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Changing the Operational Paradigm with Interactive Forecast Preparation System - IFPS

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1. Introduction

Words have always been the link between the field forecaster in the NWS and citizens and businesses in the U.S. From the time of the issuance of the first public forecast on February 19, 1871 (Whitnah, Donald R., 1961), text was used to convey forecast information. Observations were collected and interpreted, then worded forecasts were distributed by telegraph to weather stations and railroad stations, and predictions were also sent to the Associated Press. (Whitnah, Donald R., 1961) While the sophistication of the data collection systems, forecast techniques and communications systems changed over the next 115 years, the primary means of conveying forecast information, text, did not.

Interactive techniques which enable the local forecaster to control digital weather forecasts used in automatic product formatting began to be developed at the Techniques Development Laboratory (TDL) of the National Weather Service in 1985 (Sohl, C. J., and M. R. Peroutka, 1993). During the late 1980's, Weather Service Forecast Office Charleston, West Virginia integrated software from TDL into their routine operations and began issuing forecasts in a digital form, the Revised Digital Forecast (RDF), which corresponded to the text format.

Through the 1990's, other pioneer offices joined the experimental effort. Software evolved from working with low resolution digital data which corresponded to text to working with grid fields from which digital data sets and text were derived. Viewed another way, a simple 12 hour forecast originally comprised of 2 sentences (i.e. Partly cloudy with a 30 percent chance of showers. Highs in the low 80s.) is comprised of approximately 60 sets of grids (temperature, dewpoint, sky, wind, weather at 12 hour intervals along with a maximum temperature and probability grid). Some of the more notable offices and contributors include Norman, Oklahoma, Denver, Colorado, Kansas City (Pleasant Hill), Missouri and Boise, Idaho. From these efforts, the grids forecast database was to become the primary forecast product in the experimental Weather Forecast Offices. All products including text, tabular and graphical products are a byproduct of the grids database forecast process.

From the onset of this effort, the management at WFO Charleston, West Virginia periodically observed, documented and shared the experiences and anxieties of the Charleston staff and management as they transitioned from a forecast process built around words to one with a foundation of grid data. The technology gradually changed with significant improvements in user functionality and friendliness from the late 1980's to the turn of the century. In spite of the software improvements, as additional offices joined the effort to test and develop the new grid and digital techniques, the anxieties of their field meteorologists to this new way of doing business was consistent with the experiences at Charleston.

We will look at the issues with which the experimental office forecasters and management have struggled over the past 15 years. These are the same issues surfacing throughout the agency as the grid forecast database is being implemented across the Weather Service. The ability of the NWS to deal with these issues will define it s ability to transition to the new digital age.

2. Issues encountered with the new paradigm

a. Forecaster anxiety and frustration

The field forecaster can be seen as a nontraditional scientist. He/She uses a combination of scientific principles (i.e. physics) coupled with an art based on experience. The forecaster is called upon to make concrete decisions often times based upon uncertain data (observed and/or model forecast) within a finite time period. The use of words to communicate a forecast has enabled the forecaster to be both specific and/or vague, depending on their confidence, the availability of information or the time available to analyze data. The switch to constructing grid sets, rather than worded forecasts, turns this forecast process on it s head creating an atmosphere of anxiety and frustration. These frustrations and anxieties need to be acknowledged and understood before strategies to overcome them can be developed.

1) Art verses Science

The field forecaster has always viewed forecasting as both an art and a science. While

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atmospheric modeling has improved over the years, there are still many situations where the model forecast is in error and the forecaster must use their expertise to deviate. Sometimes there are sound scientific reasons to do so. Other times, less concrete factors such as experience come into play. The forecaster is comfortable doing this because through the use of words, they can be less definite or detailed to account for a more feeling based forecast. Even parameters which offer uncertainty, such as probability of precipitation, can be interpreted with text: a chance of showers or a chance of a shower. In the grid forecast age, there is no room for a broad forecast which is left open for interpretation. The forecaster is now called upon to be concrete and specific with all grid fields in both space and time.

In addition, forecaster culture has always had a high concern for being wrong. The technique developed over the years to address this concern calls for a forecast to sometimes be vague. By being vague, so the thought goes, you have less risk of being wrong. Conversely, there is discomfort with being specific as it is perceived the forecast is wrong more often.

2) We are not that good

To prepare a forecast, the meteorologist has to construct an image of the atmosphere in their mind. For example, forecasting convection does not just involve temperature but moisture, instability, etcetera in both space and time. However, with the traditional text products, the forecaster is only called upon to predict the chance of shower or thunderstorm activity. In the grid world, new fields (i.e. dewpoints) in space and time are forecast out 48 to 60 hours. In spite of the fact that a forecaster is considering dewpoints in the prediction of thunderstorms through 5 or 7 days, a typical reaction when required to commit to specific values is, we are not that good to be able to forecast dewpoints out 2 days .

3) Data, Data, Data

Radar, satellite, automated observing systems, increased model output, computer and communication improvements have increased the flow of data into the forecast office at a rapid rate. The forecaster has been able to manage this increased flow of data because their end products were a low detailed text product. The grid forecast era makes the forecast increasingly data intensive as the collection and modeling progresses. For example, instead of just high and low temperature forecasts for the next 48 hours, the forecaster is called upon to forecast hourly temperature fields at each grid point. The resultant typical reaction is, Instead of making a forecast, I feel like I m on a number production line .

4) It takes the forecaster too much time

Time has always been an integral part of the forecast process. In the traditional WFO, forecasters have always looked for as much time as possible to study and analyze the ever increasing number of data sets while the meteorological technicians have performed any other duties. Once the forecast decision was made, the typing of a few zone text forecasts was a fairly simple process. In the grid forecast world, once the forecast decision is made, it can be a time consuming process for forecasters to create all the various forecast fields out through 7 days. This has lead to a cry for more forecaster positions.

5) I lose track of the current weather

Forecasters have always had to monitor the details of the present weather and current period forecast as they worked on the forecast for tomorrow and beyond. Confronted with large amounts of forecast data, the forecaster is finding him/herself getting focused on the forecast database losing track of the current weather. There is concern that a forecast needing amendment will be overlooked, or worse, hazardous weather such as strong thunderstorms will develop unnoticed.

6) Push verses Pull

The forecast process has been unchanged for 40 years: review the new information as it becomes available from observations to model output; as scheduled product release times approach, prepare the text products; push the products out when scheduled. But, in the 1990's a change occurred in the U.S. society. With the advent of the Internet and other electronic communications systems, the U.S. began transforming to a pull society. When users need or want the information, they expect to be able to come and get the latest available. The NWS no longer dictates when new forecasts will be available. The forecasters must now respond to the availability of new information as soon as possible.

7) Quality verses Quantity

Pride in the quality of service has always been foremost in the mind of the field forecaster. With only a few paragraphs of text, much time and attention can be given into assuring the right words are used to communicate the forecast. In the grid age, the amount of forecast data can seem overwhelming. In addition, many highly detailed forecast products fall out of the database and the correctness of the computer has to be relied upon.

8) The software dilemma

With the IFPS, computer software is the fundamental tool with which a forecaster translates his/her forecast from their mind to the grid sets. The expectations regarding capability, usability, flexibility and reliability of

the software are high. In fact, minor bugs and limitations, which may be tolerated outside the work environment, may be seen as rendering the applications unusable. The extent of the problem is difficult for many managers to properly understand. The overreaction created from the anxiety of change is difficult to distinguish from the true software deficiencies that adversely impact the forecast process.

9) My mother is the customer

The forecast process has always been viewed in a personal way. Forecasters view the result of their labors as something their mother would use directly. With words they apply a personal touch or answer a perceived question (is there a chance of showers or a shower) speaking directly and personally to each citizen. Maintaining that personal image during the forecast generation process is a strong motivator and invokes a great sense of service. As the database becomes a larger and larger part of the forecaster s time and distances them from the text product suite, it becomes more difficult for them to envision the recipient of their service.

b. WFO Management Frustration

In the WFO, it is common practice for the managers to perform operational shifts. As a forecaster, they find themselves dealing with the same issues stated above. But, for the WFO managers, the frustrations are compounded. They are also responsible for the impacts these issues have on the office operations.

1) Impacts on training, professional development

The ability of a forecast office to provide an ever improving service is directly related to the ability of the staff to improve in knowledge and skill. This is accomplished through training and professional development. Managers have always relied upon, and staffs have always responded with, the utilization of fair weather time on shift.

When availability of data was limited and the release of products was rigidly scheduled, training and professional development time was periodically available throughout the year. With the introduction of the IFPS, and the ever increasing availability of information, the periodic availability of extra time during fair weather is decreased. There is now a continuous flow of information which has to be evaluated and acted upon by the operational forecaster.

2) Disconnection between the field office and management

Middle (regional) and upper (headquarters) management in the NWS are comprised mostly of professionals who have moved up through the ranks providing a good understanding of the forecast process and products. The implementation of the IFPS destroys this experience and knowledge base. The potential benefits of a forecast database by the policy makers are being realized only slowly.

3) WFO routine is broken

With the stability of products and services, which has been in place in the Weather Service for decades, there has been a routine forecast process and shift structure in each WFO. This structure included an aviation and public forecast shift. At an office which has special programs such as marine, it may be an aviation/marine shift. Lead forecasters, the shift supervisors, had little shift management responsibility during routine weather situations.

The introduction of the management of a grid database has changed this. Maintaining the traditional structure is like trying to fit a square peg (the creation and management of a database) into a round hole (traditional division of work). For example, if the public forecaster has to assume the full burden for the forecast database, the balance of work becomes significantly disproportionate.

The result is an ever changing routine. Shift managers have to routinely manage the database, personnel resources, time, etcetera. They distribute the work differently each day depending on the current weather, forecast weather, availability of data and the condition of the database. Change becomes, and will continue to be, the new routine.

It is well documented that change is an anxious and frustrating experience for employees. There is a comfort and sense of stability that comes with routine. As a result, many forecasters resist the emphasis on the database and the resultant changes in operations.

c. Middle and Upper Managements Frustration

When there are significant challenges at the fundamental level of a service organization, they are felt all the way to the top. For the Weather Service, these challenges have manifested themselves primarily in three ways at the middle and upper management level.

1) The resistance to change is powerful

The balance between what is right for the organization, the customers and the employees is often difficult to maintain. While the customers and organization are important to any manager, the vast majority of managers are not cold to the concerns of their employees.

The change in paradigm brought about by the IFPS is significant. As explained above, there are many reasons the resistance to change at the field level has been great. This is creating a periodic strong push back from the field as the organization tries to push forward.

Attempting to maintain the balance, hesitations, in response to the field, by middle and upper management gives a false indication the new paradigm shift can be avoided. Resistance may be encouraged in the sense that the field forecaster perceives it is local management, rather then the organization, wanting to move forward with the new paradigm.

2) Confidence in the organizations ability to change comes into question

The implementation of the IFPS up to now has been slow to evolve. The result has been a steady and manageable flow of resistence to change over the course of several years. The resistance triggers a concern by management about the ability of the agency to tackle the forecast process paradigm change. However, to make a change of this magnitude successfully, managers must have and communicate confidence in their staff.

3) Improvements in service must be realized

The NWS undertook a major modernization program throughout the 1990's. The three major components were the Doppler radar, the Automated Surface Observing System and the Advanced Weather and Information Processing System (AWIPS). Major improvements to services in all aspects of the organization were anticipated. The implementation of Doppler radar has improved the warning services. The implementation of the automated observing system has enabled the NWS to use it s personnel more efficiently. However, the routine products and services have changed little. To realize a significant user impact from AWIPS, the IFPS is currently the only system capable of providing extensive forecast data sets improving service and productivity. All levels of the organization need to reach this realization.

3. Meeting the challenge

The issues which have evolved around the IFPS are numerous, varied and complex. However, there are offices which have been able to meet the challenge and implement the IFPS successfully. There are four themes from these offices which can define a strategy for the successful paradigm shift across the NWS.

a. Defining customer focus

More and more it is the vendors who form the infrastructure through which forecasts move across the country. The personal nature of the forecast process and products to the forecaster has always been a strength in the NWS and there will always be a role for assuring all citizens are treated effectively, efficiently and equally in the watch, warning and advisory services. But, beyond these signature services, the NWS must put it s efforts where most effective. The primary focus must be the forecast database. While some products, such as the traditional zone forecasts, will automatically fall out of the database, it will be the database rather than the text which will be the focus. With a quality forecast data set, vendors can do what they do best developing new products and services.

b. Embracing the vision and mission

A major source of anxiety from change comes as a result of not understanding why changes are made. The vision is now becoming clear. It is through the forecast data sets that the NWS mission of protection of life and property and the enhancement of the national economy can be further achieved. The power is in the details which only a digital database can provide in an effective and efficient way.

Upper management has begun the process of carrying these messages throughout the organization. They have set up training classes for managers at all levels of the organization. Discussions of the mission and vision including grid forecast data sets is occurring. The embracing of that vision will take some time, especially in an organization which is spread out across the nation. To that end, management must be diligent in carrying the message.

c. Overhauling the operations

The traditional structuring of duties in the WFO served the Weather Service well when data was limited and products were released on rigid schedules. However, in today s pull society, users want the latest information as soon as it is available. This means setting up operations in a WFO which will always communicate the latest thinking. Based on the staffing and service requirements, WFO s need to aggressively restructure their operations to assure:

1) When new information is available, it will be assimilated into the forecast with little delay. The schedule release of a forecast will be replaced with an event driven process. Events can include changes in current weather to the availability of long range model information. The forecast process will be continuous rather then stop and go .

2) Shift structure is as flexible as possible empowering the shift supervisor to redirect human resources as needed for weather, training, professional development, etcetera.

3) All human resources are available for use. The traditional class structure must be challenged with the HMT taking an active role in the construction and/or

maintenance of the forecast database.

While changing to an unstructured environment may be uncomfortable at first, an empowerment of the participants will provide the comfort of being in control.

d. Making a business case

Two things are clear. One, this is a computer oriented world. Second, the government has spent millions of dollars updating the NWS technology. The new technology must be used to create forecast data sets providing the fuel for the private sector engine. This message needs to be captured and communicated in the vision.

4. Conclusion

Changes in the world are requiring a response from the NWS. The IFPS is part of that response. Forecasts can be produced in grid and digital, rather than text form, opening the door for seemingly unlimited possibilities. But, in order for the IFPS to be realized, changes in the long standing Weather Service traditional forecasting processes must be made. In addition, a vision for providing the best service possible in partnership with the private sector must be understood and embraced. The ability of the Weather Service to meet the challenge of change will be measured by how well it can capture and maintain the vision, provide power for the private sector and both challenge and empower it s employees to reach for the future.

References

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