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9. ABSTRACT

This report is designed to identify for the U.S. and international organizations the key policy decisions that will significantly effect the use of satellites and other communication technologies by less-developed countries; also seeks to make AID aware of the developing environment in which its program will be operating over the next five to ten years and of available options. Some issues addressed have been overtaken by time, including some experiments in remote regions in the United States and their relevancy to future efforts. Other issues include: should AID have an interest in satellite technology; what is appropriate assistance, what advisory role can AID play on selection of technologies; implications concerning use of education satellite systems as opposed to combined education/telecommunication systems; efforts to create or expand functional linkages among experimenters; design of satellite systems in relation to educational objectives rather than engineering considerations; assistance in development of informational exchange and feedback systems.

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Broadcast Satellites for Educational Development: Possible Key Decision Points, 1973 to 1978

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Dean Jamison
Steven Klees
Kenneth Polcyn

Report Number Four
1973

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FOREWORD

This is the fourth in a series of reports on policy issues on the use of instructional technology in the underdeveloped countries, prepared under contract by the Academy for Educational Development for the Agency for International Development. The studies were conducted under the general direction of the President of the Academy, and were carried on during the years 1970-1973 by nationally known specialists in educational technology.

The introduction to this report summarizes the principal issues and areas of concern regarding the use of satellites for educational development and to which the study team directed its attention.

Chapter I examines the critical problems that are confronting the educational systems of less developed countries; and, as satellites essentially provide a means for distribution of radio and television, the second part of the chapter reviews the cost performance of these media and their use in developing countries. Finally, Chapter I examines the potential of satellite distribution systems and the economic, pedagogic, and political problems that could result from their use. Chapter I was prepared by Dr. Dean Jamison, Research Economist and Chairman, Economics and Education Planning Group, Educational Testing Service; and Dr. Steven Klees, Assistant Professor of Education, Cornell University.

Chapter II begins with a discussion of the key policy points which may confront AID policy makers during the five year period, 1973-1978. This part has been prepared by Mr. Bert Cowlan, Communication Consultant. In Sections B and C, Dr. Jamison reviews the policy issues before AID and other development agencies with respect to decisions they must make about future support of research and development projects, institution building, pilot projects and operational systems aimed at improving the educational systems of developing countries through the use of communication satellites. An appendix to the report, by Dr. John Hanessian, Professor, Program of Policy Studies in Science and Technology, The George Washington University, discusses the continuing international debate about the political and legal aspects of direct broadcast satellites.

The assembly of data and backup information for this study was possible only because of the cooperation and assistance of hundreds of persons in many parts of the world. The initial stage of the study was conducted under the direction of Dr. Kenneth Polcyn, whose work provided an extensive base of information for preparation of the final report. Other contributors to the initial studies who deserve special mention, were Scott Berdine, Lee Love, Richard Mizrack, James Papay, Delbert Smith, and Douglas Starr. The Academy uses this opportunity to thank publically, the many participants in this study and to express appreciation for their contributions.

The Academy also wishes to acknowledge with warm thanks the advice, counsel and assistance provided during the course of this study by the representatives of the Agency for International Development. In particular, we are grateful to Dr. Clifford Block, Educational Technology Officer, TA/EHR/AID, who acted as project monitor for these studies, and to his associate, Ms. Annette Buckland. They have been exceedingly helpful on many occasions and we thank them for their assistance as well as their continued patience.

Alvin C. Eurich
President
Academy for Educational Development

INTRODUCTION

Section 220 of the Foreign Assistance Act of 1970 directs the Agency for International Development to undertake a wide array of activities aimed at assisting the developing countries to use communications technologies for education, agriculture, health and community development. The technologies consist of radio, television, programmed teaching systems, computers and communications satellites.

While recognizing that the legislative intent of Section 220 focuses on software, AID has interpreted its mandate as implying a systems approach that pays due regard to the other essential components as well -- specifically, the equipment configurations that transmit the software and the management practices that determine its deployment.

To carry out some of the activities mandated under Section 220, AID contracted with the Academy for Educational Development to direct scientific research on the use of educational technology, to assess educational effectiveness and cost implications of various alternative communications systems, and to develop ways of applying electronic communications systems to agriculture, nutrition, population, and community development.

This report is designed to identify for the U.S. and international organizations the key policy decisions that will significantly effect the use of satellites and other communications technologies by less-developed countries (LDCs). The report also seeks to make AID aware

of the developing environment in which its program will be operating over the next five to ten years and of available options. The Academy hopes this awareness will enable AID policymakers to formulate policy decisions in the most effective and constructive way and to develop AID's program accordingly.

The rapid change in communications technology and in the legal provisions governing that technology poses a host of problems for AID and other international organizations seeking to help developing countries make the most effective use of communications technology in improving their educational systems.

This report is primarily concerned with those issues which may have a direct bearing upon AID programs and with questions which are now or will shortly be faced by AID policy makers. In other instances, the issues and problems surrounding the international use of satellites may have only an indirect relationship to AID policy. The solution to some of these problems will therefore depend on decisions made by agencies other than AID, but even in these instances AID should be aware of the problems and of possibilities for helping to frame a decision that will be in the best interest of the United States -- particularly as expressed in Section 220.

What follows is a summary of the questions and issues to which the study team directed its attention:

Some issues as they have come to AID:

- What should be AID's relationship with the Andean countries' regional satellite feasibility study?
- Can AID relate to the domestic experiments, expecially the Rocky Mountains, Appalachia, and Alaskan projects, in ways to serve the Agency's overseas development objectives?
- What kinds of relationships or joint activities are likely to prove most profitable in terms of UNESCO, UNDP and other international agencies concerned with satellite education?
- What is AID's stake with respect to its programs in the development of U.S. policy on international regulations?
- What kinds of cooperative relationships can be developed with NASA and HEW, for example, with respect to determining priorities for broadcast satellite programs, reviewing LDC or other proposals, evaluating the outcome of the planned experiments in India and elsewhere, and in working toward low-cost receivers and similar technologies?
- How can AID best utilize the experience and data that will be generated by various satellite experiments for further LDC planning?

Areas of direct concern to AID regarding satellites:

- Should AID have an interest in satellite technology for development purposes?
- What is the most appropriate assistance for AID to provide to less-developed countries?
- What role can AID play in advising less-developing countries on a selection of technologies to achieve the best combination of media for cost-efficiency and learning effectiveness?

- What are the implications concerning the use of education satellite systems as opposed to combined education/telecommunication systems?

- What can AID do to create or expand functional linkages among experiments -- and experimenters? How can AID study and capitalize on the current satellite experiments?

- How does AID relate the design of satellite systems to educational objectives rather than to engineering considerations?

- How can AID assist in information exchange and data collection on satellites? How can AID develop cooperative, connective linkages with other U.S. government agencies, such as NASA and HEW, and liaison with other multi- and bi-lateral organizations and agencies?

- How can AID assist in helping countries establish feedback systems which play a formative role in experiments?

- How will U.S. policy on direct broadcasting affect AID programs?

Areas of indirect concern to AID regarding satellites:

- Is there a need for an ultimate coordinating satellite authority?

- What are the possible effects of domestic decisions on funds for future development of the technology?

- What are the implications and possibilities for multilateral or regional satellite systems?

- How workable are joint-funding proposals?

- How can the Free Flow of Information issue be resolved? Is it a First Amendment (to the U.S. Constitution) issue?

Other areas of importance regarding satellites:

- What are the implications of vendor activities in less-developed countries?

- What are the implications of satellites on military and technological development?
- What are the possibilities of technical agreements and regulations, e.g., WARC (World Administrative Radio Conference) regulations on orbital arcs and spectrum allocations?
- What are the implications of a moratorium on satellite-statement of the art developments?

This study does not presume to answer all of these questions, nor is its intention or purpose to make policy for AID. Many of these issues will require resolution over a period of time and appropriate policy will be determined by AID decision makers. We hope, however, that the information contained in this report will serve those who must grapple with these issues in the years ahead.

CHAPTER I. THE PROBLEMS AND POSSIBILITIES

To find the best solution to a problem, one must fully understand the problem itself. This chapter therefore first examines the critical problems that are confronting the educational systems of less developed countries: rapidly increasing demands for education, scarce resources, rising unit costs, discrepancies between the results produced by educational systems and social needs, and system inertia and inefficiency.

These problems are so severe that nontraditional alternatives for meeting them, including broadcast satellites, should at least be explored.

Since satellites basically provide a distribution mechanism for radio or television, much of the empirical evidence for determining whether to use a satellite derives from experience with using terrestrially distributed radio and television to solve educational problems. The second part of this chapter therefore reviews the cost and performance of instructional radio and television and their use in developing countries.

Finally, this chapter examines the potential of satellite distribution systems and the economic, pedagogic, and political problems that could result from their use.

A. Critical Problems Facing Educational Systems in LDC's

The current worldwide interest in using new media, including satellites, for education has grown in large part out of concern for possible remedies to a number of critical problems facing educational systems. To understand the possible potential of new educational technologies in alleviating some of these problems, it is necessary to have a grasp of the problems themselves. It is toward an understanding of these problems, their causes and their effects, that this part is aimed.

The emphasis here, as throughout this report, is on the problems faced by developing nations, although the relevant experience of more industrialized nations will also be examined. The term "education system" is used in a very broad context, referring to the total of a nation's "activities which are consciously organized for the express purpose of achieving certain prescribed educational and training objectives" (Coombs, 1968, p. 9). This definition thus includes not only the various components of the hierarchy of formal education, but also the wide variety of organized educational programs that are often grouped as nonformal education (such as literacy programs, health services and community development programs, and on-the-job training). Nonformal education has received relatively little attention until recently (especially in the research and evaluation area), but the educational problems to be discussed in

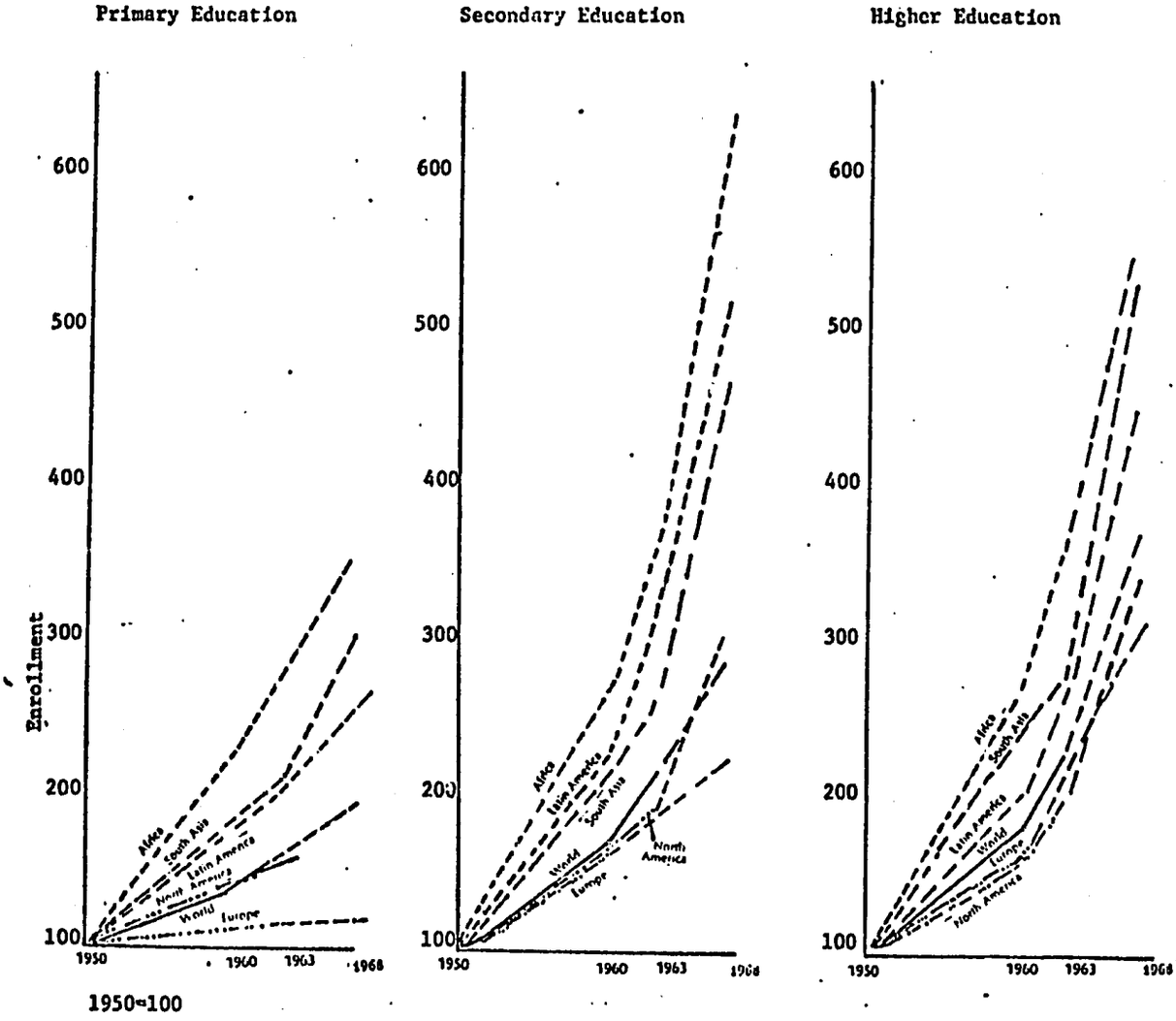
this report indicate that there is a strong rationale for greater concern with nonformal education programs; additionally, it appears that some of the most fruitful uses of new media have been and will continue to be in the area of nonformal education.

Coombs maintains that educational systems are facing an unprecedented crisis of worldwide proportions. This crisis, according to Coombs, has occurred to some degree in all countries, rich and poor, because of the historic conjunction of five related factors -- the flood of students, acute resource scarcities, rising costs, unsuitability of educational results, and system inertia and inefficiency. Regardless of whether one agrees that the situation is a crisis, there is compelling evidence that the problems Coombs describes are quite serious, especially in developing nations.

The Student Flood. Soon after World War II, there began a large expansion of education enrollment that has continued through the present and appears to be going to continue through the foreseeable future. In some respects the lessdeveloped nations have been most affected by this expansion. Figure 1 depicts the relative increase in enrollments
ig. 1 from 1950 to 1968 at the primary, secondary, and higher levels of formal schooling throughout six world regions. The rate of increase has been much greater for the developing regions of Africa, Latin America, and South Asia than for the more developed regions of Europe and North

FIGURE I

RELATIVE ENROLLMENT INCREASES IN WORLD REGIONS: 1950 - 1968



1950=100

Source: Coombs (1968, p. 19) and UNESCO (1971).

America. Table 1 shows the relative and absolute increases in enrollment for both developed and developing regions. In total, enrollments in formal educational systems for developing regions more than tripled from 1950 to 1968, increasing at an average annual rate of 6.7 percent and resulting in the average annual addition of about 8.5 million students.

le 1

The principal causes of this unprecedented increase are (1) population increases compounded by relative increases in the younger age groups, (2) increased emphasis on national development and a widespread belief that more and better education is necessary for economic growth, (3) desire for democratization of the educational system, and (4) rising educational and social aspirations of the populace.

Population increases partly account for increased educational enrollments. In developing countries the problems of rising demand caused by increases in population are exacerbated because the school age populations are growing even more rapidly than the total. The school age population is likely to increase in the future as a result of reductions in the relatively high rate of infant mortality in most developing nations (Chau, 1969). However, population growth alone cannot explain the 6.7 percent annual growth rate of school enrollments.

The growth of educational systems in recent years has been fostered by

ENROLLMENT TRENDS IN DEVELOPED AND DEVELOPING REGIONS: 1950-1968

(thousands of students)

Year	Primary		Secondary		Higher		Total	
	Enrollment	Average Annual % Increase	Enrollment	Average Annual % Increase	Enrollment	Average Annual % Increase	Enrollment	Average Annual % Increase
				Developed Regions				
1950	66,666		19,718		3,658		90,042	
		1.4		5.1		6.8		2.7
1968	85,033		48,084		11,882		144,999	
				Developing Regions				
1950	62,084		7,188		920		70,192	
		6.2		9.2		9.4		6.7
1968	184,255		35,069		4,650		223,974	

Source: UNESCO (1971).

the desire for national development. Common sense, as well as recent studies, suggests that more and better educated manpower is necessary for economic growth. In many countries this need has combined with and promoted a demand for greater economic and social equity, which governments often meet by providing more education for a greater proportion of the populace. (Carnoy, 1973, and others have, however, presented evidence that suggests income distribution is little affected by expanding education.) These factors have led to powerful political forces pushing to expand their educational systems. In the past, most developing nations had educational systems that were geared toward training a select elite; the movement toward education for the masses has and will continue to strain both the nation's resources and the ingenuity of educational planners.

Most developing nations have tried to expand their educational systems in response to these forces, and impressive gains have been made in this period. However, the World Bank (1972, p. 259) reports that "...enrollment ratios remain low in a number of countries. Among 51 countries in which the Bank had recent lending operations in education, the median primary enrollment ratio is 71%; the range is 6% (Somalia) to 99% (Greece). At the secondary level for the same group of countries in the mid-60's the median enrollment ratio is 13% and the range is 2% (Tanzania) to 54% (Ireland). Twenty-five percent of these countries have less than 8%."

Clearly, pressures on the educational systems of many of these countries will increase in the near future. The factors discussed above will not only increase the demands on the resources of the formal educational systems, but should also lead to raising the quantity and quality of non-formal educational services offered. In East Africa, for example, 70 percent of the people entering the labor force have had little or no primary school training (World Bank, 1972, p. 271). The goal of economic growth, combined with the demand for more social and educational opportunities, makes the training of these adults of high priority, and this cannot ordinarily be attained through the formal school system. This extraordinary rise in the overall demand for educational services poses grave problems for the educational systems of most developing nations, as will be evident upon examining the other contributing factors.

Acute Resource Scarcities. The expansion of educational services will require a concomitant increase in teachers, administration, buildings, and learning materials. Normally the supply of these resources is principally a financial matter. However, not infrequently, internal bottlenecks impede a nation's ability to supply these critical educational resources even if sufficient funds are available.

The principal resource problem frequently faced by developing countries is a shortage of qualified teachers. Quite often the shortage results from inadequate expansion of the teacher-training institutions. Furthermore, in

the 1960's many of these countries faced a shortage of trained manpower at all levels. Since the educational system must to some extent compete for its supply of teachers with other fields, a tight labor market served to aggravate the teacher shortage. The teacher shortage has tended both to slow the rate of expansion of educational systems somewhat and to increase the certification of lesser trained personnel as teachers. The latter is seen by many as threatening the quality of the educational system.

There are some indications that the teacher shortage is abating in a number of cases. Teacher-training institutions are trying to expand their programs more rapidly to meet the growing demand for education. Additionally, many developing countries are beginning to experience a looser labor market, which should enable educational systems to attract more and better teachers. However, sometimes the looser labor market goes too far and yields in some training categories a surplus of workers who are forced to join a growing group of educated unemployed.

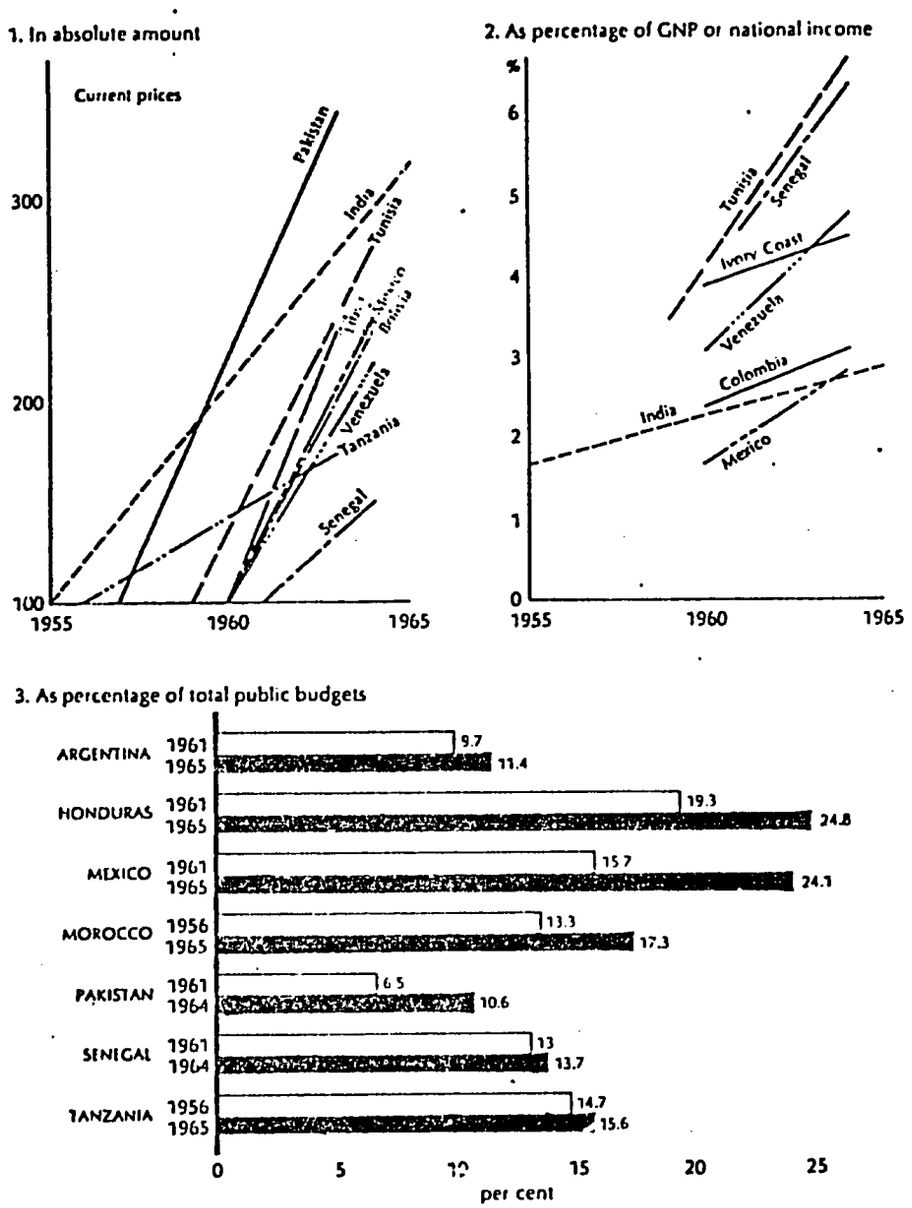
Despite the possible improvements in the overall supply of teachers, there is still strong reason to suspect that educational systems will be plagued by imbalances between the urban and rural sector. For, as most educational systems have expanded, their main emphasis has first been on urban education -- that is, education in urban locations for urban children. Gradually, concern for rural education has increased, but it still lags

considerably behind that for urban education. For example, the overall ratio of primary school enrollment in Mexico for 1970 was 79.0 percent; however, this figure disguises the wide disparity between the urban and rural sectors -- with enrollment ratios of 88.4 percent and 65.7 percent, respectively (see Klees, 1973). This urban-rural inbalance becomes much more pronounced at higher levels of education; in Mexico there are no traditional secondary schools in rural areas (although there is an educational television experiment designed to help meet this rural demand). This imbalance can partly be attributed to priorities (which are beginning to change) and to the higher relative costs of traditional rural instruction (due to lower rates of teacher and classroom utilization than in urban areas). However, another factor is a shortage of teachers who are willing to live and work in rural areas, especially at the secondary and higher levels.

Rising Costs. As enrollments and enrollment ratios rise, perhaps the main test that educational systems face is their ability to use available funds to maintain services at an acceptable level of quality. The funds available for education have not only increased in absolute amounts, but they have also taken a relatively larger share of the total resources of most countries in recent years. Figure 2 shows educational expenditures in absolute terms and as a percentage of national income and total public sector expenditures for a sample of developing countries. Absolute expenditures have risen

FIGURE 2

OVERALL EDUCATIONAL EXPENDITURES IN DEVELOPING COUNTRIES



Source: Coombs (1968, p. 60).

quite substantially, in some cases doubling or tripling within a 5- to 10-year period. In some Latin American countries, such as Mexico and Honduras, expenditures for education account for about one-quarter of the total public sector budget. Heavy foreign aid contributions have enabled some African countries, such as Tunisia and Senegal, to spend more than 6 percent of their national incomes on education. While these countries have been able to meet the financial requirements of expanding their educational systems remarkably well, it seems doubtful that they can sustain such relative increases in educational expenditures. For example, Jamison (1971) estimated that real expenditures on elementary education in Indonesia must double over the next decade simply to keep the percentage of elementary school age students actually attending school from falling, assuming no change from traditional methods. Competition among public sector programs for larger shares of the budget will increase, and in some cases it may even be difficult for education to retain its present share. The ambitious goals most developing countries have for educational systems, the population pressure, and rising unit costs all combine to present a bleak future if present methods continue.

Although increased enrollments have been a major cause of increased expenditure, this is not the whole story. Primary school enrollment in Mexico during the 1960's rose an average of 5.5 percent a year, while real expenditures on primary education during this period increased by

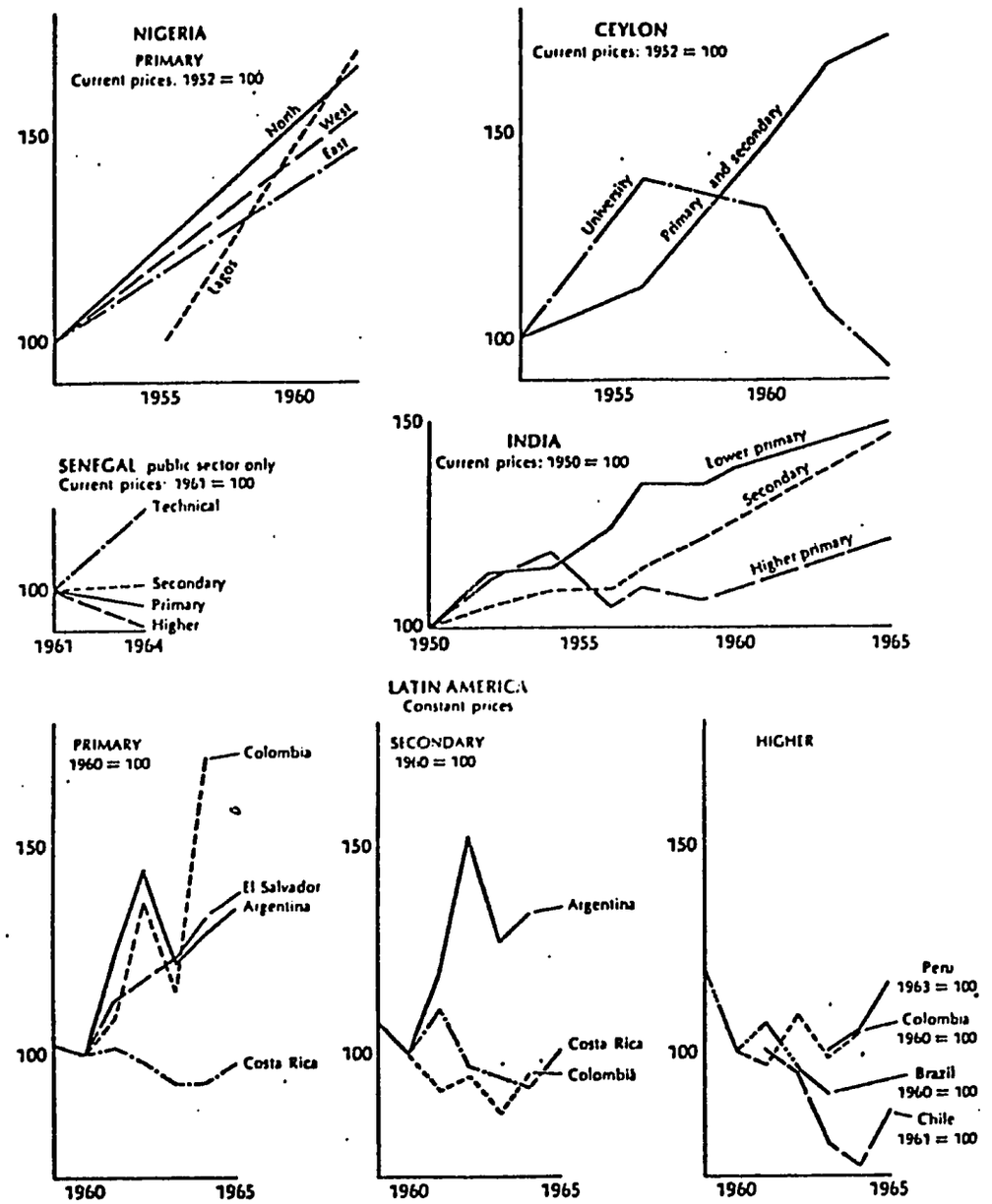
about 8.5 percent a year. In other words, is becoming more and more expensive to educate each child in the system. In Mexico, from 1960 to 1970, the real expenditure per primary school pupil increased by an average of 2.9 percent a year (see Klees, 1973, for Mexico data). Many other developing countries (and almost all developed countries) have experienced similar increases, especially at the lower levels of formal education, as can be seen from Figure 3.

In cases where costs per student have apparently decreased over time, Coombs (1968, p. 49) reasons that the gains are illusory -- caused by such factors as the lag of teachers salaries behind inflation, the use of less expensive and less qualified teachers, and increases in average class size. Increases in class size can be pushed only so far until they meet with overcrowding and political pressure, and there is strong evidence that teacher salaries can remain in step with per capita income in the long run. Additionally, many experts regard the use of less qualified teaching personnel as diluting the quality of education.

The increasing costs of educating a student do not appear to result from increases in the quality of education. On the contrary, the quality of education is probably at best remaining constant, or perhaps even declining (see Woodhall, 1967). The most plausible explanation of the increasing costs per student was formalized by Baumol (1967) and stated simply by Coombs (1968, p. 7): "Education's technology, by and large, has made

FIGURE 3

TRENDS OF RECURRENT EXPENDITURES PER PUPIL IN DEVELOPING COUNTRIES



Source: Coombs (1968, p. 50).

surprisingly little progress beyond the handicraft stage." Essentially, the point is that although education has made little, if any, gains in productivity, most other sectors of the economy have. A fundamental task of a satellite-based educational program (or, indeed, any technologically based reform) would be to provide systematic productivity increases in the educational sector.

Unsuitability of Educational Results. Perhaps more important than the quantity of schooling an educational system offers is the quality of education it produces. This dimension of a system's performance may be examined on two levels: the immediate results as measured by individual cognitive and affective attainment; and the longer run implications about how the education system is meeting the needs of society.

There is little evidence from developing countries that bears directly on the short-run results of the school process. However, certain indirect indicators have led many educators to believe that perhaps the quality of schooling has been decreasing during the rapid expansion of educational systems in the past two decades. The main factor, mentioned previously, is that to meet enrollment increases, educational systems have been forced to take teachers with much lower training qualifications than previously. It seems reasonable to suppose that these lower quality teachers will produce lower quality students. Many developing countries are aware of this and are beginning to take steps to upgrade their teaching staff through

training programs and changes in hiring policy. However, these measures can be very expensive. For in developing countries the ratios of the salary of a well-trained teacher to a poorly trained one are often quite substantial (more so than in developed countries), and therefore the cost increase required for a better trained teaching staff will usually be substantial indeed.

Educational systems have also been criticized for failing to meet societal needs. Briefly, many systems appear not to be turning out the best mix of skilled manpower necessary for national development. Furthermore, there are disparities between these manpower needs and the incentives and structure of the employment market. A number of developing countries have been plagued in recent years by the problem of the educated unemployed. Basically, many developing countries began with an elitist educational system, usually modeled on that of a more industrialized country. As the system became somewhat more egalitarian, oriented in theory toward national development, changes in curriculum and general orientation generally lagged far behind. The result has frequently been a system that bears little relationship to the needs of national development.

The problem becomes most apparent when one examines the dichotomy between urban and rural development. Most developing countries have begun to realize that rural development, which has frequently been

neglected, should be a major target. Often this realization is translated directly into the expansion of formal educational services into rural areas -- which, unfortunately, can run counter to the original goal of rural development. The educational system is usually transferred intact, with the same goals and orientation as those developed to serve an urban elite. The result is that most graduates of the rural system want to migrate to the cities where the better jobs are. This phenomenon was observed in a study of the Mexican rural secondary school system (see Mayo, McAnany, and Klees, 1973), where the problem is compounded by high urban unemployment. The immense task of providing training and employment opportunities geared toward rural development is just beginning to be realized and will probably be one of the biggest challenges faced by developing nations in the 1970's and 1980's.

Inertia and Inefficiency. Given the rapid pace of change in virtually every developing country, it is not too surprising, but it is nonetheless unfortunate, that most educational systems have been slow to respond to these changes. In general, most educational systems have grown with little change in organization, method, or orientation. Curriculum remains basically the same. The traditional method of classroom instruction remains unchallenged. The goals are the same as those of the old elitist-oriented system, merely broadened to include more people. It is perhaps not surprising that resistance to change and innovation has been strong.

In every system there are vested interests in the old order, and educational systems are deficient in incentives to innovation and change that exist for the private sector. However, if national development is to proceed at a relatively rapid pace and if rising popular aspirations are to be satisfied, these educational systems need to change drastically, and in fulfilling this need for drastic change satellites might find their most important role -- both as catalysts and as agents of change.

The preceding five problem areas pose challenges that all developing nations are facing. How well they meet these challenges may depend on their ability to skillfully use technology to overcome problems of cost and quality in educational development.

B. Educational Technology Today and Its Use in Developing Countries

Effectiveness and Costs of the New Media. Both instructional radio (IR) and instructional television (ITV) have been used and tested in a wide variety of situations, although adequate evaluations of IR have been quite a bit rarer than for ITV. Most comparative effectiveness studies come from the developed nations, even though perhaps the most widespread examples of the use of IR and ITV are found in less developed countries.

The relative effectiveness of IR has been surveyed several times in recent years. Jamison, Suppes, and Wells (1973, pp. 20-21) review two surveys and

several more recent studies and report:

> Two surveys review information relevant to the effectiveness of IR. One is Section VI of Chu and Schramm's (1967) comprehensive review of learning by television. The second is a position paper by Forsythe (1970) that, in an earlier form, was prepared for the President's Commission on Instructional Technology. Sources of further information on IR may be found in a 432-entry indexed bibliography compiled by R. Madden (1968), and an early review of research undertaken primarily in the late 1930's and early 1940's may be found in Woelfel and Tyler (1945).
>
> Chu and Schramm (1967) numbered the principal conclusions of their extensive survey. The ones most relevant to IR follow.
>
> '53. Given favorable conditions, pupils can learn from any instructional media that are now available.
>
> '58. The use of visual images will improve learning of manual tasks as well as other learning where visual images can facilitate the association process. Otherwise, visual images may cause distraction and interfere with learning.
>
> '60. Student response is effectively controlled by programmed methods, regardless of the instructional medium.
>
> Their general conclusion is that radio, particularly when appropriately supplemented by visual material, can teach effectively and, for many purposes, as well as other media.
>
> Forsythe (1970) reached a similar conclusion. . . .

Jamison, Suppes, and Wells concurred with the assessments of Chu

and Schramm and of Forsythe concerning the pedagogical efficacy of radio.

Schramm (1973) also summarized the results of a number of comparative evaluations of the effectiveness of radio versus other mediums of instruction, and concluded that radio can teach effectively in a wide range of situations and compares well with other means of instruction. Recent evaluations of two operational instructional radio programs in Mexico -- Schmelkes do Sotelo (1973) and Spain (1973) -- provide further evidence for this view.

Jamison, Suppes, and Wells (1973, pp. 26-27) also provide a review of three surveys of comparative effectiveness studies of ITV. They report as follows:

> Chu and Schramm surveyed 421 comparisons of ITV with TI (Traditional Instruction) that are reported in 207 separate studies. /Their results indicate/ all grade levels learn well from ITV, though this seems somewhat less true for older students than for younger ones. ... the effectiveness of ITV cuts across virtually every subject matter.
>
> Dubin and Hedley (1969) provided a more detailed survey of the effectiveness of ITV at the college level. They reported on 191 comparisons of which 102 favored ITV and 89 favored TI, although most of the differences were insignificant at standard levels of statistical significance. When data were available, Dudley and Hedley extended their comparisons to include the distribution of the *t* statistics of the individual comparisons of ITV and TI; in this way it was possible to weigh

appropriately differences in performance of differing degrees of statistical significance. The results of this analysis, applied to all their data, indicated a slight, but statistically significant difference in favor of TI. When studies of two-way TV were dropped from the sample, the overall comparison yielded a small, statistically insignificant advantage for TI.

An unusually stringent criterion for interpretability of results was utilized by Stickell (1963) in comparing ITV to TI, and it is worth commenting on his survey here. After examining 250 comparisons of ITV to TI, Stickell found 10 studies that fully met his requirements for adequate controls and statistical method (interpretability) and 23 that partially met his requirements. Schramm (1973) provides clear tabular summaries of these studies. None of the fully interpretable studies and 3 of the partially interpretable ones showed statistically significant differences; each of the three statistically significant cases favored the ITV group. It should perhaps be noted that when highly stringent controls are imposed on a study, the nature of the controls tends to force the methods of presentation into such similar formats that one can only expect the 'no significant differences' that are in fact found. When ITV is used in a way that takes advantages of the potential the medium offers -- as, perhaps, with Sesame Street -- we would expect more cases of significant differences between the experimental group and the 'alternative treatment' (for it would not be a 'control' group in Stickell's sense) group.

We have seen above that both radio and television can be instructionally effective; the main question is that of cost. For a general feeling for the magnitude and relationship between the costs of ITV and IR, a study by the General Learning Corporation (1968) is useful. This study estimated the costs of different instructional media systems for different audience sizes and different levels of program production quality, assuming rather

extensive production -- from 1,000 hours (for a small population) to 1,600 hours (for a large population) of instructional materials produced per year, distributed through 12 grades of school. Costs per student at the higher ranges of student utilization increase somewhat due to the additional signal distribution costs of broadcasting to a lower density population. (There is also an assumed increase in program quality for metropolitan and larger regions, but this factor merely slows the rate of decrease in program production costs per student and is not the cause of the trend reversal.) Examining these system costs on the basis of hours of student viewing shows that for reasonably large audiences (city and larger), the costs of ITV run three to five times greater than those of IR -- ranging from 5¢ to 10¢ per student hour for ITV and from 1.5¢ to 2.5¢ per student hour for IR.

The cost estimates developed in the General Learning Corporation study were for hypothetical systems and were oriented mainly toward the needs and capabilities of a relatively developed nation. Since we are concerned with using these technologies in developing countries, where different types of media systems would most likely be used (e.g., open-circuit VHF ITV), it is perhaps of more interest to examine information on costs that have actually been incurred; furthermore, since there is often a considerable difference between costs in theory and costs in practice, this type of analysis is essential.

Jamison and Klees (1973) examined cost case studies for five ITV projects

and three IR projects in developing countries and attempted to compare the data. Their summary tables are reproduced here as Tables 2 and 3, and their relevant concluding comments are as follows:

> 1. It is realistic to expect the costs of instructional television to range from 1.5¢ to 15¢ per student per hour, depending most importantly on the number of students in the system. The low end of this range can only be reached if close to a million students are using the system in a reasonably compact geographical area.
>
> 2. It is realistic to expect the costs of instructional radio to range from 1/3¢ to 3¢ or 4¢ per student per hour, about one-fifth as much as instructional television. The high end of this range can be reached with very small numbers of students (several thousand); the low end might require several hundred thousand.

The cost estimates made by Jamison and Klees (except for American Samoa's ITV project and Mexico's IR project, which have abnormally low student utilization rates) seem to agree reasonably well with the estimates made by the General Learning Corporation study.

So far we have seen that educational technology can be an effective tool of instruction, at least as much so as traditional instruction, and we have gotten an idea of how much these new media cost if terrestrially distributed. The question that now arises is how have developing countries used these new media? Have they been used to improve the quality of instruction? To offer new educational opportunities? Have they been used to reduce

TABLE 2

COST SUMMARY OF 5 INSTRUCTIONAL TELEVISION PROJECTS[a,b]

Project	Year of Information Source	N	h	F	V	AC	AC/V	Student-Hr. Cost
Colombia	1965	275,000	50.25	624,000	.859	3.13	3.95	.062
American Samoa	1972	8,100	145	1,268,000	3.06	159.60	52.2	1.10
Mexico	1972	29,000	360	598,000	4.23	24.85	5.87	.069
El Salvador	1972							
(a) Total Costs, Sec. Only		48,000	170	1,116,000	1.10	24.35	22.14	.143
(b) GOES Costs, Sec. Only		48,000	170	779,000	1.10	17.75	16.13	.104
(c) Total Costs, Elem. & Sec.		990,000[c]	170	1,920,000	.94	2.88	3.06	.017
(d) GOES Costs, Elem. & Sec.		990,000[c]	170	1,603,000	.94	2.56	2.72	.015
Ivory Coast	1970	745,000[c]	180	2,454,000	3.98	7.27	1.83	.040

[a]Values in this table were computed with a social discount rate of 7.5%: all values are in 1972 U.S. dollars.

[b]The symbols are defined as follows: N = number of students using project (in the given year, unless otherwise noted); h = number of hours per year a typical student views programs; F = annualized fixed costs; V = annualized variable costs; AC = average cost per student for the given value of N; and the student-hour cost is the cost per student-hour of viewing for the given value of N.

[c]These values of N are planned student usage for 1980.

Source: Jamison and Klees (1973, Table III.1).

TABLE 3

COST SUMMARY OF 3 INSTRUCTIONAL RADIO PROJECTS[a,b]

Project	Year of Information Source	N	h	F	V	AC	AC/V	Student-Hr. Cost
Thailand	1967	800,000	25	100,400	.221	.347	1.57	.014
Mexico	1973	2,800	233	37,700	.11	13.57	123.40	.058
Indonesia[c]	1971	1,200,000	100	102,400	.32	.41	1.27	.0041

[a]Values in this table were computed with a social discount rate of 7.5%; all values are in 1972 U.S. dollars.

[b]The symbols are defined as follows: N = number of students using project (in the given year, unless otherwise noted); h = number of hours per year a typical student views programs; F = annualized fixed costs; V = annualized variable costs; AC = average cost per student for the given value of N; and the student-hour cost is the cost per student hour of viewing for the given value of N.

[c]The Indonesia figures are based on a planning study, not project experience.

Source: Jamison and Klees (1973, Table III.2).

educational system costs? To what extent can they be used, either terrestrially or satellite distributed, to counter the problems in educational systems that most developing countries are confronting?

The Experience of Developing Countries with the New Media. Schramm (1973) categorizes educational media projects by the four main purposes that they have served: (1) national educational reform, (2) extending the school, (3) other formal education, and (4) nonformal education.* We will take a brief look at exactly what a number of these projects have tried to do and how they have fared in terms of effectiveness and cost. The following discussions are based on Schramm (1973), to which the interested reader is referred for a wealth of additional detail and analysis.

There have been four principal projects in which new educational technology has been introduced as the basis for widespread educational reform -- Niger, American Samoa, El Salvador, and the Ivory Coast. All have been almost entirely directed toward the formal educational system,

*An alternative classification might be to separate formal from nonformal education rather than to examine alternative categories of a formal education. The purposes of a formal education program might be either to reach students not presently covered (extend the school) or to improve quality and/or reduce costs for student groups already reached. The methods of a formal education program include varieties of traditional instruction, traditional instruction plus media, and out of school instruction involving correspondence and/or media. The method of traditional instruction plus media encompasses a range of possibilities from supplemental use of the media through intensive use of the media in educational reform. The two broad purposes and three broad methods provide a sixfold classification of alternatives for formal educational programs.

either at the primary level, the secondary level, or both. All have been developed out of a desire to increase the quality of schooling offered as well as to allow larger numbers of students into the system. All four projects used television as their technological vehicle to provide a good part of the core curriculum.

How effective have these projects been? The data we have do not give us a definitive answer. Clearly, a number of the initial project goals have been met. Niger was able to reduce dropouts and repeaters, provide what appeared to be reasonably good instruction while using relatively untrained classroom monitors, and produce television programs that are generally viewed as quite extraordinary. Samoa has been able to improve its students' ability in oral English. El Salvador has modernized its teaching, favorably changed the students' attitudes toward schooling, and may have increased the students' cognitive learning (evidence of this last effect is available only for 1969 -- see Schramm, 1973, p. 57). The Ivory Coast's project is still in its initial stages, and no effectiveness data are available. Unfortunately, in general, very little evaluation, especially on a comparative basis, has been done in any of these projects (except mainly for El Salvador where the Institute for Communication Research at Stanford University has almost completed a 4-year evaluation, although comparative evidence -- e.g., ITV versus traditional instruction -- is minimal). This is not surprising since most of these projects were

initiated to replace the traditional system, and by the time evaluation efforts were begun there were few traditional classes left to evaluate. Niger alone was set up on a pilot project basis in the hopes of eventually expanding nationwide. This expansion did not occur, perhaps mainly because of political reasons as Schramm (1973, pp. 144-146) suggests, even though it was one of the best of such projects.

Why was television the chosen medium in all four cases? Perhaps, as Schramm (1973, p. 114) suggests, the use of television "is necessary in order to catalyze change throughout a change-resistant system like education." An additional factor is that in recent years external funding sources have been very interested in ITV experiments -- all four projects had substantial outside aid. Whether or not radio could have been used instead remains an interesting question; certainly, given what we know about its potential effectiveness and its lower cost, such an experiment should be encouraged.

During the 1960's a number of educational systems in developing countries experimented with using radio and television to extend schooling to areas and populations that previously had no access to the system. Most of these projects either used media in a formal school setting or else supplemented the radio or television programs by other means. For example, Kenya used radio and correspondence study to provide secondary school courses to teachers in service, while Mexico used radio to expand

3-year primary schools to 6-year schools. Thailand used a closed-circuit television system, supplemented by textbooks and some discussion groups, to extend university training to the overflow of applicants, while Mexico used television to offer a formal secondary school program to some of its more rural areas.

These systems in general seem to be doing a reasonably good job, although most projects that are outside the formal system and rely heavily on student self-motivation are plagued by high drop-out rates. In Mexico, where comparative learning studies were done, the ITV and IR systems appeared to be doing at least as well as the traditional system.

Television and radio have also been used in more minor roles within the formal educational system -- for enrichment, for supplementary materials, and for small amounts of core teaching (without institutional reform in mind) -- with apparent success. Most of these projects have not taken place in developing countries, perhaps because the cost of using these media on a relatively small scale is considered prohibitive. Television has been used in India and radio in Thailand, and in both cases improvements in learning have been reported. However, Colombia's use of ITV to supplement primary school instruction did not result in significant differences in learning gains between those students who had supplementary ITV and those taught by the traditional system.

Radio is the most widely used medium for nonformal educational programs. A large number of developing countries have established programs of this sort aimed at young people and adults on a wide range of subjects--community improvement, agriculture, family planning, home management, political participation, and others. Many of these projects had rather impressive results. Schramm (1973, Chapter VIII) concludes that instructional media, while not always essential to these types of projects, can be very effective, especially when used in conjunction with other forms of instruction -- contact with teachers, group work, written material, etc.

Thus far we have seen that both radio and television have been used by developing countries in a wide variety of educational situations, often with what would appear to be a reasonable degree of effectiveness. This does not mean that these projects were good investments. The soundness of an investment must be determined by balancing the benefits of any particular project against its costs. This evaluation is quite difficult to make and is usually left to the judgment of the relevant decisionmakers.

Relatively unambiguous judgments can be made only when an ITV or IR system has substituted for a traditional system at a lower cost and performs with equal or greater effectiveness. This has rarely, if ever, been the case. The costs of ITV and IR systems reported earlier in this section are the <u>additional</u> costs to an educational system of the production,

transmission, and reception of an instructional media program. In most formal educational system projects using educational technology, the costs have been added on to the component costs of the traditional system. In nonformal educational projects using media, the ITV or IR system is not substituting for a previous program.

There are some indications, however, that an ITV or IR system can reduce costs. In formal systems this generally means that the added costs of using the technology are offset by reductions in costs in the traditional components of the system. It has been argued that if the Niger ITV project were expanded to cover the entire country, for instance, its unit costs would be less than the present costs of the traditional system, primarily because lower paid, relatively untrained monitors would be used to replace classroom teachers.* Mexico's ITV project offers a similar example. Mayo, McAnany, and Klees (1973, p. 113) concluded that if the ITV project were to replace the traditional system of secondary schooling (both the project and traditional system appear to be equally effective in terms of learning criteria), system costs would be reduced by at least 30 percent, principally because the ITV system employs lower paid teachers.

Another way of looking at the cost-reduction criteria is to compare the costs of an ITV or IR system with what it would have cost to accomplish

*Even if use of a technology increases the cost per student per year, it may reduce the cost per graduate by reducing dropout and reptition rates. This was part of the objective of the use of ETV in the Ivory Coast.

the same task by alternative means. For example, Mayo, McAnany, and Klees (1973, p. 38) report that to achieve the same level of rural secondary school coverage that the Mexican ITV system currently gives (30,000 students) would cost 50 percent more under the traditional system. Comparison of cost-effectiveness -- what it would cost to accomplish the same task by alternative means -- appears to be a sensible framework for examining most nonformal instructional media systems; unfortunately, such comparative analyses are rarely made. However, it does seem reasonable to suppose that radio is a relatively cost-effective way of spreading information and provoking thought and discussion on many topics throughout a wide geographical area, almost certainly more so than sending out trained personnel.

Potential of the New Media. What potential do these instructional media have for helping to solve the educational problems faced by most developing countries? What is the role of satellites in distributing these media? Certainly an ITV or IR system can be used within a formal educational system to help meet the increasing enrollment effectively. Projects aimed at extending educational opportunities to populations previously having no access to formal schooling have shown this to be true. The question is under what circumstances might these media systems be the best way of accomplishing this task?

If a system is confronted with a shortage of teachers, an instructional media system may be one of the most effective ways of coping with increased demand without sacrificing the quality of instruction. This was the case with Mexico's and Thailand's ITV systems (there was a shortage of teachers and facilities in the latter case) and would have been the case in Niger had the ITV system expanded.

If the expansion of the education system is threatened by rising costs, ITV and IR have the potential to reduce costs while maintaining quality, as we have discussed previously. The problem essentially is to more than offset the additional costs of the media system by reducing the traditional system's component costs. One approach, often suggested, might be to increase class sizes, thereby saving on teacher and facility expenses. Most research has indicated that class size has relatively little effect on the amount students learn. Moreover, increasing class size, which often meets with strong resistance from teachers and parents, can well be accomplished without introducing a new technology, thereby resulting in increased savings. Perhaps in some cases reducing the time students spend in school in order to increase the aggregate student-to-teacher ratio* may prove more politically acceptable than increasing class size.

An alternative is to reduce the traditional component costs by using less expensive, less qualified teachers in the classroom. Whether this is

*The aggregate ratio is the number of students in the system divided by the number of full-time equivalent teachers. This is affected by class size and by the ratio of the amount of time a student spends in school to the amount of time spent by a full-time equivalent teacher.

politically feasible or beneficial to the economic system as a whole is another question. Clearly, such an approach could most successfully be used in situations of teacher shortage. However, this solution may well be valid in the short run only. For example, Mexico used primary level teachers as secondary school classroom teachers in their ITV system, primary school teachers costing about half as much as secondary school teachers. Coombs and Hallak (1972, p. 126) suggest that these salary differentials tend to narrow over the long run, and this has certainly been the experience in industrialized countries. This is not to say that such teacher quality substitution is a poor approach. It may well be able to save substantial amounts of money in the short run; if and when the cost gap disappears, the continuation of the media system can be reconsidered.

A third possibility for reducing the costs of the traditional components of the system is to reorganize the actual instruction process substantially. The aim would be to enable the same facilities and the same teachers to serve more students, not merely by increasing class size, but by allowing the media to free the teacher to work with more students. In most formal ITV or IR systems the teacher watches the programs along with his students. Although this may have certain benefits in terms of increasing a teacher's knowledge or providing the teacher with models of good instructional technique, it may not be a rational allocation of a

teacher's time, especially for a well-trained teacher. Obviously, this approach would require substantial reorganization of teacher and student activities, as well as of the physical facilities within which they are operating. However, despite being perhaps the most difficult approach to reducing traditional component costs, in the long run it will probably prove the most cost-effective use of instructional media in an education institution.

It is often said that ITV or IR are cost-effective only when they have a large audience. This is not necessarily true. Mexico's ITV system becomes cost-effective in comparison to the traditional system with an enrollment of less than 10,000 students -- a very small fraction of the student enrollment of most educational systems. What is crucial is not only what size audience the system has, but also to what degree the added costs of the technology system have been offset by reductions elsewhere.

In dealing with certain aspects of the "unsuitability of educational results," both ITV and IR have proved to be effective. They are certainly able to compensate to some extent for the decline in teacher quality that most educational systems in developing countries have experienced over the last two decades; particularly in rural areas they hold promise of improving the quality and relevance of instruction. Satellite distribution systems have a particular advantage in reaching rural areas. Whether the media are

a reasonable vehicle for making the educational system more relevant to societal needs is another question. A good amount of curricular revision was accomplished in three of the four national educational reform projects. Much of the experience with nonformal educational programs has shown that television and especially radio can be used to deliver relevant, informative, and effective information and training. In some cases they appear to be the only means capable of so doing.

System inertia and inefficiency are perhaps the most difficult problems to combat. However, even in this area instructional technology systems may be able to help. Schramm (1973) feels that the use of ITV was a prime mover in accomplishing large-scale educational reform in Niger, American Samoa, El Salvador, and the Ivory Coast. He sees the move to an ITV system as a catalyst in the process of enrollment expansion, curricular reform, and teacher modernization. This may well hold for instructional radio systems as well, although this hypothesis remains to be tested. The national commitment required for implementing a satellite system would clearly have potential for this catalytic effect.

Educational technology is no panacea for the serious problems facing educational systems of developing countries. However, as we have seen, instructional media systems do appear to have far-reaching potential for helping developing countries to deal effectively with their problems. From the evidence presented we are not able to conclude that television is

uniformly better than radio or vice versa; the relative benefit of one medium over another depends on the project. However, since radio is lower in cost than TV and almost equal to it in instructional effectiveness, one can speculate that radio will be more attractive than TV in most cases. We have not concluded that either media is good for educational systems in any absolute sense. When presenting visual material is essential, television may in some cases be a less costly way of doing so than providing books. To judge whether or not a particular project is worthwhile requires a careful analysis of its potential benefits and costs, as well as careful examination of possible alternative means of accomplishing the same task. There are many educational tasks in which using instructional television or radio is not a good idea; on the other hand, these media appear, whether satellite- or terrestrially distributed, to have substantial potential for helping developing countries solve their pressing educational problems.

C. Communication Satellite Distribution Systems

Satellites constitute but one of a number of systems for distributing instructional radio or television (to the viewer, the technology of distribution is, by and large, irrelevant). To the extent that satellites are, in fact, close substitutes for terrestrial distribution mechanisms, the appropriate criterion for deciding whether to use a satellite system to provide instructional radio and television is cost effectiveness. That is, once the communications job to be done is specified, a cost-effectiveness

analysis should be undertaken to ascertain the most economical way of doing it. Whether satellites prove to be the most economical system will depend on the nature of the job. For this reason it is valuable to conduct preliminary analyses for a range of job specifications to determine the types of tasks for which satellites are and are not cost-effective.

Although satellite and terrestrial distribution systems provide pretty much the same service, they do differ. For this reason a cost-effectiveness analysis can only partly answer the question of the relative* desirability of satellite as opposed to terrestrial distribution systems. In addition, the essentially nationwide character of a satellite systems raises pedagogical and political problems that differ from those of more local, terrestrial systems. In the paragraphs that follow we first describe communication satellite technology, then we turn to economic considerations, and, finally, we discuss political and pedagogical issues.

Communication satellites. The first artificial earth satellites to be launched revolved around the earth in about 90-minutes at an altitude of about 150 miles. The moon, also an earth satellite, revolves around the earth in slightly over 27 days at an altitude of 235,000 miles. It is natural and correct to suppose that at an altitude somewhere between 150 and 235,000 miles there would be an orbit in which a satellite would take

*The term "relative" is important here; a cost-effectiveness analysis provides information only on the best way to proceed with a given task, not on whether it should be done at all. The purpose of cost-benefit analysis is to clarify the nature of the benefits in order to ascertain whether they outweigh the costs and justify proceeding.

23 hours and 56 minutes (the earth's rotational period) to revolve around the earth. The altitude of this orbit is 21,000 miles. In 1945, Arthur C. Clarke observed that a satellite in such an orbit would appear to an observer on the earth's surface to remain stationary in the sky if the orbit were in the plane of the earth's equator; for this reason such orbits are termed geostationary.* A geostationary orbit greatly facilitates using a satellite for a communication relay since ground station antennas need not be equipped with the costly tracking equipment required to follow the path of a nongeostationary satellite.

The major difficulty with a geostationary orbit is that its high altitude and the precision required for correct orbital insertion require a highly sophisticated launch vehicle. For this reason the early experimental U.S. communication satellites were placed in lower, nonstationary orbits, and several forms of operational systems based on nonstationary satellites were seriously considered.** Then, engineers at the Hughes Aircraft Company designed a satellite that they felt to be light enough to be launched

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*To understand why satellites in geostationary orbit appear stationary from the earth's surface, picture yourself far above the North Pole looking down on the earth. From such a perspective a place on the earth's equator -- say, Quito -- would appear to rotate around the earth's center once a day. A satellite in a 23 hour 56 minute orbit would also revolve about the earth's center once a day. So if it were once over Quito, over Quito it would stay. Actually, irregularities in the shape and mass of the earth require slight corrections to keep the satellite fixed.

**The Soviet Union has placed its Molniya (lightning) series of communication satellites into special nonstationary orbits partly because of the difficulty of attaining geostationary orbit and partly because of the special communication requirements of its high latitude.

into geostationary orbit with available low-cost boosters and at the same time sophisticated enough to serve as a communication relay. NASA agreed to test their idea, and in 1961 Syncom I was launched. Larger, more sophisticated versions of much the same basic design have been used in four generations of commercial communication satellites (INTELSAT I through INTELSAT IV) operated by the International Telecommunications Satellite Consortium (INTELSAT).

The satellites in the present INTELSAT series are used to carry very high volumes of television and telephone traffic through reasonably low-capacity spacecraft; this requires ground stations with large antennas (90 feet in diameter) and highly sensitive electric equipment. Such ground stations cost $3 million to $7 million, and the service provided by satellites using these ground stations is restricted to point-to-point long distance communication because of the ground station expense.

A satellite system for distributing instructional radio and television has very different requirements from a commercial point-to-point system. Since a satellite system must perhaps reach hundreds of thousands of receivers from one or a few sources, it is imperative that the cost of the ground station receivers be drastically reduced. This can be done by (1) increasing the capability of the satellite, (2) substantially reducing the number of television and voice channels that it is required to carry, (3)

eliminating the capability for signal return from the receiving ground stations, (4) tolerating a lower quality signal, (5) undertaking a development program to reduce the component costs of the receiving stations, and (6) using transmission techniques wasteful of spectrum in order to conserve power. Although it has been recognized for almost a decade that a combination of the above factors sufficient to allow satellite broadcasting of television to relatively low-cost receivers was or would soon be feasible, experiments to date have used only a few audio channels. Nonetheless, the technical feasibility of using satellites for this purpose is certain, although ground station costs are not. The ATS-F experiments in India and the United States in 1974-76 will demonstrate the technical feasibility of satellite broadcasting and provide improved information on its cost.

Economic Considerations. In deciding among alternative methods for distributing instructional radio and television, it is important to ascertain the cost of each method as a function of the task to be performed. This involves not only knowing the costs of the hardware components of the alternative systems but also modeling total system cost as a function of the component costs and the parameters that characterize the system. Most cost analyses fail to undertake this modeling process; instead, they specify a particular set of communication requirements and assess the cost of meeting those requirements by satellite, by terrestrial microwave, or whatever. Much valuable information may be obtained from these

particular case studies, but it is always necessary to be cautious in interpreting the results; one cannot infer that because satellites, say, provide the most economical distribution for the case studied that they would prove most economical for different system requirements (or even fairly similar ones). It is therefore desirable to model the cost of each delivery mechanism explicitly as a function of the system parameters.

Rathjens (1973) has initiated such a modeling process for comparing alternative mechanisms to distribute instructional television in LDC's (with an emphasis on the problems of Brazil and India). This report summarizes a number of his results and indicates where his analyses might be extended; readers interested in a detailed treatment are referred to the original study and accompanying papers (Butman, Rathjens, and Warren, 1973). Given the substantial evidence that radio is instructionally effective and far lower in cost than television, it is unfortunate that no analysis parallel to the one Rathjens provided for television exists for radio. *

Rathjens initially considered four separate real-time (i.e., no delay between transmission and reception) distribution systems: (1) terrestrial

*A study by Jamison with Bett (1973), which is being completed too late for discussion here, provides a more detailed analysis of the cost of radio distribution by satellite. Some discussion of costs of multiple radio-channel distribution via satellite is included in chapter 6 of Spain (1972); and a range of possible uses for multiple radio-channel broadcasting via satellite appeared in Jamison, Jamison, and Hewlett (1969).

microwave relay to broadcasting stations, (2) direct satellite broadcasting to receivers, (3) satellite broadcasting to terrestrial transmitters that would then rebroadcast the signals conventionally, and (4) a hybrid satellite system involving rebroadcast by terrestrial transmitters in regions of high population density and direct broadcast to the final receivers in regions of low population density. He then constructed a simple model of how each of these system's cost varied as a function of the cost of its components and two system parameters -- the number of receivers to be served and the geographical area through which they were to be distributed. The values he used for the capital costs of the components are listed below as they appeared in his report:

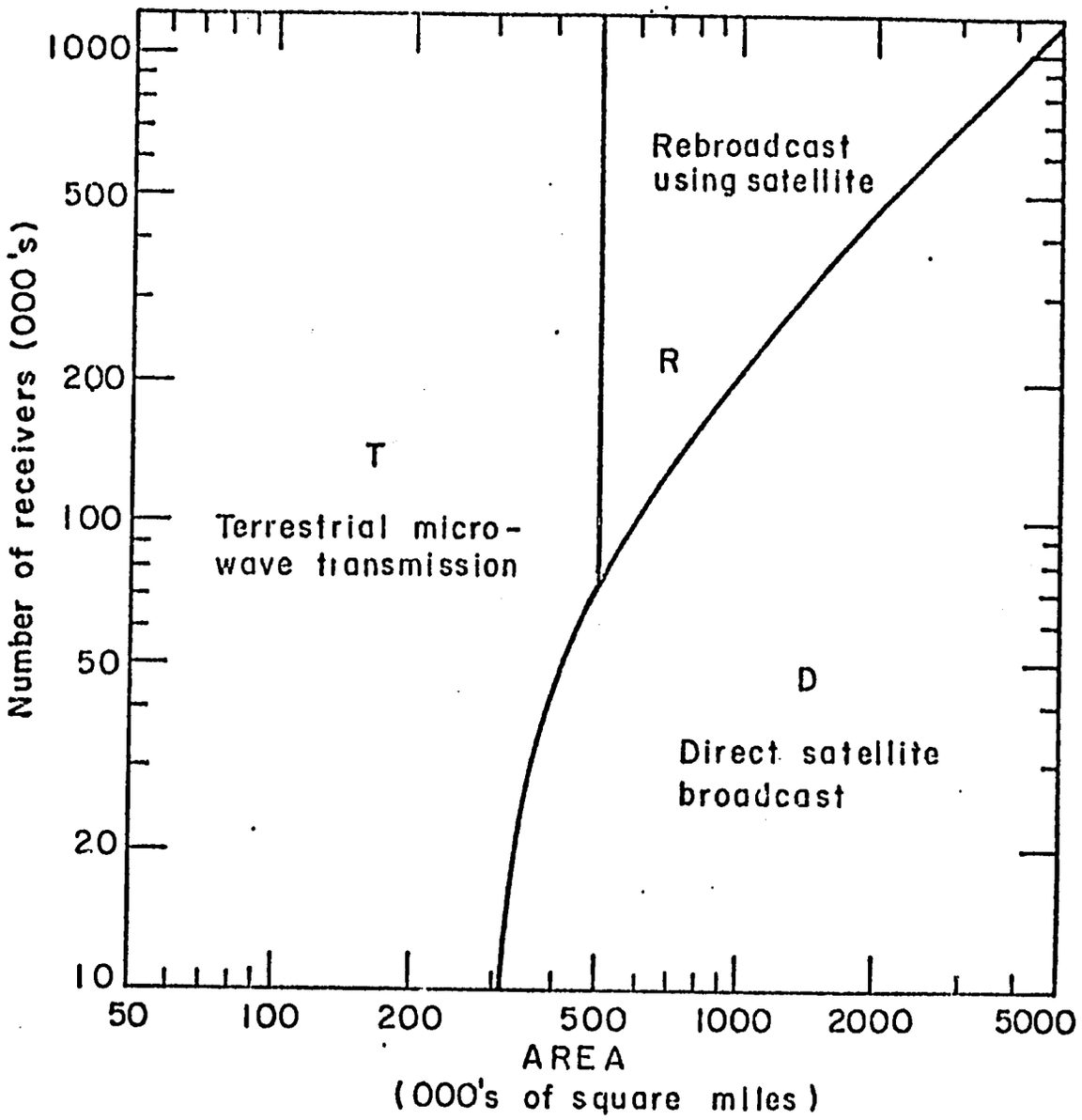
microwave relay costs	$4,000 per mile
cost of a low-power satellite to provide service for a rebroadcast mode (including an uplink transmitter and antenna)	$12 million
cost of a high-power satellite for direct transmission to individual TV sets (including an uplink transmitter and antenna	$25 million
cost of TV transmitters, including studios and radiating antennas	$0.5 million
cost of receiving antenna and other earth station equipment for each TV transmitter that is to rebroadcast satellite signals	$0.15 million
augmentation costs for individual TV sets for direct satellite reception	$250 per set

While these estimates of capital costs may differ somewhat from other estimates and can be expected to require modification with time, they provide an approximation of what is now possible. Annual costs could be computed from these capital costs by using the appropriate accounting formulas, the social rate of interest, and the equipment lifetime.

Figures 4 and 5 (Rathjens's Figures 1 and 3) show the results of a
-gs. 4, 5 comparison among terrestrial, rebroadcast, and direct broadcast satellite systems. The combinations of the area to be covered and number of receivers in the region of Figure 4 marked "T" would be most economically served by terrestrial systems; those in the region marked "R" would be best served by rebroadcast satellites; those in the region marked "D" by direct broadcast satellites. Figure 5 overlays onto Figure 4 information about the total populations and population distributions of India, Brazil, and Ethiopia to show which distribution alternative is most economical as a function of the fraction of the population served (assuming one TV receiver per 1,000 people). Figure 5 shows, for example, that if 50 percent population coverage is desired for Brazil then a terrestrial system costs the least of the three, whereas if 75 percent coverage is desired the direct broadcast satellite costs the least. With the assumed costs of equipment components, the figure indicates that under no conditions is a direct broadcast satellite system the most economical system for India.

FIGURE 4

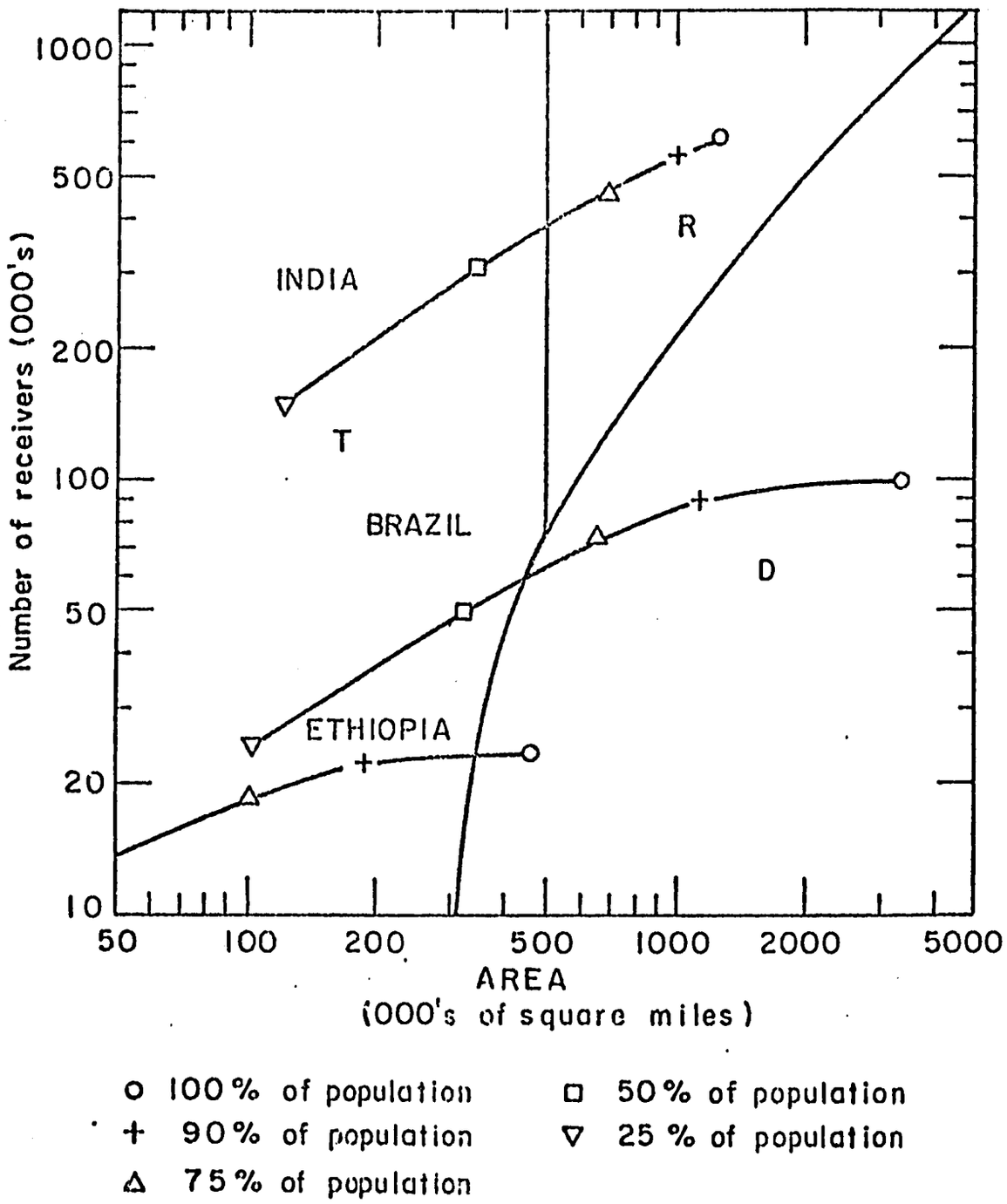
DISTRIBUTION SYSTEMS



Source: Rathjens, 1973 (Figure 1).

FIGURE 5

COVERAGE CURVES-BASE CASE



Source: Rathjens, 1973 (Figure 3).

Figures 4 and 5 dealt with only three of the four alternative real-time systems considered by Rathjens; similar diagrams can be prepared (on a country-by-country basis to allow for different degrees of population concentration) that allow consideration of hybrid systems.* In addition, non-real time systems can be brought into the analysis, and Rathjens provides cost estimates for several of these. One system that he considers is the "near-real-time microwave," in which existing microwave systems distribute the signals at night and the programs are stored on videotape for transmission the next day. Another possibility he considers is air mail circulation of videotapes, and still other possibilities include various

les 4, 5 mixtures. Tables 4 and 5 from Rathjens (his Tables I and II) give his cost estimates for various distribution systems for Brazil and India; for each percentage of population served, the cost of the minimum cost alternative is underlined. If it were administratively feasible, a circulating tape library would provide most economical distribution in many cases, if a real-time capability is not desired. If real-time service is desired, satellites appear attractive in many circumstances for both Brazil and India, and if multiple-channel coverage were desired (the analysis just presented is for a single channel), satellites become relatively more attractive.**

*It would be important to extend this analysis to include consideration of off-the-air relay systems (where local transmitters rebroadcast on a different channel signals they pick up from a nearby station) and balloon-based transmitters. India has seriously considered an off-the-air relay system (Times of India, December 6, 1970), and South Korea plans to install a balloon-based system (Aviation Week and Space Technology, May 21, 1973, p. 53).

**An operational system can expand either by adding channels or by increasing the number of receivers per thousand population. Expansion of the first type is less costly with a satellite system; expansion of the second type less costly with a terrestrial system.

TABLE 4

BASE CASE DISTRIBUTION SYSTEMS COSTS FOR BRAZIL
(millions of dollars)
(I T V SET PER 500 PEOPLE)

	% of Population Served				
	50	75	90	95	100
All microwave (real-time)	28	61	97	135	295
Satellite with re-broadcast (real-time)	32	56	82	110	225
Satellite direct (real-time)	50	62	70	72	75
Mixed rebroadcast/ direct (real-time)	28	55	63	66	69
Mixed (satellite real-time/near-real-time microwave)	21	47	63	66	69
Circulating tape library	20	43	68	94	206

Source: Rathjens, 1973 (Table I).

TABLE 5

BASE CASE DISTRIBUTION SYSTEMS COSTS FOR INDIA
(millions of dollars)
(I T V SET PER 500 PEOPLE)

	% of Population Served				
	50	75	90	95	100
All microwave (real-time)	29	61	88	103	115
Satellite with rebroadcast (real-time)	33	56	76	86	96
Satellite direct (real-time)	175	263	315	342	350
All microwave (near-real-time)	22	47	68	79	87
Circulating tape	20	43	62	72	81

Source: Rathjens, 1973 (Table II).

Much work remains to be done in constructing both general and specific cost models for television and particularly radio distribution systems. Yet much information is now available, and that information indicates that there are a number of tasks for which satellites might provide the most economical solution.

Political and pedagogical considerations. Perhaps the most salient distinction between terrestrial and satellite distribution systems for ITV in LDC's is that satellites would require nationwide planning and organization, international cooperation, and nationwide programming. For many tasks the difference in cost between satellite and terrestrial distribution systems is rather small (and probably swamped by the uncertainties in the costs of either approach); and the political and pedagogical aspects of a satellite system will tend to play a more important role when the cost differences are small rather than great. For this reason Jamison (1972) argued that, in India, the following considerations should most strongly influence these decisions:

> Which approach most promotes national unity while allowing for regional differences?
>
> Which approach shows promise of bringing the most creative talents to bear on the problem of programming?
>
> Which approach allows for the type of detailed and ongoing critical evaluation that would lead to constructive evolution of the system?

To what extent does either approach contribute to national security -- through technology creation and/or through creating dependence on foreign powers?

How important is it to reach the villages soon? (Speed of implementation is not universally considered desirable -- some claim that the development process could be thrown out of balance.)

Which approach is most apt to provide a management structure capable of assessing and implementing national objectives?

These considerations generally depend much more on the specific country than do considerations of media effectiveness or cost.

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CHAPTER II. KEY DECISION POINTS, 1973-1976

Tens of millions of dollars have been earmarked for instructional and educational communications and technology projects in the developed and developing nations. While new systems are being planned and built, old ones are in trouble. Confusion and duplication of effort are proliferating. Technological problems still remain, and political problems are demanding increasing attention.

A. Broad policy questions

In the days of engineering innocence, political problems tended to be ignored. Policymakers cannot ignore them any longer. Not only the developing nations but also some highly developed ones are voicing, in the United Nations and its agencies and in other international fora, serious concerns about the cultural and intellectual impact on their citizens of technologies hitherto regarded as neutral. These concerns were voiced most dramatically in recent debates at the UN on both the UNESCO Declaration of Guiding Principles of the Use of Satellite Broadcasting for the Free Flow of Information, the Spread of Education and Greater Cultural Exchange and the USSR Proposed Preparation of an International Convention on Principles Governing the Use by States of Artificial Earth Satellites for Direct Television Broadcasting.

Policymakers must deal with these fears whether they are voiced in increasingly restrictive language in UNESCO or other declarations

or conventions or are expressed as resentments of cultural or intellectual "imperialism" in newspaper and magazine articles and political speeches. In fact, the Declaration on Free Flow of Information is actually a declaration to restrict the flow of information. Perhaps such activities as AID's participation as a voting member of the U.S. Ad Hoc Committee on Free Flow of Information can partly help deal with this issue.

Policymakers must also be concerned with "nation-building," a concept that sometimes has military as well as political overtones. (The placement of the first television stations in a country can almost always be seen to follow the needs of perimeter defense.) The argument here is not that military objectives should not be allowed, but that policymakers should be aware of these motives and should consider them in extending aid for satellite-related programs. When dealing with such a vague and explosive concept as "nation-building," a funding country must consider its own political interests. It also must bear in mind that just as improved communications can help it build a nation, they can also help to destroy it.

Almost all satellite projects for education or development share certain common objectives. They are intended to provide education and development in such critical areas as family planning, eradication

of illiteracy, improved agricultural methodology, basic health and hygiene, nutrition, early childhood education, teacher training and upgrading, in-school instruction, and career development. Planners tend to choose to develop those areas they consider most important for their own needs. Their choices are not, by any means, always totally logical; they are frequently political. Ironically enough, however, many managers or planners of satellite projects seem to have little awareness that the projects might actually achieve their goals, which usually involve motivating the people to change their behavior in some way. Serious problems arise when satellite or educational systems do succeed in motivating people to change their pattern of living but fail to supply the goods and services they have taught the people to desire. Unfortunately, many plans that have been closely studied seem to have in them the potential for such failure. For communication consists of both the communication channel (a telephone wire, a broadband cable, a smoke signal on a hilltop, the sound of a drum, a radio signal, a television picture transmitted by satellite or other means) <u>and</u> the message carried on the channel.

Unfortunately, communications ministries in many nations -- developed and developing -- often do not coordinate their policies or plans. Each agency concentrates on building its own separate empire rather than on working for the common goal -- making the systems work and supplying the new needs of the people. Communication systems must be coordinated

because they must often interact to be effective -- for example, the efficiency of a nation's postal delivery is affected by the condition of roads and highways.

Careful coordination is also needed to see that different media are not working at cross-purposes. For example, it would hardly profit a nation to use an educational satellite to reduce in-migration to overcrowded urban centers (by advising people to stay in their rural locations and by attempting, through various programmatic means, to make rural life more pleasant) if commercial, noneducational media are, either directly or subliminally, transmitting messages that glamorize city life and thereby encourage urban migration. It may well be, then, that decisionmakers will have to look at far more than a single plan, however it is labeled, to ensure that the desired effect can be achieved.

A nation planning a satellite-based system should consider all factors that might constitute an "inventory" of communication resources -- pens and pencils, chalk and blackboard, books, typewriters and duplicating machines, telephones, radios, television sets, and computers; it should remember that trained personnel will be required to mount, manage, and maintain the system; and it should consider its total media picture because such a consideration can change the way it views the costs.

For example, it may be difficult to justify, on a cost-benefit basis, using a satellite solely for education/development purposes. However, the entire cost equation changes radically if one considers the many other purposes a satellite serves. Also, the cost-benefit basis is not the only criterion for deciding whether to support a request for aid. Social rather than economic considerations must also be taken into account.

The policymaker must also consider the question of liability, both legal and political. As satellites proliferate, so do the chances of accidents. There are serious questions as to who shall pay for the cost of damages incurred by all or part of a satellite landing in a country other than its country of origin and causing damage (although the public has been assured by technicians that a falling satellite could not survive a journey through the atmosphere, one already has -- and caused damage in a country other than its country of origin). Legally, this issue may seem relatively simple because few nations currently have launch capability. However, the problem of responsibility would become much more complex if the satellite were owned by the UN or by a consortium (consortia have been widely proposed for education and development satellites); or if the United States had given the satellite to another country or loaned it -- and at least one is soon apt to be loaned.

The legal problem is probably far simpler than the political-moral one. For example, suppose AID were to support all (or a significant part) of a satellite project in X-land, either without some clear criteria governing the giving of such funding (because such information was unavailable) or on the basis of a plan that for some reason became corrupted in its operational phase. Further suppose that as a result of the successful operation of the educational component of that satellite and the nation's inability to deliver what it has taught people they should desire to have, a political eruption takes place. Does the (moral) liability of the giver stop with the transfer of the deed of gift? Such an example has important implications for international law.

B. Specific policy questions

The key specific policy questions of course are those concerning AID's relationships with other agencies -- national and international-- that gather information on, provide funds for, or make rules about the use of communications technology. For the purposes of what follows, education and development will be considered as a single entity, since most requests for AID funding support are either presented or viewed as such.

1. What is the most appropriate assistance for AID to provide to LDC's? This basic question raises a number of secondary questions. For

example: What role should AID play in helping LDC's survey their educational needs to determine the appropriateness of using technologies and then in helping them choose the right ones? What role should AID play in helping countries develop the technical expertise necessary to select, operate, and maintain the hardware? Should AID consider funding to be applied directly to LDC satellite systems? Should AID have an interest in satellite technology for development purposes?

These questions require policy decisions on whether AID's anticipated funding can, over a long period of time, tolerate the high capital expenditures consumed by satellite systems. Up to now, the costs (or, at least, some of them) have been absorbed by other agencies. But NASA has had budgetary problems, one result of which has been the cancellation of the ATS series from ATS-G and on, a series that seemed intended specifically for the kinds of applications needed by LDC's.

Another question to be considered is how firm such countries as India, Brazil, the Arab states, Iran, Pakistan, and the nations in the Andean Consortium and various African Consortia intend to pursue their educational satellite plans. More information is needed on this subject. While it seems that India and Brazil are going ahead, we have little hard information about India, and Brazil has been discussing its own

arrangements with INTELSAT. The Germans and French are in the African picture, but there does not seem, at this stage, sufficient information for decisionmaking; this is also true of ESRO's plans.

Requiring a survey of educational needs as a prerequisite to educational technology funding may prove impossible politically and realistically. One problem is that the actual total cost of education may have risen, in many LDC's, to the point of maximum economic feasibility, regardless of whether the use of technology could lower the cost per pupil. In other words, there may simply be no more money for education. A needs survey would tend to show similar findings, one might suspect, in all the developing world. The picture, that is, would be equally dismal; it would be one of unavailable funds, under-trained teachers and administrators, inadequate physical plant, old-fashioned teaching methods, resistances to change, high drop-out rates, a rapidly increasing population under 15 years of age, antiquated curricula, and underpaid teachers working in a low-prestige occupation. In addition, there would likely be a minimal data base from which to launch a survey. Finally, one would have to deal with the fact that ministries of education in many countries are patronage machines, and that ministers of education tend to come and go rapidly in office. It seems extremely difficult, then, to design and implement a survey instrument that could produce meaningful results. One could, of course, make certain assumptions about the values of varying technologies in

roughly analogous situations -- and apply these insofar as they are, if not cost effective, practicable.

Whether funding should be applied directly to satellite systems or whether AID should have an interest in satellite technology seems, as indicated previously, to be directly a function of (a) the funds available in terms of all AID priorities and (b) the communications needs. The decisions, it would seem, are probably best made on an individual basis in this instance; no general rules would apply to all situations.

2. What role can AID play in helping LDC's select technologies to achieve the best combination of media for cost efficiency and learning effectiveness? What are the critical relationships between hardware and software? To what extent do hardware configurations have an inhibiting effect on software? Is it possible to develop learning modules that can be used in many countries? What do we need to know about the efficiency of one medium as opposed to another, or used with another? How does the learning setting affect the effectiveness of the medium?

It seems likely that AID <u>can</u> play a more effective role at this time than in the past. A great deal can be learned from the upcoming Rocky Mountain/Alaska/Appalachia Satellite experiments in the United

States, assuming, of course, that they survive the recent budgetary problems at the Office of Education. For the first time, experiments similar to those planned by less-developed countries are to be undertaken in a familiar context and, presumably, in such a way that continuous evaluations will be available to AID.

The U.S. satellite experiment, however, will not supply all the necessary information. Some small-scale experiements are needed, perhaps using such techniques as those developed in the recently completed AID/George Washington University study of "Strategies for the Use of Mass Communications Media in the Technologically Developing Nations." Some of these experiments, we believe, are now underway; their results should be reviewed in light of the questions raised above.

The development of learning modules that can be used in many countries could become an AID project. A design for a project to yield answers to this question has been drawn up by specialists in the field and might be worth consideration by AID.

Whether to concentrate on software or hardware -- or a combination of both -- is a policy decision. It clearly depends on where AID expects to be able to spend what kind of money. If there are no funds available for hardware, AID must concentrate on other forms of assistance. Concentration of this sort is facilitated by one's ability to control the purse strings to some degree.

3. What can AID do to create or expand communication and coordination of efforts among experiments and experimenters? How can AID study and capitalize on the current satellite experiments? How can AID assist in the collection and exchange of information on satellites? How can AID develop a methodology for evaluating the validity of reported results, especially in situations of political instability or sensitivity or in situations where, for other reasons, the information is generally unreliable, untimely, and incomplete? Would funds for developing an administrative cadre, technicians, and maintainence men, or for developing (or locating and loaning) specialists and consultants in program content areas provide the best results for improving technology? How can AID develop cooperative ties with other U.S. agencies -- i.e., NASA, HEW, OTP, and USIA -- and liaison with other multi- and bilateral organizations and agencies? How can AID assist an international organization or a bilateral one operating in another country? How can it assist, for example, the UN space expert in determining whether to concentrate on hard- or software areas? Should AID establish formal ties with manufacturers, either in the United States alone or worldwide? Should AID play a policymaking role in situations where the U.S. government, or any of its agencies, proposes an involvement with satellite programs (for education or development) in any other country or with a regional consortium?

Although coordination of efforts is essential, it does not really exist, partly because much data collection and experimentation are carried on in small bits by different universities and other institutions. If all this activity were "commissioned" by AID, the natural collection point would be the Agency itself. But experiments are funded by a variety of sources, governmental and private (such as foundations).

The ERIC system should be able to provide up-to-date information, at least on what is going on and what the basic findings are. Perhaps ERIC has to be more frequently employed or put on a faster basis to disseminate its findings. Perhaps AID could continually monitor ERIC's output by making one person in the agency responsible for notifying all others concerned about the outcome of relevant research in terms of need. One step in this direction is the appointment of a representative of AID's research and data needs to the UN. Some problems would be alleviated if this part-time assignment were upgraded.

It must be remembered, however, that previous attempts to obtain information on projects that use the mass media technologies for educational development quickly proved that most secondary source material is of little value. A study plan was designed (but never implemented) that would have provided data on the current programs, future plans, and modus operandi of a wide variety of agencies --inter-

national, bilateral, and public and private -- working for various development objectives. AID simply does not seem to know enough, for example, about what Swedish (or Israeli) technical assistance agencies are doing in AID's fields of interest. It knows little about such agencies as the Institute for International Solidarity (an offshoot of the Konrad Adenauer Foundation), which is doing education-development work in Africa and Latin America. It does not seem to have high-level representation at UNESCO, OECD, or various other agencies that are making policy and/or sponsoring research. A study of these agencies, such as the one proposed, might lead to recommendations for coordination and increased flow of timely, accurate information on a systematic basis.

Supposedly much of the information gathering by U. S. agencies flows into the Office of Telecommunications Policy at the White House. If it does, it doesn't seem to come back out in any form usable by AID. Perhaps the time is right for forming an Ad Hoc Inter-Agency Commission to deal with matters concerning the use of satellites for education and development. Since the Office of Education has assumed direct managerial responsibility for what is to be the first use of an educational development satellite -- the ATS-F experiment mentioned earlier in this section -- some sort of AID/OE liaison, on a continuing and systematic basis,

would be in order. This might be achieved by exchanging personnel or establishing a committee. AID certainly, it would seem, should have some voice, some way to express more than opinions on that part of the Rocky Mountain experiment that may involve cooperation with Canada for mutual satellite programming. Finally, AID should pay special attention to the operation and evaluation of those aspects of the Rocky Mountain project that have direct implications for less-developed countries.

In experiments like those of India and Brazil, AID might act as it did in the Ivory Coast and financially support evaluation personnel. In fact, American graduate students are currently working in the Brazilian satellite program, and it is not implausible that India (and other places) could use similar help. The evaluation personnel should report to AID as well as to the LDC.

More use could probably be made of the foreign offices of such American organizations as the Ford Foundation, which has one office in India, several in Latin America, and others in other LDC's. This foundation is also actively interested in exploring the potential of various technologies to help LDC's improve their educational systems. Therefore, closer liaison with the Ford Foundation and similar organizations might prove productive.

Cooperative ties could be established with manufacturers for the purpose of encouraging, or even aiding in, the development of hardware that would meet a standard set of criteria (such as radios, TV sets, phonographs, film cameras and projectors, cassettes, and the like) and be suitable for use in a less-developed country. However, considering the realpolitik of how equipment is purchased in developing nations, such arrangements would be valuable only if they included foreign as well as domestic manufacturers.

There are ways to establish such contacts at costs that are not excessive. The State Department's Bureau of Educational and Cultural Affairs, for example, sent an observer to the International Radio and Television Exhibition in Berlin two years ago. This is a place where contacts can be easily made. However, only a cursory follow-up was done on this visit and on the resulting information collected and contacts made.

Such an activity, for AID, could well become a program under the auspices of the Office of Science and Technology.

S & T also has observers in many foreign countries; an attempt could be made to systematize their findings in terms of TA/EHR's needs.

The key to the communications problem seems to be to conduct an information-gathering study, which would establish the necessary channels for information exchange.

4. How does AID relate the design of satellite systems to educational objectives rather than to engineering considerations? What are the relative merits, virtues, and liabilities, in terms of educational objectives, of the INTELSAT system, the ORBITA system, the ANIK system, the ATS-F (or G and on, if the G program should ever be restored)? What are the advantages and disadvantages of these systems in terms of national development needs and objectives?

The surest way to deal with these problems effectively is to radically improve the interaction, on a managerial level, between AID and NASA. There have been countless meetings (such as the one at Washington University in St. Louis) to provide an opportunity for an exchange of views between scientists and technologists and educators and development specialists. The meetings seemed to break down, though, because educators could not answer what was, to the others, a simple question: "What do you want? Tell us, and we'll go back to the drawing board and build it for you." The only answer given -- and it may not have been a bad one -- was "we want the same magnitude of funding you've had for research and development. Then, we'll know what we want!"

It is also worth recalling that what had then been the first proposed satellite-for-education and development, the ATS-F/India experiment, was designed solely by NASA and the Government of India. Other agencies, such as AID, were not consulted; their advice was not sought. AID might well consider planning ways to achieve multilateral relationships with NASA.

A great deal of secondary source material about the value of various satellite systems for differing purposes is available, but it has never been assembled for easy access. Indeed, particularly at the UN, people have had, or will have to have, operating experience with them all. AID might consider holding a small conference of some of these people. It should certainly seek to have a representative at the upcoming UNESCO conference which will bring together, at one time, key people from all these systems.

5. What are the implications and possibilities for multilateral or regional satellite systems? How workable are joint funding proposals?

The Mass Communications Department of UNESCO probably has had the most experience with the design of regional satellite systems and might have answers to these questions. However, UNESCO participates in many such activities (such as the proposal for a satellite consortium in the Andean Countries), and its judgments may be biased by its

earnest desire to see the experiments work. The Andean project has had serious problems; here, too, AID has not been able to gather hard data. A first step might be sending AID field offices a questionnaire designed to obtain the data. (The relatively new presence in Latin America of a specialist in educational technology, attached to AID, is certainly a step in the right direction. This specialist, though, should be alerted to watch certain lines of development and, perhaps, provided with key questions.) Failing this, AID could mount a small-scale study, directed at obtaining the most recent information, on site, from ministers of education, ministers of communication, etc. in the countries involved, cross-checking the data obtained with UNESCO data. At this point, we don't seem to know enough to answer the questions with any degree of reliability. One could, of course, postulate certain cost-benefits, on a theoretical basis, and, this too might be worth doing as a cross-check on data obtained otherwise and elsewhere. The most readily apparent benefits for the Andean Countries and for the Arab States Satellite (and some data on that could be collected from the Arab States Broadcasting Union) seem to be in savings.

Some of the problems that confront developing countries in the use of communications satellites are political as well as technological. AID will have to take this into account in deciding what, if any, assistance

to offer a given country. (Note: Can this be discussed at greater length, and in some specificity, without offending LDC's ?)

6. Should AID require a built-in evaluation system as a prerequisite of any program it considers for funding? If such a system is lacking, or inadequate, should AID play an active role in developing or improving it?

A basic answer here, of course, is the simple one: if AID believes in the need for evaluation and is paying the bill, it should demand a sound evaluation plan and should develop one if the grantee cannot. That may be too simplistic. Some questions could be raised about the value of evaluating a project with such a short life as the ATS-F/India experiment, for example. This is not to say a formative evaluation wouldn't be helpful; it is to question whether a final evaluation, given the fact that it would be starting, most likely, with a weak data base, would prove anything substantial. (If, for example, AID were to provide a developing country with a satellite and wanted to mount a meaningful evaluation effort in terms of educational efficiency, AID would have to accept the fact that many of the census figures now in use were, literally, made up as the result of a projection based on a sample size so small as to be totally inadequate by any realistic standards.)

There is a solution, though, in the case of an experiment such as the Rocky Mountain project. Present, as part of the managerial team, is a formative evaluation group from Stanford University. If AID could not achieve some influence over the team's activities through liaison with OE, certainly AID's links with Stanford are such that it should be able to obtain needed information.

AID might also take a firm stand on the issue of support standards. It is well know that many of the educational systems AID might be dealing with for satellite project support are rife with nepotism, corrupt in their purchasing practices, and have not even thought through the problems of "how does it works?"

In many cases, if AID did not establish strong criteria for evaluation plans and standards of practice as part of the support package, scarce resources and much effort would be totally wasted. The World Bank has been increasingly firm in terms of ensuring that certain of its demands, particularly in the personnel area, are satisfied.

7. How will U.S. policy on direct broadcasting affect AID programs? How can the "free flow of information" issue be resolved? Is it a First Amendment issue?

The United States has modified its position somewhat. Ideally, it would maintain the concept of free flow of information as a long-range

policy; and, on a short-term basis--until some systems are "in-place" and operating and fears of cultural imperialism have been alleviated--it would respect the genuine apprehensions of developing nations. In fact, these fears are shared by some developed nations--Canada and Sweden have been in the forefront of attempts at the United Nations to implement the UNESCO Declaration and the Soviet Convention.

The Ad Hoc Committee is undoubtedly taking the issue of free flow of information most seriously, in part, perhaps because the United States seemed to be caught by surprise by the presentation of the Soviet Convention - and certainly seemed surprised at the size of the two votes on this issue cast against it. It is also worth remembering that the technology which will permit direct broadcasting from a satellite to unaugmented home television receivers is a long way off. Perhaps AID could play an extremely valuable role by seeking to determine precisely how long through a small-scale worldwide survey of engineers and manufacturers. Technological forecasting is admittedly risky, but the date of arrival of the technology most feared has only been projected in the broadest terms and in figures that vary widely.

Whether this is a First Amendment issue is also debatable. A recent, although admittedly superficial, survey of a group of outstanding constitutional lawyers, conducted in an attempt to clarify this issue for AID, yielded only the following general conclusion: "Opinion seemed

predominantly to be that it was certainly not a clear-cut First Amendment issue. Most felt they'd like to think about it, talk about it, far more. I would strongly urge, before we take a definitive position, we convene some sort of meeting of people like those (the lawyers consulted) named above." AID might, now, do just that.

There is also another approach to this issue. At the most recent meeting of WARC (The World Administrative Radio Conference), a new regulation, 428A, was formulated. It says: "In devising the characteristics of a space station in the Broadcasting-Satellite Service, all technical means available shall be used to reduce, to the maximum extent practicable, the radiation over the territory of other countries unless an agreement has been previously reached with such countries." A strong layman's case (and, indeed, many of the lawyers consulted agreed) could be made for the fact that this language in WARC is not dissimilar to the clause in the UNESCO Declaration to which the United States objects most strongly -- Article IX, which reads: 1. In order to further the objectives set out in the preceding articles, it is necessary that States, taking into account the principle of freedom of information, reach or promote prior agreements concerning direct satellite broadcasting to the population of countries other than the country of origin of the transmission. 2. With respect to commercial advertising, its transmission shall be subject to specific agreement between the originating and receiving countries."

(The Soviet Convention has the same basic thrust, but also provides for legal sanctions and the right to shoot down a satellite transmitting "illegally.") While it is true that WARC 428A says nothing about "programs," the inference can be drawn that the radiations referred to are message carrying. The U.S. Senate has ratified the WARC regulations, including 428A. All of this obviously needs to be further discussed by specialists in international and Constitutional law.

8. In considering requests for assistance from LDC's, should AID make any distinctions between "formal" and "nonformal" education?

There does seem to be some confusion about the differences and similarities between "formal" and "nonformal" education, not only in AID and other agencies, but also among educators. For example, how does one classify the "Open University" courses broadcast over BBC; or courses on witchcraft and horse-betting, offered by some U.S. universities? Perhaps AID could establish some standard definitions that would be universally accepted (much as WARC definitions have become internationally standardized), at least by the education and development community.

9. Should AID play a key role in promoting the manufacture and use of such low-cost technologies as radio, audio and video cassettes, books and newspapers, improved telephony, streamlined and improved

postal delivery services, typewriters and duplicating machines, hand-wound and battery-operated phonographs, slow-scan video, blackboards, and 8 and 16 mm film?

There seems little doubt that this is a job that needs to be done. As one surveys the developing world, the need is obvious -- as is the failure to meet it. This may well be because these artifacts have been superseded in the imagination of ministers of education or communications, by the glamour of satellites and television. Yet, of what value is television in a desert tent? A hand-wound phonograph is probably more effective educationally than the transistor radio when the nearest replacement batteries may be a 100 miles away. Manufacture of many of these items is also, in many cases, within the reach of developing nations' technical capabilities. And, in addition to being within the reach of technical capability, such artifacts contribute to development in an economic sense.

Before advocating such devices, perhaps AID should conduct research on their value as educational instruments. (Many of the values are known, but they have often not been publicized. This, too, is an important role AID could play.) TRU in Sweden, for example, has done a superb series of monographs that compare audio and video tape recorders in terms of their educational effectiveness as well as certain operational criteria and engineering considerations. A similar undertaking, for other devices, could serve developing nations well.

10. Should AID mount a program to educate decisionmakers about the realities of using educational technologies at all levels -- a program that would provide information in nonscientific terms?

Yes, it well might. No such information is readily available except for manufacturers' handbooks on their own products, which are hardly unbiased. The Office of Public Information at the UN has been talking about such a volume for satellite technology for some time; the status of this project seems most indefinite. Most books on this topic (and many of the professional journals, even if they are readily available) are written for scholarly or professional audiences. What is contemplated here is a simple brochure -- one which says, "this is what it is; this is what it costs; this is how you use it; this is how you service it."

11. Should AID play a major role in the entire area of remote sensing by satellites, an area that is already providing high developmental information of economic value?

At their present stage of development, remote sensing satellites have already demonstrated their potential for gathering information of economic value, information of value to farmers, to planners, to demographers. Given AID's interest in agriculture -- and in transportation (determination of best routes is one function such satellites can fulfill) -- involvement seems a good idea. The satellites can also gather a fairly gross order

of information about population distribution. This, too, ties in with an AID priority.

12. Is an ultimate coordinating satellite authority needed? What are the possible technical agreements and regulations on orbital arcs and spectrum allocations, e.g., WARC (World Administrative Radio Conference)?

The question of a coordinating satellite authority is being discussed internationally. Countries disagree not about the need for such an authority but about how to meet the need. Some believe that WARC should be strengthened and provided with greater long-range planning and enforcement capabilities (this point of view was covered in a recent series of studies commissioned by the Twentieth Century Fund). This area would seem the concern of AID's Office of Science and Technology, which may well have formulated some policies or recommendations of value to TAB/EHR.

13. What are the possible effects of U.S. budget cutbacks on funds for future development of satellite technology?

The decision has already been made to stop the ATS-F satellite series at "F" and not go on to "G" and "H," which had been scheduled. Undoubtedly, this decision must have <u>some</u> effect on the entire satellites

for education/development area. It would seem worthwhile for AID to explore this question with NASA.

Recent cutbacks at the Office of Education have already affected plans for the Rocky Mountain experiment, which has important policy implications for AID. If the experiment succeeds, AID can both improve its information bank about satellite experiments and convey data to developing nations. If it doesn't live up to present expectations, that, too, will have important implications for AID and for developing countries.

14. What position should AID take on the revised Universal Copyright Convention, which grants special exceptions to developing countries in the areas of translation and reproduction of works in printed or analogous forms of reproduction? Should AID rely entirely on decisions made by other agencies? Should it collaborate with such organizations as the UN's Bureau for the Protection of Intellectual Property? Should it initiate or encourage studies that might lead to an equitable solution of the problems of the rights of copyright owners?

We agree wholeheartedly that authors and artists should be rewarded for their originality and should be protected against unauthorized use of their creations, but we also believe that developing countries should be allowed free use of such materials -- so long as such use is not for profit.

15. What are the implications of vendor activities in less-developed countries? Should AID be concerned with such activities?

A number of books have recently been written about this subject, notably Schiller's Mass Communications and American Empire. At international conferences, communications people from developing nations continually complain about what they describe as the heavy hand of American (and other) vendors. They resent tie-in sales, pressures, bribes, faulty equipment, and having virtually no recourse to higher authority in cases where they believe they have not been properly treated. They talk, too, of vendor activities that are directed at high political figures; the net result of these activities is that purchasing decisions often have no basis in educational or technological reality.

What can be done about vendor activities is another matter. Although AID clearly cannot halt such activities, it might exert some monitoring pressure since a great many vendors solicit contacts through embassies and missions. If such action were contemplated, however, AID first ought to press for universally accepted performance standards and criteria. Then the onus of the decision would rest with the LDC's official, but at least he would have some objective data on which to base his decision.

16. What are the implications of satellites for military and technological developments?

Clearly, satellites strengthen military capabilities by providing a faster and more effective means of communications. AID should keep this in mind in considering any request for assistance for an educational satellite. For example, in one speech on the ATS-F/India experiment, the President of India clearly stated that he was interested in the project because it would provide India with rocket launch capability knowledge and with improved military communications as well as with an improved educational system.

17. Should AID urge a moratorium on satellite technology until some of the legal questions have been resolved? What would be the implications of such a moratorium?

A moratorium on satellites seems basically a political question. Of course, a moratorium depends in part on NASA's long-range planning and funding, and it would affect large segments of American industry. It might not be inadvisable, however, to consider a moratorium on the portion of satellite technology that would permit ~~the~~ home reception of direct satellite transmission. Whether a technology can be stopped in midstream is arguable, and even a voluntary moratorium would not completely solve the problem of broadcasts spilling over into countries that did not want to receive them.

Nevertheless, if it were technically feasible, stopping development of satellites that would broadcast directly to home receivers would defuse much of the heat at the UN and elsewhere.

In any event, the advantages and disadvantages of a moratorium need to be explored further, perhaps by AID.

C. Research, Development, and Institution Building

AID and other funding agencies must decide the extent to which they should support research and development projects aimed at improving the prospects for using communication satellites for education. Research activities would generate knowledge that could both guide decisionmakers in choosing a potential operational system and assist in activities to develop hardware and software. Such development activities should be designed to increase the range of offerings open to decisionmakers. By providing improved alternatives or reducing the cost of conventional alternatives, development activities should help make feasible possibilities that were previously unavailable. A particularly important development activity is "institution building," that is, helping to establish indigenous capabilities for research, development, management, and operation of a complex system.

Research. The product being purchased with research funds is inevitably uncertain because of the nature of research; hence, establishing specific priorities and timetables for the research results is difficult. It is nonetheless possible to identify a number of research areas where it is likely that investments would yield results valuable for deciding on or developing an instructional broadcast satellite system. Before discussing a number of those particular areas, we shall examine several guidelines for undertaking research of this sort.

1. For reasons already mentioned, it is unlikely that research (in contrast to development) can be decided on and contracted for at high levels.* In terms of policy, then, the way to proceed is by funding ideas or individuals that show particular promise of producing results; the policymaker's task is to ensure that the research being pursued is relevant to developing satellite educational systems.

2. The research contracts should be long term (2 years or more) both to allow the researchers to become sensitive to project needs (whether they are explicitly defined or not) and to allow for the gestation period that seems inevitably to be required for quality research. Long-term research commitments need not, however, be very costly.

3. When researchers uncover valuable information, their results should influence policymaking and development efforts; this frequently fails to happen. As the professional journals tend to be read only by other researchers, additional vehicles for disseminating information are required. Perhaps having at least some researchers spend part of their time as policy advisors would be most useful; they would then be able to use research

*This is not necessarily undesirable; there is little reason to expect high-level decisionmakers to know which research issues are of great importance.

results to influence policy directly and to understand the research needs of the policy and development efforts better. Other means for disseminating information include interdisciplinary meetings of the researchers concerned with satellite education programs, perhaps along with development personnel, and periodic publication of nontechnical summaries of research results.

4. The decisionmaker who sponsors research should realize that the research results might end up being of greater value to a decisionmaker in another area; likewise, research sponsored by others can be important to him. He should expect his researchers to keep him abreast of other developments that pertain to his own efforts; by the same token, he should remain aware enough of the research he is sponsoring to be able to communicate results of value to other decisionmakers.

5. Adding a small research budget to a large development project can provide a way of learning a great deal at low cost. What the policymaker needs to avoid is having the research effort thwarted by pressures to develop a product. To avoid this, he might fund the research separately; another, sometimes more risky, approach is to put a researcher in charge of the development effort.

These guidelines pertain to multidisciplinary research that has some promise of being relevant to very practical problems. The kinds of research most relevant to using satellites in education include:

1. Problems of linguistic diversity. Brazil and India, both large developing countries, perhaps represent extremes in terms of linguistic diversity. Brazil has basically one national language, although it also has markedly different Portuguese accents, minority languages, and indigenous languages; India has 275 languages spoken by substantial numbers of people and 14 major regional languages, each with its own script. Injecting one or a few "satellite languages" into a nation with linguistic diversity could result in any of a number of reactions. The satellite language could be ignored, or it could become ubiquitous; it could become a source of divisiveness or unity. Research into the probable linguistic, pedagogical, and political effects of alternative language policies for a satellite is of high priority.

2. Problems of cultural, political, and ethnic diversity. Linguistic diversity reflects differences in cultural, ethnic, religious, and political backgrounds. The potential impact of a dense

national communications grid on each of these facets of national life requires close scrutiny. Existing research should be culled for relevant studies that could influence evolving policies. Areas where research is inadequate should be (selectively) funded, and plans should be made to undertake research in these areas during the pilot and early implementation stages of a system in order to guide its evolution.

3. Rural-urban problems. Satellites can make rural life much more attractive in comparison to life in the cities; on the other hand, they can amplify existing tendencies for the most able individuals to leave agriculture for the cities. Continued research on the ways in which mass communication can affect migration is important.

4. Economic research (educational benefits). Although literature on the economic benefits of formal schooling is substantial, it unfortunately fails to grapple directly with the connection between knowledge and acquired affective traits on the one hand and economic productivity and life satisfaction on the other. With these relationships unexamined, the correlation between higher levels of education and higher income remains subject to

a variety of interpretations. Research on the economic benefits of different types of education (nonformal as well as formal) should prove valuable in deciding on the scale and orientation of satellite educational systems.

5. Economic research (alternative system costs and pedagogical effects). More is known about the costs and probable pedagogical effectiveness of alternative systems than is known about almost any of the other areas where research might be undertaken. Existing results were discussed at some length previously. Yet, as already mentioned, there are a number of areas where further research might profitably be undertaken, and that research is of high priority. Research on costs of alternative systems and pedagogical effects should be closely directed by policymakers.

6. Technological research. It is inevitable that technological breakthroughs resulting from reasonably basic research will markedly change the range of decisionmaker's options over the next 15 years. These long-term trends will be shaped by governmental and corporate decisions largely outside the area of influence of decisionmakers concerned with satellite educational systems. It would be unwise for these decisionmakers to allocate their research resources to basic technological research.

7. Pedagogical research. Although pedagogical research has failed to provide any of the dramatic results that technological research has, its results could have tremendous impact. For this reason pedagogical research is probably worth supporting.

Although this list of seven areas includes most of the important possibilities for research on satellite educational systems, it is in no way exhaustive. Other research possibilities will open up, and decisionmakers should be sensitive to their potential relevance.

Development. Development efforts are designed to use available research knowledge and to produce "products" that increase a decisionmaker's range of choice. This can be done either by creating new possibilities or by reducing the cost or improving the quality of existing possibilities. The distinguishing feature of a development effort is the reasonably specific nature of the product to be generated; this specificity demands that difficult choices be made before development funds are committed and that reasonably close control be exercised over the developing agency.

In addition to institution building, which will be discussed in a separate section, two major development areas can be identified: developing the delivery system hardware and the content (software). Miller* has recently

*James G. Miller, Research and Development Priorities in Instructional Technologies for the Less Developed Countries, Academy for Educational Development, 1973.

reported on a comprehensive study of research and development priorities for instructional technology in general for LDC's; he lists 26 specific areas where research or development activities might profitably be undertaken, most of them of a development nature. In all these areas developing a satellite educational system would prove profitable; the interested reader is referred to the original document. The development efforts discussed here are those specifically for satellite problems (though they may perhaps be relevant to other areas); however, this does not mean that the other of the development activities on Miller's list should not be undertaken in conjunction with satellite projects.

1. Hardware. Two particular tasks are important for developing hardware. First, it is important to continue efforts to reduce the cost of small receive-only TV earth stations for satellites. These efforts, both publicly and privately funded, have already been underway for some time in many places. Nonetheless, continued funding of research on all aspects of reducing the cost of TV receivers -- including maintenance systems, power supplies, and initial installation -- is of high priority.

   Second, it is important to create products. Although, as previously discussed, there is substantial evidence that radio is pedagogically effective and potentially much lower in cost than

TV, virtually no efforts to develop hardware have as yet been undertaken that allow planners of a satellite educational system to move with confidence into use of radio. Two specific areas of development and testing are of high priority: (a) receive-only equipment for radio that is capable of selecting among multiple radio channels for distribution by either loudspeaker to a classroom or by wire to individual students (these tasks impose quite different constraints on the reception equipment), and (b) small receive/rebroadcast stations for local distribution of radio signals to inexpensive sets.

2. Software. In addition to the widely understood (though nonetheless difficult) problems of developing TV and radio software, there are a number of programming problems that arise from the large, heterogeneous nature of the audiences satellites will be expected to serve. Efforts should be made to develop software that has a single video channel accompanied by multiple audio channels to allow for linguistic diversity of the audience. This is particularly important for India, and the Indians are beginning research in this direction with their ATS-F experiment. Developments in this area would have more general application, however; it would open the door to creation of TV curriculums that could be used (and perhaps developed) by many nations.

A second task is to create radio software that can take full advantage of the potential for multiple channel broadcast that radio makes possible.* Experiments with (and use of) this technique are not limited to satellite efforts; its use is, however, particularly appropriate in a satellite context.

Institution building. An important goal of technical assistance as well as financial assistance is to succeed to the point where assistance is no longer required. Efforts should be designed to aid development of a country's own research, development, and management capability. To do this effectively, a certain amount of institution building should be made part of technical assistance programs. There are a number of ways to do this:

1. Money. Perhaps the most direct approach to institution building in LDC's is to select promising institutions and to give them money. Many, but not all, of the UNDP's efforts to provide assistance for software development to India were of this financial nature.

2. Scholarships and participant training. This method allows LDC personnel to study or work in a donor country to acquire the skills that will enable them to become effective contributors to their home institutions. For example, under a Florida State

*See Jamison, Jamison, and Hewlett (1969).

University program sponsored by AID, system management training is provided to individuals from the Brazilian National Space Commission.

3. Faculty and managerial exchange. Outside the satellite area, good examples of faculty and managerial exchange are the joint efforts of M.I.T. and the Indian Institute of Technology (Kanpur) and the Harvard Business School and the Indian Institute of Management (?) in Ahmedabad. These programs should help develop the quality of the Indian Institutions. While such exchanges are a potentially appealing approach to institution building in the satellite education area, the inability of the United States so far to establish an effective capability along these lines domestically militates against this approach.

4. Equipment. Lending or granting computers and other advanced equipment can play an important role in building technical institutions in developing countries. The planned loan of the ATS-F for the Indian SITE experiment is an example of this approach.*

The appropriate mix of the above four approaches to institution building will, of course, depend on the countries involved. The important point is that institution building should be considered essential to any international assistance for developing a satellite educational system.

*The U.S. recently told the U.N. that it would consider proposals from other countries for the use of ATS-F after India's experiment is complete (Aviation Week and Space Technology, July 16, 1973).

D. Pilot Projects and Operational Systems

This section reviews the status of pilot and operational systems, formulates a number of requests a donor agency might expect to receive from an LDC, and outlines the range of possible responses.

Status of Pilot and Operational Systems

Two satellite experiments that are important during 1972-76 are the Franco-German telecommunication satellite project, Symphonie, and the United States and Indian Satellite Instructional Television Experiments. The objective of Symphonie is to provide Europeans with "...technical knowledge and experience in the development and application of telecommunications...."*

The United States and Indian ATS-F experiments will be concerned with instructional/educational television and with testing new satellite technology in a developed and developing country. For these reasons, both developed and developed countries are extremely interested in the preparation for and the outcome of the experiment, which is now scheduled for 1974 and 1975.

Symphonie. Even though the Franco-German Symphonie experimental communication satellite program will not include experiments directly related to education during 1972-76, the French National Space Agency's plans for

*B.R.K. Pfeiffer and P. Viellard, "The Franco-German Telecommunication Satellite Symphonie," in Communications Satellites for the 70's: Systems, (Cambridge, Mass.: The MIT Press, 1971), p. 23.

future operational satellite systems are of direct interest and could have a major impact on the educational decisions of French-speaking African nations. Therefore, when attempting to anticipate the educational decisions of African LDC's in the 1972-76 period, one should closely monitor the developments in the Symphonie project and in the French National Space Agency.

The Symphonie project will be used to conduct communications experiments between France and Germany, receiving and transmitting over 1 television, 3 audio, and 1 service channel; or 192 telephone channels, plus 12 channels for each carrier; or 18 radio broadcast channels, with 1 service channel.

The French National Space Agency is considering three operational satellite systems: Retelsat, Memini, and Socrate. Retelsat is a communication satellite that would be used to tie together France, French-speaking Africa, and French territories overseas. Memini would be used to broadcast to Quebec. Socrate is the proposed educational satellite system that would provide educational television to French-speaking Africa. The acceptance of the Socrate concept by the French-speaking Africans is still in question, but, more important, there is considerable doubt that the project will

ever be funded. Nevertheless, the possibility and potential of such a system should not be overlooked.

ATS-F: U.S. Phase. Most of the emphasis of the ATS-F experiment has been on the Indian phase, but approximately one year of experimentation is scheduled to begin in the United States in the spring of 1974. Theoretically, the U.S. experiment will study the efficacy of the Community Distribution Service system. The system is scheduled to be tested in the sparsely populated Rocky Mountain area, Alaska, and the Appalachian region. The two fundamental objectives are (1) to demonstrate the feasibility of a satellite-based media distribution system for isolated rural populations; (2) to test and evaluate user acceptance and the cost of various delivery modes using a variety of materials.

The delivery modes will include real-time viewing of satellite transmissions and delayed viewing of video cassettes transmitted by satellite.

With television transmissions, the audio portion will be in English with no variation according to the learner's language background. Two-way interactive transmission may involve digital information which can be transmitted simultaneously with the TV broadcasts through separate voice

channels. There will be no computer-managed instruction or computer-assisted instruction.

Groups to be involved in the experiment have been identified within the eight-state region -- Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming -- and include Indians, Chicanos, blacks, and Anglos. The target areas are rural and isolated groups as well as Indians living on reservations and migrants, with the objective of providing education services to groups who have not been served, or have served inadequately in the past by traditional schools. The primary audience is junior high school children, who will receive material on career development. Secondary emphasis is to be placed on educating parents, educators (certified teachers), and paraprofessionals.*

ATS-F: Indian phase. The India phase of the ATS-F experiment (known in India as SITE -- Satellite Instructional Television Experiment) has the following primary instructional objectives:** to contribute to family-planning objectives; to

*Details of the experiment are changing and during the first half of 1973 the project was subjected to detailed scrutiny and refinement. Cowlan (1973) provides a detailed review of this project.
**Vikram Sarabhai, "Background Paper: Television for Development," presented at the Society for International Development Conference, Delhi, November 14-17, 1969.

improve agricultural practices; and to contribute to national integration. The India phase will require approximately one year, starting in mid-1975, and is to involve the broadcasting of instructional television programs to an estimated 4,000-5,000 Indian villages. About 2,000 villages are to receive programs from the satellite through an inexpensive community receiver (one that will cost from $200 to $1,000). The remaining villages are to be provided programs received by earth stations and redistributed to community receivers via VHF conventional transmitters.

The community receivers are to be located in 12 clusters of about 400 villages each. These clusters are to be selected to obtain a wide range of data from the experiment. To gain experience in different cultural and linguistic settings, the clusters are to be spread over different parts of the country. The current plan for community reception is to spread seven clusters throughout the states of Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Rajasthan, West Bengal, and Madras. The sets in the broadcast areas are to be located in five clusters in villages around the cities of Ahmedabad, Bombay, Poona, Delhi, and Srinagar, since the terrestrial TV transmitters are to be located there.*

ATS-F: Brazilian phase. After the Indians complete their ATS-F experiment, the satellite will be available to other countries. Brazil has developed a series of

*Singh and Jamison (1973) provide a more detailed review of the SITE plans and their role in the development of broadcasting in India.

proposals for use of ATS-F and is developing a terrestrial pretest plan for a satellite system. The proposed Brazilian ATS-F experiment is part of a larger effort by Brazil to use modern technology to upgrade education and to educate its masses. Therefore, the objectives in Brazil differ from those in India. Whereas India is concentrating on an adult audience in remote areas, providing instruction in agriculture, health, and so on, Brazil is emphasizing the test of satellite technology for central educational broadcasting, using a balance of television and radio to upgrade classroom instruction and teachers and to improve learning as a function of different broadcast media.

The terrestrial experiment is to last for approximately four years. The first year or so is to be dedicated to work with a terrestrial information distribution system, with emphasis on a satellite system throughout most of 1974. Initially, the transmissions are being made to schools via VHF and medium wave methods using three radio and two TV stations. When properly equipped, some of the experimental schools are scheduled to receive programs relayed by the ATS-F satellite. Until then, use of the satellite will be simulated through a terrestrial transmission of its signal. The actual satellite experiment will use a distribution and community information dissemination system.

Six hundred schools have been selected to participate in the experiment, which will attempt to improve the first four years of education through inservice education and student programs. These schools are of three types: elementary, elementary united, and elementary isolated. Because the main objective is to test the efficiency of the new technologies and their effectiveness on education, the program will compare those schools using all the technology, those using a portion of the technology, and those not using the technology at all. The experiment has been divided into missions according to years, with specific emphasis on the media and distribution mode to be used and on the types of individuals to whom the program content will be geared.

The major emphasis of the first year is on training supervisors, upgrading teachers, and showing both how to work with media to improve learning. Up to two hours of television and one or more hours of radio programs are provided every day, offering inservice education in the Portuguese language, social studies, health and natural sciences, mathematics, civics and moral education, and pedagogic and didactic ideas. While inservice education continues, a shift to student learning will occur in the remaining three years.*

Other projects. The preceding discussion covers most active work on

* Wolff (1973) provides an up-to-date review of Brazilian efforts to initiate experimentation with a satellite system. There are some indications that Brazil will decide by January, 1974, whether to obtain an operational system.

experimentation with use of satellites for education in developing countries. Another experiment that will be undertaken is the Canadian Technology Satellite (CTS), which will be available for experimentation in several years. Smith (1973) provides a discussion of that project. In addition to these project efforts, studies have been made of the desirability of satellite educational systems for other developing regions; UNESCO has sponsored studies of regional systems for the Andean Nations and for the Sub-Saharan African Nations, and private companies have analyzed the possibilities for Iran, Indonesia, and perhaps elsewhere.

Possible Requests and Responses

Decisions to undertake research or development projects are usually, though by no means always, initiated by a potential donor agency, and an important aspect of decisionmaking in those cases is to ensure that timely projects are begun. Decisions to support both pilot and operational satellite educational systems, however, are usually responsive, although, of course, a donor agency may suggest that an LDC become involved in such a program. Responses are here categorized so that decisionmakers can consider their options before they receive a request.

Pilot projects

1. An LDC requests time to use the ATS-F for an educational experi-

ment or pilot project.* The appropriate response will depend on the quality of the request as well as on the availability of the spacecraft. Possible responses include (1) yes; (2) no, with reasons; (3) yes, but for a shorter or longer time period or for more or fewer hours per day; (4) the LDC should rethink its plans and come in with a new proposal; (5) the proposing entity in the LDC should consider broader (narrower) involvement of other entities in the LDC; (6) the LDC should consider proposing use of an INTELSAT transponder or ATS-1 or -3 or CTS; (7) the donor agency could offer technical assistance to improve planning for an experiment, or help the LDC rethink whether it really wants to engage in such an experiment.

2. An LDC requests time on ATS-1 or -3 for experiments with two-way communications or for experiments with satellite radio redistribution systems. The possible responses here parallel those in the first request.

3. An LDC requests partial or total financial support for a pilot or experimental satellite educational system. Responses here include (1) unqualified yes; (2) no, with reasons; (3) partial support; (4) total or partial support with the assistance tied to purchases from particular countries; (5) offer of technical assistance and/or

*The U.S. government's present policy is to consider requests for time on ATS-F after the SITE experiment in India is complete.

equipment in lieu of financial support or as a supplement to multilateral funding; (7) offer of short-term expert assistance to formulate the plans and proposal better.

4. An LDC requests technical assistance (e.g., that the donor agency provide engineers, economists, and teachers) to aid program planning and development of a pilot project. The responses here parallel those cited in the previous request, with the obvious alterations. Requests of this sort have additional appeal, however, in that they tend to be less costly than total financial support, and they allow donor country personnel to acquire first-hand experience with these development problems. This experience may then be of value to other LDC's or to the donor country.

5. An LDC requests gifts of specific equipment to assist with a pilot project or experiment. The responses here again parallel those cited in the third request. Used equipment may be found that would be satisfactory for an experimenter and of low (or no) cost to the donor. For example, the Partners of the Alliance Program has, through its sister state program between Maine and Rio Grande do Norte, Brazil, provided television transmitters and receivers for the Brazilian experiment described earlier. The donor agency must not "dump" or seem to be "dumping" equipment inappropriate for the needs of the recipient.'

Operational systems

1. An LDC intending to acquire its own operational satellite educational system would need to obtain export licenses for satellite components from the U.S. State Department and launch services from NASA, or make similar arrangements with another country. An LDC might well request some or all of these services. Factors influencing decisions on requests of this sort could point in different directions. Although the United States has a stated commitment to free trade and commerce, it may wish to use whatever coercive power it has in this area to discourage competition with INTELSAT or to discourage a country from what it (or other exporting countries) might consider to be an unwise investment. Another factor is that sale of such services generates foreign exchange through purchase in industries now operating below capacity in the United States. Also, refusal of a request could stimulate approaches to Western Europe or the Soviet Union (this is not necessarily undesirable).

   Responses to a request of this sort include (1) unqualified approval; (2) approval with conditions concerning competition with INTELSAT, signal spillover, or free flow of information; or (3) rejection.

2. An LDC might request, in addition to rights to satellite and launch

vehicle purchase, financial assistance with development of the system. Possible responses parallel those cited in the third pilot project request. The inevitably greater sums involved for an operational system would, though, bring a different set of criteria into play in deciding on the country's request.

3. An LDC might request technical assistance (experts) to assist with development of an operational system. Possible responses parallel those given in the fourth pilot project request.

4. An LDC might request donation of new or used equipment to assist in development of an operational system. Possible responses parallel those given in the fifth pilot project request.

5. An LDC might request assistance in deciding whether to acquire a satellite educational system, and if it decides to acquire one, how to proceed with development. This would be a request for a form of technical assistance, but of a particularly important sort. It would be less costly to provide than most other forms of technical assistance and at the same time would play a more important role in terms of policy formulation in the LDC. The options here would be (1) no, with reasons; (2) yes; and (3) yes, with investment of a substantial intellectual commitment on the donor's part.

The reason for distinguishing between the two "yes" answers is that many of our own "experts" at this sort of planning and management may be of limited assistance;* only through great care and selectivity can a donor agency be reasonably sure of providing the type of planning assistance that would truly be of value.

The classification offered here is not meant to cover all possibilities but rather to provide an outline for examining policy on developing satellite educational systems.

*Three points support this comment. First, many of our genuinely competent experts work for private firms with vested interests. Second, the quality of work by many of our own planners in this area has been low. Third, the domestic U.S. experience with management of pilot satellite education projects can scarcely be said to constitute a good example.

APPENDIX

Direct Broadcast Satellites and Cultural Imperialism
An International Debate

The international debate on the political and legal aspects of Direct Broadcast Satellites (DBS) has grown more intense during the past few years as several developing countries, particularly Brazil and India, approach the scheduled beginning of their planning or operational program. The planned programs illustrate well the connection between advanced technology, national development programs, and national and international policy problems, for they require the attention of many of specialists in different disciplines. Among the specialists are educators, government officials, aerospace engineers to work on the space segment, and communications specialists to deal with the telephone and TV transmission. In Brazil, discussions in the Government have included not only the communications and education ministries but also industry, the national institute for space research, and the President's office.

At the international level, numerous discussions and debates have taken place since the UN General Assembly resolution on the subject in December 1968. The UN Committee on the Peaceful Uses of Outer Space created a Working Group on DBS, which convened on several occasions in 1969. In a session held in Geneva that July, major differences in national attitudes became

evident, especially between the viewpoints held by the United States and the Soviet Union. The United States takes the position that any state placing a satellite in orbit should be free to use that satellite for any purpose not in conflict with the 1967 Outer Space Treaty. The United States has also strongly expressed its opinion that the principle of "free flow of information" should be applied to the DBS programs. Its interpretation of this principle is that every person has a basic human right to receive any information that can be made available to him.

The Soviet Union and a growing number of states hold an opposite view -- that although free flow of information appears to be a good principle, it can also lead to considerable misuse, particularly "cultural imperialism." "Cultural imperialism" can take place either deliberately through the transmission of broadcasts aimed at influencing another society or accidentally through "spillover," a process in which the transmission from the satellite to the ground stations inadvertently crosses a national frontier, creating a situation in which "undesirable" programs can be received by a country against its wishes.

The Soviet view has been adopted by many countries whose leaders feel that they have an obligation to their citizens to keep away potentially offending TV broadcasts. These could include programs whose contents clash with the established cultural and/or political precepts. An authoritarian government, especially, is primarily concerned with maintaining its power;

naturally, it opposes any potential threat, often by censoring foreign publications and other information.

The UN General Assembly has for several years insisted that all international applications of advanced technology be conducted to assist developing countries. This opinion is restated in many General Assembly resolutions, especially in reference to outer space. Yet, the United Nations is sharply aware of the differing attitudes on the questions of program content and international regulatory controls. UNESCO, which is also directly concerned with the matter, has shown its concern over the potential use of such satellite systems for propaganda purposes. From the very beginning, UNESCO has presented thoughtful papers on the subject.

Major Approaches of the International Community to DBS Issues

In the last five years, four approaches have been considered by different countries: essentially laissez-faire, with research on major issues; informal international cooperation; a multilateral declaration without binding treaty requirements; and a multilateral convention establishing treaty requirements.

During the 1968-70 period, the general attitude was to encourage study of the technical, political, legal, and economic aspects of DBS. At this time,

the United Nations working group on DBS was established and several reports were issued, including a technical statement in February 1969 and summary of political and legal aspects in August 1969. The United States supported this general attitude, whereas the Soviet Union expressed misgivings.

During 1969 and 1970, Canada and Sweden, working together, emphasized the desirability of international cooperation in this field without actually calling for the establishment and operation of specific regional DBS systems. This approach was based on the belief that it was premature and possibly counterproductive to attempt to respond to some of the difficult foreseeable issues raised by DBS by formulating legal rules and principles. The August 1969 report of the UN working group essentially reflected this approach.

In accordance with this general point of view, the United States and India signed an agreement in 1969 to conduct a satellite instructional TV experiment in 5,000 Indian villages in 1974 through the use of a U.S. satellite. At the same time, Brazil began to develop a program of educational instruction to be delivered through a DBS system. Brazil has received considerable assistance from the United States and other countries during the subsequent planning period. The Canadian communication technology satellite (CTS) will also involve cooperation with the United States and Europe in experiments relevant to direct broadcasting.

UNESCO General Conference 1972

Beginning with the meeting in mid-1969, UNESCO has consistently argued for the adoption of more formal legal principles by the international community. This issue was brought to a head in October 1972 during the 17th session of the UNESCO General Conference in Paris, when a draft "Declaration of Guiding Principles on the Use of Satellite Broadcasting for the Free Flow of Information, the Spread of Education, and Greater Cultural Exchange" was debated. The final vote was 55 in favor, 7 against, and 22 abstentions. The result represented a rejection, especially by the LDC's, of the laissez-faire approach and informal international cooperation. A striking majority of states indicated that they preferred a more formal international regulation involving general and specific principles to govern the activity.

The Declaration, which is stated in general terms:

- Affirms principles of sovereignty and equality of all states (Article II, 1);

- Affirms principles of free flow of information (Article V, 1): "to ensure widest possible dissemination, among peoples of world, of news of all countries."

- Calls for providing the benefits of satellite broadcasting to all

countries without discrimination and regardless of their degree of development (Article III, 1).

- Says that use of satellites for broadcasting should be based on international cooperation: global, regional, intergovernmental, and professional.

- Lists the objectives of DBS: to accelerate expansion of education, extend education opportunities, improve content of school curricula, further training of educators, assist in struggle against illiteracy, and help ensure lifelong education (Article VI, 1);

- Declares that "Each country has the right to decide on the content of the educational programs broadcast by satellites to its people..." and that where such "programs are produced in cooperation with other countries," each country has right to take part in their planning and production, on a free and equal footing (Article VI, 2);

- States the objective of DBS as the promotion of cultural exchange " to foster greater contact and mutual understanding between peoples by permitting audiences to enjoy, on an unprecedented scale, programs on each other's social and cultural life, including

artistic performances and sporting and other events" (Article VII, 1);

- Cultural programs, while promoting the enrichment of all cultures, should respect the distinctive character, the value and the dignity of each, and the right of all countries and peoples to preserve their cultures as part of the common heritage of mankind (Article VII, 2);

- Calls for encouraging broadcasters to cooperate in the production and exchange of programs and in all other aspects of satellite broadcasting, including training of technical and programming personnel (Article VIII);

- It is necessary that states, taking into account the principle of freedom of information, reach or promote prior agreements concerning DBS to the population of countries other than the country of origin of the transmission (Article IX, 1);

- Requires that the transmission of commercial advertising be subject to specific agreement between originating and receiving countries (Article IX, 2);

- Principles of this declaration shall be applied with due regard for human rights and fundamental freedoms (Article XI).

Soviet Draft Convention and the UN General Assembly 1972

In August 1972 the Soviet Union submitted to the UN General Assembly a draft "Convention on Principles Governing the Use by States of Artificial Earth Satellites for Direct TV Broadcasting." Stressing the need for a firm and precise international treaty obligation, the USSR pressed for adopting such a path during the First Committee meeting in September and subsequently in the General Assembly. The Soviet approach, which would go beyond the UNESCO declaration in its requirements:

- Requires express prior consent before using a DBS for transmissions to foreign states.

- Prohibits states from using satellites to transmit TV programs that would publicize ideas of war, militarism, Nazism, national or racial hatred among states, immorality, pornography, or anything interfering in the domestic affairs or foreign policy of another state (Article IV). Also prohibited would be all broadcasts that would be considered detrimental to maintenance of international peace and security, or that would encroach on fundamental human rights or that would emphasize violence or horrors or that would propagandize the use of narcotics (Article VI). Broadcasts that would undermine the foundation of local civilization, culture, or traditions would also be forbidden.

Allows any state to "employ the means at its disposal to counteract illegal TV broadcasting of which it is the object not only in its own territory but also in Outer Space" (Article IX). However, no international enforcement machinery is established. This article, which would apparently give a state the right to destroy a satellite, might very well be considered in violation of the 1967 Outer Space Treaty, which explicitly provides that no states may employ weapons or military equipment in Outer Space.

Holds the state responsible for individual acts. Article VII also indicates that TV broadcasts utilizing satellites to other countries may only be carried out by organizations that are under the control of Governments of the states concerned.

Gives all states the equal right to carry out direct TV broadcasting by means of satellites, and all states an equal right to benefit from direct TV broadcasting by means of satellites (Article I).

In November 1972 the General Assembly adopted almost unanimously Resolution 2916. The vote was 102 to 1 (only the United States opposed the measure), with 7 abstentions. With a view to concluding an international agreement, the Assembly asked the Committee on the Peaceful Uses of

Outer Space to study as soon as possible the principles governing the use of artificial earth satellites for direct TV broadcasting.

The General Assembly adopted Resolution 2917 at the same meeting. Recalling its Resolution 2848 of December 19, 1968, dealing with freedom of information, the Assembly noted that the work performed on the Draft Convention on Freedom of Information and deliberations thereon in the General Assembly may be useful in discussing and elaborating on international instruments or UN arrangements for direct TV broadcasts.

The UN working group on DBS was to meet during the summer of 1973, and subsequently the legal subcommittee of the Committee on Peaceful Uses of Outer Space is expected to begin careful preparation of draft treaty principles.

Some Current Problems

Although there are those who feel that technology will be able to resolve the spillover problem, it should be noted that a single DBS satellite on the geostationary equatorial orbit is capable of blanketing one-third of the globe. Thus, the problem of accidental spillover is not going to be easy to eliminate. It is expected that only government-controlled community receivers will be employed in the immediate future -- a government can

control reception simply by controlling the placement and operation of the receivers. However, within the next few years augmented home receivers will be available at a cost of perhaps a few hundred dollars. This cost will reduce the scope of the potential problem. Of course, if a government wishes, it can physically monitor the protruding antenna or it can jam the broadcast. However, within the next 10 years unaugmented and relatively inexpensive home receivers will probably be available for reception of DBS programs. It will then become almost impossible for a government to exercise firm control over what broadcasts its citizens receive. For this reason many countries prefer to establish treaty requirements and guidelines well in advance of the employment of the technology.

Nations concerned with controlling information are insisting on adopting these legal principles and requirements governing DBS activities now rather than waiting for the gradual development of cooperative bilateral or multilateral programs.

Quite aside from the desire to censor information, many nations are deeply concerned that the unregulated intrusion of programs from developed countries will result not only in an invasion of national privacy but also in cultural degradation. They are afraid, with considerable justification,

that their cultures would be greatly diluted -- not necessarily for the better. Many have a long history of political and/or economic exploitation by developed countries, and they are understandably chary about the potential effects of a DBS system. They are also quite aware of the power of TV to sway uninformed individuals and fear that apparently harmless broadcasts might in fact constitute subtle but pervasive propaganda.

However, the type of restrictive requirements proposed in the Soviet draft would cause almost insoluble regulatory problems. Certainly, control of program content through multilateral proscription will be difficult, if not impossible, to obtain. It is hard enough to arrive at a legal definition of a term such as immorality or pornography in a single country, let alone on a global scale. What may be considered excessive violence or obscenity in one culture may be perfectly acceptable in another. As has already been noted, the Soviet draft could be interpreted as giving a state the right to destroy the satellite of another in an attempt to counteract illegal TV broadcasting. One glaring shortcoming of the Soviet draft is that it does not propose any multilateral enforcement mechanism but rather leaves enforcement to the arbitrary control of the individual states. In addition, the draft does not provide any mechanism that would aid the international community in determining illegality. Finally, it apparently gives all states the right to demand that they be given equal capacity to

broadcast TV programs directly by satellite. The possibility of legislating and enforcing such a right is very remote.

Because of these difficulties it is generally believed that the Soviet draft articles will probably be replaced by a formula that is considerably less rigorous. Perhaps the UNESCO principles, or some modification of them, will be reexamined.

Obviously, the U.S. position has suffered a crushing blow as a result of successive defeats during the UNESCO conference and in the UN General Assembly. The United States greatly overestimated the forcefulness of its arguments and equally underestimated the strength of the beliefs held by most developing countries as well as by many developed countries. The United States will have to reevaluate its position and take into account the very strong concern of LDC's with "culture imperialism." It might well consider working with the United Nations or other multilateral agencies to develop cooperative, bilateral, or regional DBS experimental systems. These experimental systems would preferably be developed so that the receiving country has full and complete control over program content. However, this will only be a first step. The real problems will arise when a number of DBS systems are operating simultaneously. Some international regulatory is needed, it seems. Perhaps some agreement can be reached on certain kinds of programs.