

OK-FIRST: AN INNOVATIVE INFORMATION-SUPPORT SYSTEM FOR PUBLIC-SAFETY AGENCIES

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1. INTRODUCTION

Since 1996, the Oklahoma Climatological Survey (OCS) has been sharing weather information with public-safety (fire, police, and emergency management) agencies; instructing officials from these agencies in the acquisition and use of the data; and providing follow-up support. Known as OK-FIRST, this program has over 80 participants from across Oklahoma (Fig. 1), with a majority of users from rural areas (65% of the participants are from towns with populations less than 10,000). OK-FIRST participants routinely access real-time WSR-88D data from 15 regional radar sites, data from the Oklahoma Mesonetwork, and information from the National Weather Service [NWS] and apply this information resource to a wide variety of weather-impacted situations.

In 1999, the OK-FIRST project was selected as a finalist in a prestigious awards program known as "Innovations in American Government[†]" (hereafter called IAG). Through the IAG awards, the Ford Foundation, the John F. Kennedy School of Government at Harvard University, and the Council for Excellence in Government have formed a partnership to recognize a small number of innovative programs which are examples of the "government's capacity to address and develop creative solutions to critical societal problems". The IAG program was developed to support two primary goals: (a) to communicate information about government effectiveness to the public; and (b) to improve government performance by identifying programs worthy of replication. OK-FIRST was selected as one of the top 25 programs from a pool of 1,609 submissions.

This manuscript will document the characteristics

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[†]Additional information about the Innovations in American Government Awards Program may be found at the Kennedy School of Government web site: <http://www.innovations.harvard.edu>.

of the OK-FIRST program (and the resulting applications of the system by participants) which correspond with the criteria used by the Innovations Program to recognize the innovative nature of this Oklahoma program.

2. THE PROBLEM ADDRESSED BY OK-FIRST

During the past 30 years, much evidence has accumulated that suggests that a major data communications problem existed between the NWS and outside agencies. Access to NWS information by *local officials* nationwide either has been cumbersome, expensive, and non-intuitive, or has lacked critical details. To make matters worse, in a few instances, the NWS did not *receive* critical storm or flood reports and could not produce adequate warnings or forecasts as a result. Some of the situations that have been documented include:

- Several major user groups received "little or no attention" from the meteorological community (U.S. Weather Bureau 1964).
- "Neither the NWS component of the Flash Flood Warning System nor that part of it involving local communities and Civil Defense did much good for anyone in the Johnstown, Pennsylvania, area" (National Oceanic and Atmospheric Administration 1977).
- "For many years, the NWS operated on the assumption that if they produced a good product, someone would come to get it and use it. Users are currently left largely to their own devices in determining what is available and how to use it; many are unaware of the information available" (National Academy of Sciences 1980).
- During the Shadyside, Ohio, flash flood event of June 1990, there was a lack of communication between the NWS and local officials. According to a NOAA report, "dissemination of the flood watch through emergency management officials was not completely effective." In addition, the NWS did not *receive* real-time flood information from local officials. "Local authorities were aware of reports of heavy rain and of the flooding in the area but did not call the NWS. The NWS did not find out about the Shadyside flood until 4 hours after the peak of the flood". (National Oceanic and Atmospheric Administration 1991).
- More recently, following the Palm Sunday Tornado Outbreak of 27 March 1994, Vice President Gore announced an expansion of NOAA Weather Radio capabilities. Although the NWS issued tornado warnings

Current OK-FIRST Participants

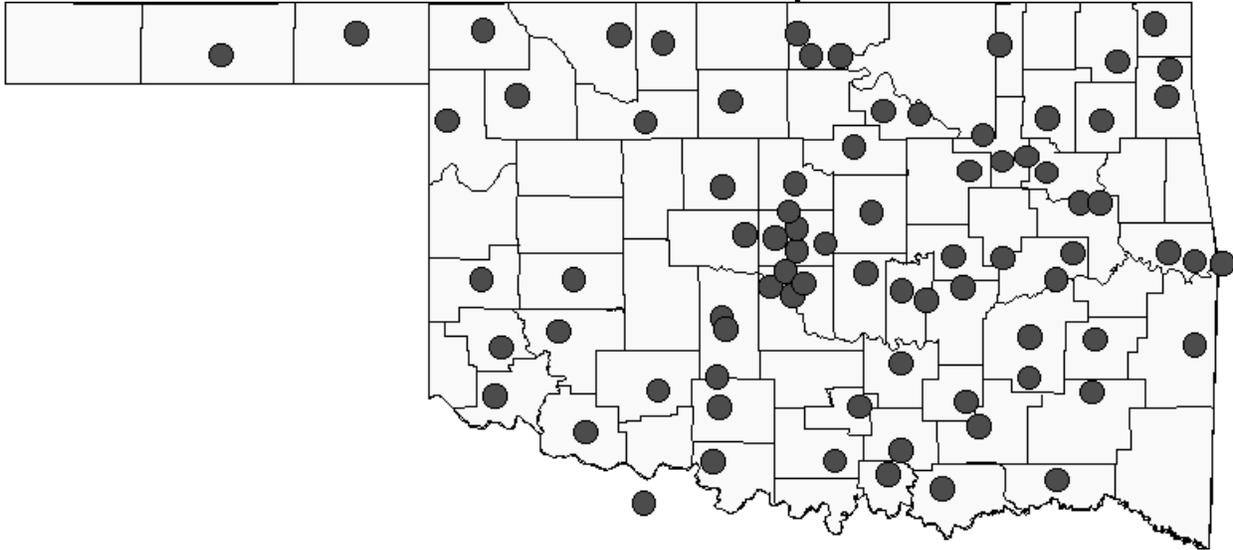


Figure 1. Locations of public-safety offices that participate in OK-FIRST.

with adequate lead time, 42 lives were claimed (including 20 at the Goshen United Methodist Church in Cherokee County, AL) because citizens at risk did not receive adequate notification. According to a NOAA report, “the warning process was somewhat compromised by the limited resources many rural county emergency managers and law enforcement officials had at their disposal for receiving the emergency messages and enacting their preparedness response plans” (National Oceanic and Atmospheric Administration 1994).

During the past three decades, the implementation of NOAA Weather Radio and the Emergency Manager’s Weather Information Network (EMWIN) improved the situation. Yet, local officials and the population at risk often do not receive adequate notification even though the NWS issues timely warnings. Most local officials around the country have not had real-time access to the NWS data products they desired, especially *graphical* products like radar imagery.

Through the decade of the 1990’s, the efforts of the NWS modernization campaign dramatically improved their observing, forecasting, and warning capabilities. Still, local officials could not access timely, modern and graphical information from the NWS *inexpensively*. In fact, this data-telecommunications problem was exacerbated because modernization activities produced vast amounts of high-quality, county-scale information while the dissemination system could handle only a trickle of information. Consequently, local officials around the country continued to make weather-impacted decisions without adequate and timely information (*e.g.*, spotters were deployed precariously because coordinators lacked information about storm location,

movement, and intensity).

3. THE INNOVATION PROVIDED BY OK-FIRST

Political scientists Altshuler and Behn (1997) define innovation in government as “novel” changes that have “significant impact on performance”. The empowerment of frontline employees to make decisions is a key characteristic of innovative programs noted in both the the Altshuler and Behn review and in the seminal work on innovative or “entrepreneurial” institutions by Osborne and Gaebler (1992). Altshuler and Behn also note that the IAG Program implicitly defines innovation as an “innovative operating program, not an innovative idea”. Thus, in the various stages of their awards program, the IAG Program judges the degree of innovation in a program according to its novelty, effectiveness, and significance. In addition, because the IAG Program promotes replication, they examine the replicability of their contestant programs.

3.1 Novelty

OK-FIRST has extended access to a wide variety of weather data to public safety officials across Oklahoma. This access was accomplished using the World Wide Web and web browser plug-in software (Wolfenbarger *et al.* 1998a-b; Morris and Duvall 1999) to display WSR-88D radar data and surface observations from the Oklahoma Mesonet. The use of the plug-ins shifted much of the data processing to the user’s computer, and provided a capability for each user to have a custom view of Mesonet or radar data. As a result, the user typically

received radar data from any of fifteen radars in the Oklahoma area within *seconds* of its production by a radar. Thus, rural public-safety users regularly have obtained critical radar information for their area, *on their time schedules*, without waiting on external broadcasts of radar data. The importance of this capability was underscored during the 3 May 1999 tornado outbreak in Oklahoma. While broadcast media properly focused on the major destruction in metropolitan areas of central Oklahoma, sparsely-populated areas received advanced notification of approaching tornadoes from emergency management coordinators who were monitoring their areas using OK-FIRST (Crawford and Morris 2000).

Access to data from these fifteen radar units and to regional and national mosaics of radar data was made possible via a NIDS (NEXRAD Information Dissemination Service) redistribution contract between the University of Oklahoma and Unisys Corporation (Crawford *et al.* 1999). To our knowledge, OK-FIRST made use of the only NIDS redistribution contract with a state agency. This public-private relationship benefited all parties involved. Unisys was able to reach a market not fully tapped by offloading management and user support to OCS. OCS broke new ground in the statewide dissemination of radar data to fulfill its legislative mandate "to acquire, process and disseminate weather and climate data to decision-makers in the state". A major benefit to public-safety users occurred with the centralized collection and dissemination of radar data through NIDS: access to the regional *network* of radars. The network approach has proven important when a given radar unit became unavailable at an inopportune time; nearby units provided weather surveillance for these public-safety users.

Before access is granted to the OK-FIRST system, users must have completed a mandatory workshop on the interpretation of the data products available. This instruction not only has focused on the proper use of the data, but also on potential *misuse* of the data. For example, several weather data providers have shared algorithm output from the NEXRAD system (*e.g.*, computer detections of mesocyclones, tornadoes, and hail size and amounts). Because these signatures have been displayed along with a composite reflectivity product, the instruction has included comparisons between the base reflectivity and composite reflectivity images and has stressed the importance of verifying the computer output against other independent sources of information.

Periodic refresher courses also have been

conducted. Experience and evaluation efforts have indicated that the refresher courses maintain a level of interest in the program, keep details of certain interpretation skills fresh in the minds of the participants, and correct previously misunderstood concepts. Post-evaluations have revealed that many of these public safety users demonstrate high interpretation proficiency after participating in a refresher course. The *data-interpretation* training component has been deemed as a critically important aspect of OK-FIRST by users, NWS officials, and project staff.

The OK-FIRST program has resulted in unique capabilities for local public-safety officials to respond to environmental emergencies based upon real-time, modern weather information. The independent project evaluator of OK-FIRST suggested that the program was successful in three critical areas: the intuitive dissemination and display of graphical information; intensive training on access and application of sometimes technical information; and follow-up support (James *et al.* 2000). Other government programs and private companies typically have limited their focus to the distribution of textual and/or graphical weather products, with much less attention to either the training or support components. It appears as if few programs have successfully addressed all three components (data access, training, and on-going support).

3.2 Effectiveness

When seeking to judge the effectiveness of a contestant program, the IAG Program examines the ability of the program to meet its stated goals and objectives. The IAG Program also determines whether the contestant programs produced unanticipated benefits for clients. The OK-FIRST project contracted with an independent team to evaluate the effectiveness of OK-FIRST using a set of goals and objectives. The stated goal of OK-FIRST was "to develop a transportable, agency-driven information system that helps public safety agencies harness the information age ... through the implementation of a decision-support system for police, fire, and emergency managers." Several programmatic objectives that were originally outlined for OK-FIRST include:

- Establish the initial base-line of knowledge, skills, and abilities of end-users about using the "National Information Infrastructure".
- Secure adequate computer resources for local agency participants.
- Establish computer linkages for participant agencies.

- Increase participants' understanding of the many environmental data sources available, including access to the suite of Oklahoma Mesonet, NEXRAD, and NWS products.
- Increase participants' ability to apply environmental information to their operations.
- Improve the packaging, transfer, and display of environmental data so that it is more suitable to real-time operations for the participants.
- Provide routine follow-up support throughout the project (e.g., on-site visits, on-line conferencing).
- Quantify the impact of OK-FIRST by documenting changed work-habits and new approaches to old problems.

To satisfy these objectives, each participant completed a computer skills workshop and a data interpretation workshop. Specific objectives were formulated for each of these workshops as well. The project evaluation team used several techniques including pre- and post-tests, focus groups, and surveys to determine how successful the OK-FIRST team was at accomplishing these goals and objectives.

The summary finding of the independent evaluator was published in his final report (James *et al.* 2000):

... through its training, access to real-time data, and support, OK-FIRST was able to accomplish an important goal. The project was able to change the behavior of local public safety officials and their approach to decision-making. The increased skills and capacity of the OK-FIRST participants have had a positive influence on the types of decisions they make, how they make those decisions, and when they are willing to make a decision.

An example of such a decision occurred during the 3 May 1999 tornado outbreak. On this night, one emergency manager prevented an ambulance transporting a tornado victim from driving into another tornado (Crawford and Morris 2000).

Analysis of product usage by OK-FIRST participants also has provided some insight into the effectiveness of OK-FIRST. Since April 1998, the OK-FIRST system generally has shared over 40,000 files of NEXRAD radar data per month. Several months during this time period witnessed in excess of 80,000 NEXRAD files shared. In fact, during two record-setting tornado outbreaks, the OK-FIRST system performed superbly. Over 25,000 files were shared in 24 hours during the 4 October 1998 outbreak. During the 3 May 1999 killer tornado outbreak, OK-FIRST participants downloaded 36,278 radar files.

3.3 Significance

The IAG Program evaluates the significance of an applicant program by determining whether the applicant has addressed a problem of national importance. In addition, the IAG staff and their National Selection Committee determine whether applicants have made substantial progress toward diminishing a problem within a given jurisdiction.

The end result of the OK-FIRST program has been manifested in the fact that many public-safety users in Oklahoma approach their job differently after acquiring access to OK-FIRST. Several users have commented that they would retire from their positions if OK-FIRST were taken away because they feel it would be too difficult to work without their new-found information. Fewer storm spotters have been deployed but with greater efficiency and safety because the intensity and movement of storms is known and is easily related to spotter locations. Additional applications of OK-FIRST in severe weather, flooding, and fire-fighting situations were reported by Morris *et al.* (1999).

Although most citizens who are beneficiaries of OK-FIRST are not aware of the program, the impact on their lives has been considered the ultimate measure of the program's success. During the 3 May 1999 tornado event (Crawford and Morris 2000), rural citizens were kept abreast of storm conditions through radar updates broadcasted via scanner. One emergency manager stated that many of these rural men and women (who typically did not heed storm warnings) took shelter that evening. During non-severe weather situations, fire departments have been alerted to wind shifts when fighting fires. Just as important, other examples of the impact of OK-FIRST documented by the evaluator illustrate the ability of local users to decide when the appropriate action is to do *nothing*:

- On Christmas Day the river was within 6 inches of flood stage. Instead of having to run down to the river every couple of hours or pulling people away from their families, I was able to use OK-FIRST and see that the crest had already passed and [the river] was going back down.
- We provided detailed rainfall guidance [for] a parade that had the governor's wife as grand marshal. [We] would have canceled parade without OK-FIRST.
- We were able to watch [a winter storm] over the course of a few hours and could tell (by the temperature) that the snow wasn't going to hit us. The city could send the snow crews home and saved a lot of overtime pay.

Finally, OK-FIRST has been used in other law enforcement activities, including investigations of homicides and fatality aircraft accidents.

3.4 Replicability

There has been interest shown by several neighboring states and by the NWS in trying to replicate OK-FIRST. The most successful replication efforts might well be accomplished by state- or region-level jurisdictions, rather than a national implementation. When the NWS attempts to provide a modern data service to public-safety officials on a national basis, difficult questions often arise about the involvement of the private sector. In addition, a "national" implementation might not be sensitive to needs and constraints in rural areas. OK-FIRST specifically targeted rural areas because these areas traditionally have had inadequate information resources and technology.

Based upon successes with OK-FIRST, OCS and the NWS have established a new project known as ONALERT (Observations Necessary for Aiding Local Emergency Response via Telecommunications; Kloesel *et al.* 2000a,b) to explore the replication of OK-FIRST-type technology on a potential national basis. ONALERT is an experimental national prototype system, and includes phenomena not necessarily present in Oklahoma. In addition, ONALERT is being designed to complement existing and future NWS dissemination technologies including NOAAPORT and the Local Data Acquisition and Dissemination (LDAD) system.

The ONALERT efforts have demonstrated the ease of replication of OK-FIRST technology. The time required to initially implement ONALERT was less than six months because much of the infrastructure required for the new project was already available.

4. SUMMARY

An independent partnership of organizations that are interested in restoring public confidence in government through the publicity and replication of "innovative" government programs have selected the OK-FIRST program at the Oklahoma Climatological Survey as one of the top 25 innovative federal, state, local, and/or tribal government programs in 1999. Through this honor, the Innovations in American Government program has recognized specific attributes of OK-FIRST that are novel, significant, effective, and replicable.

As a consequence of the implementation of OK-FIRST, the Oklahoma Climatological Survey has developed the strategies, materials, technologies, and methods to effectively change the work habits of public safety officials when they are presented with weather-related situations. These officials now

work on an informed basis with current weather data and relevant instruction. Armed with these resources, they routinely mitigate the effects of both hazardous and non-hazardous weather events on the citizens within their jurisdictions. We believe they have no peers worldwide who can make these types of decisions.

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