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AUTHOR Connolly, A. J.; And Others
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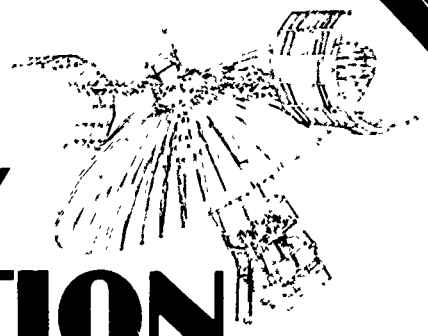
ABSTRACT

The Satellite Technology Demonstration (STD) designed research for a satellite-based communication system that would transmit educational television programs. Their procedures were subject to a series of external and internal evaluations by the project sponsors, the National Institute of Education. In regard to external evaluation, STD recommended that: (1) The National Institute of Education should communicate in a more consistent, rapid fashion, provide more research and technical information, and facilitate information exchange between related research projects; (2) project personnel should be able to provide input into projected bids being evaluated by the sponsors and receive evaluations made by outside agencies; (3) the cost of these evaluations be considered at the project's onset. In regard to internal evaluations, STD recommended that: (1) experienced research personnel be hired at the project's initiation and work closely with management activities; (2) the additional positions of project historian, expeditor of data acquisition, and disseminator be filled. This is one of five papers on the project. (NR)

SATELLITE TECHNOLOGY DEMONSTRATION



FEDERATION OF ROCKY MOUNTAIN STATES, INC.

technical report

TR0209

THE PROCESS OF PLANNING AND DESIGNING RESEARCH FOR AN EDUCATIONAL TELECOMMUNICATIONS EFFORT

A. J. CONNOLLY JOYCE B. DALE RON HART WILLIAM ZELMAN

INTRODUCTION

Interest in the potential use of satellites for communications has grown steadily the past few years. Over 40 satellite-related projects, in various stages of planning and development, currently are progressing in countries, such as Indonesia, Brazil, Iran, and India, as well as in the United States.

Many of these projects, however, are proceeding without the benefit of accurate information about the capabilities of satellite-based media systems or about the problems entailed in operating these systems. There is a pressing need for empirical data.

It was precisely to address this need that the Satellite Technology Demonstration (STD) of the Federation of Rocky Mountain States, Incorporated was instituted. From 1972-75, the STD combined technology, courseware, and human support elements to provide a variety of educational services to rural, isolated populations in the Rocky Mountain Area. Project sponsors believed that this prototypic effort would furnish essential information on the development and implementation of satellite communications systems for future decision-makers planning similar projects.

Now that the STD has completed its operational period, documentation products have been developed to distribute the findings. This report is part of that documentation. Instead of focusing on the findings, however, the report describes the process used by the STD to design and conduct research efforts.

THE PROBLEM

A telecommunication satellite, such as the ATS-6 used by the STD, is extremely versatile, complex, and expensive; its potential is enormous. The research effort surrounding this satellite is, in turn, large and complex. The STD's Project, for example, involved many agencies: the National Aeronautics and Space Administration; the Department of Health, Education, and Welfare; the Federal Communications Commission; the Interagency Radio Advisory Committee; the National Institute of Education; the departments of education and their respective bureaus in eight participating states; public television stations in the Rocky Mountain Area; and

local school districts, instructional staff, and students. This mix of direct participants and involved agencies helped to shape the STD's Project--its goals and its research effort, both of which are interrelated.

The STD used part-time consultants to obtain research input during its early planning and proposal activities. No central research organization was established at that time. People who had extensive research experience were hired only as the need for research or evaluation expertise appeared. This staffing and organizational strategy made it difficult to formulate clearly Project goals and an overall research plan.

In spring, 1973, three events changed the STD's strategy:

1. The federal sponsor, the National Institute of Education, met with Project officials and negotiated a clear set of Project goals.
2. Project funding was reduced substantially.
3. A newly-appointed Project director reorganized the STD and created a Research Component to handle all research and evaluation efforts.

The Research Component was charged with designing, implementing, and documenting a comprehensive research plan that would address the new Project goals and also provide the information needed by sponsors and participants.

DEVELOPING A FOUNDATION FOR RESEARCH AND EVALUATION

The Research Component was supported fully by Project management, but it needed more than support to accomplish its tasks. It needed additional time and money. These resources were not available, because, as mentioned before, the Research Component was established after Project funds had been cut. It also needed a large and competent staff to handle the complex activities at hand. The diversity and quality of this input--compared to the available fiscal resources--dictated the creation of a research advisory board and the acquisition of continuing consultants.

The advisory board reflected various perspectives and areas of expertise, including: research design and analysis; social action research methodology; educational measurement

methodology; and communications technology. Board members were prominent figures in [redacted]a-tion: Dr. Dale Hamerus, director of the International Institute for Educational Technology, American International University, San Djego, California; Ms. Naomi McIntosh, director of survey research, British Open University, London, England; Dr. Harold Mendelsohn, chairman of the Department of Mass Communications, University of Denver, Denver, Colorado; and Dr. Casper Paulson, Jr, director of programs for evaluation research, Teaching Research, Oregon State System of Higher Education, Monmouth, Oregon.

From its inception, the board was given up-to-date information on Project goals and research activities. Its ongoing role was to provide advice on the:

1. Determination of research policies and documentation strategies.
2. Formation and implementation of a research plan.
3. Resolution of evaluation problems.
4. Interface with external evaluators.
5. Identification of research consultants and related resources, if necessary.

Board activities began in summer, 1974, when board members met with Project management and research personnel in Denver to help create a research and evaluation plan. The meeting and attendant activities outlined--in detail--Project goals, resources, constraints, and audiences.

The Project goals, established June 8, 1973, in a "Memorandum of Understanding" to the National Institute of Education (the STD's federal sponsor) were:

1. To demonstrate the feasibility of a satellite-based distribution system for rural, isolated populations.
2. To test and evaluate user acceptance and the cost of various delivery modes using different materials.

From a research perspective, these goals were broad and vague. Terms, such as "demonstrate," "feasibility," "distribution systems," and "acceptance," had not been defined. The goals for research purposes were redefined as follows:

1. To collect, analyze, and interpret data which described and/or illustrated

the possibility or capability of developing, implementing, and maintaining the Demonstration's hardware and support services.

2. To collect, analyze, and interpret data concerning the internal and overt acts which indicated agreement or approval by individuals, groups, agencies, or institutions of the Demonstration's hardware, support services, and courseware.
3. To collect, analyze, and interpret data concerning the costs of the hardware and support services which were relevant to the delivery of programs.

Subsequent input from participating states and sites led to the inclusion of an additional goal:

4. To collect, analyze, and interpret data concerning the educational benefits which were obtained by students who participated in the Demonstration and who had different characteristics (age, grade, sex, achievement, and ethnic).

Descriptive and quasi-experimental methods were used to obtain the information detailed in the Project goals. Descriptive methods are extensive; they create a broad data base. These methods not only facilitate post-Project comparisons to investigate specific cause-effect relationships, but they also provide baseline data for future planners who have the resources to conduct in-depth inquiries and analysis.

The decision to use descriptive rather than experimental methods to collect the data was based on these nonmutually-exclusive facts:

1. Ethnic and political constraints precluded random selection of populations and random assignment to treatment.
2. The highly variable study conditions diminished the ability to control all treatments.
3. Complex data analysis techniques were needed to analyze the research variables; these techniques required more sites per "cell" than were available.
4. The exploratory nature of the Project precluded the anticipation of all important research variables.

SPECIFYING RESEARCH AND EVALUATION METHODS

The STD decided to emphasize summative (descriptive) research for two reasons. First, some new products and services had been planned and developed prior to the implementation of the Research Component. Second, many new products and services had to be evaluated and tested in a short period. The STD further decided to meet the Project's formative needs on a pragmatic basis; to develop experimental methods only as the need for these methods appeared.

A set of seven summative research studies initially was designed to meet the Project's redefined goals. These studies addressed the following:

1. Did the technical delivery system work?
2. Who initially used the delivery system?
3. Who continued or discontinued to use the delivery system?
4. Did the people who came and participated in the programs like the system and its products?
5. Did the people who used the delivery system receive the intended benefits?
6. What steps were taken by Project management to overcome the problems associated with implementing the delivery system and its products?
7. What costs were associated with the delivery system and its products?

The initial research plan was submitted to the National Institute of Education (NIE) with the acknowledgement that the plan, though comprehensive, was regarded by Project personnel and advisory board members as the basis for further research and evaluation. The NIE subsequently approved the plan. This approval helped the STD to allocate staff resources to the studies and to assign research personnel to particular studies. During the next six months, all aspects of the summative studies were reviewed and refined.

An essential aspect of the refinement period was the involvement of permanent, part-time consultants to provide input and reaction to specific studies. Before obtaining a consultant, the Research Component developed a "work plan" which defined the needed input; then, Research personnel asked the advisory board members to recommend consultants who could provide the specified input. These recommendations helped the STD to select a group of

continuing consultants: Dr. Wilmar Bernthal, School of Business and Administration, University of Colorado; Dr. Ron Corwin, Department of Sociology, Ohio State University; Dr. Phil Doughty, Department of Mass Communications, Syracuse University; and Dr. Thomas Drabek, Department of Sociology, University of Denver. Because the Project and research efforts were complex, the STD decided not to employ "one-shot" consultants.

By February, 1974, the STD had consolidated the summative aspects of the research plan into six major studies. These studies centered on the following:

1. Hardware and Hardware Support. This study addressed the broadcast and engineering elements of the satellite communications system and sought answers to these questions:
   (a) What is the quality of audio and video signals that participating sites receive?
   (b) What are the factors (weather and/or atmospheric conditions, satellite instability, and geographic location) which affect signal quality? To what degree do these factors influence quality?
   (c) How reliable is the equipment that constitutes the delivery system? When repairs are needed, how responsive is the repair service?
   (d) Can site personnel with varied backgrounds be trained to use the communications hardware?
   (e) Are there factors, such as free-time activities and past work experiences, which relate to the relative effectiveness of site personnel in using the communications hardware?
2. Acceptance Study. This study addressed acceptance of the STD and its hardware, support services, and courseware by specific audiences. Major questions for the study included:
   (a) What was the student's level of acceptance for the STD and its programs, supplementary materials, and two-way voice communications?
   (b) What are the expressed opinions of audience members (teachers, administrators, and community members) at different sites to participating

in the Demonstration, viewing the programs, receiving instruction from the media, and using the two-way voice communications?

(c) What do behavioral indicators, such as attendance patterns and resource allocations, suggest about a selected audience's acceptance of the STD?

(d) Are there aspects of audience acceptance which can be explained by the type of site (Intensive, Receive-Only, and Open), by participant demographics, and/or by the influence of others?

(e) What are the levels of acceptance for the STD and its products and services among relevant decision-makers at state and local levels who are not direct audience participants?

3. Student Benefits Study. This study addressed the career-related knowledge and attitude acquisition of participating junior high school students. The study sought answers to these questions:

(a) What was the average change/gain in participating students regarding--

(1) career-related knowledge?

(2) career-related attitudes?

(b) How did the average change/gain benefits of participating students compare to change/gain benefits of nonparticipating students?

(c) Are there differences in the students--

(1) career-related knowledge?

(2) career-related attitudes?

(d) Can these differences be explained by--

(1) type of site (Intensive, Receive-Only, or Open)?

(2) student characteristics (age, grade, sex, achievement, or ethnic)?

(3) affluence of school?

(4) availability of support materials?

(5) teacher acceptance?

4. Case Studies. The purpose of this study was to observe carefully the "Dissemination-Adoption" process at three selected sites. Observations were guided

by these questions:

(a) How were the sites selected?

(b) How were the site preparations initiated?

(c) What were the STD's positive/negative inputs in terms of curriculums, resource allocations, school procedures, and school/community relations?

(d) What were the acceptance patterns among audience members to various STD products and services?

(e) Did participation in the STD enhance/detract from the site's willingness to be involved in possible future efforts?

5. Significant Events Study. This study addressed the significant Project events, issues, and decisions that were associated with planning, developing, implementing, and evaluating the Demonstration. Major questions for this study included:

(a) What were the objectives of the Demonstration? How did these objectives evolve?

(b) What was the organizational structure of the Demonstration? How did this structure evolve?

(c) What were the major managerial issues faced by the Demonstration? What strategies and procedures were devised to deal with these issues? Which strategies and procedures appeared most effective? What might future projects learn from the STD's experiences with a satellite-based communications system?

(d) What were the major responsibilities of each STD component (Research, Broadcasting & Engineering, Programming, and Utilization)? How did each component organize itself to deal with these responsibilities? What problems (both anticipated and unanticipated) did they encounter? What might future projects learn from each component's experiences?

(e) What was the nature of the relationships between the STD and its federal-sponsoring agencies? What were the major issues in interacting with these agencies? What insights can be derived for structuring

future relationships?

(f) How did the Demonstration address specific concepts, such as "interaction," "user-based communications systems," and "regional approaches to common problems"? What insights can be gained from the STD's experiences in these areas?

6. Cost Study. This study addressed the documentation and analysis of costs incurred in selecting products and services. Emphasis was placed on developing and maintaining a comprehensive chart of accounts which would facilitate on a post-hoc basis:

   (a) A functional analysis with various aggregations of costs.

   (b) The projection of costs into an operational system by amortizing costs across populations, time, products, and sites.

By spring, 1974, the research effort centered on two areas. The first area focused on the identification and/or development and refinement of appropriate data collection instruments and procedures for the summative studies. The second was directed toward providing formative evaluation support for the development of educational television programming, particularly the career development series for junior high school students. (See TR0210, The Formative Process Used by the Satellite Technology Demonstration in the Development of Television Programming for Junior High School Students for a a step-by-step description of the formative process.)

COLLECTING AND ANALYZING DATA

Data was collected (as needed) from STD sites and the region throughout the planning and development phases of the Demonstration. Data collection efforts did not become systematic and intense, however, until the STD began transmitting programs via satellite. These efforts were coordinated by the Utilization Component (or field service arm), which collected information about STD products and services in the field from state and site coordinators. Site personnel served at the local level to obtain data from school and community participants,

as specified by the STD's research instruments and procedures.

Prior to the operational period, state and site personnel were provided training in all phases of their work; special attention was directed toward data collection and data integrity. Upon completion of training, site personnel helped to collect baseline data on: (1) participant awareness of the Demonstration; (2) participant expectations; (3) participant demographics; (4) student career-related knowledge and attitudes; and (5) school climates and organization.

With the beginning of program transmissions, routine procedures were established for collecting data. Site coordinators sent weekly reports to the STD's headquarters in Denver. These reports consisted of: (1) daily signal quality measures and reports of any hardware malfunction; (2) daily or weekly student and teacher acceptance measures of STD products and services; (3) weekly audience acceptance measures of other products and services; and (4) a comprehensive weekly site report, addressing product effectiveness, product use, audience attendance, and STD support time. The weekly data flow provided Project management with a continuing source of information from the field.

Additional data collection efforts were completed in accordance with the specifications in the research studies. These efforts included: (1) case-study observations; (2) a time series analysis of school staff acceptance; (3) a time series analysis of site operator hardware preferences; (4) midyear post-testing of first semester students and pre-testing of incoming second semester students; and (5) final post-testing of second semester students.

In obtaining its massive data base, the research staff used multiple-pupose instruments and procedures, which covered the information needs of all the studies. This procedure meant that audience and respondent populations would not have to fill out duplicate forms.

Data handling and analysis procedures for the Demonstration included: (1) optical mark read (OMR) instrumentation, if possible; (2) a minicomputer for data file maintenance and descriptive level output; and (3) large computers external to the Project for major statistical outputs.

DOCUMENTING AND DISSEMINATING THE DATA

With input from the research advisory board, Project management and research adopted a documentation strategy that was designed to send information to many constituents who had expressed interest in the Demonstration. The primary vehicles for this information flow were: (1) a brief, factual summary designed for mass dissemination; (2) an "executive" summary designed for moderate dissemination; (3) a series of 26 technical reports addressing specific topics and designed for distribution to selected audiences; and (4) a comprehensive final report designed for limited distribution.

RESULTS

The research effort conducted by the STD produced a major data base, which included:

1. Quality of the ATS-6 signals and the factors that affected quality.
2. Reliability of hardware.
3. Performance and acceptance of hardware by site operators.
4. Acceptance of received STD products by users and the factors that affected acceptance.
5. Acceptance of the STD and its products and services by other Project participants and relevant community and state decision-makers.
6. Changes in career-related knowledge and attitudes by participating students and the factors that affected observed changes.
7. Analysis of the events, procedures, personnel, and acceptance patterns that were associated with the participation of three selected STD sites.
8. Analysis of the costs that were associated with the various phases of the STD and its components, products, and services.
9. History of the Demonstration and the factors that affected development.

The steps taken to create the data base were considered as "interim" products. These steps included three comprehensive research designs, three formative evaluation models, and 40-plus different instrument packages.

None of these steps were accomplished without overcoming problems: Chief among these was the late involvement in the Project of a centralized Research Component. A second major problem was the incongruity between the scope of the effort and the available resources. The STD invested approximately 10 percent of its adjusted budget to formal research and evaluation activities, excluding: (1) the contributions of the field services network (state and site personnel) to facilitate data collection; (2) the major roles of technical personnel in hardware-related investigations; and (3) the contributions of Project management. This situation was made more acute by a failure to estimate adequately the time and resources that would be needed to address the Project's formative activities.

The STD experienced not only internal, but also external problems. Communication with the National Institute of Education (the STD's federal sponsor) proved inconsistent and slow on matters relating to the initial research plan; the need for instrument clearances; the alleged opportunity to have early bids for external summative evaluations; and the need to obtain a final report from the external evaluations.

SUMMARY

The STD appears to have met the goals delineated in the "Memorandum of Understanding" with the National Institute of Education. It designed, implemented, and evaluated the STD's satellite-based communications system that was used to deliver a variety of products to a variety of users. Technical performance of the system was excellent, and most of the disseminated software products were rated good to excellent by users. Similarly, students who participated in the Demonstration showed significant gains over nonparticipants in desired subject areas.

From a research standpoint, five of the summative studies were conducted as planned, and the resulting information base was equal to, or in excess of, the anticipated base. The summative efforts included were the hardware study, acceptance study, student benefits

study, case studies, and cost study.

Clearly, the formative efforts exceeded that which was originally anticipated. In one of the summative studies, however, the information yields were less than planned. The area which was to address the creation of an interpretive history of the Project (the significant events study) was seriously weakened by the midyear departure, for personal reasons, of the principal investigator.

RECOMMENDATIONS

Based on its experience, the STD makes the following observations and recommendations regarding similar research efforts.

External

1. Federal Sponsors (the National Institute of Education)

   (a) The posture of federal sponsors should be modified to reflect a more co-operative and involved stance toward project grantees. Although the adoption of such a posture has the inherent danger of nepotism, the NIE's current posture creates an adversary climate with inherent communications problems and inherent distrust.

   (b) Consistent with the first recommendation, provisions should be made for more frequent (at least twice yearly) and less formal project visists by federal sponsors.

   (c) The NIE should be a source of counsel and advice on research matters. In the STD's project, however, input was obtained only as a result of annual site reviews and could be described best as a "thumbs up or thumbs down" feedback. In the future, the NIE should establish a service arm to provide some technical support and liaison to the research efforts that it sponsors.

   (d) In the interest of promoting the best possible projects and research efforts, the NIE should facilitate design, instrumentation, and procedure exchanges among related projects.

2. External Evaluations. Having experienced two external evaluations--one formative and the other summative--the STD believes that its federal sponsors would have obtained more benefit by investing the additional resources in the original research. This observation not withstanding, the STD makes the following recommendations regarding external evaluations:

   (a) If funds are provided for an external evaluation, they should be restricted to this purpose and focus on whether the project accomplishes agreed-upon tasks in a manner which supports the findings.

   (b) An ongoing project should have an opportunity to make recommendations regarding the contents of any request for quotations for external evaluations. In discussions about external evaluation contracts, bidders repeatedly asserted that the request was misleading and did not take into account Project research activities. The attempt by the NIE to maintain "separateness" generated much frustration, confusion, and initial duplication of effort.

   (c) Products of external evaluations systematically should be available to project personnel; further, the manner in which this distribution is to be accomplished should be documented carefully in all operational plans. (The Educational Policy Research Center at Syracuse University, the STD's external evaluator, consistently shared status reports with the Project.)

   (d) Project personnel should be given an opportunity to provide written addenda to reports generated by external evaluators in order to support perceptions presented or to clarify positions on differing perceptions.

   (e) Budget negotiations should be given careful consideration at the initiation of the project to determine the type and extent of external evaluation that is needed.

   (f) External evaluations should be reviewed on the basis of cost benefits.

Projects should be permitted to subcontract for an external verification of those elements that are deemed necessary by project sponsors.

Internal

1. Design. Research input should play a major role in planning a comprehensive project. Future decision-makers should insure that this input is acquired early in the project by hiring experienced research personnel or by creating an ongoing research advisory board.
2. Staffing. In a comprehensive, but short-term project, it is difficult to obtain a staff with sufficient expertise to handle all the research tasks. Thus, provisions should be made, as in the STD, to support the internal research staff with selected ongoing consultants. Each staff member in the STD's Research Component, for example, was assigned to specific studies and tasks. As a result, unanticipated events and requirements (which emerged continuously) were dealt with as "overloads." Any large-scale project should possess at least two staff members beyond those needed for its summative studies: one to serve as project historian across all components; the other to facilitate data acquisition and data return to participants.
3. Implementation. Many problems experienced by the STD's Research Component were the direct result of its relatively late implementation as a component. Integrating research personnel across all STD components did not provide the cohesion that was necessary to establish an overall Project research plan. It is recommended, therefore, that early implementation be incorporated into the research planning and development function. And, in projects that require a massive information base, it is further recommended that this function be tied closely to management's activities.

Relation to STD Users

1. Data Flow. In the STD, data return from the sites could be accomplished through two channels: (1) directly to the Denver regional office; or (2) through the state coordinators to the regional office. Operational experience strongly

suggests that direct mailing is the most expeditious channel, but not the most effective channel for data flow; it does not facilitate as complete data returns as does routing data through the state coordinators. It is recommended, therefore, that in systems which require quick "turnaround," direct mail techniques should be used. But in systems which require comprehensive data (for example, pre- and post-test data), intermediary techniques should be used; all data should be routed through the official who has direct responsibility for site performance.

2. Data Dissemination. Provisions should be incorporated into the operational and organizational plans to permit research personnel to disseminate data (at regularly scheduled intervals) to participant groups.

The above recommendations grew out of the STD's effort to plan and design research for a satellite-based communications system. Hopefully, the end of the STD's effort will mark the beginning of similar efforts in the future. The need for empirical data is great.

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