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RECOMMENDATIONS ON PLANNING A LARGE SCALE COMBINED MONITORING AND MODELING EFFORT BASED ON THE EXPERIENCE OF THE SJV / AUSPEX AIR QUALITY STUDY: A PANEL DISCUSSION

by

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INTRODUCTION

The San Joaquin Valley Air Quality Study (SJVAQS) began in 1986, combined with the Atmospheric Utilities Signatures, Predictions, and Experiments (AUSPEX) study in 1988; the joint study will conclude in 1994. [See Roth, et al.[1], Roth, et al.[2], and Thuillier[3,4] for discussions of project scope.] To date, planning, technical support, and field activities have been completed. The data acquired during the summer of 1990 has been archived, and emissions, meteorological, and air quality modeling efforts are well under way. The purpose of this paper is to pause, take stock, see where we have been and what we have learned about conducting a study such as this, coalesce our thinking, and convey our views.

Our observations are categorized according to activities: planning and design, technical support studies (TSSs), start-up, field operations, and administration/ management. Both successes and areas of needed improvement are discussed.

PLANNING AND DESIGN

About eighteen months were allotted for planning and design, and an additional twelve months were available for continued planning during the TSS phase of the work. During this period, a general project plan was prepared; funding requirements were developed; the draft plan was revised in light of funding constraints; technical support studies were identified, scoped, funded, and initiated, including limited field studies during the summers of 1988 and 1989; AUSPEX joined with the SJVAQS for the study of ozone, PM-10, and visibility degradation during the summer of 1990; a detailed field program plan was prepared and implemented, and emissions and air quality modeling plans were formulated. Adequate funding was allocated for planning.

Successes

A key result of the planning activity was the sound integration and balancing of needs associated with emissions data acquisition and modeling, air quality and meteorological modeling, and the field study. A number of conscious and well-reasoned compromises were made which resulted in a balance of resource allocations among program elements.

The Technical Committee maintained oversight of scientific and technical aspects of the project. Committee members proved to be knowledgeable and experienced in most aspects of the program; took work assignments seriously, joining in planning activities as needed and completing their portions in a timely manner; worked cooperatively, with virtually no friction; and questioned policy positions that might compromise the technical integrity of the project.

The final plan represents a consensus of views, based on both technical and policy considerations, of a large number of sponsors, participants, planners, and reviewers. Consensus building was achieved by assigning the day-to-day planning effort to a small number of people who carefully guided plan development (and who asked and listened). Once budgetary decisions were made, elements of the overall study and trade-offs among elements were evaluated in light of objectives and budget. [See also "Areas of Needed Improvement" following.]

The planning process worked reasonably well in developing a given draft of the plan, due to broad participation and good communication. The process proceeded roughly as follows:

> The Principal Investigator (PI) and staff query the sponsors and technical community for general ideas concerning elements of the study;

> The PI prepares a list of program elements and priorities and circulates it for review and comment; this process continues until consensus is reached;

> The next level of detail is now developed; staff prepares "straw man" plans for each element; experts and interested parties are asked to review and comment on the "straw men"; responsible staff modifies the element plans;

> The element plans are then assembled into a draft work plan, and budget estimates (which tend to be greater than available funds) are prepared;

> Planning staff works with the Technical and Policy Committees to assess priorities, make compromises, and reduce scope sufficiently to meet budgetary constraints (or, alternatively, obtain an increase in budget); the PI revises the work plan to reflect the changes, and circulates it for review and comment;

> Planning staff solicits comments and suggestions in an open forum (meeting, workshop), with the requirement that suggested additions must be offset with compensating reductions in scope and budget; the staff assesses suggestions in terms of objectives and priorities; after review and approval by the Technical and Policy Committees, staff revises (finalizes) the plan.

The field program plan (Blumenthal, et al.[5]) proved to be quite valuable as a reference throughout the planning, start-up and operational portions of the project. It was explicit in stipulating requirements; consequently, the document was used as a primary reference for bidders responding to requests for proposals (RFPs).

It has long been recognized that an important use of models is as an aid in planning field programs through identification of data requirements. Specifically, sensitivity runs can be carried out to assess the relative value of alternative data acquisition plans. Usually, however, such efforts are not undertaken due to lack of availability of a suitable model, a paucity of data, or insufficiency of budget or time. Fortunately, we were able to use grid-based air quality and meteorological models to aid in assessing data needs and in planning the field program (including identification of some monitoring sites) and emission data acquisition. While the results were not as helpful as we might have wished, due to the relatively coarse resolution of the models, the effort was nevertheless beneficial.

Areas of Needed Improvement

The initial guidance given the contractors by the sponsors (seven dominant sponsors, more than 60 in total) was to design a technically sound study that would satisfy stipulated goals; no budgetary limits were offered. The budget estimated for the initial study design exceeded what the governing Policy Committee viewed as feasible to raise. A revised plan scaled down both the scope of the study and the budget; this budget, too, was judged to be greater than the sponsors' ability to secure. A third round of planning, now based on a somewhat arbitrary budgetary target, was carried out, scaling down the second plan. This third draft plan, which served as the basis for the final plan, was scaled up when AUSPEX merged with SJVAQS. This overall approach consumed a substantial amount of time due to the number of sponsors participating, the lack of clear definition of policy and technical objectives, the time required for each revision, and the somewhat lengthy intervals between Policy Committee meetings.

A preferred approach might be to clearly define objectives, scope a program that will satisfy the objectives, and prepare a rough budgetary estimate. Then, eliminate lower priority objectives and reduce the scope until the budgetary estimate corresponds to the funds available. In developing an overall approach, one must decide if the budget or the objectives (or, if unavoidable, neither) are to be maintained fixed during this revision process; flexibility will be needed in evolving a plan. In any event, clear unambiguous guidance concerning objectives and budget should be provided at the outset.

Contracts to carry out the planned work must, of course, fully reflect needs and, thus, the plans. Because planning and administration were carried out by different groups, occasions arose when contract provisions did not fully or properly represent needs. In addition, questions arose in the field that required knowledge of the planning process and of established priorities in order to develop an appropriate response. Thus, planning, administration (legal, coordination, and oversight), and operations management must work closely together to ensure that plans are properly translated into practice.

Ideally, one might wish to perform planning tasks serially. In the case of SJVAQS/AUSPEX, an initial plan was formulated and revised and TSSs were planned and carried out, with the results to serve as technical support in drafting a final plan. In practice, aspects of the final plan were developed before the TSS results were available; schedule requirements precluded waiting for all of the results. Typically, it will not be possible to pursue a fully sequential set of planning tasks. Thus, it is important (a) to develop a schedule that accommodates carrying out work in parallel wherever possible and (b) to remain flexible, allowing for changes and modifications to a plan to the extent possible, as new information is always becoming available.

One objective set by technical staff and consultants was to develop detailed modeling and data analysis plans against which the data acquisition plan might be checked. The modeling and analysis plans were to carefully document data requirements for the analyses planned. The field program plan could then be compared with these requirements. Unfortunately, completion of the modeling and analysis plans was delayed several months while awaiting resolution of legal interpretations of conflict of interest provisions of California law. Thus, cross-checking was carried out only informally through discussions between field study and analysis planners. We still believe, however, that formal, careful comparison of data needs and field program plans should be a key component of the overall planning endeavor.

The quality assurance and data management teams should participate in the planning process. Thus, the teams should be chosen early and should participate in all practical planning discussions. Adequate funding should be provided for these activities. To a considerable extent this integration was accomplished in SJVAQS/AUSPEX; however, earlier participation would have been beneficial.

The need for extensive data management and "data quality assurance" should be recognized at the outset. Often, there is a tendency to underestimate the time and budgetary demands associated with this activity. Also, "level 2" data validation procedures should be well defined. As definition was neglected in the project plan, specifications were developed only after the data had been collected.

Data files, data structures, variable-naming conventions, formats, and units should be specified prior to monitoring. As some of these specifications had not been developed, confusion occurred on occasion when attempts were made to integrate data collected by various investigators. Lacking guidelines, errors resulted. Also, additional costs were incurred in attempting to avoid errors and in correcting errors.

A number of other details related to execution of the field program were not worked out until the time for air quality monitoring was at hand. We suggest that the four month period prior to start-up be used to identify issues, potential problems, and details, culminating in a manual prepared for distribution to all participants. Also, as contractors are engaged, they should establish communications with other contractors as soon as possible to work out logistics pertinent to their activities.

TECHNICAL SUPPORT STUDIES

TSSs are studies carried out during the planning phase that were designed to address unresolved issues and/or produce information needed to support effective planning. Topics of study included:

- assessing techniques for sampling and analysis of volatile organic compounds (VOCs),
- evaluating meteorological measurement methods,
- attempting to determine an optimum allocation of available resources between surface and aloft monitoring,
- assessing the representativeness of surface monitoring sites,
- scoping an emissions modeling effort that would satisfy project needs,
- evaluating approaches to modeling meteorological fields,
- making micrometeorological measurements to determine the importance of near-surface nighttime and early morning stability in stratifying and layering emissions from sources discharged at different elevations,
- evaluating alternative approaches to modeling dry deposition, scoping observational needs, and designing a combined monitoring and modeling program,
- testing a monitoring approach for measuring horizontal pollutant fluxes, and
- carrying out limited measurements of transport from the San Francisco Bay Area into the northern San Joaquin Valley.

Successes

Commitment to a full roster of TSSs, a provision unique to this project, provided a sound foundation for planning and a rich array of information. The willingness of project sponsors to support such activities with little precedent is commendable.

The contracting process, establishment of oversight committees and ongoing management of each TSS initiated administrative practices that proved valuable in later activities. Given the large number of activities, the novelty of the various sponsors working together and the many demands placed on participants, this period served well in establishing general practices and working relationships.

Areas of Needed Improvement

Some studies took longer to complete than planned. Some required greater oversight - pertaining to technical focus and direction, budgetary expenditure, and conformance to schedule - than was provided. The net consequence was that results were not always available when needed, some budget overruns occurred, and, in two instances, technical direction diverged from that desired or the actual product fell short of that planned. More thorough involvement on the part of the technical project team with the technical direction and content of the ongoing work would have reduced the number of such occurrences.

Late delivery of product could have, to a large extent, been alleviated by pressing the project administration (Policy Committee, contract office, and/or legal department) to conform to schedules that ensured timely performance. In several cases, delays in approval of work scopes or RFPs, in legal evaluation, and in contracting set back the time of inception of the TSS by several months.

START-UP

"Start-up" refers to the period of several months preceding the inception of the intensive field measurement program during which monitoring sites are identified and leases arranged; trailers, air conditioners, and other equipment are ordered, delivered, and placed at sites; pollutant and meteorological monitoring equipment is ordered or procured, delivered to the field, and set up; operating protocols are tested and implemented; in-field training of personnel takes place; communications hardware is installed and tested; monitoring equipment is put through "start up" and "shakedown" testing; and "first round" quality control efforts and quality assurance audits are carried out.

Areas of Needed Improvement

Many delays in start-up were experienced. Causes of delays included problems attending:

> site preparation, including time to acquire agreements or leases for use of property,

> scheduling and installation of telephone lines,

> siting to achieve representativeness,

> installation of data loggers,

> acquisition and installation of cooling systems for trailers,

> operational status of data management system, and

> availability of storage space for VOC canisters and other equipment.

As with other causes of delay, adequate time must be allowed to accommodate unforeseen problems that inevitably arise. Contracts must be in place for such activities as siting and quality assurance long before the start of the field program. Adequate time must be allotted to evaluate and select sites, review choices, modify as appropriate, and procure sites. Unfortunately, the time available for the full range of start-up activities was insufficient.

In undertaking large scale observational programs, it may be not be wise to assign responsibility for installation of monitoring stations to a single contractor. [Opinions vary on this matter.] This effort includes identifying, checking, and acquiring rights of use for each site, and acquiring and installing power, trailers, and communications. This responsibility overwhelmed the field management team because of the relatively short time available, the limited number of skilled staff members available, the extent of effort required, and the substantial distances between sites.

Site selection criteria, reasoning underlying the choice of each site, identification of sites considered and rejected at an earlier stage, and the rationale for rejection are all valuable information. While the field plan explicitly specified sites, supporting rationale was, in most cases, not provided. When a recommended location had to be changed due to lack of an available site, lack of power, inability to locate a representative site, or for some other reason, the omission of documented selection criteria prolonged the search process, delayed completion of the siting effort, and added costs.

Because of the many issues requiring attention during the short and intensive start-up period (and, also, during the operational phase), it probably would be helpful in the future to have an individual assigned the role of facilitating communication with the operations center and ensuring that issues are given proper attention. Additionally, all administrative functions should be clearly defined, and each should be assigned to a member of the operations staff.

Provision should also be made for added staff on a contingency basis, as needed. Where such help was required in SJVAQS/AUSPEX, sponsors volunteered the participation of staff, who provided vital support at critical times. Sponsors, in turn, benefitted by gaining a full appreciation of the nature of the data collection process, the quality of data acquired, and the types of procedures required to assure high data capture rates.

As the details of site locations were not documented adequately, potentially valuable information was lost. While aerial photography was used recently to document the sites, trailers and instrumentation were no longer in place. Photographic documentation should be carried out during the active phase of the field program as a matter of course.

Successes

Despite some planning lacunae and several causes of delay, the program was successfully launched within days of the 8 July 1990 target. This was accomplished through the extraordinary efforts of a large number of participants - the field operations center team, contractors, and sponsors' staffs. All participants pitched in when needed, putting in many extra hours. The commitments and energy of these individuals was indispensable to the program's success.

OPERATIONS

Operations includes management and execution of day-to-day, ongoing activities - in effect, the "command and control" and coordination functions. Among the key activities are forecasting of episodes with sufficient lead time that participants can respond with adequate warning; ensuring that monitoring equipment is operational and expendables are available in adequate supply; acting as a communications center, receiving relevant information, informing field staff of decisions, and giving general direction, as appropriate; coordinating daily meetings of "client representatives" who must make or ratify "go" or "no go" decisions; anticipating needs and problems; and troubleshooting.

Successes

The project overseers set up a forecasting, communications, and coordination structure that allowed field monitoring decisions to be made objectively and quickly. Decisions were communicated to a large number of participants in field monitoring in a manner that facilitated timely responses.

The project forecasting team did an excellent job of developing accurate and reliable forecasts. The success of the program derived in no small part from their exceptional efforts.

Field studies often require additional funds for unexpected events or needs. If a process or mechanism is not in place prior to the field study that permits rapid authorization and disbursement of needed funds, the overall study could be impaired, perhaps seriously. Fortunately, proper mechanisms for authorization and disbursement were established; where needed, funds were made available with dispatch.

The field operations center proved to perform quite well. Operations functioned smoothly throughout the summer 1990 data acquisition period. Having a manager who served as the point of focus was critical to the success achieved. The overall teamwork was notable; a high level of cooperation persisted throughout the monitoring period.

The planning of communications proved successful. Installation of telephone lines, availability and use of cellular telephones, use of facsimile machines and computers, and availability of appropriate hardware and software facilitated communications and enhanced performance. A network that allowed transmission of data in real time to the field operations center also proved valuable. The network facilitated troubleshooting, particularly at unmanned sites. It also served as a resource in developing forecasts.

The overall plan provided that the field manager functioned as a decision maker and facilitator, and not as a director. Field elements were generally designed such that each contractor knew what to do and how to do it and that no direction by the field manager was required. [Note: The primary role of the field manager and his supporting staff should be to determine the inception and termination times of intensive efforts, and to provide information and assistance, as needed, to contractors. To support decision making, the field manager should be knowledgeable of the operational status of all the contractors and should have the necessary forecast information. However, he should not be involved in directing contractors in the performance of their duties. If these guidelines are respected, the field manager will be free to provide support, information, and help to the contractors and to "fight fires" as they occur.]

Areas of Needed Improvement

Expendables, notably canisters (for VOC sampling) and cartridges (for carbonyl sampling), frequently ran low, requiring immediate and costly action to ensure an adequate supply. Expendables needed for a study should be on hand at an early a time as possible, preferably at the inception of the field program.

A scheduled "pony express" system for facilitating pick-ups and drop-offs would have proven convenient and cost effective. The point-to-point, ad hoc service actually put in place was inefficient and costly.

ADMINISTRATION / MANAGEMENT

Effective project administration requires an overall vision of project objectives and the means for achieving them, sensitivity to schedule and budgetary constraints, appropriate assignment of responsibilities and division of labor, effective implementation of plans, and a multiplicity of other conditions. As the project proceeds, administrative needs become clearer and the time and capacity for effecting them becomes more limited. On the whole, project administration was successful.

Successes

In order to carry out the program, efforts were segmented into a relatively large number of self-contained, well defined projects. Over thirty RFPs were prepared; over forty contractors were engaged to carry out the work. A few contractors were retained to undertake planning, review, and oversight activities; sponsors participated heavily in some of these roles as well. This approach succeeded due in large part to the commitment and involvement of members of the technical committee.

Various program needs were fulfilled by identifying roles for participants, setting up the appropriate structures, and maintaining good communications. The Policy and Technical Committees, Principal Investigators, project and task leaders, sponsors' staffs, and contractors pursued their missions, got along well, and performed at high levels.

CONCLUSIONS

We have learned a great deal about planning in the course of this study.

> Allow adequate time and budget for sound planning.

> Define objectives, develop priorities, establish budgetary limitations, and set schedule as early as possible in the planning process.

> Develop and adhere to a focused planning process.

> Allow adequate time for start-up and shakedown.

> Recognize and plan for needs that are often overlooked during the planning process, such as data management and quality assurance.

> Build flexibility into planning; accommodate needed change to the extent possible.

> Identify and define clearly the roles and responsibilities of participants. Assure that oversight for all program needs is unambiguously assigned.

This program has served well as a vehicle for "learning how to do it right".

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