Equipment Management System
For The National Weather Service Wilmington, Ohio

By

Sean P. Wink

Submitted to
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_____	_____
Sean P. Wink	Date
_____	_____
Dr. Sam Geonetta, Faculty Project Advisor	Date
_____	_____
Lawrence G. Gilligan, Department Head	Date

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I would also like to thank the entire staff at the National Weather Service office in Wilmington, Ohio for all the support I have received these past three years, especially my closest colleagues who had to work harder in my many absences.

Dedication

To my mother and father, two people who continue to show me the way. To them I owe everything.

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Abstract

Accurate and timely forecasts by the National Weather Service (NWS) rely almost exclusively on a wide variety of electronics and computer systems. As with any electronics/computer system, there are problems that can hinder or even incapacitate operations. Being able to quickly determine the operational status of all mission critical systems utilized by the National Weather Service office is imperative to the success of our mission. Returning these systems to a full operational status in a timely manner is just as important. Lastly, being able to respond appropriately when faced with equipment failures will greatly enhance the ability to complete the NWS mission. A severe deficiency has been noted in current NWS equipment management practices. This report discusses these deficiencies and outlines and implements a solution to the problems they represent.

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1. Statement of the Problem

1.1 Definition of the Need

Oftentimes operators are not fully aware of the current status of all mission critical systems. The root of this problem is the constant turnover from one operational shift to the next. The briefing the new shift receives is short and generally only focuses on the current weather conditions. If a new shift is lucky, there may be something annotated in the shift logbook. After reviewing several months of shift logs, I calculated that approximately 95% of the time equipment status was not noted. This lack of information prohibits staff meteorologists from making important decisions concerning back-up plans and setting repair priority, thus leading to tools being unavailable to create and distribute National Weather Service products.

It is important for repair technicians to know the status of all mission critical systems. Currently the staff meteorologist passes on this information, or a request for maintenance action is sometimes submitted in writing, or a technician performs operational checks on all the equipment. This practice has lead to malfunctioning equipment going unreported for extended periods of time.

The current practices involving equipment management are dysfunctional. This word-of-mouth system is unreliable, inefficient and redundant. A recent example illustrates this problem. An operator received a call from a Cincinnati resident indicating that the Cincinnati NOAA Weather Radio broadcast was off air. After quickly looking

into the situation the operator determined the problem to be with the audio feed (phone line) to the transmitter. He initiated a trouble ticket with the local Telco. Nothing was written down and no one else was told of the problem. This all took place during the day with three technicians on duty. I spoke with this operator several times throughout the day. Six hours later, just before the end of my shift, a confused operator asked me to take a call from the local Telco. I took the call and found out about the trouble ticket. I was informed that extensive testing was done on the line and no problem was found. A problem had existed for over six hours and this is the first time a technician was informed. The true problem was discovered and fixed within a half an hour. Following this incident, the Meteorologist in Charge, Ken Haydu, stated, "Some mechanism needs to be established to vastly improve office communications concerning operational equipment".

Another issue is determining the correct course of action when a problem develops. When a mission critical system becomes non-operational several decisions must be made. Some of these decisions include determining the scope of the problem (e.g., Can the problem be fixed via operator intervention or is a technician required?), setting the technician response priority, and determining who is the proper technician to notify. The information needed to make some of these decisions is often buried in cumbersome manuals and handbooks. Because of this many operators don't even bother making decisions. Once again, this leads to undue equipment downtime. This oftentimes causes un-needed overtime charges because of unnecessary technician callback.

The need for an improved system of tracking and communicating the status of operational equipment has been the topic of much e-mail over the past year. Operators

share complaints like “I didn’t even know there was a problem with the CVG ASOS”. Many lead forecasters have also indicated that they would like to have more control over the operational environment. The consensus of the lead forecasters is that with the right information at their fingertips, a lot more problems can be resolved without technician intervention. Comments such as “If I had known it was that easy to restart the APS I could have done that myself.” illustrate their frustration.

Many solutions have been suggested to solve this problem but all have had pitfalls similar to the current defunct paper shift log and extensive paper Trouble-Shooting flowcharts. These suggestions were dismissed because of their decentralized nature and their user unfriendliness. I met with many of the operators and discussed my ideal of a Web/Database application. I conducted an informal interview with them to determine what features they would like to have and what their ideal interface would be.

2. Description of the Solution

The solution is a Web-based program that connects to a back-end database. This Web-based application can be accessed by any number of operational PCs. The only requirement on the client side is MSIE 5.0. This requirement has already been met. Active Server Pages (ASP) will query an Access database, running on a local Web Server. This same server will also house the Access database. Its initial function allows users to quickly and easily view and change the current status of all mission critical systems. The user is able to annotate additional messages concerning individual equipment, which can be reviewed by the incoming shift or technicians. This is a centralized solution, with everyone having access to the same database.

The Web server houses additional Web Pages that form a Trouble-Shooting/decision making wizard. The application leads users through various Trouble-Shooting scenarios by asking questions, witch lead to a recommended course of action based upon their answers. If the problem can't be resolved using the Trouble-Shooter, the user is provided with the appropriate support contact information.

2.1 User Profile

The target audience for this product is the operational staff of the National Weather Service office, Wilmington, Ohio. The operational staff members are Meteorologists, Hydrologist and Meteorological technicians. Most operators have earned a Bachelors or Masters degree in their field. The operational staff members are a well-educated group of professionals. The information technology literacy of this group is high. The operational staff uses a variety of complex computer systems every day. All can be classified as proficient computer users.

2.2 Design Protocols

The application is accessed through Microsoft's Internet Explorer Web browser. The user enters the URL for the site or loads it from the Favorites menu. The user is taken directly to the Equipment Status page, which serves as the home page of this application. From this page all other features of the application are accessed. Graphical elements help the user navigate and use the application, including buttons, hyperlinks and a menu bar. Help can be accessed from within the application itself through a link in the menu bar. A record set navigation tool allows users to view equipment status history. Figure 1. is an illustration of the home page of this application, highlighting it navigational and graphical elements.

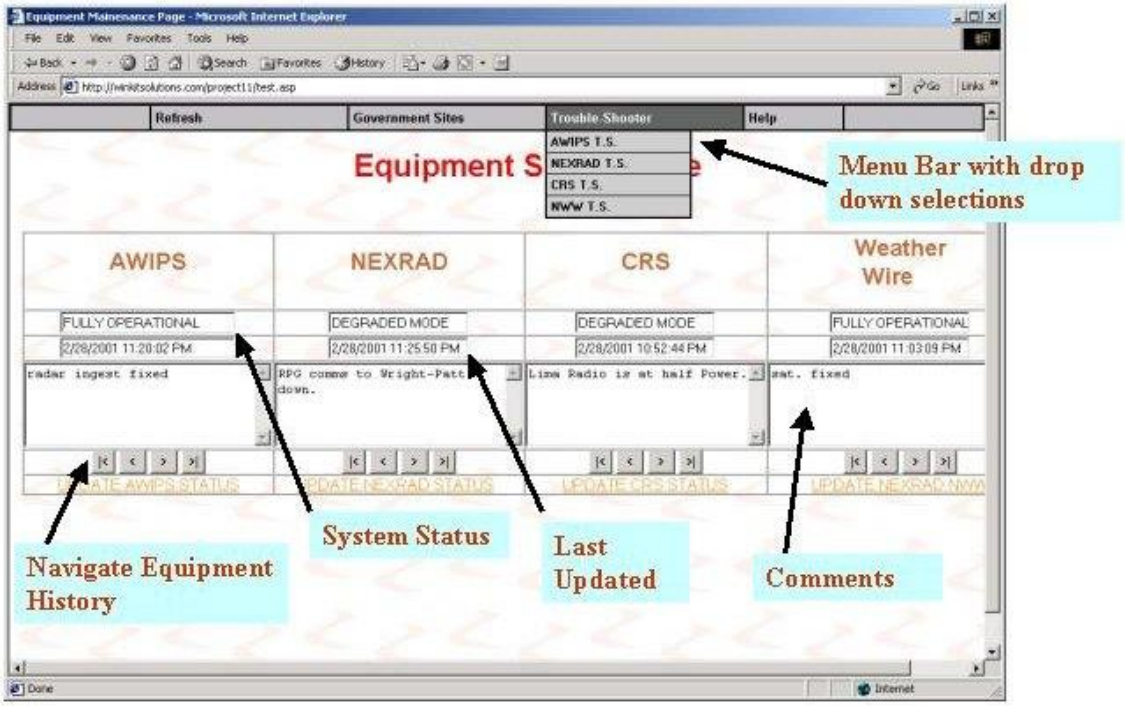

Figure 1. Equipment Status Home Page

Figure 2. shows the organizational flow of the application. It shows the Equipment Status page as the center of the application. All other pages can be accessed through it. It also demonstrates that any page can be accessed from wherever the user may be within the application, giving the user complete navigational control.

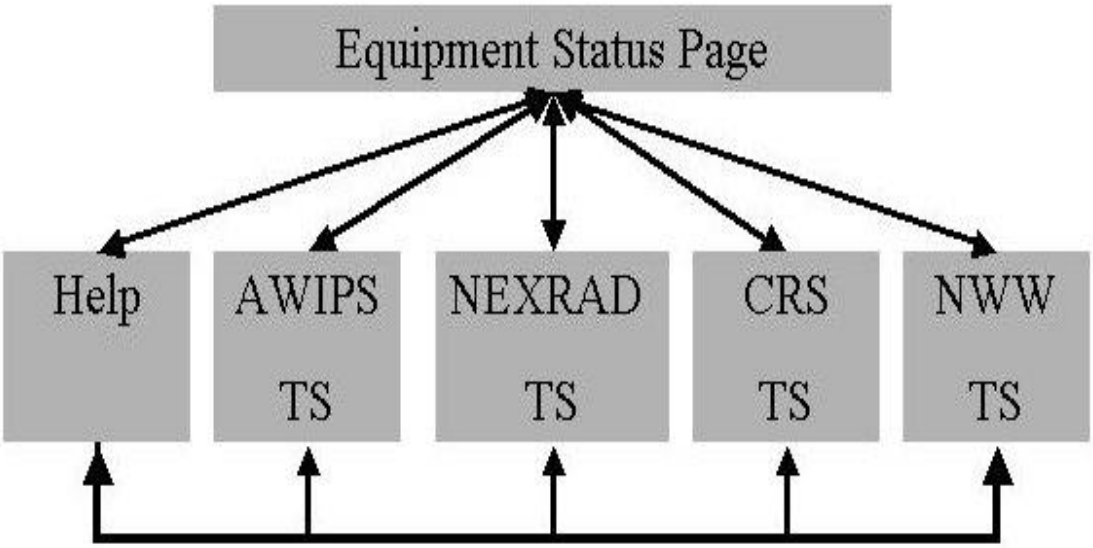

Figure 2. Application Organizational Flow

Figure 3. is a typical view of a Trouble-Shooting session. At this point the Web Browser is divided into two frames. The left-hand frame remains the same while the user interacts in the right-hand frame. The left-hand frame contains links to all other pages within the application. The right-hand frame loads the appropriate Trouble-Shooting session. All Trouble-Shooting sessions maintain a common look and feel. This is accomplished through a consistent use of graphical elements. Some of these graphical elements are large, bold TS sub-topics, numbered instructions, boxed highlighted textual information, shaded question blocks, a previous slide navigation button, and a home navigation button.

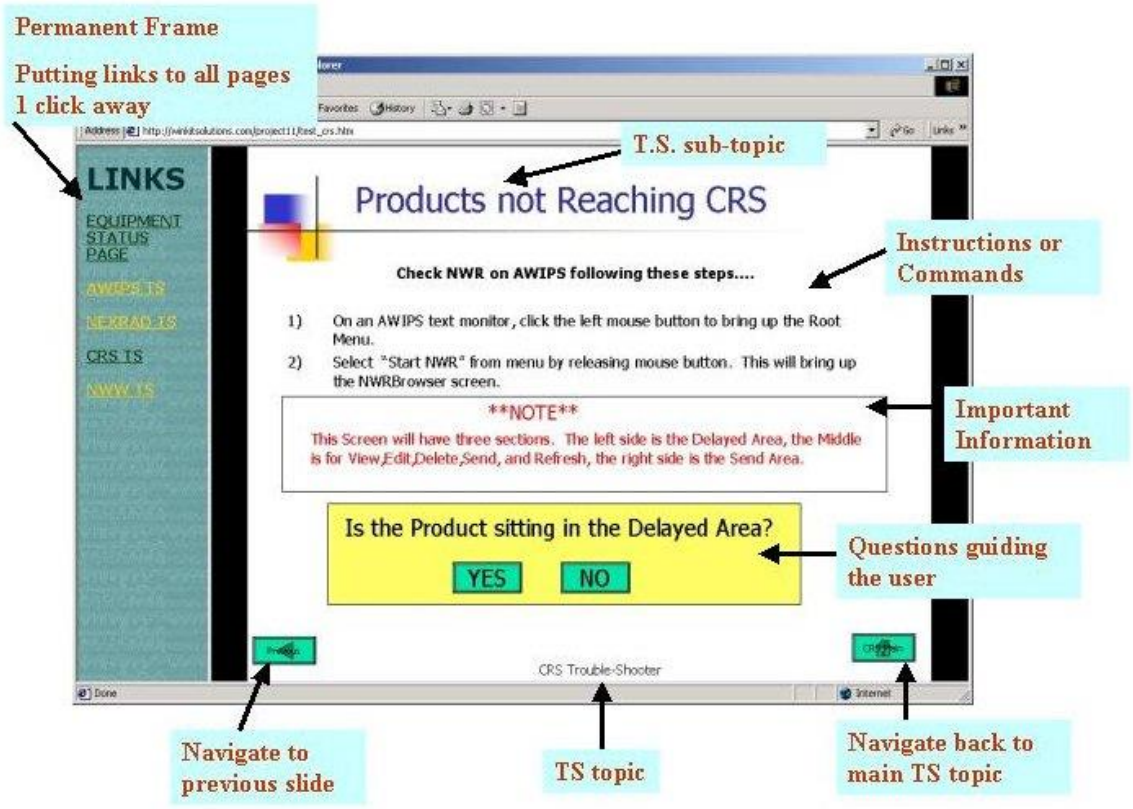

Figure 3. Typical Trouble-Shooter Session

3. Objectives of the Project

This Senior Design Capstone Project had two major goals.

1. Improve office communications concerning operational equipment, leading to higher equipment availability

2. Improve decision-making concerning operational equipment, leading to higher equipment availability and eliminate undue overtime charges.

These goals have been met with these project deliverables.

1. A Web-based application that allows for a better flow of information concerning the status of all mission critical systems used by the National Weather Service Wilmington, Ohio.

2. The application allows staff members to view, modify, and update equipment status through a Web browser interface.

3. The application helps staff members Trouble-Shoot common equipment problems through a Web browser interface.

4. The application helps staff members make decisions concerning courses of action through a Web browser interface.

5. The application consists of a clean design that is easy to use and navigate.

6. The application contains an online help section.

7. The application is hosted in a secure environment to prevent unauthorized access.

4. Design and Development

5.1 Budget

Please see Appendix A.

5.2 Timeline

Please see Appendix B.

5.3 Software

Please see Appendix C.

5.4 Hardware

Please see Appendix D.

5. Proof of Design

The first step to meeting the project deliverables was to create centralized data storage. This was accomplished with an Access database containing a table with the appropriate data fields, system name, time of failure, system status, and a comments field. A system DSN was then set up on the Web Server. The system DSN for this project was called equip1.

The main Web page for this application is an ASP page (TEST.ASP) that queries the Access database and extracts the appropriate information for each system and displays it in a table (see Figure 1.). This ASP page creates a Recordset for each System using a Visual Interdev Design Time Control (DTC) and an SQL statement. The following is an example of the SQL statement for the System AWIPS.

SELECT System, Status, `Date`, Comments FROM equip1 WHERE (System = 'awips') ORDER BY `Date` DESC

Equipment status is change through a Web form (STAT2.HTM). Users fill out the form by using drop down combo boxes and input text boxes. The information entered is sent to another ASP page (STATCHANGE.ASP) after the user clicks the submit button. The following shows how this is accomplished.

<FORM action="STATCHANGE.ASP" method=post id=form1 name=form1>

STATCHANGE.ASP is the Web page that writes the new data into the database. The following ADO code was used to create the database connection and the Recordset.

```
<%
dim dbconn
dim rst1
dim strPW
dim strverify
dim strSQL
dim strsystem
dim strstatus
dim strdate
dim strcomments
strSystem=request.form("name")
strStatus=request.form("status")
strtime=request.form("text1")
if strtime="now()" then
        strtime = now
end if
strcomments=request.form("textarea1")
```

```
strSQL= "select * from equip1"
set dbconn2=server.createobject("ADODB.CONNECTION")
set rst1=server.createobject("ADODB.RECORDSET")
dbconn2.open "equip"
rst1.open strsql,dbconn2, 2, 3

        rst1.addnew
        rst1.fields("system") = strSystem
        rst1.fields("status") = strStatus
        rst1.fields("date") = strtime
        rst1.fields("comments") = strComments
        rst1.update
        response.write "Status has been updated!!<br>"

rst1.close
%>
```

The Trouble-Shooting and decision making section of the application were created by incorporating PowerPoint shows into Web pages (see Figure 3.). The PowerPoint Show provides the user with appropriate instructions and important information on various topics. The user is then directed to the next appropriate slide based upon their answer to a YES/NO question. The user continues this course until the problem is resolved or, if the problem could not be resolved, the user is then directed to the appropriate support contact information.

All Web pages and PowerPoint Shows maintain a consistent look and feel through the use of tables and frames. Graphical elements and visual keys are placed consistently in the same location. A top menu bar and a links frame allow for easy navigation (see Figures 1. and 3.). The Equipment Status page or any Trouble-Shooting session and the help section can be accessed at any time within this application (see Figure 2.) A help page (about.htm) is provided to aid in the use of this application.

This application will be hosted on a Web Server in our local Intranet. This server is located behind a firewall and is inaccessible from the Internet, thus providing a secure environment.

6. Conclusions and Recommendations

The application has accomplished its main goal, to improve office communications concerning operational equipment. The centralized location for this information has led to a much higher reliability of accurate equipment status reporting. Not being informed about equipment status is no longer a major problem. Lost or misplaced handwritten reports are no longer a concern.

This application has not been in place long enough to gauge its effectiveness in improving Trouble-Shooting/decision making concerning operational equipment. I have no documented cases of its success or failure in this area. I remain confident that it will prove effective and reduce overtime calls significantly given the history of overtime callbacks evaluated over the past six months.

Members of both the operational and support staff have many recommendations to improve the usability and increase the effectiveness of this application. Among suggested improvements are:

1. When a user clicks on "Update AWIPS Status", make AWIPS the default selection on the Web form (STAT2.HTM), or the default NEXRAD if "Update NEXRAD status was clicked.

2. Make the equipment failure time always equal the current time. Equipment status is the key information. The user can annotate the time in the comments field if necessary.

3. Create more customized equipment status selections to choice from the drop down combo box based upon the System selected to update.

4. Automatic e-mail notification to support staff when equipment status changes to non-operational.

5. Incorporate pictures into the Trouble-Shooting section where appropriate.

6. Make paper copies of the Trouble-Shooting section. Put a number inside the YES/NO check boxes corresponding to the slide it will take the user to help facilitate the use of the paper copies.

Appendix A.
Budget

This project was completed for under $1,000. All hardware is already in place. The main costs of this project were for software development tools. Funding for this project was costs.

Software	Price Per	Licenses Needed	Cost
Microsoft Office 2000 which includes Microsoft Access Microsoft FrontPage Microsoft PhotoDraw Microsoft PowerPoint	$449.00	1	$449.00
Microsoft Visual InterDev	$549.99	1	$549.99
		TOTAL	**$998.99**

Figure 4. Budget

Appendix B.
TimeLine

The timeline is a Gantt Chart created in Microsoft Project illustrating specific tasks and dates of completion.

Appendix C.
Software

Software
Microsoft Office 2000 which includes Microsoft Access Microsoft FrontPage Microsoft PhotoDraw Microsoft PowerPoint
Microsoft Visual InterDev
Microsoft Internet Explorer 5.0

Figure 5. Software

Appendix D.
Hardware

No additional hardware was purchased to complete this project. The Wilmington, Ohio LAN infrastructure is more than adequate to handle the small increase in Network traffic and computing overhead. Figure 6. gives an overview of the Hardware components. Only a few client PCs are show to illustrate a typical configuration.

Hardware	**Already Existing**
Server	Dell PowerEdge Server
Client1	Dell PIII 128 meg RAM
Client2	Dell PIII 128 meg RAM
Client3	Dell PII 64 meg RAM
~ ~ ~ ~ ~	

Figure 6. Hardware

Notes

This is a list of terms and acronyms specific to the National Weather Service that may require some explanation.

APS	Asynchronous Product Scheduler (Unix process)
ASOS	Automated Surface Observing System
AWIPS	Advanced Weather Interactive Processing System
CRS	Console Replacement System (voice of the NWS)
CVG	Call letters for the Greater Cincinnati International Airport
NEXRAD	Next Generation Radar
N.O.A.A.	National Oceanic and Atmospheric Administration
NWR	N.O.A.A. Weather Radio
NWS	National Weather Service
NWS products	Forecasts, watches, warnings, etc.
NWW	NOAA Weather Wire

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