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PROFS

PROTOTYPE REGIONAL OBSERVING AND FORECASTING SERVICE: FROM CONCEPT TO IMPLEMENTATION

D. W. Beran and C. G. Little
Environmental Research Laboratories
Boulder, Colorado

BIOGRAPHICAL SKETCH

Dr. Donald W. Beran completed his Ph.D. in Meteorology at the University of Melbourne in 1970. Presently, Dr. Beran is Chief of the Prototype Regional Observing and Forecasting Service (PROFS) Program. PROFS is concerned with the development, testing, and implementation of an improved local scale weather service.

Dr. C. Gordon Little specializes in electromagnetic or acoustic remote sensing of properties of the atmosphere or ocean. He heads NOAA's Wave Propagation Laboratory, located in Boulder, Colorado.

1. INTRODUCTION

Weather services are shaped by three primary forces: 1) requirements of the user, 2) new research products, and 3) distribution of resources by management in response to political, social, and financial pressures. These forces are interdependent to some degree. New research products can stimulate management decisions and ultimately create new user requirements. On the other hand, unmet user requirements often stimulate new research activity and management decisions to reallocate resources. These forces are dynamic and evolve with time. As one need is met, the next demands attention; as each new research product appears, it opens the way for further progress. A continually evolving program is therefore needed to identify user requirements, to accept and integrate new technology into larger systems, and to provide a mechanism for feedback between the operational and research communities.

The concept for the Prototype Regional Observing and Forecasting Service (PROFS) began to take shape almost three years ago in NOAA's Wave Propagation Laboratory. This research-oriented laboratory demonstrated the feasibility of measuring atmospheric parameters remotely by creating and demonstrating a large range of ground-based remote sensing techniques. The observational capacity of operational meteorology could potentially be revolutionized by applying such remote sensing techniques. The optimum range of these ground-based techniques makes them most effective on the smaller (meso) scales, where the collection of equivalent amounts of data with conventional methods would be far too costly, if not impossible. Although the effectiveness of this new technology had been demonstrated in a research environment, its transfer into an operational setting was not a foregone conclusion. A host of difficulties ranging from the initial cost of sophisticated remote sensing systems to the proper integration and interfacing with existing systems needed to be resolved before transfer could be effected.

Early versions of the PROFS concept were slanted toward these new remote sensing techniques and the potential benefits that could accrue from applying them in the area of mesoscale meteorology. As discussions continued, it became apparent that major research progress had been made in other areas, and the scope of the PROFS concept was broadened considerably to include all elements of a local weather service system. In the process, it was found that too little communication had existed between researchers in different areas. For example, techniques used by the operational forecaster are inseparable from his observational data base, yet researchers studying new observational techniques and those developing new forecasting methods seldom worked closely together. Thus new forecast techniques were based largely on the presently available, sparse conventional data sets when future data sets may be more nearly complete in time and space. The separateness of research activities was one of the factors preventing an easy flow of technology into operations. Many newly developed technologies were incompatible with each other, and with existing service systems, and would therefore disrupt operations if they were abruptly introduced. However, such problems would not occur if adequate attention was given to early integration of new technologies with each other and with existing operational methods.

The PROFS focus on mesoscale meteorology also emphasized the need to develop more effective techniques of disseminating information to the

user. The present weather services dissemination system has evolved in support of what was primarily a longer range, synoptic-scale forecasting system. Visual presentations of local weather information, on which the user can locate the site of interest to him, are of course far more effective than complicated word descriptions, yet such presentations are available only once or twice a day (during commercial TV weather shows).

Critical to the evolution of the PROFS concept was the recognition that the nature of weather forecasts and services could change with the new emphasis on mesoscale meteorology. Present weather services world-wide are designed to meet a number of requirements, with safety being the dominant one. The system of observations, forecasts, and communications established to fulfill the safety requirement also provides convenience forecasts that have some economic benefit. If highly reliable site-specific weather services were made available, the economic-benefit aspect of the service could become dominant, and significant changes would be made in the design of future services. The systems approach and careful attention to the real benefit/cost ratio would take on more importance, and we would no longer need to appeal to the emotional issue of safety to gain support for improved service systems.

The PROFS concept likewise took into account the necessity of long-range planning. Studies in such "soft" sciences as social psychology, human behavior, and marketing, to relate weather information to the potential future user needs, became a part of the PROFS concept. Without such planning, the service system would simply react to the latest crisis or current fashion. Such a mode of operation could often produce major resource reallocations and less than optimum, quick-fix solutions. If a problem is not identified soon enough, too little time exists for the orderly development of cost-effective and efficient new technology. Even worse, once the quick-fix is in operation, its existence may block the use of a better solution that could have been developed with more time.

Without long-term planning, service systems will have the following drawbacks. First, the operational system will be burdened with many devices and solutions that are far from optimum. This will increase the forecasters' workload, and waste valuable time that could be directed toward meteorological problems. Second, the quick-fix solutions bar the introduction of more effective new technology. Thus the level of service for the user of the weather information could be much higher at potentially lower cost if we use long-range planning based on carefully projected future requirements.

Besides assessing future forecast needs, the PROFS concept considered the impact that new technology might have on these needs. Many users don't know what they need until they see what is possible. However, it is not practical to develop and implement all possible new technologies, so the potential benefactor can see the promised service improvements and then decide what he likes. The cost and chaos of this extreme approach would be excessive. Yet new technologies do create new needs. Both the needs perceived by the user (and interpreted by the social psychologist) and the needs created by new technology must be considered as we design future systems.

Although it began as a simple prototype to acquire meteorological data for the mesoscale, the PROFS concept rapidly expanded into the design for a total local weather service system that includes research, technology transfer, and information dissemination, as well as preparation of mesoscale weather forecasts. As used in the PROFS concept, weather services are seen as a total social/technological system based on the following tenets:

1. Users' requirements for weather services (both as perceived now, and as they evolve) justify a service system.

2. New technologies can stimulate improved levels of service.

3. New systems must complement and merge with existing weather services.

4. Because of their complexity, future weather services can best be identified and integrated through the systems approach.

2. THE PROFS PROGRAM

NOAA currently has no procedure, staff, or facility dedicated solely to the range of activities encompassed by PROFS. The PROFS program will be directed by an independent group within the Environmental Reserach Laboratories of NOAA in Boulder, Colorado. The PROFS group will be free to accept proven research concepts from research groups in ERL as well as from other government laboratories, academic groups, or private concerns, and in some instances it will sponsor necessary research.

The PROFS group will establish an Exploratory Development Facility (EDF) in Boulder that will be used to integrate new research products into larger subsystems of a total local service, and to test subsystems in simulated operational environments. The work of this facility has been the subject of much debate. On one hand, the EDF

could dedicate a large portion of its efforts to the immediate improvement of day-to-day operational problems of the National Weather Service ("short-term fixes"). On the other hand, the EDF could concentrate on testing and developing systems, which include newly developed research products, that will require major investments and could have maximum effect only many years in the future. It has been decided that the EDF will function in both ways. Although the system designs will be based primarily on established service requirements, the EDF will test new technology and incorporate it into the designs when applicable. When new technology shows the promise of stimulating new service opportunities, PROFS will use marketing research techniques to determine the validity of this promise. As new subsystems are created they will be made available for procurement by NWS. This will create an environmment favorable for continual improvement in local weather services.

The actual physical location of the EDF has also been debated. Some think that the facility should be part of an operational WSFO whereas others think it should be an isolated facility with maximum freedom to explore new technology. The solution appears to be that the EDF should maintain a functional WSFO, partially manned by line forecasters who will work as though they were in a typical WSFO. Their forecasts will not necessarily be disseminated but can be compared with those of a nearby WSFO to test the effectiveness of a new technique or procedure.

Research staff will work in the EDF's simulated operational environment while their new product is being tested and integrated into the operations of the WSFO. The line forecasters and research personnel will rotate through the facility on a regular basis, and a skeletal permanent staff will maintain continuity and monitor tests.

The EDF will derive several side benefits from combining research and operations. First, it will provide an environment in which research and operational people can work side-by-side. The researcher will have the opportunity to see the problems facing a forecaster, who must work on a fixed schedule, and take them into consideration when developing new technology. The line forecaster, who will have received individual training in the application of new techniques, will be better prepared to employ new tools. He may also have a better appreciation of the researcher's problems. Second, the EDF can examine the question of optimum man/machine mix for any simulated situation. Disruptions to ongoing operations will be avoided by providing the EDF with the flexibility to conduct such tests.

A functional WSFO in the EDF will also provide the mechanism for testing new dissemination techniques and user reaction to new products. For instance, a controlled test (a frequently used market research technique) could be conducted to evaluate dissemination methods. The responses of a real test population, which received a new product disseminated by radically different techniques, could be evaluated by well-established methods.

The EDF is a major tool that will be used in the development of systems within the PROFS program. The total program, however, contains many other important features. To prevent duplicating effort and to enhance feedback PROFS will establish interfaces with other government agencies interested in local weather service, especially the Departments of Transportation and Agriculture, and those that produce new technology. Weather services need - and will continue to need - the advanced technology produced by such agencies as NASA. PROFS can service such groups by helping to keep them aware of operational needs and (through the EDF) providing an opportunity for the early test and evaluation of their products.

3. PROFS AND PRIVATE ENTERPRISE

Private meteorological services have traditionally provided local-scale services to weather-sensitive businesses such as fruit growers, aerial photographers, and outdoor entertainment. Many may view PROFS as a possible threat to such private enterprises because its emphasis on the mesoscale may result in more NOAA services. However, reduced participation by the private sector is neither likely nor desired. PROFS will gather and update the fundamental data base, which will be used to develop prototype designs for many styles of local weather services at any conceivable location. PROFS designs will be available to the private sector, as well as to the National Weather Service and other agencies concerned with local weather service. We would expect the more detailed PROFS data and the availability of new techniques to lead to expanded services by the private sector.

PROFS studies will interact with the private sector through means, such as contracts and grants, where the basic needs of the private sector for improved data and new techniques for forecasting and dissemination can be incorporated into the PROFS program. This should allow for federal support for R&D and system engineering which also will be a direct benefit to the private as well as the federal sector.

The private sector should view PROFS not as a threat but as a vehicle for increasing the public awareness of the potential availability and benefits of improved services and for producing greater demand for these services.

4. CONCLUSIONS

PROFS will adapt the systems approach in designing social/technological systems for providing local weather services. PROFS will monitor research to discover new products which may be applicable to such weather service. It will conduct studies combining social psychology, marketing research, and economic models to predict demands for service. Its findings will be synthesized through computer simulation and analysis. As alternative service patterns are identified, field tests will be conducted - or sponsored - to evaluate components and techniques.

Preliminary system designs will evolve into a prototype design that can be implemented and tested as a full-scale real-time service system. Only after successful completion of testing will the system be put into actual operation. However, since research in technology and changing user requirements will never end, PROFS-like activities will be needed to continue to create future service systems in response to the evolving needs of society.

ACKNOWLEDGMENT

Over the past three years PROFS has grown from a collection of ideas on ways to improve our nation's weather services to a unified program to achieve this goal. This happened because of the interest and concern of many people from within NOAA, other agencies and the private sector. The thoughts expressed in this paper reflect this broad input. The authors wish to express their thanks to the many individuals who contributed their time and effort on working groups, design teams and as reviewers of the development plans.