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DISTANCE EDUCATION VIA SATELLITE: A CASE STUDY OF THE INDONESIAN DISTANCE EDUCATION SATELLITE SYSTEM

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TABLE OF CONTENTS

PREFACE i
INTRODUCTION 1
CHAPTER ONE: THE INDONESIAN SETTING 3
A. Why Was Indonesia Chosen as a Site? 3
B. Why Did the Satellite Project Focus on Higher Education? 5
C. Why Was the Satellite Project Placed in Eastern Indonesia? 6
D. Was the Selected Location a Good Choice? 8
CHAPTER TWO: DESIGNING THE SYSTEM 13
A. What Were the Criteria for the Design of the System? 13
B. What Were the Characteristics of the Final Design? 19
C. What Equipment Was Selected for the Classrooms? 23
D. How Did the Project Build a Working Relationship with the Telecommunications Authority? 27
CHAPTER THREE: ESTABLISHING A MANAGEMENT SYSTEM 29
A. How Did the Project Fit into the Existing Administrative Structure? 29
B. How Was the Project Managed? 31
C. What Staff Were Needed? 34
D. What Was the Role of Foreign Technical Assistance? 37
CHAPTER FOUR: PUTTING THE SYSTEM INTO PLACE 40
A. What Were the Steps in Installing the System? 40
B. What Were the Main Problems Encountered? 45
CHAPTER FIVE: TRAINING STAFF AND USERS 50
A. What Were the Goals of the Training Effort? 50
B. Who Needed To Be Trained and Why? 51
C. How Was Training Accomplished? 55
CHAPTER SIX: HOW THE SYSTEM WAS USED 60
A. What Type of Activities Were Run? 60
B. How Were Courses Developed and Delivered? 64
C. What Were the Key Components of All Programs? 69

CHAPTER SEVEN: REVIEW OF PROJECT RESULTS 72
A. How Well Did the Technical System Work? 72
B. What Did the Students Think of the Course Program? 75
C. What Were the Reactions of the Local Tutors? 77
D. What Were the Reactions of the Master Teachers? 79
E. What Were the Reactions of the Seminar Participants? 81
F. What Are the Costs of an Audioconferencing System? 83
G. What Are the Major Problems Now Facing SISDIKSAT? 87
CONCLUSION 90
AID RURAL SATELLITE PROGRAM PUBLICATIONS 92
ACKNOWLEDGEMENTS 93

LIST OF FIGURES

Figure 1: Area of Coverage of the Palapa-B Satellite 12
Figure 2: Rural Satellite Program: Indonesia Project Sites 15
Figure 3: Satellite Configurations Considered for SISDIKSAT 22
Figure 4: Site Equipment 24
Figure 5: Layout of Classroom Equipment in Indonesia 26
Figure 6: Staffing Pattern at Central Office and Sites 35
Figure 7: Time Frame for Selected Project Activities 41
Figure 8: Typical Classroom, Indonesia Project 44
Figure 9: RSP Training Strategy 52
Figure 10: SISDIKSAT Training Materials 59
Figure 11: SISDIKSAT Schedule, August-December 1985 61

PREFACE

The past three decades have seen a revolution in telecommunications--from the first television transmissions via satellite in the early 1960s to the video- and computer-conferencing activities of the 1980s. Today, telecommunications serve as the "nervous system" of many societies; they are multi-purpose in use and pervasive in effect. Telecommunications provide significant social and economic benefits critical to improving and maintaining national economies and, by extension, the quality of life.

In the relatively short time that communications satellites have been with us, satellite technology has displayed amazing range and versatility. The technology has demonstrated its value to telephone and telex communications, radio and television broadcasting, business communications, and the delivery of public services to isolated communities.

It has also proved a sound financial and, according to many, productive development investment. Indeed, telecommunications' vital contribution to development was noted in The Missing Link, a report by the ITU's Independent Commission for Worldwide Telecommunications Development:

> Henceforth no development program of any country should be regarded as balanced, properly integrated or likely to be effective unless it includes a full and appropriate role for telecommunications and accords a corresponding priority to the improvement and expansion of telecommunication.

In the last decade, it has become evident that the developing world also considers telecommunications a worthwhile investment. Indonesia, India, Brazil, Mexico, China, and a coalition of 22 Arab nations have launched their own satellites. Through Intelsat, 27 other developing nations have established internal satellite-based communications systems.

Satellite communications offer the potential to reach the isolated and rural areas which characterize much of the Third World and which have long remained outside the vital flow of information.

In 1980 the U.S. Agency for International Development initiated the AID Rural Satellite Program to explore the potential of telecommunications as a means of extending scarce expert resources and expanding educational opportunities to remote and rural areas. Building on simple, interactive, and inexpensive telephone-based technologies, the Program developed teleconferencing systems for use as a development tool. Three pilot projects--in Indonesia, the West Indies, and Peru--were implemented to test and demonstrate that audioteleconferencing could reliably and affordably support development activities in education, health, and agriculture.

In Indonesia and the West Indies, distance education programs were established with national universities. Linking 13 distant universities in Indonesia and six universities in the West Indies, audioconferencing systems are used to provide academic courses to university students, to upgrade faculty skills through in-service training programs, and to

facilitate administrative and institutional communication. The effect is to make the expert resources of each institution available to all members of the network, thus multiplying each professional's outreach and effectiveness. Over 15 courses are taught each semester to thousands of university students in Indonesia. The University of the West Indies trained over 500 doctors and nurses in 1985 and doubled the annual number of teaching certificates awarded because of expanded training opportunities offered by the teleconferencing system.

In Peru, the Rural Satellite Program provided basic telephone service to seven rural communities and established an audioconferencing link for in-service training of health workers, agriculture extension agents, and teachers—connecting them for the first time with experts in the capital city of Lima. Over 300 audioconferences were requested by field personnel in 1985; over 92 percent of users indicated that the training improved their work.

The experiences of the Rural Satellite Program in Indonesia, the West Indies, and Peru have shown that:

- Telecommunications can be adapted to provide affordable communications services in rural areas and provide a cost-effective means of extending social services to these areas.

- Telephone-based technologies can be made to operate reliably in the developing world. The RSP pilot project networks operate at a 90 to 98 percent reliability rate.

- Teleconferencing, specifically audioconferencing, is an effective means of providing quality instruction and essential training to rural and isolated public service personnel.

Beyond these major research conclusions, the Rural Satellite Program projects have afforded valuable lessons in the planning and implementation of distance education programs, the design of appropriate technical systems, the programmatic and technical management required by these programs, the process of technology transfer, and the identification of the most suitable uses and audiences.

The following report, one of a monograph series, describes one aspect of the experience of the Rural Satellite Program.

INTRODUCTION

Distance educators are continually searching for new and better ways of reaching present and potential learners. Print materials still form the heart of most distance education programs, but educators have made use of new technologies as they have been developed, such as slides, radio and TV broadcasts, audio and video cassettes, computers and video disks. A continuing concern has been to find means of providing for two-way interaction between teacher and learner in order to facilitate learning, maintain motivation, and ensure steady progress. Some distance education systems have tried to supply this human element through correspondence between teacher and learner or by occasional face-to-face tutorials. Countries with advanced telecommunications networks have made use of telephone, audioconferencing, two-way video, and a combination of one-way video and two-way audio connections. All have been shown to be reliable and effective deliverers of instructional programming in nations where telecommunications networks are very extensive and of high quality. Such systems have not normally been used in the Third World due to the uneven quality of the existing telecommunications infrastructures, their limitation to mainly urban areas, and the perceived high costs of creating such educational systems.

Until recently, little was done in the developing world to bring the benefits of telecommunications facilities to rural and remote areas and to utilize them for educational purposes. Terrestrial systems had to be built one step at a time radiating out from profitable major urban centers and had to overcome great geographic barriers and high costs to reach remote areas. Telephone system planners saw no way to justify the great expense of expanding to rural areas where the numbers of potential users were too small to make such service profitable. Thus rural and remote areas were generally left out of the revolution in telecommunications that has swept the world in this century.

The rapid development of satellite technology over the last three decades has changed this situation. Earth stations placed at remote sites can create a nationwide communications network without the need to laboriously build a complete chain of cable and microwave links covering the entire country. Technical advances have led to more powerful satellites, smaller earth stations, and a general reduction in the cost of all elements of satellite-based systems. A global ring of satellites now makes it possible to connect almost any spot on earth into the international telecommunications network. From an educational standpoint, this network can be viewed as an all-encompassing, two-way delivery system that can be used to promote human resource development and information exchange.

The capability now exists for instructional programming to originate from and be received by almost any spot on earth. A U.S. professor can hold a live seminar with students in one or more countries. Doctors in Europe and Africa can simultaneously view and discuss x-rays or cardiograms. In-service training can be given to teachers, agriculture and health workers, and other field personnel scattered in remote areas across a single country or the world. Regular meetings can be held between national office personnel and local staff in all outlying areas. All of this and more can be done over simple telephone lines. Interactive telecommunications networks make it possible to reach both small and large groups of widely spread learners. Scarce expertise can be called upon to provide instruction or advice to multiple sites without the high cost of

travel and lost time. Modern telecommunications systems can provide reliable, multi-site, two-way communication facilities to achieve a wide variety of instructional and administrative goals. The challenge for educators is to identify and demonstrate how this existing technology can best be used for these purposes.

The Rural Satellite Program was created to take up this challenge and to explore ways in which satellite technology could be used to foster educational and rural development. This report looks at the largest of the three field projects developed under that program, the Indonesian Distance Education Satellite System. The report is meant to be a guide to those who wish to use similar systems for their own nation's educational needs. The information given should be of interest to a range of people from satellite engineers to educators. The report is arranged in chapters that focus on different aspects of the project, such as system design and staff training, and readers should feel free to select the sections that best match their own interests. The chapters are built around questions that planners of such systems should ask, and the main elements of the answers to those questions are identified based on the experience of the Indonesian project. The intent of the entire report is to use the Indonesian example as a means to help others benefit from the Rural Satellite Program's five-year experience in putting such systems into place.

The need for distance education programs is particularly great in the Third World where expertise and physical resources are limited and the bulk of the population is in rural or remote areas. Telecommunications can be a powerful means for the sharing of human resources and the management of widespread development projects. The Rural Satellite Program has demonstrated that satellite technology and audioconferencing networks can meet real and important needs in the Third World, especially for the development of remote areas. The Rural Satellite Program hopes that its efforts will encourage others to explore and expand the use of interactive telecommunications systems as educational and developmental tools. The technology already exists. The cost is affordable. The possibilities are endless.

CHAPTER ONE
THE INDONESIAN SETTING

A. WHY WAS INDONESIA CHOSEN AS A SITE?

- WIDESPREAD ARCHIPELAGO
- HIGHLY DEVELOPED DOMESTIC SATELLITE SYSTEM
- NEED TO USE SATELLITE FOR DEVELOPMENT PURPOSES

The Indonesian archipelago consists of 5,000 inhabited islands stretched across almost 3,000 miles of ocean. The combination of great distances and vast expanses of water served to isolate the islands from one another for much of their history. During the Dutch colonial period of over 300 years only limited communications facilities were established, mostly on the main island of Java. After the War of Independence with the Dutch (1945-48), the new Indonesian Government recognized that a good communications network was essential for promoting political unity and national development. Work went ahead on expanding the limited, existing terrestrial facilities, but progress was slow. With the development of satellite technology in the 1960s, the Indonesian Government recognized that a satellite system might solve the problem of linking widely scattered sections of the country quickly and relatively cheaply. A new communications system was seen as being particularly essential for the coordination of the far-flung operations of Pertamina, the national oil company that was entering into a tremendous growth period.

Studies were done in the early 1970s, and it was decided at the highest level to proceed with the development and installation of a domestic satellite system. The initial plans were for 42 earth stations and two satellites: a primary satellite and a backup satellite to be built by the Hughes Company of the USA. The satellites were named Palapa A-1 and Palapa A-2. The name "Palapa" was chosen because of its connection with a quote by a famous historical figure, Prime Minister Gadjah Mada, who vowed that he would not eat "palapa" (a very popular food dish of that era) until the islands of Indonesia were united into one nation. This new Palapa, the result of one of mankind's major achievements in high technology, now serves to carry out that vow and to truly make Indonesia one nation.

The Palapa A-1 satellite was launched in 1976, and Indonesia became the first Third World nation to inaugurate its own domestic satellite system. Over the next decade the Palapa system was expanded to 120 earth stations. Domestically, the satellite was used primarily to provide telephone, telex, radio, and television coverage to all 26 provinces. Internationally, transponder space was leased to some of Indonesia's partners in the ASEAN consortium, namely, Malaysia, Thailand, and the Philippines. The introduction of satellite technology into Indonesia stimulated the growth of related industries. A wide range of companies came into existence to manufacture earth terminals, modems, and other equipment. In 1984 Indonesia had its third satellite, the Palapa B-1, put into orbit by the U.S. space shuttle as an eventual replacement for the A-1. In pursuit of its goal

to bring basic telecommunications services to all of its people, the government is now making preparations for a second major expansion of the system. Plans are under way to add at least another 100 earth terminals before 1990 and to bring basic telephone and telex service to all of the country's district centers.

Given Indonesia's satellite capability, it was natural that it receive major consideration as a project site when the Rural Satellite Program began in 1981. Although Indonesia was a pioneer in adopting satellite technology, little had been done to use its vast and expensive satellite network for specific development programs. Here was a country with an extensive telecommunications network, including its own satellites, a trained and well-organized cadre of technicians, and many development needs that could benefit from better communications. The Palapa system was a major resource that could be used to achieve development goals far beyond those of basic telecommunications services. The challenge was to identify some of those goals and to demonstrate the power of telecommunications for development.

The Rural Satellite Program (RSP) was begun in response to such challenges. Sponsored by the Office of Education, Bureau for Science and Technology, of the U.S. Agency for International Development (USAID), the program's mission was to organize a few projects in the Third World that would demonstrate some of the ways satellite technology could be used to assist development efforts. AID contracted with the Academy for Educational Development (AED) to provide the technical assistance and planning required for carrying out the demonstrations. Projects were implemented in the West Indies and Peru, as well as in Indonesia.

The project in Indonesia arose from the context of a long relationship with AID in developing an Indonesian capacity to use educational technology. Key Indonesians attended the first U.S. conference on educational applications of satellites held in 1974 at the sites of U.S. educational experiments utilizing the Applications Technology Satellites launched by the National Aeronautics and Space Administration. The organizer of that conference, Dr. Clifford Block of AID, subsequently participated in Indonesia's first policy workshop on educational applications of the Palapa system held even before the first Palapa was launched. Extensive AID funding of educational technology activities ultimately occurred. Thirty Indonesians received advanced degrees in the United States in educational technology, and a major educational media center (Communications Technology Center) was established in Jakarta with AID assistance. AID, both in its Washington development research bureau and in its Mission in Indonesia, thus was well primed to think of Indonesia when important educational technology applications were being considered, and Indonesia trusted the quality of AID's intellectual and technical support.

Beginning in 1981, several RSP planning teams visited Indonesia, and in-depth discussions were held with the Ministries of Health, Agriculture, and Education, local USAID personnel, the staff of Perumtel (the national telecommunications authority), and other contacts developed during AID's decade-long involvement in educational technology in Indonesia. A number of possible scenarios were identified and explored for the use of the satellite system for these ministries, and some potential system configurations were examined. Based on these initial studies, both the Government of Indonesia and USAID agreed that the RSP project should focus on the development of higher education in the eastern part of Indonesia.

B. WHY DID THE SATELLITE PROJECT FOCUS ON HIGHER EDUCATION?

- NATIONAL NEED FOR MORE TRAINED MANPOWER
- GREAT DEMOGRAPHIC PRESSURE ON THE EDUCATION SECTOR
- SHORTAGE OF FACULTY AND FACILITIES
- GOAL OF DOUBLING UNIVERSITY ENROLLMENT BY THE YEAR 2000
- NEED TO INCREASE QUANTITY AND QUALITY OF EDUCATION
- NEED TO INCREASE EQUALITY OF ACCESS
- NEED FOR INSTITUTIONS TO SHARE RESOURCES

During the Dutch colonial period, Indonesia's educational system remained largely undeveloped. At the time of Independence in 1945, Indonesia had fewer than 1,000 university graduates. The first Indonesian university was not founded until 1949. The primary and secondary school sectors were also underdeveloped. Facing the tremendous task of moving the newly created nation toward modernization, the leadership decided to concentrate resources on a bottom-up strategy with major initial investment in primary education. As it neared the goal of universal, free primary education, the Ministry of Education shifted more resources to the development of the secondary school level.

During this period a great deal of attention was also given to higher education. Between 1949 and 1982 the government established a higher education structure of 10 teacher training institutes and 33 universities which by 1979 annually enrolled over 200,000 students. The development of higher education, however, did not keep pace with the expansion of the primary and secondary school systems and the nation's need for trained manpower. The investment in the primary system succeeded in producing greater numbers of graduates, many of whom sought further education in the secondary system. The additional resources put into the secondary school system had the same degree of success and a similar result: increased demand for education beyond high school.

The demographic bubble slowly traveled through the system until today there is tremendous pressure on the Directorate General of Higher Education of the Ministry of Education and Culture to expand enrollments. In recent years over 500,000 young people have taken the college entrance examination for the 43 government-run institutions of higher learning. Because of a shortage of all resources (staff, materials, infrastructure), the government has been able to accept only about 18-20 percent of these applicants. The rest must enter private institutions (generally of lower quality), wait until next year's exam, or give up the idea of post-secondary education. This situation has created both personal and national crises. A large percentage of Indonesian young people are not able to pursue their goals of higher education. This resource-wealthy nation of over 160,000,000 people is unable to meet its ever-expanding need for trained manpower.

Higher education in Indonesia indeed faces a crisis. It is facing an unprecedented demand for its services, for more graduates, and even demands for its own personnel to serve in non-education capacities. The rapid development that Indonesia experienced in the last two decades has created a large group of secondary school graduates eager for higher education, a rapidly expanding economy that requires ever greater numbers of university-trained graduates, and, hence, a constant demand for the participation of faculty members in government and private sector projects. To meet this crisis, the

Directorate General of Higher Education announced a plan to double university enrollment by the year 2000. This will require, of course, more teachers, more buildings, and a larger budget. It will also require balancing the need for more resources with the need for quality and equality. The number of graduates has to be doubled, but the quality of instruction and learning also needs to be greatly improved if the diplomas are to mean anything. In addition, the Directorate must attempt a better distribution of resources within the university system so that outlying institutions are raised to the level of the institutions on Java. The Directorate must produce more graduates; these graduates must be from all of the provinces, not just from a few.

Increasing quantity and improving quality and equality will cause immense problems for the higher education establishment. Solutions to these problems are hindered by a number of weaknesses in the higher education establishment itself. These include:

- little capacity for growth based on self-reliance
- inter-university imbalances in resources
- low numbers of graduates due to poor management and a lack of facilities, faculty, and self-directed student learning
- limitation on the number of students who can be enrolled
- inappropriate administrative structures

C. WHY WAS THE SATELLITE PROJECT PLACED IN EASTERN INDONESIA?

- EXISTENCE OF A UNIVERSITY ASSOCIATION BASED ON RESOURCE SHARING
- ESTABLISHED NEED FOR REGULAR COMMUNICATIONS AMONG REMOTE SITES
- NEED TO BUILD UPON PREVIOUS AID/INDONESIA PROJECT

In 1978 in the eastern part of Indonesia, a group of rectors (presidents) of 10 government universities and teacher training institutes organized the Eastern Islands Universities Association, a cooperative working group whose aim was to promote the further development of its institutions through the sharing of ideas and resources. These rectors recognized that their institutions would not be able to advance rapidly enough through a policy of self-reliance. Educational resources were scarce in the eastern islands, and there was uneven development among the institutions there. Hasanuddin University in Ujung Pandang had received special attention from the Directorate with the goal of developing it as a "hub university"--an institution that would receive extra resources so that it would become a resource center for the entire eastern area. On the other hand, the universities at Palu and Kendari were among the youngest government institutions in the country, having been founded in 1981; they had only minimal facilities. Under the leadership of the Rector of Hasanuddin University, the rectors created this Association with the support of the Director General and the Minister of Education and Culture.

With only limited resources, the association started some modest programs such as periodic meetings of the rectors and the sharing of materials. With additional support from Jakarta they conducted a faculty exchange program, whereby a teacher from one institution would travel to another campus to teach one or more courses that were not available on that campus because of a lack of faculty. Other programs were started that

involved sending students to Hasanuddin University or to the Agricultural Institute at Bogor on Java for graduate study. Although these programs demonstrated that there was an established need for regular communications between sites, the universities had to rely primarily on mail and personal meetings to maintain those programs.

When the government decided to focus more on "eastward-bound development" and allot additional resources to the eastern islands, the Government of Indonesia and USAID agreed to launch a five-year project to develop the agricultural expertise of the universities of eastern Indonesia. This project brought together Washington State University (WSU), the USAID contractor, and the Eastern Islands Universities Association for the goal of strengthening the agricultural sector of the Association through a variety of programs, including degree training programs in the United States for faculty, the development of materials for five basic courses (soil science, forestry, nutrition, ecology, and English), the creation of experimental farms and rural development projects, and many workshops bringing together university personnel such as librarians and home economics teachers for the purposes of study, sharing, and networking.

Meanwhile the Directorate General of Higher Education was looking for other solutions to the problems it confronted. It knew that its ambitious plans for doubling enrollment also would entail a massive staff development effort in order to recruit new teachers and upgrade the skills of present faculty. In searching for ways to use its resources to the maximum, it looked more closely at distance education strategies. The major result was the creation in 1984 of the Open University--a distance education institution that would be open to high school graduates of any age. The announcement of plans for creating an open university was met with such enthusiasm throughout the country that its initial plans to start its first year with no more than 10,000 students in only a few provinces was changed to accommodate over 60,000 students across most of the country. The Open University would rely mainly on print materials sent to students through the regular postal system. There would also be the occasional use of newspapers and of television as a delivery medium and an attempt to establish a tutor network to support the students.

Discussions with AID's Bureau for Science and Technology about the Rural Satellite Program took place at the same time as consideration of an Indonesian open university. The Director General of Higher Education saw this as an opportunity for the Ministry of Education and Culture to explore the use of interactive telecommunications for distance education, both for the direct instruction of students and also for staff development and administrative activities. His idea was to establish such a system first only in part of the country as an experiment to determine if it could be a viable strategy for meeting some of the needs of higher education, particularly the need for high quality education in specialized subjects in universities outside of Java. If it proved successful, he proposed to extend it from a regional to a national system. In determining where to establish such a system, both he and USAID officials naturally looked to the eastern islands where there was an established association trying to share resources and a USAID project that was already in operation. It was hoped that the satellite system could help maintain the momentum of inter-institutional cooperation started by the Association and the USAID-WSU project.

D. WAS THE SELECTED LOCATION A GOOD CHOICE?

ADVANTAGES

- CRITICAL NEED FOR MULTI-SITE COMMUNICATIONS
- HISTORY OF RESOURCE SHARING AMONG INSTITUTIONS
- OBSTACLES TO DEVELOPMENT THAT COULD BE LESSENED BY A COMMUNICATIONS SYSTEM
- A STRONG, INTERESTED LEADER

DISADVANTAGES

- SITES GROUPED ON BASIS OF GEOGRAPHY AND NOT COMMON NEEDS
- INHERENT WEAKNESS IN THE HOST ORGANIZATION
- STAFFING BY PART-TIME PERSONNEL
- GREAT DISTANCE FROM ADMINISTRATIVE SOURCE OF BUDGET
- LACK OF UNIFORMITY AMONG MEMBER INSTITUTIONS
- LACK OF CLARITY ON ADMINISTRATIVE STATUS OF PROJECT

The first major consideration in establishing a communications system is to determine if there is an important communications need that can best be addressed by telecommunications. This was clearly the case in eastern Indonesia. The members of the Association were located on four islands spread over an area of 900,000 square miles. The goals of the Association and the existing USAID-WSU agriculture project were to develop the institutional capacities of project members through a sharing of resources and the development of networks among groups of university personnel. The AID contribution of $8 million and the counterpart funds of the Directorate represented a huge investment in the Association. The money allowed for dozens of faculty to go to the United States for further study and for a variety of cooperative projects to be run by groups of faculty from all of the institutions. It was clear, however, that most of these networking activities would not continue after AID and Directorate funding ended in 1984. The travel expenses alone were great, often taking up most of the budget for many project activities. There was also concern that the various faculty members working toward degrees in the United States would lose their cohesiveness as a group after they returned to their remote campuses. Due to the high costs of long distance telephone service ($1.00-$2.00/minute) and air travel, it was not feasible to expect that people would keep in contact with each other after it was no longer possible for them to meet face-to-face on the WSU campus or in workshops. Thus it was feared that much of the progress of the previous four years (1979-83) would be lost when external funding ended. AID/Indonesia considered extending the WSU contract beyond 1984 but eventually decided not to do so.

The experience of the previous four years of the Association had already helped it to identify areas where cooperation was needed. It was particularly interested in using an interactive system for course sharing between campuses. The system of having visiting faculty teach a course on one or two visits of one or two weeks' duration was unsatis-

factory. There were limitations on how long faculty members could leave their campuses and how many could be funded during a given semester. Given his regular teaching load at his own institution, a faculty member could visit only one campus per semester. This meant that each institution had to enter into its own agreement with the institution supplying the teachers. Because of its larger and better-trained faculty, Hasanuddin University was the primary supplier of "flying teachers" for these programs; however, some institutions did bring in faculty members from universities outside of the Association.

Another interest of the Association was to continue the spirit of cooperation that it had been cultivating for so long. It needed a means of exchanging scholarly and administrative information. It also wanted to continue the program of staff development begun with AID funding for overseas study and Directorate funding for locally held workshops and project teams. The Association also needed a forum in which it could meet to maintain the Association itself. The twice-yearly meetings of the rectors would not be sufficient to sustain the momentum of the last few years.

The use of satellite communications to link the campuses into one network was viewed as an important step toward reducing some of the obstacles to development cited earlier. The problem of **little growth based on self-reliance** would be ameliorated because the telecommunications network would link an institution to many other institutions, so that human resources could be shared. Such a system also offered the possibility of including institutions outside of the Association. The satellite network could also be used to bring in expertise from outside the higher education community. Potential participants included anyone who lived within traveling distance of one of the sites.

The problem of **university imbalances** could be addressed partially through the sharing of local expertise over the network. The Directorate's plans included the creation of centers of specialization within the university system. Each university was given responsibility for developing special expertise in a particular area. For instance, the university at Samarinda (UNMUL) in the midst of the rich Kalimantan forest area was designated to be a center of expertise in forestry. The university at Ambon (UNPATTI) in the Moluccа islands was given additional resources to concentrate on fisheries and ship-building. This strategy would enable the Directorate to develop content area specialists on most major topics and thus strengthen the overall capabilities of the government university system; however, it would need a mechanism to ensure that the expertise developed at one campus would be shared with other campuses. The satellite system appeared to be one such mechanism.

The problem of **low productivity resulting from poor management and a lack of facilities, staff, and self-directed student learning** was another obstacle that could be lessened by the judicious use of a telecommunications network. The network could be used for administrative meetings for information exchange and training, for inter-library loan programs and consultations, for distance education courses led by a master teacher, for staff development activities such as seminars or training programs, and for stimulating students with outside materials and instructors.

The **limitation on the number of students that could be enrolled** could be addressed only partially by an interactive telecommunications system. By delivering quality courses taught by senior faculty members from outside institutions, a telecommunications system could make it possible for on-campus senior faculty members to concentrate on other courses, thus increasing the total number and variety of courses available. By pairing a junior faculty member as a local tutor with an experienced master teacher via audioconferencing, it was also hoped that there would be a training effect

upon the tutor, increasing his/her knowledge and teaching skills so that eventually s/he would be able to teach the course. The overall effect of the telecommunications system would be to increase staff skills and the total number and variety of courses that could be offered in any semester. This would help students get through their programs faster and thus open up space for new students. The typical B.A. student in Indonesia spends five to six years completing a four-year program. Part of the problem is caused by the unavailability of faculty members and courses. With classrooms seating at least 50 students and an annual program of 30 courses, SISDIKSAT would have the potential of reaching 1,500 students per campus per year.

The problem of **inappropriate administrative structures** could not be directly ameliorated by the introduction of a telecommunications system. A communications system, however, can facilitate the shift to more appropriate structures by providing a forum where people can discuss administrative problems and where administrative policies and procedures can be reviewed, explained, or debated.

The choice of the Eastern Islands Universities Association as the site for the Rural Satellite Program was appropriate because:

- There was a strong, important communications need.
- The remote location of many of the sites and their geographical spread indicated that telecommunications would be a cost-effective way of addressing some of their problems.
- There already existed an organization that had ongoing programs based on the concept of resource sharing.
- There was a strong leader who was knowledgeable about telecommunications and enthusiastic about its use for education and who held the two main positions crucial to the success of the project: Rector of Hasanuddin University and Chairman of the Universities Association.
- The satellite project, to a certain extent, would be a follow-up of a previous USAID project that also promoted networking and resource sharing.

During the actual implementation of the project, however, it was discovered that there were some distinct disadvantages in locating the satellite project in the eastern islands. Because these factors affected almost every aspect of the project and played a large role in determining the degree of success it was able to achieve, it is important that they be reviewed at this point so the reader can better understand the context in which the project operated.

- Geographical Basis of Membership: The Association was a geographical grouping, but geography is one of the least important factors to consider when creating a satellite telecommunications system, whose great strength is that it is impervious to distances as long as all locations are located within its "footprint" (i.e., the boundary of its transmission and reception ability).
- Great Disparities in Needs of Members: The Association contained a wide variety of institutions in terms of their needs, goals, resources, and stages of development. For instance, there are two teacher training institutes (iKIPs) and eight universities, each with different curricula and goals. Because of these

disparities it became extremely difficult to devise a course program that met everyone's primary needs.

- Loss of Key Leader: Before the project even began, one of the key figures in the planning of the project, the Rector of Hasanuddin and Chairman of the Association, moved to another post in the Ministry of Education. Thus a very important leader was removed from the scene early in the program.

- Weakness of the Host Institution: The Association proved to be much weaker than originally estimated. It managed itself primarily through semi-annual meetings of the rectors. It had a central secretariat that helped to coordinate and organize activities but which had little power to make independent decisions.

- Limitation of Part-Time Personnel: Being located at a university meant that the professional staff would all be university faculty. Given the scarcity of faculty at Indonesian universities, none of them could work on the project full time; some had their teaching loads partially reduced, but most had to continue to meet their regular faculty responsibilities while working on the satellite project.

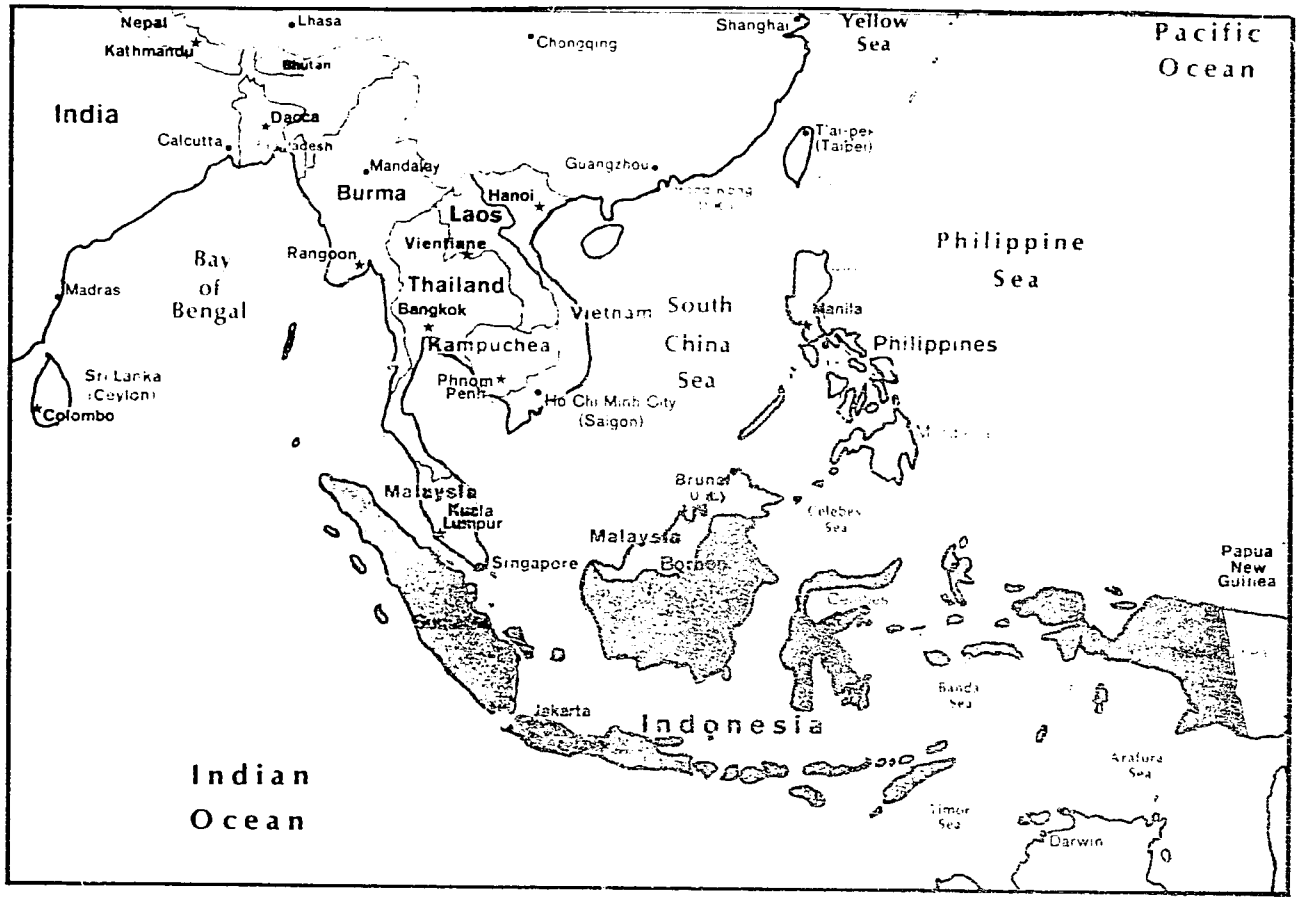
- Budget Transfer Problems: The satellite project became one of the few national level projects in Indonesia that had its headquarters at a provincial site instead of in the capital, Jakarta. This caused serious financial problems, because there was a great deal of difficulty in getting funds released and transferred from Jakarta to the regional office.

- Lack of Uniformity among the Sites: Although all of the members came under the Directorate General of Higher Education, there was little uniformity in their semester schedules. This created a major problem in scheduling the satellite semester, because one set of dates was never appropriate for all institutions.

- Lack of Clarity on the Administrative Status of the Project: The project was directly under the control of the Directorate General of Higher Education in Jakarta (a national organization) but charged with meeting the needs of the Association (a regional organization) consisting of autonomous institutions of higher learning located in the provinces. The project was to meet the needs of all of these groups while having no power of its own to direct them. Conversely, no single client group had to take responsibility for the success of the project.

Some of these disadvantages were noted at the planning stage of the project but were believed to be resolvable. Others were not recognized until the project was in the installation or operational phase. Planners of any project should give thought to these types of problems before launching their own projects.

FIGURE 1



AREA OF PALAPA-B SATELLITE COVERAGE

CHAPTER TWO
DESIGNING THE SYSTEM

A. WHAT WERE THE CRITERIA FOR THE DESIGN OF THE SYSTEM?

- APPROPRIATE FOR TELECOMMUNICATIONS NEEDS
- APPROPRIATE FOR HUMAN AND PHYSICAL ENVIRONMENT
- ECONOMICAL
- TECHNICALLY FEASIBLE
- RELIABLE AND MAINTAINABLE

The first consideration was to specify the general type of communications system appropriate for the telecommunications needs of the prospective user groups. In this case, the members of the Eastern Islands Universities Association and the Directorate General of Higher Education were primarily interested in a two-way system that would unite the campuses with the Directorate and a strong university outside the Association. Their major communications needs were for:

- inter-institutional course sharing
- faculty development programs
- administration
- promotion of research
- off-campus outreach activities

Because programming conceivably might originate at any of the sites, the Association stressed that all sites should be similar in their transmission and reception capabilities: there should be no master site serving as a broadcast center. The obvious communications option was a fully interactive conferencing system to link all of the campuses in the system, with each campus able to serve as an initiator of programming.

After assessing the interest and commitment of each of the institutions, the Directorate and the Association recommended that the satellite system consist of 11 sites linking nine of the 10 Association member institutions with the Directorate General in Jakarta and the Institute of Agriculture in Bogor. The University of Halu Oleo (UNHALU) in Kendari was not included in the plan because it was a very new university fully occupied with its own development. The Directorate did not believe that this university would be able to devote resources to the satellite project. (After three years of forceful efforts, UNHALU got funds that enabled it to join the network in 1986.) The 11 sites to be connected were, from east to west:

1. Cenderawasih University (UNCEN-J) in Jayapura
2. Cenderawasih University Agriculture Campus (UNCEN-M) in Manokwari
3. Pattimura University (UNPATTI) in Ambon
4. Sam Ratulangi University (UNSRAT) and the Institute of Education (IKIP) in Manado

5. Tadulako University (UNTAD) in Palu
6. Hasanuddin University (UNHAS) in Ujung Pandang
7. Institute of Education (IKIP) in Ujung Pandang
8. Mulawarman University (UNMUL) in Samarinda
9. Lambung Mangkurat University (UNLAM) in Banjarmasin
10. Directorate General of Higher Education (DIKTI) in Jakarta
11. Institute of Agriculture (IPB) in Bogor

Later in the project, a twelfth site was added with the installation of a small, solar-powered earth station in the rural area of Wawatobi, Southeast Sulawesi. This site was to provide the universities with the means to use telecommunications for rural development experiments.

Any technical system introduced into a new area must take into account the special needs of the human and physical environments. The system must fulfill the needs of a specific set of users in specific locations. In the case of Indonesia, the following factors related to the human environment were considered:

1. Who would design and deliver the programs?

Most programs would be designed and delivered by university faculty who were generally busy and who did not have a great deal of time to develop elaborate programs or visual aids. Almost all would have experience with microphones and overhead projectors, but few would be acquainted with sophisticated communications technologies like microcomputers.

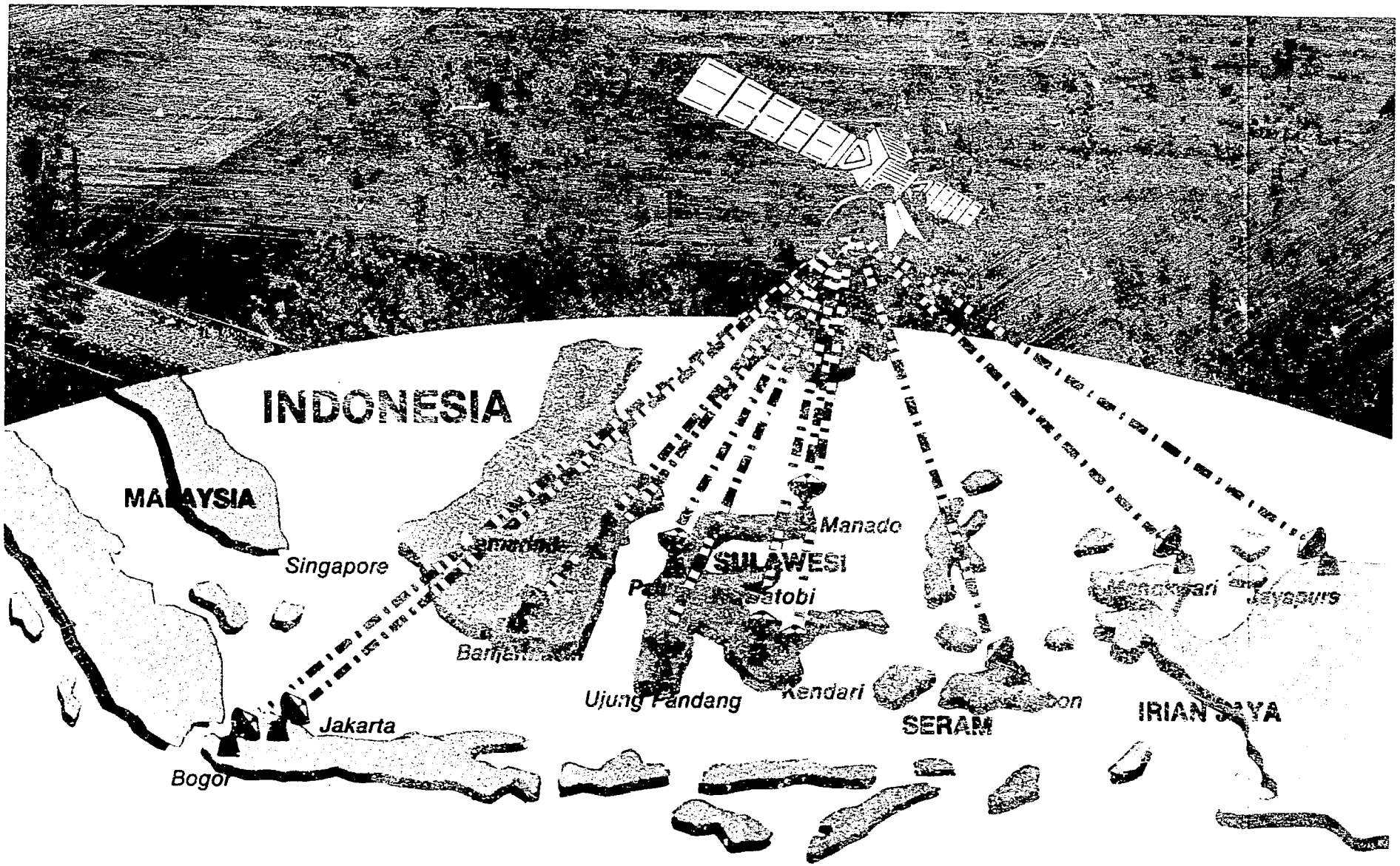
2. What communications facilities would the users be likely to need and use?

The basic need would be for a two-way voice connection that linked all of the sites. This could be supplemented with a visual element that could entail the use of full motion video or narrow-band technologies like facsimile for the transmission of documents, slow-scan video for the transfer of pictures or print, or telewriters for the transmission of live writing or text.

The bulk of the programming would be academic courses which were normally taught without visuals that would require the facilities of full motion video. In their teaching, most Indonesian faculty normally use a blackboard. A few occasionally use an overhead projector. They rarely, if ever, use videotape or film. In addition, the busy schedules maintained by most faculty indicated that they would have little time to prepare visuals in advance for display during a program. If a visual element were to be included in the design, the best choice would be to give the faculty a capability akin to the blackboard--a device that requires little or no preparation and can be utilized for writing, drawings, and diagrams created on the spur of the moment.

3. Who would the audience be for this type of programming?

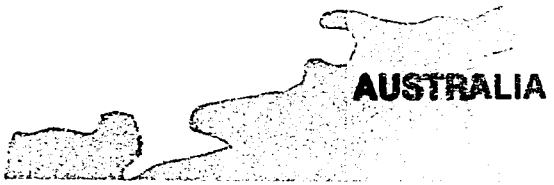
The audience for the classes would be mainly undergraduate students. The audience for seminars and other staff development programs would be faculty members and administrators. Target groups for outreach programs would vary. Of course, all groups would require at the minimum a one-way audio connection. A two-way system would be preferable because it would allow questions and discussions. Given the limited amount of time set aside for interaction in regular face-to-face courses in Indonesian universities,



RURAL SATELLITE PROGRAM

Indonesia Project Sites

FIGURE 2



it was not clear if teachers and students would really use a two-way communications system. In situations where the participants were of the same level (i.e., seminars, staff development activities, administrative meetings), it was assumed that there would be both a need and a desire for interaction. Although the RSP believed strongly that interaction was the key to the best use of a telecommunications system, it was not clear in the beginning how interactive the programs would be.

4. What would be the size of the participating groups at each site?

From one to 10 people per site were expected to participate in administrative meetings; 20-40 per site were expected for academic courses. The participants in outreach programs would vary between these limits. Audience size affects the choice and design of both the audio and visual systems.

5. What degree of technical expertise could be expected at the sites to support the maintenance and repair of the equipment?

The highest degree of technical ability to be expected at most sites was someone with an engineering background or experience in electronics who could work at least part-time as a supervisor. It was hoped that local telephone company personnel might assist in the operation and maintenance of the equipment in emergencies.

6. What degree of technical expertise could be expected of the people who would actually operate the equipment on a daily basis?

Although it might be possible to have operators at each location with some experience in electronics or audio-visual equipment, it was also altogether possible that some people would have no background in operating any type of electronic equipment. Therefore, the daily, full-time equipment operation had to be simple enough for novices to handle.

7. What degree of technical expertise would be required to oversee the installation, maintenance, and operation of the entire system?

With relatively limited levels of local technical expertise, it was important to have several people at the central office who could work with the U.S. engineers in the installation of equipment, become familiar with the classroom equipment and how it interfaced with the national telecommunications system, function as technical liaison with Perumtel, and serve as technical supervisors and support persons for all of the sites.

It is essential that technical planners closely examine the physical environment in which the system will operate. Among the questions they should ask are:

1. What are the climatic conditions in which the system would operate?

A tropical country, Indonesia consistently has high temperatures and humidity levels. Given the high cost of air conditioning, most sites would not be able to provide it for their classrooms. This would mean that dust and humidity would cause problems. Indonesia also has a rainy season that could cause flooding that might affect underground cable and electrical storms that could interfere with communications systems.

2. Would there be reliable electrical power at all sites?

All locations (except the small earth station demonstration) were located in areas where there were electric power plants; however, all sites experienced periodic power outages lasting up to several days, as well as power surges and drops that varied the voltage levels. Lengthy outages would greatly affect the reliability of the system, while surges and drops in the voltage would harm the equipment.

3. Would there be regular transportation links between all sites?

Although distance is not an obstacle to satellite technology, it is a problem for the people who maintain and repair the overall communications system. There would be a need for periodic visits by supervising technicians for routine maintenance and emergency repair. There would also be a need for the shipment of spare parts to certain sites, because no system can run without breakdowns. While many of the sites were in remote areas spread over thousands of miles of ocean, nearby airports handled both passengers and freight. Air travel, however, was relatively expensive, and even express air mail took 5 to 10 days to reach some of the sites. Sea travel was also available to most sites, but it entailed weeks instead of days for roundtrip travel to the more remote sites.

One of the major goals of the Rural Satellite Program was to develop satellite-based communications systems that were economical and thus well suited to the limited resources of most Third World nations. This meant that the systems had to be designed to be as cost-effective as possible. Therefore, all designs were made with several points in mind:

- Existing telecommunications facilities should be utilized wherever possible. No great expenses should be incurred for creating a telecommunications network through the installation of ground stations or outside plant. All system designs should utilize the existing domestic and international satellite networks as much as possible.

- The design should utilize as little as possible of the satellite and ground segments. This meant that the system should depend on narrow-band technologies that use single telephone lines rather than broad-band technologies like television that utilize the equivalent of 600 telephone circuits.

- To keep down procurement, maintenance, and repair costs, purchased equipment should be commercially available (i.e., off-the-shelf as opposed to one-of-a-kind prototype equipment).

These guidelines led to the following decisions regarding system design:

- Full motion video would not be used because of the prohibitive costs of the space segment and of equipping all sites with television transmission capability to have a fully interactive system.

- Because it would rely on existing facilities, including local telephone lines, the design would have to anticipate and protect itself against deficiencies in the existing telecommunications network.

- The audio design would have to choose between full duplex (two people can talk at one time and interrupt each other) and half-duplex (only one person can talk at a time, and a stricter operational protocol is needed to maintain order).

- To reduce costs, as few channels as possible would be used.

- The overall system from satellite to classroom should depend on existing and proven equipment and not experimental technologies.

Of course, technical feasibility is the prime ingredient of any system that is meant to be practical and not theoretical. But it is also true that what is practical in one situation may be only theoretically possible in another situation. When U.S. engineers made the initial design of the system, they always had to consider what was workable in Indonesia with the Palapa system and under local conditions. One of the engineers had lived in Indonesia and had worked with the Palapa system for five years. In addition, several engineers made technical review trips to Indonesia; however, there were still gaps in their knowledge of the Indonesian telecommunications network. It was one matter to design a complete system; it was another to anticipate the actual conditions in which the system would have to work, such as:

- the condition of the land lines to all sites during different parts of the year,
- the overall stability of the Perumtel system from one month to the next,
- the level of training and discipline of the Perumtel staff members at each location, and
- the quality of the interface between the Perumtel system and equipment purchased outside of Indonesia (i.e., would it all work as planned?).

To lessen the problems that might arise during installation and to begin to build a relationship that was crucial to the success of the project, RSP continually consulted with Perumtel throughout the planning and equipment selection process. Perumtel reviewed and approved all of the major technical decisions from the overall design to the selection of classroom equipment. Periodic meetings were also held throughout the planning and installation phases to review progress, problems, and solutions. Despite this collaborative effort, many problems did arise that were unforeseen, but most of them eventually were solved. Without this collaborative relationship, the project never would have emerged from the planning stage into reality.

A telecommunications system must be reliable and maintainable with a minimum of breakdown time. This is especially true for an audioconferencing network that links multiple sites for live programming. A technical failure that cuts out one site may make the entire program less valuable and perhaps totally impossible. It is difficult to reschedule a program if it means finding a new time that is suitable to five or ten different locations in three time zones. Participants will also lose faith in the technology if there are repeated technical problems. People will be patient in the beginning with a new technology, but they will soon tire of it if they are subjected to a series of failures. A successful telecommunications system has to work with a high degree of reliability. Part of that reliability lies in the capacity of project staff at both central and local levels to maintain the equipment and system in peak condition. Maintenance and reliability go hand in hand.

It is less important to have state-of-the-art equipment than it is to have equipment with a history of reliable use in similar climates and programs. Generally, it is better to have simple equipment rather than sophisticated equipment. Simple equipment has fewer parts that can fail, and there is a greater likelihood that someone will be able to repair it if it eventually does fail. It is also generally easier to operate. The overall system must be maintainable by the quality of staff that is actually available--not by the type of staff

that one wishes were available. It is better to choose the equipment for the people, rather than to hope that the right people will be available for the equipment.

In summary, the reliability of an audioconferencing system will largely depend on:

- the quality of the station-to-station satellite link (usually not a major problem except for the tuning of the earth station modems)
- the quality of the earth station to central office link (usually not a major problem if microwave is used)
- the quality of the central office to local site link (usually a major cause of problems in the Third World where local telephone lines are often very noisy)
- the quality and discipline of the staff who operate and maintain the satellite and telephone links (Do they maintain the system in good and steady condition?)
- the quality of the end equipment in the classroom (Is it simple in design and easy to operate and maintain? Has it been used by others in similar conditions and found to be reliable?)
- the existence of a maintenance center with sufficient test and repair equipment, spare parts, and trained staff guided by a systematic plan for the maintenance of the system
- the quality and thoroughness of the maintenance plan (Is it simple enough for people to follow, but comprehensive enough to handle most problems? Is there a regular and reasonable maintenance schedule? Is there backup support for local technicians? Is there a good communications path between the project staff and the telecommunications authority?)
- the availability of funds to support the maintenance center and the implementation of the maintenance plan, including adequate travel money to cover maintenance trips to the sites (A rule of thumb is to annually budget 10 percent of the total value of the equipment for maintenance to keep it at its original level of efficiency.)
- the quality and thoroughness of the personnel who are in charge of supervising the operation and maintenance of the system (Good management of the technical area is as important as good engineering.)
- the quality and discipline of the staff who will maintain and operate the end equipment (Are they skilled enough and given enough training so that they can follow the maintenance plan?)

B. WHAT WERE THE CHARACTERISTICS OF THE FINAL DESIGN?

- TWO-CHANNEL, DEDICATED, AUDIOGRAPHICS SYSTEM
- HALF DUPLEX, LOOPBACK SPACE SEGMENT

After analyzing the situation according to the above outline and discussing the needs and feasibility of the proposed telecommunications system with Perumtel and higher education officials, it was decided that the best configuration for this system would be a two-channel, dedicated, audiographics system. The first channel would be an audioconferencing system connecting all sites in an open network: all would be tuned into the same satellite channel at all times, and thus anything said at one location would be heard simultaneously at all other locations. The second channel would be used to provide a variety of services: graphics in support of the audio via facsimile and telewriting machines, private conferencing telephone facilities, and emergency backup to any failure of the audio channel. Both channels would be leased on a full-time basis.

All audioconferencing systems need a main distribution point where the transmissions from one site can be relayed to all the other sites. This distribution point or "bridge" can be on the ground (terrestrial) or in space. The RSP engineers studied intensively two main design options for bridging point-to-multipoint signals.

The first option used a terrestrial bridge to link all sites. This design had two major advantages. First, it would provide full duplex telephone service. Second, the bridge would serve as a monitoring and control station over the sites. It would link the transmitting site to all of the receiving sites. The transmission from one site would come into the bridge from the satellite and then be re-transmitted up to the satellite and out to all of the other sites. There were significant advantages to being able to monitor and control the transmissions of each location. The bridge operator would be able to judge the relative quality of the transmissions from each site continuously. He could assess their transmission levels and determine if adjustments were necessary. He could also determine if a site was transmitting noise into the system. If one site were found to be particularly noisy and disruptive of the entire system, the operator could cut off its ability to transmit while still allowing it to receive. It would also be possible for that operator to measure and regulate the signal levels coming in from the various sites.

There were two main disadvantages to the terrestrial bridge design. One was that it would require a "double hop" in the transmissions from all but the master site: transmissions from local sites would first go through the satellite to the bridge location and then be re-transmitted to all other locations. This would create about a one-second delay between the original transmission and its reception at all sites. But the major disadvantage of this design was that it would require 40 channels on the satellite for a 10-site system. Each site would require two full duplex channels of its own. The cost of the channels and the bridging equipment made this design very expensive.

The second option for the design of the system was based on the use of only two channels using the satellite itself as a bridge. Two possibilities were proposed. The first one utilized equipment that allowed for frequency switching. A lecturer would begin to talk on frequency one (F1) and all sites would receive him on F1. Questions from another site would be transmitted to him on frequency two (F2). This F2 signal would only go straight to the lecturer's location, where it would be re-transmitted to all other sites on F1. The advantage of this system is that it would allow for full duplex operation--speakers could be interrupted for questions or comments. The main disadvantage was that additional equipment and procedures would be needed in the classroom and at the local Perumtel offices. This would increase the complexity and maintenance requirements of the system. Another disadvantage was that this design would create a one-second delay in the transmission of speech just like the terrestrial bridging system.

The second possibility for a satellite bridging system was to connect all sites in what is called the "loopback mode." Transmissions from any site would go straight to the satellite and then be transmitted down to all sites. Echo suppressors at the transmitting site would prevent its signal from returning to the originating classroom.

There were two main disadvantages to this type of design. First, it would give only a half duplex audio connection: only one site could talk at a time as in a CB radio connection. That meant that the users would have to be disciplined in their use of the system, because speakers could not be interrupted as long as they continued talking. There would have to be strict protocols on speaking over the system. Speakers would have to pause at regular intervals to see if there were questions or comments from the other sites. They would also have to call on the participating sites in turn to get their comments. If more than one site tried to respond at the same time, all that would be heard would be a crashing sound as the two transmissions collided in the satellite. Because most of the projected programming for the Indonesian system (e.g., courses and seminars) would be organized with one site and one person as the leader, this loss of full-duplex capability was not seen as a major drawback to this design. (The final design of the telephone terminal actually allowed for full duplex facilities through the use of both channels for voice conferencing.)

The second disadvantage to this option was the danger of noise entering into the audio system. The audio system was to be an open network with all sites linked by open, dedicated lines. If noise from an electrical storm, poor local cable, or faulty equipment was loud enough to trigger the modem at the local earth station, that noise would automatically be transmitted to all other sites. Unlike the bridging system, there would be no way to stop that noise or even to trace its origin. The only way to identify the source of the problem would be to contact the Perumtel master control station on Java and ask it to run a check of all sites. This transfer of noise proved to be the major disadvantage of this design in Indonesia. It was partially solved by the improvement of local lines by Perumtel and by the installation of a gating system at all sites: a system that prevented local line noise from being transmitted into the network. This gating system is discussed in detail in Chapter Four.

Another disadvantage with this and all of the other designs was that they involved changes in procedure on the part of the Perumtel staff at the project's nine earth stations. This was worrisome, because a failure on the part of a few Perumtel staff to adapt to these changes might create problems with the entire network. Whenever possible, it is better to try to design a system within the standard operating procedures of an organization.

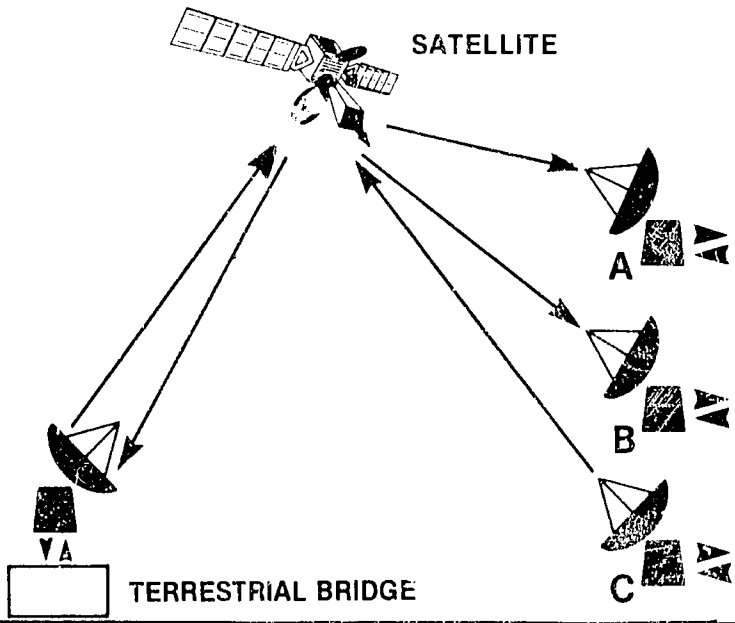
Perumtel personnel preferred the terrestrial bridging option because it would provide the best service and reliability; overall it was the better way of creating such a network. Both RSP and the Directorate General of Higher Education, however, decided in favor of the loopback design--primarily for economic reasons. The RSP was interested in developing a model that could be transferred to other nations. It believed that the total cost had to be low if the system was to be acceptable to others. The Directorate was also interested primarily in the final cost of the system, because the telecommunications charges were by far the single largest item in the total budget. The system had to be affordable, and it was estimated that the loopback design would cost hundreds of thousands of dollars less per year than the terrestrial bridging option. Because the loopback mode offered economy as well as the required facilities, it was decided to base the overall design on the loopback configuration.

SATELLITE CONFIGURATIONS CONSIDERED FOR SISDIKSAT

TERRESTRIAL BRIDGE:

Each of the sites is assigned its own channels. All transmissions first go to the central bridge at one location and then are re-transmitted to all locations on their allocated channels.

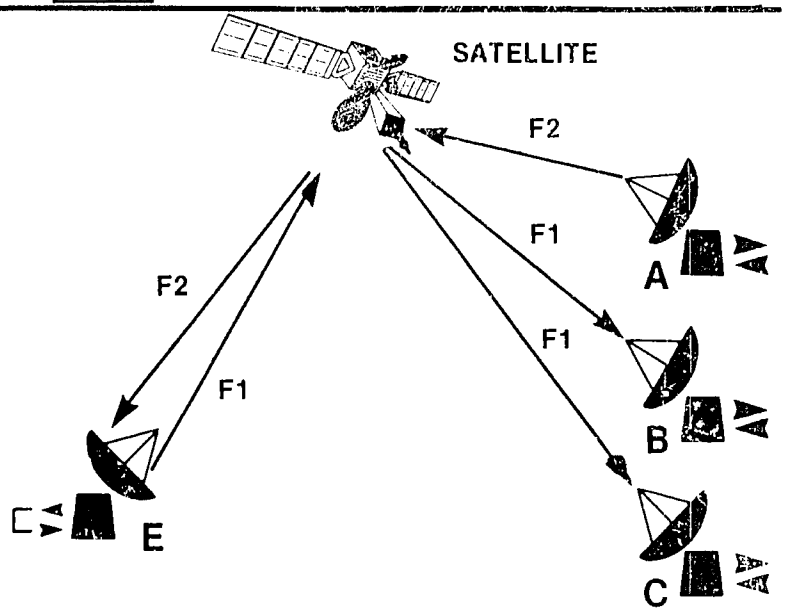
Example: Site C transmits to the satellite on its own channel which goes down to the control bridge. The bridge then re-transmits that signal to all other sites on their respective channels.



FREQUENCY SWITCHING:

Equipment is installed in the classrooms and earth stations allowing for frequency switching. At the start of a program the controlling site sets its transmit at F1 and receive at F2. All other sites are set to receive on F1. When a remote site wishes to transmit, it switches to F2. Only the controlling site receives the F2 transmission. It bridges it over to F1 and re-transmits it on F1 so that all other sites can hear it. F2 to F1 Bridge at all sites.

Outstation 'A' replies on F2. 'B' & 'C' listen via audio loopbacked by control on F1.
(Reception of F1 by 'A' is blocked by 'A')



LOOPBACK:

Transmission of any one site goes up to the satellite and back down to all sites. All sites rely on echo suppressors to prevent their own transmitted signal from coming back into their classrooms.

Example: Site E Transmits to the satellite and all other sites receive on the same channel.

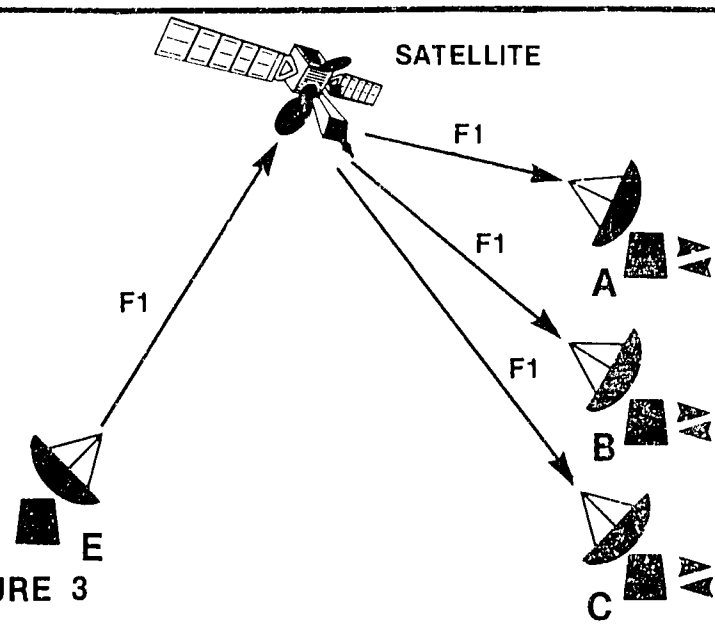


FIGURE 3

C. WHAT EQUIPMENT WAS SELECTED FOR THE CLASSROOMS?

- TELEPHONE TERMINAL
- AUDIOCONFERENCING EQUIPMENT
- FACSIMILE
- GRAPHICS SYSTEM
- EMERGENCY POWER SUPPLY

Based on the decision to design a two-channel, dedicated, audiographics system and the needs and abilities of the prospective users, the equipment on the following list was purchased for each site. It is important to note that these equipment choices were made in 1982 based on what was then available in the marketplace. Because revolutionary changes are now commonplace in the world of electronics, many new products have come onto the market in the intervening years. Some of the equipment choices might be very different for someone planning a similar system today.

Perumtel took the responsibility for the communications network up to the point at which it entered the classrooms. The satellite system, ground stations, and local telephone lines all came under Perumtel's control, and Perumtel installed four pairs of telephone wires to each site--two pairs of cable for each channel because this was a four-wire network. Inside the classroom these cables were attached to a telephone terminal which was used to set the receiving and transmitting levels and to control the various dialing functions. The terminal connected one channel (A) to the audioconferencing equipment (microphones, speakers, and convener) and allowed the second channel (B) to be used with a variety of equipment: private conferencing telephone, facsimile, and telewriter. This equipment and system were determined to be the most suitable for the types of activities that the Directorate and rectors wanted to conduct.

The audio connection was the heart of the system. If the voice channel worked well, the system would be successful. If it did not, the system would fail. None of the other equipment could replace the audio channel. The anticipated programs could not be carried out without a high-quality audio connection. The terminal and audioconferencing equipment were purchased from well-established firms with a long history of producing high quality, reliable hardware. Some adaptations were made in the equipment to make it less susceptible to corrosion in Indonesia's hot and damp climate (e.g., gold plating of microphone connections, use of military style jacks and plugs, and anti-fungus coating of circuit boards).

The telephone terminal was made from off-the-shelf modules assembled in a unique configuration to meet the needs of this particular communications system. While all of the parts were standard and readily available from the manufacturer, no one had ever ordered that particular mix of parts before, so the telephone terminals for Indonesia were unique. This was a drawback in the early phase of installation when several problems arose with the terminal. Although the manufacturer was very willing to correct the problems, his engineers were hampered by the fact that they did not have a similar terminal at their factory for analysis and testing of possible corrective measures.

Figure 4

SITE EQUIPMENT

Equipment	Number	Function
Telephone Terminal	1	setting of transmit and receive levels for both channels; control of dialing functions and selection of equipment on Channel B
Audioconferencing: Channel A		
Convener	1	setting of audio receive volume; voice switching
Microphones	12	push-to-talk transmission of voice signal to all sites
Loudspeakers	2	reception of voice signal from all sites
Graphics Support: Channel B		
Conferencing Phone	1	private calls on point-to-point or multi-point basis
Facsimile	1	transfer of paper copy between sites
Telewriter	1	microprocessor, modem, and light pen for transmission of handwriting or drawings
Monitors	3	19-inch monitor for telewriting directly on the screen with light pen; two 26-inch monitors for display of telewriting, video, or live television broadcasts
Signal Coupler	1	transfer of graphics signal from microprocessor to the 26-inch video display monitors
TV Tuner	1	reception of off-air broadcasts
Tape Recorder	1	taping audio or graphics signals and replaying pre-recorded graphics tapes
Emergency Power Supply		backup power system consisting of rechargeable batteries, charger, voltage stabilizer, and inverter to supply electricity for the audioconferencing system for up to 12 hours without recharging

The audioconferencing equipment consisted of microphones, speakers, and a convener. Push-to-talk microphones were chosen to avoid the possibility of people turning a microphone on and then forgetting to shut it off when they were finished speaking. With 132 microphones spread across thousands of miles of ocean, it was important to limit the entrance of extraneous sounds into the system. The microphones were linked in sequence with six-feet long cables that allowed one microphone to be shared among three to six people depending on the arrangement of tables.

The graphics channel was much more complex than the audio channel in many ways. Because it utilized three sets of equipment on one channel and was designed with numerous dialing functions, the telephone terminal became much more complicated than if it had been designed only for audioconferencing. In addition, much of the graphics equipment itself was very complex and sensitive, particularly the facsimile and the telewriting system. Even the Channel B telephone system became complex (and very expensive) when a privacy feature was added to protect the confidentiality of telephone conversations. In trying to put together a system that would be versatile and able to meet the needs of the prospective users, the designers temporarily lost sight of their own goals of simplicity and reliability. Functions were gradually added during the planning process, so that the graphics channel grew in complexity. Unfortunately this error was compounded by the sensitivity and complexity of the end equipment itself.

The facsimile (a machine that telecommunicates documents) was an off-the-shelf model from Burroughs that had been in use worldwide for a number of years. An analog machine, rather than a digital one, was selected because at that time the analog machines were thought to be more reliable. The facsimile enabled teachers to send handouts and supplemental materials to distance classes and administrators to send documents to other sites.

The selection of a graphics system was more problematic. In 1982 there were only a few specialized types of graphics equipment available: electronic blackboard, slow-scan video, and a relatively new graphics system developed by the Open University of the United Kingdom. The electronic blackboards were too expensive to be supplied to every site. The slow-scan videos could not transmit live writing and required too much preparation on the part of the users. The graphics system developed by the Open University seemed to be the best choice for a number of reasons. It provided not only for the transmission of live writing but also for the recording and replaying of writing and other graphics on regular cassettes. It had been developed and extensively field-tested by the Open University specifically for distance education college courses, and it was inexpensive enough to permit the purchase of one unit per location. In addition, the manufacturers also marketed a more sophisticated "studio" version of the unit, which made possible the creation of more elaborate graphics cassettes. The decision was therefore made to purchase this equipment from the commercial supplier, Aregon International of England; this proved to be the most regretted decision of the program. (More is said about this in Chapter Four.)

The basic graphics system developed by the Open University used a 14-inch monitor, microprocessor, light pen, and modem. Because a 14-inch monitor would be too small for the larger groups expected in Indonesia, the system was redesigned to include two 26-inch monitors to serve as the main display screens. The size of the smaller monitor was increased to 19 inches to allow for more writing space and better viewing. Because the large monitors would be placed up to 20 feet from the processor, a booster system and special cabling were needed to send the graphics signal over that distance.

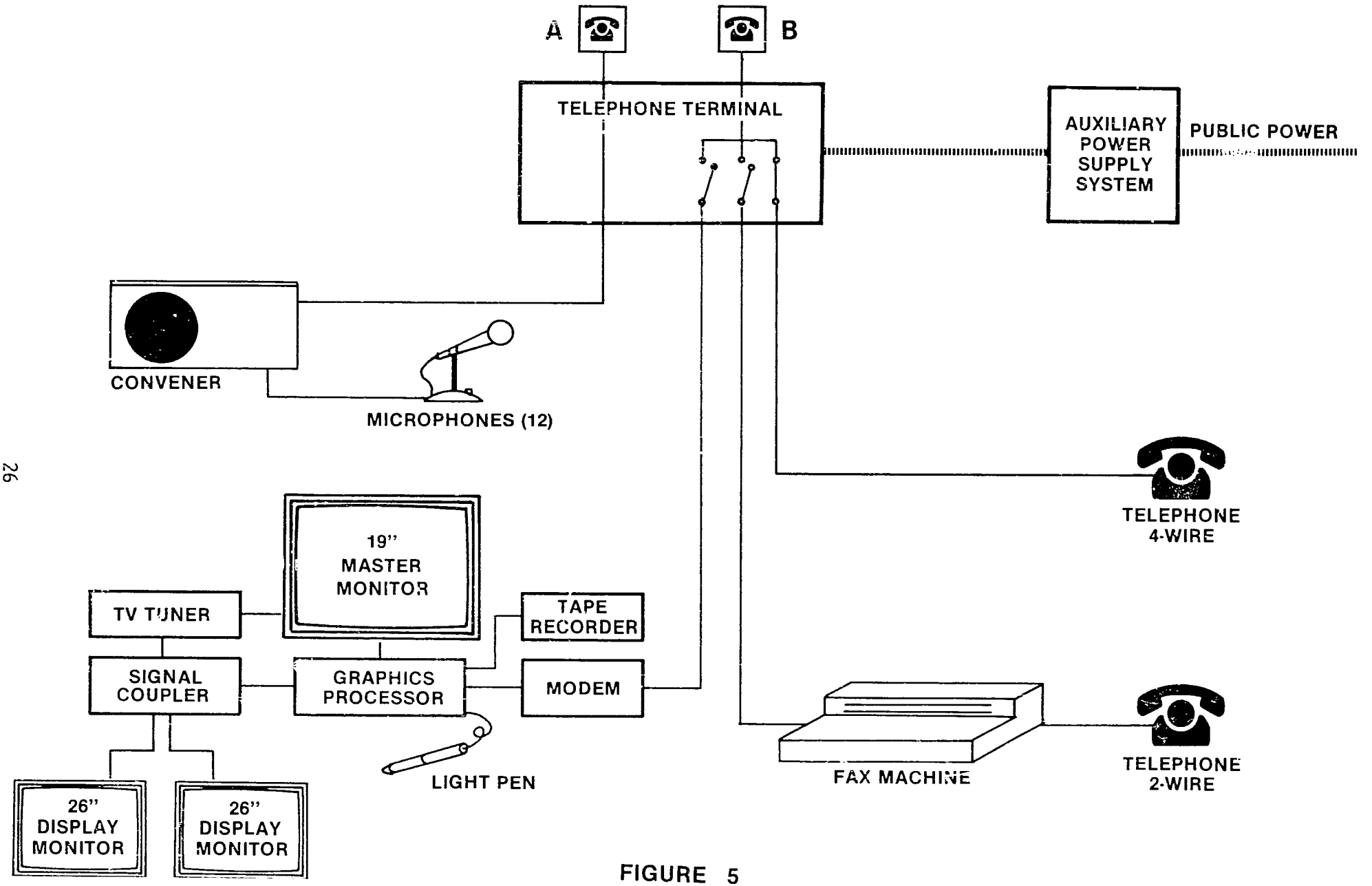


FIGURE 5

LAYOUT OF CLASSROOM EQUIPMENT IN INDONESIA

When the Indonesians expressed interest in experimenting with videotape and television as part of some programs, additional cables and a TV tuner were added. Thus, the graphics system expanded in complexity and in cost. Fortunately, all of this additional equipment worked well. Unfortunately, major problems occurred with the basic hardware and software.

The decision to provide an emergency power supply system proved to be a wise one. Small, portable generators were considered, but were found to lack power stability and operational durability. Larger generators (4 kw+) were expensive and costly to operate. It was not certain that all sites would be able to handle the logistical and financial cost of maintaining a generator. In addition, generators were too noisy to be located near audioconferencing facilities.

An alternative to generators was battery power. Designs were made to develop a system using regular car batteries; however, it was discovered that those batteries would not survive deep discharging and frequent recharging. Although they were much cheaper than high quality rechargeable batteries and available at almost every site, their lifespan was very limited. The choice was between inexpensive, domestically produced car batteries that wore out quickly and expensive, imported rechargeable batteries that could be endlessly recharged for 5 to 10 years. Despite the major difference in cost, it was decided to use the more reliable rechargeable batteries. Again, one of the main considerations was that the sites might not be able to manage the cost and logistics of constantly replacing regular car batteries.

The rechargeable batteries were connected to an inverter, voltage stabilizer, and charger to provide a system that regulated the regular electricity supply and supplied backup power immediately whenever the regular power went off. This happened at all sites on a regular basis, so that the emergency power system was in frequent use. The entire system proved to be highly reliable and invaluable. The project vehicle, on the other hand, used up four domestically produced batteries in less than two-and-a-half years.

All of this equipment combined to provide a system that had these main capabilities:

- VOICE CONNECTION with all sites via the Channel A open audioconferencing network or the private telephone on Channel B.
- PAPER CONNECTION with all sites via a facsimile network that could send documents site to site.
- GRAPHICS CONNECTION with all sites for the transmission and reception of telewriting, taped graphics, or typed text for those sites with keyboards.

D. HOW DID THE PROJECT BUILD A WORKING RELATIONSHIP WITH THE TELECOMMUNICATIONS AUTHORITY?

- COLLABORATIVE PLANNING
- COORDINATING TEAMS
- COOPERATIVE WORK PLANS

All telecommunications in Indonesia are controlled by the national telecommunications authority, Perumtel. Developing a good working relationship with it was critical for the success of the project and for achieving some of the project's other goals of technology transfer. From the beginning of the project, Perumtel was a part of the planning process. It was very interested in seeing the Palapa system used for development purposes and had even organized a workshop on the topic before the launching of the first satellite. In addition, it was legally responsible for overseeing all equipment that connects with the Palapa system. All of the technical specifications for the overall system and the equipment were passed to Perumtel for its approval.

Every effort was made to make the creation of this system a collaborative process. In the beginning the RSP staff assumed the role of catalyst between Perumtel and the Directorate General of Higher Education, mainly because the RSP had technical expertise that the Directorate did not have. Later in the project as the Indonesian engineers gained experience, they took over this role of catalyst and coordinator. After the initial talks on the possibility of carrying out such a project, Perumtel assigned a coordinating team at each stage in the process. During the planning stage, regular meetings were held with Perumtel's satellite planning division. This division coordinated visits to the Perumtel offices at all of the prospective sites and supplied data and advice on the design. During the installation phase, coordination was passed to the master control station at Cibenong. Several large meetings were held at Cibenong to draw up cooperative work plans with Perumtel staff from all of the divisions related to the project. Excellent cooperation was received from all of these divisions.

Almost all of the Perumtel staff viewed the project in at least two ways: as a task and as an opportunity. As professional engineers, they approached the task with their usual goal of doing the best job possible. In this case, they were stimulated to work with even more intensity because this was such an unusual task. They also viewed the project as an opportunity to learn something new--to do something with their system that had never been done before. They saw this as an opportunity to demonstrate to people how "their" system could be used in an innovative way to support the cause of national development.

CHAPTER THREE
ESTABLISHING A MANAGEMENT SYSTEM

A. HOW DID THE PROJECT FIT INTO THE EXISTING ADMINISTRATIVE STRUCTURE?

- NATIONAL PROJECT STATUS
- NATIONAL, REGIONAL, AND LOCAL PROJECT LEVELS
- NATIONAL AND LOCAL FUNDING SOURCES

As a bi-national effort of the Directorate General of Higher Education and USAID, the Indonesian Distance Education Satellite System (SISDIKSAT) was given the status of a national "project." This meant that it had a temporary status with its funding coming totally from the national development budget rather than from the routine budget that finances permanent entities like the Directorate. The Directorate's initial aim was to experiment with the satellite system in the eastern part of the country. If it proved to be successful in achieving its goals, the system would be expanded to cover other parts of the nation. In keeping with the government's policy of decentralization, it was decided to place the headquarters of SISDIKSAT in Ujung Pandang, South Sulawesi, in the eastern region.

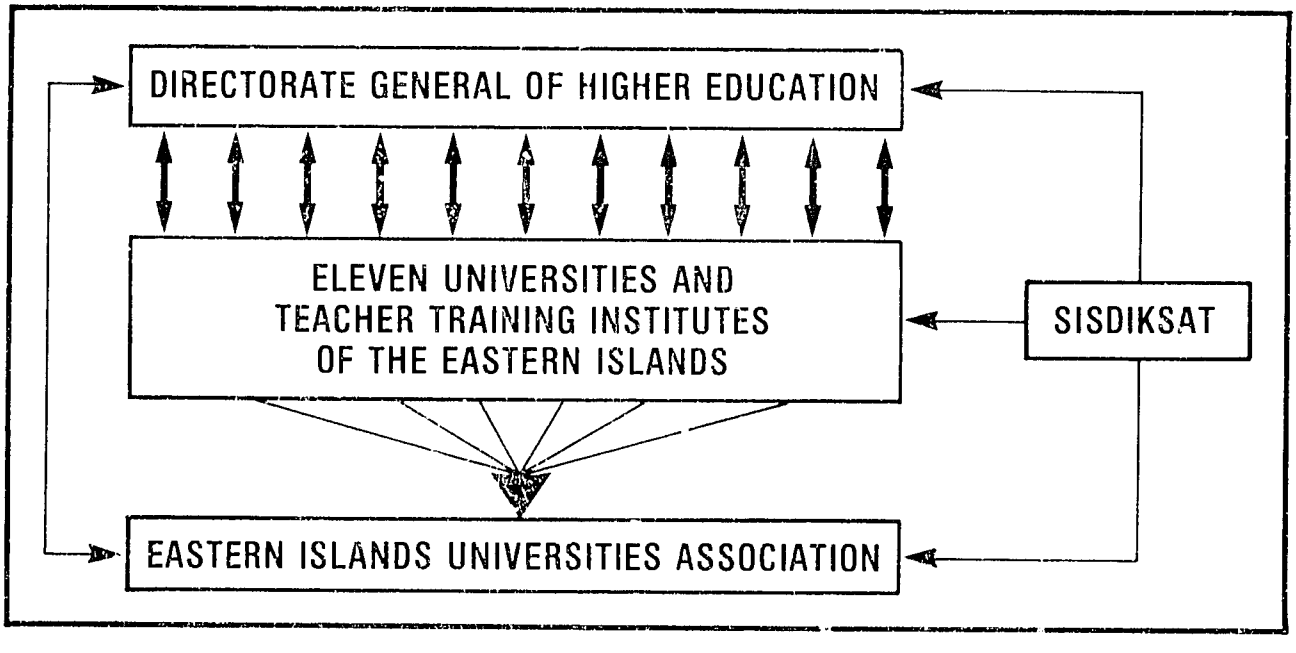
Although this decentralization strategy was logical and laudable, it was difficult to implement effectively because of the nature of the existing administrative structure and the needs of a multi-site communications network. Although the Directorate General theoretically oversaw all of higher education, particularly the 43 government-funded institutions directly under its power, each institution had a large degree of autonomy. The rectors of each institution, chosen by the Ministry of Education and Culture and the Directorate, exercised considerable independence once appointed. Although higher education associations existed in both the eastern and western parts of the country, the rectors generally dealt directly with the Directorate regarding matters pertaining to their own institutions. The associations functioned mainly as organizations for the achievement of limited, common objectives and as counterpart groups for the distribution of development aid. They never exercised any more power than what was explicitly delegated to them by their members.

SISDIKSAT connected all of these highly independent institutions into one network where cooperation was a crucial ingredient for success. Although the Directorate was the administrative head of this grouping of institutions, it did not play a major role in the daily management of the project. It controlled funding and appointed a director who reported to Jakarta, but people at the Directorate hoped that the Association would play the leading role in managing the project. The central headquarters of the Association, however, was already overwhelmed by the administrative needs of a different ongoing USAID project and never really assumed responsibility for the satellite project because of its limited mandate and the strong hand of Jakarta in controlling the budget and director. Thus the project fell into a leadership and organizational vacuum. It was a national project without strong national leadership. It was also a regional project that

was linked to a weak regional association that was unable to exercise any leadership at the time. When the Project Director failed to fill this vacuum or at least mediate a solution, the mid-level staff at the project office in Ujung Pandang moved ahead and assumed the leadership role in the network even though they had no power whatsoever over any of the sites, including the site personnel and teachers. They could lead only with the consent of the network members. Fortunately there was very close cooperation between the SISDIKSAT central office and site staffs. Some problems did arise due to a lack of supervisory authority over the teaching staff. Without this authority SISDIKSAT could not deal with instances of absenteeism and late delivery of course materials by teachers. The lack of a clear understanding of the project's administrative status or "home" was a problem that continually plagued the project and hindered its growth.

The administrative structure of SISDIKSAT, therefore, ranged over three levels: national, regional, and local. It was a national project with direct input and general supervision from the Directorate General. It was a regional project in that it was based in the east and linked to a regional association; however, its essence was the 11 local sites that made up the network. It operated between the Jakarta-based central administration and the provincial university bureaucracies. Its role was to lead and coordinate, but it had no position of power or influence over any of the participants.

SISDIKSAT ADMINISTRATIVE PLACEMENT



The very nature of a multi-site telecommunications system creates the possibility of administrative confusion in networks linking a number of independent institutions--as opposed to a structure where sites are already organized in a hierarchy (e.g., a single company's multi-site audioconferencing system). The absence of a strong hierarchical structure means that management must be based more on cooperation and collaboration than on strict lines of authority. Although collaborative planning is essential for good programming decisions, it is not an appropriate mechanism for daily management and supervision tasks. The management of SISDIKSAT was made more difficult because of the project's lack of authority over any participants in the network. The staff had to rely completely on the goodwill of the participating institutions and their locally appointed SISDIKSAT staff. Fortunately, the local staffs proved very loyal and cooperative.

Severe problems occurred with the funding of the network because of this multi-level structure and the lack of clarity about the project's administrative position. The overall budget for SISDIKSAT was allocated by the Directorate and then broken up into 13 different pieces: a Directorate budget to pay for telecommunications charges and Jakarta expenses; a project office budget to pay for program development, technical maintenance, and daily operations; and 11 site budgets to help pay for local staff and the daily operation of the classrooms. In addition, each site used local funds to pay for the furnishing of the classrooms and for staff and other costs. The SISDIKSAT central office had no direct control over any of the money spent at the local level. Guidelines for its use were established, but although it was earmarked for SISDIKSAT activities, it fell completely under the control of the local administration.

The central office also encountered repeated problems in getting control of its own budget. Although the government's policy was to decentralize project control away from Jakarta and into the provinces, there were difficulties with this decentralizing effort. Both the bureaucrats and bureaucratic procedures were obstacles to the successful implementation of this policy and especially to the speedy transfer of funds from Jakarta to the project office. As one of the very few national projects with its headquarters outside of Jakarta, SISDIKSAT experienced many problems because of this novel status and because of the unique nature of its multi-site funding needs and vague administrative position.

B. HOW WAS THE PROJECT MANAGED?

- MULTI-LEVEL STRUCTURE
- TECHNICAL COMPONENT
- ADMINISTRATIVE COMPONENT
- PROGRAMMING COMPONENT
- MANAGEMENT INFORMATION SYSTEM

As a project that crossed different layers of the higher education establishment as well as great geographic distances, SISDIKSAT had a need for a multi-level management structure that linked the sites in the provinces with the project office in Ujung Pandang and the national Directorate in Jakarta. The link to Jakarta was mainly for administrative purposes, while the link between the project office and the sites had to encompass three areas: technical operations, administration, and programming.

The original plan for coordination between the project office in Ujung Pandang and the Directorate in Jakarta a thousand miles away involved three mechanisms:

1. An active project director in Ujung Pandang who would work closely with the Jakarta officials overseeing the project;

2. A high-level policy committee consisting of representatives from all involved groups: the Directorate, Ministry of Communication, USAID, Perumtel, University Association, and the project office that would meet several times a year to solve major problems and give direction to the project;

3. Regular use of the audioconferencing system between the project office and the Directorate.

The link between the regional project office and the sites was to depend on:

1. A highly active project staff in Ujung Pandang who would serve as the leaders, managers, and trainers for the three main project components (technical operations, administration, and programming) for the entire system;

2. A locally appointed staff at each site who would be responsible for managing local operations in the same three areas.

ADMINISTRATIVE LEVELS AND PERSONNEL

Level	Personnel
National	Directorate General National Policy Committee
Regional (Ujung Pandang)	Project Director SISDIKSAT Central Staff University Association Staff
Local (sites)	SISDIKSAT Local Staff Local Users/Presenters

Unfortunately, none of the three mechanisms for coordination between the project office and the national office was ever successfully operationalized. A part-time project director was appointed who worked actively in the early planning stages. His attention to the project greatly declined when the implementation phase began. He never was able to devote much time to the project and to carry out his duties properly because of the demands of the other positions he held. Any innovative program of this nature must have a strong project director who deeply believes in the goals of the project and who is willing to convince others at least to try the innovation. The absence of such a director at SISDIKSAT was a great detriment to the development of the project and to the maintenance of close ties with Jakarta, because such a person would have been the only one with sufficient seniority to work comfortably with higher officials.

The idea for a policy committee of upper-level officials representing all participating groups was outlined in the bi-national agreement establishing the project. The committee, however, was never created by the Directorate. For unknown reasons, the Directorate resisted the establishment of such a group. This left the project without a senior advisory board that could set general policies (e.g., on program priorities) and help the project staff solve problems that were beyond their power (e.g., budget requests).

Communication with the Directorate via the satellite system was sporadic. For important discussions, the senior officials in Jakarta preferred to talk to the Project Director in person. Before the system ever went into operation, one of the rectors predicted that high-level officials would not be likely to use it themselves. His experience had been that they did not feel comfortable discussing management issues over the telephone and therefore would be unlikely to use an audioconferencing system. "It is a

cultural thing," he said. "They want to see you in person when they need to discuss something, even if it can be easily settled over the phone." Some mid-level officials in the Directorate did use the system for discussions with the project staff; however, a great many trips had to be made to Jakarta to settle project business face to face. On the other hand, senior people at the remote sites regularly used the system, including rectors, vice rectors, and professors.

This failure to establish lines of communication between the Directorate level and the project level was a major hindrance to the smooth progress of the project. People at the highest level were not well informed of the project's achievements and needs--especially budget requirements. The Jakarta-based senior officials were very busy people with many other tasks, including much larger projects, to oversee. They did not have time to concentrate on SISDIKSAT. Therefore it was crucial that someone from the project level take the responsibility for keeping them informed of the progress and requirements of the project. There was a great need for someone to serve as an advocate and promoter of the project: to explain its goals, importance, achievements, and problems. Unfortunately there was no one to fulfill that function.

Fortunately a strong technical, administrative, and programming infrastructure was established from the project level on down to the site level to carry out the daily operations of the project. Despite the serious problems that occurred because of the poor communications between the project level and the Directorate, the presence of dedicated people at the operational level (project office and sites) made it possible for the project to move forward and succeed in its efforts. These successes could have been much greater if a closer relationship had been established with the people in Jakarta who controlled the flow of resources into the project.

A management information system was gradually put into place to generate the data needed by central office personnel for management purposes. The technical people relied on a daily logbook of technical performance, a master list of the status of the equipment at each of the sites, equipment fault and repair forms, and an inventory list to track the stock of spare parts. The administrative section compiled data on attendance, production and delivery of support materials, and program cancellations. The programming component relied on survey forms and an elaborate observation system. Survey forms were given to teachers, local tutors, students, and seminar participants to get their reactions to the programs and materials. The observation system used student monitors who listened to the audio channel 54 hours a week and catalogued what they heard at 10-second intervals. The monitoring form had 22 categories. Fourteen of the categories related to interaction in the programming and tracked the amount of time used by presenters and participants for such behaviors as lecturing, questioning, and answering. The other eight categories accounted for other uses of SISDIKSAT time (e.g., news, technical maintenance, course administration), periods of silence, and technical problems. Some of these data were passed on to the presenters along with comments by the programming staff. Some were used by the administrative and technical people. All of the data were used for evaluation purposes to detail what was actually happening on the satellite network.

The great mass of data generated by the surveys often went beyond the capacity of the part-time, SISDIKSAT personnel to deal with it. Overburdened by the work load and stymied by a lack of resources, they were unable to process the information fast enough for it to have a formative effect. It served mainly as summative evaluation information. The observation system worked much better because RSP funds were used to hire special personnel to collate and interpret the data.

C. WHAT STAFF WERE NEEDED?

- CENTRAL OFFICE AND LOCAL SITE-LEVEL STAFF
- ADMINISTRATIVE STAFF
- TECHNICAL STAFF
- PROGRAMMING STAFF

As discussed above, there was a need for staff at the central, regional, and local levels for the three project components of administration, technical operations, and programming. In retrospect it would have been better for the project if there had been a project liaison person at the Directorate who could have served as a coordinator and advocate for the project. Some people occasionally filled that role as needed, but it was never fully delineated and formalized, like most of the intended linkages between the project and the national level. The situation was better at the regional level and functioned best at the local sites. Figure 6 shows the staffing pattern that was followed at the central office and at all of the sites.

At the beginning of the project the staffing needs of the central office and the local sites were identified and short job descriptions were drawn up. To a great extent these staffing patterns were followed by all the local offices and were found to be adequate. One of the problems encountered was finding people to work full time on the project. Most of the professional staff were recruited from among faculty members at the sites. Usually these people already had additional jobs beyond their teaching assignments, so their work with SISDIKSAT became one more additional task.

There were never any professional-level personnel working full time on the project. The only people who did work full time were some of the operators and clerical staff. Everyone else had to divide their attention between SISDIKSAT and one or more other jobs--most of them demanding. This was not a satisfactory situation, but it was the reality of project life in Indonesia. The lack of trained manpower, especially at the university level, meant that skilled senior people were in great demand by university departments, university projects, private schools, and private industry. A faculty member had to work at a number of jobs to be able to afford a middle class lifestyle. To compensate for the lack of full-time people, a greater number of people were involved in the project.

The project was led by a Project Director who was appointed by the Directorate and the university to which he was assigned. His role was to oversee operations and personnel, draw up and supervise budgets, develop long-term plans for use of the system, and serve as the main advocate and contact person for the project. The importance of having an active and committed person in this position cannot be overstated. It is the key position for garnering the financial and political support a project needs in order to survive and flourish.

Figure 6

STAFFING PATTERN AT CENTRAL OFFICE AND SITES

Position	Major Responsibilities
Project Office:	
Project Director (one-quarter time)	— supervise personnel and budget — maintain relations with higher level — promote project goals
Administrator (one-half time)	— supervise central office operations — schedule time on the system — coordinate administration with Local Coordinator
Administrative Assistant (one-half time)	— supervise production and distribution of program and evaluation materials — supervise record-keeping — maintain budget records
Chief Technician & Asst. Chief Technician (one-half time)	— supervise operations, maintenance, repair — provide technical support for sites — manage training of technical staff — coordinate operations with Perumtel
Chief Operator (full time)	— coordinate daily operations of operators — oversee inventory of spare parts — maintain and repair equipment
Program Coordinator & Asst. Coordinator (one-half time)	— supervise development of programming — train and support users — evaluate programs
Local Sites:	
Local Coordinator (one-quarter time)	— manage local site — coordinate activities with central office and local users — identify program needs and target groups
Administrative Assistant (one-half time)	— handle distribution of program materials and messages sent over the system — assist coordinator
Local Technician (one-third time)	— supervise local technical operations — do local maintenance and repair
Local Operators (half to full time)	— carry out daily operation and maintenance of classroom equipment — maintain records — assist users

Under the Project Director were the coordinators of the activities for the administrative, technical, and programming components: the Project Administrator, Chief Technician, and Program Coordinator. They were on an equal level and formed the core

group that ran the project on a daily basis. These positions were filled by university faculty members who were able to allot 5 to 25 hours per week depending on the demands of their various jobs. Because of their part-time status, they were assigned assistants. The assistants were also university faculty, but they were usually of mid-level or junior status and generally able to give more time to the project.

The administrative level was led by an Administrator who managed the scheduling of the satellite system and the operation of the project office. She was aided by an Administrative Assistant who was able to devote most of his workday to the project. One of the main roles of the Administrator was to maintain close contact with the Local Coordinators at each site. These were usually senior faculty members who oversaw all local activities related to SISDIKSAT, including supervision of the Local Technician and Operators and management of the budget allotted to the site by the Directorate. The Local Coordinators were the key people in carrying out program needs assessments, creating local interest and support for the project, and serving as the main contact between the project office, the local campus staff, and the outside community.

The technical area was headed by a Chief Technician and Assistant Chief Technician headquartered at the project office. These people were members of the engineering faculty and specialists in electronics. They supervised the overall operation and maintenance of the system, provided technical support and training to the local sites, and coordinated all work with Perumtel.

Each site appointed a Local Technician who served as the main technical supervisor of the classroom. These people were faculty members who either had engineering degrees or some experience in electronics. They also worked on a part-time basis.

The daily operation of the local equipment was in the hands of the Local Operators. These people varied in background for the job. Most were high school graduates. Some had graduated from a vocational or technical school. Most had some experience operating electronic or mechanical equipment, but others had almost no experience at all. Each site appointed from two to five operators to staff the classroom from 7:00 a.m. to 5:00 p.m. Operators also worked beyond 5:00 p.m. on those days when their site participated in early evening programming. The number of operators per site varied depending on how busy they were with other jobs. For instance, some operators also worked as lab technicians. The general requirement was to have at least one person on duty in the classroom throughout the day.

The Programming Office was headed by a Program Coordinator and Assistant Coordinator. They were responsible for development of the presentations to be delivered over the system including courses and seminars, for assistance to users, and for evaluation of the programming. They worked closely with the Local Coordinators in assessing the needs of the sites and in coordinating the logistics of programming. For decisions on the academic course program, they worked with a standing committee of the vice rectors of academic affairs of each institution, who met several times a year to choose the courses and teachers. They also worked closely with faculty members in the development of materials for courses. Because supervising the development of 15 courses per semester was too much work for two people, an attempt was made to recruit and train five materials development specialists to work with the course teams on the preparation of print materials and the audioconferencing sessions. Budget problems, however, forced the cancellation of this effort.

The project was able to operate with this level of manpower and to carry out a fairly full schedule of programs. There is no doubt, however, that the almost total dependence on part-time professionals limited the range and quality of that programming. There was a lack of follow-through in identifying different types of programs and user groups and in ensuring that the materials for each program were prepared according to project guidelines. Also there were not enough people to provide continuous assistance to long-term users. Another problem with using part-time people who have other major commitments is that their schedules will vary as to the times at which they can work on the project. The Administrator may be able to come in every afternoon, while the Program Coordinator may be able to work only three days a week in the mornings. It is difficult to establish a schedule that covers all of the tasks that need to be done and that allows for interaction among staff members. Under such conditions it is important that there be at least one time a week when the core staff can meet together to make a weekly or monthly work plan.

On the positive side, the use of faculty members for all key positions on this education project ensured that the project staff understood higher education and its programming needs. They were also personally acquainted with many people at the participating sites. Thus, there was little distance between the project and the user community of teachers, students, and educational administrators.

D. WHAT WAS THE ROLE OF FOREIGN TECHNICAL ASSISTANCE?

- TECHNICAL DESIGN
- EQUIPMENT SELECTION, PROCUREMENT, AND INSTALLATION
- MANAGEMENT SUPPORT
- SHORT- AND LONG-TERM CONSULTATION

The USAID-funded technical assistance was intensive in the beginning of the project and gradually declined over the four-year period of the project. USAID awarded two contracts related to the Rural Satellite Program: one to the Academy for Educational Development for the actual implementation of the project and another to a research firm for the evaluation component.

The Academy and its engineering subcontractor took the major responsibility for surveying sites and designing the technical system. Numerous trips were made to Indonesia to study the technical system, meet with Perumtel staff, and plan the uses of the system with the Directorate General of Higher Education. The initial design was done by an RSP engineer who had worked in Indonesia for five years helping to install the Palapa system. The specific equipment for the classrooms was chosen after the people at the sites and the Directorate had identified the types of capabilities that would be useful. The long and complicated process of equipment procurement was carried out by the RSP. All engineering and hardware costs were paid for by the USAID contract.

Although a number of engineers were involved in the planning stages, one RSP engineer had full responsibility for all of the field work in Indonesia after the initial technical survey. This continuity was very beneficial because he was able to build good working relationships with the technical staffs at the project and at Perumtel and needed

no briefings to get acquainted with local conditions during all subsequent trips. This engineer worked side-by-side with the Indonesian Chief Technician and Assistant Chief Technician during all of his visits (approximately 11 months in the field in two-and-a-half years). When back in Washington, he kept in touch with developments in the field through contact with the RSP home office and through telephone conversations with the RSP Field Director and SISDIKSAT's Chief Technician.

The engineer's and the Chief Technician's skills complemented each other because the engineer was an expert in telecommunications systems and the Chief Technician was more skilled in electronics and computers. During the early stages of the project, the U.S. engineer took the lead in meetings with Perumtel, given his longer experience with the design of the system and the equipment. The Chief Technician soon reached the U.S. engineer's level of knowledge about the equipment and the basics of the system and increasingly became the primary engineer. By the end of the last technical visit, the Chief Technician was well prepared to take full responsibility for the technical system.

On the management side, at least six trips to Indonesia were made by RSP and/or AID/Washington staff to assess Indonesian interest in participating in RSP, to negotiate the terms of the project agreement, and to help the Directorate develop initial implementation plans. These planning trips consumed over six person-months of staff time. The Education and Human Resources Division of USAID/Indonesia assisted in these efforts and monitored the project's progress on a regular basis.

The RSP placed an education/training specialist as RSP Field Director in Ujung Pandang for three-and-one-half years to manage the delivery of equipment, coordinate technical assistance, and serve as primary advisor to the project staff and Directorate. He worked closely with the project staff in all areas: management, technical operations, and programming. In addition to the RSP engineer, other Washington-based staff spent significant amounts of time (12 person-months) in Indonesia assisting the Field Director with the installation and inventorying of equipment and the preparation of evaluation, training, and management materials.

Several short-term consultants (six person-months) were brought in from the United States to assist the project staff members in planning their management and administrative systems, to run workshops on audioconferencing and distance education, and to help prepare educational materials. A number of Indonesian short-term consultants were also hired by the RSP for specific tasks. The first consultant, a staff member from the government's Communications Technology Center in Jakarta, visited several classrooms and drew up designs on how to improve their acoustics with locally available materials. Later in the project, one of his colleagues came to Ujung Pandang twice to work with programming personnel on guidelines for developing and assessing course materials. Other Indonesians were hired on a short-term basis to help SISDIKSAT personnel with the clearance of equipment through customs, the preparation of technical drawings and training and program materials, and the implementation of evaluation activities. In addition to the obvious goal of using specialized manpower to meet immediate needs, the hiring of Indonesian consultants had another rationale. The RSP wished to create linkages with other agencies, groups, and individuals that could help support the project after U.S. assistance ended. This effort was successful in bringing other government and private organizations into contact with the project, and several productive relationships were established. This networking was a very important product of the RSP's use of local consultants.

All consultants associated with the project, both foreign and domestic, were assigned counterparts regardless of the length of their work period. The only exceptions were those people who were hired to do a very specific task that would not be repeated (e.g., creation of technical drawings). The consultants were required to work closely with their project counterparts. The counterparts provided knowledge about the project, the working environment, and the topic area, and the consultants provided the counterparts with in-depth knowledge on the content area of the consultancy. Whenever possible, this training function was made part of the consultant's scope of work. This policy worked very well in most cases, especially when the two people developed a good personal relationship.

One of the problems in developing on-the-job training of consultants was the part-time nature of all of the professional project staff. In some cases the RSP did not bring in a consultant because there would be no one to work with intensively. The varied schedules of the project staff and the dispersed locations of the course developers made the provision of technical assistance very difficult. There had to be a "critical mass" to make a consultancy worthwhile. It was not feasible to fly someone to a site to work only a few hours a day, at most, with the person developing a course.

Formal training of personnel was a very important aspect of the technical assistance supplied as part of this project. It is discussed in detail in Chapter Five.

CHAPTER FOUR
PUTTING THE SYSTEM INTO PLACE

A. WHAT WERE THE STEPS IN INSTALLING THE SYSTEM?

- EQUIPMENT SELECTION, PROCUREMENT, AND TESTING
- SHIPMENT, INVENTORYING, AND TESTING
- INSTALLATION AND TESTING THROUGH THE SATELLITE
- TROUBLESHOOTING AND REPAIR
- ADAPTATION AND OPERATION

Because no one had ever put together a system of this nature in a developing country, there were no guidelines for the planners to follow in estimating how long the process would take. The initial plan foresaw a six-month period as adequate for the entire process from procurement to operation. It soon became apparent that this estimate was unrealistic. Almost every step of the process took much more time than anticipated. For instance, agreement on the selection of the equipment by the Indonesians took months instead of weeks. Some equipment took longer to assemble than originally estimated; some equipment suppliers simply did not meet agreed-upon deadlines. Shipping also took longer than estimated, and Indonesia's customs clearance proved to be a much more time-consuming process than originally thought, even though the equipment was a grant to the Indonesian Government.

In some cases delays in the process were caused by slow action on the part of individuals. In many cases, however, the failure to keep on schedule was mainly due to unrealistic expectations of how quickly things could be done. Many deadlines could not be met because they were not practical. Therefore, the six-month plan became a 12-month plan, and eventually 18 months passed from the approval of the equipment by Perumtel to the transmission of the first course. Because this was a pioneering project, it was expected that original estimates might be inaccurate. The main problem was that in some instances decisions were made on the basis of inaccurate timelines and some resources were not utilized efficiently (e.g., some user training programs were run many months before the system was actually ready for use).

One of the purposes of the project, however, was to identify the difficulties in establishing audioconferencing systems in the Third World. This purpose was accomplished with resounding success, although it was never a cause for rejoicing among the staff as they encountered, identified, and surmounted these obstacles. The figure on the following page details the actual time periods required for each of the major steps in the installation of the audioconferencing system in Indonesia. The length of time required to install a similar system in another place would vary depending on such factors as the amount and type of human and financial resources available, the condition of the existing telecommunications network, and the physical environment of the sites (e.g., heat, humidity, distance, remoteness). Given the amount of knowledge gained from installing this system, a similar system undoubtedly could be installed in another part of Indonesia in less than a year.

Figure 7

TIME FRAME FOR SELECTED PROJECT ACTIVITIES

Activity	1982	1983	1984	1985	1986
Signing of Project Agreement	o				
System Design	oooooo	ooo			
Equipment Procurement, Shipping, and Clearance		oooooooooo			
Training of Indonesian Staff	oo	oo oo oo	oo oo	o	o
RSP Field Manager in Indonesia		oooooooooooo	oooooooooooo	oooooooooooo	oooooo
Testing of Equipment (Factory, Post-Shipment, Post-Installation)		oo o	o ooooo		
Installation of Lines by Perumtel		oooo	oooo		
Installation of Equipment		oo	oooo		
Installation of Gating System			o	ooo	
Course Delivery			ooo	oooo ooooo	ooooo oooo
Seminar Programs			o	o ooo	oo o

Equipment selection was basically made by RSP staff members who already had experience with and knowledge of different types of audioconferencing equipment. Therefore, there was no discrete time period for equipment selection. RSP staff kept abreast of what was on the market and made an extensive review of available hardware preceding each purchase. Price and reliability were main criteria for purchases. RSP engineers discussed the technical suitability of certain types of equipment with Perumtel engineers during their trips to Indonesia, and the user groups were also consulted on the types of facilities they would require. The specifications of the final hardware items were sent to the Directorate and Perumtel for approval.

Procurement was a long process governed by U.S. government purchasing policies which require at least three bids for certain types of purchases. Foreign-made equipment like the graphics system required special justification and approval. Contracts had to be negotiated and signed with all of the vendors and their compliance monitored. Some of the contracts included provisions for the training of personnel and the installation of the equipment itself in Indonesia (small earth station). No major equipment purchases were made in Indonesia.

In general, better service was obtained from established companies producing standard products (facsimile, telephone terminal, and audioconferencing equipment). Most problems occurred with a small firm that was producing specially designed equipment (small earth station) and an older, larger company that was marketing a new commercial version of a field-tested product (telewriter). Cost must always be a major consideration, but one needs to look at the final cost of a product as well as its initial purchase price. A product may have a low purchase price but need expensive servicing and repair or other types of expenditures in order to work well. The initial cost of equipment from an established, reputable company may be higher, but that equipment may prove more reliable in the long run, thus saving the cost of repair and lost time. It is important to consider a company's reputation for supporting its products after they are in the field and to identify what servicing facilities, if any, are available in the areas where the equipment will be used.

All of the major system components underwent a period of factory testing under the supervision of an RSP engineer before they were accepted and final payment made. This is necessary to ensure that the equipment does what it is supposed to do (i.e., meets all technical and operational specifications). Of course, it is not always possible to conduct the tests under exactly the same conditions that will exist at the final sites, but an approximation can be made and certain problems can be identified and solved before the equipment is packed and shipped.

Shipment and inventorying are other time-consuming activities. Someone must make certain that the right numbers and types of equipment are being shipped to the entrepot. Sea shipments take two months to reach Indonesia; then customs clearance takes another one to two months. A missing part cannot be replaced in less than one or two months even if it is sent by air. When equipment is being bought from several companies, it is advisable to accept shipment at a central area where it can be checked and consolidated for shipment overseas. If this is not possible and the companies ship directly to the overseas site, it is important that someone monitor the equipment lists to ensure that at least the paper inventory is correct. If the shipped equipment is to undergo customs clearance at the port of arrival, the process can be accelerated if all of the required documents are in order and copies are sent to the receiving party as soon as possible.

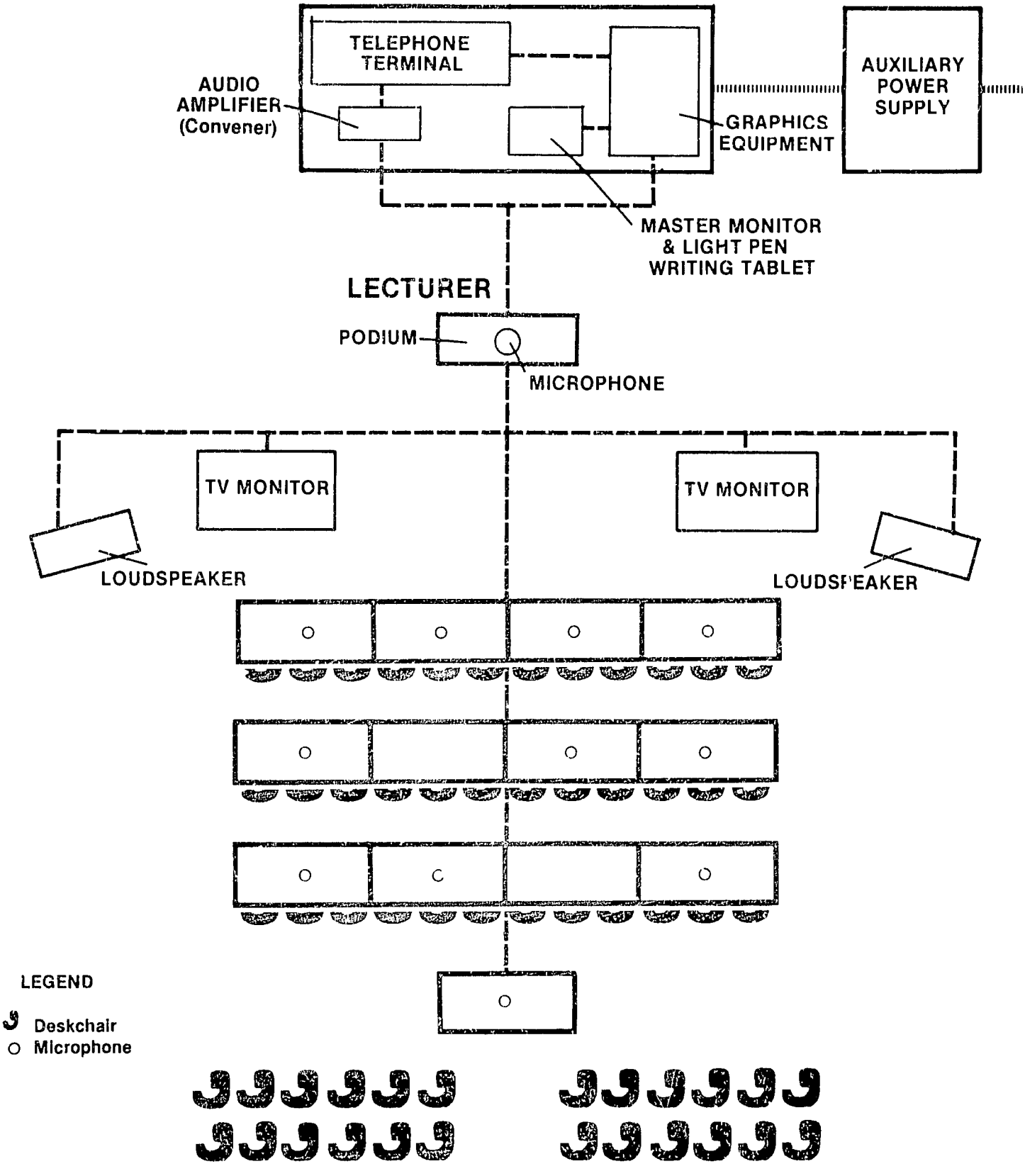
After the equipment arrives in-country and before it is shipped to the local sites, it is very important to inventory and test it to determine if all parts are enclosed, if any damage has occurred during shipment, and if everything is working properly. Because many of the SISDIKSAT sites were in very remote areas, all of the most sensitive equipment (telewriter, fax, terminal, televisions, etc.) was tested in Jakarta before it was sent out to those sites. Three units were hooked together at one time for testing purposes to ensure that they would work in a multi-site configuration. The equipment was then divided according to site and shipped.

Installation and initial system testing of the system occurred in two phases. In the first phase, Perumtel took responsibility for providing four pairs of telephone lines to each location. Every location required some expansion of the local telephone infrastructure because no classroom building had even a single telephone, and telephone service at all campuses was very limited. Demand for telephone service in Indonesia far exceeds the supply, and few sites had excess capacity that could be used for the project. Thus, in most cases Perumtel had extensive work to do. Existing cable had to be checked to measure and improve its quality, and additional cable had to be installed. In Jayapura, Perumtel installed 20 kilometers of new cable across a mountain and onto the campus. In Bogor, 15 kilometers of new cable were strung. In Ambon, an existing radio link from the local telephone office across a bay was extended to the classroom site. All this work represented a massive effort by Perumtel to add additional telephone facilities and to upgrade the links to meet international standards for data transmissions. Despite many obstacles, Perumtel did an excellent job in providing the basic telecommunications system linking the classroom sites.

The second phase of the installation involved the placing of equipment in the classroom and initial testing through the satellite. This was a cooperative effort on the part of SISDIKSAT and RSP engineers, a team of engineers from Perumtel's central office, and the local technical staffs of Perumtel and SISDIKSAT. The local site was given a list in advance of the labor and materials needed by the installation team. Immediately preceding installation, the Local Technicians from each site were brought to Ujung Pandang for an intensive seven-day training program on the operation and maintenance of the equipment.

The basic placement of the equipment in the classroom was a relatively simple affair completed in a single long day of work. It was much more difficult to get the equipment communicating from site to site through the regular telephone and satellite network. Field testing required the cooperation of personnel at the master control earth station near Jakarta, the local earth station, and the local telephone office. The Assistant Chief Technician remained in Ujung Pandang operating the classroom there as the other end of the testing line.

Numerous problems were encountered during this installation phase, and it took the combined efforts of all of the technical people involved to solve them. The Perumtel engineers understood their own basic system, and the project engineers understood the classroom equipment. But both groups were unfamiliar with how this classroom equipment would operate over the telecommunications system, especially in a multi-site, loopback configuration. They were breaking new ground, and it required hard work and ingenuity on the part of Perumtel and project engineers to put a site into operation. This was generally accomplished in about three to four days and nights of work. It would have taken a week per site if everyone had not worked overtime.



TYPICAL CLASSROOM INDONESIA PROJECT

FIGURE 8

During installation there was a constant need for troubleshooting throughout the whole system to identify and correct problems. Perumtel temporarily installed field phones at each site to give its personnel instant communication with its own network. Even then, the installation team members often had to move between the classroom, telephone office, and earth station to properly set transmission and reception levels and locate the source of problems. Despite the previous tests conducted in the United States and Jakarta, equipment failures occurred during installation. The project engineers carried spare parts with them to each site and, therefore, were able to make most repairs immediately.

As more sites were added to the network, problems with the level of noise entering the system increased. After all the sites were installed, system-wide tests were conducted with Perumtel staff monitoring the system at all points in the network to identify the sources of the noise. After each test Perumtel central staff either visited or sent instructions to their local offices for more local testing and troubleshooting. Uncertain about the degree of success Perumtel would have in upgrading the quality of its lines, the project engineers devised an adaptation for the ground system that would limit the noise: transmission gates. This innovation is discussed below.

Although the installation of classroom equipment was completed by April 1984, the system was used only intermittently for messages and meetings because of its low reliability. It was not until September 1984 that the system reached the level of reliability necessary to schedule regular classes. SISDIKSAT began operations with an experimental semester of two courses (Statistics I and Food Science I) to test the quality and reliability of the system before beginning a full schedule of activities. When these courses ran without a single cancellation due to technical interference, the decision was made to proceed with a full semester of 10 courses beginning in February 1985.

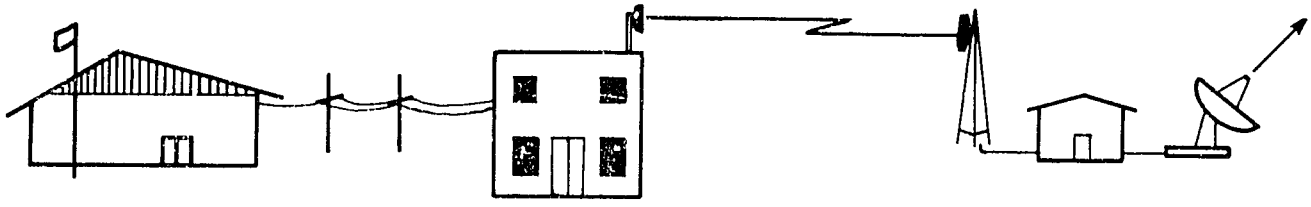
B. WHAT WERE THE MAIN PROBLEMS ENCOUNTERED?

- POOR LOCAL LINE QUALITY
- VARIABILITY OF TELECOMMUNICATIONS NETWORK
- EQUIPMENT FAILURE

Creation of the satellite network was very complicated and fraught with difficulties at every step: procurement, shipment, customs clearance, testing, etc. These were preliminaries, however, to the main task of putting the system into place and making it reliable enough to carry educational programming. The last, and most formidable, stumbling blocks to operationalizing a high-quality system were problems with the existing telecommunications infrastructure and with some of the classroom equipment.

When more than seven sites were linked into the network, noise levels increased alarmingly, and when all 11 sites were finally linked together, periods of high quality would be interrupted by loud bursts of noise which continued for seconds, minutes, and sometimes even hours. The overall quality of the system varied greatly from day to day and even from hour to hour. Some sites were most often identified as sources of the noise, but almost every site, at one time or another, experienced problems. The system simply was not usable as a medium for regularly scheduled programming.

TYPICAL GROUND AND SPACE SEGMENT LINKS



CLASSROOM Local Lines TEL.OFFICE Lines or Microwave EARTH STATION

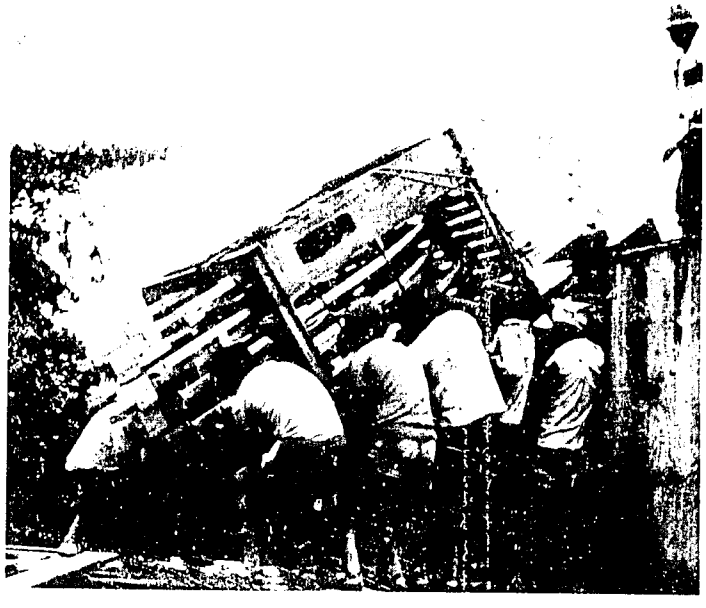
Perumtel and project staff worked closely together to locate the sources of problems--sometimes through scheduled test sessions but mostly through quick reporting of technical disturbances. The main problem seemed to be poor local line quality. In some areas old cable from colonial times was still in use. Some cable was underground and exposed to groundwater following the rainy season. Some local connections were made of various types of cable spliced together. Overall the cabling system was often not grounded and balanced in a way to ensure high-quality transmissions. At times crosstalk was a major problem: Channel A conversations could be heard on Channel B and vice versa.

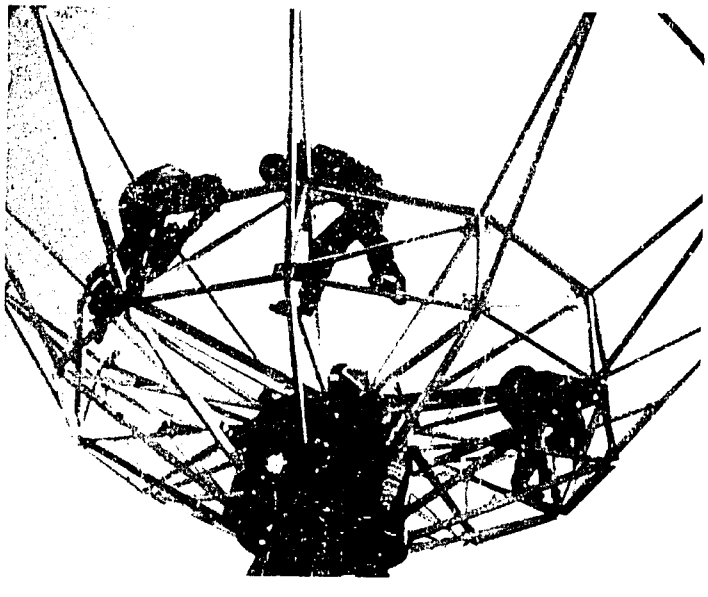
Beyond the problem of the local cabling was the variability of the overall Perumtel system. Although system checks revealed that most of the noise was coming from the outside plant (cables), the checks also showed that some earth stations and microwave connections were also contributors of noise and other problems. In addition, a site that was very good one week would be one of the worst in another week. A problem would be solved at a site in one month only to recur the next month. It was apparent that the problems were rooted in the maintenance and operations of the Perumtel system as well as in its equipment.

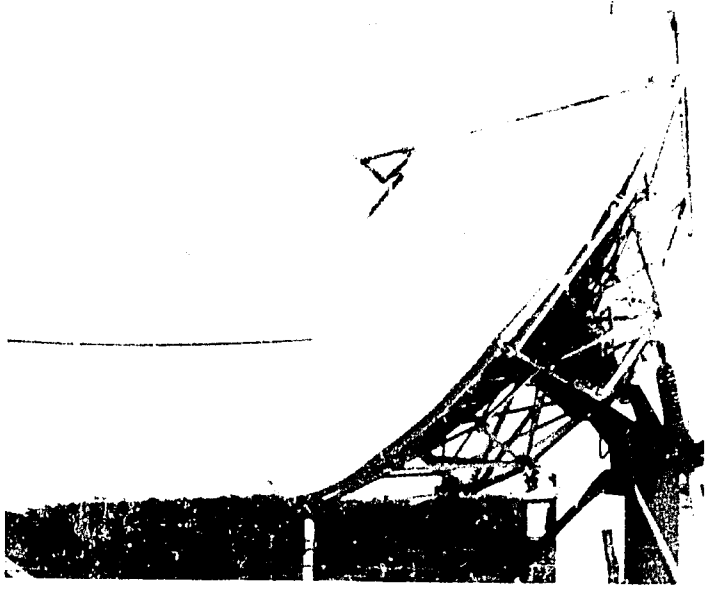
A reliable, high-quality telecommunications system needs trained and disciplined personnel working according to a very detailed operations and maintenance plan. Failure to adhere to the plan and carry out continuous monitoring and adjustment of the system leads to technical problems. Often a problem such as a complete block of transmission capability would occur with the SISDIKSAT network. A public telephone would have to be used to request emergency assistance from the local earth station or the central control station in Jakarta. On some occasions what appeared to be a major system-wide problem would be cleared up in a few minutes. In other cases it took hours for master control to monitor each location one by one to locate the problem site. These "simple" problems indicated that there were failures in operational procedures as well as in the Perumtel equipment. Local telecommunications personnel were not always successful in keeping their equipment operating at peak performance. There was possibly also some confusion related to the changes in equipment set-up that were necessary for the dedicated SISDIKSAT system but not for the regular telephone system. Personnel sometimes forgot to treat the SISDIKSAT channels in a special way. Some other technical problems were directly related to the introduction of new modems at the earth stations and the technicians' inexperience with that equipment.

Perumtel made a major effort to correct the deficiencies that were found. Loaded with test equipment, teams of engineers from the central office made several trips to the sites to help local personnel identify and correct technical problems. Gradually they

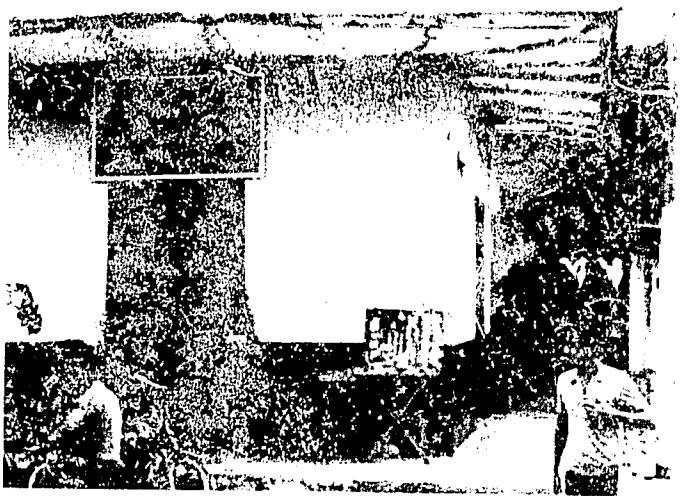
Images from the AID Rural Satellite Program







Satellites can provide telecommunications services to remote and rural areas. The smaller the earth stations, the lower the costs. The Peru Rural Satellite Project is the first to successfully use small six-meter stations with the international satellite system for internal communication.

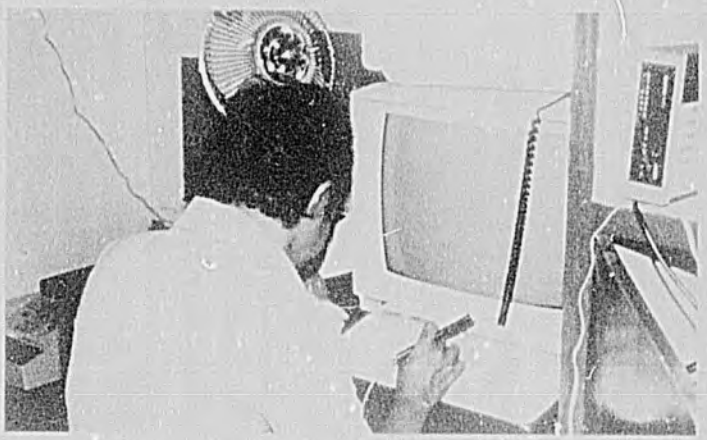


Basic telephone service is essential to rural development. For the first time, the rural Peruvians in the remote San Martin region are connected with the nation's commercial and political centers—and with each other. Within months, the new telephone system was used to capacity and has since been expanded twice to accommodate heavy usage. Over 110,000 phone calls were made in 1985, generating over $100,000 in revenues.

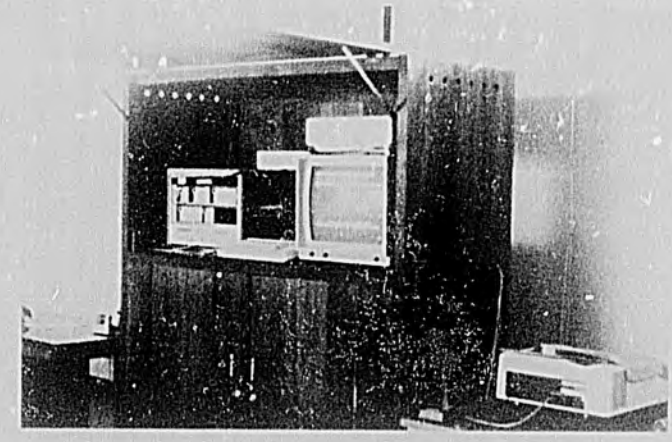
Push-to-talk microphone

Telephone terminal and private telephone

Facsimile machine



Telewriter/graphics display



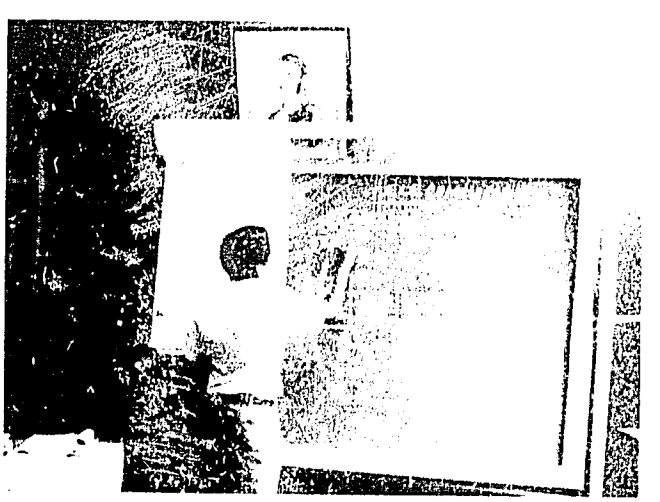
Typical classroom layout

Special equipment attached to telephone lines can transform ordinary telephones into audioconferencing systems linking many groups over vast distances. Using a simple telephone circuit, groups of people can talk, view pictures transmitted by telewriters, and receive text via facsimile. The Rural Satellite Program installed 25 "electronic classrooms" for three different projects.

In-service training of primary school teachers

Administration of rural institutions

University teaching to thousands of students

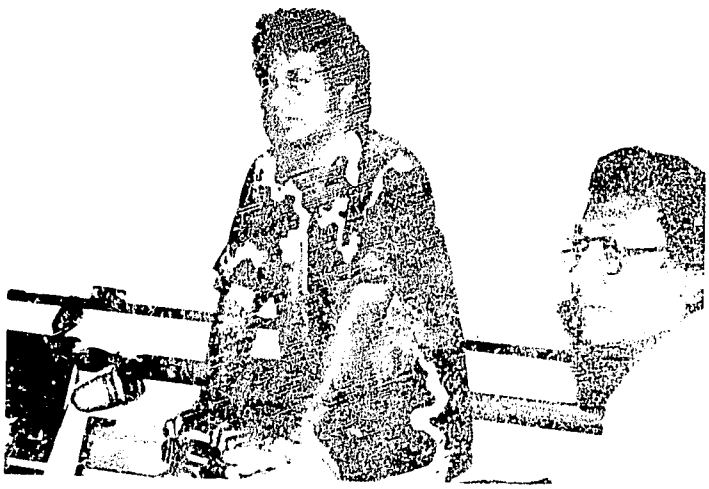


Technical training for telecommunications personnel

Interactive audioconferencing networks can reliably and affordably support many different development activities. Audioconferencing provides a means of extending scarce expert resources and educational opportunities to remote and rural areas. The Rural Satellite Program explored its applications for health, education, and agriculture. The Pilot Projects in Indonesia, the West Indies, and Peru used audioconferencing for university teaching, in-service training of health care workers, teachers, and agricultural extension agents, medical consultations, research exchange, and rural administration. Over 92 percent of the participants indicated it helped them do their jobs better.

Animal husbandry training for extension agents

Coordination of Child Health Campaign



DEPARTEMEN PENDIDIKAN DAN KEBUDAY
UNIVERSITAS HASANUDDIN
KANTOR PUSAT
PROYEK PENDIDIKAN JARAK JAUH
MELALUI SATELIT
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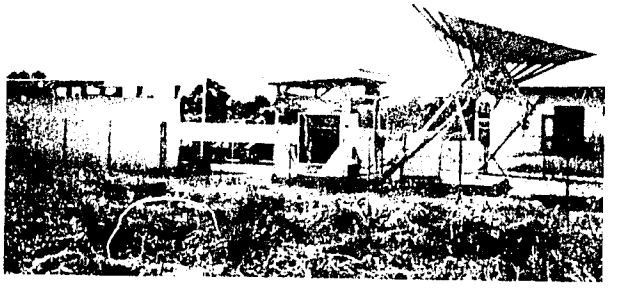
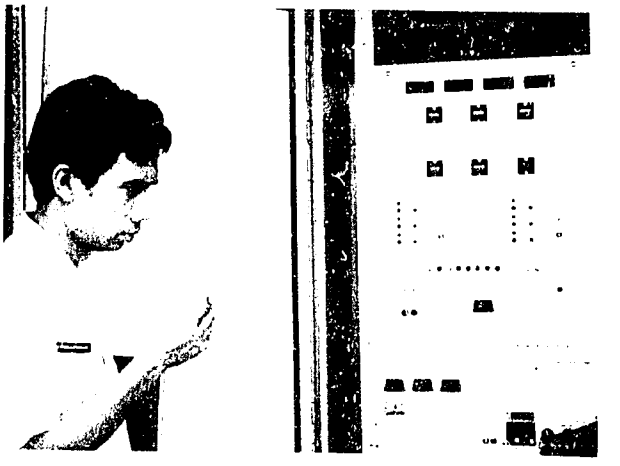
Effective audioconferencing programs need careful coordination and management of programming, technical, and administrative components. General requirements for successful communications support projects include:

- a central coordinating office supported by staff at all sites
- accurate identification of user needs and appropriate program development
- thorough training of management and technical staff, as well as program presenter and general users
- development and distribution of educational support materials
- adequate budget for central office and local site operations

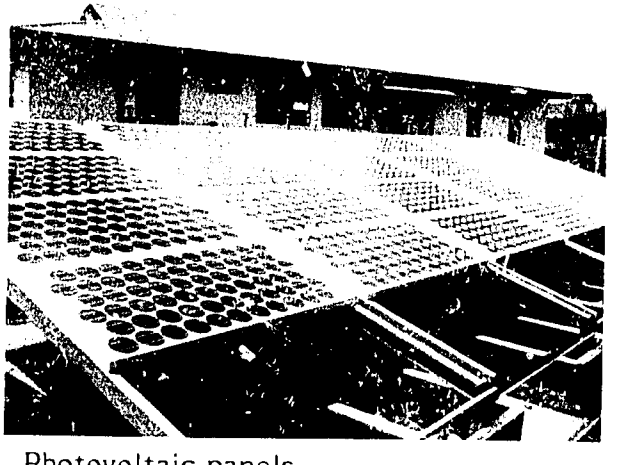


Earth station, photovoltaics, and audioconferencing room

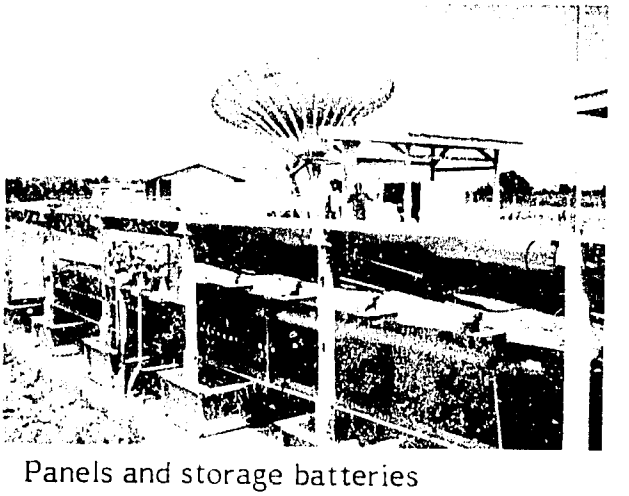


Station requires only quarterly maintenance visits

Satellite technology can be adapted to withstand the rugged conditions prevailing in rural areas. In the remote Indonesian village of Wawatobi, the Rural Satellite Program designed and installed a small solar-powered earth station and photovoltaic array. The station provides multi-channel telephone service with low maintenance and power requirements. It operates on less electricity than a home steam iron.



Photovoltaic panels



Panels and storage batteries

succeeded in increasing both the quality and reliability of their channels. To lessen the misunderstanding of local Perumtel personnel regarding required technical procedures, Perumtel engineers and the SISDIKSAT Chief Technician used Perumtel's closed circuit television channel to present a one-way video, two-way audio program for earth station and telephone personnel. Written materials were prepared in advance and sent to each location. SISDIKSAT local staff were asked to go to the earth station to participate in the program in order to review the technical data and meet their technical counterparts at Perumtel. This program was a great success.

At the same time that Perumtel was planning its intensive effort to improve the system, the project engineers were studying the noise transmitted by the classroom equipment to determine if that was a significant contributor to the problem. They found that the ambient noise of the classroom was not a problem when the equipment was in proper working order. They had already trained the Local Technicians in how to measure the noise coming from the classroom and how to deal with equipment problems. They also solicited ideas from the manufacturer of the telephone terminal on how to reduce the ambient noise even more and modified the equipment accordingly.

Not knowing how successful Perumtel would be in reducing the noise problem, the project engineers came up with the idea of installing a "gating system" that would regulate the transmission lines from each location. In the original loopback configuration, any sounds strong enough to trigger the earth station modems were transmitted from one site to all sites. This meant that interference produced by poor lines or local electrical storms, as well as voice signals, would be transmitted if it was strong enough to operate the modems. With sites spread across 2,500 miles of ocean, the engineers surmised that a great deal of the noise might be caused by atmospheric disturbances that were being picked up by unbalanced local lines.

The gating system greatly reduced the chances of local line noise being accidentally transmitted throughout the entire network. At a cost of $2,000 per site, special switching equipment was added to the telephone terminals in each classroom and placed at the other end of the local telephone cable leading from the classroom--usually the telephone office or earth station. Normally the switch remained open, preventing any transmissions from going up to the satellite inadvertently. When someone wished to use the classroom equipment, however, an electrical current from the classroom rushed down the cable and closed the switch, making transmissions possible. This electrical signal operated automatically whenever a microphone button was pressed or some other equipment operated. Thus it prevented the transmission of any other sounds that did not originate in the classroom, such as electrical storm disturbances. The gating system served as a noise controller rather than a noise eradicator. Bad local lines remained bad; the gating system did not improve the voice transmissions from any site. It did ensure, however, that the ambient noise of one site would not be transmitted continually by satellite to every other site in the network.

The combination of the work of Perumtel and the installation of the gating system solved the noise problems of SISDIKSAT. It is impossible to say which played the greater role. Perumtel did a very good job in improving the condition of the signals from a number of sites. On those occasions when a site was particularly noisy, however, the gating system prevented that noise from being automatically transmitted to all locations. It also provided a means of identifying which, if any, site was producing noise from its local lines, because that noise would be heard only when that site was transmitting. The gating system represents a theory that was successfully implemented, and it can be of great value to other audioconferencing systems where noise is a problem.

Equipment failure was also a major problem during the installation period. Some equipment was found to be faulty during the Jakarta testing phase immediately preceding shipment to the various sites. Some of this equipment, like two of the large TV monitors, were repaired locally; other units that were still under warranty and had no local representative were sent back to the manufacturer. During installation an alarmingly high rate of failure occurred among certain modules of the telephone terminal, especially those with logic circuits. Some of these failures were caused by heat and humidity and the rigors of installation. A number of modules said to be faulty were later found to be all right. In the rush to install the equipment and deal with problems, the technicians sometimes quickly substituted parts without really checking to see if the modules were actually faulty. Luckily the installation team carried a whole range of spare modules with them and substitutions were quickly made. Because the modules were easily shipped and still under warranty, the faulty ones were sent back to the manufacturer.

Some failures followed a pattern and could be solved. The potentiometers on many of the 19-inch monitors blew out, and the liquid crystal displays on the multimeters for each site leaked. The engineers surmised that this was directly related to the effects of humidity and the faulty design of the part. The manufacturers of both types of equipment had already experienced such trouble before and had designed replacement parts that were more rugged. These new parts were installed on all the monitors and meters.

Some of the problems with the telewriting equipment defied any easy categorization or solution because they were widespread and lacked a pattern. Over half of the modems experienced technical problems and were repaired by the manufacturer's representative in Jakarta, but no single part or set of parts was found to be the cause of the failures. Some of the microprocessors overheated during use. The technicians found that the processors operated more reliably if a fan was placed directly behind them. This indicated that there was a design problem that was causing a buildup of heat in the machine. The light pens and keyboards also proved too sensitive for the environment which included dust, high humidity, and occasional rough handling by the operators.

Overall, relatively few problems occurred with the audioconferencing equipment, cabling, facsimile machines, private telephones, emergency power supply, and video display systems, excluding the 19-inch monitors. After the initial shakedown period, the telephone terminal and multimeters operated well. The only piece of equipment that continued to present problems was the telewriting system. Although the manufacturer had said that it would operate in 99 degree Fahrenheit heat and 99 percent humidity, it was obvious that it required air conditioning--a need that could not be addressed at most campuses because of the high expense of air conditioning units and electricity. At one point the chief engineer from the manufacturer was brought out from England to check the equipment and put it in working order. He succeeded in doing so in a three-week period, although new failures occurred even as he worked on the units. On the eve of his departure from Indonesia, new reports were received of failures of the repaired equipment. It was apparent that this experiment with telewriters was not going to succeed because of problems in the design of the equipment, weaknesses in manufacturing, lack of support by the manufacturer, the rigors of the environment, and difficulties with transmitting on a regular basis over the Indonesian phone lines. Before the end of the project, the manufacturer announced that it was ceasing production of the telewriter.

Other than the failure with the telewriter, equipment problems were brought under control and corrected. From time to time small problems occurred with a microphone, convener, or some other piece of equipment, but no major technical failures hit the system after it was in operation. After the failures in the first few months of operation,

the condition of the equipment stabilized. There were only occasional failures in the telephone terminal modules. When this occurred, spare parts were shipped to the site by air, and the inoperative part was sent to the central office to be repaired and added to the stock of spare parts. No site really suffered a serious loss of service resulting from equipment failure. The heart of the system--the audioconferencing channel--worked extremely well.

CHAPTER FIVE
TRAINING STAFF AND USERS

A. WHAT WERE THE GOALS OF THE TRAINING EFFORT?

- DEVELOPMENT OF STAFF TO MANAGE THE SYSTEM AND ITS PROGRAMMING
- DEVELOPMENT OF STAFF TO OPERATE AND MAINTAIN THE SYSTEM
- DEVELOPMENT OF AN INTERNAL TRAINING CAPACITY
- DEVELOPMENT OF KNOWLEDGEABLE AND CREATIVE USERS OF THE SYSTEM

Considerable project resources were put into an effort to train the personnel who would be working with the satellite system. This training encompassed both formal and informal educational approaches and was a continuing process throughout each phase of the project from the planning to the operational stages. The training component of the project had four main goals:

1. to provide project staff with the skills and knowledge to manage a distance education satellite system and prepare programming for that system

2. to provide technical staff with the skills and knowledge necessary to operate, maintain, and repair the technical system

3. to develop an institutional capacity for training within the project itself, so that training would be a continuing process following the end of outside support

4. to orient users to the procedures and techniques for using the system and the ways in which programs and materials should be developed

In addition to these formal training goals, the Rural Satellite Program also was charged with helping higher education decision-makers and Perumtel officials understand the value and possible uses of audioconferencing systems. This goal was primarily pursued through personal discussions with these people and through their involvement in the project itself.

Training was conducted in a variety of situations (face-to-face and distant, classroom and on-the-job, group and individual, in-country and out-of-country, etc.) and via a number of different methods including formal classes, seminars, in-service training, and individual consultations. Initially all of the training was done by non-Indonesians. As Indonesians were trained in the various areas, they took an ever-increasing role in developing and leading training programs. All consultants--Indonesian and non-Indonesian--involved in training activities worked with counterparts from the project staff so that there could also be a transfer of knowledge and training skills from the consultants to the

staff. By the second year of operations, all training was being done by Indonesian staff members with minor support from the RSP Field Director.

B. WHO NEEDED TO BE TRAINED AND WHY?

- UPPER-LEVEL DECISION-MAKERS AND PLANNERS
- CENTRAL PROJECT STAFF
- SITE STAFF
- PERUMTEL STAFF
- PROGRAM DEVELOPERS AND PRESENTERS
- PROGRAM PARTICIPANTS

As outlined in Chapter Three, the operational system required a number of staff members at central and local levels to operate, maintain, and manage the satellite system. Beyond the immediate staff, there was also a need for some degree of training or orientation for a host of other people from the higher education leadership to the students who would participate in the courses. They all required some information or skills to be able to utilize the satellite system to meet their personal needs.

In the project planning stage, there was a need to provide the upper-level leadership of the higher education establishment with information about the possible uses of telecommunications, especially audioconferencing, for higher education purposes. Although a few people in this group knew something about the uses of telecommunications, the majority did not. The people who would make decisions about Indonesian participation in the Rural Satellite Program had to be given exact information on what an audioconferencing system would look like, what it probably would cost, and what it could do for their departments. The rectors of the universities needed to learn what such a telecommunications network was capable of and what type of programming was suitable for that capability.

After the decision was made to conduct a satellite project in Indonesia, there arose an immediate need for a core of people who had an understanding of how audioconferencing and the proposed technical system could be used to carry out the programmatic goals of the Association. These people would become the central project staff who would actually run the technical, administrative, and programming activities of the project. They would be the first "converts" to accept the value of audioconferencing for higher education. They would be the initial spokespersons for the project, reaching out to prospective users of the system and convincing them of the viability of the project and its potential for meeting the needs of higher education in the eastern islands.

As actual planning got under way and local sites were asked to prepare classrooms for the installation of the equipment, a Local Coordinator was needed to oversee the preparation of project facilities on campus, start informing people about project goals and capabilities, and serve as a link between that site and the project office. As the planning progressed, the Coordinator also had to see that a Local Technician and Local Operators were appointed to operate the classroom equipment.

Figure 9

RSP TRAINING STRATEGY

Personnel	Content of Training or Orientation	Processes Used
Upper-Level Administrators	--information necessary to decide if Indonesia should utilize satellite telecommunications for its purposes --information on how telecommunications can help Indonesia meet its needs	--overseas orientation workshop (4-week USIA program) --in-country workshop on distance education (4 weeks, organized by AID) --one-on-one discussions
Project Staff	--information and skills in the areas of management, technical operations, and programming of a distance education telecommunications project	--overseas training programs (3-8 weeks) --personal support from RSP field staff and short-term consultants (continuous) --resource materials from RSP --personal support from project engineer --back-up support by RSP Washington staff
Site Staff	--information and skills in the areas of management, technical operations, and maintenance of SISDIKSAT	--face-to-face workshops (7 days) --distance workshops (4-24 hours) --on-the-job training --personal support from RSP and SISDIKSAT staff --management and technical manuals, support materials, and video
Program Developers and Presenters	--information and feedback on how to develop materials for and deliver programs over an audioconferencing system --knowledge of capabilities of the system and use of equipment	--face-to-face workshops (7 days) --distance training sessions (2-4 hours) --personal support from RSP and SISDIKSAT staff --materials on audioconferencing course development and delivery
Program Participants	--information on how to use the equipment --information on the audioconferencing process	--introduction to the system (half hour) --pamphlets on system and use of equipment --visual aids on use of equipment --personal support from local SISDIKSAT staff
Perumtel Staff	--information on the design and operation of audioconferencing systems and their interface with telephone and satellite networks	--technical meetings --collaborative work with RSP and SISDIKSAT engineers --closed-circuit TV broadcast (4 hours)

Just before the installation of the equipment, the local technical staff had to be given training in the operation and maintenance of the equipment and in the pre-installation technical preparations of their sites. An information program also had to be launched to inform national and local Perumtel personnel about the technical needs of SISDIKSAT.

Preceding the operational stage of the system, all SISDIKSAT staff had to understand the operational procedures and rules for their component. In this case, staff at all levels participated in the preparation of these procedures and rules, thus ensuring that the results were practical and acceptable. In the beginning this collaborative effort required face-to-face meetings. After the installation of the system, the administrative procedures of the project were discussed at length over the system, thus bringing more people (e.g., Local Operators) into the planning process.

Before the system was fully operational, it was necessary to train program developers and deliverers. The main target group consisted of faculty members at all of the campuses. The senior faculty who were to develop and teach the academic courses had to know how to adapt their present courses to the distance education setting and how to run a class over the system. (The course development process is discussed in detail in the next chapter.) Faculty members who were interested in using the system for staff development activities like seminars needed to learn about the system's capabilities. Administrators had to learn how to arrange meetings using the system. After the system became operational, all program participants were given an introduction to the electronic classroom by the local site staff and by central office staff over the system.

The training/orientation effort began well before the system was even designed, and it continued throughout each stage of the project. These stages and the target groups during each stage were as follows:

SURVEY STAGE: To assess the interest of Indonesian officials in utilizing this type of technology, their level of knowledge about the technology had to be raised. Early visits of RSP people served to introduce and explain the basic idea. Indonesian educators were included in other related training opportunities not directly funded by RSP. The Chairman of the Eastern Islands Universities Association was invited to the United States on a study tour that included telecommunications as one of the topics. AID/Washington support made possible a four-week seminar in Indonesia on distance education. One of the many participants was the person designated to be the director of SISDIKSAT. Discussions were also held with Perumtel officials to get their response to the feasibility of putting together such an audioconferencing system.

PLANNING STAGE: After the Indonesian Government agreed to participate in the RSP, the same kind of activities as those in the survey stage were expanded to include other people and to discuss further the specifics of the design and capabilities of the proposed system. At this time it was also necessary to begin to form the core group that would later serve as the project staff. Training activities also became more organized and formal, and people were selected to go to the United States for hands-on training.

PRE-INSTALLATION STAGE: Before the system could be installed, the equipment had to be cleared from customs, inventoried, tested, and re-shipped to the local sites. The person at the Directorate who was experienced in customs clearance had recently been transferred, and his replacement had not yet learned about the customs process. RSP therefore hired an Indonesian consultant to assist Directorate personnel in the clearance process. This person worked closely with Directorate officials on the

clearance of several shipments until they understood the process well enough to do it themselves. Another member of the RSP staff helped the SISDIKSAT staff with inventorying of the site equipment and spare parts supply and with the logistics of transshipment.

Training efforts also had to be carried out in the three main areas of management, technical operations, and programming. Separate face-to-face workshops were held for Local Coordinators, Local Technicians, and faculty members. The entire personnel infrastructure had to be developed in preparation for the installation and operational stages.

INSTALLATION STAGE: Part of the training for the Local Coordinators and Local Technicians related to the preparations that had to be made for equipment installation. During installation at each site, the Local Technician and Project Engineers used some of the time for on-the-job training of the Local Operators and local Perumtel technicians. Meanwhile, RSP staff worked with the course development teams.

TESTING STAGE: The technical testing stage of the project provided a time for all of the technical staff to get acquainted with the classroom equipment and operational procedures. Several system-wide tests were conducted together with Perumtel. These tests brought local Perumtel personnel into the classrooms and helped develop personal relationships between SISDIKSAT and Perumtel staff that were considered important for the success of the project. To increase the knowledge of its personnel about SISDIKSAT, Perumtel arranged for a closed circuit TV connection to all of the earth stations involved in the project. To solidify the relationship between local SISDIKSAT and Perumtel personnel, the Local Technician and Local Operators were also asked to go to the earth stations to participate in the broadcast (one-way video, two-way audio). The SISDIKSAT technical staff prepared a booklet that was sent to all earth stations and detailed system charts that served as visuals for discussion.

Meanwhile on the programming side, plans went ahead for several courses to be delivered during the experimental phase. Faculty members were given individual instruction on the use of the equipment, the preparation of print materials, and the organization and delivery of class sessions.

EXPERIMENTAL STAGE: While the initial two courses were being taught over the system, the programming staff worked with those teams and the other teams that were preparing courses for the 1985 semester. Manuals on the preparation of course materials and teaching over the system were completed and distributed to the teaching staff. All teaching staff and local tutors were invited to two-hour training sessions on materials development and distance teaching conducted over the satellite network. Pamphlets were also prepared for tutors and students explaining the system and how it would work.

OPERATIONAL STAGE: After the system entered its operational stage, all activities became regularized to a great degree. Training sessions for all teachers were held before the beginning of each semester, with additional time set aside on the system for discussions between the master teachers and their local tutors. On the technical side, it became apparent that the on-the-job training given to Local Operators was not sufficient for them because of turnover in their ranks; because of the need for review activities, especially on technical procedures that were only implemented at long intervals (e.g., system leveling); and because of the desire of operators and technicians to improve their skill level and understanding. Therefore, a five-day training program was conducted over the system each year between semesters for the Local Operators with the Local Technicians serving as local tutors and the Chief Technician as the master teacher.

Informal training activities were also carried out for part-time personnel at the central office level. College students were recruited and given on-the-job training for the operation of the graphics production studio and for the observation system that monitored activities on the system 54 hours a week.

C. HOW WAS TRAINING ACCOMPLISHED?

- OVERSEAS AND IN-COUNTRY PROGRAMS
- FACE-TO-FACE AND DISTANCE TRAINING WORKSHOPS
- FACE-TO-FACE AND DISTANCE TRAINING SESSIONS
- PERSONAL INTERACTION AND INDIVIDUAL CONSULTANCIES
- SUPPORT MATERIALS

All of the initial training took place outside of Indonesia. These training activities were conducted overseas for several reasons including:

1. a lack of indigenous expertise in audioconferencing operation, repair, management, and programming

2. the difficulty of finding foreign experts in these areas who were able to travel to Indonesia for longer than two or three weeks

3. the need to have people see a fully operating teleconferencing system and talk to the people operating and using it

4. the need for factory training for the Chief Technician

5. the advantage of getting people out of the country, so that they could work exclusively and intensively on project-related activities without the distractions of daily life that were certain to occur in-country

When the time came to train personnel in-country at the local sites, the people trained overseas served as the core training group. Later in the project, they conducted training activities without major outside support. After the system was fully operational, it became a major tool for in-house training. Training programs which were run over the system served both the purposes of training and of providing examples for other groups to follow in their training activities.

Training opportunities arranged outside of Indonesia were:

- A four-week tour of U.S. educational telecommunications programs for the Indonesian Project Director, including visits to ACSN (Appalachian Community Service Network) in Kentucky, IHETS (Indiana Higher Education Telecommunications Service) in Indiana, and CIP (Center for Interactive Programming) in Wisconsin. He was accompanied by his counterpart, the RSP Field Director.

- A six-week factory training and testing program for the Chief Technician with the telewriter manufacturer in England and the telephone terminal producer in California. He was accompanied by the RSP Project Engineer.

- A three-week study program in the United States and England for four faculty members from four of the 11 sites. (Financial considerations made it impossible to select one person from each site, so participants were selected on the basis of their availability to help other sites in addition to their own.)

- A four-week study program for three central office staff--the Program and Assistant Program Director and the Administrator.

These programs were successful in achieving their goals and were greatly appreciated by the participants. Almost all participants wished that the time could have been longer. Jet lag and adapting to a different culture and climate particularly affected those who had not been overseas before. Thus they were not at peak efficiency during the first week in the United States. After the major cost of travel is paid for, it makes good economic and educational sense to have participants stay for a period exceeding three weeks. After the decision is made to conduct overseas training, it is better to have participants take the utmost advantage of the situation and have time to assess and absorb what they are experiencing.

One of the problems encountered in arranging this type of training was the paucity of places in the United States where a participant could go for first-hand experience with distance education--particularly via audioconferencing systems. Most places in the United States utilize television rather than audio only. All of the active programs are deeply involved in the operation of their own systems and do not have a great deal of time to devote to participant training.

The Project Director's training consisted primarily of observation of a number of projects and technologies in use. Therefore, he visited four states across the country. The Chief Technician's travel was dictated by the locations of the manufacturers. The group of four Local Coordinators visited two states and England, and they found it difficult to absorb so much in so little a time. The final U.S.-based training was for three members of the central office. Given that a number of people had already visited various projects, their training was made more specific. The Administrator went to the Learn Alaska Program for a three-week internship on management, while the two programming people went to the University of Iowa to study distance education and to prepare specific materials for the project. This last program was more beneficial to the project in terms of the actual creation of products rather than solely increased knowledge or skills.

The overseas training fulfilled its goals and provided the project with a group of people who later served as key members of the project team. Before their final selection for U.S. training, all of the participants were asked to make a personal commitment to work with the project for at least two years. In addition, their rectors were asked also to make a commitment to allow them to work with the project for that same period. The overseas training served as an incentive and reward for making that commitment. Fortunately, all of the participants more than fulfilled that agreement and continued to work actively with the project past that two-year time span.

The training probably would have been more productive if the participants had been given more time in the United States. One of the great advantages of these programs

was that the participants were available full time for the sole purpose of the project. After they returned to Indonesia, they had to balance their work on the project with their regular faculty jobs, family responsibilities, and other commitments. Given the personnel situation in Indonesia, this was the only time period when they would devote more than a week or two exclusively to project-related activities.

In light of later problems with support from officials in Jakarta, it may have been advantageous for the project if one or more of those senior officials had been sent overseas. Several senior officials had participated in some telecommunications training programs under another AID project, but they had been promoted out of their positions before SISDIKSAT became operational. In hindsight, one can only wonder if an opportunity to see other similar projects in other countries would have increased the understanding and support of the project on the part of senior officials. Both the Project Director and the Administrator were sent to participate in international conferences, and both returned with a higher regard for SISDIKSAT after having shared experiences with others involved in distance education.

Several face-to-face and distance training programs were run for a variety of participants. Four face-to-face workshops of six or seven days were run before the system went into operation. About 60 faculty members from a number of the sites participated in the first two. These programs focused on the use of audioconferencing for higher education, the preparation of course materials for distance education, audioconferencing teaching techniques, and the operation and use of some of the equipment. Because the project equipment had not yet been installed, a room-to-room system was used for practice sessions.

When the equipment was available after clearance and testing, a seven-day workshop was held for the Local Technicians. One person from each site came to Ujung Pandang where three sets of equipment had been set up for instructional and practice sessions led by the senior technical staff. This training was followed a month later with a week-long program for the Local Coordinators which focused on the management system, training resources, budgeting, and audioconferencing.

After the system was in place and operating, all subsequent formal training programs were held over the system. Face-to-face training programs were very expensive because of the cost of travel and living expenses; thus they were limited to only one or two people per site. Programs over the system could reach hundreds of people. The major training programs were run for the Local Operators during the time between semesters. The programs ran for three hours in the morning and three hours in the afternoon. Printed materials were sent to all participants, and the Local Technicians served as tutors with the central office technical staff serving as the main instructors. Actual testing and maintenance of the equipment occurred with directions coming from Ujung Pandang and local supervision supplied by the Local Technician.

Whenever possible, in-country opportunities for training and networking with other educational groups were pursued. Two staff members attended a two-week workshop in Jakarta organized by the Center for Educational Technology on the writing of print materials. Another staff member attended a one-week seminar on distance learning systems organized by USAID and the Open University. In addition to the learning that occurred, staff members made important contacts with organizations with goals similar to SISDIKSAT's.

Shorter face-to-face and distance training sessions were run for periods of less than a day. Presentations were made to course development and other prospective user groups by the central office and RSP staff. Two- to three-hour programs were organized over the system for master teachers on materials development and course delivery via audioconferencing. Other sessions were held with the master teachers and local tutors on the management and delivery of courses over the system. Care was taken to ensure that these sessions would also serve as good examples of how audioconferences should be organized. Written materials were sent in advance to all participants.

The one use of television for training purposes was the one-way video, two-way audio program run for Perumtel and SISDIKSAT technicians at all locations using the Perumtel training TV system. The SISDIKSAT Chief Technician and Perumtel Project Officer made presentations on various aspects of the system over the TV channel using specially prepared diagrams. Questions and answers were carried over the audio connection. A 34-page booklet describing the technical system was sent to all participants in advance.

At the beginning of each semester, one of the central office staff attended the first session of each class to introduce students to the system, the equipment, and the procedures for its use. During each session several students at different locations were invited to speak in order to reduce any student reluctance about using the microphones. Examples were given of speaking too close and too far from the microphone.

Personal interaction and individual consultancies were among the most productive tools of training, although they were limited in reaching large numbers of people. The job of explaining the system and its capabilities was one of the main goals of visits to each of the sites by RSP and SISDIKSAT staff in the first year. Perhaps because of the use of television monitors for the graphics system, many people thought that the system was going to use full motion video, and that idea was difficult to erase. Even in the second year of operations there were still some people who thought that the graphics system was really going to be regular television.

Personal interaction was the main tool used for educating high-level officials about the system. It was also the most productive tool for getting teachers to adapt their lecturing techniques to accommodate the satellite system. Suggestions made in person to a teacher by a staff member who sat through a class were often followed. There was a reluctance among Indonesian staff members about giving direct feedback over the system to teaching staff. This feedback process was also hindered by the fact that most of the master teachers were older and more senior in status than the project staff.

The final training tools used in the project were the wide variety of support materials that were prepared. These were primarily illustrated print materials, posters, and a videotape. They are listed in the following figure according to the target audience.

At the beginning of the project, all of the materials were first written in English and then translated, whenever possible, into Bahasa Indonesia. As the project staff gained more experience and knowledge, they began to produce their own materials directly in Bahasa Indonesia. The only materials that remained in English were the Resource Collection, Selected Readings, Activity Guide, and some parts of the Technician's Manual.

Figure 10

SISDIKSAT TRAINING MATERIALS

Target Group	Type of Materials
Technical Staff	Technician's Manual: a 300-page manual with an overview of the system and technical specifications of all classroom equipment Operations Manual: instructions on how to operate the classroom equipment System Overview: a 34-page description of the classroom equipment and how it interfaces with the Perumtel network Technical Training Booklets: five booklets for the operators on the design, operation, maintenance, and simple repair of the classroom equipment Videotape on Maintenance Procedures: depicts how to perform general maintenance tasks, level setting, and troubleshooting of equipment and system problems
Local Coordinators	Local Coordinator's Manual: contains project and equipment descriptions, administrative procedures and policies, examples of forms, details of management information system Resource Collection: a collection of 12 books and articles on audioconferencing and materials development for distance education to serve as a resource for the Coordinator and other users on campus
Course Writers	Course Development Guide: suggestions on how to adapt a regular course for a distance setting, prepare a study guide, and incorporate visual aids into a distance education course
Program Presenters	Introduction to SISDIKSAT: short pamphlet identifying the equipment, its capabilities, audioconferencing procedures, and how to arrange for time on the system Teaching Via Satellite: a detailed guide for program presenters on how to teach over an audioconferencing system Selected Readings: compilation of eight articles on audioconferencing Activity Guide: a book with exercises related to the selected readings and other training activities Operations Guide: photoguide to the operation of the equipment most likely to be used by the program presenters
General Users	Introduction to SISDIKSAT: short pamphlet identifying the equipment, its capabilities, and the procedures of audioconferencing Wall Poster: depicting how to use the microphone Microphone Labels: numbering the microphones and explaining how to use them

CHAPTER SIX
HOW THE SYSTEM WAS USED

A. WHAT TYPE OF ACTIVITIES WERE RUN?

- COURSE-SHARING PROGRAM
- STAFF DEVELOPMENT ACTIVITIES
- TRAINING PROGRAMS
- ADMINISTRATIVE MEETINGS
- MESSAGE SERVICE
- SYSTEM OPERATIONS

The main use of the system was for an undergraduate course-sharing program between the campus sites: the seven universities and two teacher training institutes in eastern Indonesia and the Institute of Agriculture at Bogor, Java. (An eighth university, Halu Oleo in Southeast Sulawesi, joined the system in 1986 with funding from another program.) After the technical problems decreased in late 1984, SISDIKSAT decided to test the quality and reliability of the system by offering two courses (statistics and food science) in an experimental semester to determine if the system was ready to be used intensively for programming. When both of these courses ran without any major technical problems, a full semester of 12 courses was begun in February 1985. The number of courses was increased to 15 for the second semester of 1985. This was believed to be the optimum number of courses that could be offered during regular class times given the need to have system time available for other uses. In fact, 17 courses were actually delivered, because Cenderawasih University of Irian Jaya, in great need of law courses, paid for the development and delivery of two courses on criminal and agrarian law during the evening hours when the system was not otherwise in use.

The sample schedule on the following page shows the apportionment of time between the course program and other activities during the academic semester. The system quickly grew in terms of the number of operating hours per week and the number of those hours which had regularly scheduled programming. Non-programmed time was used for messages, impromptu meetings, and facsimile transmissions.

AVERAGE NUMBER OF HOURS OF SYSTEM USE
PER WEEK PER SEMESTER

Semester	Operational Hours	Programmed Hours
I	32.5	16
II	54	40
III	68	54.5
IV	64	49.5
V	68	52.5

Figure 11

SISDIKSAT SCHEDULE

August-December 1985

HOUR	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
6:00	Administrative Conferencing and Fax Time for Eastern Time Zone Sites: UNCEN-Jayapura, UNCEN-Manokwari, UNPATTI-Ambon					
7:30	SYSTEM CHECK-OUT FOR ALL SITES OUTSIDE JAVA					
8:00	Basic Natural Science P=UNHAS	Methods of Social Research P=UNCEN-J	Macro Economics P=UNHAS	Resource Economics P=UNLAM	Industrial Law P=UNSRAT	Technology of Cattle Production P=IPB
10:30	ROLL-CALL OF SITES / NEWS AND FAX TIME					
11:00	Basic Ecology P=UNMUL	Audioconfer-encing & Seminar & SISDIKSAT Time	Theory of Adult Education P=IKIP-Ujg.Pdg.	Social System of Indonesia P=UNHAS	Summer Institute of Linguistics IPB-UNHAS Grad. Ag. Program	Statistics I P=IKIP-Ujg.Pdg.
1:30	ROLL-CALL OF SITES / NEWS AND FAX TIME					
2:00	Methods of Fishing P=IPB	Food Science P=UNSRAT	Animal Physiology P=IPB	Open University P=O.U./Jakarta	Soil Science P=UNHAS/UNPATTI	Fish Diseases P=UNHAS
4:30	ROLL-CALL OF SITES / NEWS AND FAX TIME					
5:00	Agrarian Law P=UNHAS	Open University P=O.U./Jakarta	Criminal Law P=UNHAS			
7:30						

Central Indonesian Time

P=Presenting Site

During Semester I, the experimental period, the system was staffed only during regular campus office hours. In addition, two reserve time slots were set aside for the statistics and food science courses in case there should be a cancellation due to technical problems. When the system proved that it could operate reliably, this practice of scheduling reserve hours was discontinued in favor of additional programming.

Some time slots during the semester and most of the scheduled time between semesters was used for staff development seminars for faculty and off-campus people, administrative meetings, training programs, and system testing. However, because of a lack of funding and staff to develop other uses of the system, SISDIKSAT generally had a great deal of unused time during the non-course periods.

The use of the system for staff development efforts was always an important goal, but it took some time for that activity to fully develop. The original implementation plan called for the system to be used in support of an ongoing national faculty development program called Akte Lima. This program sought to improve the skills of junior faculty members through a mandatory program that utilized print materials on different content areas and pedagogical topics and local classes arranged at the discretion of each institution. SISDIKSAT staff invested a great deal of time in exploring how the system could best be used to support this program, even to the extent of running a one-week workshop for senior professors teaching in the Akte Lima program. The plan was abandoned, however, because of a lack of funding and other weaknesses in the Akte Lima program.

In order to include programming that might aid the faculty members of the eastern islands, SISDIKSAT began to explore the use of seminars to provide isolated faculty members with new information in their fields and opportunities for scholarly discussions with their peers. Thousands of faculty members are spread across the eastern islands with little opportunity to engage in intellectual exchange with their colleagues and little access to up-to-date information because of the limitations of campus libraries and other sources of information. With little time and money to spare, SISDIKSAT began broadcasting seminars that were originally planned for one location in Ujung Pandang. The first program involved a "population and the environment" seminar that was organized by a SISDIKSAT staff member with a junior minister as one of the participants. The minister's presence stimulated attendance at the various sites. The SISDIKSAT staff member served as moderator and took particular care to include all of the sites in the discussion periods. The success of this first seminar emboldened others to seek SISDIKSAT time for their seminars. These were fairly successful when they were publicized in advance at the locations and when the moderator made the sites part of all discussions. A three-day seminar on ocean resources suffered drastic declines in the number of participants at the remote sites when the moderator of the face-to-face seminar continually forgot to include them in the question and answer periods.

In the second stage of the seminar program, faculty members approached SISDIKSAT and requested time and support for one or more audioconferences on their specialties. One such program was arranged on forestry; a three-session program on poultry production was organized by a faculty member from Hasanuddin University. In the third stage, with direct support from RSP, SISDIKSAT began to arrange its own seminar series supported by publicity and print materials for all participants and based on recently completed doctoral and master's research. These seminars proved tremendously successful with over 99 percent of surveyed participants asking for more such programs. SISDIKSAT had definitely identified a strongly felt need of eastern islands faculty members.

When Indonesia's newly formed Open University expressed a desire to launch a training program for its local tutors all across the country, it requested system time from SISDIKSAT to experiment with the use of telecommunications for reaching the tutors in the eastern islands. The program began with four hours a week in the late afternoon and early evening hours and gradually progressed to 10 hours a week in 1986. Tutors for specific courses met for two-hour periods with the writers of the Open University teaching materials to discuss the content and teaching process. The time between semesters was often used for training programs for local operators and technicians and for shorter training sessions for course developers and presenters.

Time was also allotted for administrative meetings for groups such as the IPB-UNHAS Graduate Agriculture Program and the Summer Institute of Linguistics (SIL). Faculty members at IPB and UNHAS used the system for the coordination of a joint graduate program in which students studied at both campuses. SIL used the system for weekly staff meetings between team members at five of the SISDIKSAT locations. SISDIKSAT took advantage of the fact that it spanned three time zones to allocate early morning time to Cenderawasih University for communication between its main campus at Jayapura and its agricultural campus at Manokwari over 500 miles away. They were able to use SISDIKSAT for inter-campus communications from 7:00 a.m. until 8:30 a.m. Eastern Indonesian Time because most of the other SISDIKSAT sites were in time zones that were one or two hours behind them. This greatly alleviated their inter-campus communication problems. The Open University also used the system for administrative communication via audio and fax links with its staff in the eastern islands.

SISDIKSAT also served as a major message service. Even before the system was fully operational, faculty members and administrators began sending messages to the Local Operators for delivery over the system. In response to this demand, SISDIKSAT created two services: the "audiogram" and the "faxigram." The audiogram passed messages orally over the system to the receiving site where they were written down on an audiogram sheet and delivered to the campus address. The faxigram service utilized the facsimile machines for the transfer of paper copy from site to site. The audiogram became the most popular of the two because it was simpler to use, free of the technical problems that often occurred on the graphics channel, and met the Indonesian proclivity for personal interaction. It also provided the eager Local Operators with an official reason for using the system.

A crucial use of the system was for the operation of SISDIKSAT itself. The administrative staff used the system for communications with the Local Coordinators, Jakarta officials, and course development teams and to track the shipment of materials to all of the sites. The programming staff used the system for meetings with academic rectors and deans for setting up the course-sharing program and for orientation programs for materials developers, teachers, tutors, and students. The technical staff used the system for training programs for Local Technicians and Operators and for carrying out system tests and maintenance functions.

In the absence of any programming or official messages, the Operators took advantage of the system to conduct independent tests of their technical links and to chat with their fellow Operators in the other locations. Although they were generally careful not to interfere with scheduled programming, their domination of the system during these "free" periods sometimes conflicted with the desire of some sites to transmit audiograms or faxigrams. The chatting Operators had to be interrupted and asked to remain silent while the message was being transferred. It was more difficult to interrupt them when they were using the graphics channel with its privacy feature. Although this

use of the system for personal reasons was bothersome at times, it did have some positive results. The constant use of the audioconferencing channel for informal conversations alerted Operators to any problems with the transmit and receive paths of the sites; it relieved some of the boredom of the job and gave them another reason to maintain the equipment in good order; it created a feeling of fellowship among the Operators and heightened their morale and their concern for good operation at all sites. Over the system they were able to make friends with people they could never visit. A number of site staff exchanged pictures, and soon all of them were able to recognize each others' voices. On the other hand, a lack of discipline among some of the 40 or more Local Operators sometimes caused technical problems and lowered system reliability.

B. HOW WERE COURSES DEVELOPED AND DELIVERED?

- NEEDS ASSESSMENT
- NEGOTIATION AND AGREEMENT
- SELECTION OF COURSE DEVELOPMENT TEAM
- REVIEW OF EXISTING COURSE MATERIALS
- MATERIALS DEVELOPMENT PLAN AND TRAINING
- EDITING AND RE-WRITE PHASE
- AUDIOCONFERENCING DELIVERY PLAN AND TRAINING
- LOCAL TUTOR SUPPORT AND TRAINING
- COURSE DELIVERY
- COURSE EVALUATION AND REVISION

The first step in organizing the course-sharing program was a needs assessment of the participating institutions to identify the courses to be developed. This was done by a written survey and individual and group discussions with all the sites. A questionnaire was sent to all rectors asking them and their staffs to identify the courses that they greatly needed and the courses that their institution would be willing to offer over the system. The Local Coordinators at each site assisted the rectors in the completion of the form by contacting the academic vice rectors and the deans of the different faculties. These forms were returned to SISDIKSAT, where the responses were collated. SISDIKSAT staff found a greater degree of diversity and less commonality than originally expected. This partly resulted from the great differences among the institutions (e.g., IKIPs and universities, new and old institutions) and to the program of specialization that the Directorate was promoting (e.g., each institution was given a mandate to give special attention to a field such as forestry, adult education, etc.). Several institutions, therefore, requested courses to help them develop their special area. Only a few topics, such as statistics, were mentioned by a large number of sites.

Two lists were then prepared: a list of the 25 courses most often requested and a list of the courses that sites had offered to teach. These lists were sent to all of the sites to begin the process of negotiation and agreement. Several weeks were allowed for the rectors to consult with the vice rectors, deans, and department heads. Then several meetings were held over the system with the Local Coordinators and deans to discuss the

lists and decide upon the 10-15 courses that should be developed for the coming semester. This process was later changed to make the academic vice rectors the main decision-makers in selecting 30 courses for an entire academic year. Because Indonesian culture encourages consensus, there was little conflict in agreeing on the course program. Although all sites were eager to have their main priorities addressed, they readily understood the need to have courses that were of interest to a number of sites and to see that each site participated in a number of courses. Their rule of thumb was that each course should have a minimum of two or three receiving sites.

After the courses were chosen, the vice rectors decided on the course development teams, usually consisting of three faculty members. Often, the teams were chosen from the list of courses that sites were willing to offer; this list already had two- or three-person teams named. Otherwise, the vice rectors determined the best person to teach a specific course. Given the prerequisites of a master's degree and senior status, the pool of candidates for a specific course was generally very limited. Most of the vice rectors were familiar with the senior faculty of all the institutions and therefore were quickly able to nominate teaching teams. In the few cases where they were not able to come up with candidates, one of the stronger institutions was asked to provide a team. The practice of selecting senior faculty with graduate degrees was essential for credibility and the participation of the local sites. The only drawback was that weight was not given to the teacher's ability and willingness to adapt to this new teaching environment. Seniority and education level were paramount. Although most of the teaching staff were enthusiastic and diligent in carrying out their duties, there were always a few people each semester who performed poorly. Social and political factors sometimes led to choices that were not optimal.

Following the identification of the team, the vice rectors of the offering institutions informed the teachers of their responsibility for a SISDIKSAT course. In most cases this course became part of their regular teaching load. At this time, too, SISDIKSAT staff informed the teachers of the conditions of their teaching contracts, including the payment schedule for teaching and for developing print materials. All of the course team members were sent information on how to review their existing course materials and adapt them for delivery over SISDIKSAT. They were sent guidelines on how to develop new materials such as study guides and visual aids along with samples of distance education materials. After they received these materials, SISDIKSAT organized a training session over the system to discuss the process of review, adaptation, and development of print and audio-visual materials and to answer any questions the faculty members might have.

The senior faculty member serving as team coordinator usually apportioned the writing task among the team members. It generally took the teams three to six months of part-time work to complete the written materials for the course. The work load was often unequally distributed. In many cases, the team leader did almost all of the writing; in other cases, the junior members of the team did a large share of the work. The actual teaching over the system was usually done by the team leader or shared by team members who of equal status. Very junior team members rarely, if ever, were allowed to lead classes.

The Rural Satellite Program had intended for existing materials to be adapted for teleconferencing use, for study guides to be developed, and for other special print materials and visuals be tailored to the distance education format. However, the first survey of course materials revealed glaring weaknesses in the amount and quality of the types of existing materials. They ranged from 20 to 80 pages per course. Sometimes

books in English were assigned which were not available in all places. Even when they were, they were of little use to the majority of students who read English poorly. With a lack of basic texts in Bahasa Indonesia, the materials development plans of most course teams concentrated on the writing of text rather than study guides. This was an unexpected but necessary diversion from the original plan to focus on supplementary materials to support the basic existing texts. These new texts proved to be very successful; all of them were well accepted and came to be used for non-SISDIKSAT courses as well.

To give the project some control over the quality and the degree of standardization of the materials produced, SISDIKSAT attempted to develop a core of materials development specialists who could monitor the writing of materials for certain courses. The course teams would send their materials to the appropriate specialist in two or three stages. The specialist would review the materials to ensure that they were well written according to an established format and then authorize payment for that portion. Five faculty members with experience in materials development were recruited by SISDIKSAT and trained by an expert from the Center for Communications Technology in Jakarta in the writing and review of course materials. Unfortunately, a lack of local funds forced SISDIKSAT to cancel this attempt to establish an editing unit.

The project, therefore, was unable to exert any editorial function over print materials or to hold the writers to a three-stage schedule. In addition, in the first semesters of operation SISDIKSAT staff had no control over the payment to writers; that was handled directly from Jakarta. Thus they had no financial control either. They acted more as consultants to the course teams. As a result, some of the materials suffered from a lack of editing, a failure to follow the prescribed format, and tardiness in completion. At the receiving end, however, the students and faculty members were generally very enthusiastic about the quality of the materials they were receiving from SISDIKSAT, because they often far surpassed what was available locally.

To ensure that some course materials were developed as completely as possible, RSP funds were used to support the development of four prototype courses. For example, an extensive textbook series and a student study guide were developed for one of the statistics courses. The study guide gave week-by-week instructions to the students and local tutors, study questions and problems, and supplementary notes. It will no doubt be the basis for future statistics courses at all of the eight sites that participated in the course. To demonstrate how a course with a practicum could be taught, RSP assisted the poultry production teaching team to develop a range of materials: a textbook, a detailed reference text with supplementary material, a series of 70 slides to illustrate some of the lecture and practicum topics, practicum exercises for local use, and a student workbook for those exercises.

The SISDIKSAT course was a three-pronged effort which included:

- the development of course materials, including textbooks, study guides, and visual aids
- weekly class meetings over SISDIKSAT balanced between lecture and interactive discussion
- improvement of local tutors' ability to teach similar courses through increasing their knowledge of the content and teaching methods and the provision of quality materials

This strategy would have the greatest impact on the institutional capacity of the system members. It met the short-term need for teaching courses that were not taught or were taught poorly on the local campus, and it also met the long-term need for appropriate materials and teachers who could teach these courses themselves. SISDIKSAT'S goal was to deliver a course once, revise it, teach it again, and then move on to other courses with the confidence that the local tutors could now teach the course locally--using the system only for occasional support from the master teachers.

As mentioned previously, the lack of good texts in Bahasa Indonesia shifted the materials development emphasis away from study guides and other supplementary materials to the writing of texts, although several texts did include such study guide components as learning objectives, study questions, and problems. The next two steps were to help the teachers adapt their teaching to the satellite system and to provide a mechanism for skill transfer to the local tutors.

The major format for college teaching in Indonesia, as it is in most countries of the world, is the lecture. The average two-credit course in Indonesia consists of one 100-minute lecture period per week for 16 weeks with several assignments per semester, and a limited amount of reading material, usually in the form of 40-80 page "lecture notes" prepared and sold by the instructor. Tests generally are based on the lectures and notes. Supplementary reading materials may be assigned, but they may not be available in the library or may be in English, a language not well understood by most students. Classes often do not meet the required 16 times, and the meetings that do occur are often shorter than 100 minutes and usually are not very interactive, although that varies with the instructor and the department. The challenge for SISDIKSAT was to improve this by working with the faculty members for incremental changes in their teaching style rather than promoting a radical change that was doomed to failure.

Because of the special payment made for the development of materials and the prestige that was associated with being selected to teach over SISDIKSAT, teachers were willing to put more time into the development of the materials. The course teams were paid a total of 1.5 million rupiah ($940) for writing new materials and Rp.600,000 ($375) for revising those materials before the course was offered a second time. The course materials ranged in length from 100 to 200 pages. It is difficult to estimate the amount of time spent by the teams on materials development because they worked part time over a period of months and produced materials of various lengths and degrees of complexity. The average total time invested was probably one person-month of full-time work, given that all team members were experienced teachers who already had written materials that they could build upon. A few teams probably invested as much as two person-months in producing the lengthier course materials.

In order to try to affect the teaching styles of the team members slated to teach over the system and influence their use of system time and the local tutors, SISDIKSAT organized a second satellite training session which focused on planning and delivering audioconferences. The teachers were sent the SISDIKSAT manual Teaching Via Satellite, which explained how the equipment worked, how to teach over the system, how to utilize the local tutor network, and how to incorporate activities that would enhance interactivity and interest. Indeed, the major theme of this training was that the system should be used interactively and that the lectures should supplement and amplify the readings, not merely repeat the same material. The teachers were also provided with an audioconferencing planning booklet to help them map out their individual classes. The training session itself was carefully planned to be a good example of an educational audioconference.

This three-hour training session was followed by a series of meetings between the master teachers and the local tutors to discuss the development of the materials, coverage of the content, and the organization and administration of the course. A SISDIKSAT staff member served as the moderator for these meetings (one for each course) and helped guide the discussion around those topics. During the semester an extra 20-30 minutes was added to each course's time slot for a master teacher/local tutor meeting. It was hoped that this time would be used to: 1) review the past lesson and any problems that students encountered, 2) preview the coming week's lesson and answer any questions the tutors might have on the material or their role, and 3) coordinate the administration of the course. The local tutors would have an opportunity to ask questions that would help them to improve their own knowledge, and the master teacher would have the chance to use the tutors as his eyes, ears, and hands at the local level by involving them in the management and teaching of the course.

To some extent these functions were fulfilled in some courses; however, the entire process was not as effective as it could have been. The major hindrance to the tutor meeting as a staff development tool was the absence of strong management of the process. The tutor meetings were held sporadically and were not methodical in their coverage of the three areas. The weekly organization of the tutor meetings was left to the teaching teams, but their responsibilities for this aspect of the course were not specified in their teaching contracts. They received no extra money for the extra half hour, and there was no supervision to validate that the meetings were actually taking place. A number of teachers were willing to spend the extra time to support the tutors, and they regularly asked for questions from the tutors at the end of the lecture time. There was no overall management of this process by SISDIKSAT, however, to ensure that this goal was being reached. Observations of 134 class meetings in 1986 showed that only 21 percent of them actually used the additional time for tutor meetings. In many cases interactions with tutors occurred during or at the very end of the regular class sessions and were not counted as full meetings.

Although this system did not work as well as planned and the scheduled system time was not always utilized, the whole idea of using the course delivery system to upgrade the skills and knowledge of junior faculty was shown to be a good one, and a high degree of success was achieved even without a comprehensive system of regular meetings. This success is documented in the next chapter.

Course delivery consisted of a two-and-a-half hour session on the SISDIKSAT system once a week plus any additional activities that were conducted by the local tutors, such as local discussions or practical work. The 150-minute time slot included 10 minutes for getting all the sites ready before the class, 100 minutes of instructional time, 5 to 10 minutes for a relaxation break, and 30 minutes for a tutor meeting. This proved to be much more time than was necessary because most teachers did not use the break time nor did they use all of the 30 minutes assigned for a tutor meeting. A suggestion was made to hold tutor meetings only every other week. This was not implemented for several reasons, including the need to adhere to the hour/half-hour starting times, inherent problems of alternate scheduling, and the desire to avoid making the tutors come to the classroom twice a week instead of once.

The general format of a class had alternating periods of lecture by the teacher and question and answer sessions with the students. A class session would begin after the Local Operator at the teacher's site "scanned" the participating locations to ensure that all were present and receiving well. The teacher would then come on line and greet the sites and local tutors and proceed with the first part of his lecture. After 10 to 20

minutes he would then ask for questions and comments from the sites, calling on them one by one. Locally, the tutors would organize the questioning process and encourage their students to ask questions. After answering all of the questions, the teacher would then lecture for another short period and once again stop for questions and comments. This sequence would continue until the end of the class period.

At least once during the semester, the students were asked to evaluate the course and SISDIKSAT. Based on that information and consultations with the local tutors, the master teachers would revise the course and materials for subsequent semesters.

C. WHAT WERE THE KEY COMPONENTS OF ALL PROGRAMS?

- INTERESTING TOPIC AND QUALIFIED PRESENTER
- MEETING TIME APPROPRIATE FOR PARTICIPANTS
- PROGRAM MODERATOR
- TIME FOR INTERACTION
- SUPPORTING PRINT MATERIALS

An essential ingredient of any educational program is that it have an interesting topic and a qualified presenter. The course program based its topic selection on a detailed needs assessment of SISDIKSAT membership. Seminar topics were chosen with specific audiences in mind, such as agriculture and nutrition specialists. A "qualified" presenter was usually someone with senior status and a graduate degree. University administrators insisted that course teams be led by senior faculty with at least a master's degree. Seminar audiences also showed more interest in presentations by people with graduate degrees.

Selecting an appropriate meeting time for the participants was always an important consideration. Course activities were scheduled in the prime morning and early afternoon hours to coincide with the regular class times at the campuses. Teachers' participation was solicited for the days and times that would fit into their daily schedules. Staff development activities were placed in the late afternoon hours when faculty were free of their teaching duties or run during the prime hours during the semester breaks. Meeting times were chosen on the basis of time available after the courses and other weekly programming was scheduled.

For a number of reasons, a program moderator or chairman was required for all activities. Someone had to be in charge of coordinating the scheduling with SISDIKSAT. The multi-site nature of the telecommunications system required that someone be in control of all sessions. With the half-duplex facility, it was important that people speak in order. When two people from different sites talked at the same time, the transmission signals clashed in the satellite creating a burst of noise. With programs that involved up to 11 sites at a time, it was highly probable that this type of interference would occur. It was therefore essential that someone guide all of the discussions.

An essential ingredient of all SISDIKSAT programming was the incorporation of time for interaction. One of the main tenets of Western educational theory holds that dialogue promotes interest and learning. Many Asian educational systems, however,

emphasize rote learning over interaction between learner and teacher. Therefore SISDIKSAT project planners were concerned about the degree of interaction that would take place over the satellite system. There was also apprehension that students would be even less likely to ask questions over a satellite network and that the intermediary technology would make them even more hesitant to make comments.

Because the teachers and other presenters would largely control the format of the satellite programs, they were the main targets of SISDIKSAT's effort to promote interaction. Training sessions for presenters and training materials on the use of the system stressed the importance of interaction and offered a number of techniques for incorporating discussion periods into SISDIKSAT programs. The main technique used by all presenters was question and answer periods. Although there were few uses of other techniques such as panel discussions and small group work, most teachers were fairly faithful in setting aside several periods for student questions. A comparison of 317 SISDIKSAT classes with 55 regular face-to-face classes showed that the satellite classes generally had much more time for student participation and interaction with the teacher. These data show that:

- SISDIKSAT CLASSES WERE MORE LIKELY TO HAVE INTERACTIVE PERIODS: 97 percent of SISDIKSAT classes had time for students to talk while only 55 percent of the regular classes surveyed allowed time for students to speak.

- SISDIKSAT CLASSES USED A LARGER PERCENTAGE OF CLASS TIME FOR STUDENT TALK: student talk in SISDIKSAT classes averaged 12 percent of the class time compared with only 6 percent in regular classes.

- SISDIKSAT CLASSES USED MUCH MORE CLASS TIME FOR DISCUSSIONS BETWEEN STUDENTS AND TEACHERS: satellite classes averaged 31.6 minutes for student questions and faculty answers while regular classes used only four minutes.

The greater amounts of time for interaction in SISDIKSAT classes were probably due to the training of the instructors and the fact that the classes were generally longer than regular classes. In addition, some students reported that they felt more at ease in addressing a question over the satellite system to an unseen teacher than to a teacher in front of them. It seems obvious that the technology did not hinder their readiness to ask questions.

SISDIKSAT classes came very close to the target of 100 minutes of instructional time with an average of 97 minutes per class. The 55 regular classes surveyed averaged only 65 minutes. Faculty members teaching over SISDIKSAT were much more likely to reach the target teaching time. The half hour used for student questions and teacher answers means that the students "control" almost one third of their classes, thus making the instructor respond to their needs. Over 74 percent of the students felt that the question periods helped their own learning. Within the scope and resources of this project, it was not possible to confirm this link between interaction and learning.

Interaction in the seminar programs was much higher than in the undergraduate program. Seminar participants used around 23 percent of seminar time for questions and comments. The opportunity for interaction was one of the factors that attracted participants to the voluntary seminar program. It was an essential ingredient in the nature of the program and in guaranteeing the satisfaction of the participants.

A key element in all of the SISDIKSAT programming was the use of supporting print materials. All of the undergraduate courses had extensive text materials. Every seminar had a 20- to 30-page handout. The technical training programs used a series of booklets with elaborate diagrams. Some seminars and courses incorporated locally shown slides or transmitted graphics to accompany the audioconferencing sessions. Besides their obvious value as study aids, the materials also served as a visual focus for participants unable to see the presenter. Many presenters referred to the print materials during class. The statistics classes, in particular, relied heavily on references to charts and tables in the manuals. Instead of sitting docilely listening to a disembodied voice, participants were often told to follow certain points in their books, and they often asked questions about information in the texts.

In the seminar programs, the availability of print materials was cited by many participants as an important factor encouraging their attendance. In a survey of 604 participants in one of the main seminar programs, 98 percent said that they would attend other SISDIKSAT seminars if handouts were available. Only 37 percent were certain they would attend if there were no handouts. Similar responses were received from 242 participants in another seminar program. Given the scarcity of such materials in the outer islands, the print materials greatly enhanced the participants' appreciation of the seminars and whetted their appetite for more material as evidenced by their evaluation comments.

CHAPTER SEVEN
REVIEW OF PROJECT RESULTS

A. HOW WELL DID THE TECHNICAL SYSTEM WORK?

- SUCCESSFUL USE OF LOOPBACK CONFIGURATION
- SUCCESSFUL DESIGN AND USE OF GATING SYSTEM
- HIGHLY RELIABLE AUDIOCONFERENCING NETWORK
- LESS RELIABLE GRAPHICS SUPPORT CHANNEL
- TECHNICAL MANAGEMENT AND MAINTENANCE DEFICIENCIES

After the initial technical problems described in Chapter Four were overcome, the performance of the SISDIKSAT network became quite good. In the 1985-86 academic year, less than 3% of the 441 scheduled class sessions and none of the 28 faculty seminar programs were cancelled due to technical problems. The technical system actually performed better than the human system in that a much larger percentage of classes were cancelled because of teacher absences than technical failures. Even then, SISDIKSAT's class completion rate was slightly better than that recorded for on-campus classes.

The loopback configuration proved to be a very viable design, especially after the problems in the local lines were reduced. Although a terrestrial bridging system still has advantages over the loopback configuration (discussed in Chapter Two), the tremendous difference in cost makes the loopback-based system the best design when cost is a major consideration. Use of the system in the half-duplex mode never was a major problem. Even in a full-duplex mode there would have been the same need to control the flow of conversation. The fact that most of the programs had a main transmitting site (presenter) and a number of receiving sites (participants) reinforced the operational strategy of making one site the "chairman" of the meeting. There may have been a few cases where participants wished that they could interrupt the speaker; however, such interruptions, if carried out by several people, could have led to pandemonium on the system.

The gating system, the second major technical innovation in the project, also performed very well. It is difficult to estimate the extent to which it was responsible for the elimination of the noise problems on the system because the transmit gates were installed just as Perumtel was completing its own major effort to improve the quality of the lines. At times, however, it was very evident that the gates were effective when a particular site was having local problems. The noise on the local lines at that site would come into the system whenever that site tried to transmit. However, the gates prevented that noise from entering into the system during the much longer period when that site was not transmitting. In addition, the gating equipment itself performed flawlessly, suffering no failures and creating no problems of its own. The Indonesian technicians are copying the design and producing the equipment locally for the three sites that are being added to the network.

The audioconferencing network and related equipment (i.e., convener, microphones, telephone terminal) worked very reliably. Of the 441 class sessions scheduled in the

1985-86 academic year, only 10 (2.3%) were cancelled because of technical problems. The observers who monitored the audio system for over 2,100 hours noted hearing technical disturbances during only 2.7% of that time. The observers' report somewhat understates the percentage of time hindered by technical problems on the audio channel (A) because of the occasional use of the graphics channel (B) as an alternative audio channel. In instances where a particular site could not hear well on Channel A, the Local Operators would switch the audioconferencing equipment to Channel B. This was done 19 times during the August-December 1985 semester and 29 times in the February-June 1986 semester.

The need to switch channels was most often in response to a problem at one particular site rather than a system-wide problem (e.g., a presenting site could not transmit clearly or a receiving site could not hear well). In addition, a few locations like Bogor and Samarinda caused an inordinate percentage of the switching incidents. Perumtel never seemed able to make those sites as reliable as the others, and SISDIKSAT management never applied sufficient pressure to force improvements in service. Many of the incidents occurred within a certain time period rather than randomly throughout the semester. A three-week period in April accounted for 17 of the 29 switches that occurred that semester. System-wide problems often were caused by one site transmitting continuous noise or by Perumtel suddenly changing the assignment of satellite channels and assigning channels to SISDIKSAT that were susceptible to interference from other busy satellite channels.

Undoubtedly the availability of a second channel and the ease of making the switch by pushing buttons on the telephone terminal encouraged the Local Operators to change channels immediately instead of waiting to see if the Channel A problem would clear up. Although the availability of a second channel was no doubt a major factor in keeping the audioconferencing system 98% reliable, it also served to make the technical staff somewhat complacent. It gave them a greater margin of error and less incentive to maintain the system and to encourage Perumtel to provide more reliable service.

The graphics support channel never became as important or as reliable as planned. The experiment with telewriters failed because of hardware deficiencies, the adverse effect of the environment on the equipment, and the technical difficulties of getting the telewriters to work reliably on a multi-site basis. The multitude of problems encountered left no easy explanation for why the telewriting system did not work. (The use of French-made telewriters in the Rural Satellite Project in the West Indies also was unsuccessful. Limited trials with microcomputers in both projects have had better success.)

The facsimile and private conferencing telephone services on Channel B were much more reliable but little used for their planned purposes. The facsimile machines had few mechanical problems in two years of operation; however, they were used for only a few hours a week at the most. They never became a major carrier of documents between sites. Although the machines seemed to be in operational order, there were repeated problems in making links between sites, perhaps because of a failure to maintain the transmission and reception settings at their optimal levels. These levels were supposed to be checked once a month, but they were set only two or three times a year. Optimal level settings were more important for the operation of the Channel B equipment than for the audio channel. The telephones were rarely used for private conferences between two or more sites. They were most often used to transmit messages between sites and for SISDIKSAT communications. The multiple functions assigned to Channel B and the complexity of the equipment that was used made the graphics channel much more complex to operate and maintain than the relatively simple audio channel.

Of the three field projects conducted by the Rural Satellite Program, Indonesia was the only one to utilize two channels. On the basis of the experience so far, it is difficult to recommend that a graphics support channel be a necessary component of other systems. In addition to the technical complexity and added expense, there is the major issue of degree and quality of use. Graphics support can be an important adjunct to educational programming if time is spent on the preparation of relevant visuals. The experience in Indonesia showed that very few instructors had the time or inclination to develop special visual aids for their courses. This was a major reason for the choice of a telewriting system that could be used without preparation. But without preparation, there is a strong probability that the graphics created will not be of sufficient merit to justify the additional cost of the graphics system. If it is used well and often, a graphics system may be worth the investment. Otherwise, it is not. The audio channel, backed by support materials sent to each site, can be very effective without the live transmission of graphics. Print materials, slides, and other visual aids can provide a graphics component that will supplement the audio instruction.

Technological developments that have occurred over the last four years have resulted in a range of equipment that may make graphics support more reliable and less costly. Slow-scan or freeze-frame units that transmit single video frames now have a history of reliable use. Microcomputers can be configured to provide telewriting, graphics creation and display, and text transfer. Four of the Indonesian sites have installed computers in the classrooms and report success in sending text from site to site. A number of companies are developing computer-based instructional systems that combine slow-scan, text, and telewriting capabilities. A modem is now on the market that will allow for the simultaneous transmission of voice and graphics on a single channel. Of course, none of this equipment, with the possible exception of microcomputers, has yet been rigorously tested in Third World environments.

After the initial installation problems were surmounted, the system performed extremely well considering the deficiencies in the technical management and maintenance capability. The Directorate never provided the project with the financial and human resources to follow the original maintenance plan. There was little money for travel, spare parts, and overtime pay. More importantly, there was a lack of forceful management. The technical staff did a very good job of dealing with the technology and troubleshooting problems. But they did not have the time, resources, or authority to effectively manage the technical component on a daily basis. As full-time faculty members, both the Chief Technician and Assistant Chief Technician had limited time to manage the entire system. They were usually forced to spend that limited time responding to emergencies rather than actively carrying out a regular maintenance program. An independent technical evaluation of SISDIKSAT done by an Indonesian electronics firm in 1985 concluded that the major causes of technical problems were a failure to follow through on maintenance procedures and a lack of discipline in using the system. A dedicated, intensively used telecommunications system requires strict management of all of its components if it is to be highly efficient. This means that there has to be sufficient resources and senior leadership available to carry out that management. More than anything else, SISDIKSAT suffered from this lack of forceful senior leadership. The project staff did a fine job of creating a great success with minimal resources and little authority. The success could have been greater if a little more local operating money ($10,000-$20,000) had been provided per year by the government for technical support and if the overall management of the project had been better.

B. WHAT DID THE STUDENTS THINK OF THE COURSE PROGRAM?

- GOOD MATERIALS, TEACHERS, AND CLASSES
- ADEQUATE AUDIO QUALITY
- SUFFICIENT TIME FOR INTERACTION
- PREFERENCE FOR FACE-TO-FACE INSTRUCTION

Sixty undergraduate courses were delivered over the system between October 1984 and December 1986. Thirty-five were new courses developed for SISDIKSAT. The rest were repetitions of those courses after revisions. The courses that were developed were:

Adult Education
Agrarian Law
Animal Husbandry
Animal Physiology
Basic Ecology
Basic Forestry
Basic Natural Sciences
Cattle Breeding
Criminal Law
Educational Evaluation
Educational Technology
Fish Diseases
Fisheries Management
Fishing Equipment
Fishing Methods
Food Enzymes
Food Science
Human Ecology
Indonesian Social System
Industrial Law
Macro Economics
Management
Micro Economics
Nutrition
Organizational Behavior
Population and Environment
Poultry Breeding
Poultry Management
Resource Economics
Social Science Research I
Social Science Research II
Soil-Borne Pathogens
Soil Science
Statistics I
Statistics II

SISDIKSAT generally delivered about 85% of its scheduled class sessions. This is slightly above the average recorded for face-to-face courses. Teacher absence accounted for a majority of the class cancellations occurring in both SISDIKSAT and regular courses. Many Indonesian faculty members apparently do not place a high priority on holding the required 12-16 classes per course. Teachers probably were more faithful in attending SISDIKSAT classes than they were in attending their face-to-face classes.

Student attendance fluctuated from week to week because of the general lack of emphasis on attendance in the university system and the irregular attendance of some local classes that used the SISDIKSAT courses as a supplemental activity. The average weekly attendance for a single course ran from 470 for a mandatory freshman course to only 20 for a more specialized course. The average weekly attendance for all courses during the first three regular semesters ran from 1,200 to 2,500 students.

Two major surveys of student attitudes toward the SISDIKSAT course program were made between August 1985 and June 1986. Responses were received from 2,286 students who had participated in courses during those two semesters. The students from both semesters generally held similar views. They felt that the SISDIKSAT teachers were as good as or better than their on-campus resources and that the classes were well organized with sufficient time for interaction. Eighty to 90% of those students thought that the print materials had clear objectives and complemented the presentations over the satellite. Over 80% of the students from both semesters felt that the materials were as good as or even better than their local materials.

Over 81% of the students surveyed thought that SISDIKSAT teachers were as good as or better than their local instructors; however, from the August semester to the February semester there was a drop from 46% to 12% in the number of students who believed that SISDIKSAT instructors were better than their local instructors and a corresponding growth in the percentage who felt they were the same as their local faculty. The reason for this shift in opinion is unclear. In almost all cases, the SISDIKSAT teachers had higher academic qualifications than local teaching staff so students were not using that as an indicator of "better." It does not appear either that their attitudes toward SISDIKSAT teachers were based on the dedication of the teacher (as measured by teacher attendance and number of classes given) nor by the degree of student interaction allowed by the teacher. Interviews with some classes indicated that many students preferred instructors who covered the course content at a leisurely pace that all students could follow. Perhaps the presentation styles and pace of the instructors affected the students' opinions.

In general, the students thought that classes were organized and presented well and that there was sufficient time for participation. Only about 15% to 20% had negative impressions of the organization and presentations. Most students (60-67%) were also fairly positive about the quality of the audio system. About 20-30% of the students from each semester said that they could not always hear the lecturer's voice clearly. This could be due to the larger classes at some locations (exceeding 50 students) and the lack of discipline in maintaining silence in many university classes. The smaller and more orderly seminar groups using the same classrooms gave a 90% favorable rating to the sound quality.

The vast majority of students were also positive about the time for interaction in SISDIKSAT classes, and over 86% of them felt that the master teachers encouraged students to participate. Fifty-six percent of the students reported that they had used the microphones at least once during their course. Six-and-a-half percent said that they had used it every class session. Eighty-five percent of those who had used a microphone used it to ask a question on the content of the lesson. Only 15% had used it solely to ask about the organization of the course or to comment on the lecture.

Most students thought that the time for interaction was very valuable. Almost 74% said that they learned from hearing the questions of other sites. The same percentage rejected the idea of reducing the interaction time in favor of more lecture time.

Although most students had positive attitudes toward the materials, teachers, and organization of the classes, and the monitoring system showed that SISDIKSAT classes met as reliably as local classes and had much more time for student-teacher interaction, 59% of the students said that, given the option, they would prefer taking a face-to-face class over a satellite class. Only 19% said that they would prefer a SISDIKSAT class, and 22% were neutral. This probably reflects a natural human preference for face-to-face instruction rather than a rejection of audioconferencing. Seventy percent of the respondents said that they learned as much or more from SISDIKSAT classes than regular classes, while 30% felt that they learned less. The opinion of this 30% contrasted greatly with that of their local tutors. Sixty percent of the tutors thought that their students learned more in SISDIKSAT classes, and 35% of them estimated that their students learned at least as much. Only 5% of the tutors said that students had learned less than in face-to-face classes. Because it was impossible to run comparative studies during this project, there are no hard data on scholastic achievement that would clarify this issue. Course examinations were modified and graded by local tutors, so there was no standardized information achievement. In addition, few of the master teachers also

taught their course in front of local students who could serve as a control group for comparative purposes.

Given the highly positive attitudes from participants in other SISDIKSAT programs, it appears that the audioconferencing system and the programs it provides may be more popular with older learners with specific learning needs and good motivation. Professionals, field workers, graduate students, and upperclassmen are probably a more suitable and appreciative audience for this type of system. They have a better idea of what they want to learn, strong motivation to learn it, and an appreciation of the expertise and opportunities that an audioconferencing system can provide. The in-service training of professionals, therefore, is one of the best uses for this type of system. The mature learner often relishes the interaction provided by an audioconferencing system and may be disappointed if the degree of interaction does not meet his or her expectations. In one of the higher-rated seminars of the very popular seminar series, the speaker spent only 15 minutes for her presentation and used the rest of the two hours for questions and discussion. In the evaluations of almost all the seminar programs, participant satisfaction was often found to be directly related to the amount of time allowed for interaction.

C. WHAT WERE THE REACTIONS OF THE LOCAL TUTORS?

- COURSES MEET THE NEEDS OF THEIR CAMPUS
- HIGH QUALITY MATERIALS
- MORE STUDENTS LEARNING VIA SISDIKSAT
- INCREASED TUTOR CAPACITY TO TEACH SIMILAR COURSES
- INCREASED TUTOR UNDERSTANDING OF COURSE CONTENT
- SISDIKSAT COURSES BEST USED AS REQUIRED SUPPLEMENT

A survey was made of 43 tutors participating in the February 1986 semester, and interviews were held with most of them. Seventy-nine percent of them had a bachelor's degree, and the remainder had the Indonesian equivalent of a master's degree. Fifty-eight percent were experiencing their first semester as a SISDIKSAT tutor, 21% had finished their second semester, and 21% had worked with SISDIKSAT for three or four semesters. Thirty-seven percent had been teaching for less than five years, 33% for less than 11 years, and 30% for more than 11 years. This was an older group than expected.

The tutors were also generally active in the conduct of the course. Sixty-five percent said that they were present for all of the SISDIKSAT class sessions. Only one tutor out of the 43 said that he had attended less than four classes. Some classes had more than one local tutor so there may have been some rotation of responsibility from week to week. All of the tutors reported having had at least one meeting with their students outside of the SISDIKSAT time. Ninety-five percent had had at least two meetings by the twelfth week in the semester. The majority (63%) had held at least seven such meetings. The goals of the tutors in holding such meetings were to clarify content (67%), monitor class activities (37%), give exercises and tests (37%), and to gather information for the master teacher (33%).

Seventy-four percent of the tutors believed that the syllabus of the SISDIKSAT course met the needs of their own institution, and 83% of them thought that the course matched the needs of the Association. It was almost impossible to make each course exactly fit the needs of each participating campus because each campus had slightly different needs and different types of students. For instance, the statistics course might be taken by economics students at one campus, agriculture students at a second, and by statistics students at a third. Most master teachers sought suggestions from the local tutors on the topics to include in their course, but it was impossible for them to meet all of the varying needs. Hence, there was a need for the local tutors to add material to the course that they believed necessary and to de-emphasize the importance of some material covered by the master teacher. Master teachers found the disparity in the backgrounds of their students to be one of the major difficulties in teaching over the system. Some were unable to cover as much material as they would with students who were majoring in the topic.

Credit for the courses was granted by the local institutions, so local tutors had the flexibility to adapt the materials and the tests to meet their local needs. Only 17% of the tutors reported that they used the master teacher's tests unchanged. Seventy-two percent adapted the tests or used them as guides for making their own tests. Eleven percent of the tutors did not make use of the master teacher's tests at all. This was one of the major reasons why it was impossible to compare the grades of students at different locations.

The local tutors generally held high opinions of the print materials developed by SISDIKSAT. They felt the materials were as good as (63%) or even better (37%) than what was available locally, and all of them stated that they would continue to use the SISDIKSAT materials for non-SISDIKSAT classes either as a resource reference for students (75%), a guide for organizing their own courses (51%), a reference for a different course (35%), or as the main reading for one of their courses (21%). It is not clear why more tutors are not planning to use the materials as the main reading for their local course. It may be because the materials are too extensive, do not fit their exact needs, or because they simply have a preference for the use of the shorter lecture notes supported by the lectures themselves. In any case, the tutors were generally happy about the effect of the SISDIKSAT courses upon their students. Over 60% believed that their students learned more from the SISDIKSAT course or at least the same (35%) as they would have in a regular course. Only 5% felt that their students learned less.

One of the goals of the SISDIKSAT course program was to improve the capability of local instructors to teach these courses themselves. This was to be accomplished through the provision of materials, the experience of working with the SISDIKSAT course for at least two semesters, and by regular meetings with the master teacher to discuss the course and its content. Only 48% of the tutors said that they had had meetings with the master teacher, although 54% stated that the master teacher had helped them prepare for local tutorials. Of the tutors who had meetings, 86% believed that the meetings were useful for planning and running the course, and 67% thought that they helped them understand the content of the course. Over 51% felt that those meetings increased their teaching skills.

When asked to rate the value of the entire SISDIKSAT experience, the tutors gave similar responses. Eighty-six percent felt that they had increased their ability to design and teach similar courses. Over 81% thought that this experience had increased their understanding of the course content, and 51% believed that it had increased their actual teaching skills. All of the tutors felt that they would now be able to teach the same

course in a better way. It appears that SISDIKSAT enjoyed a good measure of success in this area of staff development despite the uneven implementation of the formal meeting system.

When asked to choose one or more of four alternative uses of their particular SISDIKSAT course in their own institution, 86% of the tutors favored using the SISDIKSAT course as a required supplement for the regular campus course. This option is similar to the present situation wherein a local tutor is in charge of the course, devises and grades the exams, and is therefore free to add or de-emphasize subject matter to make the course content match the specific needs of his students and department.

Sixty percent of the tutors thought that the SISDIKSAT course could be a non-credit enrichment course, and 26% favored having it as an elective within their departments. Only 23% felt that it should be a replacement for their regular face-to-face course. The tutors probably are reluctant to see the on-campus course totally replaced by a SISDIKSAT course because of their felt need to adapt the content coverage of the satellite course, their desire to retain local control over the course and credit-granting process, and their feelings of uncertainty about how such a system would operate.

The rectors and academic vice rectors of the participating institutions recently declared that all members should enter the SISDIKSAT courses into their regular schedules so that no identical on-campus courses are run during the same semester. The weaker institutions, in particular, are strongly in favor of assigning junior faculty members as SISDIKSAT tutors and freeing their senior faculty to teach other courses or pursue graduate studies. Without SISDIKSAT, they normally assign a junior and senior person to their courses.

D. WHAT WERE THE REACTIONS OF THE MASTER TEACHERS?

- SISDIKSAT COURSES MORE DEMANDING FOR THEM
- MODIFIED THEIR TEACHING STYLE
- ALLOWED MORE TIME FOR STUDENT PARTICIPATION
- FELT COMFORTABLE TEACHING OVER SISDIKSAT

Another survey was undertaken of 20 faculty members who had served on SISDIKSAT course teams during the 1985-86 academic year. These teachers generally had higher academic qualifications and/or more teaching experience than most of the local tutors. Seventy percent of the master teachers held a master's or doctorate degree compared with the 21% of the tutors who had master's degrees. In addition, almost two thirds of the master teachers had more than 13 years of teaching experience; two thirds of the tutors had less than 13 years.

Three quarters of the SISDIKSAT teachers said that teaching over SISDIKSAT was more demanding than teaching regular classes. Compared with face-to-face classes, SISDIKSAT teachers said that they spent more time on materials preparation (55%) using a more detailed format (42%) and that they produced a greater amount of material (37%) for the satellite course. Only 5% of the respondents estimated they had spent more time

and used more materials in a more detailed format for their regular courses. Seventy-five percent of the teachers said that they had received information on course preparation and audioconferencing from SISDIKSAT, and all of these people felt that the information was useful to them. Although 95% of them stated that they utilized as much reading material or more for their SISDIKSAT class as for their regular classes, only 79% felt that the content was more complete than in their regular classes. This may be related to the necessity of providing more general coverage in their materials because of differences in the backgrounds of the students from different universities and departments. The statistics professor, for instance, found that he could not cover all of the topics he normally covered in his regular classes because many of his SISDIKSAT students were not from mathematics departments and did not have the background of his regular students. He found he had to cover material at a slower pace because of this lack of a common background. Because 60% of the teachers were from the two oldest and strongest universities in the network (i.e., Hasanuddin University and the Bogor Institute of Agriculture), it is also possible that their regular students had access to more detailed materials than the students of SISDIKSAT's remote sites.

Compared with their regular teaching, 30% to 40% of the teachers thought that they had to spend more time in general preparation for the SISDIKSAT course and particularly for the class sessions. No one estimated that they had spent less time than for a regular class. All of the instructors said that they had made modifications in their normal teaching styles to suit SISDIKSAT. A study carried out in the first semester of 1986 showed that there was a very significant modification in at least one aspect of their teaching approach--time allotted for student participation.

To make a comparison between SISDIKSAT and regular class teaching styles and use of class time, permission was obtained from Hasanuddin University, the main source of teachers for SISDIKSAT, to allow the RSP class observers to collect data in regular university classes. The observers attended one class session for 55 different courses. That information on regular classes was then compared with the same type of data collected on the 134 SISDIKSAT classes monitored that same semester. Although the data collection processes were somewhat different (i.e., synchronic and diachronic studies), knowledgeable Indonesian educators who reviewed the data found it correctly reflected reality.

The observers monitored the 189 classes using the standard RSP observation form containing nine categories for teacher speech and five categories for student speech. They sat through the entire class and categorized speech events at 10-second intervals. As expected, there was a great degree of commonality between the two sets of data because the teachers were basically from the same peer group. The amount of time for acts such as "giving praise" or "use of a student's idea" was extremely small. Less than a minute of each class was spent on "questions to the students on the lesson" and "instructions." About three to four minutes were spent on "talking about things other than the lesson."

SISDIKSAT teachers spent significantly more time asking "questions to the students not on the lesson." This primarily resulted from the need for the teacher to call on the multiple sites one by one. They also spent more time on "answers not on the lesson" as they responded to the replies or questions of the different sites. The one category in which the regular teachers exceeded the time spent by the SISDIKSAT teachers was for "lecturing on the lesson." They lectured almost five minutes longer than SISDIKSAT teachers. But the major difference between the two sets of teachers was in the time spent answering students' questions: three minutes for regular teachers versus over

23 minutes for the SISDIKSAT teachers. It appears that the emphasis of the SISDIKSAT training effort on the importance of interaction as well as the influence of the technical system itself played a major role in getting teachers to give time for answering student questions. This represented a significant change in their teaching behavior.

The data show that SISDIKSAT classes averaged over 10 questions a class, and the regular classes averaged less than two. In addition, SISDIKSAT classes were much more likely to have time for interaction. Over 97% of the SISDIKSAT classes had time for student participation, but only 55% of the regular classes did. While students in regular classes averaged one minute per class for questions on the content of the lesson, SISDIKSAT students averaged over eight minutes. The only category in which the regular students surpassed the SISDIKSAT students was in "initiated talk." They averaged over two minutes for impromptu talk, and SISDIKSAT averaged only a half minute. SISDIKSAT students were no doubt constrained by the protocols governing use of the system; however, they also had the opportunity to speak with their local tutor. Those local exchanges were not observed.

These data show that SISDIKSAT students had more control over their classes because they were able to use eight minutes per class for asking questions which got them 23.5 minutes of responses from their teachers. The ratio of question to answer time (1:3) was the same for the regular classes; however, the total time spent was only one minute for students and three minutes for teachers. It is assumed that the 31.5 minutes of SISDIKSAT class time spent specifically on students greatly aided the learning process.

Another major revelation of these data is that SISDIKSAT classes lasted much longer than the regular classes surveyed. SISDIKSAT classes averaged 95 minutes for this semester and 99 minutes for the previous semester. The regular classes averaged only slightly over 65 minutes. The standard time for such classes is 100 minutes. SISDIKSAT classes may have been longer because of the conscientiousness of the instructors and the fact that their classes were now being broadcast to a great many other locations and open to supervision by their peers.

Regarding their personal feelings toward SISDIKSAT and its programs, all instructors agreed that the offered courses were needed by the Association. Ninety-five percent said that they were comfortable teaching over the system with 85% stating that the equipment was easy to use, and 84% expressing satisfaction with the experience of teaching over SISDIKSAT

E. WHAT WERE THE REACTIONS OF THE SEMINAR PARTICIPANTS?

- VERY USEFUL, INTERESTING, AND WELL ORGANIZED
- VERY GOOD VOICE QUALITY
- VERY GOOD AND EFFECTIVE HANDOUTS
- SUFFICIENT PARTICIPATION TIME
- OVERWHELMING SUPPORT FOR MORE SEMINARS

As discussed in Chapter Six, several different seminars were conducted over the satellite system. The two major seminar programs were a four-part series on nutrition

and a 24-part science series which mainly focused on topics in agriculture, animal science, statistics, pharmacy, and medicine. Total attendance for these 28 sessions was almost 1,800 people, all of whom attended voluntarily during their free time. The science series ran during the break between semesters and attracted mostly faculty members and some off-campus professionals in the fields of agriculture, medicine, education, and family planning. The nutrition series ran once a month during the regular semester and thus attracted a large number of students. Both of these programs were extensively evaluated by means of a questionnaire filled out by 842 participants. The results from both of these surveys were almost identical, so this report will focus mainly on the findings from the larger group, the 604 respondents who attended sessions of the science seminar series in early 1986.

Each topic in the series was allotted two hours of satellite time. Print materials of 20 to 30 pages in length were prepared by presenters and sent to all sites in advance. Presenters were asked to limit their speaking time and allow enough time for questions and answers. A moderator was assigned to each session to assist the presenter and organize the discussion periods. The general format was to have the presenter deliver his material in two 15-minute segments and to have at least two discussion periods.

The overwhelming majority of the participants said that the seminars were very useful, interesting, and well organized. Ninety-nine percent thought that they were very useful, over 95% found them very interesting, and almost 90% believed that they were very well organized and well presented.

The participants also thought that the voice quality was very good. Ninety percent reported that the voices were clear enough for them to understand everything that was said. This far exceeds the 67% approval registered by the students even though there were more sites on line and a greater degree of interaction occurring in the seminars than in undergraduate courses. The smaller number of people at each site and their greater degree of order and attention probably accounts for much of the difference.

The handouts that accompanied each seminar topic were extremely popular. Ninety-five percent of the participants thought that they were very good. An even higher percentage of people stated that the handouts made the seminar more interesting (98%) and more effective (96%) and made it easier for them to understand the content of the topic being discussed (97%). Most participants were so enthusiastic about the handouts that they predicated their future attendance at seminars on the availability of such materials. Although 98% of the participants said that they would attend other seminars if they had handouts, only 37% said they were willing to attend if the seminars did not have them. Given the scarcity of good print materials and up-to-date research findings in the eastern islands, it is easy to understand the enthusiasm of the participants over the handouts. The handouts also freed them from extensive note-taking and provided them with a visual element for discussion purposes. Some of the seminars also used slides shown locally but cued by the presenter. The use of slides was also very popular with the participants and received much the same ratings as the handouts.

Interaction time was seen as an essential element of the seminar programs. Unlike most of the students, many seminar participants came to the seminars expecting to be able to make comments and ask questions and were disappointed if they were not able to do so. With large groups exceeding 150-200 participants, the number of questions per site had to be limited to give all sites participation time and still stay within the two and a half-hour time limit. When the number of participants fell below 100, it was generally

possible to accept an unlimited number of questions. With groups of around 50, there was more flexibility to allow for follow-up questions and more extensive give and take.

The use of SISDIKSAT moderators served to control verbose presenters, although there occasionally was a problem in managing presenters who greatly outranked them in seniority. An average of 23% of seminar time was used by the participants to ask questions and make comments. (The average amount of time used by students in the SISDIKSAT courses was 12%.) Presenters generally spent one to three minutes responding to each minute of questions and comments by participants. Therefore, the participants actually controlled the majority of seminar time and had the presenter focus on the issues and ideas that were important to them. This greatly increased their satisfaction with the seminars.

The overwhelmingly positive response of faculty members and others to the seminar program showed that there was a great need for this type of program in the eastern islands. Because local doctors, school teachers, government planners, and other officials were also interested in the seminars signifies that the need for information and intellectual exchange goes beyond the university setting to the surrounding community. People in remote areas simply do not have access to the range of information and expertise available in large urban areas. This seminar program showed that many of them would willingly spend several hours of their time to get information on a topic of interest to them. It also showed that these type of people are accepting and positive users of a technology such as audioconferencing. When asked if they hoped that SISDIKSAT would continue to deliver seminars similar to the one they had attended, 99.2% said "Yes."

F. WHAT ARE THE COSTS OF AN AUDIOCONFERENCING SYSTEM?

- AUDIOCONFERENCING EQUIPMENT AND SITES
- TRANSMISSION NETWORK
- MANAGEMENT STRUCTURE

The cost of owning and operating an audioconferencing network will vary from situation to situation depending on a variety of factors, such as number of sites and channels, local telecommunications tariffs, and range and complexity of the audioconferencing equipment. Generally costs will fall into three main categories: 1) the cost of the audioconferencing equipment that is installed at each site as well as the cost of the site itself; 2) the cost of the transmission system that will carry the voice signals between locations either by terrestrial or satellite networks; and 3) the expense of managing, maintaining, and operating the system.

The cost of the audioconferencing equipment will depend on the range of equipment used as well as the price of each item. If the entire system is simply based on a single audio channel, the cost of 12 microphones, a convener, 2 speakers, cabling, a small telephone terminal, and spare parts can run to US$6,000 dollars per site. This will provide a high quality system capable of handling groups of up to 50 people per session. It is possible to reduce those costs by using less expensive equipment or by hooking the equipment up to the telephone lines without a terminal interface; however, there probably will be a decrease in the quality of the audio connection.

The addition of other equipment will greatly increase this basic cost. In the two-channel Indonesian system, the total cost for each site was over $29,000, including cabling and spare parts but excluding engineering, shipping, and installation expenses. This high cost per classroom was the result of the other special equipment and facilities that were provided. The costs of the major pieces of equipment were:

- $4,200 for the audioconferencing equipment
- $5,800 for the telephone terminal and multimeter
- $3,000 for the facsimile machines
- $5,300 for the telewriting system
- $3,100 for the video display system
- $3,000 for the emergency power supply system
- $2,000 for the gating system

The graphics channel equipment, and specifically the telewriting system, accounted for a great deal of the cost of each electronic classroom. The price of the telephone terminal also greatly increased because of the added complexity necessitated by the multipurpose graphics channel. A system with much the same sort of graphics capabilities can be assembled today at a lower cost given the improvements in microcomputers and slow-scan television units.

At each location, the universities provided a large room adequate for groups of at least 40 people. They also had to provide the necessary furniture including a special cabinet for the placement of the equipment. Most sites used existing classrooms and furniture so it is difficult to assess the extent of their costs.

To operate between sites, the equipment needs a transmission system to carry the audio and graphics signals. SISDIKSAT used the existing network of telephone lines and satellite earth stations. Similar systems can be created solely using terrestrial telephone networks or earth stations. The transmission system may be paid for on a demand basis (charges are levied only for the time used as with a regular long distance call) or on a leased basis (where a fixed sum is paid for 24-hour use of dedicated telephone channels). Because it expected intensive use and needed lines available at specific times, SISDIKSAT was a dedicated system with its own leased channels. The annual payment to Perumtel for the entire two-channel transmission network was 400 million rupiah (approximately $250,000 at the 1986 exchange rate of 1,600 rupiah per U.S. dollar). A single channel system would have been half the cost.

The third major cost component for an audioconferencing system is for the entire management structure which includes the administrative, technical operations, and programming components at both the central and local level. Each SISDIKSAT site received 5 million rupiah ($3,125) annually from the Directorate for the operation of the local classroom and payment of staff. This was the minimal amount necessary to staff, operate, and maintain the electronic classroom. It was supplemented by subsidies from the university in the form of payment of some local SISDIKSAT staff and the local tutors and for the purchase of supplies.

The most underfunded component of the entire project was the budget for the central office in Ujung Pandang. Although various annual budget requests were submitted for amounts ranging from 100 million to 250 million rupiah ($62,500-$156,000), the central office never received more than 50 million rupiah a year ($31,000) to carry out the management and operation of the entire system. That presented severe problems which were masked for a time by support from RSP and the willingness of SISDIKSAT

staff to work long and hard without financial reward and to carry out all activities with a minimum of expense.

This lack of funds combined with the absence of top level management hindered the development of programs, the maintenance and repair of the system and, consequently, the degree of success that the project achieved. After its technical problems were solved, SISDIKSAT became a powerful delivery system ready to be used for a variety of programming for many different purposes. The lack of proper funding and leadership, however, meant that the system could not be used as well or as often as possible. A great deal was accomplished under these trying circumstances, but more things could have been done in a better way if those circumstances had been more positive. Materials could have been printed and delivered faster. More types of programs could have been run. The maintenance and repair plan could have been carried out in a proper manner thus reducing the technical problems even further. To a certain degree, SISDIKSAT was like a new race car that was ready to go anywhere but lacked enough gas and an experienced driver to realize its full potential.

In a dedicated audioconferencing system like SISDIKSAT, the major costs are fixed. The equipment and telecommunications charges account for most of the financial outlay. The money spent on programming largely determines how cost-effective the system ultimately will be. After spending $300,000 on equipment and another $250,000 on annual telecommunications charges, it is unwise to then try to save money by reducing the budget needed to operate the whole system at peak efficiency. That $550,000 investment can be used to support an hour's programming or four thousand hours of programming. After the major fixed investments, the intensity of use and number of users will determine if the audioconferencing network is to be cost-effective.

Although a cost analysis of the entire system was not done by the evaluation contractor, a few examples will suffice to illustrate how an expensive investment in an audioconferencing network can be worthwhile. Basically such a network can do certain things cheaper than they can be done otherwise, and also, it can do things that otherwise are just not possible.

For this example, the annual cost of SISDIKSAT is calculated at Rp.760,000,000 ($475,000) even though this much money was never actually spent by the Indonesian Government. This number is a target figure for a fully funded SISDIKSAT. The cost items would include:

- Rp.400,000,000 ($250,000) to Perumtel for the 2-channel, 12-site telecommunications system
- Rp.60,000,000 ($37,500) for local operation of 12 sites
- Rp.200,000,000 ($125,000) for central office operations including staff, materials, maintenance, and program development
- Rp.100,000,000 ($62,500) for the amortization of the cost of the equipment over a 5-year period although most of the equipment has a life span closer to 10 years

The annual cost for a one-channel system with the graphics being alternated on the same channel with the audio would be approximately Rp.560,000,000 ($350,000). If the graphics equipment were eliminated altogether, the cost would be closer to Rp.480,000,000 ($300,000).

A major instrument for training and idea exchange in Indonesia is the workshop. One or two participants from a number of different institutions are flown to a central

location for a five- or six-day meeting that focuses on some issue or field of knowledge. Two of the major expenses are air travel and living expenses. An average Association workshop in Ujung Pandang with two representatives from each of 10 SISDIKSAT sites would entail an expense of Rp.5,000,000 for airfare and Rp.6,500,000 for eight days of living expenses in Ujung Pandang including travel time. Additional expenses for materials and staff would bring the total cost of a six-day workshop for 20 people to over Rp. 15,000,000 ($9,375). If 50 of these workshops were held in a year, the total annual cost would be Rp.750,000,000 ($468,750). These workshops could be delivered over satellite instead with program coordinators at each location and with the same level of support in terms of materials, honoraria, and even snacks. By accomplishing this task of running 50 workshops for 20 people per workshop, SISDIKSAT would pay for itself and the satellite system would still be available for other activities such as courses, seminars, and meetings because the workshop activities would only occupy six to eight hours of SISDIKSAT time during a 12-hour workday.

Even this example does not reveal the full potential of SISDIKSAT. It is just as easy for SISDIKSAT to run a workshop for two people per site as it is to run one for 20 or more people per site, all within the Rp.760,000,000 budget. Although a 20-person face-to-face workshop would cost Rp.15,000,000, a similar SISDIKSAT workshop would cost only 8 million, a ratio of 1.85:1. However, a 200-person face-to-face workshop would cost over 128 million rupiah ($80,000), but a SISDIKSAT workshop would only increase in cost to 18 million ($11,250), a ratio of 7:1. The ratio changes drastically because travel and living expenses comprise such a large percentage of face-to-face workshops. An increase in the number of SISDIKSAT participants mainly increases costs for materials and honoraria for participants.

The Directorate General of Primary and Secondary Education has had a goal of providing in-service training to 6,000 teachers in the eastern islands. So far it has reached only 60 through face-to-face workshops. It will be impossible to reach all of them with such workshops because the costs would run into billions of rupiah. A second alternative would be to establish several training teams (math, science, reading, etc.) that would fly to the provinces and conduct regular workshops at the provincial or district level. Participant travel would be limited to travel between their school and the training center. There would be extensive travel costs for the training teams and a great deal of time lost during movement from site to site. A third alternative would be to carry out that training over SISDIKSAT with an expert team in each field delivering instruction to all sites simultaneously. The training could be done faster, less expensively, and with less of a drain on the expert manpower of the Directorate. Having examined the alternatives, the Directorate is presently preparing a plan to do this training over SISDIKSAT.

The costs of installing and operating a dedicated audioconferencing network like SISDIKSAT are substantial, although basic telecommunications costs will vary from country to country and network to network. Per hour line charges in the three projects of the Rural Satellite Program range from $40 in Peru to $100 in Indonesia and $200 in the West Indies. The University of the South Pacific, a multinational institution, recently concluded an agreement with five national telecommunications authorities and Intelsat that will provide a single audio channel for only $27,000 a year. It is important that other telecommunications authorities also offer similar concessionary rates for development activities if telecommunications are to be used extensively by social service agencies. These agencies usually cannot pay the same charges as the private sector.

In general a dedicated audioconferencing network's cost-effectiveness will depend on how efficiently and intensively the system is used and the intrinsic importance of its

programming. The more expensive the system, the greater the need to use it for long hours with large numbers of participants or for activities that produce highly important benefits like the transfer of medical information that may save lives. A non-dedicated network can simply judge its cost-effectiveness on a program-by-program basis. The Indonesia system is larger and more expensive than the other two RSP projects and thus has to produce more extensive benefits to balance its higher cost. To a great extent it has succeeded by reaching thousands of people compared with hundreds in the other projects, and it is used very intensively. It would be much more cost-effective if it were reduced to one channel or if the number of programs and participants were increased by better management of programming selection and site participation.

G. WHAT ARE THE MAJOR PROBLEMS NOW FACING SISDIKSAT?

- LACK OF A STABLE INSTITUTIONAL BASE
- LACK OF STRONG LEADERSHIP AND MANAGEMENT
- NEED TO REVIEW AND CLARIFY GOALS AND PROGRAMS
- NEED TO IMPROVE COST-EFFECTIVENESS

In its first two years of operation, SISDIKSAT has shown itself to be a reliable and effective delivery system for a range of programming and personnel. Now that it has completed its experimental and demonstration stages as a project, it is important that it resolve some of the major problems that have been hindering its development. It needs to become more effective by increasing the impact of its programming and the number of its participants.

One of the first problems that needs to be settled is the issue of its institutional base, a question which has not been fully settled even at this late date. Although the project began as an adjunct to the Eastern Islands Universities Association, the Association's secretariat never became involved in the management of the project. SISDIKSAT generally dealt directly with the member institutions and the Directorate. With the end of the Washington State University-AID project, the Directorate General greatly reduced its financial support of the Association thus weakening an already weak organization. New projects with the Canadians and Australians are now being planned that may rejuvenate the Association, and the Directorate and the Association are anticipating that SISDIKSAT will play a major role in helping to support those two new projects. Four years of experience, however, indicate that the Association probably cannot provide the solid institutional base that SISDIKSAT requires. Other options that have been discussed include giving SISDIKSAT independent status as a special unit directly under the Directorate General with its offices in Ujung Pandang or in Jakarta or making it a sub-unit of the Open University. With the conclusion of foreign support, SISDIKSAT can no longer continue with its project status. For its long-term welfare, it has to be linked to an existing institution that can provide it with the support and direction it needs.

After its institutional standing is clarified, SISDIKSAT desperately needs to have strong leadership that will identify promising directions for system use, solidify political and financial support, and galvanize the widespread staff, and a management system that will keep the network and its programming running efficiently. The middle level faculty members now running the system require the presence and support of a senior level

person. They need to be given the time and resources to be able to carry out their resporsibilities with an even higher degree of quality without the continual challenge of trying to do the most with the least. SISDIKSAT also would benefit from the creation of an advisory committee made up of its members and a Perumtel representative that can give it general direction and high level support. The technical system can be made more reliable with an improved reporting and response system that tracks equipment and Perumtel technical problems. Better selection and organization of the course program could raise attendance from the present high of 3,000 students a week to 4,000-5,000 a week and make attendance more consistent from week to week. More resources and tighter administration can reduce the cancellations caused by teacher absences and the time for production and delivery of materials.

A third area that needs to be addressed is the review and clarification of goals and programs. In the last two years SISDIKSAT has offered a number of programs and services to a variety of participants. Based on this experience and the needs of its members, it should review this past history and decide if it should continue in the same manner or make adaptations in its programming and audience. Among the issues to be resolved are:

- How can the course program be restructured to include more sites and students for each course?
- Should the course program focus on basic courses for large groups of undergraduates or more specialized courses for smaller groups of upperclassmen?
- Should SISDIKSAT begin to deliver graduate courses in response to the demand from faculty members and government officials who have no other access to graduate programs?
- Should SISDIKSAT concentrate more time and resources on in-service training activities for education personnel and less time on academic courses?
- To what extent should SISDIKSAT provide time and support to non-Association users like the Open University or potential users outside of the education sector like the family planning and regional planning agencies?

A final major area that needs to be examined is increasing the cost-effectiveness of SISDIKSAT operations. The course programs should be arranged so that more sites and/or more students participate in each course. At present, some courses are followed by only two or three of the eight sites that receive courses (Two sites are mainly presenters of courses; the other two sites are for special applications.) The Association members also should work toward reducing fluctuations in weekly attendance and standardizing the starting times of their semesters.

Given the low use of the graphics channel, the wide range of course needs, and the high demand for network time, SISDIKSAT should seriously consider converting the graphics channel into a second open audioconferencing channel. Two programs could be carried simultaneously, thus doubling the number of courses that could be offered and making more time available for other users, such as the Open University. Sites could choose which program to follow or could add a parallel classroom so that they could follow both programs. Another option would be to reduce the system to only one channel, thus cutting the telecommunications cost almost in half. The fax and graphics could still be used but not simultaneously with voice transmissions. SISDIKSAT might wish to experiment with the new modems that provide for simultaneous voice and graphics transmission. The use of one channel, however, would mean that SISDIKSAT management

would have to improve their own technical maintenance effort and encourage Perumtel to do the same, because SISDIKSAT no longer would have the option of switching channels to avoid technical problems.

Another strategy that the Directorate might wish to consider is a reallocation of the classrooms based on the participation record of each site. In the second semester of 1985, for example, Cenderawasih University in Jayapura had an average of 500 students per week attend SISDIKSAT courses, while Lambung Mangkurat University in Banjarmasin had an average of only 30 students. The Directorate should seriously consider closing the electronic classrooms at the few sites with a very low participation record and moving the equipment to other universities that have more of an interest and need for the services that SISDIKSAT can provide. Such a plan certainly would bring attention to the value of SISDIKSAT membership and perhaps put the universities on notice that SISDIKSAT facilities are not to be taken for granted. It is important that SISDIKSAT's limited resources be fully utilized. Although a reallocation of membership in SISDIKSAT would be politically difficult to undertake, it would improve the overall effectiveness of the network. Membership in the network could be based more on common need and less on loose Association ties. This should increase both participation levels and satisfaction with the satellite programs. Membership based on common needs and interests rather than geography is the strongest foundation for building a satellite network.

By the end of 1986, SISDIKSAT had expanded from the original 12 sites to 15 sites with the addition of classrooms at the Open University headquarters near Jakarta, Halu Oleo University in Kendari, and the Institute for Teacher Training in Manado. These classrooms were added with funds obtained from non-RSP sources. The Directorate General of Higher Education and the rectors of the universities in western Indonesia have been sufficiently impressed with the results of SISDIKSAT to include plans in their next World Bank loan proposal for a replication of SISDIKSAT in western Indonesia. In eastern Indonesia, plans are now under way to also use SISDIKSAT to support new higher education development projects sponsored by Australia and Canada. These highly positive developments are an indication that SISDIKSAT has convinced Indonesian leaders of the effectiveness of satellite communication for educational purposes and may receive the interest and support necessary to enable it to solve its outstanding problems and improve its already high level of efficiency.

CONCLUSION

Despite the great obstacles it faced as a complex and pioneering project, SISDIKSAT was able to overcome most of the difficulties it encountered and successfully demonstrate and develop the use of interactive telecommunications as an effective tool for distance education. In the technical area, the loopback design was shown to be a cost-efficient and effective basis for an audioconferencing network, and the gating system proved to be an innovative and workable response to the problem of telephone line noise. During its two-year demonstration phase; SISDIKSAT delivered a variety of programs to all of its member sites, including 60 academic courses and over 30 seminars. Over 10,000 people in the eastern islands benefited from these interactive programs and the other services offered by SISDIKSAT. Textbooks and study guides were developed, and hundreds of master teachers and local tutors were introduced to new materials development and interactive teaching methods. Convinced of the value of SISDIKSAT, three additional institutions joined the network in 1986, thus increasing the total number of sites to 15. In addition, the Directorate General of Higher Education is planning a replication of SISDIKSAT in western Indonesia as part of its next World Bank loan.

Beyond its quantifiable accomplishments, SISDIKSAT also produced some additional benefits which are more difficult to assess. Hundreds of faculty members were given the opportunity to work with senior experts in their fields, provided with high quality materials, and given a role model to emulate. A concerted effort was made to increase the quality and standardization of courses within higher education institutions and increase the degree of student-teacher interaction in classes. Perumtel staff became familiar with the use of different types of equipment over their lines, the technical aspects of creating an audioconferencing network, and the developmental potential of their telecommunications system. Other groups working on a national or regional scale were exposed to an audioconferencing network and given a functioning example of how the Palapa system could be used to meet their own administrative and training needs. The Open University, the Directorate General of Primary and Secondary Education, and other agencies are presently developing plans for the use of telecommunications in their own programs.

Most importantly, SISDIKSAT demonstrated that an audioconferencing network could be built in the Third World and used in a variety of ways for educational development. Both undergraduates and professionals in a wide range of fields received instruction and enthusiastically participated in discussions with distant experts. Academic courses, in-service training programs, meetings, and information exchange were carried out effectively. People in remote areas were given access to learning opportunities that otherwise would not have been available. The major lesson of SISDIKSAT is that audioconferencing systems can be created in the Third World, can meet important communication needs that are not presently being met, and can do so in a cost-effective manner. Audioconferencing systems can provide developing countries with a powerful tool to extend educational opportunities to remote areas, to support and train professionals in the field, to share scarce human resources, and to enhance administrative efficiency. All countries possess a basic telecommunications infrastructure. SISDIKSAT demonstrates that this existing technology and infrastructure can be used to help solve the problems of today and to prepare for a better tomorrow.

Although building such systems is not an easy task, the Indonesian experience shows that the acceptance and use of high technology is not as difficult to accomplish as the successful creation of appropriate management systems that will effectively utilize that technology. Every country in the world has people who can learn to install, operate, and repair sophisticated electronic equipment. It appears to be more difficult to develop the managers and management systems that will provide for the smooth operation of the technical, administrative, and programming components of such a network. A concentrated effort has to be made to make the management systems, as well as the technical system, work with a high degree of efficiency and reliability. An equal emphasis has to be placed on the two.

SISDIKSAT has shown that an audioconferencing system can be very successful under less than ideal conditions and that it can use its own telecommunications facilities to help overcome some of its problems. It is also true that "ideal" conditions will never be approximated until developing nations are given the experience of dealing with such technologies. SISDIKSAT has provided the Indonesian Government with that experience and has enhanced the chance that educational applications of interactive telecommunications systems will be developed and successfully implemented in Indonesia and in other countries. The Rural Satellite Program has identified many of the problems that will be encountered whenever anyone seeks to use telecommunications services for distance education purposes, and its experience should help others to avoid or reduce many of those problems. The more important result of RSP, however, has been to reveal the opportunities and achievements that can be realized when the power of today's telecommunications systems is used for educational goals. It is not a question of transferring high technology to the Third World but of using the high technology already there in innovative ways to promote human and national development.

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