with his/her WFO or RFC.

Overwhelmingly, common forecast challenges and physiographic boundaries were the top two choices from 100 individuals who submitted input to the CONOPS team. In addition to common forecast challenges and physiographic boundaries, there were several other primary considerations for grouping offices into clusters:

- Pre-lab system performance calculations indicate that current AWIPS Architecture restricts the cluster domain to ~120,000 grid points
- Multi-regional participation within clusters is important
- The clusters need to cover a diversity of forecast challenges:
    - Hurricane
    - Tornado
    - Marine
    - Flood
    - Winter weather
    - Fire weather
    - Mountainous terrain
    - Water management

The CONOPS Team determined that four clusters would address high-impact forecast challenges, involve all CONUS regions, accommodate opportunities for NOAA partnerships, engage a broad spectrum of field offices in refining the Clustered Peer approach, and lay the foundation for nationwide implementation. These clusters also maximize the potential to test the involvement of NCEP in the provision of services associated with collaboration and guidance. The NWS Corporate Board accepted the recommendations of the CONOPS Prototype Team for the Pacific Northwest, Great Plains, Great Lakes, and Southeast U.S. prototype clusters.



Pacific North West Cluster - Seattle, Portland, Spokane, Pendleton
Great Plains Cluster - Dodge City, Wichita, Lubbock, Amarillo, Norman, Tulsa
Great Lakes Cluster - Green Bay, Milwaukee, Chicago, Northern Indiana, Grand Rapids, Northern Lower Michigan, Detroit, Cleveland
Southeast US - Greenville-Spartanburg, Atlanta, Wilmington, Charleston, Jacksonville, Tallahassee, Columbia

2.3 Laboratory

Under the guidance of the CONOPS Prototype Team, the Earth Systems Research Laboratory (ESRL) Global Systems Division (GSD) developed and implemented a plan for conducting a real-time laboratory exercise from September through early October, 2006. This was a pre-prototype activity which focused on the hardware, software, and infrastructure needed to support a CONOPS prototype with current staffing levels and under the existing AWIPS architecture. This was a Stage 2 activity under the Operational Services Improvement Process (see Appendix A for further information relevant to OSIP). The major goals for this laboratory were:

- Determine whether AWIPS software, hardware, and communication components, and enhanced features, can support a CONOPS expanded domain capability;
- Provide feedback and recommendations to NWS management and developers on the various components and sub-components of the system when used to support an expanded CONOPS domain capability;
- Provide feedback and recommendations to NWS management and developers on the initial forms of a Daily Resource Allocation Process (ReAP), used to collaborate on a regular basis to assess and determine the best use of cluster resources during routine situations and for high-impact events;
- Provide feedback and recommendations to NWS management and developers on the utility of the tools developed for the initial forms of a ReAP;
- Provide feedback and recommendations to NWS management and developers on human factors issues resulting from the expanded domain and ReAP;
- Reduce operational prototype risks regarding AWIPS software, hardware, and communications components, and enhanced features; and,
- Provide the necessary information for a decision by the NWS Corporate Board to move forward with operational prototypes.

The CONOPS lab was the first time that many of the software components installed on standard AWIPS hardware with expanded domain capabilities had been tested. Testing during the exercise was conducted by field personnel and was designed to load AWIPS and the communications network using possible operational scenarios within CONOPS. The CONOPS exercise used two non-operational AWIPS systems, one located at GSD ("FSLC") in Boulder and the other at NWS Central Region Headquarters in Kansas City ("BCQ"). The systems were configured with "enhanced" operational AWIPS software and other non-AWIPS components. Multi-protocol Label Switching (MPLS) communications was used for data ingest and data exchange. The exercise was conducted primarily inside the AWIPS firewall.

The CONOPS lab was successful. It tested all the necessary components and identified what must be done to make the technology work during the prototype. It provided valuable information for the future. It demonstrated that expanded domain within the enhanced GFE software is viable. The lab also identified the human factors, technology and training issues that must be addressed to support the prototype effort. The field staff that participated in the lab was exposed to the clustered peer concept of operations and felt that it had significant potential. The partnership with GSD was also a resounding success. GSD worked extremely hard to create and support the laboratory. Finally, the

lab provided the opportunity to learn by "doing". The lab provided the first step in a voyage of discovery toward a new Concept of Operations.

Summary of Major Findings from the Lab

IFPS/GFE

Graphical Forecast Editor (GFE)

Many of the GFE comments were related to the slow performance of the GFE due to the expanded cluster domain size (about 120,000 grid points, on average). This was most noticeable by participants who used much smaller domain sizes, and in some cases lower resolution, at their home offices.

Text Formatters

Performance of the formatters degraded in proportion to the size of the expanded domain. During full-cluster scenarios, the formatters often took upwards of an hour to generate some text products, which were deemed unacceptable by the lab participants and observers.

Graphical Hazards Generator (GHG)

The complexities of cluster operations and expanded domain were evident. More significant problems with GHG involved the issuance of hazard products for areas not under all WFO's area of responsibility (e.g. marine and fire weather areas). These hazard-specific differences between CWAs in a cluster will require system development and training to overcome.

Intersite Coordination (ISC)

ISC performance appeared to negatively affect lab operations on several occasions and was most noticeable with large areas of responsibility and when ISC grids were being exchanged between sites. At times, participants noted ISC applications taking 30 to 60 minutes to complete. Participants said GFE performance was sluggish when this occurred.

Smart Tools

Participants also commented on slowness of running Smart Tools over the expanded domain. In addition to slowness, workstation stability also became a problem, with several crashes of GFE while Smart Tools were executing.

Network Performance

Preliminary analysis by GSD, OST and CRH personnel indicate that network bandwidth does not seem to be impacted by the extra traffic incurred by the larger grid size and quantity of grids. However, the lab exercise did not reflect the bandwidth necessary for NOAANet at the WFO, but rather the lab traffic was limited to site-to-site traffic for just ISC and FXC traffic. Perhaps the most promising finding of the network testing in the lab is the possibility of message delays seems very remote given the new CONOPS capabilities and network topology under MPLS.

General System Configurability

Many of the most significant changes to the system made for the lab render the AWIPS of cluster offices "incompatible" with AWIPS at non-cluster offices. The incompatibility of ISC grids between legacy and CONOPS sites must be mitigated in order that neighboring WFOs be able to exchange and view ISC grids.

Collaboration

FX-C (FX-Collaborate), developed by GSD, has been used on AWIPS systems for several years to generate graphics, but not to collaborate. Prior to the lab, GSD configured FX-C to operate in the cluster-peer configuration. Forecasters were required to use FX-C multiple times each day in varying scenarios. From the responses of the participants, FX-C was one of the most positive aspects of the entire lab, and generated a lot of enthusiasm for its potential use in collaboration. FX-C was the highest-rated application in the lab, rating 3.55 on average from the end-of-shift questionnaires and 3.67 on average from the end-of-week questionnaires.

Resource Allocation Process (ReAP)

For the purposes of the lab, a very rudimentary ReAP was created, utilizing a combination of FX-C and GFE/D2D configuration scripts set up by GSD for the purpose of reconfiguring the GFE at each lab site based on the results of the ReAP and collaboration sessions. In general, lab participants found the ReAP concept showed a lot of promise, and it functioned smoothly given the structure of the lab. Participants were cautious regarding how it would work with more WFOs participating, and with more complex weather than what was experienced in the lab. Much more robust tracking and monitoring capabilities will be needed for ReAP to work between more than just a few offices. In addition, NCEP is not currently able to share their NAWIPS-generated graphics with AWIPS via FX-C, so additional development or configuration work is needed to allow NCEP to more fully participate in the ReAP and collaboration processes.

Service Backup

One of the most encouraging findings from the lab was the utility, efficiency, and overall "enthusiasm" generated on the part of forecasters for this new concept of service backup. The fundamental reason for the new efficiency is that the expanded domain required for clustered-peer operations has the "side effect" of making it much easier for one office to issue the products, including grid and legacy text products, on behalf of another office. The current service backup concept is time-consuming, inefficient, and thus difficult to implement, utilize, train, and practice.

Training

Participant responses and comments from lab observers showed that much could be done to improve training prior to prototyping in field offices. Forecasters in the lab also commented on the need to better understand the meteorology,

climatology, product, and customer needs of the WFOs in the cluster for which they were forecasting. This includes knowledge of the effects on weather that terrain and other geophysical and local effects has on the forecast elements, as well as the varying factors of product domains and specific customer needs for certain products (e.g. fire weather).

The findings from the lab required the team to reanalyze the approach for the prototype. Originally, it was thought that the four clusters, which included 25 WFOs, could be spun up in a relative short amount of time. However, the lab findings dictate that a more deliberate approach be taken.

3.0 Prototype Introduction

3.1 Prototype Philosophy and Goals

The NWS will use a measured, incremental approach to validate that a group of WFOs, operating as one large unit, can be more effective and efficient than each office on its own. The prototype will address the following goals:

- Increase focus during high impact events through dynamic resource allocation
- Harvest efficiencies through the use of dynamic resource allocation during benign weather that can be applied to training, outreach, professional development, etc.
- Specifically utilize some of the efficiencies gained through the Clustered Peer concept of operations to further the NOAA mission

The ultimate result of this prototype will be a Corporate Board decision as to whether or not to move forward with the Clustered Peer CONOPS across the NWS.

3.2 Principles

There are a number of principles of the CONOPS prototype effort:

- The “home” WFO will retain the responsibility for short and long term high impact events, except during Backup or Continuity of Operations situations
- Each cluster WFO will have at a minimum one qualified forecaster on duty at all times during the prototype period
- NOAA All-Hazards Radio processes will not change
- The expanded domain capability and ReAP tools cannot substantively impact the performance of AWIPS or the network.

3.3 Constraints

A number of limitations exist that will constrain this prototype. However, this plan has dealt realistically with the constraints with the objective of providing the NWS Corporate Board with sufficient information to make an informed decision on a national implementation of the Clustered Peer concept of operations.

The following constraints are primarily technical in nature:

- Primary and Secondary Service Backup responsibilities do not change
- Cluster WFOs must have the capability to operate both with the Expanded Domain GFE and legacy GFE (Backup issue)
- Service associated with climate program cannot be transferred to another WFO
- No ability to move full WSR-88D volumetric data to all cluster WFOs
- Service associated with the hydrology program cannot be transferred to another WFO that is not the Primary Service Backup

3.4 Risks

Prototype demonstrations have inherent risks. The CONOPS Prototype Team has made every effort to reduce risks through careful planning, laboratory testing and good communications. However, there are several functional areas where risk continues to exist. Those areas are:

- Technology
- Project management
- Training
- Demonstration Process
- Cost and Resources

The CONOPS Prototype Team recommends two key actions that will mitigate technology risks:

- As part of the test and evaluation of the upgraded software needed to support the prototype effort, WFO Boulder and WFO Pueblo should be identified as a prototype test bed pair. This is consistent with WFO Boulder's designation as an Experimental Forecast Center and will provide a rapid feedback process to the software developers.
- The CONOPS-version of the Graphical Forecast Editor (GFE) should be placed on a non-baseline processor. This will allow cluster offices to retain the baseline version of GFE in AWIPS and also significantly reduces the complexity of the prototype related to secondary service-backup capability.

Appendix B contains a complete listing of the risks and mitigations that have been identified.

4.0 Prototype Strategy

4.1 Prototype Overview

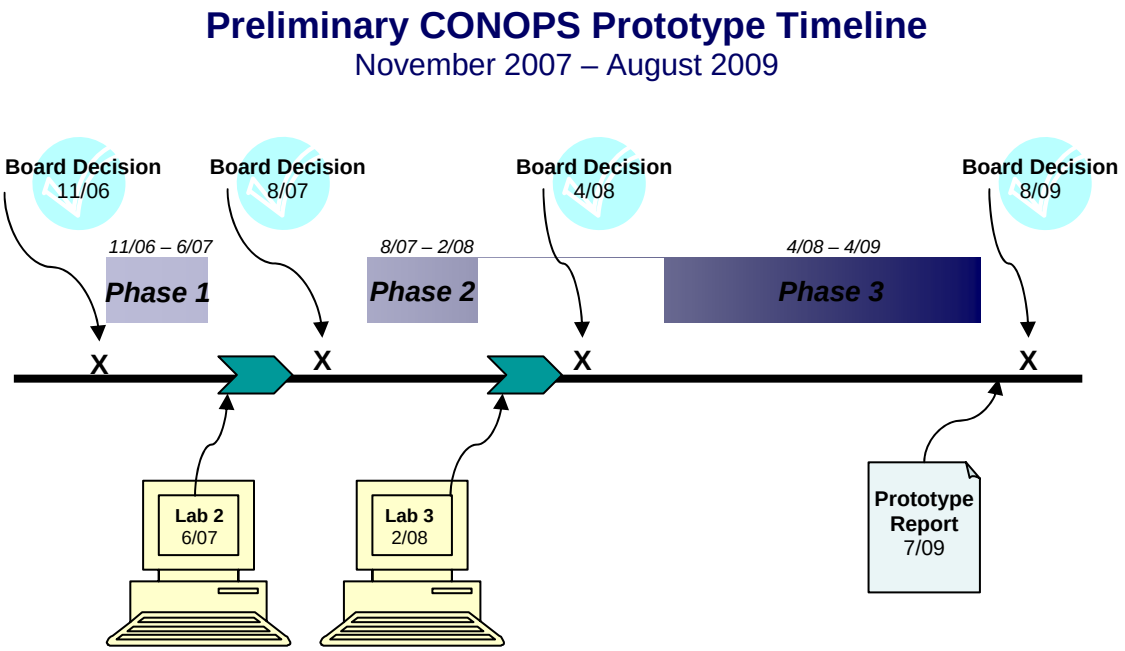


Figure 4.1

The prototype demonstration will be divided into 3 phases with system support validation labs prior to Phases 2 and 3. Phase 1 begins with the decision by the Corporate Board to proceed with the prototype demonstration. During this phase, Impact and Implementation negotiations with NWSEO will be accomplished, training and GFE software upgrades necessary to support the prototype process will be developed, and Cluster Management Teams (see section 4.2) will decide on rules of engagement, common tools, and common forecast methodologies.

Phase 2 will begin after a second laboratory (Lab #2) validates that software upgrades and hardware additions to support expanded domain operations and enhanced collaboration are operationally ready. Lab #2 is scheduled for June 2007 with field deployment of CONOPS software and hardware scheduled for August 2007. Only WFOs who are currently service-backup pairs within the original 4 geographical areas will participate (see Figure 4.2). This will reduce the number of prototype offices from the original 25 to 20. These two-office clusters will develop a capability to operate as a team under the Clustered Peer concept of operations.

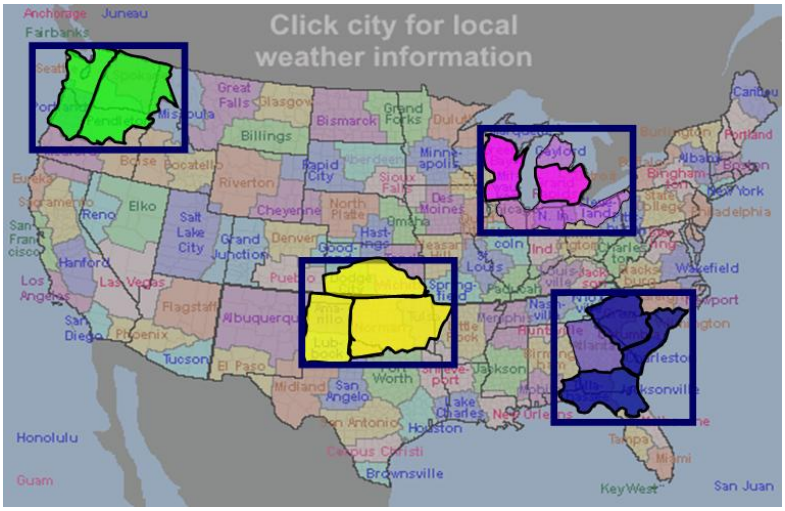


Figure 4.2

Lab #3 will precede Phase 3 of the CONOPS Prototype Demonstration. Software necessary to support four-office clusters of less than 100,000 grid points will be validated in Lab #3. Results of this lab will be presented to the Corporate Board for approval prior to launching into Phase 3. Lab #3 is scheduled for February 2008. During Phase 3, four-office clusters will develop the capability to operate as a multi-office team utilizing the cluster peer concept of operations. It should be noted that not all two office clusters created in Phase 2 will be able to migrate to four office clusters because of domain size limitation (see figure 4.2). Phase 3 will start in May 2008 and conclude May 2009.

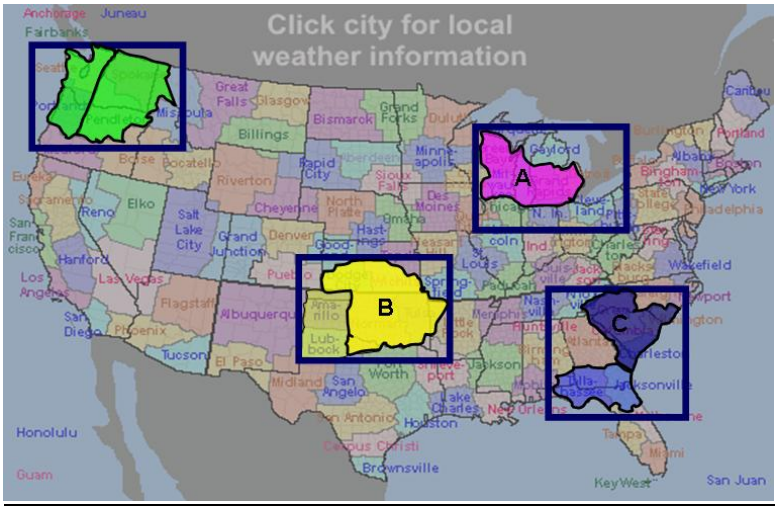


Figure 4.3

4.2 Prototype Definitions

Cluster Management Team

The Cluster Management Team (CMT) is among the most important entities of the prototype demonstration. The CMT provides operational oversight to the cluster. The CMT is comprised of the MICs from the cluster WFOs, HIC(s) from RFC(s) providing

hydrologic services to the cluster, and a regional representative. The CMT for the Phase 3 4-office clusters (Detroit/Grand Rapids/Green Bay/Milwaukee, Wichita/Dodge City/Tulsa/Norman, and Greenville-Spartanburg/Columbia/Wilmington/Charleston) should conduct business as a single entity beginning in Phase 1. Each 2-office cluster (Seattle/Portland, Spokane/Pendleton, Amarillo/Lubbock, and Jacksonville/Tallahassee) will also have a CMT. If the cluster were to involve two regions, each region will have a representative on the CMT. NCEP will serve in an advisory capacity to the CMT. It is anticipated that the CMT will have broad authority and will make significant decisions throughout the prototype process. If the CMT is unable to reach consensus on an issue, the issue can be elevated to the Regional Director(s).

The tasks of the CMT, either directly or through delegation, include the following:

- Organize and conduct the Cluster Kick-off Meeting, Cluster Resource Summit, Methodology Summits, and ReAP Table Top Exercise
- Ensure that required training is accomplished
- Oversee and verify the operational readiness of prototype software
- Review and approve cluster office readiness assessments
- Approve Operational Strategy Pages for use in the playbook
- Develop "rules of engagement" and cluster governance policy for the cluster ReAP process. Establishing an authority process will be one of the primary issues
- Incrementally integrate the hydrologic service program into cluster operations
- Identify and report technical issues beyond the capability of the cluster to resolve
- Communicate cluster activities to the organization, field, region, etc

The CMT should seek pre-decisional input from NWSEO on issues affecting working conditions of the employees.

<u>Expanded Domain</u>
The cluster peer CONOPS requires that a single WFO be able to forecast for an area larger than its current County Warning Area. The expanded domain capability will allow a WFO to forecast for a multiple-CWA area.

<u>Temporal Split</u>
The grids originally could be split by area only (County Warning Area), but during Lab #1 it was determined that the grids can be split by time. The restriction of sharing grids for all 7 days was a large impediment to demonstrating the benefits of Clustered Peer operations. This crucial discovery will allow offices to share forecast work much more easily and frequently. This will require an upgraded method to monitor responsibility status.

<u>Weather Element Split</u>
During Lab #1 it was determined that the forecast grids can be split by weather element as well as by area and time. This capability allows a coastal office to retain marine responsibility and a mountain office to retain fire weather but transfer the rest of the grids to another cluster office. This will require an upgraded method to monitor responsibility status.

Resource Allocation Process

The Resource Allocation Process (ReAP) will be carried out both routinely (i.e. at the beginning of each shift) and on an event driven basis (prior to a high-impact event such as a severe weather outbreak or prior to responding to a HAZMAT spill). This is the process by which the workload distribution in the cluster is determined. It is based on Operational Strategy pages in the Cluster Playbook that are agreed upon in advance by the CMT. This process becomes very complex when grids are split by not only area but by time and/or weather element between multiple WFOs in a cluster.

Methodology Summit

Currently, WFOs use methodologies and tools that have developed independently from their surrounding offices. In order for offices to act as a cluster team in a truly collaborative environment, methodologies will have to be much more consistent and standard within the cluster. Meetings to determine these methodologies and tools will occur periodically throughout the pre-prototype and prototype periods. Other issues that must be addressed are differing services provided by each cluster WFO and Internet/Intranet issues. There should be pre-decisional input from the NWSEO on issues affecting working conditions of the employees.

Playbooks/Operational Strategy Pages

Operational Strategy Pages describe a workload sharing configuration for the cluster. Operational Strategy Pages are by definition comprehensive, that is, the role of every cluster office is clearly stated. There are Operational Strategy Pages that dictate the dynamic resource allocation of gridded forecast responsibility and aviation forecast responsibility. It is envisioned that grid and aviation Operational Strategy Pages will be separate entities. (See Appendix C for example)

Lead-in WFOs

These are the offices that will initiate two-office cluster operations within the 4 clusters in Phase 2. The SOOs from these offices participated in Lab #1. These office pairs are Detroit-Grand Rapids, Seattle-Portland, Tulsa-Norman, and Wilmington-Charleston**.**

4.3 Prototype Training

A considerable amount of training is required prior to the start of Phase 2. This ranges from educational training focused on the concepts of Clustered Peer operations to "knobology" training in the use of expanded domain and collaboration tool software. There also is a need for human interaction training (i.e. collaboration, conflict resolution, teamwork, etc.). It is expected that staffs from cluster WFOs will take the training together, whenever possible. This will foster forecaster exchange and develop cluster identity. Training does not stop with the initiation of Phase 2. It is ongoing and certain components of training and practice are necessary requisites to the expansion playbooks for four-office cluster operations in Phase 3. Appendix D provides complete details of each course.

Major components of the training are:

- CONOPS 101 - Introduces the philosophies, intention, and the overall vision of the CONOPS design.
- CONOPS 201 - Introduces cluster trainees to the CONOPS Prototype Plan that will direct cluster spin-up and operations. CONOPS 101 is a prerequisite.
- Human Factors - These courses will help forecast personnel with issues including conflict resolution, teamwork, collaboration, etc
- GFE Expanded Domain Operations - This training demonstrates the new expanded domain capabilities of the GFE and teaches WFO forecast personnel how to utilize those capabilities in single and multiple CWA configurations
- Resource Allocation Process (ReAP) Operations - This training focuses on the dynamic resource allocation process, the complexities of the ReAP, and the collaboration tools that will support the ReAP. Forecasters will receive training in the rules of engagement and cluster governance developed by their CMT.
- Cluster Forecast Methodology - This training demonstrates the cluster forecast methodology to the cluster forecast staff based upon agreements within the cluster on common tools and methods for producing the grids.
- Cluster Climatology and Forecast Issues - This training will teach forecasters about the climatology and local forecast issues across the entire cluster versus knowledge necessary for forecasting across their home CWA. This may include extensive training for some cluster participants where new service programs are introduced (e.g., inland office required to produce marine forecasts).
- Cluster Forecaster Practice - This training will utilize the Weather Event Simulator (WES) to allow forecasters to practice producing gridded and aviation forecasts for the cluster. Each cluster WFO will build WES cases representing benign weather conditions for its CWA, including the grids that were issued operationally. These WES cases will be shared with the other cluster WFOs. Forecasters will practice creating grids and aviation products for these cases on the WES and compare their output to the products and grids generated operationally. Cluster MICs will track the progress of their staff in these practice/training sessions and report the readiness of their WFO to participate in the ReAP to the CMT.

4.4 Phase 1

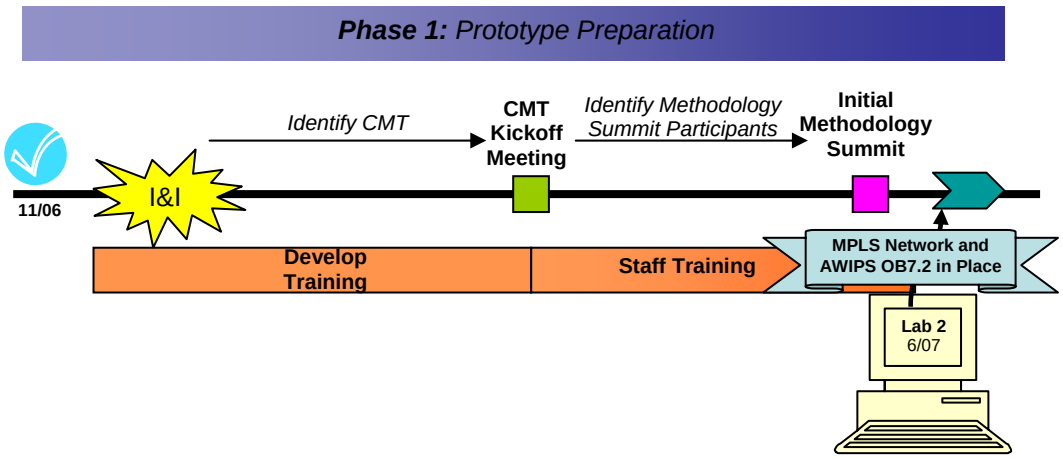


Figure 4.4

During this preparatory period, training necessary for Phase 2 will be developed and provided to the forecast staffs at the participating cluster offices. The CMT will be instituted and accomplish many of the tasks described in section 4.2 (the CMT for the Phase 3 4-office clusters should conduct business as a single entity from the outset). The following meetings, training components (Appendix D), and exercises (Appendix E) are expected to be conducted prior to Lab #2/Phase 2.

Training

CONOPS 101, CONOPS 201, Human Factors, Cluster Forecast Methodology, and Cluster Climatology and Forecast must be accomplished during this period. This training will occur after I & I negotiations with NWSEO have been completed

Cluster Kick-Off Meeting

This meeting lays the framework for cluster operations. The Cluster Management Team will be constituted and it will address the list of tasks necessary for spin-up of the cluster. One of the pre-requisites of this meeting will be for the WFO Management Teams to identify how the efficiencies gained through dynamic resource allocation will be utilized.

Initial Methodology Summit

Participants, as determined by the CMT, will determine the initial cluster methodology. This will be an evolutionary process and Methodology Summits will be necessary throughout the Prototype Period.

The GFE software to be tested in Lab #2 will be developed during this period. Also there will be an effort during this phase to improve the WFO-NCEP collaboration tool for ReAP support. The WFO-WFO and WFO-RFC collaboration tool tested in the lab does not have the necessary capabilities.

Impact and Implementation Negotiations for this plan will occur at the beginning of this phase. This will be an intense period of meetings, exercises, and training for the staffs in the cluster WFOs in order to be ready to begin activities of Phase 2. It is acknowledged that this is in addition to the normal training and proficiency exercises required for current operations.

4.5 Phase 2

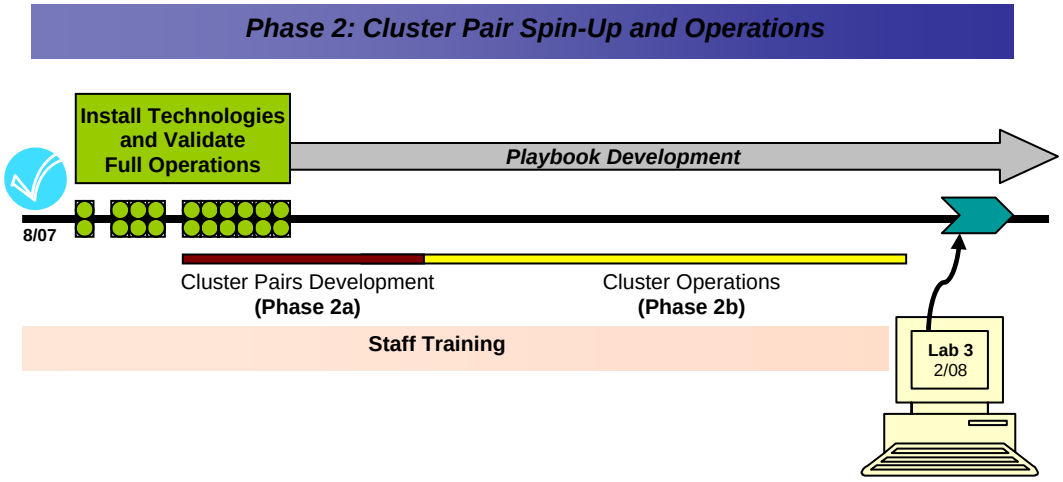


Figure 4.5

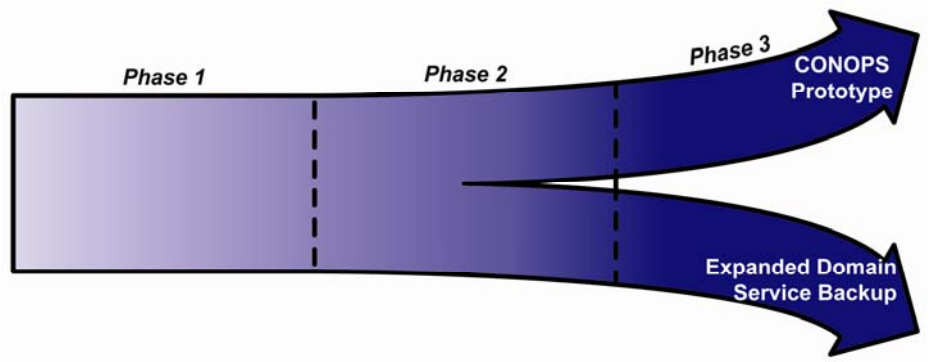
Phase 2 will begin after Lab #2 is completed, identified deficiencies resolved and the Corporate Board provides approval to proceed. Also the MPLS network and AWIPS OB7.2 must be in place. During this phase of the CONOPS Prototype demonstration, 20 primary backup offices in the four geographic areas (Pacific NW, Central Plains, Great Lakes, and SE US) will operate as Clustered Peers. These 10 pairs of offices will build a capability to share forecasting responsibilities spatially, temporally and possibly by weather element. This will be done through the ReAP using advanced collaboration tools. These backup office pairs form the building blocks to larger clusters.

Early in this phase (Phase 2a), the additional capacity made available through the ReAP will be used for training to allow for maximum utilization of the playbook by the entire staff. Once this has occurred (Phase 2b), the additional capacity will be used to move toward impact based forecasting, improved decision support for partners, and other important non-forecasting functions. This capacity would also be used to work more closely with other NOAA line offices, especially in Seattle, Detroit, Charleston, and Norman. Greater focus on high impact events will be possible as well.

Clustered Peer operations go far beyond the service backup responsibilities. Service backup occurs because some situation requires that it be invoked. Cluster Peer (CONOPS) operations occur because the offices collaborate to share forecasting responsibilities to seize other opportunities.

Assuming that the expanded domain capability can be successfully demonstrated in

Phase 2, the option exists to expand this capability nation-wide as early as July 2008 with the release of AWIPS Operational Build 8.3. This represents a significant improvement over the current service backup protocol and will allow more offices to participate in an environment that supports culture change and service evolution. This option lies outside of the scope of the CONOPS Prototype, but represents a substantial early success and a tangible dividend on investment.



Figures 4.6

Install and Validate Technology

Because WFO Detroit and WFO Grand Rapids are already using the original "homegrown" expanded domain capabilities and have developed a Clustered Peer type relationship, the technology tested in Lab #2 will be installed at this pair of offices first. Once full operations have been validated, the technology will be installed at the other lead-in WFOs – Portland/Seattle (Pacific NW), Wilmington/Charleston (SE US), and Norman/Tulsa (Central Plains).

The technology will then be installed at the remaining office pairs – Green Bay/Milwaukee (Great Lakes), Greenville-Spartanburg/Columbia (SE US), Jacksonville-Tallahassee (SE US), Lubbock-Amarillo (Central Plains), Wichita-Dodge City (Central Plains) and Spokane/Pendleton (Pacific NW).

The primary technologies to be added at WFOs for this phase of the prototype are a version of the GFE (referred to as CONOPS GFE) that enables forecasting over expanded domains and the sharing of workload among cluster WFOs, and FXC which facilitates collaboration between WFOs and between WFOs and National Centers using graphical capabilities. An additional capability to track grid responsibilities will also be made available at each prototype office.

Training

GFE Expanded Domain Operations and ReAP Operations training will be conducted as soon as the software has been installed. It is envisioned that ReAP simulation exercises will be accomplished prior to using the capability operationally to familiarize the forecasters with the ReAP process. Additionally, Cluster Forecaster Practice on the

Warning Event Simulator (WES) will commence as soon as the system can support this capability.

Playbook Development
Playbooks, as described earlier, are living documents that will continue to evolve as technology changes, experience in various operational scenarios is acquired, and the number of offices in the cluster grows. During Phase 2, there will be limited playbook development that will focus on temporal and weather element splits.

Methodology Summits
Concurrent with playbook development are methodology summits. These meetings, organized by the CMT and described earlier, will be held periodically during Phase 2. This effort should result in more commonality among cluster WFOs in the way gridded forecasts are produced. The agreements reached at the methodology summits will result in Smart Tool and technique sharing among cluster WFOs. New tools and new techniques will be introduced to forecasters and training will be conducted on the WES and eventually incorporated into operations. The goal of these summits is for smoother and more efficient execution of the playbook and high quality grids and products production by cluster WFOs.

4.6 Phase 3

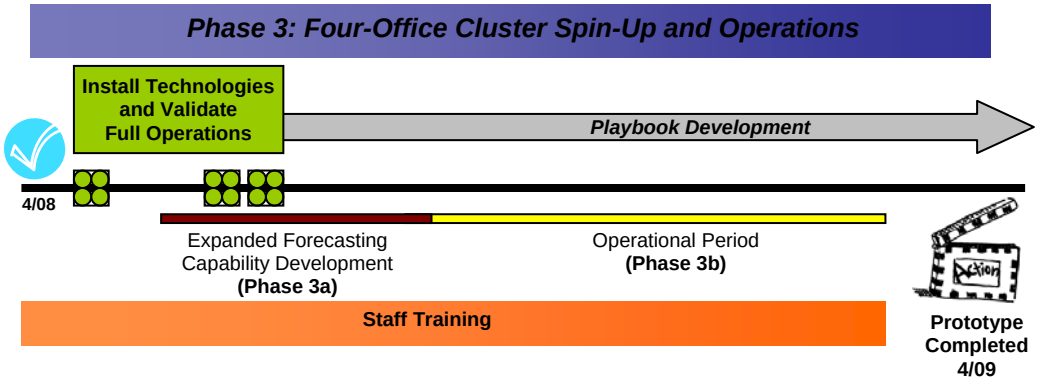


Figure 4.7

Phase 3 will begin after Lab #3 is completed, identified deficiencies resolved and the Corporate Board provides approval to proceed. This phase of the prototype will determine whether Clustered Peer operations can be performed by four-office teams. WFOs in the four-office clusters will expand capabilities exhibited in Phase 2 to share workload and create capacity (time). It should be noted that not all two office clusters created in Phase 2 will be able to migrate to four office clusters because of the domain size limitation. However, the 2 office clusters will continue to operate as Clustered Peers.

The four-office clusters in the Great Lakes, Central Plains, and SE US geographical areas will again use the first months of the phase (Phase 3a) to develop the capability to

provide forecast services for the entire cluster area. Capacity generated through the ReAP process will be used for training during this time period. Individual Operational Strategy (OS) Pages based on Phase 2 cluster operations should be quite simple initially. OS Pages should be designed to minimize risk of impact to customers. As the cluster becomes increasingly proficient and comfortable with the execution of the playbook, more OS Pages with increasing complexity may be added. Ultimately the playbook should contain a reasonable number of OS Pages (20-25) that can be executed with confidence by the cluster.

At this point the four-office clusters move into an operational period (Phase 3b). This period of the prototype is focused on demonstrating the capability of the cluster to create significant workload capacity using the Operational Strategy Pages created during Phase 3a. The cluster exercises the ReAP per CMT guidelines, makes decisions, and operates accordingly. The CMT may continue to expand the playbook during this period. It is during this period that the cluster WFOs will exercise dynamic resource allocation to the fullest extent possible.

Additional capacity (time) made available to WFOs through the ReAP during benign weather periods will be measured and cataloged. It is anticipated that this time will be used to work with other components of NOAA, determine impacts of critical weather conditions, develop decision support processes for our partners, professional development, training, outreach and other non-forecasting functions that WFOs have been unable to do with existing resources.

Also during this period, the frequency that offices use the dynamic allocation of resources to focus on high impact events by transferring routine forecast duties to non-affected WFOs in the cluster is expected to increase. These occurrences will also be measured and cataloged.

The cluster offices, as well as the remainder of the offices in the NWS, should benefit from the increasing availability of a gridded product suite from NCEP. Higher resolution gridded guidance from HPC, OPC, SPC, TPC, and CPC should be available during phase 3 as will probabilistic guidance suite from EMC.

Install and Validate Technology

The upgraded technology tested in Lab #3 will be installed in the Great Lakes 4-office cluster first. Once it has been validated that the technology can support operations then the technology will be installed in the SE US and Central Plains four office clusters.

The primary technologies to be added at WFOs for this phase of the prototype are an upgraded version of CONOPS GFE that enables forecasting over the larger expanded domain and the sharing of workload among the four office cluster. A more robust grid tracking capability will be installed to provide a tool to inform the forecasters of the status of the ReAP. In other words, it will track the spatial, temporal, and weather element forecast responsibilities by each WFO in the cluster.

Training

Cluster Climatology and Forecast training and Cluster Forecaster Practice on the Warning Event Simulator will be the primary training activities of this phase. Offices that have been operating as two-office teams now will have to expand forecasting capabilities for an additional pair of offices. Also some GFE Expanded Domain Operations and Resource Allocation Process (ReAP) Operations training will be necessary to account for larger and more complex cluster operations.

Methodology Summits

Since four-office CMTs were constituted in Phase 1 and worked together in Phase 2, most methodology issues should have been addressed. However, operating in a 4 office mode may identify issues that require resolution. These summits should be held through the life of the prototype.

A Gantt chart detailing the important milestones of the phased CONOPS prototype is included in Appendix F. This chart is a work in progress and will be refined as more information becomes available.

5.0 CONOPS Prototype Evaluation Process

The implementation of the Clustered Peer operational structure is a significant undertaking for the NWS. It must be understood that much of our traditional NWS culture will be shifted during this exercise at Cluster WFOs (and perhaps at other offices as well). These "Key Shifts" were clearly identified by the first CONOPS Team. As such, the expectations for the CONOPS Prototype should be more focused on developing an operational configuration that supports efficiency and building of capacity. This operational configuration will ultimately lead toward a skilled and nimble workforce that does its best work supporting customers during high impact events and consistently supports NOAA environmental services. As such, expectations should not include improvement in GPRA goals within the CONOPS Prototype period. However, the NWS should be well positioned to make solid progress in the years that follow. Throughout the Prototype period, it is essential that the NWS does not "slide backwards" as we work to develop a new era of focused operations. Our customers deserve our best and the lives of the American public depend upon us. As such, the Prototype is committed to operations equal or greater than currently exists (i.e., no degradation of service). Ensuring this level of service will be one focus of the evaluation process.

Technologically, the ability of various hardware, software, and network systems to support the new CONOPS environment will continue to be assessed during laboratory exercises that separate each phase of the prototype. This includes, but is not limited to, the GFE Expanded Domain software, AWIPS D2D functionality, collaboration software (FX-C and 12Planet with whiteboard capability), other operational software (AVNFPS, SAFESEAS, etc.), and evolving remote briefing capabilities used to deliver NWS services. System performance and hardware/software functionality will be evaluated using staff feedback, performance monitoring software, and usage logs.

Evaluation and assessment of Phase 1 will focus on:

- Training to support Phase 2
- Cluster Management Teams performance of responsibilities delineated in section 4.2

Evaluation and assessment of Phase 2 (nine 2-office clusters) and Phase 3 (three 4-office clusters) will focus on:

- ReAP decision process
- impact of an expanded forecast domain on operational staff situation awareness
- the frequency that offices transfer work to other cluster WFOs
- the number of times that work was transferred to focus on high impact events
- the number of additional hours made available during benign weather through ReAP for non-forecast work
- the type of work that was accomplished with these additional hours
- the cultural shift towards a cluster identity
- the integration of hydrologic services into cluster operations

- effect on the quality of work life and job satisfaction
- an assessment of Operational Strategy Page selection
- NDFD metrics

Externally the focus will be on customer perceptions of service quality and timeliness. It will also be important to involve emergency managers and other key partners in the assessment of the prototype.

It is envisioned that this evaluation will be accomplished by an independent entity to eliminate any perception of a conflict of interest with support from ESRL's Global Systems Division Information Systems Branch. The GSD Information Systems Branch has a proven track record of assessing previous NWS Initiatives, and possesses the expertise needed to provide a comprehensive analysis of the CONOPS demonstration while minimizing the impact of the evaluation process on office staff. Significant input for the evaluation will be obtained from the NWS Performance and Evaluation Branch, and through a contractor specializing in employee and customer satisfaction measurement. It is further envisioned that The National Academies of Science or similar institution will review the results of the prototype to determine if the concept of operations is valid for national implementation.

Evaluation tools will include a combination of interviews, observations, online evaluations, and questionnaires. Information will be gathered as close to real time as possible, so that feedback can be incorporated into the prototype demonstration process. This is consistent with the notion that the demonstration is a process of discovery, and that adjustments can be made to refine components of the CONOPS during the prototype period.

6.0 CONOPS Prototype Report

This report, based on the information from CMTs, forecasters, regional and national program managers, the Heads of Training, ESRL/GSD, and the evaluation contractor, will be completed by September 30, 2009. It is anticipated that the Corporate Board will have sufficient information to make an informed decision on whether or not to implement the Cluster Peer Concept of Operations nationally. However, the new AWIPS platform and re-architected GFE will be necessary to determine the optimum number of offices in a cluster and the national cluster configuration.

Appendix A: Operations and Service Improvement Process

OSIP project number 06-058 documents the overarching CONOPS Statement of Need (SON) and Project Plan. This SON is intended as an "umbrella" SON for other, more specific OSIP projects which provide the foundation for further investigating the CONOPS that was developed and which the Corporate Board approved for testing. Some of these projects are anticipated to include, but are not limited to:

- Expanded domains (e.g. multiple WFO domains: SON #06-059);
- Resource allocation (SON #06-060); and,
- Performance assessment and feedback (SON #06-061).

Additionally, there are existing OSIP projects which will directly support the implementation of the CONOPS. Some of these include, but are not limited to:

- AWIPS evolution Umbrella (SON #04-005) and subordinate projects:
- Data Delivery Paradigm (SON #05-040)
- Visualization Techniques (SON #05-021)
- Information Generation (SON #05-041)
- NWS Collaboration (SON #05-042)
- GFE performance enhancements (SON #06-051)
- Analysis of Record (SON #05-009)
- Accelerate Environmental Modeling & Prediction Capabilities (SON #05-065)
- Verification & Performance Management System (SON #05-032)
- Downscaled NWP Grids of Sensible Hydrometeorological Elements (SON #06-041)

Appendix B: CONOPS Laboratory Findings and Recommendations

Complete information concerning the CONOPS laboratory can be found in the Laboratory Report.

GFE Smart Tools and Procedures

Finding: A subset of Smart Tools and Procedures were successfully modified and used to generate forecast grids during the exercise.

Finding: Participants need a more complete set of their offices' Smart Tools and Procedures to efficiently generate forecast grids for their home and cluster CWAs.
Recommendation: Integrate a more complete suite of each office's Smart Tools and Procedures before future CONOPS testing.

Finding: Smart tools and procedures ran significantly slower over the cluster-sized expanded domain.
Recommendation: Explore and adopt options to improve Smart Tool and Procedure performance by considering Smart Tool software changes, run-time configuration changes, and domain size changes.
Recommendation: Proposed cluster offices should determine a common suite of Smart Tools and Procedures that would effectively run over their entire cluster domain.

Graphical Hazard Generator

Finding: Participants successfully generated a variety of hazards and associated VTECs and were able to switch between normal operations and service backup using the lab GHG capabilities.

Finding: Participants rated the GHG capabilities as slightly less than acceptable (average 2.8 on a 5-point scale with 3.0 being adequate) when used to support CONOPS testing.

Finding: The GHG monitor did not always display all hazards issued by the office.

Finding: CWAs marine and fire weather hazard areas did not always align with their other warning areas. Further, map boundaries within CWAs and between adjoining CWAs did not always align, all of which caused occasional erroneous hazard identifications.
Recommendation: Correct mapping and display problems noted during the lab and consider better alignment strategies for program-specific hazard areas of responsibility within each CWA.
Recommendation: Develop scripts and procedures to streamline and automate as much of the hazard generation process as possible.

GFE Intersite Coordination Grids

Finding: ISC performance was often noted as problematic during the exercise.

Finding: Performance of ISC-related programs within the GFE (e.g. ISCMosaic) was the likely cause of the ISC performance problems, not network bandwidth.
Recommendation: Review ISC-related programs within the GFE to determine what improvements can be made generating ISC mosaic fields.
Recommendation: Improve ISC Grid status information to include whether grids do or do not need to be sent, or are currently being sent, received, and processed.
Recommendation: Future testing should better emulate a full load of incoming and outgoing ISC traffic in order to better determine adequate bandwidth requirements.
Recommendation: Review the ISC process to determine whether other architectural frameworks can better accommodate ISC requirements and capabilities.

Formatters

Finding: In general, participants found the performance of the formatters to be unacceptably slow during simulated CONOPS operations (e.g. when running formatters for multiple WFOs).
Recommendation: Smaller domains, better/faster hardware, and more efficient software are all possible solutions to this problem. It may also be possible to separate product generation from "assembly", i.e. run one formatter containing multiple sites' products. This would require changes to the product editor.

Finding: The domain covered by various formatters (e.g. public vs. fire weather vs. marine) varies in some cases from office to office and product to product, resulting in complexities in editing grids and running the formatters for other WFOs in the cluster.

Finding: In particular, formatters for products associated with fire weather were the most problematic.
Recommendation: Proper configuration of domain size and setup of formatters should greatly improve this during prototype activities.

Finding: Better tracking, status monitoring, and product-generation automation capabilities are needed in AWIPS to allow forecasters to manage the numerous products that must be generated for each WFO.
Recommendation: Changes to the product editor (e.g. replace tabs with a matrix) will likely alleviate these problems.
Recommendation: Issues associated with differences between local WFO formatter's vs. baseline or "cluster" formatters must be explored in future prototype activities.

AWIPS D2D Workspace

Finding: In general, participants found the D2D performance to be better than acceptable for supporting simulated CONOPS operations.

Finding: Participants liked the area of responsibility map backgrounds but wanted an automated process to change backgrounds when the WFO's area of responsibility changed.

Finding: Participants need access to all locally-generated D2D procedures, data, and model output, for CONOPS operations.

Finding: D2D viewing scales and Local Analysis and Prediction System (LAPS) were not always properly aligned with the CONOPS cluster areas.

Finding: Participants need training on D2D changes when upgrades to the system occur.

Finding: Screen space became problematic with more applications and larger areas of responsibility.
Recommendation: D2D is acceptable for further CONOPS testing with minor enhancements and configuration changes to better accommodate cluster operations and cluster spatial areas.
Recommendation: Automate CWA/area of responsibility map background changes to reflect area or responsibility changes as they occur.
Recommendation: Consider adding more screens or larger screens to AWIPS to improve screen management characteristics of the system.

Configurability

Finding: Many enhancements made to AWIPS to support clustered-peer operations will require potentially significant development to allow cluster and non-cluster offices to interact.
Recommendation: Require all offices within a prototype cluster to be comprised of primary service backup pairs.
Recommendation: Development agencies will need to resolve the issues associated with "legacy" and cluster versions of AWIPS capabilities and their interoperability.

Finding: Forecasters noted several configuration problems in the lab involving map backgrounds, data mosaics, and domain problems with other AWIPS applications (e.g. LAPS).

Finding: Office-to-office differences in GFE weather elements, product coverage areas, edit areas, and other configuration items will need to be resolved prior to field prototyping.

Recommendation: Non-GFE configuration issues must be resolved by the CMTs prior to prototyping; GFE issues will require technical solutions by the developers.
Recommendation: Offices in the cluster prototypes need to be configured to receive additional radar data (either from the SBN or via the WAN from other ORPGs in the cluster).

Service Backup

Finding: Aside from performance issues (e.g. system slowness due to expanded number of grid points), the expanded-domain enhanced AWIPS as tested in the lab provides a superior Service Backup capability over current baseline capabilities.
Recommendation: Given developments that support performance enhancements, future prototype testing should test the feasibility of this form of service backup replacing the current baseline capability.
Recommendation: Given successful testing, this capability for service backup should be targeted for national implementation at the earliest opportunity (e.g. as early as OB8.3 in 2008).

Finding: Modifications to AWIPS to support expanded domain render it impossible for a non-prototype office to provide service backup to a prototype office.
Recommendation: Until national deployment is possible for this service backup capability, prototype clusters must be comprised of primary service backup pairs of offices.

Resource Allocation Process (ReAP)

Finding: The ReAP process worked well given the constraints of the lab (only 2 WFOs, generally benign weather).

Finding: There did not seem to be technical issues with the ReAP process itself that would prevent it from being used in WFOs during prototype testing.
Recommendation: ReAP must be tested under a larger variety of scenarios, and involving more offices, in order to refine the concept.

Finding: simple audio technology (a dedicated phone line) proved very valuable to quick and efficient coordination between lab participants.
Recommendation: NWS should examine other popular audio-visual technologies for use in collaboration and the ReAP process (e.g. PC-based LiveMeeting/GoTo Meeting, streaming audio/video via web, etc).

Finding: A better way of monitoring the status of the division of forecast responsibilities between cluster offices is required.

Finding: There needs to be a way for forecasters to monitor the current status of ISC grids.

Recommendation: Developers should work with the lab and prototype participants to develop requirements for a monitoring and grid status capability.

Collaboration

Finding: Having an open line on the telephone between the Boulder and Kansas City lab sites was very helpful in coordination.
Recommendation: Cluster Management Teams should investigate the viability of having open "telephony" between peer offices within a cluster. VoIP and other web-based technologies may be of use.

Finding: The 12Planet-Whiteboard application was provided at the last minute to the lab participants, with little or no configuration or optimization, and had minimal interactive collaboration capabilities. 12Planet-Whiteboard was not deemed useful in the lab.
Recommendation: Without the addition of significant interactive collaboration capabilities, 12Planet-Whiteboard is not recommended for prototype activities.

Finding: Additional capabilities for FX-C were requested to increase its usability (such as changing menus, access to GFE data, etc).

Finding: Forecasters prefer a single application or mode that includes chat, drawing, and screen/image sharing.
Recommendation: Pre-prototype development is needed in FX-C to accommodate the highest priority requested capabilities.

Training

Finding: More training is needed on the specific aspects of system changes from baseline AWIPS operations.
Recommendation: Specific training modules must be developed and delivered to prototype participants on the software tools (i.e. FX-C, D2D and GFE enhancements in support of clustered-peer operations), and on ReAP tools.

Finding: Training specific to collaboration (beyond methodology, to include culture) is needed.
Recommendation: Training on collaboration, beyond "knobology", extending to human factors and culture issues, is needed for prototype participants.

Finding: Cluster participants need training on the meteorological and geophysical characteristics for WFOs in the cluster, and on the varying product and customer needs.
Recommendation: CMTs develop and implement a training program to increase knowledge of local issues at all offices within the cluster prior to full cluster operations.

Future Testing

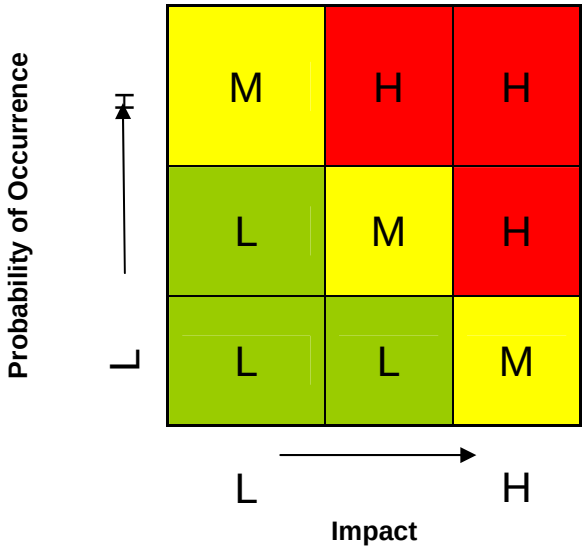
Finding: Several items were identified that require testing before Phase 2.

Recommendations: Test the following:

- Grids are received at appropriate destinations from Prototype WFOs
- Legacy text products from cluster offices can be disseminated
- Applications (Hydro, AVNFPS, NWR, FFMP, SCAN, etc) operate properly with CONOPS GFE
- All aspects of WarnGen work properly with CONOPS GFE
- Outside applications/methodologies not in the baseline (BoiVerify, MatchObsAll, ADJ Databases) work properly with CONOPS GFE

Appendix C: Prototype Risks

In an effort to asses the overall risk to the successful completion of the prototype, the protocol below was used:



The table that follows identifies many of the risks that could affect the success of the prototype effort. Several of these risks are to items that are on the critical path.

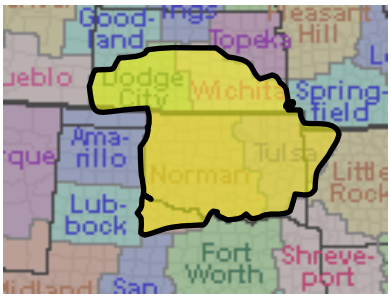
Type	Description	Probability	Impact	Overall Risk	Mitigation Strategy
Technology	Unsuccessful Laboratory Demonstration	L	H	M	Develop immediate plan to allow for development and/or retest of features that caused the failure of the laboratory to meet success criteria.
Technology	Inability of Cluster WFOs to provide backup to non-cluster WFOs	L	H	M	Develop immediate plan to allow for development and/or retest of features that caused the failure of the laboratory backup test.
Technology	Expanded Domain and enhanced collaboration tools negatively impact operations at prototype WFOs	L	H	M	Thorough testing in a laboratory environment and careful integration into WFO operations.
Technology	MPLS schedule	L	H	M	Work with CIO on aligning

Type	Description	Probability	Impact	Overall Risk	Mitigation Strategy
	doesn't support current prototype demonstration schedule				schedules; challenge will be with clusters that contain multiple hubs
Technology	AWIPS Operational Build 7.2 deployment delay	L	H	M	Monitor and work with SEC
Technology	Operations and necessary performance are not supported by the demonstration system (e. g., ISC, VTEC, communications, formatters/product (s)	L	H	M	For prototype demonstration, Mitigation will be through system testing and refinement on systems under operationally-realistic loads, with secondary backup sites initially being able to quickly perform routine duties if required.
Technology	AWIPS Evolution schedule does not match implementation time frame	L	H	M	Stay engaged with OST/SEC on the development of AWIPS Evolution plans
Project Management	ESRL/GSD resources conflict with NWS operational priorities	L	H	M	Identify ESRL/GSD resources required to support the laboratory and prototype demonstrations and ensure those resources are not in conflict with ESRL/GSD resources needed for continuing AWIPS O&M and associated Raytheon activities.
Project Management	There are insufficient human resources to execute the prototype demonstration	H	H	H	Create a structure within the NWS organizational hierarchy that will provide authority, responsibility, and accountability for executing the prototype plan
Training	Phase 1 training is not sufficiently robust to support initiation of cluster operations	M	H	H	NWSTC, COMET and/or WDTB resources must be identified to support CONOPS prototype effort
Training	The WES computer cannot support the training required to expand the cluster playbook	M	H	H	Training resources from WDTB or other training entities must be made available to create necessary scenarios.
Demonstration Process	The Cluster Management Team does not have	L	H	M	Regional and National leadership must provide necessary resources and

Type	Description	Probability	Impact	Overall Risk	Mitigation Strategy
	sufficient resources and authority to make necessary decisions				delegation of authority
Demonstration Process	Cluster operations are ineffective under the operational leadership of the lead forecasters.	L	H	M	CMT must provide sufficient rules of engagement and tools must be sufficient to support the lead forecasters in this role.
Demonstration Process	Resource Allocation Tools and Playbooks do not support effective cluster operational decisions	L	H	M	Sufficient guidance and training to cluster staffs must be provided
Demonstration Process	Meteorological training is not sufficient to support a robust playbook	L	H	M	SOOs and training organization must provide forecasters with training necessary to forecast for areas beyond current CWA
Demonstration Process	Increased capacity is not created by cluster operation	L	H	M	National, Regional, Cluster, and WFO management must encourage the frequent sharing of work through the ReAP.
Demonstration Process	Non-NWS entity is not acquired to evaluate the success of the prototype demonstration	L	M	M	Contractor or independent organization (i.e. NRC) must be identified to assess metrics and internal/external reaction to prototype operations
Cost and Resources	Sufficient funding and personnel are not available for execution of prototype demonstration	M	H	H	NWS Corporate Board must continue to support CONOPS as the number one priority

Appendix D: Cluster Playbook Operational Strategy Page Example

Central Plains Cluster Playbook
Operational Strategy: OS-2:



WFO TSA Provides Routine Public and Fire Weather Services For WFO OUN Through Day Seven

Description: WFO TSA provides public and grid-based fire weather forecast services for WFO OUN. This includes all program-related text and coded public forecasts, and all grids through Day 7.

All other cluster assignments remain in normal operational mode.

Playbook OS-2 Assignment Matrix

CWA	Public	Short Term	Aviation	Fire
TSA	TSA	TSA	TSA	TSA
OUN	TSA	OUN	OUN	TSA
DDC	DDC	DDC	DDC	DDC
ICT	ICT	ICT	ICT	ICT

WFO TSA Assumes responsibility for the following WFO OUN Products:

PUBLIC: AFD CCF HWO SFM PFM ZFP
FIRE FWF FWM FWS

Implementation Checklist:

1. Verify GFE reconfiguration at TSA for expanded domain covering OUN CWA for public and fire weather forecast grids
2. Confirm expected OUN return to routine service date and time
3. Schedule next Cluster ReAP
4. OUN-specific programs/services assumed by TSA:

Appendix E: Prototype Training

Course:	***CONOPS 101***
Description:	CONOPS 101 introduces the philosophies, intention, and the overall vision of the CONOPS design.
Objective:	To gain cluster participant understanding of CONOPS in order for the trainee to effectively participate in the prototype. The student should understand the reason for the prototype, the importance of the underlying concepts, and key shifts expected in the CONOPS era.
Audience:	All personnel in the cluster WFOs, national center staff with the responsibility for providing guidance to the clusters, plus regional and national headquarters staff with a significant stake in the project. River Forecast Center and Center Weather Service Unit staff with service area in a cluster.
Method:	PowerPoint slide show.
Delivery:	Presentation by one of the CONOPS Prototype Implementation Team members. Trainees are encouraged to attend one of the live sessions. One of the sessions will be recorded for playback on the web.
Time:	1 hour
Prerequisite:	None
Developer:	CONOPS Implementation Team.
Costs:	one-half day FTE (WDTB) for recording and posting to web

Course:	***CONOPS 201***
Description:	CONOPS 201, a follow-up to CONOPS 101, introduces cluster trainees to the CONOPS Prototype Plan that will direct cluster spin-up and operations.
Objective:	To gain cluster participant understanding of the Clustered Peer Prototype Plan. The student should comprehend the phases and tasks necessary to spin-up a cluster in numerous areas including development of playbook operations, the ReAP, expanded domain GFE concepts and more
Audience:	All personnel in the cluster WFOs, national center staff with the responsibility for providing guidance to the clusters, plus regional and national headquarters staff with a significant stake in the project. River Forecast Center and Center Weather Service Unit staff in the cluster.
Method:	PowerPoint slide show.
Delivery:	Presentation by one of the CONOPS Prototype Implementation Team members to cluster management at the local CONOPS Kick-Off Meeting. Electronic presentation by WDTB to the workforce involved in the clusters once the plan has been approved for distribution to the workforce.
Time:	1 hour
Prerequisite:	CONOPS 101
Developer:	CONOPS Implementation Team and WDTB.
Costs:	2 FTE days for WDTB development and delivery

Course: ***Human Factors***
Description: These on-line and WFO-led courses will help forecast personnel with issues including conflict resolution, teamwork, collaboration, etc. This training is to support necessary work life changes in a successful cluster environment.
Objective: To prepare cluster workforce for change to operations in a cluster Environment
Audience: All cluster participants.
Method: Mostly gleaned from available material, working with HOTG.
Delivery: On-line and team exercises. Team exercises may be limited to individual WFO participation, but may be possible to do some virtual team exercises
Time: Estimated for two team exercises for all cluster participants and 1-3 online courses of approximately 2 hours each.
Prerequisites: CONOPS 101 & 201, Cluster Resource Summit
Developer: Training Division, and CONOPS Implementation Team.
Costs: To-be-determined

Course: ***Cluster Forecast Methodology***
Description: This training demonstrates the cluster forecast methodology to the cluster forecast staff based upon agreements within the cluster on common tools and methods for producing the grids. This element may actually be split time-wise by the cluster as necessary depending on plan roll out.
Objective: To understand and utilize the agreed upon methods and tools for producing grids across the cluster
Audience: All WFO lead forecasters including the MIC, SOO, WCM, and any others who occasionally fill the lead forecaster role.
Method: One-on-one or one-to-many.
Delivery: Delivered by the local office SOO.
Time: 1 day per forecaster
Prerequisites: All Pre-Cluster Preparedness training
Developer: Cluster Management Team's forecast methodology sub-team
Costs: To-be-determined

Course: ***GFE Expanded Domain Operations***
Description: This training demonstrates the new expanded domain capabilities of the GFE and teaches WFO forecast personnel how to utilize those capabilities in a cluster environment
Objective: To achieve proficiency using new expanded domain features of the GFE by WFO forecast staff
Audience: All WFO forecasters including the MIC, SOO, WCM, and any others who occasionally fill the forecaster role. Course should be available to RFC Hydrometeorological Analysis and Support (HAS) Forecasters.
Method: One-on-one or one-to-many.
Delivery: Delivered by the local office SOO.
Time: ½ day per forecaster

Prerequisites: All Pre-Cluster Preparedness training
Developer: GSD, Training Division, and CONOPS Implementation Team. Based on Laboratory training of initial cluster pair SOOs.
Costs: Most already assumed by those of the laboratory

Course: ***ReAP Operations***
Description: This training demonstrates the process and capabilities of the ReAP. This follows the tabletop exercise with the ReAP, so most of this training is aimed at software knobology and documentation of the decisions in a cluster environment.
Objective: To achieve proficiency of the ReAP toolset including use of enhanced FX-C software and electronic capture of decisions. To enable effective collaborative resource decision making
Audience: All WFO lead forecasters including the MIC, SOO, WCM, and any others who occasionally fill the lead forecaster role. Course should be available to RFC staff, and required for HAS forecasters. *Note: HAS units at the RFCs will need FXC in order to collaborate with WFOs during ReAP.*
Method: One-on-one or one-to-many.
Delivery: Delivered by the local office SOO.
Time: ½ day per forecaster
Prerequisites: All Pre-Cluster Preparedness training
Developer: GSD, Training Division, and CONOPS Implementation Team. Based on Laboratory training of initial cluster pair SOOs
Costs: To-be-determined

Course: ***Cluster Climatology and Forecast Issues***
Description: This training will teach forecasters about the climatology and local forecast issues across the entire cluster versus knowledge necessary for forecasting across their home CWA. This may include extensive training for some cluster participants where new service programs are introduced (e.g., inland office required to produce marine forecasts
Objective: To understand cluster climatology and local meteorology
Audience: All WFO forecasters in each cluster.
Method: Various. Determined by the cluster.
Delivery: Various. Determined by the cluster
Time: Unknown
Prerequisites: CONOPS 101 & 201
Developer: Cluster Science and Forecast Teams (comprised of primarily of SOOs) with technical help from WDTB. Costs: WDTB one month FTE

Course: ***Cluster Forecaster Practice***
Description: This training will utilize the Weather Event Simulator (WES) to allow forecasters to practice producing forecast grids and aviation forecasts for the cluster. Mostly benign weather "events" will be archived on the WES.
Objective: To ensure forecasters can forecast for other areas in the cluster without degrading the forecast quality

Audience:	All WFO forecasters in each cluster
Method:	SOOs in each cluster will be responsible for generating at least one WES case for the entire cluster to use. In the Pacific Northwest, SOOs may need to generate two each since there are only four offices. Regional personnel and WDTB will facilitate this activity.
Delivery:	WES
Time:	Approximately one to one and a half full weeks per forecaster (depending on how many cases are needed in each cluster).
Prerequisites:	CONOPS 101 & 201
Developer:	Cluster Science Team with technical help from the regions and WDTB.
Costs:	WDTB one-half month FTE

Appendix F: Meetings and Exercises

Meeting: ***Harvesting Efficiencies Meeting***
Description: This summit allows cluster WFO management to brainstorm ideas on how to optimally use efficiencies (time) gained during the dynamic resource allocation process.
Objective: To identify the work that will be done given that the ReAP process provides time to accomplish more non-forecast responsibilities
Audience: Primarily the cluster WFO management teams, though WFO personnel may be included at management's discretion.
Method: WFO brainstorming session accompanied by very short introductory presentation.
Delivery: WFO meeting. Introductory presentation delivered via web presentation.
Time: 2-3 hours
Prerequisite: CONOPS 101
Developer: CONOPS Implementation Team
Costs: None

Meeting: ***Cluster Kick-Off Meeting***
Description: This meeting lays the framework for cluster operations. All cluster WFOs and HICs will be represented with the meeting held at one site among the initial cluster pair.
Objective: To form the Cluster Management Team and develop a list of tasks necessary for spin-up of the cluster.
Audience: Management representatives from all WFOs and RFCs in the cluster, a representative from the CONOPS Implementation Team, and representatives from the associated regions.
Method: Two-day facilitated meeting at a cluster WFO. CONOPS Implementation Team and NWS Training Division will develop an outline of issues to be covered in the meeting.
Delivery: WFO meeting (CONOPS 201 will be delivered to cluster management at this meeting).
Time: 2 days
Prerequisites: CONOPS 101, Harvesting Efficiencies Meeting
Developer: CONOPS Implementation Team and Training Division.
Costs: Three management personnel from each cluster office travel (63 * $250), Four CONOPS team travel (4 * $750). Seven regional travel (7 * $500) ≈ $23K. Follow-up meeting ≈ $20K (does not include travel for other meetings)

Meeting: ***Methodology Summit***
Description: Several methodology summits are envisioned. These meetings will produce the necessary methodology for producing grids across the cluster. The methodology includes standard SmartTools, initializations, and

procedures in the GFE. The summit should also lay out at least a framework for the process of creating and disseminating the grids and other forecast products.

Objective: To the extent possible, standardize the methods used across the cluster, similar to what would be done in a single WFO.

Audience: Representatives from all WFOs in the cluster. Representatives will be determined by the CMT. Technical advisors from the associated regions may also be included.

Method: Two-day facilitated meeting at a cluster WFO. CONOPS Implementation Team will develop an outline of issues to be covered in the meeting.

Delivery: WFO meeting.

Time: 2 days

Prerequisites: CONOPS 101 and 201, Harvesting Efficiencies Meeting, Cluster Kick-off Meeting.

Developer: CONOPS Implementation Team.

Costs: To be determined.

Exercise: ***ReAP Tabletop Exercise***

Description: This exercise allows cluster WFO personnel to practice the ReAP (daily or by shift) just prior to exercising ReAP operationally in the Development period. This exercise will include the entire cluster. Decisions reached in this exercise will be documented in a similar fashion to actual ReAP operations.

Objective: To prepare prototype participants for actual ReAP operations. The exercise will also provide the cluster with guidance on adjustments to ReAP methodology prior to the actual cluster implementation.

Audience: WFO management and lead forecasters. Others at cluster discretion.

Method: Tabletop exercise. Decisions documented by written form. Review of previous decision next day or shift. Weekly reviews conducted by cluster evaluation team.

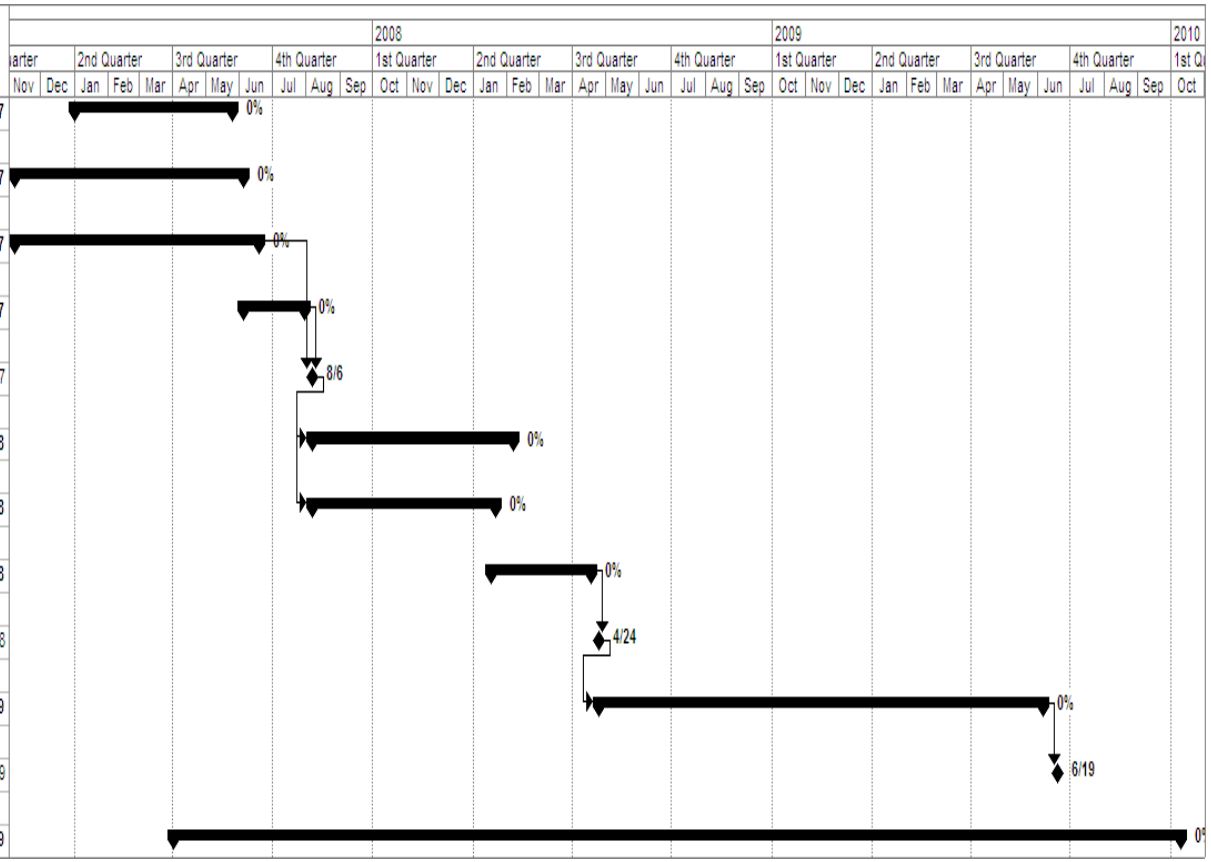
Delivery: Cluster conference calls; daily or by shift. Electronic assistance may be added when available.

Time: 30 minutes per day or shift. 1-hour weekly review call.

Prerequisites: CONOPS 101 & 201, Cluster Methodology Summit

Developer: Training Division, GSD, and CONOPS Implementation Team.

Costs: To-be-developed by GSD or Training Division

Appendix G: Preliminary Prototype Gantt Chart

ID		WBS	Task Name	Duration	Start	Finish
1		1	External projects	105 days	Mon 1/1/07	Fri 5/25/07
8						
9		2	CONOPS Management	150 days	Tue 11/7/06	Mon 6/4/07
12						
13		3	Phase I - Cluster pair preparation	160 days	Tue 11/7/06	Mon 6/18/07
27						
28		4	Lab #2 execution	40 days	Tue 6/5/07	Mon 7/30/07
32						
33		5	Phase 2 Go/No Go decision	0 days	Mon 8/6/07	Mon 8/6/07
34						
35		6	Phase 2 - Cluster pairs	132 days	Tue 8/7/07	Wed 2/6/08
60						
61		7	Phase 3 Preparation	120 days	Tue 8/7/07	Mon 1/21/08
75						
76		8	Lab #3 execution	65 days	Fri 1/18/08	Thu 4/17/08
80						
81		9	Phase 3 Go/No Go Decision	0 days	Thu 4/24/08	Thu 4/24/08
82						
83		10	Phase 3 Four office cluster operations	291 days	Fri 4/25/08	Fri 6/5/09
108						
109		11	Corporate Board decision on cluster peers	0 days	Fri 6/19/09	Fri 6/19/09
110						
111		12	Software development	660 days	Mon 4/2/07	Fri 10/9/09