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ABSTRACT

The program described was developed to produce a viable engineering continuing education in rural areas. The system as explained consists of three major elements: 1) the suppliers, 2) the consumers, and 3) the delivery system. Answers to why such a program is needed, what its goals should be and how such a program can be implemented are presented in itemized form. For each component of the project, research teams were organized. The investigators for these teams are identified. An outline showing the development and the cost breakdown is presented. A detailed description is given of slow scan television, equipment, and equipment cost and uses. Television system distribution cost is also estimated as is the cost of a microwave educational television system for Idaho. (EB)

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THE EDUCATIONAL USE OF THE SLOW SCAN TV SYSTEM FOR DELIVERY OF ENGINEERING CONTINUING EDUCATION IN REMOTE AREAS

BY

A.L. RIGAS, DIRECTOR

ENGINEERING CONTINUING EDUCATION

COLLEGE OF ENGINEERING

UNIVERSITY OF IDAHO

MOSCOW, IDAHO 83843

INTRODUCTION

The purpose of this program is to develop a viable engineering continuing education in rural areas. For this program a viable continuing educational program is considered from a system's point of view, and must have the following characteristics:

1. It must continue to improve and develop forums conducive to the exchange of innovative ideas and information.
2. It must identify and support a means of preparing an individual for the lifelong learning process during the individual's formal educational development.
3. It must be able to assess and measure the educational market in terms of demographic distribution and demand.
4. It must cater to the individual, to the small company professional as well as to the large company.

WHY CONTINUING EDUCATION ?

Personal Needs

1. Prevent obsolescence
2. Career requirements - present position, advancement
3. Legal requirements - licensing and renewal of license
4. Professional pride and personal satisfaction

Industrial & Practice Needs

1. Maintain staff competency
2. Personnel relations

WHAT KIND OF CONTINUING EDUCATION ?

Self study

Personal writing and publications

Locally conducted seminars on specific topics

Technical meetings and conferences

Special topic short courses

Courses for academic credit

NOTE: Only the last two types may depend on institutional assistance. All others can be conducted personally and locally without institutional involvement.

WHAT SHOULD BE THE GOALS OF A CONTINUING EDUCATION PROGRAM ?

1. To develop a relevant post-secondary education system for engineers working and residing in the region regardless of the geographical and socio-economic situations.

2. To explore and implement alternatives, new techniques, and systems for increasing the opportunities and effectiveness of continuing education for engineers on a regional scale.

3. To help practicing engineers in the region to maintain the level of competence necessary for leadership in the fast-paced technological society.

HOW CAN A CONTINUING EDUCATION PROGRAM BE IMPLEMENTED ?

The intermountain region remote areas with sparse and dispersed population presents different problems from those in heavy populated urban areas.

A consortium systems approach:

1. Assess and determine nature of need - define the problem
2. Inventory available regional institutional resources and costs
3. Compare needs with resources and costs
4. Determine if the market can support a given program
5. Determine the cost and how will the cost be paid
6. Determine the "critical mass" of participants in a given program
7. Generate added resources if needed
8. Design a feasible system model

Make a personal commitment.

Establish local coordinating agency.

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Committee Chairman: Gordon H. Flammer, Utah State University

B. Course Development and Review

Committee Chairman: Leonard B. Baldwin, University of Wyoming

C. Delivery Systems and Learning Systems

Committee Chairman: Joe Hootman, University of North Dakota

D. Evaluation and Future Direction

Committee Chairman: A. L. Rigas, University of Idaho

E. Dissemination of Information

Committee Chairman: Fred F. Videon, Montana State University

PROJECT RESPONSIBILITIES

For each component of the project there are research teams organized around the major areas of investigation. Investigators are those committed to the work; cooperators and advisors, those who have agreed to cooperate and/or advise.

A. Remote Q-A System and Student Evaluation Using Slow Scan Television (SSTV)

Principal Investigators: Joe Hootman, University of North Dakota
A. L. Rigas, University of Idaho

B. Video and Audio Cassette System

Principal Investigators: Leonard B. Baldwin, University of Wyoming
Gordon H. Flammer, Utah State University

C. Communication by Telephone with Programmed Instruction System

Principal Investigators: John A. Roberson, Washington State University
Gordon H. Flammer, Utah State University

D. Slide-Cassette Lectures System

Principal Investigators: Fred F. Videon, Montana State University
A. L. Rigas, University of Idaho

The System

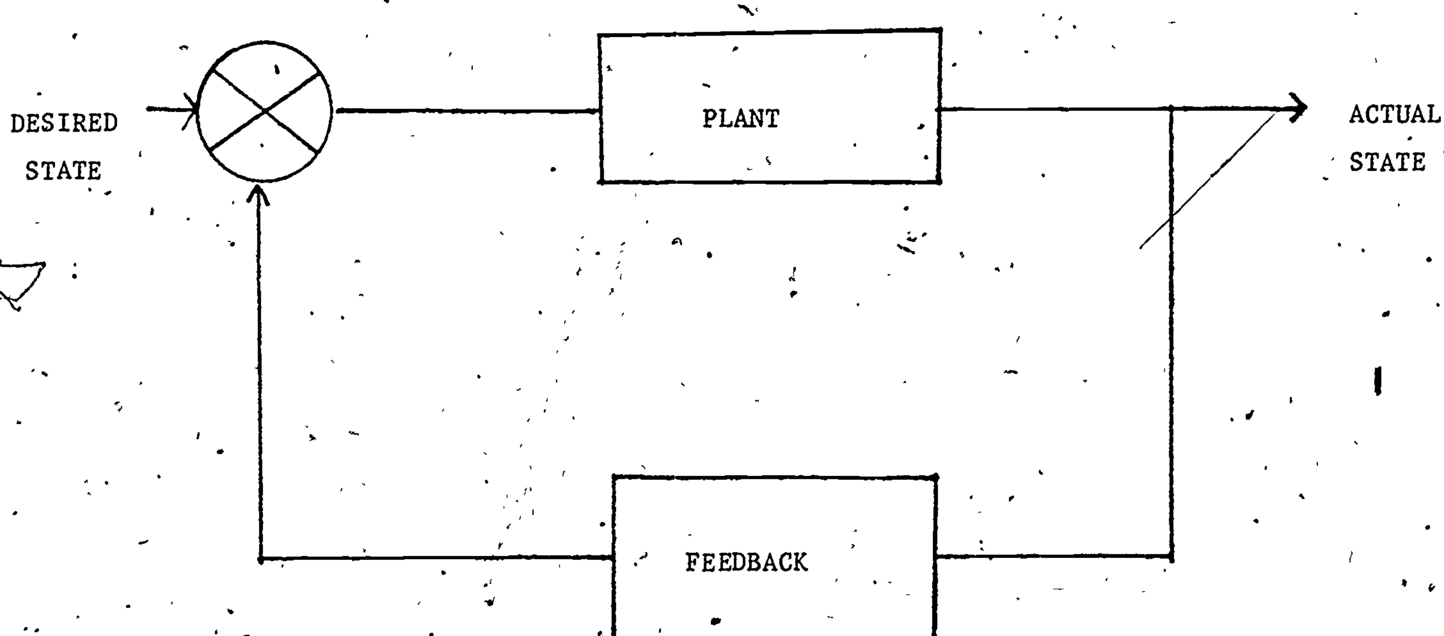
An educational system consists of three major elements:

1. The suppliers
2. The consumers
3. The delivery systems

An educational system is a closed loop feedback system. A study of such a system will consist of the following:

1. A model of the system
2. The analysis of the system
3. The decision-making process or conclusions
4. The optimization-making process or revisions

A block diagram representation of such a system is:



The PLANT consists of:

1. The suppliers
2. The delivery systems

These are the dynamics of the system.

The FEEDBACK consists of:

1. The needs assessment
2. The cost effectiveness
3. The overall evaluation and authentication of the system

The actual states of the system are: the present overall effectiveness of the educational process, i.e., the present status of the educational system.

The desired states are:

1. The external social pressures
2. The technological advancements
3. The economic conditions

These constitute the drives for learning.

The suppliers are:

1. Academic institutions
2. Private educational organizations
3. Industrial organizations and government agencies

The consumers are:

1. Young adults-students
2. Industrial and governmental employees
3. The private citizen

The delivery systems are:

1. Live instruction
2. Printed communication, which includes,
   A. Individualized self-paced instruction
   B. Programmed text instruction
   C. Audio cassettes
   D. Sound-on-slide systems
   E. Video cassettes
3. Instructional television, which includes,
   A. Live T.V.
   B. Cable T.V.
   C. Slow-scan T.V.
   D. Video tapes
   E. Satellite transmission, such as INTELSAT, ATS, etc.
4. Computers, which include,
   A. Computer simulation
   B. Individualized computer-aided program instruction, such as CAI, PLATO, etc.

DEVELOPMENT OF THE SYSTEM

The steps necessary in the development of such a system are:

1. Define the nature of the problem
   A. Gather information on what the system is supposed to do
   B. Define the constraints which will limit the design
   C. Consider the alternatives
2. Having defined the problem,
   A. Develop a model representing the system
   B. Analyze the system using the model
3. Having analyzed the system,
   A. Make decisions
   B. Optimize the decisions

The following four questions should be considered in the development of materials:

1. How are deficiencies identified?
2. How are remedies selected?
3. How does development occur?
4. What problems bear on future directions?

Instructional material development sequence:

1. Identify
2. Assess
3. Plan
4. Write
5. Test
6. Revise
7. Publish

CONTINUING EDUCATION - WHAT WILL IT COST ?

Any program must pay its own way.

Cost will vary:

- Self study - reference material
- Local seminar - outside speaker
- Workshops - $25 to $300/participant
- 3-credit course
  - Commuting faculty - $4500/course
  - Affiliate faculty - $3000/course
  - Commuting student - $500 to $1500/student
  - Tutorial - $150 to $550/student
  - Video - $7.5 to $12.5/student lecture hour or $340 to $570/course

    (Based on $30 to $50 per lecture hour for typical television operation and an average of 4 students per class receiving TV signals)

CONTINUING EDUCATION

BREAKDOWN OF COURSE COST

Cost Basis

1. Course must pay its own way
2. Cost include,
   - (a) Faculty salary
   - (b) Travel expense; 15 round trips
   - (c) Institutional indirect cost
3. 3-credit course; weekly meetings; 15 week duration
4. Faculty salary based on 20 course credits/year as full load.

   3 credits is 3/20 or 15% of salary. Assume $15,000 average salary.
5. No local facility cost

Cost/3-credit course

Faculty salary 15% of $15,000	$ 2,250
Travel 15 trips @ $100	$ 1,500
Indirect cost @ 20%	$ 750
Total, 3-credit course	$ 4,500

WHAT IS SLOW SCAN TELEVISION

Slow scan or voice band television is not like the TV one sees at home. Slow scan TV signals go over individual voice channels, such as telephone lines or the radio, while each broadcast TV signal occupies more than 1,000 telephone channels. The total bandwidth is limited to 2300-2500 Hz. The black frequency is set at 1500 Hz, and the white frequency is set at 2300 Hz. The video swing is from 1500-2300 Hz or a total swing of 800 Hz.

Because of this difference, it takes much longer to send a voice band TV picture. One picture takes 8 seconds for completion. During that time, broadcast TV sends more than 500 separate pictures.

Each picture is a "snapshot". In the case of broadcast TV the snapshot lasts 1/60 of a second, short enough to capture motion. With slow scan TV, the camera acts like it is taking an 8-second time exposure.

The picture is viewed on a display tube similar to that used in radar. In radar, the line moves around like the hands on a clock; in slow scan TV, the writing line is horizontal and moves from top to bottom.

As the writing line proceeds, previously written portions of the picture slowly fade. The picture is visible at all only because of the persistence of the yellow-green phosphor in the display tube. This "persistence image" is relatively faint, accounting for the need to view it with the eye somewhat adapted to darkness.

The slow scan picture contains 128 scan lines occurring at a rate of 15 lines per second (broadcast TV contains 525 at a rate of about 15,750 lines per second.) This limits the amount of detail that can be seen.

It is not practical to talk and send pictures at the same time over a conventional phone line or radio set. Of course, two phone lines or two radio channels will provide simultaneous voice and picture. On a single channel, voice communication must be discontinued while picture transmissions are taking place.

It is technically possible, but many more times expensive, to make the picture as bright as broadcast TV. This can be done by a digital memory hold device which stores the information and retransmits it on broadcast TV.

SSTV TRANSMISSION

Slow scan or voice band television permits transmission of TV pictures over a wide variety of economical communication channels such as:

1. Telephone lines
2. Shortwave
3. Radio
4. Any communication channel that will carry voice transmission

SSTV EQUIPMENT

The SSTV system consists of the following standard equipment:

1. Slow Scan TV Camera

This is a sampling camera and it provides a means of transmitting live pictures, printed material, etc., by use of any voice communication channel. With the use of good room lighting (60-100 watt lamp directed at the subject) the camera will transmit sharp clear pictures of a subject placed from 14 inches to 15 feet from the camera. It will transmit sharp clear characters of 1/4 inch size and up.

2. Slow Scan TV Monitor

The slow scan monitor consists of a CRT using a long-persistence phosphor such as P7 to view the picture.

The monitor demodulates and displays pictures transmitted by the camera of SSTV video signals received from telephone lines, on a shortwave receiver, radio, etc.

3. Standard Audio Tape Recorder or Audio Cassette Unit

The SSTV system works on the audio tone principle; hence, it is possible to record the video picture information on a standard audio cassette recorder, store this information and play back pictures at a later time.

4. Slow Scan Television Keyboard

The slow scan TV keyboard is a system whereby a keyboard is used to generate alphanumeric information at the proper SSTV frequency levels through a direct digital (TTL) process. By using the keyboard the operator simply types out the message to be sent as one would on a typewriter. The use of the keyboard also "frees up" the SSTV camera from looking at a "menu board", so that it may be used for live scenes of the operator or other subject matter. The keyboard also provides the necessary switching to switch from keyboard to camera and vice versa.

The SEEC SSTV Keyboard Specifications

The SSTV keyboard will produce the following SSTV screen format, when properly encoded:

30 characters per SSTV frame = 6 characters horizontally and 5 characters (lines) vertically.

Other character formats will be made available in the form of modification kits to produce the following:

35 characters per SSTV frame = 7 characters horizontally and 5 characters (lines) vertically.

6 characters per SSTV frame = 3 characters horizontally and 2 characters (lines) vertically.

The standard SSTV frequencies used in the HCV-3KB are as follows:

Number of SSTV lines: 120-128	Black frequency: 1500 Hz
Time per full frame: 8.0-8.5 sec.	Sync frequency: 1200 Hz
Modulation: FM 1 volt PP	Sync pulse (duration)
White frequency: 2300 Hz	Vertical: 30 ms.
	Horizontal: 5 ms.

Reed Key Switches -- Average life 30 million operations.

5. Digital Slow Scan to Fast Scan Converter

This is a digital memory hold device which stores the information and retransmits it on a regular broadcast TV set.

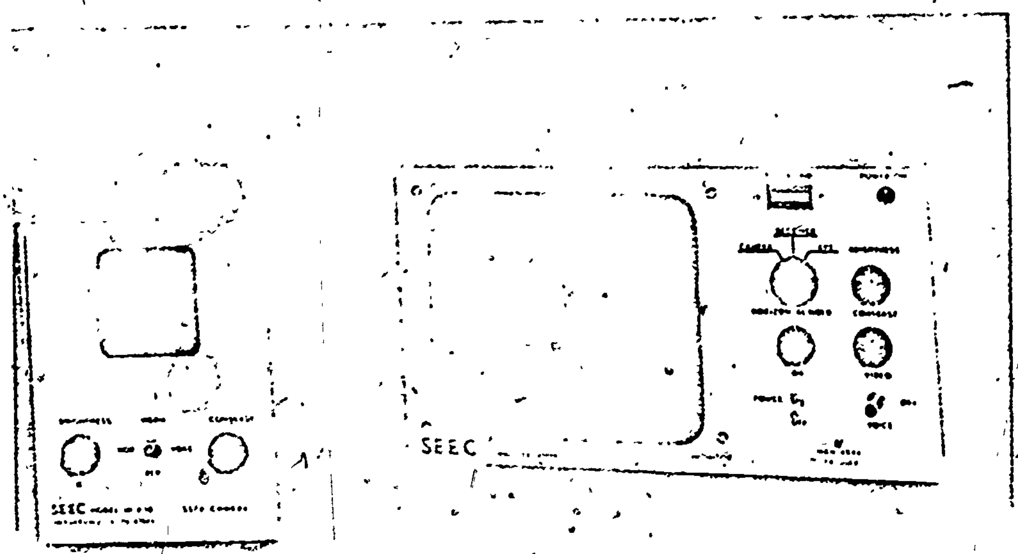
During normal operation, each incoming SSTV line is received by a line buffer and added to the video refresh memory, one line at a time. The refresh memory acts as a highspeed disk or drum and continuously recirculates the SSTV picture information at a fast rate to provide conventional fast scan television (FSTV) video.

Recently Robot Research, Inc., developed and marketed the Model 300 Scan Converter which accepts standard TV signals from a TV camera or other video sources and converts them to SSTV audio tones. Also it accepts SSTV audio tones in the range of 1200-2300 Hz and converts them to TV standard video signals capable of being reproduced on any home type TV set. This unit sells for $1295.

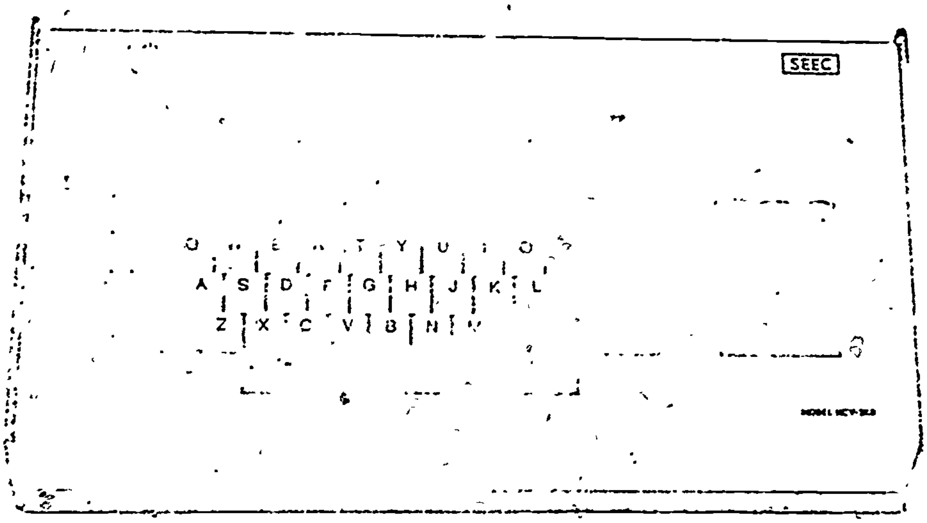
USES FOR SSTV SYSTEMS AT PRESENT

1. Scientific measurements
2. Industrial and commercial instrumentation
3. Medical instrumentation
4. Space Systems
5. Microscopy
6. Credit card verification
7. Check signature verification
8. Commercial video telephone
9. Weather satellite monitoring
10. Surveillance

SSTV CAMERA & MONITOR



SSTV KEYBOARD



SSTV SYSTEM AS A CONTINUING EDUCATION FEEDBACK
AND STUDENT EVALUATION INSTRUMENT FOR REMOTE AREAS

The Intermountain Consortium is proposing to:

1. Develop and use the SSTV system in an educational environment.
2. Develop and investigate the concept that a question-answer feedback instrument need not have the instructor and student in time coincidence.
3. Develop and evaluate this unique educational system in the remote areas of the intermountain region.
4. Develop a generalized evaluation methodology which accounts for the impact of the SSTV system in remote educational settings.
5. Determine and evaluate the cost effectiveness of the SSTV system as an educational tool in remote geographical areas.

COST OF SLOW SCAN TV

1. SSTV.	
HCV-1B SSTV Camera	$ 475.00
HCV-2A SSTV Viewfinder Monitor	493.00
Lens	70.00
2. Stand & Lights Combo #CS-3 & #23-4	52.00
Powerstrip	14.00
3. Stereo 8 Track Deck	
Woolensak Model 8050A	160.00
4. Supplies for modification of tape recorder head phones, amplifiers, microphones, etc.	350.00
Necessary money for one unit only	$ 1,614.00
5. HCV-3KB SSTV Keyboard	495.00
6. Digital Memory Unit	2,000.00
TOTAL PRICE FOR A SINGLE REMOTE Q-A UNIT	$ 4,109.00

COST OF MICROWAVE EDUCATIONAL TELEVISION SYSTEM FOR IDAHO

The following list is an estimated summary of the total cost involved in a two-way microwave statewide educational television system. The translators listed will give television on the E.T.V. channel to only a finite number of selected locations. Complete statewide television is not practical for the low population density of Idaho.

Engineering study	$ 28,000.00
Non-microwave translators	85,114.00
Microwave controlled translators	324,868.00
Duplex E.T.V. microwave	552,504.00
PROJECT TOTAL	$ 990,486.00

Total for microwave controlled translator system	$ 324,868.00
Total translator system	$ 409,982.00

This portion of the report gives approximate costs for a microwave system to link the three educational television studios in the State of Idaho. A full duplex system is described which would carry voice and television signals in both directions between studios simultaneously.

Prices are approximately listed as of October, 1973. They are for a 6.7 MHz system using existing state radio sites.

Total equipment cost	$ 483,800.00
Spare parts	$ 30,000.00
Installation	$ 38,704.00
Total Cost	$ 552,504.00

Two-way microwave system	$ 552,504.00
Translator system	$ 409,982.00
Total E.T.V. System	$ 962,486.00

COST ANALYSIS OF A TV EQUIPPED CLASSROOM FACILITY

A TV related facility needed to equip a classroom for video taping comes to a total price of about $50,000. This price includes a 3-camera classroom TV system, instructor's desk, instructor's lights, 5 cassette recorders and 50 blank cassettes, all other necessary related hardware and installation, checkout and training. Such a facility could easily program 19 courses/semester (38 courses/year).

Attached is an assumed cost recovery analysis. This analysis is based on the assumption of a 2-semester year, a low student fee and full utilization of the TV classroom used in the example. Other parameters may easily be substituted for specific "real world" cases.

COST RECOVERY ANALYSIS

1. Assume a semester system and that the institution teaches 19 courses/semester, 38 courses/year in each TV classroom.
2. Assume only one TV classroom and courses offered only by video tape. The estimated cost of the facilities would be $50,000.
3. Assume tuition charge is $60/course.
4. Assume annual incremental operating and maintenance cost of $36,675.00 (as follows):

Student operators at $3/hr. x 40 hours/course x 38 courses =	$ 4,560.00
Engineer/administrator at $15,000 x 1.3 (overhead) =	$19,500.00
Tape shipment (one-way) = $1.50/tape x 5 users x 40 hrs./ course x 38 courses =	$11,400.00
Spare parts	$ 1,215.00
	$36,675.00

5. Assume in each of the first three years, different courses are recorded making 3 x 38 = 114 different courses recorded in total. Further, assume that for remote students, the first year's courses will be offered in each of the following two years, the second year's courses will also be offered during the third year and the third year's courses will be offered only once during that year. Then the:

   TOTAL course offerings in 3 years = 3 x 38 + 2 x 38 + 1 x 38 = 228 courses

6. Using the above model:

   TOTAL operating costs to be recovered in 3 years:

   3 x \$36,675 + 2 x \$11,400 + 1 x \$11,400 = \$144,225

   AND

   TOTAL cost institution must recover in 3 years:

   \$144,225 + \$50,000 = \$194,225

7. From (5) and (6) above:

   Cost recovery required per course = $\frac{\$194,225}{228 \text{ (total courses)}}$ = \$852/course

   From this we have the average number of students required per course:

   $\frac{\$852}{\$60 \text{ (tuition)}}$ = 14 students

COST OF COLOR VIDEO CASSETTE SYSTEM EQUIPMENT

Component	Cost
Color Video Cassette Recorder/Player	\$1,500-1,800
Color Video Cassette Player	\$1,100-1,400
Deluxe Color Video Camera	\$3,500-12,000
Color Video Monitor (19")	\$600-700
Color Syne Generator	\$800-1,000
Cassette Accessories	\$1,000-5,000
TOTAL	\$8,500-21,950

NOTE: 3/4" Video Cassette Tape (60 min.) \$35 each.

TELEVISION SYSTEM DISTRIBUTION COSTS

System Component & Operation	Capital Cost	Yearly Cost	Hourly Cost**
Overhead			$20-30
Classroom Modification			
1. Colorado State	$25,000	$6,000	$7
2. Martin-Veague	$42,000*	$10,000	$11
3. Davis-Livermore	$15,000	$3,500	$4
Delivery System			
1. Point-to-point one direction, one hop	$20,000-40,000	$4,000-8,000	$4.5-9
2. Point-to-point two directions, one hop	$35,000-55,000	$7,000-11,000	[illegible].5-12
3. ITFS broadcast without talkback	$20,000-40,000	$5,000-10,000	$5.5-11
4. Videotape system per receiving location tape & delivery per receiving location	$1,000-3,000	$900-1,300	$3
Talkback			
1. ITFS channel	$20,000-25,000	$5,000-6,000	$5-7
2. Leased line for 20 mile average distance		$1,000-2,000	$1-2

NOTE: Equipment costs amortized at 6% for 5 years.

* Includes $19,000 for control room.
** Hourly cost is based on 30 hrs./week for about 30 weeks/yr.

SOUND-ON-SLIDE SYSTEM

The sound-on-slide system is manufactured by the Visual Products Division of 3M Corporation and sells for $850 each. Basically, the system consists of a 35mm automatically programmed slide projector with a recordable slide frame surrounding the system. The system has a great deal of flexibility and should be an excellent device for tailor-made audio-visual programs for continuing education at remote sites. The system is simple to use since it only requires making simple drawings and graphs which can be photographed in any standard audio-visual center. The instructor then only needs to record the message that accompanies each slide. One of the best features of this system is that is allows a great deal of flexibility since material can be easily updated by merely replacing a single slide frame.

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