# APPLICATION OF A SOCIO-TECHNICAL ASSESSMENT MODEL TO TELECOMMUNICATION PLANNING: A CASE STUDY IN SOUTH KOREA

By

Susanna Eun

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

College of Communication Arts and Sciences

Mass Media

1983

ABSTRACT

APPLICATION OF A SOCIO-TECHNICAL ASSESSMENT MODEL TO TELECOMMUNICATION PLANNING: A CASE STUDY IN SOUTH KOREA

By

Susanna Eun

This research applies a new policy-analysis tool, Socio-Technical Assessment, to explore the potential roles of telecommunication technologies in developing countries. Based on data from field work in a rural village in South Korea, this study had three objectives: (1) to provide guidelines for telecommunication policy planning in developing countries; (2) to expand the traditional scope of telecommunication policy research by introducing an analytic methodological tool; and (3) to test the validity and the utility of the Socio-Technical Assessment Model.

The main parts of the study are divided into two areas: validation of the Model, and operation of the Model. The validity of the Model was tested by examining a quality-of-life scheme, and by assessing the effects of telecommunication technologies within the village. The quality-of-life scheme was both reliable and valid enough to constitute a rational criterion in guiding strategies for technological development. The policy implications of empirical findings on effects of telecommunication technologies can be summarized under three aspects: (1) telecommunication technologies do have significant effects upon the quality of life; (2) in policy planning, a collective approach

encompassing diverse technologies in one frame seems more fruitful than piecemeal approaches; and (3) point-to-point telecommunication modes merit special consideration.

The operation of the Model was designed for analyzing initial policy alternatives in long-range planning. With the areas confined to Nourishment, Shelter, Clothing, and Health, the Model identified telecommunication modes that transmit written messages without unreasonable delay at low cost to a large group of people as the most desirable choices. Newspaper and Postal Service were found to be the best choices in enhancing the overall quality of life, Television and Theatrical Films, the least desirable choices.

## ACKNOWLEDGMENTS

In presenting this small piece of work, I would like to extend my deepest thanks to the guidance committee members and many others who made this work possible.

First of all, I am most grateful to Dr. Baldwin who gave me a chance to try out the Ph.D. business. His fairness and intellectual encouragement has been extremely helpful. Dr. Muth, who served as the guidance committee chair, has provided numerous emotional support and cheer, without which life would have been senseless. Prof. Murray, for all his insightfulness and warmth, deserves special thanks. I am also grateful to Dr. Abel for providing assistantship.

And there was a man who molded my brain for all these years. Dr. Montgomery, the finest of mankind, and the hardest of all to please, has served as a true mentor throughout my Ph.D. years. Believe me Dr. Montgomery, I did my best not to produce another "pathetic" dissertation.

To my parents, to sum up my deepest gratitude, I dedicate this dissertation to you two. My husband, who has endured a long separation, deserves the greatest credit. Without his love and understanding, I could have never finished the Ph.D. works.

There are many others to be remembered. Many people in Wa-Bu who fiercely helped me out in collecting data, Ann Alchin of the Telecommunications Department, Michelle and Martha of the Metallurgy, Material Science, and Mechanics Department, and many of my friends who shared joys and sorrows with me. To all of you, I extend my thanks.

TABLE OF CONTENTS


| | Page |
|---|---|
| LIST OF TABLES | vi |
| LIST OF FIGURES | ix |
| LIST OF APPENDICES | x |
| CHAPTER | |
| I. INTRODUCTION | 1 |
| Problem Statement | 1 |
| Purpose of the Study | 3 |
| Assumptions and Research Questions | 5 |
| Testing Validity of the Model | 5 |
| Operation of the Model | 7 |
| Definition of Terms | 7 |
| Structure of the Study | 8 |
| Overview | 9 |
| II. LITERATURE REVIEW | 10 |
| Theory of Development | 10 |
| Economics | 11 |
| Socio-Psychology | 13 |
| Political Science | 15 |
| Quality-of-Life Indexes | 17 |
| Telecommunication and Development | 19 |
| Technology Assessment | 22 |
| Appropriate Technology and Technology Assessment | 26 |
| Overview | 27 |
| III. THE SOCIO-TECHNICAL ASSESSMENT MODEL | 29 |
| General Description of the Model | 29 |
| Operationalization of the Model | 34 |
| 1. Definition of Objectives | 34 |
| 2. Delineation of the Scope of Assessment | 35 |
| 3. Construction of the Model | 39 |
| 4. Validation of the Model | 45 |
| 5. Operation of the Model | 45 |
| Overview | 46 |

TABLE OF CONTENTS (continued)


CHAPTER | | Page
---|---|---
IV. | COLLECTION OF DATA | 47
| Socio-Economic Conditions of the Village | 47
| Telecommunication Environment of the Village | 51
| Data-Collection Process | 54
| 1. Sampling among the Villagers | 54
| 2. Inventory Schedule of Telecommunication Modes. | 65
| 3. Panel Discussion among Experts | 71
| 4. Evaluation of Demands for Technical Characteristics to Activate Technical Functions. | 74
| 5. Interviews with the Decision-Makers | 78
| Overview | 81
V. | VALIDATION OF THE MODEL | 84
| The Quality-of-Life Scheme | 84
| Telecommunications and the Quality of Life | 112
| Overview | 126
VI. | OPERATION OF THE MODEL | 127
| Phase I | 127
| Phase II | 131
| Phase III | 133
| Phase IV | 153
| Overview | 153
VII. | CONCLUSIONS AND FUTURE DIRECTIONS | 155
| Conclusions | 155
| Quality of Life | 156
| Effects of Telecommunications Technolgies | 159
| Operation of the Model | 161
| Future Directions | 166
| Final Discussion | 174
APPENDICES | | 176
REFERENCES | | 199

LIST OF TABLES


| Table | | Page |
|---|---|---|
| Table 1. | Employment by Occupation in South Korea and Wa-Bu . . . | 178 |
| Table 2. | Increase of GNP per cap. in South Korea (1974-1980) . . | 179 |
| Table 3. | Penetration Ratio of Telephone in South Korea, Wa-Bu, and Seoul (1981) . . . . . . . . . . . . . . . . . . . . . | 180 |
| Table 4. | Distribution of Education, Income, Age, and Sex among the Subjects (N=200) . . . . . . . . . . . . . . . . . | 58 |
| Table 5. | Mean of Education, Income, Age of Five Societal Sectors and of the Total Subjects . . . . . . . . . . . . . . . | 59 |
| Table 6. | Mean of the Basic Human Needs and the Overall Satisfaction Level of Five Societal Sectors and the Total Subjects . . . . . . . . . . . . . . . . . . . . . . | 61 |
| Table 7. | Mean of Access to the Telecommunication MOdes (N=200) . | 63 |
| Table 8. | Mean of Frequency of Using the Telecommunication Modes (N=200) . . . . . . . . . . . . . . . . . . . . . . . | 65 |
| Table 9. | Technical Characteristics of the Telecommunication Modes . . . . . . . . . . . . . . . . . . . . . . . . | 72 |
| Table 10. | Demands for the Technical Functions to Promote the P, E, F, J Components of <u>Nourishment</u> . . . . . . . . . . . | 75 |
| Table 11. | Demands for the Technical Functions to Promote the P, E, F, J Components of <u>Shelter</u> . . . . . . . . . . . . . | 75 |
| Table 12. | Demands for the Technical Functions to Promote the P, E, F, J Components of <u>Clothing</u> . . . . . . . . . . . . | 76 |
| Table 13. | Demands for the Technical Functions to Promote the P, E, F, J Components of <u>Health</u> . . . . . . . . . . . . . | 76 |
| Table 14. | Demands for the Technical Characteristics to Activate the Technical Functions . . . . . . . . . . . . . . . . | 77 |
| Table 15. | Mean of the Overall Satisfaction Level of the Villagers as Estimated by the Decision-Makers and the Sample Subjects . . . . . . . . . . . . . . . . . . . . . . | 79 |

| | | Page |
|---|---|---|
| Table 16. | Decision-Makers' Weight Assignment to the P, E, F, J Goals | 80 |
| Table 17. | Decision-Makers' Weight Attachment to the Five Societal Sectors | 81 |
| Table 18. | Reliability Estimate of the Quality-of-Life Scheme with 17 Items | 87 |
| Table 19. | Reliability Estimate of the Quality-of-Life Scheme with 14 Items | 88 |
| Table 20. | Analysis-of-Variance Test for the Quality-of-Life Scheme with 17 Items | 185 |
| Table 21. | Hotelling's T-Squared Equality-of-Means Test for the Quality-of-Life Scheme with 17 Items | 186 |
| Table 22. | Correlation Coefficients between the Basic Human Needs and the Overall Satisfaction Index S | 91 |
| Table 23. | Multiple Regression with the Basic Human Needs on the Overall Satisfaction Index S | 94 |
| Table 24. | Correlation Matrix of the 16 Basic Human Needs | 187 |
| Table 25. | Factor Matrix of the 16 Basic Human Needs: Maximum-Likelihood Non-Rotated Solution | 98 |
| Table 26. | Factor Matrix of the 16 Basic Human Needs: Principal-Factoring Quartimax-Rotation Solution | 102 |
| Table 27. | Factor-Score Coefficients of the 16 Basic Human Needs: Maximum-Likelihood Non-Rotated Solution | 109 |
| Table 28. | Correlation Coefficients between Access to the Telecommunication Modes and the Overall Satisfaction Index S | 113 |
| Table 29. | Effects of Education, Income, Profession to the Access to the Telecommunication Modes: Three-Way Analysis-of-Variance Tests | 115 |
| Table 30. | Mean of Total Access Score by Education, Income, and Profession Breakdowns | 188 |
| Table 31. | Effects of Education, Income, and Profession on the Overall Satisfaction Index S: Three-Way Analysis-of-Variance Tests | 117 |

Page


| | | |
|---|---|---|
| Table 32. | Effects of Access to the Telecommunication Modes to the Overall Satisfaction Index S: Analysis-of-Covariance Tests | 119 |
| Table 33. | Correlation Coefficients between Frequency of Using the Telecommunication Modes and the Overall Satisfaction Index S | 121 |
| Table 34. | Effects of Education, Income, and Profession on the Frequency Scores: Three-Way Analysis-of-Variance Tests | 123 |
| Table 35. | Mean of Total Frequency Score by Education, Income, and Profession Breakdowns | 189 |
| Table 36. | Effects of Frequency of Using the Telecommunication Modes on the Overall Satisfaction Index S: Analysis-of-Covariance Tests | 125 |
| Table 37. | Factor Matrix of the Basic Human Needs for the Professionals: Maximum-Likelihood Non-Rotated Solution | 190 |
| Table 38. | Factor Matrix of the Basic Human Needs for the Clerical Workers: Maximum-Likelihood Non-Rotated Solution | 191 |
| Table 39. | Factor Matrix of the Basic Human Needs for the Commercial Sector: Maximum-Likelihood Non-Rotated Solution | 192 |
| Table 40. | Factor Matrix of the Basic Human Needs for the Non-Agricultural Laborers: Maximum-Likelihood Non-Rotated Soultion | 193 |
| Table 41. | Factor Matrix of the Basic Human Needs for the Farmers: Maximum-Likelihood Non-Rotated Solution | 194 |
| Table 42. | Expected Rate of Increment of the Overall Quality of Life of the Villagers Attributed by the Telecommunication Modes from the Provision of the Basic Human Needs | 152 |

## LIST OF FIGURES

Page

Figure 1. Categorization of Human Goals . . . . . . . . . . . . 31

Figure 2. Conceptual Scheme of the Socio-Technical Assessment Model . . . . . . . . . . . . . . . . . . . 40

Figure 3. Measurement Scheme of the Socio-Technical Assessment Model . . . . . . . . . . . . . . . . . . . 42

Figure 4. Map of Korea . . . . . . . . . . . . . . . . . . . . 176

Figure 5. Map of Wa-Bu . . . . . . . . . . . . . . . . . . . . 177

Figure 6. A Restricted Regression Model of the Quality-of-Life Scheme . . . . . . . . . . . . . . . . . . . . . . 105

Figure 7. An Unrestricted Regression Model of the Quality-of-Life Scheme . . . . . . . . . . . . . . . . 107

LIST OF APPENDICES


| Appendix | | Page |
|---|---|---|
| A. | Maps | 176 |
| | Figure 4. Map of Korea | 176 |
| | Figure 5. Map of Wa-Bu | 177 |
| B. | Backgrounds of the Sample Site | 178 |
| | Table 1. Employment by Occupation in South Korea and Wa-Bu | 178 |
| | Table 2. Increase of GNP per capita in South Korea (1974-80) | 179 |
| | Table 3. Penetration Ratio of Telephone in South Korea, Seoul, and Wa-Bu (1981) | 180 |
| C. | Questionnaire Items | 181 |
| D. | Reliability Estimate of the Quality-of-Life Scheme | 185 |
| | Table 20. Analysis-of-Variance Test with 17 Items | 185 |
| | Table 21. Hotelling's Equality-of-Means test with 17 Items | 186 |
| E. | Correlation among the Basic Human Needs | 187 |
| | Table 24. Correlation Matrix of the 16 Basic Human Needs | 187 |
| F. | Telecommunication Usage among the Subjects | 188 |
| | Table 30. Mean of Total Access Score by Education, Income, Profession Breakdowns | 188 |
| | Table 35. Mean of Total Frequency of Usage Score by Education, Income, Profession Breakdowns | 189 |
| G. | Relationship between the Basic Human Needs and the Canonical Human Goals in Each Societal Sector | 190 |
| | Table 37. Factor Matrix of the Basic Human Needs for the Professionals: Maximum-Likelihood Non-Rotated Solution | 190 |
| | Table 38. Factor Matrix of the Basic Human Needs for the Clerical Workers: Maximum-Likelihood Non-Rotated Solution | 191 |
| | Table 39. Factor Matrix of the Basic Human Needs for the Commercial Sector: Maximum-Likelihood Non-Rotated Solution | 192 |

Appendix Page

G. (con't)

Table 40. Factor Matrix of the Basic Human Needs for the Non-Agricultural Laborers: Maximum-Likelihood Non-Rotated Solution . . . . . . . . 193

Table 41. Factor Matrix of the Basic Human Needs for the Farmers: Maximum-Likelihood Non-Rotated Solution . . . . . . . . . . . . . . . . . . . . 194

H. Mathematical Procedure of the Socio-Technical Assessment Model . . . . . . . . . . . . . . . . . . . . . . . . . . 195

# CHAPTER I

# INTRODUCTION

## Problem Statement

Formulation of telecommunication policies in the developing countries has largely been problematic. In the absence of adequate guidelines, expansion of telecommunication technologies in the developing countries has concentrated in the urban and the few industrial sectors where transaction activities are dominant. The studies on telecommunication policies of the developing countries, most of which view the ultimate purpose of telecommunication as bringing the market mechanism into full swing, have not been successful in rectifying the imbalance of telecommunication services in those countries. Ignored are such matters as access to information sources and the demand for various types of information on the part of the rural populations. Although some developing countries started to show interest in expanding telecommunication service for the rural sector, they often found themselves frustrated because of the lack of policy guidelines for planning allocation of public resources.

The lack of adequate guidelines can be attributed to two major factors: inadequate theoretical framework in telecommunication research in the context of the development process, and the absence of an analytically-oriented policy tool.

The theoretical framework commonly adopted in studies of telecommunication in the developing countries suffers from three major shortcomings. First, it considers the prime function of telecommunication, notably that of mass media, to be the creation of attitudes leading to higher economic productivity. The need for information to aid the provision of fundamental human needs is not given special attention. Second, it neglects the adverse impacts of telecommunication technologies. Much of earlier work (Lerner, 1958; Schramm, 1964; Rogers, 196 ) discussed the benefits of telecommunication technologies, ignoring the potential harmful effects. A few studies elaborate the adverse impacts of telecommunication technologies in the developing countries (Lent, 1975; Golding, 1974; Schiller, 1975-1976), but they fail to suggest policy alternatives. Third, the role of telecommunication focuses on the effects of mass media, with little attention given to the point-to-point technologies such as telephone, telegraph, or postal service. In the absence of a holistic frame in which effects of both mass media as well as point-to-point technologies can be assessed, telecommunication policy studies are characterized by fragmental approach and short-sightedness.

Closely related to the problem of an inadequate theoretical basis are the difficulties confronting the methodology area. For instance, a group of studies presented empirical findings that support positive effects of telecommunication technologies in the developing countries (Inkeles & Smith, 1974; Rogers & Shoemaker, 1971). Policy implications of those studies are tenuous, however, since they are mainly concerned with a single dimension, namely "modernity." Most typically, the changes with time are ignored so that dynamic social reactions induced by telecommunication technologies are left unestimated. Furthermore, little effort has been made to construct a quantification scheme in which competing interests of various social groups can be determined and balanced to find optimal policy decisions. In the absence of anlytically-oriented policy tools, the expected impacts of policy alternatives remain purely conjectural, subject only to intuitive judgment. Although sophisticated methods of operations research, decision theory, system analysis are used widely in other disciplines, communication scholars rarely adopt advanced techniques in exploring policy-making processes.

One analytical approach to development of telecommunication policy studies can be found in a new scheme called the "Socio-Technical Assessment Model." This Model, which has been developed over the past decade by the Group for the Analysis and Assessment of Technology at Michigan State University, attempts to provide a systematic procedure to aid the formulation of policies concerned with technological matters. In this Model, the criterion for measuring the desirability of a given technological choice is identified as the potential contribution of the technological choice to enhancing the overall quality of life of the society. Systematic identification of human goals serves as the basis of analysis. Some aspects of the Model would require refinement as will be guided by empirical results. Nevertheless, the application of the Model promises to bring valuable insights in development of telecommunication policy studies.

## Purpose of the Study

The present study is an application of a methodological scheme "Socio-Technical Assessment Model" to telecommunication policy planning in the developing countries. A rural village in South Korea is selected as representative of rural areas in the developing countries. The objectives of the study are three-fold:

(1) By exploring potentialities of various telecommunication technologies for enhancing the quality of life of the rural populace, the study aims to aid the policy-makers of the developing countries in allocating public resources into the telecommunication sector;

(2) By introducing a quantification scheme in which reactions among the key decision variables are determined and balanced to find optimal policy alternatives, the study aims at expanding the traditional boundary of telecommunication policy studies;

(3) By applying the Model to a real-world setting, the study hopes to test the validity and usefulness of the Model.

Establishment of rational telecommunication policies seems to be one of the most crucial areas of concern for the developing countries. A well-planned telecommunication infrastructure can make a substantial contribution to achieving development goals by substituting some forms of travel and by stimulating information-generating and -processing activities among the rural populations. Yet, at the same time, telecommunication technologies can be a powerful force in destroying indigenous culture and regimenting the masses. To find optimal policy decisions, the threats as well as the promises of telecommunication should be estimated, weighed, and planned for. The ultimate purpose of the present study is precisely to meet that end--to suggest a new perspective in planning public-resource allocation in the capital-scarce developing countries by indicating the possible effects of specific telecommunication technologies.

## Assumptions and Research Questions

A detailed explanation of the theoretical and methodological assumptions of the Socio-Technical Assessment Model will be given later. Some important assumptions of the Model are:

(1) The quality of life in a given society is determined by the extent to which a set of basic human needs are provided for;

(2) The extent to which a set of basic human needs are provided for is to be measured by the degree of fulfillment of human goals;

(3) Potential impacts of any technological undertaking are quantifiable in terms of their contribution to the overall quality of life in a given society; and

(4) A realistic impact assessment of any technological undertaking is to incorporate values held by potential beneficiaries, the decision-makers of a given society, and by the experts in the relevant field.

The research questions to be examined in the present study are divided into two groups: those required in testing the validity of the Socio-Technical Assessment Model, and those required in the operation procedure of the Socio-Technical Assessment Model.

### Testing Validity of the Model

The validity of the Socio-Technical Assessment Model will be tested by focusing on two areas: the quality-of-life scheme proposed in the Model, and the relationship between telecommunication technologies and the quality of life of the village populations.

The quality-of-life scheme, as applied to the present study, comprises the 16 basic needs and the four human goals. The basic needs include: Nourishment, Shelter, Clothing, Health, Physical Security, Unpolluted Air-Water-Soil, Pleasant Living Conditions, Public Safety, Opportunity for Education, Opportunity for Profession, Political Freedom, Entertainment and Culture, Judicial Justice, Social Justice, Economic Justice, and Communal Solidarity. The human goals include: "Individual-Material Goal," "Group-Material Goal," "Individual-Spiritual Goal," and "Group-Spiritual Goal."

The research questions to be addressed in testing the validity of the quality-of-life scheme of the Model are:

<u>Question 1</u>: Do the 16 basic human needs and the overall satisfaction level constitute reliable and valid criteria in determining the current quality of life of the village populations?

<u>Question 2</u>: Do the basic human needs present clearly distinguishable patterns that can be identified as "Individual-Material," "Group-Material," "Individual-Spiritual," and "Group-Spiritual" goals?

<u>Question 3</u>: Is the overall satisfaction level of the village population ascertainable in terms of the degrees of fulfillment of "Individual-Material," "Group-Material," "Individual-Spiritual," and "Group-Spiritual" goals?

In examining the relationship between the quality of life of the village populations and telecommunication technologies, a total of ten telecommunication modes will be considered. They are: Postal Service, Telegraph, Telephone, Audio-Cassette, Loudspeaker, Theatrical Film, Radio, Television, Newspaper, and Magazine. The research questions to be addressed in assessing the effects of the telecommunication modes are:

<u>Question 4</u>: Does <u>access</u> to the telecommunication modes have significant effects on the overall satisfaction of the village populations?

<u>Question 5:</u> Does <u>frequency of usage</u> for the telecommunication modes have significant effects on the overall satisfaction level of the village populations?

Operation of the Model

Since time and resources do not permit a full operation of the Model, the present study confines its scope of analysis to those basic human needs that are generally believed to be the most urgent ones in the developing countries. Specifically, the basic human needs to be investigated in this study are: Nourishment, Shelter, Clothing, and Health. The operation procedure of the Socio-Technical Assessment Model consists of four phases. The research questions to be examined are:

Phase I: What is the degree of association of the basic human needs under investigation with each of the "Individual-Material Goal," "Group-Material Goal," "Individual-Spiritual Goal," and "Group-Spiritual Goal?"

Phase II: How much can the basic human needs under investigation contribute to enhancing the overall quality of life of the village population?

Phase III: How effective are the telecommunication modes in facilitating the provision for the basic human needs under investigation?

Phase IV: What are the net contributing rates of the telecommunication modes to enhancing the overall quality of life of the village population, from the provision for the basic human needs under investigation?

The final outcomes of the Model operation which will designate the desirability of each telecommunication mode under consideration in the village society will serve as effective guidelines in planning allocation of public resources.

## Definition of Terms

In the present study, the developing countries are loosely defined as the nation-states in which provision of the basic human needs--material as well as spiritual is severely limited. A more precise description can be found in chapter 2 of McHale and McHale (1978). Telecommunication is defined as transmission of information across distances beyond the range of sensory stimuli.* Information is defined as a selection from a set of possible messages (Shannon, 1963, p. 3). Technology is here defined as the set of implements and practices by means of which a society copes with its material environment. Pulbic policy is defined as the set of measures undertaken or forgone by means of whcih a polity attempts to meet the needs and wishes of its collective membership.

## Structure of the Study

Chapter 1 presents the problem statement, the purpose of the study, and the research questions to be explored in the present study. Chapter 2 contains a review of literature relevant to the present study. Chapter 3 gives the theoretical and mathematical assumptions of the Socio-Technical Assessment Model, as well as the operationalization of the Model. Detailed accounts on the data-collection process are given in Chapter 4. The results obtained from testing the validity of the Model are presented in Chapter 5. Chapter 6 describes the procedure involved in the operation of the Model. The policy implications of the findings obtained from the application of the Socio-Technical Assessment Model, and suggestions for future research, are addressed in Chapter 7.

*Footnote: Ordinarily, telecommunication is restricted to a very short transmission of time and, therefore, implies electromagnetic signaling.

## Overview

The present study applies a new policy analysis tool called Socio-Technical Assessment Model to explore the potentialities of telecommunication technologies for enhancing the quality of life of the village populations in South Korea. By illustrating the roles that telecommunication technologies are likely to play, the study hopes to shed new insights in telecommunication policy research. The complex process involved in adoption of technologies will be systematically treated in an attempt to produce numerical properties that specify the desirability of specific technologies. The Model attempts to combine the analytic frameworks emphasized in engineering, with the critical perspectives on societal actions as found in the social sciences. The study hopes to contribute not only to telecommunication policy studies, but also to other disciplines that show growing concern in the technology-society relationship.

## CHAPTER II

## LITERATURE REVIEW

A review of the literature is divided into the four major categories: theory of development; quality-of-life indexes; telecommunication and development; and technology assessment. The first section examines the shift of emphasis in the theory of development in the disciplines of economics, socio-psychology, and political science. The second section introduces attempts to establish quality-of-life indexes in terms of satisfaction of basic human needs. The implications of telecommunication for the development process are discussed in the third section. The fourth section explores the historical development as well as the state-of-art of the technology-assessment movement. The notion of appropriate technology is incorporated. This chapter concludes with an overview that addresses the applicability of technology-assessment schemes to telecommunication planning for the developing countries.

### Theory of Development

When a number of excolonial states entered international politics after World War II, the concept of "development" gained instant popularity. The prevailing attitude was that development can be easily achieved by rational planning and external assistance. Although the concept had been interpreted in slight different fashion in each discipline, there was a general belief that "development-modernization" is a continuing process involving a series of developmental stages that all nations must undergo in a similar manner. Typical attributes of a modern society were known to be high industrialization, high role differentiation, and high social mobility. The "backward societies" were characterized by an agricultural-based economy, low role differentiation, and perseverance of traditional values.

Since the late 1960's, when the failure of massive development efforts came into focus, the old development model has been sharply challenged. The shift of paradigm in the theory of development will be examined in three major disciplines: economics, socio-psychology, and political science.

## Economics

Perhaps the most widely-known theoretical generalization of the development process is the stage economic-development theory of Rostow (1960). He hypothesized that economic growth proceeds in five distinguishable stages: traditional society, preconditions for take-off, the take-off, drive to maturity, and mass consumption. Assuming that economic evolution in the United States would be an appropriate model for the developing countries, Rostow emphasized the significance of a "take-off" that leads to high consumer-goods production--the prime indicator of a developed society. Equally important as a development economic theory is the technical-innovation theory of Prebisch (1964). He proposed a sophisticated industrial model that possesses a high consumer orientation. The implication of Prebisch's model is that the capital-intensive model that had worked well for Western Europe would be equally effective for the developing countries. The economic theories that emphasize external assistance, technical innovation, and rapid industrialization had widely been accepted in both academia and international organizations.

At the other extreme, some economists pointed out the weaknesses of development model based on Western economic rationality. Warning of a danger of generalizing experience in development, Ward (1965) contended that the economies of developing countries cannot expand according to the classical model of a competitive market. Frank (1966) argued that underdeveloped conditions in the developing countries are the consequences of interference on the part of the industrialized nations. An increasing control of multinational corporations was articulated by Barnet and Muller (1974). Collectively known as the "dependency" theorists, these economists insist that persistent poverty in the developing countries cannot be resolved unless fundamental changes in international political-economic relations occur.

By the late 1960's, there was a growing awareness that the living conditions of the poor had not improved despite the efforts to "take-off" and "industrialize." The theories of neither Rostow nor Prebisch could be sustained by the evidence. Furthermore, consumer-oriented development planning has been blamed for creating high demands for consumption before it yielded the motivation for production. In the midst of the movement toward the "New International Economic Order" in which the developing countries demand a fairer share of international trade, a need to establish a new perspective on development was acutely felt (Harlan Cleveland, quoted in McHale & McHale, 1978, p. 5-6).

Increasing numbers of economists came to acknowledge that economic development may not be possible without political stability and other institutional support. The qualitative aspects of human life were brought into focus. An important work along this line of thinking is that of Ademan and Morris (1973). Introducing a concept of "equity" in the development concept, they found complex interaction effects among social, political, economic, and cultural variables. They also pointed out that the beneficiaries of economic development tend to be the economically well-off sectors, particularly in the lowest-income countries. Stressing the significance of a holistic approach rather than piece meal planning, Myrdal (1970, p. 21) claimed that "what a nation-state needs...is precisely a macro-plan for inducing changes simultaneously in a great number of conditions, not only in economics." Haq (1976, pp. 27-47) summarized the key elements of new perspective on development as follows:

--A direct attack on mass poverty, rather than fostering increases in the Gross National Product;

--Pursuit of the satisfaction of basic human needs rather than satisfaction of market demands; and

--A radical change in the direction of investment toward the poorest sectors of a society.

Although no existing economic model provides a complete answer for the complex development processes, a large number of economists acknowledge that development should be aimed at enhancing the quality of life, not merely increasing the Gross National Product (GNP) level.

Socio-Psychology

Most of the socio-psychologists examining the development process assumed that social change requires the adoption of new normative standards. The pioneering work in explaining the development process on the basis of attitudinal variables was conducted by Lerner (1958).

The key concept in his modernization theory is "empathy," which can be defined as "psychic mobility" or "the ability to project oneself into the role of another." He hypothesized that personality structures in traditional society are held inert and confined, hence the transition from a "traditional-being" to a "modern-being" can be achieved only by giving an individual "a high capacity for identification with new aspects of his environment." Lerner saw that exposure to the mass media can stimulate higher literacy, which in turn will lead to urban growth and political participation. A similar argument was advanced by Schramm, whose much-acclaimed book "Mass Media and National Development" (1964) laid the cornerstone in the development communication researches. Other scholars who postulate positive effects of mass media in modernization are Inkeles and Smith (1966, 1974), Rogers (1963), Pool (1963), Pye (1963) and Kahl (1968).

Just as in the economics theory, the new socio-psychological perspectives toward the development processes arrived in the 1970's. Forcefully denying the assumption that the mass media stimulate development activity, Schiller (1975-1976) claimed that exposure to them has created a phenomenon of admiring materially-abundant Western societies and denigrating traditional values and norms. Golding (1974, 1977) argued that entertainment-dominated mass-media fare tends to divert political dissidence while perpetuating cultural dependency of the ex-colonial states on the industrialized nations. Singh (1977) suggested that the mass media in poor countries serve mainly the entertainment and economic needs of the urban elite class; hence the rural populations are the least likely beneficiaries of the mass-media systems. Katz and Wedell (1977) attributed the failure of the mass media, particularly the broadcasting media, in the poor countries to the lack of comprehensive communication policies relevant within socio-cultural context of each country.

The objectives of development viewed from a new socio-psychological perspective are succinctly addressed by Inayatullah and by Goulet. Challenging the Western concept of development, Inayatullah (1976) defined the goal of development as: control over nature, realization of national destiny, and expansion of individual opportunities. To him, no goal has absolute priority, and the ultimate goal of development is to maintain balance among the three major goals. Goulet claimed that development planning that destroys traditional values in the developing societies would have far-reaching negative impacts. The aim of development is, in Goulet's terms, to achieve "survival" as a minimal goal while striving for higher goals such as "satisfaction of self-esteem" and "fulfillment of freedom."

## Political Science

In earlier days, many political scientists manifested their deep-rooted prejudice in rationalizing the process of transforming the "backward" societies into "democratic" ones. Almond (1960, p. 64) contended that "the model of political modernization can only be derived from analysis of modern Western societies." Bendix (1970, p.3) defined modernization as "the type of social change since the 18th century consisting in the economic and political advances of some pioneering societies and subsequent changes in follower societies" (emphasis supplied). Riggs (1960, p. 61) also saw modernization as "the process of emulating the characteristics of another superior culture" (emphasis supplied).

Transplantation of Western-style democracies into the developing countries, unfortunately, was largely unsuccessful. The Tanzanian President Julius Nyere (1972) argued that the classical form of Western democracy is not adequate for the radically different socio-political conditions prevailing in the developing countries. Advocating "African socialism," Nyere believed that the one-party system is a "truer expression" of democracy for the developing countries than is the multi-party competitive system. Kautsky (1972) criticized the conventional notion of determining the level of democracy based on voting measures. Noting the increasing conflicts between the newly-emerged ruling classes and the peasant group, Kautsky cautioned that peasants may vote, not because they want to, but because they are afraid to show objection to the ruling classes.

In sum, in various theoretical disciplines, the primary objective of development is viewed as the meeting of diverse basic human needs. A summary of the new perspective can be found in so-called "Cocoyac Declaration," a document prepared by development specialists in the United Nations (1974). It stated that:

> "Our first concern is to redefine the whole purpose of development. This should not be to develop <u>things</u> but to develop <u>man</u>. Human beings have basic needs: food, shelter, clothing, health, education. Any process of growth that disrupts them is a travesty of the idea of development...Development should not be limited to satisfaction of the basic needs. It includes freedom of expression and impression, the right to give and to receive ideas and stimulus. There is a deep social need to participate in shaping the basis of one's own existence, and to make some contribution to the fashioning of the world's future..." (p.91).

## Quality-of-Life Indexes

Corresponding to the new development perspective in which satisfaction of basic human needs is the focal point, the concept of quality of life became a widely pursued area of research. Although the concept of quality of life did not receive high visibility until the mid 1970's, some basic criteria for evaluating the standard of living had been set forth in the early 1950's. In a report entitled "International Definition of Standards and Levels of Living," the United Nations adopted 12 criteria in characterizing the quality of life: Health, Food and Nutrition, Education, Condition of Work, Employment Situation, Aggregate Consumptions and Savings, Transportation, Housing, Clothing, Recreation and Entertainment, Social Security, and Human Freedom (UN, 1954).

For the past decade, the United Nations has produced a series of reports on socio-economic indicators, most of which are not radically different from those in its 1954 report. Typically, the dimensions included in the socio-economic indicators are: population, health and nutrition, housing and environment, education and culture, employment, social welfare and security, and income and consumption of wealth (Rao, 1975). The Organization and Economic Cooperation and Development (OECD) published a similar report on measurement of the level of well-being (OECD, 1973; Christian, 1974). The principal criteria adopted by the OECD are: health, individual development through learning, employment and quality of working life, command over goods and services, physical environment, personal safety, and social opportunity and participation.

In addition to material aspects of human life, attempts were made to incorporate the individual-psychological feelings in the quality-of-life concept. Proponents of individual-psychological approach include Dalkey (1972), Mitchell et al. (1971), and Campbell and Converse (1972). Dalkey (1972, p. 58) defined the quality of life as "a person's well-being, his satisfaction or dissatisfaction with life, or his happiness or unhappiness." Mitchell et al. (1971) identified a quality-of-life criterion based on needs, values, and beliefs of individuals. Campbell and Converse (1972) argued that the quality-of-life is largely determined by the quality of personal experience. According to their scheme, the highest state of the quality of life is characterized by the "full life"--a state in which individuals are gratified in all their basic needs, satisfying the demands for love and sense of security, feeling of worth and self-respect.

One of the most important works in quality-of-life research incorporating the notion of the basic human needs was advanced by McHale and McHale (1978). Their basic human needs scheme has four interrelated dimensions: biophysical and psychological needs in one direction; internal metabolic processes and external metabolic processes along the other. The biophysical needs include food, water, shelter, health, heating (and cooling), light, and clothing. The psychological needs consist of communication, education, transportation, security of various kinds, recreation, and social mobility. Adopting Maslow's notion of hierarchy of human needs (1968), McHale and McHale classified the human needs into three categories: the first-floor deficiency needs that must be met to maintain survival; the second-floor sufficiency needs that are required to maintain living standards at some desirable level; and the third-floor growth needs that allow individual development above material sufficiency. The contribution of McHale and McHale to identification of the basic human needs is a noteworthy advance over earlier attempts, yet their scheme suffers from two serious flaws: the categorization of the basic human needs is too loose and overlapping to be operationally useful; and the postulation of an absolute hierarchy in the basic human needs is highly questionable.

The efforts to establish quality-of-life indexes parallel the new perspective on development. Review of the existing literature suggests, however, that most of the indexes lack sufficient validity and reliability to provide a realistic scheme for the policy-makers. Ayres (1972) proposed classification criteria for quality-of-life indexes. The four principal criteria that he suggested are:

--The classification should be unambiguous (i.e., have no overlap of categories);

--All possible cases should be covered (i.e., there should be no gaps);

--The number of classes should be small enough to manipulate but large enough to permit adequate detail; and

--Any entity should be homogeneous within a class but should be differentiated from entities in other categories.

In conclusion, it appears that if the quality-of-life indexes are to constitute useful guidelines for planning public resource allocation, they should meet at least the criteria of the type set forth by Ayres.

## Telecommunication and Development

As reviewed earlier, a multiplicity of studies that explore the role of information in the development process have focused on the effects of the mass media. The implications of point-to-point telecommunication services, such as telephone, telegraph, and postal service, have largely been neglected in the development-communication research until quite recently. The studies which advocate the role of telecommunication, particularly that of point-to-point telecommunication, can be largely grouped into two categories: economic analysis focused on correlation measures between telecommunication penetration ratio and the Gross Domestic Product (GDP) or the GNP (Saunders & Warford, 1979; Shapiro, 1976); and socio-benefit analysis that examines the efficiencies of telecommunication in delivering health and educational services (Hudson and Parker, 1975; Goldschmidt, 1978). The recent work of Pool et al. (1981), which was based on sample surveys on Egyptian villages, presents the potential benefits of telephone systems as a substitute for travel. Unfortunately, the aforementioned studies do <u>not</u> provide an analytic frame within which a society's overall demands for various kinds of information can be estimated.

With regard to estimating information needs in society, two recent studies merit some attention. Clippinger (1980) suggests four different methods of estimating information needs: comprehensive-needs assessment and country profile, sectoral-needs assessment, program-needs assessment, and project-needs assessment. Although Clippinger's work offers a plausible scheme to measure the information needs, it may lack practicality, especially when telecommunication technologies are viewed as tools to satisfy the basic human needs. Vinogradov et al. (1981) provide a much more operationally-oriented scheme. They classify information needs in three major categories:

individual needs, societal needs, and economic needs. The individual information needs are often selective and subjective, dependent as they are on the economic and social interests of a society. Collective information needs do not exist independently of the individual needs, yet they can be defined in terms of social and economic goals of a society. Economic-information needs pertain to economic productivity, scientific advancement, and international information exchange. At each level, information needs are influenced by both material and spiritual factors, with material elements dominating. The work of Vinogradov et al. can serve as basis of analyzing information needs of any given society regardless of its development level.

Those who claim that telecommunication will induce socio-economic development generally agree that there is an urgent need to establish a new conceptual and methodological model. Wellenius (1972) claims that estimating the demands for telecommunication cannot be left solely to consideration of the forces of the market. Rather, he sees that the single most important measure in allocating public resources into the telecommunication sector is the foreseeable impacts of technological elements upon the people in a given society. Chasia (1976) contends that desirable telecommunication technologies appropriate for rural development must have certain attributes such as cost effectiveness, low power consumption, low maintenance requirement, high reliability, and high flexibility. Hudson (1982) states that telecommunication infrastructure may be as important as any other infrastructure in reducing the urban-rural and rich-poor dichotomies that prevail in the developing countries. She fails, however, to present a concrete frame for estimating the information needs of the rural populations.

Despite the continuous efforts of these researchers, we have not witnessed practical guidelines on which developing countries can rely when they want to expand their telecommunication sectors. The problem of differentiating "telecommunication" from "mass media" is still widespread, so that an integrative approach that encompasses all telecommunication technologies has not been established. In the absence of a systematic framework, the criteria for evaluating technological alternatives at a given resource level remain ambiguous. If telecommunication is to perform as an active element in accelerating development process, it seems imperative to adopt a macroscopic view in which demands for telecommunication technologies can be assessed in the relevant socio-economic-political context of a given society. The choice of a particular telecommunication technology will affect not only quantitative dimensions of information flow, but also the quality and the nature of that flow. The most important question in determining the demands for telecommunication technologies will then be how much the members of a given society can benefit from adopting particular technologies. The following section examines attempts to establish criteria for evaluating the desirability of a given technological choice in society.

## Technology Assessment

Technology has long been believed to offer an assured way to the better life. Massive utilization of technology has brought unprecedented material abundance to the Western industrialized nations. Yet, technology has also produced a number of undesirable consequences. In the early 1960's when the erosive effects of technology on human life were increasingly noted, the United States Congress initiated a series of studies of critical policy issues concerning science and technology. The opening of the report prepared by the National Academy of Sciences (1969) epitomizes the concern in technology applications. The report stated that:

> "In recent years concern has mounted over society's seeming inability to channel technological developments in directions that sufficiently respect the broad range of human needs."

The attempts to meet the challenge of better guidance of society with respect to technology applications have developed along the two major lines: one, Technology Assessment led by physical scientists and engineers; two, Social Impact Assessment led by social scientists. In both cases, the aim is to assess the likely consequences of proposed technological undertakings on society. Since Social Impact Assessment is peripheral to the present study, interested readers are merely referred to accounts by Finsterbush & Wolf (1977), Dickens & Hill (1978), Daneke & Priscoli (1979), Finsterbush (1980), and Leistritz & Murdock (1981).

Technology assessment attempts to maintain a balanced view between the two extreme viewpoints on technology: a utopian one that views technology as a panacea for liberating man from poverty and despair (Mesthenes, 1969); and an apocalyptic one that perceives technology as a force inherently destructive to maintaining a sound social and physical environment (Nader, 1972; Reich, 1971; Meadows et al., 1972). V. Coates (1972, ix) defines technology assessment as "the systematic identification, analysis and evaluation of the full range of social impacts, both beneficial and detrimental, which may result from the introduction of a new technology, or [from] changes in the application and utilization of existing technology." Susskind (1973, p. 127) advanced a simpler definition: "technology assessment is the evaluation of adverse as well as beneficial effects of technological innovation." Acknowledging harmful as well as beneficial effects of technology, technology assessment hopes to provide the decision makers with a working tool with which technological development can be stimulated, directed, and if necessary restrained. Implicit in the approach is that planning of specific technological choice is relevant to the general welfare.

Efforts to arouse concern in legislative circles of the U.S. Congress over relentless use of technology resulted in the passage of the Technology Assessment Act (1972). The Office of Technology Assessment (OTA) was formally established as a Congressional service responsible to Congress for identifying probable impacts of technological applications. Since its inception, OTA has sponsored a number of projects of presumed high significance in public-policy formulation and modification. In the meantime, a great number of studies that sporadically apply sophisticated techniques such as operational research, systems analysis, or decision theory, have been published (Cetron & Bartocha, 1973; Duckstein et al., 1977; Philips & DeFilippi, 1976; Rubinstein & Horn, 1978). Yet the current state-of-art of technology assessment does not seem to differ drastically from that of the early 1970's: the conceptual and methodological problems embedded in technology assessment remain largely unsolved.

Unfinished tasks of technology assessment can be grouped into two areas. First, there is a lack of a mechanism by which the desirability of a given technological choice can be assessed. Despite enthusiastic claims about measuring "the net benefit of society as a whole," the criteria for evaluating "goodness" of a given technological choice tend to be predominantly technical rather than social (Skolimowski, 1976). Bell (1981, p. 264) states that "the source of our predicament [in technological development] is not the imperatives of technology, but a lack of mechanism for choosing the kinds of technology and social support patterns we want." Kash (1982, p. 9) summarized the massive failings of technology-assessment movement as "(technology) impact research has done a good bit to identify the inadequacy of intellectual frameworks while not offering any significant conceptual and intellectual alternative."

Secondly, conventional technology assessment has not been successful in linking itself to technology forecasting. Huddle (1972) emphasized that technology assessment cannot be complete unless it suggests where emerging technological developments or long-range technological trends might lead. Traditionally, technology forecasting is divided into two categories: <u>mission-oriented</u> (or <u>normative</u>) forecasting, and <u>opportunity-oriented</u> (or <u>exploratory</u>) forecasting (Jantsch, 1966). Normative forecasting employs demand-pull methods to assess what technological innovations are required to achieve a specific mission. It starts with a normative statement of what ought to be, and guides technological development in the direction of achieving the predetermined norms. Exploratory forecasting, on the other hand, attempts to find applications for technological devices by changing previously-held norms and values. Exploratory forecasters view technology as subject to an internal law of development. The current state-of-art of technology assessment is far from absorbing either normative forecasting or exploratory forecasting.

The potentialities of assessment schemes for aiding the public-policy making may indeed be abundant. As the effects of technology become more pervasive and far-reaching, a practical and realistic assessment scheme can make a significant contribution to guiding the advancement of human civilization. The need for an effective assessment scheme may be more crucial for the developing countries than for the industrialized nations. The materially well-off industrialized countries may be able to afford an occasional blunder in trying out a new technology. The developing countries, which suffer from capital-scarcity and population explosion, must rely on technological forces to solve the wide-spread starvation and disease. With a well-grounded assessment scheme, the developing countries may find optimum solutions in resource-allocation plans without destroying their own traditional value systems.

## Appropriate Technology and Technology Assessment

The notion of appropriate technology is in a sense similar to that of technology assessment, in that pursuit of technological development has to coincide with the specific goals and technological-economic capacities of a given society. Proponents of appropriate technology (e.g., Schumacher, 1975) argue that capital-intensive advanced technologies developed in the industrialized nations are not only inadequate for the prevailing situations in the developing countries, but they are likely to intensify the technological dependence of the developing countries on the industrialized ones. According to the appropriate technologists, technologies suitable for the developing countries should be labor-intensive, inexpensive, unsophisticated, small-scale, and locally available. Yet, pursuing only small-scale inexpensive technologies without considering the long-term effects can be as dangerous as adopting advanced technology in full scale. Depending upon a society's resource level and the specific tasks that technology is to perform, advanced technologies can sometimes be more cost-beneficial. Without rational guidelines for exploiting technological forces, the developing countries might have to prolong their technological dependence upon the technologically advanced countries. What, then, constitute the criteria for evaluating "appropriateness" of their technological choices? Noting the difficulty of finding desirable technological strategies for the developing countries, Eckhaus (1977, p. 20) noted that "it is extremely difficult to obtain those quantitative measurements of the characteristics [of technology] that are necessary to determine the economic and social implications of specific methods." The present study attempts, in part, to answer Eckhaus' question.

## Overview

The review of the literature included in this chapter suggests that the basic-human-needs approach constitutes a legitimate and sound basis for studying development processes. The problem relating to telecommunication policy planning stems mainly from a lack of a proper frame for evaluating the information needs of a society in parallel with the capacities of information technologies. Efforts to assess the past and foreseeable impacts of technological actions have led to the technology-assessment movement. Yet technology assessment has not received wide acceptance because of the lack of a mechanism to measure the social benefits of a given technological choice. The notion of appropriate technology appeals to the moral responsibility of researchers, but its main thrust is too simplistic to provide rational guidelines for the public-policy makers.

Hope for establishing a sensible and workable assessment scheme can perhaps be found in a political philosophy that treats technological development as a part of progress in meeting the human goals. Telecommunication policy planning for the developing countries can benefit substantially from an assessment scheme in which the increment of the quality of life functions as the key decision variable. With a well-founded assessment model, the optimal allocation of public resources in a given society can be estimated satisfactorily.

Partly supported by the researches cited above, and partly out of the belief that the notion of technology assessment can be applicable to the developing countries, the present study applies the Socio-Technical Assessment Model in investigating telecommunication policy planning for the developing countries. Chapter 3 describes the theoretical as well as mathematical assumptions of the Model, and the operationalization of the Model as applied in the present study.

## CHAPTER III

## THE SOCIO-TECHNICAL ASSESSMENT MODEL

This chapter presents a general description and the operationalization of the Socio-Technical Assessment Model. The first part of this chapter explains the philosophical background and some important working assumptions of the Model. The second part of this chapter gives a detailed account of the operationalization of the Model.

### General Description of the Model

As reviewed in Chapter II, since the late 1960's numerous reports have been published under the rubric of technology assessment and social-impact assessment. Despite the initial promises, neither of those activities seems to have had major impact in formulating practical guidelines to aid the decision-making. The evaluation criteria proposed by technology assessors tend to be predominatly technical. The social-impact analysts have made conjectures about quality-of-life indexes, yet there seems to be little regard for just how adequately those indexes are addressed. Often they are too ambiguous and overlapping to ensure reliability and validity in operationalization. The reasons for the growing skepticism converge on one factor: there is a nearly complete lack of attention to the significance of formulating a criterion that will tell in what sense a given strategy for technology application is better than, as good as, or worse than another one.

The most important feature of the Socio-Technical Assessment Model employed in the present study is that it offers a realistic

criterion for assessing social impacts of technology (Montgomery, 1980). The criterion of the Model is formally stated as: Maximize a well-being index that incorporates the totality of human goals. Based on the idea that the validity of an impact-assessment scheme rests on successful identification of the full range of human goals, the well-being index of the Model encompasses aspects of human needs that may be overlooked, yet are significant in defining a "good life." Under the condition that the human goals should be few enough to allow practical application, and numerous enough to admit a realistic account of human behavior, the Model proposes a two-by-two human-goal-classification scheme.

The scheme of human goals illustrated in Figure 1 comprises "Individual" and "Group" goals in one dimension, and "Material" and "Spiritual" goals in the other. The division of human goals into "Individual" and "Group" categories reflects the evolutionary requirement that man be selfish enough to ensure his own survival until at least reproductive age, but altruistic enough to ensure the survival of the human species. The division of "Material" and "Spiritual" goals reflects the psychological-cultural requirements that man lives by bread, but not by bread alone. Here, the P, E, F, J serve as respective cognates for each of the four human goals: P for the Provision of material goods for individual survival to meet the Individual-Material needs; E for the preservation and protection of the quality of material Environment to meet the Group-Material needs; F for the Freedom and self-Fulfillment opportunities to meet the Individual-Spiritual needs; and J for the Justice in retributive and distributive process, in order to meet the Group-Spiritual needs.

Figure 1

Categorization of Human Goals

| | Individual (Personal) | Group (Societal) |
|---|---|---|
| Material (Physical) | P<br>Provision for Physiological Needs and Desires: Nourishment, Shelter, Clothing, Health Services, Reproduction and Sex, Physical Security, etc. | E<br>Presence of Healthful Physical Environment: Clean Air, Clean Water, Uncontaminated Soil, Low Noise and Vibration, Safety against Burglary and Fire, Safe Level of Radiation, etc. |
| Psychological (Spiritual) | F<br>Opportunity for Spiritual and Aesthetic Fulfillment: Opportunity for Education, Occupation, Residence, Freedom of Expression, Political Liberty, Recreation and Entertainment, etc. | J<br>Presence of a Sound Social Environment: Retributive Justice of Equal Treatment under the Law, Distributive Justice for Equal Sharing of Wealth, Promotion of Social Solidarity, etc. |

The entries in each category are representative of the human needs which are especially strong in satisfying the particular goal, but which also make some contribution in satisfying other goals.

The operationalizing guideline for the criterion of the Model is set forth in a generalized utilitarian principle of "choose an action which promises the greatest good to the greatest number of people, under the constraints of limited resources and disparate interests." A full explanation of the Model is beyond the scope of the present study. Hence, discussion of the Model will be confined to the definition and the working assumptions of the constructs relevant to the present study.

1) The Good. The good, that is, the quality of life of a given society, is characterized by the degree of fulfillment of the P, E, F, J human goals. The P, E, F, J goals are called canonical human goals. They form exhaustive and mutually exclusive variables that span a hyperdimensional space. The quantification process of the quality-of-life index is derived from the mathematical assumptions of the Model. The first assumption is that the canonical human goals P, E, F, J can be quantified not only individually, but also in terms of a common measure. The second assumption is that there exists at any time $t$, an overall satisfaction index $S$ which is a function of P, E, F and J. The degrees of fulfillment for each canonical human goal are represented as $S_P$, $S_E$, $S_F$, $S_J$, which are labeled as the partial satisfaction indexes. In mathematical terms, the overall satisfaction index $S$ will be approximated as a linear superposition of weighted partial

satisfaction indexes $S_P$, $S_E$, $S_F$, $S_J$. The relationship between $\underline{S}$ and $S_P$, $S_E$, $S_F$, $S_J$ is represented as:

$\underline{S}(P, E, F, J) = \alpha_P S_P + \alpha_E S_E + \alpha_F S_F + \alpha_J S_J$, in which the $\alpha$'s are weights of each canonical human goal relative to $\underline{S}$.

2) The Number of People. The "people" in a given society have to be aggregated into a workable set of "societal sectors," within each of which the individuals share enough interests to be treated as identical in the relevant context. Like the number of canonical human goals, the number of societal sectors must be small enough to be manageable, large enough to afford a realistic description of the diversity of human roles. The classification of societal sectors again has to be exhaustive and mutually exclusive.

3) Constraint of Resources. The "resources" are defined as the materials and attributes of the physical, institutional, and technological environment that are useful in achieving the human goals. The "constraint" of the resources reflects the concept that at any given time $\underline{t}$, the resources $\underline{R}$ are finite. In practice, the exploitation and utilization of the resources obey a supply-demand schedule.

4) Disparate Interests. The "disparate interests" recognize that the differences in the value systems of the decision-makers will result in different views of the importance of the several human goals and of various societal sectors. The differences of the decision-makers' value systems arise from varied tastes, talents, personal experiences, and public roles.

With this background, the following section describes the operationalization process of the Socio-Technical Assessment Model.

## Operationalization of the Model

A great deal of impact-assessment schemes borrow the frame of reference from operations research, systems analysis, decision analysis, and cost-benefit analysis, all of which adopt mathematical modeling to find optimum solutions. The steps commonly included in operations research are: formulation and definition of problem, construction of the model, solution of the model, validation of the model, and implementation of the results (Moscowitz & Wright, 1979, p.18).

The operationalization process of the Socio-Technical Assessment Model modifies the conventional methods of operations research. The framework of analysis of the Model consists of the five major steps:

1. Definition of Objectives
2. Delineation of the Scope of Assessment
3. Construction of the Model
4. Validation of the Model
5. Operation of the Model

### 1. Definition of Objectives

The objective of the Socio-Technical Assessment Model is to estimate potential impacts of proposed technological undertakings upon the quality of life of the rural populace in a developing country in order to provide rational guidelines for allocating public resources into the proposed undertakings.

2. <u>Delineation of the Scope of Assessment</u>

The scope of the Socio-Technical Assessment Model is composed of seven parts: representative sample site, potential beneficiaries, technology under assessment, general areas of application, direct areas of application, interested parties to be included in the decision-making, and time frame.

A. <u>Representative Sample Site</u>: A rural village in South Korea is the choice to represent the rural populace of the developing countries.

B. <u>Potential Beneficiaries</u>: The potential beneficiaries are the villagers of the sampled village. The village population is to be aggregated into the five <u>societal sectors</u> (j=1,2,3,4,5):

1. Professionals (governmental officials, school teachers, high-level managers, etc.)
2. Clerical Workers (low-ranking managers, clerks, etc.)
3. Commercial Sector (big- and small-scale shopkeepers)
4. Non-Agricultural Laborers (construction workers, factory workers)
5. Farmers

C. <u>Technology under Assessment</u>: The technological undertakings to be assessed in the present study are telecommunication technologies of various telecommunication modes, a total of ten modes that are likely to be the major candidates are selected. These are (m=1,2,3,....10):

1. Postal Service
2. Telegraph
3. Telephone
4. Audio-Cassette
5. Loudspeaker (Public Address Systems)
6. Theatrical Film
7. Radio
8. Television
9. Newspaper
10. Magazine

Each telecommunication mode will be evaluated in two dimensions: technical functions that they are to fulfill, and technical characteristics describing each mode. The <u>technical functions</u>* that are to be considered in the study consist of technical characteristics that will be examined in the study consist of ($p=1,2,\ldots.6$):

1. Specific Instruction
2. Marketing Information
3. News, Weather Service
4. Entertainment
5. Opinion Formation
6. Personal Correspondence

The <u>technical characteristics</u> consist of ($q=1,2,\ldots.7$):

1. Promptness
2. Effective Bit Rate
3. Cheapness
4. Reliability
5. Accessibility
6. Storage/Retrieval Capacity
7. Confidentiality

D. <u>General Areas of Application</u>: The proposed telecommunication modes will be used to raise the overall quality of life of the villagers. The <u>overall quality of life</u> is measured by:

$\underline{S}$ (Overall Satisfaction Index).

The overall quality of life is hypothesized to be determined by the extent to which a set of basic human needs are provided for. The <u>basic human needs</u> to be considered are ($v=1,2,3,\ldots..16$):

1. Nourishment
2. Shelter
3. Clothing
4. Health
5. Physical Security
6. Unpolluted Air, Water, Soil
7. Pleasant Living Conditions (low noise level, freedom from fumes, pleasant scenery, etc.)
8. Public Safety (against fire, burglary, criminal acts)
9. Opportunity for Education
10. Opportunity for Profession

*Footnote: technical function is here used in the sense of technical activites that are designed to serve various purposes of communication.

11. Political Freedom
12. Entertainment and Culture
13. Judicial Justice (equal treatment under law)
14. Social Justice (against ethnic, geographic, sexual prejudices)
15. Economic Justice (equitable distribution of wealth)
16. Communal Solidarity (preservation of social fabric, benevolence, hospitality)

The degree of satisfaction for the basic human needs is hypothesized to be reflected in the fulfillment of the canonical human goals. The canonical human goals consist of (i=1,2,3,4):

1. Individual-Material Goal (P)
2. Group-Material Goal (E)
3. Individual-Spiritual Goal (F)
4. Group-Spiritual Goal (J)

Among the basic human needs, some needs are expected to be particularly important in fulfilling one of the canonical human goals: <u>Individual Material Goal</u> (P Goal, i=1) is expected to be most strongly affected by Nourishment (v=1), Shelter (v=2), Clothing (v=3), and Health (v=4); the <u>Group-Material Goal</u> (E Goal, i=2) by Physical Security (v=5), Unpolluted Air, Water, Soil (v=6), Pleasant Living Conditions (v=7), and Public Safety (v=8); the <u>Individual-Spiritual Goal</u> (F Goal, i=3) by Opportunity for Education (v=9), Opportunity for Profession (v=10), Political Freedom (v=11), and Entertainment and Culture (v=12); the <u>Group-Spiritual Goal</u> (J Goal, i=4), by Judicial Justice (v=13), Social Justice (v=14), Economic Justice (v=15), and Communal Solidarity (v=16).

E. <u>Direct Areas of Application</u>: In this study, the scope of analysis will be restricted to the four basic human needs that are generally believed to be the most urgent needs in the

developing countries. The basic human needs under investigation are: Nourishment (v=1), Shelter (v=2), Clothing (v=3), and Health(v=4). Since the Model postulates that each basic human need relates to each of P, E, F, J canonical human goals, each basic human need is resolved into the four components. The components of the four basic human needs under investigation are (h=1,2,3,4):

Nourishment (v=1)

1. Production of enough foodstuffs (P component)
2. Protection against environmental contamination caused by food-production (E component)
3. Provision for a variety of food for individual tastes (F component)
4. Equitable distribution of foodstuffs (J component)

Shelter (v=2)

1. Construction of enough housing units (P component)
2. Protection against degradation of environment caused by housing construction (E component)
3. Provision for electricity, sewerage, heating and cooling systems (F component)
4. Equitable distribution of housing units (J component)

Clothing (v=3)

1. Manufacturing or purchasing enough clothing (P component)
2. Protection against pollution caused by manufacturing of clothes (E component)
3. Provision for a variety of clothing for individual preference (F component)
4. Equitable distribution of clothing (J component)

Health (v=4)

1. Provision for enough basic health-care services (P component)
2. Protection against pollution caused by chemical discharges from hospitals and other sanitary measures (E component)
3. Provision for a variety of health-care measures (F component)
4. Equitable access to the health-care services (J component)

F. Interested Parties to Be Included in the Decision Making: The interest groups whose opinions are to be reflected in the decision making are grouped into two categories: experts and decision makers.

Experts: A group of experts who have special knowledge about various aspects of Nourishment (v=1), Shelter (v=2), Clothing (v=3), and Health (v=4) of the sampled village.

Decision Makers: A group of decision-makers who are directly responsible for the sampled village's budget-planning and other administration activities.

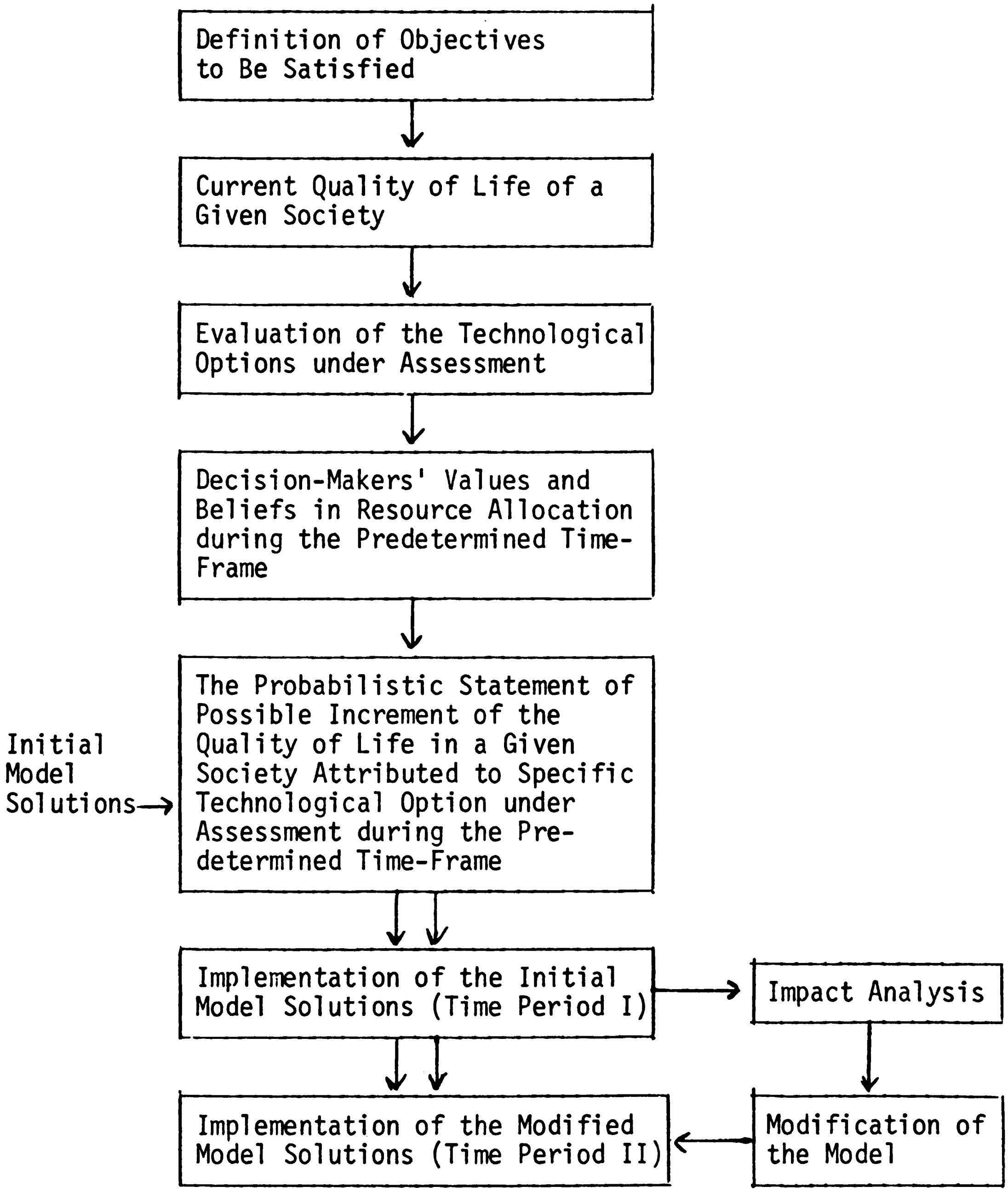
G. Time Frame: The time frame of the Model application is set forth as the next five to ten years.

3. Construction of the Model

The Socio-Technical Assessment Model has been constructed at two different levels: the conceptual level and the measurement level. The conceptual scheme of the Model is given in Figure 2. The conceptual scheme of the Model reflects the time-evolving nature of social changes and technological progress. The conceptual scheme of the Model implies the need for time-series analyses after implementing the results obtained from the initial Model inputs and the Model solutions. The Initial Model Inputs consist of: definition of objectives to be satisfied; current quality of life of the people in a given society; evaluation on the technological options under assessment; and decision-makers' values and beliefs in public resource allocation during the pre-determined time-frame. The Initial Model Solutions are identified as: the probabilistic statement of increment of the quality of life in a given society during the pre-determined time-frame attributed to the specific technological options under assessment.

Figure 2

Conceptual Scheme of the Socio-Technical Assessment Model



The measurement scheme of the Model is illustrated in Figure 3. The measurement scheme of the Model was established to derive the Initial Model Solutions of the conceptual scheme. As shown in Figure 3, the measurement scheme of the Model is divided into the four phases, each of which requires different data bases and mathematical operations.

The objective of Phase I is to determine how much the four basic human needs under investigation--Nourishment, Shelter, Clothing, and Health--relate to each of P, E, F, J canonical human goals in each of the five societal sectors. The degree of association of the four needs will be inferred from the satisfaction level for those needs among the villagers. The degree of association of each need will be tabulated in a 4 x 5 matrix form ($\underline{\underline{R}}_{ij}^{v}$); hence a total of four matrices will be produced for Nourishment ($\underline{\underline{R}}_{ij}^{1}$), Shelter ($\underline{\underline{R}}_{ij}^{2}$), Clothing ($\underline{\underline{R}}_{ij}^{3}$) and Health ($\underline{\underline{R}}_{ij}^{4}$) respectively.

The objective of Phase II is to estimate the extent to which each of Nourishment, Shelter, Clothing, and Health can contribute to enhancing the overall quality of life of the villagers as a whole. At this stage, the prime interest rests on projection of the likely changes in the future. The projection of the likely changes in the future will be made by integrating the decision-makers' values and beliefs in plans for allocating public resources. The decision-makers' value systems will be measured in quantitative terms by identifying their weightings on each of P, E, F, J canonical goals, as well as on each of the five societal sectors. The decision-makers' weightings on the P, E, F, J canonical human goals will be represented in a 1 x 4 matrix form ($\underline{V}_i$), and their weightings on the five societal sectors will be represented in a 5 x 1 matrix form ($\underline{W}_j$). The potential contributing rate of the

Figure 3

Measurement Scheme of the Socio-Technical Assessment Model

Phase I

Extraction of the Degree of Association of the v-th Basic Human Need under Investigation to the Fulfillment of the i-th Canonical Human Goal for the j-th Societal Sector

↓

Phase II

Estimation on the Potential Contributive Rate of the v-th Basic Human Need under Investigation in Increasing the Overall Quality of Life of all Societal Sectors during the Next Five to Ten Years

↓

Phase III

Estimation on the Effectiveness of the m-th Telecommunication Mode under Assessment in Furthering the Provision for the v-th Basic Human Need under Investigation

↓

Phase IV

Derivation on the Net Contributing Rate of the m-th Telecommunication Mode under Assessment to Increasing the Overall Quality of Life of All Societal Sectors from the Provision for the v-th Basic Human Need under Investigation during the Next Five to Ten Years

Model Solutions

v-th basic human need to increasing overall quality of life will be determined by the formula:

$$\Delta \underline{S}^{v} = \underset{(1\times4)}{\underline{V}_i} \cdot \underset{(4\times5)}{\underline{\underline{R}}^{v}_{ij}} \cdot \underset{(5\times1)}{\underline{W}_j} .$$

The outcomes of Phase II will consist of four scalars for each of Nourishment ($\Delta \underline{S}^1$), Shelter ($\Delta \underline{S}^2$), Clothing ($\Delta \underline{S}^3$), and Health ($\Delta \underline{S}^4$).

The objective of Phase III is to estimate the effectiveness of the ten telecommunication modes in facilitating the provision for Nourishment, Shelter, Clothing, and Health. To estimate the effectiveness of the modes, a complicated mathematical operation will be required. The major elements to be included in the mathematical operation are:

1) Significance-Component Matrix ($\underline{C}^{v}_{h}$), which identifies the significance of the h-th component in furthering the provision for the v-th basic human need. The significance of the four components for each basic human need will be represented in a 1 x 4 matrix form for Nourishment ($\underline{C}^{1}_{h}$), Shelter ($\underline{C}^{2}_{h}$), Clothing ($\underline{C}^{3}_{h}$), and Shelter ($\underline{C}^{4}_{h}$). Estimation of the Significance-Component Matrix will be derived from the satisfaction level of the four basic human needs under investigation.

2) Component/Function Demand Matrix ($\underline{\underline{D}}^{v}_{hp}$), which specifies the demand for the p-th technical function in promoting the h-th component of the v-th basic human need. The demands for the six technical functions with respect to the four components of each basic human need will be represented in a 4 x 6 matrix form for Nourishment ($\underline{\underline{D}}^{1}_{hp}$), Shelter ($\underline{\underline{D}}^{2}_{hp}$), Clothing ($\underline{\underline{D}}^{3}_{hp}$), and

Health ($\underline{\underline{D}}_{hp}^{4}$) respectively. Estimation of the Component/ Function Matrix will rely on evaluation by a group of experts.

3) <u>Function/Characteristic Demand Matrix</u> ($\underline{\underline{D}}_{p}^{q}$), which identifies the demand for the q-th technical characteristic in activating the p-th technical function. The demands for the seven technical characteristics with respect to the six technical functions will be represented in a 6 x 7 matrix form. Estimation of the Function/Characteristic Demand Matrix will be made by the telecommunication researchers.

4) <u>Characteristic/Mode Supply Matrix</u> ($\underline{\underline{S}}_{m}^{q}$), which represents the q-th technical characteristic supplied by the m-th telecommunication mode. The seven characteristics of the ten telecommunication modes will be represented in a 7 x 10 matrix form. Estimation of the Characteristic/Mode Supply Matrix will be made by the telecommunication researchers.

To determine the effectiveness of the telecommunication modes, the four matrices will be combined with each other in a systematic pattern. The result of a set of mathematical operations will be in a scalar form ($E_{m}^{v}$) that refers to the effectiveness of the m-th telecommunication mode in facilitating the provision for the v-th basic human need. The outcome of Phase III will be forty scalars for each of the four basic human needs--Nourishment, Shelter, Clothing, and Health--and for each of the ten telecommunication modes--Postal Service, Telegraph, Telephone, Audio-Cassette, Loudspeaker, Theatrical Film, Radio, Television, Newspaper and Magazine.

The objective of Phase IV is to derive the Initial Solutions of the Model that designate the expected rate of increment in the overall quality of life in the village, as attributed to the specific telecommunication modes. Here the properties obtained in Phase II and Phase III will be integrated through the formula:

$$\Delta \underline{S}_{m}^{v} = \Delta \underline{S}^{v} \cdot E_{m}^{v} ,$$

in which $\Delta \underline{S}_{m}^{v}$ refers to the net contributing rate of the m-th telecommunication mode in incrementing the overall quality of life of all societal sectors from the provision of the v-th basic human need. The final outcome of the Model operation will consist of forty scalars for each of the four basic human needs under investigation, for each of the ten telecommunication modes under assessment.

Details of the data-collection process based on the measurement scheme of the Socio-Technical Assessment Model are given in Chapter IV.

## 4. Validation of the Model

The validation of the Socio-Technical Assessment will be focused on two major issues: first, whether the quality-of-life scheme proposed in the Model is reliable and valid as tested with empirical data; second, whether the telecommunication modes produce significant effect on the quality of life of the village population so as to constitute a meaningful technological force worth investigating. Details of the validation processes will be given in Chapter V.

## 5. Operation of the Model

After the validity of the Socio-Technical Assessment Model is established, the four phases proposed in the measurement scheme of the Model will be executed. The final outcome of the Model solution will

designate the expected level of enhancement in the overall quality of life attributed by specific telecommunication mode in the sampled village. The operation of the Model will be dealt with in Chapter VI.

## Overview

Chapter III presents an overall description and operationalization of the Socio-Technical Assessment Model. The Model avoids a common failing of technology-assessment and social-impact-assessment schemes by offering a specific criterion according to which desirability of a given technological choice can be estimated. In the Model, the desirability of a given technological choice is defined in terms of the potential contribution of specific technological choice to increasing the overall quality of life in a given society. The application of the Model will address the degree to which the rural populace within the developing countries can benefit from specific telecommunication technologies.

# CHAPTER IV

# COLLECTION OF DATA

With the framework specified in the operationalization of the Model, the field study was conducted in a rural village in South Korea during May and June of 1982. To provide a general picture of the sampled village, a brief description of the overall socio-economic conditions of the village and its telecommunication environment will be given. The major portion of the rest of this chapter is a detailed explanation of the data-collection process and the basic characteristics of data.

## Socio-Economic Conditions of the Village

The sampled village, named Wa-Bu, is located about 20 miles north-east of Seoul, the capital of South Korea (See Figure 4 in Appendix A). As a part of the Nam-Yang District, Wa-Bu consists of 13 smaller administrative units (See Figure 5 in Appendix A).

Wa-Bu has an area of approximately 24 square miles (62 sq. km.), about ten percent of which is rice paddies, the rest serving for live-stock breeding, industrial factories, and residential areas. The estimated population of Wa-Bu at the end of 1981 was 25,000, corres-ponding to a density of 403 persons per kilometer. There are 5,430 households in Wa-Bu, each household averaging 4.7 persons. Sixty-five percent of the villagers dwell in their own residences, the average size of which is 700 square feet. It is estimated that about 60 percent of the villagers are served by sewerage systems.

Compared with other parts of South Korea, Wa-Bu is a predominantly agricultural village. (For the breakdown by occupation of Wa-Bu and the whole South Korea, see Table 1 in Appendix B.) About half of the villagers are farmers. The industrial and sales workers respectively constitute 15 percent and 7 percent of the total villagers. The median annual income per household is estimated at $3,571, which is substantially lower than the average income per farm household for entire South Korea ($4,837: Korea Statistical Yearbook, 1981, p. 100). About three percent of the villagers live under the minimum subsistence level of $2,415 per year set by the South Korean government. Ten percent of the villagers earn more than $10,000 annually.

The main commodity of the market is rice. The average size of a farm is about 0.32 hectare (.79 acre). Most of the landless farmers have been absorbed by industrial sector, and the majority of farmers now own their own rice paddies. The key financial institution is the Farmers' Cooperative, through which most transactions for agricultural commodities are handled. The Cooperative, which was established in the early 1960's as one of the measures of national agricultural policy, also makes small loans to farmers. All of the farmers use the Cooperative in one way or another. There are two supermarkets, and one Cattle Market which operates every five days for livestock transactions.

During the past few years, a number of small- and medium-size industrial factories have been established in Wa-Bu. All of these factories are owned by Seoul entrepreneurs and their foreign partners seeking cheaper labor and factory sites than those in Seoul. Among

the industrial factories, five factories that produce auto parts, polyester, and other chemical goods employ more than 500 workers each.

The literacy level of the villagers is about 95 percent. The educational institutions include seven elementary schools (6-year system), three junior-high schools (3-year system), and one professional high school (equivalent to a 3-year senior-high school). There is one public-health-service bureau and two private hospitals. The public-health-service bureau is responsible for regular vaccination of students, and also provides free service for family planning.

The major transportation system in Wa-Bu is town bus. About 20 town buses link various smaller villages in the Wa-Bu area. For the trip to Seoul area, ten additional buses are available. Other transportation systems in Wa-Bu are 20 taxis, about 100 passenger cars (40 of which are owned by governmental officials, 60 by private citizens), and a few trains that link Seoul and the mining areas in the farther eastern area.

As to religion among the villagers, 40 percent are Buddhists, 20 percent are Christians, and the remaining 40 percent are of no specific religion. The forms of entertainment show the prevailing influence of Western culture: traditional folklore and games are rapidly disappearing, their places being taken by two billiard parlors, seven tea-rooms (serving coffee, tea and soft drinks), ten night-clubs, and one movie theatre.

The political aspects of life in Wa-Bu are like those in other areas of South Korea in that any form of political activity that might present "threats to internal security" is strictly prohibited. Most of the villagers show indifference to political events, and some do not

want to be asked about politics at all. The government officials, who are more conscious about intelligence activities of the central government, tend to support various governmental policies unconditionally.

The gap between the rich and the poor is not as striking as in the bigger cities, yet many of the industrial workers express strong discontent about low wages, inadequate sanitary measures, and the lack of social security after retirement. Farmers seem to be much more satisfied than the industrial workers in their general view toward society.

In summary, Wa-Bu possesses many typical traits of the rural areas in South Korea. Rapid economic development, along with vigorous policies to transform rural areas, has resulted in almost total elimination of poverty (for increase of GNP in South Korea, see Table 2 in Appendix B). All of the households are served by electricity. Other components of infrastructure such as transportation systems, irrigation facilities, and sewerage systems, are constantly improving. Success of the Farmers' Cooperative movement is evidenced in the increases in the overall agricultural productivity.

Nonetheless, transformation from an agriculture-based economy to an industry-oriented one has created a distinctively disadvantaged social group consisting of factory workers--a position once held by the landless farmers. As in other areas in South Korea, the extreme rich and the extreme poor coexist. The constant surveillance and suppression from the central government have numbed the villagers' sensitivity to political events. For most of the villagers, the central concern in life focuses on monetary reward, followed by the desire for entertainment. The concept of social or economic justice is still relatively new for most of the villagers, a result partly due to the

strong influences of Confucianism. Western influences in the villagers' life-styles are not so prevalent as in urban areas; however, the majority of the villagers expressed a strong desire to immigrate to foreign lands, particularly the United States, a land which is believed to be blessed with milk and honey.

## Telecommunication Environment of the Village

Most of the telecommunication services in Wa-Bu are handled by the main Post, Telegraph, and Telephone Office, located in the downtown. The nature of the telecommunication services will be reviewed, focusing on the ten telecommunication modes specified in the Model operationalization.

Postal Service: The average number of personal letters received per month is 1.8 per villager; the average number sent is .68. Domestic mails are delivered within three days. The base postage price for domestic mail is approximately 9¢.

Telegraph: The telegraph services are mostly used for emergency notice among family members. The average number of telegraphs sent and received per day for the whole villagers is estimated at seven. The base price for a telegraph service is 75¢. Four postal workers are in charge of delivering both postal and telegraph services.

Telephone: The total number of telephones installed in Wa-Bu as of the middle of 1982 is 700, of which 600 are in private residences. The telephone penetration rate amounts to approximately 11 telephones in every 100 households. The cost of installing a telephone is about $186, equivalent to that of a black-and-white television set. Seven hundred

additional telephones are expected to be installed within the next two years. Persons not having easy access to telephones can use facilities at the main Post, Telegraph and Telephone Office. About 70 percent of all telephone calls are made within the Wa-Bu area. For comparative distribution of telephone facilities in Wa-Bu, Seoul, and entire South Korea, see Table 3 in Appendix B.

Loudspeaker: There are about 100 loudspeakers serving as the public-address systems. The amount of broadcasting time varies from one administrative unit to another. On the average, loudspeakers are used about three hours daily. The messages transmitted are agricultural instructions, marketing trend of agricultural commodities, basic health care, and other public announcements from the Farmers' Cooperative and the local government. Occasionally, messages for specific individuals can be sent through loudspeakers.

Audio-Cassette: About 30 percent of the villagers own audio-cassette players. A cassette player can be purchased for approximately $50. Typically, villagers purchase pre-recorded cassettes from the local bookstore, and play them during leisure time. The cost of a 60-minute pre-recorded cassette-tape is close to $5. The most popular material in pre-recorded cassettes is contemporary music.

Theatrical Movie: There is one movie theatre in Wa-Bu. The average turn-over time for movies is 5 days. The majority of the movies are domestically produced, although foreign movies are occasionally available. The admission price is $1.75.

Radio: Most households have at least one radio set, and some have three or four sets for individual household members. The consumer price for a radio set varies a great deal, ranging from $5 to $100. In total, eight radio channels (five AM, three FM; all broadcast from Seoul) can be received in Wa-Bu. All stations broadcast 21 hours daily. Three AM stations and one FM station are owned and operated by the government-subsidized Korean Broadcasting System (KBS). The KBS-owned-and-operated FM station carries advertising messages. Two AM stations and one FM station, owned by private entities, are operated from revenues accrued from advertising. The content of messages differs depending on ownership: KBS-owned stations are more inclined to public affairs and instructional material, commercial stations to entertainment-oriented material.

Television: Television sets, which once were recognized as symbols of wealth, are now readily available to most of the villagers. Currently, the penetration rate for television sets is estimated to be almost 100 percent. The price of a black-and-white television set is approximately $200, that of a color set, close to $800. Those who own television sets at home have to pay a monthly subscription fee of $2 for a black-and-white set, $4 for a color set. A total of five television channels (four VHF, one UHF) are broadcast from Seoul. The Korean Broadcasting System (KBS) owns and operates three VHF stations. One VHF station is owned by a private company. One of the KBS-owned-operated VHF stations and the privately-owned VHF station accept advertising. The KBS-owned UHF station deals exclusively with instructional materials. The daily television broadcasting hours vary between weekdays and weekends--eight and a half hours during weekdays, and 18 hours during weekends.

Newspaper: Among a total of 5,430 households, 1,950 households (about thirty-six percent) subscribe to daily newspapers. Like radio and television, all newspapers available in Wa-Bu come from Seoul.

The monthly subscription rate for a newspaper is about $4. Besides the daily newspapers, farmers receive a free Farmers' Newspaper published by the local government unit. This paper typically contains material on new agricultural techniques, announcements from the Farmers' Cooperative, information on family-planning practices, and additional agriculture-related matters.

Magazine: The subscription rate for magazines is of little interest because most magazines are bought at the local bookstore. The average price for a monthly magazine is estimated at $3.50

The following section provides a detailed description of the data-collection process and the characteristics of data.

## Data-Collection Process

The data-collection process was divided into five major parts: 1) sampling among the villagers; 2) inventory schedule of telecommunication modes; 3) panel discussion among a group of experts; 4) evaluation of demands for technical characteristics to activate technical functions; and 5) personal interviews with the decision-makers.

### 1. Sampling among the Villagers

The sampling among the villagers will be explained in terms of development of questionnaire items, sampling technique, interviewers, and group discussion.

Questionnaire Items: The questionnaire items are grouped into three categories: a) current satisfaction level of the 16 basic human needs, and overall satisfaction level in one's daily life; b) access to and frequency of usage for the ten telecommunication modes in one's daily life; and c) demographic information including education, income, age, sex, and religion. The questionnaire items are given in Appendix C.

All of the questionnaire items were initially constructed by the author. As a pretesting measure, the items were reviewed by the public-opinion specialists of the Korean Gallup Research Institute in Seoul. Some wording and syntax problems in the original questionnaire were corrected in accordance with the advice from the specialists. The revised questionnaire then had to be reevaluated by the local police authority to get security clearance. Two of the items, Political Freedom and Economic Justice, were then removed from the questionnaire.

Sampling Techniques: Stratified sampling was chosen, since the population elements to be included in the sample were separated into non-overlapping groups of five societal sectors (Scheaffer, Mendenhall & Ott, 1979, p. 59). The size of the total sample comprising the five societal sectors was chosen as 200. The size of each stratum (societal sector) was then made roughly proportional to occupational breakdown among the villagers. The sizes of the strata were: 24 for Professionals (including government officials, school teachers, religious leaders, and other managerial workers); 28 for Clerical Workers; 29 for Commercial Sector (keeper of big and small shops); 21 for Non-Agricultural Laborers (construction workers, low-waged factory workers); and 99 for Farmers. The sampling procedure followed conventional stratified practice in that the samples were drawn independently and at random in each stratum (Scheaffer, Mendenhall & Ott, 1979).

Interviewers: A total of ten interviewers were hired among graduates of the Wa-Bu Junior High School. The main reason for selecting interviewers from the local area was to forestall antagonism and secluded attitudes among the villagers toward urban elites. All of the interviewers had finished senior high school education, and some had finished college. All interviewers were currently working in the Wa-Bu area, some as school teachers, some as low-level administrators for the local government, and some as liaison officers for the Farmers' Cooperative. The interviewers were trained for three days with emphasis on accuracy in coding and on minimizing personal bias. After training, each interviewer was assigned to conduct 20 or more personal interviews with the preselected subjects.

Group Discussion: To obtain information on the two items ruled out by the local police authority (Political Freedom and Economic Justice), a group discussion for each societal sector was scheduled. Five to seven villagers participated in the group discussion for each sector. All of the participants were asked to discuss freely their living conditions, and then to estimate the degree of satisfaction for Political Freedom and Economic Justice. The values obtained from group-discussion participants were averaged for each societal sector.

The basic characteristics of data obtained from stratified sampling cover demographic information, satisfaction level, and telecommunication usage.

## Demographic Information

The distribution of level of education, annual income, age, and sex among the total sample subjects is given in Table 4. The distribution of education showed highest frequency for elementary-school graduates with 81 subjects (40.5 percent). For annual income among the subjects, the relatively poor group (annual income between $2,001 and $3,500) with 69 subjects (34.5 percent) constitutes the major portion. The age group between 40 and 49 had highest frequency, with 50 subjects (25.0 percent). Among 200 subjects, 138 (69.0 percent) were men and 62 (31.0 percent) were women.

Means of education, annual income, and age for each societal sector and for the total subjects are listed in Table 5. The education level was highest among Professionals, and lowest among Farmers. The average annual income for the 200 subjects was $3,933. The Professionals had highest income of $5,815 and Non-Agricultural Laborers had lowest income of $2,603. Farmers, whose educational level was lowest, had the highest age level; and Non-Agricultural Laborers, who earned the smallest income, had the lowest age level. Means of all three demographic variables--education, annual income, and age--differed significantly across the societal sectors.

## Satisfaction Level

The subjects were asked to estimate the degree of satisfaction for the 14 basic human needs (excluding Political Freedom and Economic Justice), and overall satisfaction level in one's daily life, in a 7-point integer scale ranging from -3 to +3. To facilitate statistical processing the responses recorded in the -3 to +3 scale were coded in an all-positive 7-point scale ranging from +1 to +7. For satisfaction level of Political Freedom and Economic Justice, the average values obtained from the group discussions were entered into coding.

The means of the satisfaction level of the 16 basic human needs and of the overall satisfaction level in one's daily life for the total sample subjects and for each societal sector are given in Table 6.

TABLE 4

Distribution of Education, Income, Age, and Sex among the Subjects (N=200)

| Education | Number | Percentage |
|---|---|---|
| No Schooling | 3 | 1.5 |
| Elementary-School Graduates | 81 | 40.5 |
| Junior-High Graduates | 52 | 26.0 |
| Senior-High Graduates | 45 | 22.5 |
| College Graduates | 19 | 9.5 |
| | N=200 | 100.0 |
| **Annual Income (in U.S. $)** | | |
| Extremely Poor (less than $2,000) | 40 | 20.5 |
| Relatively Poor ($2,001 - $3,500) | 69 | 34.5 |
| Average ($3,501 - $5,000) | 30 | 15.0 |
| Relatively Well-Off ($5,001 - $7,000) | 52 | 26.0 |
| Rich ($7,000 or more) | 9 | 4.5 |
| | N=200 | 100.0 |
| **Age** | | |
| 19 years or less | 2 | 1.0 |
| 20 to 29 years | 38 | 19.0 |
| 30 to 39 years | 40 | 20.0 |
| 40 to 49 years | 50 | 25.0 |
| 50 to 59 years | 42 | 21.0 |
| 60 years or more | 28 | 14.0 |
| | N=200 | 100.0 |
| **Sex** | | |
| Male | 138 | 69.0 |
| Female | 62 | 31.0 |
| | N=200 | 100.0 |

TABLE 5

Mean of Education, Income, and Age for Each Societal Sector and for the Total Subjects

| Societal Sector | Education* | Annual* Income (in US $) | Age* |
|---|---|---|---|
| Professionals (n=24) | 3.58 | 5,815. | 39.13 |
| Clerical Workers (n=26) | 2.76 | 3,840. | 32.19 |
| Commercial Sector (n=29) | 2.00 | 5,300. | 42.52 |
| Non-Agricultural Laborers (n=21) | 1.90 | 2,602. | 30.14 |
| Farmers (n=99) | 1.42 | 3,422. | 51.36 |
| Total (N=200) | 1.98 | 3,932. | 43.63 |

* $p < .001$

Education Level: 0=No Schooling, 1=Elementary-School Graduates, 2=Junior-High Graduates, 3=Senior-High Graduates, 4=College Graduates

From now on, the overall satisfaction level in one's daily life will be referred to as the Overall Satisfaction Index S. In Table 6, Average refers to the satisfaction level obtained by averaging the scores for all 16 basic human needs. The Overall Satisfaction Index S for the total sample subjects and for each societal sector do not deviate much from the average satisfaction score of the 16 basic human needs, with the one exception of Non-Agricultural Laborers. Among the 16 basic human needs, the satisfaction level for Entertainment and Culture was lowest with 2.61; the highest for Communal Solidarity with 5.06, taking all 200 subjects into account. With regard to the Overall Satisfaction Index S, Professionals had the highest satisfaction score (4.92), followed in order by Commercial Sector (4.79), Clerical Workers (4.19), Farmers (3.92), and Non-Agricultural Laborers (2.62). Among the 16 basic human needs, nine needs--Nourishment, Shelter, Clothing, Health, Physical Security, Unpolluted Air, Water, Soil, Pleasant Living Condistion, Public Safety, and Communal Solidarity--differed significantly across societal sectors. The Overall Satisfaction Index S across societal sectors also showed significant differences.

The relationship between the satisfaction scores and demographic variables will be dealt with extensively in Chapter V.

## Telecommunication Usage

With regard to telecommunication usage, each subject was asked to estimate access to, and frequency of use of, each of the ten telecommunication modes in one's daily life.

TABLE 6

Mean of the Basic Human Needs and the Overall Satisfaction Index S

(1-7 scale)

| Need | Total (N=200) | Professionals (n=24) | Clerical Workers (n=26) | Commercial Sector (n=29) | Non-Ag Laborers (n=21) | Farmers (n=99) |
|---|---|---|---|---|---|---|
| Nourishment*** | 4.49 | 5.50 | 4.31 | 5.24 | 3.04 | 4.36 |
| Shelter*** | 4.36 | 5.46 | 4.08 | 5.21 | 3.14 | 4.16 |
| Clothing*** | 4.33 | 5.58 | 4.11 | 5.03 | 3.04 | 4.14 |
| Health*** | 3.77 | 5.33 | 3.85 | 4.38 | 2.57 | 3.43 |
| Physical Security*** | 4.35 | 3.38 | 4.65 | 4.00 | 5.00 | 4.47 |
| Unpolluted Air, Water, Soil*** | 4.74 | 3.50 | 4.42 | 4.28 | 5.47 | 5.13 |
| Pleasant Living Condition*** | 4.42 | 3.04 | 4.08 | 4.21 | 5.14 | 4.28 |
| Public Safety*** | 4.41 | 3.42 | 4.42 | 3.93 | 5.33 | 4.59 |
| Opportunity for Education | 3.36 | 3.50 | 3.46 | 3.52 | 2.71 | 3.36 |
| Opportunity for Profession | 3.16 | 3.58 | 3.38 | 3.38 | 2.67 | 3.01 |
| Political Freedom | 3.19 | 3.58 | 3.38 | 3.38 | 2.67 | 3.06 |
| Entertainment and Culture | 2.61 | 3.08 | 2.62 | 2.83 | 2.14 | 2.56 |

Table 6 (cont'd.)

| Need | Total (N=200) | Professionals (n=24) | Clerical Workers (n=26) | Commercial Sector (n=29) | Non-Ag Laborers (n=21) | Farmers (n=99) |
|---|---|---|---|---|---|---|
| Judicial Justice | 4.40 | 3.92 | 4.31 | 4.48 | 4.62 | 4.46 |
| Social Justice | 4.11 | 4.04 | 4.11 | 3.83 | 4.24 | 4.18 |
| Economic Justice | 4.04 | 4.04 | 4.12 | 3.79 | 4.62 | 3.96 |
| Communal Solidarity* | 5.06 | 4.17 | 4.17 | 4.77 | 4.79 | 5.38 |
| Average | 4.05 | 4.07 | 4.00 | 4.14 | 3.51 | 4.06 |
| Overall Satisfaction Index S*** | 4.07 | 4.92 | 4.19 | 4.79 | 2.62 | 3.92 |

*  $p < .05$ (across societal sectors)

***$P < .001$ (across societal sectors)

Access Score: In estimating access to the telecommunication modes, a distinction was made between point-to-point telecommunication and the mass media. For the four modes representing point-to-point telecommunication--Postal Service, Telegraph, Telephone, and Audio-Cassette--the subjects were asked to estimate relative easiness in receiving and sending messages through each mode. A 5-point scale ranging from 1 to 5 was used--1 for least easy and 5 for easiest. For the remaining six modes representing mass-media form--Loudspeaker, Theatrical Film, Radio, Television, Newspaper, and Magazine--the subjects were asked about relative easiness in receiving messages through each mode. The mean access scores for the ten telecommunication modes for all 200 subjects are given in Table 7.

TABLE 7

Mean Access Score for the Telecommunication Modes (N=200)

| Mode | Access Score (1 - 5 scale) |
|---|---|
| Postal Service | 3.16 |
| Telegraph | 2.54 |
| Telephone | 2.87 |
| Audio-Cassette | 3.60 |
| Loudspeaker | 4.88 |
| Theatrical Film | 1.60 |
| Radio | 4.96 |
| Television | 4.99 |
| Newspaper | 3.56 |
| Magazine | 2.40 |

Frequency of Usage: Four different bases were used in estimating the frequency score. For Loudspeaker, Radio, Television, and Newspaper, the base of estimation was the number of hours spent per day; for Telephone, the number of calls made per week; for Postal Service, Audio-Cassette, Theatrical Film, and Magazine, the number of uses per month; for Telegraph, the number of uses per year. For each telecommunication mode, the subjects were asked to specify the absolute usage in the corresponding base of estimation. Since the base differed across the modes, absolute frequency scores were transformed into Relative Frequency Scores. The scale for the Relative Frequency contained the five integers from 1 to 5. The mean and the standard deviations of absolute frequency scores served as the basis for creating the scale of Relative Frequency Scores. The score 3 was assigned to those values which fall within ±1.0 standard deviation unit from the mean of Absolute Frequency Score, 4 to those which fall within +1.01 to +2.0 standard deviation units, and 5 to those which lie above +2.01 standard deviation units. In analogous fashion, 2 was assigned to those values which fall within -1.01 to -2.0 standard deviation units, and 1 to those values which fall below -2.01 standard deviation units. The Absolute and Relative Frequency Scores for the ten telecommunication modes are given in Table 8.

The relationship between telecommunication usages, the demographic variables, and satisfaction scores will be explored in detail in Chapter V.

TABLE 8

Mean of Frequency of Use of the Telecommunication Modes (N=200)

| Mode | Mean of Absolute Frequency | Mean of Relative Frequency (1-5 scale) |
|---|---|---|
| Postal Service | 4.30 (per month) | 1.19 |
| Telegraph | 2.57 (per year) | 2.26 |
| Telephone | 10.97 (per week) | 1.97 |
| Audio-Cassette | 10.14 (hours per month) | 4.55 |
| Loudspeaker | 3.18 (hours per day) | 3.01 |
| Theatrical Film | .52 (per month) | 3.38 |
| Radio | 2.38 (hours per day) | 2.59 |
| Television | 2.78 (hours per day) | 2.81 |
| Newspaper | .10 (hours per day) | 2.01 |
| Magazine | 1.21 (hours per month) | 1.76 |

2. Inventory Schedule of Telecommunication Modes

The objective of this stage was to evaluate the telecommunication modes in terms of their technical characteristics. Some of the basic facts concerning these were provided by the Wa-Bu Post, Telegraph, and Telephone Office. But owing to the absence of guidelines for integrating various telecommunication modes into one frame, many conceptual and measurement problems were encountered. The rationale and measurement processes in establishing scales will be explained item by item.

Promptness: In measuring Promptness of the modes, Shannon's communication theory was employed. Shannon described the process of communication in terms of information source, transmitter, channel, receiver, and destination (Shannon & Weaver, 1949). Within this frame, Promptness in this study was defined through "time elapsed to deliver messages from the sending end to the receiving end." Accordingly, average delivery time for each mode was estimated. Average delivery times for Postal Service and Telegraph were determined as 3 days and 8 hours respectively. Delivery time for Telephone, Loudspeaker, Radio, and Television was considered negligible. Average delivery time for Newspaper was taken as 1 day, and that of Magazine as 1 month, since the most widely-read magazines in Wa-Bu are the monthlies. The estimates for Audio-Cassette and Theatrical Film were fairly arbitrary because sending end, transmitter, receiver, and receiving end of both modes did not fall neatly into the conceptual frame. The most prevalent form of usage for Audio-Cassette was purchase of pre-recorded cassette tapes from the local bookstore. In such a case, the sending end of messages may be considered to be the manufacturer of pre-recorded cassettes, the transmitter, the Postal Service; and the receiver the local bookstore. The delivery time for Audio-Cassette, therefore, should account for amount of time required for delivering pre-recorded cassette tapes from manufacturers to the local bookstore, and amount of time that new cassette tapes are high in demand among the villagers. Under this rationale, the average delivery time for Audio-Cassette was taken as four weeks: the sum of the time required for delivering pre-recorded cassette tapes from manufacturers to the local bookstore (normally, 2 weeks), plus the time that new cassette tapes are popular among the villagers (on the average, 2 weeks). Estimation of delivery time for Theatrical Film suffers from the same difficulty. In case of

Theatrical Film, the sending end of messages could be the movie-producer, the transmitter the Postal Service, and the receiver the local theatre. Average delivery time for Theatrical Film was estimated at 35 days, since newly released domestic films were available in Wa-Bu in about one month, and the average turn-over rate of films was 5 days.

The average delivery times for the ten telecommunication modes were then readjusted in a 5-point scale ranging from 1 for least Prompt, to 5 for most Prompt (Note: Mean and standard deviation are not useful because of the extreme skewness and large standard deviations among the average delivery time). The Promptness scores represented on a somewhat arbitrary 5-point scale for the ten telecommunication modes are:

| Mode | Average Delivery Time | Promptness (1-5 scale) |
|---|---|---|
| Postal Service | 3 days (=72 hours) | 2.0 |
| Telegraph | 8 hours | 4.0 |
| Telephone | Instantaneous | 5.0 |
| Audio-Cassette | 4 weeks (=672 hours) | 1.0 |
| Loudspeaker | Instantaneous | 5.0 |
| Theatrical Film | 35 days (=840 hours) | 1.0 |
| Radio | Instantaneous | 5.0 |
| Television | Instantaneous | 5.0 |
| Newspaper | 1 day (=24 hours) | 3.0 |
| Magazine | 1 month (=672 hours) | 1.0 |

Effective Bit Rate: Shannon (1963) showed how to characterize the capacity of a communication channel by a bits-per-second measure. The bit, which is a contraction of "binary digit," is defined as the amount of information when one of two equally likely alternatives is specified (e.g., Abramson, 1963, p. 12). A number of studies have identified capacities of various telecommunication modes in terms of bits transmitted per second through specific modes (Martin, 1969;

Pierce, 1972). Nevertheless, measurement of a channel capacity based on bits transmitted per second is of little relevance to the effective rates of human communication, because the bit rates receivable by humans is controlled by their ability to process information rather than what is available to them (McCormick, 1970, p. 88).

Since the present study mainly concerns the evaluation of telecommunication modes from the user's perspective, the basis of analysis was chosen as Effective Bit Rate. The Effective Bit Rate is defined as "the maximum number of bits per second actually comprehensible by humans." The key factor in estimating the Effective Bit Rate is the slowest link among the five elements of the telecommunication modes: information source, encoder/transmitter, channel, decoder/receiver, and information destination. Except for Telegraph, in which the slowest link is encoder/transmitter, the Effective Bit Rate is controlled by the ability of the human cognitive system in processing information.

Many investigations indicate that the maximum bit rate for human comprehension for oral and written communication is about 50 bits per second (Pierce & Karlin, quoted in McCormick, 1970, p. 93). This result may be a little conservative since those studies were mainly concerned with meanings of words or symbols without considering other human sensory elements such as loudness, pitch, or visual perception. Nevertheless, a 50 bit-per-second rate will serve as a reasonable basis for further analysis.

The estimate for Postal Service presented some conceptual difficulties since this mode can deliver not only personal letters but also objects containing messages such as Audio-Cassette, Theatrical Film, Newspaper, or Magazine. To avoid confusion, estimate of the Effective Bit Rate for Postal Service is confined to personal letters and other written materials such as pamphlets and fliers, but not newspapers and magazines. The Effective Bit Rate for Postal Service was approximately fifty bits per second, equivalent to the maximum bit rate for human reading speed. For Telegraph, the number of bits that can be handled in encoding/transmitter is estimated to be not greater than 30 bits per second. Thus, the Effective Bit Rate for Telegraph is taken at 30 bits per second.

For the four modes that transmit oral messages--Telephone, Audio-Cassette, Loudspeaker, and Radio--attributes of human hearing such as loudness, pitch, and tones were considered. In the absence of any practical guidelines in measuring the hearing attributes, 10 more bits beyond the 50 assumed earlier were arbitrarily assigned (c.f. section 2.3.2 in Human Engineering Guide to Equipment Design, 1972). Hence, the Effective Bit Rate for Telephone, Audio-Cassette, Loudspeaker, and Radio was taken at 60 bits per second.

For Theatrical Film and Television, 20 more bits were assigned in addition to 50 bits per second--10 for audio sensory elements, and 10 for visual perception. The Effective Bit Rate for Newspaper and Magazine was chosen as 55 bits per second, since both of the modes carry some form of visual images such as pictures and sizes and shapes of symbols, in addition to the written text.

The Effective Bit Rate for the ten modes was readjusted arbitrarily to a 5-point scale, 1 for least effective, and 5 for most effective. The Effective Bit Rates for the modes are:

| Mode | Absolute Effective Bit Rate (bits/second) | Relative Effective Bit Rate (1-5 scale) |
|---|---|---|
| Postal Service | 50 | 2.0 |
| Telegraph | 30 | 1.0 |
| Telephone | 60 | 4.0 |
| Audio-Cassette | 60 | 4.0 |
| Loudspeaker | 60 | 4.0 |
| Theatrical Film | 70 | 5.0 |
| Radio | 60 | 4.0 |
| Television | 70 | 5.0 |
| Newspaper | 55 | 3.0 |
| Magazine | 55 | 3.0 |

Cheapness: In estimating Cheapness of the telecommunication modes, the cost of unit per service from the user's perspective served as the basis of analysis. The unit cost per service for the six modes was estimated at: 9¢ for Postal Service (the base postage price for domestic mail); seventy-five cents for Telegraph (the base price for a telegraph service); zero for Loudspeaker; $1.75 for Theatrical Film; $4.00 for Newspaper (the monthly subscription fee for a daily paper); and $3.50 for Magazine (the average price for a monthly magazine).

For the four modes that require personal ownership of the receivers--Telephone, Audio-Cassette, Radio, and Television--the unit cost per service involves the price paid for the receiving unit, and the price for the subsequent service. The unit cost per service for the four modes were computed as: $200 for Telephone ($186 for installation fee, plus monthly service charge); $60 for Audio-Cassette ($50 for a cassette-player, $5 for a 60-minute pre-recorded cassette, $5 for battery or electricity-consumption cost); $55 for Radio ($50 for a receiving unit plus battery or electricity-consumption cost); and $220 for Television ($200 for a black-and-white television set, plus monthly subscription fee and electricity-consumption cost).

The unit price per service was coded on a 5-point scale, 1 for most expensive, and 5 for least expensive. The results are:

| Mode | Unit Cost/Service | Cheapness (1-5 scale) |
|---|---|---|
| Postal Service | $ .09 | 5.0 |
| Telegraph | $ .75 | 5.0 |
| Telephone | $200.00 | 1.0 |
| Audio-Cassette | $ 60.00 | 2.0 |
| Loudspeaker | $ 0.00 | 5.0 |
| Theatrical Film | $ 1.75 | 4.0 |
| Radio | $ 55.00 | 2.0 |
| Television | $220.00 | 1.0 |
| Newspaper | $ 4.00 | 3.0 |
| Magazine | $ 3.50 | 3.0 |

[Note: Undoubtedly, a sounder estimate can be made by more sophisticated cost analysis. Universal agreement, however, does not exist as to the best procedure, and additional work for more refined analysis does not seem warranted at current level of analysis.]

Reliability, Accessibility, Storage/Retrieval Capacity, and Confidentiality: Estimates for Reliability were made by the workers of the Wa-Bu Post, Telegraph, and Telephone Office based on breakage, loss, and the degree of satisfactory performance of each mode. Accessibility scores were taken from rounded values of the mean Access Scores obtained from stratified sampling (listed in Table 7). For Storage/Retrieval Capacity, and Confidentiality, estimates were again made by the employees of the Wa-Bu Post, Telegraph, and Telephone Office. The seven characteristics of the telecommunication modes under assessment represented in 1-5 scale are tabulated in Table 9.

3. Panel Discussion among a Group of Experts

A panel discussion among seven experts was held to determine the degree of demand for the technical functions with respect to the "Direct Areas of Application." All seven experts have extensive knowledge on socio-economic conditions of Wa-Bu, and possess specialized experience in one of the four basic human needs under investigation.

TABLE 9

Technical Characteristics of the Telecommunication Modes

(1 - 5 scale)

| Mode | Promptness | Effective Bit Rate | Cheapness | Reliability | Accessibility | Storage/ Retrieval Capacity | Confidentiality |
|---|---|---|---|---|---|---|---|
| Postal Service | 2.0 | 2.0 | 5.0 | 4.0 | 3.0 | 4.0 | 5.0 |
| Telegraph | 4.0 | 2.0 | 5.0 | 2.0 | 3.0 | 4.0 | 4.0 |
| Telephone | 5.0 | 4.0 | 1.0 | 3.0 | 3.0 | 1.0 | 4.0 |
| Audio-Cassette | 1.0 | 4.0 | 2.0 | 2.0 | 4.0 | 5.0 | 3.0 |
| Loudspeaker | 5.0 | 4.0 | 5.0 | 4.0 | 5.0 | 1.0 | 1.0 |
| Theatrical Film | 1.0 | 5.0 | 4.0 | 4.0 | 2.0 | 2.0 | 1.0 |
| Radio | 5.0 | 4.0 | 2.0 | 5.0 | 5.0 | 1.0 | 1.0 |
| Television | 5.0 | 5.0 | 1.0 | 4.0 | 5.0 | 1.0 | 1.0 |
| Newspaper | 3.0 | 3.0 | 3.0 | 2.0 | 4.0 | 5.0 | 1.0 |
| Magazine | 1.0 | 3.0 | 3.0 | 3.0 | 2.0 | 5.0 | 1.0 |

The Direct Areas of Application in this Model have been specified as the P, E, F, J components of the four basic human needs--Nourishment, Shelter, Clothing, and Health. Most of the panel discussants were currently engaged in development activities in the Wa-Bu area. The panel discussants were: the Chief of Agricultural Extensive Service, the Chief of Modern Farming Techniques, and the Chief of Housing (all three work for the Nam-Yang District Office which supervises the activities of the Wa-Bu local government unit); the Head of the Wa-Bu Public Health Bureau, a medical doctor who operates a private hospital in Wa-Bu; a home economics teacher at the Wa-Bu Professional Senior High School; and a college professor who teaches at a university in Seoul but resides in Wa-Bu.

In the beginning of the panel discussion, the overall purposes of the session were presented by the author. The participants were asked to discuss the most salient problems in carrying out specific development tasks. For Nourishment, the most urgent task was viewed as raising the production of rice to a self-sufficient level (about 50 percent of the rice consumed in Wa-Bu is supplied from other parts of South Korea). For Housing, the panelists agreed that there is the lack of a policy to facilitate the financing of housing for economically deprived families. For Clothing, the influence of urban life, particularly as portrayed through television, was noted as the prime source of discontent. As to Health, the panelists agreed that effective health-support systems cannot be provided in the absence of long-term governmental policies that consider all the other basic human needs.

After various aspects of Nourishment, Shelter, Clothing, and Health had been extensively discussed, the author described categorization of the four needs into the P, E, F, J components. Next, the focus of discussion was directed to the potentialities of communications in improving the current conditions. The panelists agreed that some form of network activities that integrate the development agents and telecommunication modes would be vital to implement development tasks. The author described the information content that can be of use for development along with the six major categories: Specific Instruction, Marketing Information, News Weather Service, Entertainment, Opinion Formation, Personal Correspondence.

After the concept of each technical function seemed adequately understood, the panelists were asked to estimate the demand for specific functions in promoting each of the P, E, F, J components of Nourishment, Shelter, Clothing, and Health. Each of the six technical functions was estimated successively with respect to the P, E, F, J components of Nourishment, Shelter, Clothing, and Health. In estimating the demand for the technological functions, a 1-5 scale was used, 1 signifying the least strongly required, 5 the most strongly required. The means of the six technological functions as estimated by the group of experts are given in Table 10, Table 11, Table 12 and Table 13.

4. Evaluation of Demands for Technical Characteristics to Activate Technical Functions

Ideally, estimation of the demands for the specific technical characteristics to activate each technical function is to be made by communication specialists who have extensive knowledge of the village.

TABLE 10

Demands for the Technical Functions to Promote the P, E, F, J Components of Nourishment

(1-5 scale)

| Component | Specific Instruction | Marketing Information | News, Weather | Entertainment | Opinion Formation | Personal Correspondence |
|---|---|---|---|---|---|---|
| P | 4.29 | 3.86 | 4.29 | 1.49 | 2.43 | 1.43 |
| E | 2.43 | 1.29 | 1.43 | 1.57 | 3.00 | 1.14 |
| F | 1.71 | 4.29 | 1.14 | 1.86 | 1.57 | 2.00 |
| J | 1.14 | 2.00 | 1.00 | 1.29 | 3.86 | 1.86 |

TABLE 11

Demands for the Technical Functions to Promote the P, E, F, J Components of Shelter

(1-5 scale)

| Component | Specific Instruction | Marketing Information | News, Weather | Entertainment | Opinion Formation | Personal Correspondence |
|---|---|---|---|---|---|---|
| P | 3.71 | 3.86 | 1.57 | 1.29 | 2.14 | 2.14 |
| E | 2.28 | 1.43 | 1.86 | 1.14 | 2.86 | 1.14 |
| F | 1.57 | 1.71 | 1.71 | 1.43 | 1.71 | 1.43 |
| J | 1.43 | 2.14 | 1.86 | 1.29 | 3.57 | 1.71 |

TABLE 12

Demands for the Technical Functions to Promote the P, E, F, J Components of Clothing

(1-5 scale)

| Component | Specific Instruction | Marketing Information | News, Weather | Enter-tainment | Opinion Formation | Personal Correspondence |
|---|---|---|---|---|---|---|
| P | 2.14 | 3.29 | 1.14 | 1.29 | 1.86 | 1.29 |
| E | 1.43 | 1.43 | 1.10 | 1.14 | 1.29 | 1.49 |
| F | 1.43 | 4.29 | 1.14 | 2.57 | 1.43 | 1.71 |
| J | 1.00 | 2.86 | 1.43 | 1.29 | 1.71 | 2.86 |

TABLE 13

Demands for the Technical Functions to Promote the P, E, F, J Components of Health

(1-5 scale)

| Component | Specific Instruction | Marketing Information | News, Weather | Enter-tainment | Opinion Formation | Personal Correspondence |
|---|---|---|---|---|---|---|
| P | 3.86 | 2.43 | 1.86 | 1.29 | 2.57 | 1.57 |
| E | 3.71 | 1.57 | 2.00 | 1.43 | 3.14 | 2.14 |
| F | 2.28 | 4.14 | 1.43 | 1.86 | 1.71 | 1.86 |
| J | 1.29 | 2.14 | 2.00 | 1.14 | 4.43 | 1.71 |

TABLE 14

Demands for the Technical Characteristics to Activate the Technical Functions

(1 - 5 scale)

| Function | Characteristic | | | | | | |
|---|---|---|---|---|---|---|---|
| | Promptness | Effective Bit Rate | Cheapness | Reli- ability | Accessi- bility | Storage/ Retrieval Capacity | Confiden- tiality |
| Specific Instruction | 3.00 | 4.00 | 4.00 | 4.00 | 5.00 | 4.00 | 1.00 |
| Marketing Information | 4.00 | 4.00 | 4.00 | 4.00 | 5.00 | 2.00 | 2.00 |
| News, Weather Service | 5.00 | 4.00 | 4.00 | 5.00 | 5.00 | 1.00 | 1.00 |
| Entertainment | 3.00 | 5.00 | 2.00 | 2.00 | 3.00 | 1.00 | 1.00 |
| Opinion Formation | 2.00 | 4.00 | 5.00 | 4.00 | 5.00 | 3.00 | 1.00 |
| Personal Correspondence | 2.00 | 3.00 | 3.00 | 4.00 | 5.00 | 2.00 | 5.00 |

Since no communication experts were available in the Wa-Bu area, the author made the estimation intuitively in collaboration with her dissertation director. The demands for each of the seven technical characteristics to activate each of the six technical functions are given in Table 14. Again, a 1-5 scale was chosen, 1 for the least strongly required, and 5 for the most strongly required.

5. Interviews with the Decision-Makers

The purpose of interviewing the decision-makers was two-fold: first, to estimate the cognitive distance between the decision-makers and the villagers concerning the current quality of life of the latter; second, to assess the value systems of the decision-makers. A total of 12 decision-makers, five from the Nam-Yang District Office, and seven from the Wa-Bu local government unit, were interviewed individually by the author.

All of the decision-makers were presented with three tasks. First, each decision-maker was asked to estimate the overall satisfaction level of the villagers as a whole, and that of each of the five societal sectors. To maintain consistency with the scale used in stratified sampling, a 7-point scale ranging from -3 to +3 was used. For computation, the decision-makers' estimate measured in the -3 to +3 scale was shifted to a 7-point scale ranging from 1 to 7.

The mean of the overall satisfaction level as estimated by the decision-makers and by the subjects are given in Table 15. By way of the difference-of-mean test, the estimates by the decision-makers for the villagers as a whole and for each societal sector were compared with the results obtained through stratified sampling. Except for the Clerical Workers, the decision-makers' perception of the

TABLE 15

Mean of the Overall Satisfaction Level of the Villagers as Estimated by the Decision-Makers and by the Sample Subjects

(1-7 scale)

| | Total Villagers* | Profess-ionals** | Clerical Workers | Commercial Sector* | Non-Ag Laborers*** | Farmers* |
|---|---|---|---|---|---|---|
| Estimates by the Decision-Makers | 4.32 | 5.57 | 4.20 | 5.23 | 4.05 | 4.50 |
| Estimates by the Sample Subjects | 4.07 | 4.92 | 4.19 | 4.79 | 2.62 | 3.92 |

p* < .05

p** < .01

p*** < .001

villagers' quality of life was considerably higher than that of the sample subjects.

Secondly, the decision-makers were asked to assign weights to each of P, E, F, J Goals in terms of their relative importance for setting development goals for the next five to ten years. In this task, the Maximum Expected Value (MEV) technique of operations research was applied. Based on the Bayesian probability theorem, the MEV requires the following criteria: 1) Assign a probability to each event with the probabilities summing to unity; 2) Compute the expected value of each action by multiplying each value by its corresponding probability and summing these products; 3) Choose an action whose expected value is greatest (cf., e.g., Moscowitz & Wright, 1979, p. 123). The first criterion of the MEV was applied to this case; thus the weight assignments to P, E, F, J Goals by the 12 decision-makers were averaged, and then normalized to make the sum of weights equal to 1. The normalized weight assignments to P, E, F, J Goals are given in Table 16.

TABLE 16

Decision-Makers' Weight Assignment to the P, E, F, J Goals

| P Goal | E Goal | F Goal | J Goal |
|---|---|---|---|
| .167 | .191 | .380 | .262 |

Thirdly, the decision-makers were asked to attach weights to each of the five societal sectors in terms of each sector's relative importance in public-resource-allocation plans.

The weights attached to the five societal sectors were averaged, and then normalized to unity. The decision-makers' weight attachments to the five societal sectors are given in Table 17.

TABLE 17

Decision-Makers' Weight Attachment to the Five Societal Sectors

| Professionals | Clerical Workers | Commercial Sector | Non-Ag Laborers | Farmers |
|---|---|---|---|---|
| .158 | .093 | .285 | .164 | .300 |

## Overview

This chapter presented a detailed description of the field study conducted in a rural village of South Korea. As background information, the overall socio-economic conditions and telecommunication environments of the sampled village are provided. The data-collection process was divided into the five major parts: stratified sampling among the villagers, inventory schedule of the telecommunication modes under assessment, panel discussion among a group of experts, evaluation of demands for the technical characteristics to activate the technical functions, and personal interviews with the decision-makers of the sampled village.

In stratified sampling across the five societal sectors, the interest was focused on three areas: the degree of satisfaction for the 16 basic human needs and overall satisfaction level in one's daily life; patterns of telecommunication usage; and basic demographic information about the sample subjects. The results of stratified sampling disclose a high degree of association between demographic variables and the overall satisfaction level. Among the five societal sectors, Non-Agricultural Laborers--who earn the smallest income--have the lowest overall satisfaction level. The Professionals, with the highest education as well as income, expressed the highest degree of satisfaction in daily life. As to the patterns of telecommunication usage, villagers showed a relatively high degree of access to the telecommunication modes. In terms of frequency of using the telecommunication modes, Audio-Cassette was identified as the highest, and Postal Service the lowest mode.

Inventory schedule of the telecommunication modes was completed based on estimates of the seven technical characteristics of each mode. Owing to the lack of theoretical principles for incorporating diverse telecommunication modes in one frame, some conceptual and measurement problems have emerged. Measurement of the technical characteristics was directed toward developing relative estimates rather than absolute scores.

The demand for technical functions in facilitating the Direct Areas of Telecommunication Application was estimated by a group of experts who possess extensive knowledge of the sampled village. The Direct Areas of Telecommunication Application were resolved into the four parts for each of the basic human needs under consideration; hence each of Nourishment, Shelter, Clothing, and Health was divided into the P, E, F, J components.

Owing to the absence of telecommunication experts in the Wa-Bu area, the demands for the specific technical characteristics required

for activating each of the technical functions had to be estimated by the author.

Through interviews with the decision-makers, it was found that the decision-makers' estimates of the villagers' quality of life are much higher than those made by the villagers themselves. The value systems of the decision-makers were placed in quantitative terms by their weight assignment to the four canonical human goals (P, E, F, J) and their weight attachment to the five societal sectors.

The empirical data serving as initial input for the Socio-Technical Assessment Model have been collected and tabulated. Before conducting operation of the Socio-Technical Assessment Model, the validity of the Model will be explored in the following chapter.

# CHAPTER V

# VALIDATION OF THE MODEL

This chapter presents various statistical tests performed to validate the Socio-Technical Assessment Model and the results of the investigation. Since testing of the whole methodological frame of the Model would require amounts of data and computations beyond our current resources, this study concentrates on areas in which the practical utility of the Model can be tested in a restricted field. The validation procedure is divided into two parts which explore the issues of: 1) how reliable and valid is the quality-of-life scheme adopted in the Model; and 2) to what extent telecommunication modes exert effects on the current quality of life of the villagers.

## The Quality-of-Life Scheme

The reliability and validity of the quality-of-life scheme were tested with the following three sets of questions:

Question 1: Do the basic human needs and the Overall Satisfaction Index S constitute reliable criteria in determining the current quality of life of the villagers?

Question 2: Do the basic human needs present clearly distinguishable patterns in a hyperdimensional space spanned by P, E, F, J Goals?

Question 3: Is the Overall Satisfaction Index S ascertainable in terms of the degree of fulfillment of P, E, F, J Goals?

Question 1: Do the basic human needs and the Overall Satisfaction Index S constitute reliable criteria in determining the current quality of life of the villagers?

To answer Question 1, three hypotheses were formulated.

$H_{1-1}$: The degree of satisfaction of the 16 basic needs and the Overall Satisfaction Index S measure the same dimension, namely, the quality of life.

$H_{1-2}$: The degree of satisfaction of each of the 16 basic needs shows positive and significant correlation with the Overall Satisfaction Index S.

$H_{1-3}$: The variance in the Overall Satisfaction Index S is sufficiently explained by the variances in the 16 basic needs.

Testing of Hypotheses

$H_{1-1}$: The degree of satisfaction of the 16 basic needs and the Overall Satisfaction Index S measure the same dimension, namely, the quality of life.

In testing $H_{1-1}$, the alpha reliability test of Cronbach was employed. In psychometric research, reliability usually refers to the degree of "repeatability" and "consistency" of empirical measurement (Zeller & Carmines, 1980, p. 48). Repeatability concerns with the stability of measurements over time in the same population. With respect to consistency, an estimate of reliability focuses on equivalence or internal consistency of measurements at a single point in time. Since replication of measurements was not possible in this study, the reliability of the quality-of-life items was assessed on the basis of internal consistency among the items included in the quality-of-life scheme. Cronbach's alpha reliability test produces a unique statistical product called the Alpha Coefficient that estimates the overall consistency of all items by computing the intercorrelation among the individual items (Cronbach, 1951). Cronbach's Alpha varies between 0 and 1--the closer it is to 1, the more consistent are the overall measurements supposed to be.

The results of the Conbach's alpha reliability test are given in Table 18. Here item-total correlation coefficients refer to the magnitude of correlation between the score for one item and the scores for all the other items in the set. The alpha for each item in Table 18 is a rough estimate of overall consistency of the total scale score after deleting the particular item. The standardized overall reliability estimate of the 17 items included in the quality-of-life scale was .63373, a little lower than the suggested level of acceptance of .70 (Nunnally, 1978, p. 245).

In many social science and psychometric studies, items whose item-total correlation coefficients lower than .30 are normally discarded, since such items do not explain at least 10 percent of the variance relating to the common factor among the items. In Table 18, only four of the basic needs--Nourishment, Shelter, Clothing, and Health--and the Overall Satisfaction Index S show item-total correlation coefficients higher than .30. Among the items, three of the basic human needs that relate strongly with the Group-Material Goal (E)--Unpolluted Air - Water-Soil, Pleasant Living Conditions, and Public Safety--show particularly low item-total correlation coefficients. Since these three items might have deflated the overall alpha estimate, a second test was performed with these items removed. The result of the second Cronbach's alpha reliability test are shown in Table 19. The overall reliability estimate was increased, as expected, to .72218. The item-total correlation coefficients for the items that relate strongly to the Individual-Material Goal (P)--Nourishment, Shelter, Clothing, and Health, and to the Individual-Spiritual Goal (F)--Opportunity for Education, Opportunity

TABLE 18

Reliability Estimate of the Quality-of-Life Scale with 17 Items

(N=200)

| Item | Item-Total Correlation Coefficient | Alpha If Item Deleted |
|---|---|---|
| Nourishment | .38492 | .58695 |
| Shelter | .33098 | .59249 |
| Clothing | .38517 | .58728 |
| Health | .29592 | .59847 |
| Physical Security | .34338 | .59193 |
| Unpolluted Air, Water, Soil | -.01592 | .64508 |
| Pleasant Living Condition | -.00696 | .64558 |
| Public Safety | .04631 | .63524 |
| Opportunity for Education | .18752 | .61568 |
| Opportunity for Profession | .27856 | .60240 |
| Political Freedom | .28165 | .60196 |
| Entertainment and Culture | .25208 | .60578 |
| Judicial Justice | .15003 | .61988 |
| Social Justice | .28158 | .60154 |
| Economic Justice | .24846 | .60650 |
| Communal Solidarity | .14488 | .62097 |
| Overall Satisfaction Index S | .48930 | .57291 |

Reliability Coefficients of 17 items:

Overall Alpha: .62283 Standardized Item Alpha: .63373

TABLE 19

Reliability Estimate of the Quality-of-Life Scale with 14 Items

(N=200)

| Item | Item-Total Correlation Coefficient | Alpha If Item Deleted |
|---|---|---|
| Nourishment | .53000 | .68200 |
| Shelter | .43922 | .69102 |
| Clothing | .52603 | .68286 |
| Health | .47635 | .68621 |
| Physical Security | .12844 | .72897 |
| Opportunity for Education | .33221 | .70542 |
| Opportunity for Profession | .40716 | .69697 |
| Political Freedom | .39695 | .69809 |
| Entertainment and Culture | .33266 | .70513 |
| Judicial Justice | .06291 | .73512 |
| Social Justice | .21793 | .71810 |
| Economic Justice | .20701 | .71858 |
| Communal Solidarity | .05224 | .73724 |
| Overall Satisfaction Index S | .61068 | .67329 |

Reliability Coefficients of 14 items:

Overall Alpha: .72044 Standardized Item Alpha: .72218

for Profession, Political Freedom, and Entertainment and Culture--have increased substantially in the second test. On the other hand, the items relate strongly to the Group-Spiritual Goal (J)--Judicial Justice, Social Justice, Economic Justice, and Communal Solidarity--showed much lower item-total correlation coefficients in the second test.

The results of the two Cronbach's reliability tests furnish some interesting points. First, changes of the item-total correlation coefficients over the two tests seem to indicate that the quality-of-life scale may not in fact be reducible to a single dimension as hypothesized in $H_{1-1}$. The variances of the items over the two tests showed consistency within the range of each item's corresponding canonical human goals. Second, low item-total correlation coefficients of those E-Goal-related items may be due to particular situations prevailing in the developing countries. In many of these, the development policies usually give primary impetus to industrialization in order to raise overall economic productivity. As a result, the natural environment tends to deteriorate because of increasing chemical pollution. Even in the industrialized nations, ecological aspects were not given much attention until quite recently. For these two reasons, it may not be appropriate to discard the E-Goal-related items from the quality-of-life scale.

In the absence of empirical results obtained in other societies, it is difficult to judge generalizability of the quality-of-life scheme. Therefore, two additional statistical tests were performed to measure the reliability of the quality-of-life scheme including the 16 basic needs and the Overall Satisfaction Index S.

The results of Analysis-of-Variance test and Hotelling's T-squared equality-of-means test are given in Table 20 and Table 21 in Appendix D. The analysis-of-variance test that estimates variance between the item scores as against the residuals computed from linear composition of the items yielded an overall F value of 40.65, significant at .001 level. Hotelling's T-squared equality-of-means test among the 17 items included in the quality-of-life scale produced an overall F value of 22.48, significant at .000 level.

The statistics applied to test $H_{1-1}$ can be summarized as follows: Cronbach's alpha reliability test yielded an overall reliability estimate of .63373 for the quality-of-life scale. Though this somewhat low reliability estimate appears to be caused by the three basic human needs that relate strongly with the E Goal, the underlying reason may yet be the multiple dimensions within the quality-of-life scheme. Two other statistical tests suggest that the overall reliability level of the quality-of-life scheme based on the 16 basic needs and the Overall Satisfaction Index S is statistically significant. Therefore, one can conclude that the quality-of-life scheme employed in this Model, though promising, needs further exploration.

$H_{1-2}$: The degree of satisfaction of each of the basic human needs shows positive and significant correlation with the Overall Satisfaction Index S.

To test $H_{1-2}$, Pearson product-moment zero-order correlation tests were performed with each of the 16 pairs. Table 22 lists the mean of the basic human needs and the Overall Satisfaction Index S, and the correlation coefficients between each need and S. The latter again indicate the multidimensional aspects of the quality-of-life scale.

TABLE 22

Correlation Coefficients Between the Basic Human Needs and the Overall Satisfaction Index S

(N=200)

| Need | Mean (1-7 scale) | Correlation Coefficient between need and S(r) |
|---|---|---|
| Nourishment | 4.49 | .5611*** |
| Shelter | 4.36 | .5997*** |
| Clothing | 4.33 | .6194*** |
| Health | 3.77 | .5144*** |
| Physical Security | 4.35 | .0326 |
| Unpolluted Air, Water, Soil | 4.74 | -.1829** |
| Pleasant Living Conditions | 4.42 | -.2344*** |
| Public Safety | 4.41 | -.1954** |
| Opportunity for Education | 3.36 | .3267*** |
| Opportunity for Profession | 3.16 | .2675*** |
| Political Freedom | 3.19 | .2608*** |
| Entertainment and Culture | 2.61 | .1868** |
| Judicial Justice | 4.40 | .0147 |
| Social Justice | 4.11 | .0651 |
| Economic Justice | 4.04 | .0341 |
| Communal Solidarity | 5.06 | .0349 |
| Overall Satisfaction Index S | 4.07 | |

*p < .05

**P < .01

***p < .001

The basic human needs that are believed to relate strongly to the P Goal show strong positive correlation coefficients, all significant at .001 level. The three basic human needs that have distorted the internal consistency of the quality-of-life scheme exhibit significant negative relationships with the Overall Satisfaction Index S. Those basic human needs that relate strongly to the F Goal show significant positive relationships with S. Nevertheless, correlation coefficients for those F-Goal-related needs are much smaller compared with those for the P-Goal-related needs. The basic human needs that contribute to the J Goal show little correlation with the Overall Satisfaction Index S.

The Pearson product-moment correlation tests can be summarized as follows. First, the 16 basic needs and the Overall Satisfaction Index S suggest the multidimensional aspects of the quality-of-life scheme. Second, there seems to be some order among the basic needs in terms of their relationship with the Overall Satisfaction Index S. The order of the human needs with respect to overall satisfaction level may vary from one society to another. In the particular case of Wa-Bu Village, the order seems to be in a descending order from the P-Goal-related needs to the F-Goal-related needs, the J-Goal-related needs, and the E-Goal-related needs.

> $H_{1-3}$: The variance in the Overall Satisfaction Index S is sufficiently explained by the variances in the 16 basic human needs.

In testing $H_{1-3}$, multiple-regression tests were applied by construing the Overall Satisfaction Index S as the dependent variable. Two different regression procedures have been employed. First, all the 16 needs were entered into the equation simultaneously without

arbitrary constraint. Second, the constant (intercept) was forced to go through zero while the independent variables were entered into the equation in such order that the independent variable explaining the greatest amount of variance in the dependent variable S was entered first, the independent variable explaining the second largest amount next, and so on.

The results of the two regression procedures are given in Table 23. The total amount of variance in S explained by the 16 basic needs is fifty four percent ($R^2$ = .54027) by the first method. The second method yielded $R^2$ value of .95262, meaning that more than 95 percent of the variance in S was explained by the 16 basic needs. The overall F value obtained through the first method was 13.44136, and that through the second method was 233.77210. The overall F values from both methods were significant at .000 level. Among the 16 basic needs, five--Shelter, Clothing, Health, Opportunity for Education, and Communal Solidarity--were found to make significant effects on the Overall Satisfaction Index S. With the statistics obtained from the two regression tests, $H_{1-3}$ was confirmed.

Overall, the statistical results acquired from testing $H_{1-1}$, $H_{1-2}$, and $H_{1-3}$ enable us to affirm that the basic needs and the Overall Satisfaction Index S constitute reasonably reliable criteria in estimating the quality of life of the villagers.

Question 2: Do the basic human needs present clearly distinguishable patterns in a hyperdimensional space spanned by P, E, F, J Goals?

The second question deals with the most important feature of the Socio-Technical Assessment Model. The multidimensional aspects of the

TABLE 23

Multiple Regression with the 16 Basic Needs
on the Overall Satisfaction Index S

(N=200)

| Need | Method 1[a] Constant | Method 1[a] Standardized Regression Coefficient | Method 2[b] Constant | Method 2[b] Standardized Regression Coefficient |
|---|---|---|---|---|
| | -.70745 | | 0 | |
| Nourishment | | .02852 | | .01336 |
| Shelter | | .29284** | | .26134** |
| Clothing | | .29167** | | .29223** |
| Health | | .17373* | | .12750* |
| Physical Security | | -.05259 | | -.03731 |
| Unpolluted Air, Water, Soil | | .09910 | | .07244 |
| Pleasant Living Conditions | | -.10674 | | -.10830 |
| Public Safety | | .05703 | | .03147 |
| Opportunity for Education | | .17015* | | .10979* |
| Opportunity for Profession | | -.00706 | | -.01027 |
| Political Freedom | | .08989 | | .06389 |
| Entertainment and Culture | | .00305 | | .00002 |
| Judicial Justice | | .05819 | | .04548 |
| Social Justice | | .00792 | | .01589 |
| Economic Justice | | .02909 | | .00935 |
| Communal Solidarity | | .12856* | | .12539* |

a: All variables are entered into the equation simultaneously without arbitrary constraint.

b: Variables are entered into the equation in step-wise order with constant forced to be zero.

*p < .05
**p < .01

quality-of-life scheme were suggested in $H_{1-1}$ and $H_{1-2}$ of Question 1. In Question 2, the proposed multidimensional aspects were directly tested with statistical tests. Here, the prime research interest is focused on the validity of the quality-of-life measurement. Validity is defined as the extent to which an instrument measures what it is supposed to measure (Zeller & Carmines, 1980, p. 78). Among various statistical tests, factor analysis often offers an attractive way of assessing validity of measurement by identifying the linkage between theoretical concepts and empirical measurements. Accordingly, factor analysis was chosen to reply to Question 2.

In this case, factor analysis served as confirmatory rather than exploratory, since the Model has already postulated the number of factors likely to emerge, and the likely clustering of the basic needs variables. A confirmatory factor analysis usually requires an *a priori* model to test the validity of the measurement. Along the guidelines suggested by Armstrong and Soelberg (1969) in establishing an *a priori* model in confirmatory factor analysis, the following two hypotheses were formulated:

$H_{2-1}$: The number of factors likely to appear is four (P, E, F, J Goals);

$H_{2-2}$: The clustering of the basic human needs will form four sets along each of the P, E, F, J Goals:

Nourishment, Shelter, Clothing, and Health will cluster around the P Goal;

Physical Security, Unpolluted Air-Water-Soil, Pleasant Living Conditions, and Public Safety will cluster around the E Goal;

Opportunity for Education, Opportunity for Profession, Political Freedom, and Entertainment and Culture will cluster around the F Goal; and

Judicial Justice, Social Justice, Economic Justice, and Communal Solidarity will cluster around the J Goal.

Testing of Hypotheses

Two different methods of factor analysis--Maximum-Likelihood, and Principal-Factoring with Iteration--were chosen to test $H_{2-1}$ and $H_{2-2}$.

Maximum-Likelihood Solutions

For this study, the Maximum-Likelihood formulation of factor analysis has distinct advantages over other techniques. With the Maximum-Likelihood solutions, one can test sufficiency in the number of common factors by exploring the variance among the observed variables accounted for by the common factors. Unlike other factor-analysis techniques that force the common factors to account for as much as possible of the variance in the observed variables, Maximum-Likelihood seeks the common factors which relate to the observed variables maximally (Harman, 1967, p. 219). Commonly used in causal-modeling statistics, Maximum-Likelihood solutions can provide estimators of the population parameters based on the observed values. The Maximum-Likelihood method assumes that all common factors are independent of one another (i.e., orthogonal), and that the observed variables have normal distribution with zero mean and unit variance. The hypothesis concerning the numbers of common factors can be tested with the Chi-Square probability distribution. The Maximum-Likelihood solution established by Joreskog (1966) was available in a packaged computer-program format in the supplement of the Statistical Package of Social Sciences (Michigan State University, SPSS supplement, 1979).

Before computation begins, the Maximum-Likelihood method inquires as to the adequacy of the correlation matrix for the observed variables (in this case, the degree of satisfaction for the 16 basic needs).

In assessing this adequacy, Dziuban and Shirkey (1974) proposed three statistical tests. First, the determinant of the correlation matrix has to be close to zero, and the probability associated with the Bartlett's test of sphericity (Bartlett, 1950) that measures independence among the factors has to be statistically significant. Second, the greater the number of zeros in the off-diagonal elements of the anti-image covariance matrix, the more appropriate is a correlation matrix. Third, Kaiser-Meyer-Olkin's sampling-adequacy test should yield values close to one (in its range from zero to one).

The results of these three tests were as follows:

1. The determinant of the correlation matrix was .0003671, extremely close to zero. The Bartlett's test of sphericity yielded a value of 1525.30 which was significant at the .000 level with 120 degrees of freedom;
2. Only 40 (or 16.67 percent) of the off-diagonal elements of the anti-image covariance matrix were greater than zero (actually greater than .9); hence 83.33 percent of the off-diagonal elements were close to zero;
3. The Kaiser-Meyer-Olkin's sampling adequacy test produced an estimate of .73333, a value which can be considered close to one.

With these statistics, the adequacy of the correlation matrix for the sixteen basic needs was confirmed. The correlation matrix itself is given in Table 24 in Appendix E.

Next, the Maximum-Likelihood factor analysis was performed. To avoid arbitrary constraints, a non-rotated method was chosen. The factor loadings, thus obtained, are listed in Table 25. Here, the

TABLE 25

Factor Matrix of the 16 Basic Needs:
Maximum-Likelihood Non-Rotated Soluation

(N=200)

| Need | Factor (F Goal) | (P Goal) | (J Goal) | (E Goal) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | .218 | .816 | .172 | .176 | .781 |
| Shelter | .203 | .734 | .045 | .280 | .660 |
| Clothing | .238 | .748 | .108 | .185 | .662 |
| Health | .207 | .669 | .140 | .027 | .511 |
| Physical Security | .029 | -.188 | .225 | .488 | .325 |
| Unpolluted Air, Soil, Water | -.337 | -.385 | .076 | .602 | .629 |
| Pleasant Living Conditions | -.381 | -.356 | .110 | .617 | .666 |
| Public Safety | -.155 | -.436 | .191 | .442 | .446 |
| Opportunity for Education | .655 | .060 | -.093 | -.018 | .441 |
| Opportunity for Profession | .977 | -.102 | .029 | .018 | .965 |
| Political Freedom | .882 | -.064 | .019 | .059 | .786 |
| Entertainment and Culture | .528 | .028 | .128 | -.003 | .296 |
| Judicial Justice | -.214 | -.127 | .419 | .041 | .239 |
| Economic Justice | -.124 | -.051 | .824 | -.097 | .707 |
| Social Justice | -.102 | -.082 | .870 | -.161 | .800 |
| Communal Solidarity | -.138 | -.194 | .379 | .062 | .204 |
| Variance Components | 3.00 | 2.79 | 1.95 | 1.37 | |
| Percentage of Variance Explained | 18.8 | 17.5 | 12.2 | 8.6 | |

estimated communality ($h^2$) refers to the amount of variance in each basic human need accounted for by the four common factors (P, E, F, J Goals). The estimated communalities were computed by summing the squared factor loadings across each row. The variance components of the common factors represent the amount of variances in all of the 16 basic needs accounted for by specific factors. In the usual way, the variance components (commonly known as the Eigenvalues) are obtained by summing the squared factor loadings down each column. The percentage of variance explained by each of the common factors was calculated by dividing the variance of each component by 16 (presuming that total variance in the 16 basic human needs equals 16).

As appears clearly in Table 25, the 16 basic needs cluster around the four common factors, which can be identified as the F, P, J and E canonical goals. The factor loadings of the basic needs were consistent as hypothesized in $H_{2-2}$: Nourishment, Shelter, Clothing, and Health show the highest factor loadings on a common factor that can be identified as the P Goal; Physical Security, Unpolluted Air-Water-Soil, Pleasant Living Conditions, and Public Safety show the highest factor loadings on a common factor that can be identified as the E Goal; Opportunity for Education, Opportunity for Profession, Political Freedom, and Entertainment and Culture show the highest factor loadings on a common factor that can be identified as the F Goal; Judicial Justice, Social Justice, Economic Justice, and Communal Solidarity show the highest factor loadings on a common factor that can be identified as the J Goal. Estimated communality of the basic human needs shows differing degree of magnitude, suggesting that some of the needs can perhaps be omitted in formulating a quality-of-life index. The first common factor (F Goal) accounts for 18.8 percent of the total variance in the 16 basic needs; the second (P Goal), for 17.5 percent; the third (J Goal), for 12.2 percent; and the fourth (E Goal), for 8.6 percent.

The hypothesis which stipulates that the number of common factors as four ($H_{2-1}$) was tested with the Maximum Likelihood Estimate ($U_m$) of the factor loadings upon the four common factors. The formula for the Maximum Likelihood Estimate ($U_m$) is:

$$U_m = -2 \log \lambda,$$

in which m refers to the number of common factors (in this case, m=4), and $\lambda$ refers to the likelihood ratio. Here $U_{(m=4)}$ was estimated as 130.771. The $U_{(m=4)} = 130.771$ was then evaluated against the Chi-Square distribution. The number of degrees of freedom was given by the formula:

$$v = \tfrac{1}{2} [(n-m)^2 - n - m],$$

in which n stands for the number of the observed variables (in this case, 16 for the 16 basic needs), and m stands for the number of common factors (in this case, 4 for the P, E, F, J Goals). Here v, which refers to the degrees of freedom, was calculated as 62. The Maximum-Likelihood Estimate $U_4 = 130.771$ was significant at the .001 level at 62 degrees of freedom, indicating that the goodness-of-fit of the factor-analysis model is satisfactory.

In sum, the statistics obtained through the Maximum Likelihood non-rotated factor analysis enabled us to confirm both $H_{2-1}$ and $H_{2-2}$.

Principal Factoring with Iteration

The Principal-Factoring method follows the patterns common in the classical factor analysis. The correlations among the observed variables are assumed to be the result of the commonly-shared factors underlying the observed variables. Each of the common factors is forced to account for as much as possible of the variance in the observed variables. With iteration, the main diagonal of the correlation matrix for the observed variables is replaced by the estimated communality of each observed variable (Harman, 1967, p. 137). The results of analysis then give the factor loadings of the observed variables on the inferred common factors.

In this study, since each basic human need is hypothesized to load highly onto a single factor, the Quartimax rotating technique was chosen. In the Quartimax Principal-Factoring method, the observed variables are manipulated to produce the highest loading on one common factor that has a high degree of association with the specific observed variables, and to have minimal loadings onto the other common factors that have much less to do with the observed variables (Nie et al., 1975).

The results of the Principal-Factoring with Quartimax rotation are given in Table 26. Again, the clustering of the basic human needs showed the patterns as suggested in $H_{2-2}$. In comparison with the factor loadings acquired from the Maximum-Likelihood non-rotated solutions as listed in Table 25, those in Table 26 are somewhat higher. In the Principal Factoring, the first common factor (P Goal) was forced to account for 24.56 percent of the total variance in the 16 basic human needs, a value much higher than the 18.8 percent accounted for by the first factor (F Goal) in the Maximum-Likelihood solution. Yet the

TABLE 26

Factor Matrix of the 16 Basic Needs:
Principal-Factoring Quartimax Rotation Solution

(N=200)

| Need | Factor 1 (P Goal) | Factor 2 (F Goal) | Factor 3 (J Goal) | Factor 4 (E Goal) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | .869 | .098 | .007 | -.107 | .776 |
| Shelter | .803 | .065 | -.122 | -.024 | .665 |
| Clothing | .788 | .124 | -.027 | -.107 | .648 |
| Health | .681 | .125 | .030 | -.190 | .517 |
| Physical Security | .050 | .146 | .140 | .567 | .400 |
| Unpolluted Air, Water, Soil | -.183 | -.249 | .049 | .714 | .608 |
| Pleasant Living Conditions | -.155 | -.283 | .096 | .716 | .625 |
| Public Safety | -.233 | -.045 | .147 | .631 | .476 |
| Opportunity for Education | .127 | .630 | -.161 | -.094 | .448 |
| Opportunity for Profession | .041 | .969 | -.089 | -.054 | .952 |
| Political Freedom | .072 | .877 | -.098 | -.017 | .784 |
| Entertainment and Culture | .117 | .507 | .053 | -.078 | .280 |
| Judicial Justice | -.050 | -.129 | .484 | .142 | .273 |
| Social Justice | .052 | -.014 | .826 | .039 | .687 |
| Economic Justice | .021 | -.000 | .868 | .003 | .754 |
| Communal Solidarity | -.103 | -.071 | .433 | .178 | .235 |
| Eigenvalue | 3.93 | 2.06 | 1.85 | 1.29 | |
| Percentage of Variance Explained | 43.0 | 22.5 | 20.3 | 14.1 | |

second, third, and fourth factors in the Principal Factoring account for smaller amounts of variance than the corresponding factors in the Maximum-Likelihood solutions. The difference in the factor loadings is largely due to the arbitrary constraints imposed in the Principal-Factoring methods. Therefore, we can conclude that the statistical information obtained through the Maximum-Likelihood non-rotated solution appears to be less contaminated by the statistical artifacts than that produced by the Principal-Factoring methods.

In conclusion, two different factor-analysis solutions have confirmed that the 16 basic needs display clearly distinguishable patterns in hyperdimensional space spanned by the four canonical goals underlying the quality-of-life concept. Accordingly, the reply for <u>Question 2</u> is found to be positive.

<u>Question 3</u>: Is the Overall Satisfaction Index $\underline{S}$ ascertainable in terms of the degree of fulfillment of P, E, F, J Goals?

In <u>Question 3</u>, we are interested in testing the mathematical assumption of the Socio-Technical Assessment Model as proposed in equation (1):

$$\underline{S}(P, E, F, J) = \alpha_P S_P + \alpha_E S_E + \alpha_F S_F + \alpha_J S_J \ldots (1)$$

To answer <u>Question 3</u>, the following hypothesis was formulated.

$H_3$: The variance in the Overall Satisfaction Index $\underline{S}$ can be adequately explained by the variance in the partial satisfaction indexes $S_P$, $S_E$, $S_F$, and $S_J$ as they occur in the linear composition of $\underline{S}$.

<u>Testing of Hypothesis</u>

In testing $H_3$, a critical question of measuring the partial satisfaction indexes for each canonical human goal emerged. In many social-science investigations, the prime function of factor analysis is the

reduction of the number of observed variables to a manageable number of underlying factors. New scales typically are created on the basis of a small number of observed variables that have high factor loadings on one of the common factors (Gorsuch, 1974; Horn, 1965; Alwin, 1973). The conventional methods of creating new scales relying on the variables that dominate particular factors, however, are not applicable in the present study. The major reason for not following conventional methods is that the Socio-Technical Assessment Model hypothesizes that $S_P$, $S_E$, $S_F$ and $S_J$ are determined not only by the basic needs that dominate the corresponding goal, but also by other needs included in the quality-of-life scheme.

For sake of discussion, nevertheless, two different approaches were tried. In the first approach, the partial satisfaction indexes $S_P$, $S_E$, $S_F$, $S_J$ of each individual were obtained by averaging an individual's scores for the basic needs that show high factor loadings on the corresponding factor. An overall scheme of the first approach is illustrated in Figure 6. Here, $S_P^*$, $S_E^*$, $S_F^*$, $S_J^*$ for the k-th individual were computed through formulas:

$$S_{Pk}^* = \tfrac{1}{4}\,(S_k^1 + S_k^2 + S_k^3 + S_k^4),$$

$$S_{Ek}^* = \tfrac{1}{4}\,(S_k^5 + S_k^6 + S_k^7 + S_k^8),$$

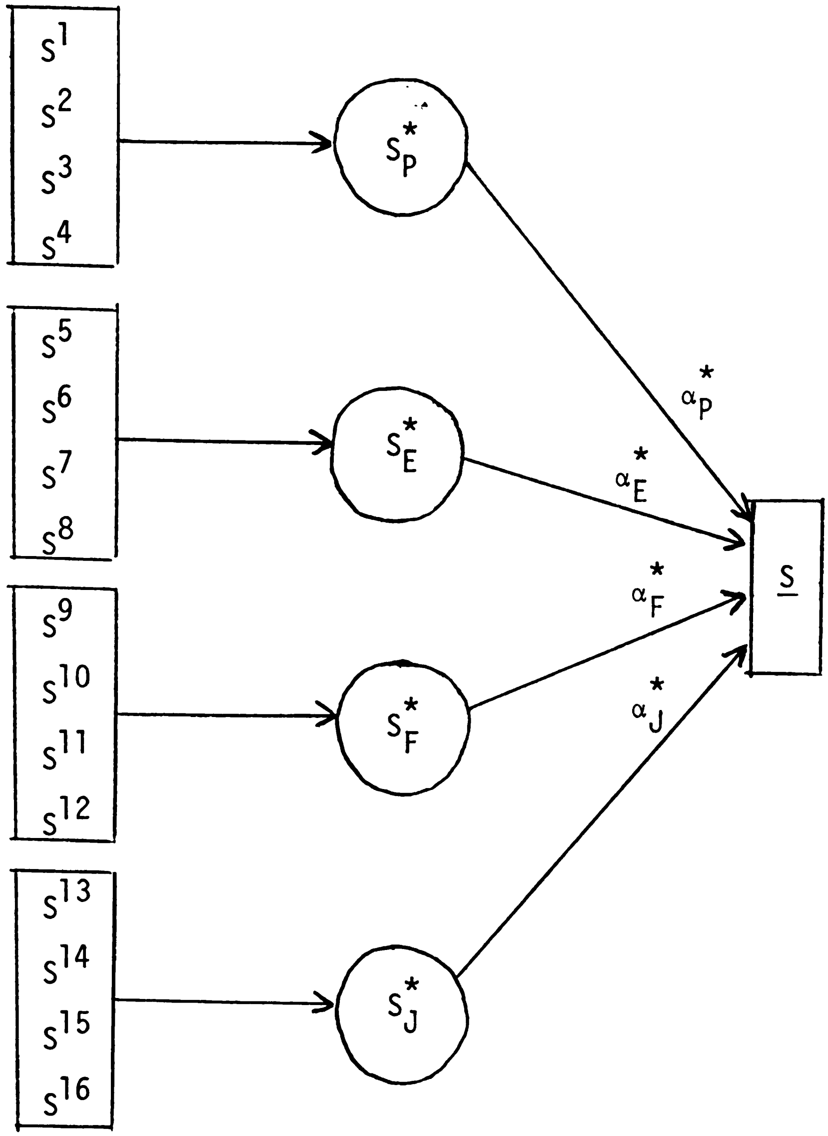
$$S_{Fk}^* = \tfrac{1}{4}\,(S_k^9 + S_k^{10} + S_k^{11} + S_k^{12}),$$

$$S_{Jk}^* = \tfrac{1}{4}\,(S_k^{13} + S_k^{14} + S_k^{15} + S_k^{16}),$$

in which $S_k^v$ refers to the satisfaction score of the k-th individual for the v-th basic need. In other words, the $S_P^*$ score of each individual was computed by averaging the score on Nourishment (v=1), Shelter (v=2), Clothing (v=3), and Health (v=4). The $S_E^*$ score is the average of

Figure 6

A Restricted Regression Model of the Quality-of-Life Scheme




$S_i^*$: Alternative Partial Satisfaction Index of the i-th Canonical Human Goal

$S^v$: Satisfaction Level of the v-th Basic Need.

$\alpha_i^*$: Contributing Rate of the $S_i^*$ to the Overall Satisfaction Index $\underline{S}$

Physical Security (v=5), Unpolluted Air, Water, Soil (v=6), Pleasant Living Conditions (v=7), and Public Safety (v=8). The $S_F^*$ score is the average of Opportunity for Education (v=9), Opportunity for Profession (v=10), Political Freedom (v=11), and Entertainment and Culture (v=12). The $S_J^*$ score is the average of Judicial Justice (v=13), Social Justice (v=14), Economic Justice (v=15), and Communal Solidarity (v=16).

The $S_P^*$, $S_E^*$, $S_F^*$, $S_J^*$ scores of each individual were then regressed on his/her score for the Overall Satisfaction Index $\underline{S}$. To maintain consistency with equation (1), the constant was forced to be zero. The results of the regression analysis in the first approach can be summarized as:

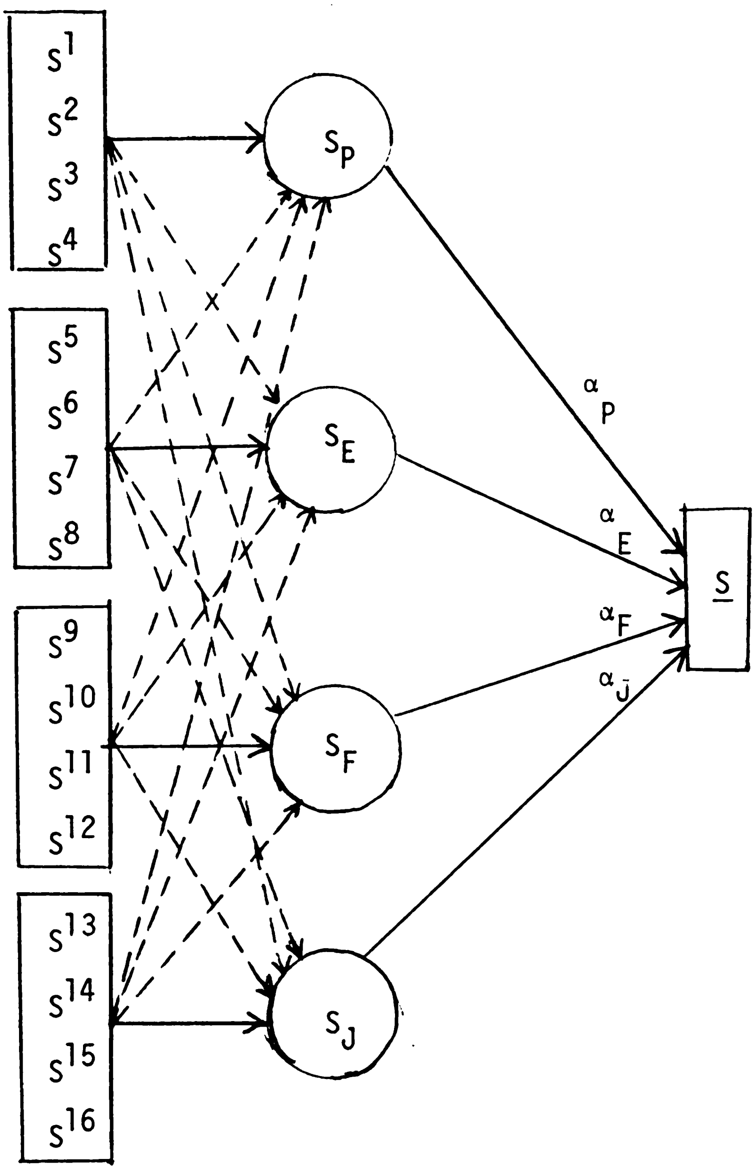
$$\underline{S} = .685\ S_P^* - .012\ S_E^* + .168\ S_F^* + .154\ S_J^* \ \ldots \ (2)$$

In equation (2), the regression analysis produced a Multiple R value of .70726, R-Squared ($R^2$) value of .49257, and an overall F value of 210.99, which is significant at the .001 level. The regression coefficient for $S_P^*$ is significant at the .001 level, and those of $S_F^*$ and $S_J^*$ are significant at the .05 level. The regression coefficient for $S_E^*$, which exerts negative effect on $\underline{S}$, is not statistically significantly different from zero.

In the second approach, the partial satisfaction indexes $S_P$, $S_E$, $S_F$, $S_J$ were construed to reflect not only those basic needs that have high factor loadings on the corresponding goal, but also all the other human needs included in the quality-of-life scheme. An overall scheme of the second approach is presented in Figure 7. Here, the partial satisfaction indexes were viewed as exogenous variables that cannot be measured directly but are to be inferred from the observed values in the parameter estimates. The estimates of the partial satisfaction

Figure 7

An Unrestricted Regression Model of the Quality-of-Life Scheme




$S_i$: Partial Satisfaction Index of the i-th Canonical Human Goal

$S^v$: Satisfaction Level of the v-th Basic Human Need

$\alpha_i$: Contributing Rate of $S_i$ to the Overall Satisfaction Index $\underline{S}$

indexes were taken from the factor scores obtained in the Maximum-Likelihood non-rotated solutions. The formula for extracting the factor score of the k-th individual in the i-th canonical goal (i.e., i-th factor) is given by:

$$S_{ik} = \sum_{i=1}^{16} F_i^v \cdot Z_k^v$$

in which $F_i^v$ refers to the factor-score coefficient of the v-th basic need with respect to the i-th canonical goal, and $Z_k^v$ refers to the standardized value of the k-th individual's score on the v-th basic need. Undoubtedly, the most crucial measurement criterion in this case is the factor-score coefficients. The factor-score coefficients, which are analogous to the regression coefficients in regression analysis, designate the amount of variance in the underlying common factors explained by each observed variable. The $Z_k^v$'s, which represent the standardized value of the k-th individual's score on the v-th basic need, are obtained from the definition:

$$Z_k^v = \frac{S_k^v - \text{Mean of } S^v}{\text{Standard Deviation of } S^v},$$

in which $S_k^v$ refers to the k-th individual's score on the v-th basic need. The $S_i$'s computed from these formulations are represented as vectors in the i-th factor space. Logically, the $S_{ik}$ for the k-th individual can be accepted as his/her relative position in the i-th canonical-goal space.

The factor-score coefficients obtained in the Maximum-Likelihood non-rotated solutions are given in Table 27. With the factor-score coefficients listed there, the formula for computing the $S_p$ score for the k-th individual ($S_{pk}$) becomes:

TABLE 27

Factor-Score Coefficients of the Basic Needs:
Maximum-Likelihood Non-Rotated Solution

(N=200)

| Need | Factor P Goal | E Goal | F Goal | J Goal |
|---|---|---|---|---|
| Nourishment | .380 | .198 | .029 | .098 |
| Shelter | .220 | .182 | .017 | .017 |
| Clothing | .225 | .121 | .020 | .040 |
| Health | .139 | .012 | .012 | .036 |
| Physical Security | -.028 | .160 | .001 | .042 |
| Unpolluted Air, Water, Soil | -.106 | .359 | -.026 | .026 |
| Pleasant Living Conditions | -.109 | .408 | -.033 | .041 |
| Public Safety | -.080 | .176 | -.008 | .043 |
| Opportunity for Education | .011 | .007 | .034 | -.021 |
| Opportunity for Profession | -.302 | .120 | .808 | .105 |
| Political Freedom | -.030 | .061 | .178 | .011 |
| Entertainment and Culture | .004 | -.001 | .022 | .023 |
| Judicial Justice | -.020 | .012 | -.008 | .069 |
| Social Justice | -.018 | -.074 | -.012 | .352 |
| Economic Justice | -.042 | -.178 | -.015 | .555 |
| Communal Solidarity | -.025 | .017 | -.005 | .060 |

$$S_{Pk} = .380\ Z_k^1 + .220\ Z_k^2 + .225\ Z_k^3 + .139\ Z_k^4$$
$$- .028\ Z_k^5 - .106\ Z_k^6 - .109\ Z_k^7 - .080\ Z_k^8$$
$$+ .011\ Z_k^9 - .302\ Z_k^{10} - .030\ Z_k^{11} + .004\ Z_k^{12}$$
$$- .020\ Z_k^{13} - .018\ Z_k^{14} - .042\ Z_k^{15} - .025\ Z_k^{16}.$$

The $S_{Ek}$, $S_{Fk}$, $S_{Jk}$ scores were obtained in similar manner, i.e., with the factor-score coefficients and the standardized value of the k-th individual score on the v-th basic need.

The partial satisfaction indexes of each individual were then regressed on his/her score for the Overall Satisfaction Index $\underline{S}$. The results can be summarized as:

$$\underline{S} = .593\ S_P + .172\ S_E + .321\ S_F + .162\ S_J \ldots (3)$$

In this equation, the Multiple R was .71465, $R^2$ was .51073, and the overall F value was 51.1490, significant at the .001 level. All four of the regression coefficients were significant at the .001 level.

Compared with Equation (2) in which the $S_P$, $S_E$, $S_F$, $S_J$ scores are the average values for the basic needs that produce high factor loadings on the corresponding goal variables (P, E, F, J), Equation (3) produces somewhat similar Multiple R and $R^2$ values. Yet, the regression coefficients for the two equations show considerable divergence. The regression coefficient for $S_P$ decreased to .593 in equation (3) from .685 in equation (2). The regression coefficient for $S_E$ increased drastically from -.012 to .172. The regression coefficient for $S_F$ also showed a substantial increase from .168 to .321. The regression coefficient for $S_J$ increased to .162 from .154. The changes of the regression coefficients between the two different approaches suggest underlying interrelationship among the basic needs. The drop in the

regression coefficient for $S_P$ can perhaps be explained by the conjecture that a substantial portion of the variances in Nourishment, Shelter, Clothing, and Health is actually absorbed in E and F canonical goals. In addition, a drastic increase in the regression coefficient for $S_E$ suggests the following hypothesis: although those E-Goal-related basic needs appear to have negative relationship with the Overall Satisfaction Index $\underline{S}$, after partialing out their influences on P, F, and J Goals, the E-Goal-related needs contribute substantially to the changes in $\underline{S}$. The increase of the regression coefficient for $S_F$ suggests also that the F-Goal-related basic needs may exert more influence on the Overall Satisfaction Index $\underline{S}$ than they appear to.

The empirical findings in testing $H_3$ can be summarized as:

1) The variance in the Overall Satisfaction Index $\underline{S}$ is explained by the variances in the partial satisfaction indexes $S_P$, $S_E$, $S_F$, $S_J$ as they occur in the linear composition of $\underline{S}$.

2) All of the partial satisfaction indexes contribute substantially to the Overall Satisfaction Index $\underline{S}$.

3) In this particular case of the village in South Korea, $S_P$ has the most dominant effect on the Overall Satisfaction Index $\underline{S}$, followed by $S_F$. $S_E$ and $S_J$ exert modest but significant effects on the Overall Satisfaction Index $\underline{S}$.

In conclusion, the quality-of-life scheme adopted in the Socio-Technical Assessment Model was found to be reliable and valid as tested with empirical data. We are, therefore, in position to investigate the technological part of the Model in the second part of this chapter.

Telecommunication and the Quality-of-Life

The second part of the validation of the Model deals with the potentiality of the telecommunication modes for enhancing the quality of life in the village by examining their current effects on the villagers' quality of life. The two research questions will be explored in the second part of this chapter. They are:

Question 4: Does access to telecommunication modes have significant effects on the Overall Satisfaction Index S of the villagers?

Question 5: Does frequency of usage for telecommunication modes have significant effects on the Overall Satisfaction Index S?

Each question was examined in conjunction with several hypotheses.

Question 4: Does access to telecommunication modes have significant effects on the Overall Satisfaction Index S of the villagers?

Question 4 was operationalized with three hypotheses:

$H_{4-1}$: For each individual, the access to the telecommunication modes correlates positively with the Overall Satisfaction Index S.

$H_{4-2}$: For each individual, the access to the telecommunication modes is affected by the level of education, level of income, and profession.

$H_{4-3}$: For each individual, the access to the telecommunication modes affects the Overall Satisfaction Index S, after controlling for level of education, level of income, and profession.

Testing of Hypotheses

$H_{4-1}$: For each individual, the access to the telecommunication modes correlates positively with the Overall Satisfaction Index S.

$H_{4-1}$ was tested with the Pearson product-moment correlation tests. Besides the access scores of all of the ten telecommunication modes, a new scale called "Total Access" was created by averaging the access

scores of the ten modes. The results of the correlation analysis are given in Table 28. Except for Radio, all modes and the Total Access showed positive correlation coefficients. Access to the four modes representing mass media--Theatrical Film, Radio, Television, and Newspaper--was found to have little effect on the Overall Satisfaction Index S. The access to the remaining six modes, and the Total-Access Score, showed positive and significant correlation coefficients with varying degree of magnitude. The correlation coefficient for the Total-Access Score was higher than that of any other mode, suggesting that access to the telecommunication modes has a far-reaching impact on the overall satisfaction level when the modes are considered collectively rather than individually.

TABLE 28

Correlation Coefficients between Access to the Telecommunication Modes and the Overall Satisfaction Index S

(N=200)

| Mode | Correlation Coefficient (r) |
|---|---|
| Postal Service | .188** |
| Telegraph | .231*** |
| Telephone | .189** |
| Audio-Cassette | .169** |
| Loudspeaker | .122* |
| Theatrical Film | .065 |
| Radio | -.048 |
| Television | .027 |
| Newspaper | .058 |
| Magazine | .179** |
| Total Access | .297*** |

*p < .05 **p < .01 ***p < .001

$H_{4-2}$: For each individual, the access to the telecommunication modes is affected by the level of education, level of income, and profession.

An analysis-of-variance test was used to test $H_{4-2}$. Access to the ten telecommunication modes and the Total-Access Score were considered to be the dependent variables, each of which is affected by the three independent variables--level of education, level of income, and profession. Education was classified into five levels: No Schooling, Elementary-School Graduate, Junior-High Graduate, Senior-High Graduate, and College Graduate. Income was divided into five levels: Extremely Poor (annual income \$2,000 or less), Relatively Poor (\$2,001 - \$3,500), Average (\$3,501 - \$5,000), Relatively Well-Off (\$5,001 - \$7,000), and Rich (\$7,001 or more). "Profession" was replaced by the five different societal sectors.

The results of 11 different analysis-of-variance tests are given in Table 29. Since three of the independent variables may have a strong degree of association with each other, a three-way interaction design was employed to remove the interaction effects. After partialing out the interaction effects among the independent variables, only three modes--Telephone, Theatrical Film, and Newspaper--were found to be significantly affected by the independent variables. The effects of the independent variables upon the Total Access Score were also found to be significant.

The access to Telephone is most significantly affected by differences in societal sector ($F=3.676$, $p=.007$): Professionals have the highest access to Telephone, followed by Commercial Sector, Clerical Workers, Non-Agricultural Laborers, and Farmers. The access to Theatrical Film is most significantly affected by the level of education

TABLE 29

Effects of Education, Income, Profession on the Access to the Telecommunication Modes: Three-Way Analysis-of-Variance Tests

(Overall F Values, N=200)

| Mode | Combined Effects | Level of Education | Level of Income | Profession | Total Effects after Accounting for Interaction |
|---|---|---|---|---|---|
| Postal Service | 1.049 | .321 | .276 | 2.423 | 1.080 |
| Telegraph | 1.689 | 1.771 | 1.245 | 1.411 | 1.458 |
| Telephone | 5.028*** | 2.221 | 1.277 | 3.676** | 2.417*** |
| Audio-Cassette | 2.660 | 2.307 | 1.097 | 1.301 | 1.291 |
| Loudspeaker | 2.967 | 2.237 | 2.711* | 3.361* | 1.308 |
| Theatrical Film | 4.739*** | 4.625*** | 2.823* | 1.570 | 2.907*** |
| Radio | 1.511 | 2.496 | 2.068 | 2.193 | .949 |
| Television | .354 | .529 | .125 | .546 | .448 |
| Newspaper | 3.783*** | 1.198 | 3.158* | 3.082* | 2.033* |
| Magazine | 1.220 | 1.931 | 1.277 | 1.533 | 1.037 |
| Total Access | 3.038*** | 2.770* | 1.174 | .721 | 1.750** |

*$p < .05$

**$p < .01$

***$P < .001$

(F=4.625, p=.001): Senior-High Graduates have the highest access to the Theatrical Film, followed by Junior-High Graduates, Elementary-School Graduates, No Schooling, and College Graduates. The access to Newspaper is most strongly affected by the level of income (F=2.158, p=.016): the higher the level of income, the higher the access to Newspaper. In the Total-Access Score, level of education exerts the strongest effect (F=2.770, p=.034): the higher the level of education, the higher the Total-Access Score was. The mean values of the Total-Access Score broken down by the level of education, level of income, and societal sector, are listed in Table 30 in Appendix F.

> $H_{4-3}$: For each individual, the access to the telecommunication modes affects the Overall Satisfaction Index $\underline{S}$, after controlling for level of education, level of income, and profession.

Before testing $H_{4-2}$, inquiries had been made on the extent to which the demographic variables affect the Overall Satisfaction Index $\underline{S}$. Again, a three-way analysis-of-variance test was applied with $\underline{S}$ as the dependent variable, and with level of education, level of income, and profession as the independent variables. As shown in Table 31, the individual effects of each demographic variable on $\underline{S}$ were found to be significant.

After partialing out the interaction effects among the three variables, their combined effect on $\underline{S}$ produced an overall F of 2.484, significant at the .001 level.

After individual and combined effects of the demographic variables on the $\underline{S}$ were confirmed, $H_{4-3}$ was tested by means of analysis of covariance. Here, the Overall Satisfaction Index $\underline{S}$ was the dependent

variable, and the access to the telecommunication modes and the Total-Access Score were the independent variables. The three demographic variables were construed as the covariates that vary in parallel with S. In applying the analysis-of-covariance test, two different methods were employed. The first method removed extraneous variance in S caused by the three covariates, and then estimated the effects of the access scores on S. The second method examined the effects of the access scores on S first, and then estimated additional variance in S due to the covariates.

TABLE 31

Effects of Education, Income, Profession on the Overall Satisfaction Index S: Three-Way Analysis-of-Variance Test

(Overall F Values, N=200)

| Combined Effects | Level of Education | Level of Income | Profession | Total Effects after Accounting for Interaction |
|---|---|---|---|---|
| 6.252*** | 2.018* | 2.459* | 9.083*** | 2.484*** |

*p < .05 ***p < .001

The results of the two different analysis-of-covariance tests are given in Table 32. In the first method, after partialing out combined and individual effects of the three covariates on S, only two modes--Postal Service and Telegraph--were found to have significant effects on S. In the second method, somewhat different results were obtained: five modes--Postal Service, Telegraph, Telephone, Audio-Cassette, and Magazines--produce significant effects on S. Before removing effects of level of education, level of income, and profession on S, the Total-Access Score is also seen to make significant effect on the Overall Satisfaction Index S. The statistics obtained in two analysis-of-covariance tests can be summarized as follows:

1) Before any constraint on sources of variance in the Overall Satisfaction Index S is imposed, the effects of the access to the telecommunication modes on S are found to be significant.

2) After removing effects of level of education, level of income, and profession on S, the effects of the access to the telecommunication modes on S are found to be minimal.

3) The major reason for this seemingly insignificant effects of the access scores on S can be attributed to the fact that an overwhelming portion of variance in S is accounted by level of education, level of income, and profession.

Testing of $H_{4-1}$, $H_{4-2}$, and $H_{4-3}$ confirms that access to the telecommunication modes does produce some effects on the overall satisfaction of the villagers. Access to those modes that represent the mass media, notably Radio and Television, seems to have little effect on the overall satisfaction level. The point-to-point telecommunication modes such as Postal Service, Telegraph, and Telephone produce more significant and positive effects on the overall satisfaction level of

TABLE 32

Effects of Access to the Telecommunication Modes on the Overall Satisfaction Index S: Analysis-of-Covariance Tests

(Overall F Values, N=200)

| Mode | Method 1[a] | | | Method 2[b] | | |
|---|---|---|---|---|---|---|
| | Effects of Covariates | Effect of the Mode | Total Explained | Effect of the Mode | Effects of Covariates | Total Explained |
| Postal Service | 11.551*** | 2.529* | 6.396*** | 2.825* | 11.156*** | 6.396*** |
| Telegraph | 11.429*** | 3.318** | 6.794*** | 5.738*** | 8.202*** | 6.794*** |
| Telephone | 11.376*** | 1.846 | 5.930*** | 3.056** | 9.763*** | 5.930*** |
| Audio-Cassette | 11.300*** | 1.429 | 5.659*** | 2.774* | 9.506*** | 5.659*** |
| Loudspeaker | 18.351*** | .522 | 5.052*** | .872 | 10.627*** | 5.052*** |
| Theatrical Film | 11.050*** | .338 | 4.929*** | .512 | 10.819*** | 4.929*** |
| Radio | 11.144*** | .499 | 6.886*** | .292 | 11.283*** | 6.886*** |
| Television | 11.118*** | .267 | 6.777*** | .200 | 11.162*** | 6.777*** |
| Newspaper | 11.240*** | 1.669 | 8.847*** | .784 | 11.535*** | 8.847*** |
| Magazine | 11.242*** | 1.708 | 8.859*** | 7.404*** | 15.242*** | 8.859*** |
| Total Access | 7.519*** | 1.782 | 4.241*** | 3.029* | 7.190*** | 4.241*** |

a: Effects of Covariates (level of education, level of income, and societal sector) on the Overall Satisfaction Index S are removed first, and then effect of access to the telecommunication mode on S is calculated.

b: Effect of access to the telecommunication mode on S is calculated first, and then the additional contribution to S is estimated from the Covariates (level of education, level of income, and societal sector).

*p < .05 **p < .01 ***p < .001

the villagers. Although causality between access to the telecommunication modes and the Overall Satisfaction Index S could not be established, it seems reasonable to conclude that access to the telecommunication modes, particularly the point-to-point ones, can contribute to enhancing the quality of life of the villagers.

Question 5: Does frequency of usage for telecommunication modes have significant effects on the Overall Satisfaction Index S?

Question 5 was operationalized with three hypotheses:

$H_{5-1}$: For each individual, the frequency of using the telecommunication modes correlates positively with the Overall Satisfaction Index S.

$H_{5-2}$: For each individual, the frequency of using the telecommunication modes is affected by level of education, level of income, and profession.

$H_{5-3}$: For each individual, the frequency of using the telecommunication modes affects the Overall Satisfaction Index S, after controlling for level of education, level of income, and profession.

## Testing of Hypotheses

$H_{5-1}$: For each individual, the frequency of using the telecommunication modes correlates positively with the Overall Satisfaction Index S.

In testing $H_{5-1}$, the Pearson product-moment correlation tests were employed. Just as in the access to the modes, a new scale called "Total Frequency" was created by averaging the frequency scores for the ten modes. The correlation coefficients between each telecommunication mode and the Overall Satisfaction Index S are given in Table 33. Among the ten modes, three modes--Telephone, Loudspeaker, and Magazine--proved to have significant and positive relationships with the Overall Satisfaction Index S. The correlation coefficient for the Total Frequency was .222, a value higher than for any other individual mode.

One important finding in the correlation analyses is the significant negative correlation coefficient for Television (r=-.130). The negative relationship between frequency of using Television and the Overall Satisfaction Index S seems to support arguments advanced by Schiller (1975-1976) and Gloding (1974), who claim that television, in fact, induces higher dissatisfaction among the rural populace of the developing countries.

Table 33

Correlation Coefficients between Frequency of Using the Telecommunication Modes and the Overall Satisfaction Index S

(N=200)

| Mode | Correlation Coefficient (r) |
|---|---|
| Postal Service | .052 |
| Telegraph | .055 |
| Telephone | .278*** |
| Audio-Cassette | .105 |
| Loudspeaker | .185** |
| Theatrical Film | .016 |
| Radio | .115 |
| Television | -.130** |
| Newspaper | .058 |
| Magazine | .179** |
| Total Frequency | .222*** |

*p < .05 **p < .01 ***p < .001

$H_{5-2}$: For each individual, the frequency of using the telecommunication modes is affected by level of education, level of income, and profession.

$H_{5-2}$ was tested with analysis of variance. Here, the dependent variables were the frequency of using each mode and the Total-Frequency

Score; the independent variables were level of education, level of income, and societal sector. A three-way design was chosen to remove interaction effects among the three independent variables. The results of 11 different analysis-of-variance tests are given in Table 34. A total of six modes--Postal Service, Telegraph, Telephone, Theatrical Film, Newspaper, and Magazine--were found to be significantly affected by the three independent variables. For Postal Service, those who have higher education level use the postal service more frequently than those having lower education level ($F=2.631$, $p=.026$). The frequency of using Telegraph is strongly affected by level of education ($F=2.257$, $p=.034$): the higher the education level, the higher the frequency of using the telegraph. Difference in societal sector is found to be the prime source in affecting the frequency of Telephone use ($F=7.441$, $p=.000$): Professionals use it most frequently, followed by Commercial Sector, Clerical Workers, Non-Agricultural Laborers, and Farmers. For Theatrical Film, level of education ($F=5.349$, $p=.001$) and societal sector ($F=5.994$, $p=.001$) have significant effects on the frequency score. The frequency of watching Television descends from Commercial Sector, to Farmers, Non-Agricultural Laborers, Clerical Workers, and Professionals. For Newspaper, the Professionals show the highest frequency score, the Non-Agricultural Workers the lowest. The frequency of using Magazine parallels the level of education ($F=5.883$, $p=.000$). The Total-Frequency Score is most strongly affected by level of education ($F=2.766$, $p=.038$): the higher the level, the higher the Total-Frequency Score. The societal sector also contributes significantly to the Total-Frequency Score ($F=2.634$, $p=.030$): the Professionals show the highest Total-Frequency Score, followed by Clerical

TABLE 34

Effects of Education, Income, Profession on the Frequency of Using the Telecommunication Modes: Three-Way Analysis-of-Variance Tests

(Overall F Value, N=200)

| Mode | Combined Effects | Level of Education | Level of Income | Profession | Total Explained after Accounting for Interaction |
|---|---|---|---|---|---|
| Postal Service | 1.554 | 2.631 | .136 | .891 | 1.993*** |
| Telegraph | 2.713** | 2.257* | 1.443 | 1.128 | 2.340*** |
| Telephone | 7.336*** | 1.181 | 1.562 | 7.441*** | 3.366*** |
| Audio-Cassette | 1.003 | .563 | .863 | 1.402 | 1.084 |
| Loudspeaker | .825 | .522 | 1.419 | .386 | .334 |
| Theatrical Film | 6.797 | 5.349*** | 1.362 | 5.994*** | 3.685*** |
| Radio | 1.255 | .466 | 1.906 | 1.527 | 1.067 |
| Television | 1.664 | 1.119 | .574 | 2.627* | 1.364 |
| Newspaper | 3.805*** | .794 | 3.335*** | 2.840* | 1.309** |
| Magazine | 5.897*** | 5.883*** | 2.910 | .672 | 2.628*** |
| Total Frequency | 1.667 | 2.766* | .617 | 2.634* | 2.288*** |

$p^{*} < .05$

$p^{**} < .01$

$p^{***} < .001$

Workers, Commercial Sector, Farmers, and Non-Agricultural Laborers. The means of Total-Frequency Score by level-of-education, level-of-income, societal-sector breakdowns are listed in Table 35 in Appendix F.

> $H_{5-3}$: For each individual, the frequency of using the telecommunication modes affects the Overall Satisfaction Index S, upon controlling the effects of level of education, level of income, and profession.

Analysis of covariance was employed to test $H_{5-3}$. Here, the dependent variable is the Overall Satisfaction Index S, the independent variables are the frequency of usage score for each mode and the Total-Frequency Score. The covariates are level of education, level of income, and societal sector. Just as in testing $H_{4-3}$ that estimates the effects of access scores on S, two different methods were applied. The first method partials out the effects of covariates on S before estimating the effects of frequency scores on S. The second method explores the effects of frequency scores on S first, and then estimates effects of the covariates on S.

The results of the two methods are given in Table 36. After removing the effects of level of education, level of income, and societal sector on S, none of the telecommunication modes were seen to have important effects on S. With the second method, six telecommunication modes--Postal Service, Telegraph, Telephone, Loudspeaker, Newspaper, and Magazine--were shown to have significant impacts on the Overall Satisfaction Index S. The Total-Frequency Score was found to have significant effect on S.

The frequency of using mass media, notably that of Radio and Television, was found to have little effect on the overall satisfaction level of the villagers. Point-to-point telecommunication modes, on the

TABLE 36

Effects of Frequency of Using the Telecommunication Modes on the Overall Satisfaction Index S: Analysis-of-Covariance Tests

(Overall F Values, N=200)

| Mode | Method 1[a] | | | Method 2[b] | | |
|---|---|---|---|---|---|---|
| | Effects of Covariates | Effect of the Mode | Total Explained | Effect of the Mode | Effects of Covariates | Total Explained |
| Postal Service | 12.688*** | 1.464 | 5.673*** | 2.047* | 11.717*** | 5.673*** |
| Telegraph | 11.029*** | .395 | 4.383*** | 3.077** | 9.893*** | 4.383*** |
| Telephone | 10.522*** | 1.147 | 4.271*** | 3.459** | 5.897*** | 4.271*** |
| Audio-Cassette | 9.354*** | .913 | 4.078*** | 1.777 | 7.915*** | 4.078*** |
| Loudspeaker | 11.519*** | 1.926 | 5.124*** | 2.420* | 10.533*** | 5.124*** |
| Theatrical Film | 11.020*** | .206 | 4.841*** | .272 | 10.933*** | 4.841*** |
| Radio | 11.154*** | .832 | 4.703*** | 1.395 | 10.216*** | 4.703*** |
| Television | 11.130*** | .748 | 4.641*** | 1.419 | 10.012*** | 4.641*** |
| Newspaper | 11.451*** | 1.011 | 4.555*** | 2.011* | 11.012*** | 4.555*** |
| Magazine | 11.258*** | 1.561 | 4.633*** | 3.009** | 10.781*** | 4.633*** |
| Total Frequency | 11.001*** | .610 | 3.208*** | 3.686** | 7.772*** | 3.208*** |

a: Effects of Covariates (level of education, level of income, and societal-sector difference) on the Overall Satisfaction Index S are removed first, and then effect of access to the telecommunication mode on S is calculated.

b: Effect of access to the telecommunication mode on S is calculated first, and then additional contribution to S is estimated from the Covariates (level of education, level of income, and societal-sector difference).

p* < .05 p** < .01 p*** < .001

other hand, showed distinct effects on the Overall Satisfaction Index S. The statistics acquired in testing $H_{5-1}$, $H_{5-2}$, and $H_{5-3}$ indicate that the overall satisfaction level of the villagers is affected by frequency of using telecommunication modes, particularly in the point-to-point modes. Again, the potentiality of the telecommunication modes for raising the quality of life of the villagers was found to be modestly positive.

## Overview

By means of various statistical tests, this chapter explored the reliability and the validity of the Socio-Technical Assessment Model. Two major issues were addressed: one, whether the quality-of-life scheme proposed in the Model is reliable and valid in the light of empirical data; two, whether the telecommunication modes, as possible technological options to increase the quality of life of the villagers, exert significant effects on the current quality of life of the villagers. The results of diverse statistical tests confirmed reliability and validity of the quality-of-life scheme. The telecommunication modes, especially point-to-point modes, are found to have potentiality in improving the quality of life of the villagers, as examined by their positive effects on the current quality of life of the villagers.

Now that the validity of the Socio-Technical Assessment Model has been substantiated by empirical data, the operation of the Model will be described in the next chapter.

# CHAPTER VI

# OPERATION OF THE MODEL

This chapter describes the procedure involved in the operation of the Socio-Technical Assessment Model. For clarity, the presentation of the Socio-Technical Assessment Model is divided into four major phases. The first phase explores how strongly the four basic human needs under investigation--Nourishment, Shelter, Clothing, and Health--associate with each of the P, E, F, J canonical human goals in each of the five societal sectors. The second phase examines the extent to which the four basic human needs can contribute to raising the overall quality of life of the village as a whole. The third phase estimates the effectiveness of the telecommunication modes under assessment in facilitating the provision for the four basic human needs. The fourth phase seeks to obtain the Initial Solutions of the Socio-Technical Assessment Model, which will specify the expected increment in the overall quality of life of the village as a whole, as attributed to each of the ten telecommunication modes.

## Phase I

The objective of the first phase of the measurement scheme is formally stated as follows.

Objective: To determine the degree of association of the four basic human needs under investigation--Nourishment, Shelter, Clothing, and Health--with each of the canonical goals--P, E, F, J goals--in each of the five societal sectors--Professionals, Clerical Workers, Commercial Sector, Non-Agricultural Laborers, and Farmers.

The extent to which a given observed variable associates with the underlying dimensions can be inferred from the factor loadings determined from factor analysis. Accordingly, five separate factor analyses were performed for each of the five societal sectors. As in the section on Validation of the Model, the Maximum-Likelihood non-rotated method was chosen to detect the relationship between the 16 basic needs and the four common factors: P, E, F, J canonical goals. The results of the Maximum-Likelihood non-rotated factor analyses for the five different societal sectors are given in Tables 37-41 in Appendix G. In all five societal sectors, the 16 basic human needs showed distinct patterns relative to the P, E, F, J common factors.

The mathematical properties of Phase I--the degree of association of Nourishment, Shelter, Clothing, and Health with the P, E, F, J canonical goals--were determined by each basic human need's factor loadings. The factor loadings of the four needs are tabulated in Matrix 1 (v=1, Nourishment), Matrix 2 (v=2, Shelter), Matrix 3 (v=3, Clothing), and Matrix 4 (v=4, Health) respectively. Each of the four matrices has four rows representing P(i=1), E(i=2), F(i=3), and J(i=4) Goals, and five columns representing Professionals (j=1), Clerical Workers (j=2), Commercial Sector (j=3), Non-Agricultural Laborers (j=4), and Farmers (j=5).

Matrix 1. The Degree of Association of Nourishment (v=1) with the i-th canonical goal in the j-th societal sector ($\underline{\underline{R}}^{1}_{ij}$)

$$
\begin{array}{rc}
 & \begin{array}{ccccc} j=1 & j=2 & j=3 & j=4 & j=5 \end{array} \\
\begin{array}{r} i=1(P) \\ i=2(E) \\ i=3(F) \\ i=4(J) \end{array} &
\begin{bmatrix}
.924 & .772 & .813 & .695 & .824 \\
.102 & -.274 & -.169 & -.264 & .164 \\
-.364 & .036 & .200 & -.144 & .224 \\
-.072 & .021 & .058 & -.082 & .143
\end{bmatrix}
\end{array}
$$

Matrix 2. The Degree of Association of Shelter (v=2) with the i-th canonical goal in the j-th societal sector ($\underline{\underline{R}}^{2}_{ij}$)

$$
\begin{array}{rc}
 & \begin{array}{ccccc} j=1 & j=2 & j=3 & j=4 & j=5 \end{array} \\
\begin{array}{r} i=1(P) \\ i=2(E) \\ i=3(F) \\ i=4(J) \end{array} &
\begin{bmatrix}
.451 & .642 & .679 & .744 & .733 \\
.203 & -.208 & .066 & .235 & .285 \\
-.609 & .416 & -.237 & .022 & .178 \\
.018 & -.153 & -.125 & -.150 & .227
\end{bmatrix}
\end{array}
$$

Matrix 3. The Degree of Association of Clothing (v=3) with the i-th canonical goal in the j-th societal sector ($\underline{\underline{R}}^{3}_{ij}$)

$$
\begin{array}{rc}
 & \begin{array}{ccccc} j=1 & j=2 & j=3 & j=4 & j=5 \end{array} \\
\begin{array}{r} i=1(P) \\ i=2(E) \\ i=3(F) \\ i=4(J) \end{array} &
\begin{bmatrix}
.147 & .731 & .839 & .885 & .789 \\
.261 & -.011 & .112 & -.156 & .273 \\
-.443 & .389 & -.015 & .189 & .203 \\
.084 & -.069 & -.115 & .172 & .166
\end{bmatrix}
\end{array}
$$

Matrix 4. The Degree of Association of Health (v=4) with the i-th canonical goal in the j-th societal sector ($\underset{=}{R}^{4}_{ij}$)

$$
\begin{array}{l}
 \\
i=1(P) \\
i=2(E) \\
i=3(F) \\
i=4(J)
\end{array}
\begin{array}{c}
\begin{array}{ccccc} j=1 & j=2 & j=3 & j=4 & j=5 \end{array} \\
\begin{bmatrix}
.781 & .857 & .704 & .677 & .803 \\
.124 & .017 & -.163 & -.252 & .158 \\
-.213 & -.032 & -.096 & .195 & .153 \\
-.218 & -.156 & .171 & .141 & .112
\end{bmatrix}
\end{array}
$$

In general, the four basic needs under investigation show highest degree of association with the Individual-Material P-Goal, with varying degree of intensity across the societal sectors. An interesting deviation is found in the first societal sector [Professionals (j=1)] whose satisfaction for Shelter (v=2) and Clothing (v=3) relates more strongly to the Individual-Spiritual F Goal (i=3) than to the Individual-Material P Goal (i=1). Furthermore, for the Professionals, all Nourishment, Shelter, Clothing, and Health associate negatively with the Individual-Spiritual F Goal. This finding can be interpreted as that the individual-material aspects of the four needs among the Professionals have been fully satisfied, yet these persons feel deprived with respect to individual-spiritual aspects of the four needs. With the exception to the Professionals, the degree of association of Nourishment, Shelter, Clothing, and Health with the Group-Material E Goal (i=2), the Individual-Spiritual F Goal (i=3), and the Group-Spiritual J Goal (i=4) appears to be weak.

## Phase II

The second phase of the measurement scheme concerns how much the four basic needs under investigation can contribute to increasing the overall quality of life of the village society as a whole. The objective of the second phase is formulated as:

Objective: To estimate the potential contributing rate of the four basic needs under investigation--Nourishment, Shelter, Clothing, Health--to enhancing the overall quality of life of the village society as a whole, during the next five to ten years.

In Phase II, the decision-makers' values and beliefs in public-resource allocation plans are integrated into the Model. The rationale for integrating the decision-makers' value systems is that changes in the future within a given society are most likely to be controlled by the decision-makers' perceptions and plans. The degree to which the four basic needs associate with each of the P, E, F, J canonical goals in each of the five societal sectors was determined in Phase I. Yet, the extent to which each specific basic need can contribute to increasing the overall quality of life can perhaps be more strongly controlled by the decision-makers' weightings for each of the P, E, F, J canonical human goals, and for each of the five societal sectors.

The mathematical basis of Phase II is derived from the Maximum Expected Value (MEV) technique of operations research. Moscowitz and Wright (1979, p. 123) explain the MEV criteria as: 1) Assign a probability to each event with the probabilities summing to 1; 2) compute the expected value of each action by multiplying each value [of each consequence] by its corresponding probability, and summing these products; and then 3) Choose an action whose expected value is greatest. The decision-makers' weightings on the P, E, F, J canonical goals, and on the five societal sectors, reflecting the first criterion of MEV, are given in Table 16 and Table 17 in Chapter IV. Here, the second criterion of MEV was applied by incorporating the properties of Phase I with the decision-makers' weightings. Integration of the properties of Phase I with these weightings was implemented according to the formula:

$$\Delta \underline{S}^{v} = \underline{V}_i \cdot \underline{\underline{R}}^{v}_{ij} \cdot \underline{W}_j, \quad \ldots(4)$$

in which $\Delta \underline{S}^{v}$ refers to the rate of the contribution of the v-th basic human need to increasing the overall quality of life of all societal sectors; $\underline{V}_i$ refers to the decision-makers' weights assigned to the i-th canonical goal in terms of each goal's relative importance during the next five to ten years; $\underline{\underline{R}}^{v}_{ij}$ refers to the degree to which the v-th basic human need associates with the i-th canonical human goal in the j-th societal sector; and $\underline{W}_j$ refers to the decision-makers' weights attached to the j-th societal sector in terms of each sector's relative importance in public-resource-allocation plans.

Along the operating guidelines given in formula (4), the potential contributing rate of each Nourishment ($\Delta S^1$), Shelter ($\Delta S^2$), Clothing ($\Delta S^3$), and Health ($\Delta S^4$) was estimated. The potential contributing rate of Nourishment ($\Delta S^1$) was computed with the aid of $\underline{\underline{R}}^{1}_{ij}$, $\underline{V}_i$, and $\underline{W}_j$ as:

$$\underbrace{\begin{array}{cccc} i=1 & i=2 & i=3 & i=4 \\ [.167 & .191 & .380 & .262] \end{array}}_{\underline{V}_i} \cdot \underbrace{\begin{array}{cc} & \begin{array}{ccccc} j=1 & j=2 & j=3 & j=4 & j=5 \end{array} \\ \begin{array}{c} i=1 \\ i=2 \\ i=3 \\ i=4 \end{array} & \begin{bmatrix} .924 & .772 & .813 & .695 & .824 \\ .102 & -.274 & -.169 & -.264 & .164 \\ -.364 & .036 & .200 & -.144 & .224 \\ -.072 & .021 & .058 & -.082 & .143 \end{bmatrix} \end{array}}_{\underline{\underline{R}}^{1}_{ij}} \cdot \underbrace{\begin{array}{cc} \begin{bmatrix} .158 \\ .093 \\ .285 \\ .164 \\ .300 \end{bmatrix} & \begin{array}{c} j=1 \\ j=2 \\ j=3 \\ j=4 \\ j=5 \end{array} \end{array}}_{\underline{W}_j} = .153$$

The potential contributing rate of Shelter to increasing the overall quality of life of the village society as a whole was calculated with the Matrix 2 ($\underline{\underline{R}}^2_{ij}$), and with $\underline{V}_i$ and $\underline{W}_j$; for Cloting, with the Matrix 3 ($\underline{\underline{R}}^3_{ij}$); and for Health, with the Matrix 4 ($\underline{\underline{R}}^4_{ij}$).

With formula (4), the degree to which each of Nourishment, Shelter, Clothing, and Health enhances the overall quality of life of the village society as a whole during the next five to ten years is estimated as:

| | | |
|---|---|---|
| Scalar 1: | Nourishment ($\Delta \underline{S}^1$) | = .153 |
| Scalar 2: | Shelter ($\Delta \underline{S}^2$) | = .114 |
| Scalar 3: | Clothing ($\Delta \underline{S}^3$) | = .185 |
| Scalar 4: | Health ($\Delta S^4$) | = .143 |

Among the four basic human needs under investigation, the contributing rate of Clothing is found to be greatest, followed by Nourishment, Health, and Shelter.

## Phase III

In the third phase of the measurement scheme, the effectiveness of each of the technological options under assessment was estimated. The objective of Phase III was formulated as:

Objective: To estimate the effectiveness of the ten telecommunication modes under assessment in facilitating the provision for the four basic needs under investigation--Nourishment, Shelter, Clothing, and Health.

The effectiveness of the telecommunication modes in facilitating the provision for the specific needs was estimated on the basis of the following four facets:

1) How significant the h-th component is in furthering the provision for the v-th basic need;

2) How much the p-th technical function is required for promoting the h-th component of the v-th basic need;

3) How much the q-th technical characteristic is required to activate the p-th technical function;

4) How much the m-th telecommunication mode can supply the q-th technical characteristic in the sampled village.

Each of the four facets was placed in matrix form to facilitate the mathematical operation. The background for constructing the four matrices will be explained one by one.

1) Significance-Component Matrix ($\underline{C}_h^v$): Each of the basic needs under investigation was decomposed into the four components representing the P-th component (h=1), the E-th component (h=2), the F-th component (h=3), and the J-th component (h=4). The significance of the h-th component in furthering the provision for the v-th basic need was inferred from the factor loadings produced in the Maximum-Likelihood non-rotated method, taking all the societal sectors into account (refer to Table 25 of Chapter V). The factor loadings of each of Nourishment (v=1), Shelter (v=2), Clothing (v=3), and Health (v=4) are tabulated in a 1 x 4 matrix form in which the four columns represent the P-th component (h=1), E-th component (h=2), F-th component (h=3), and J-th component (h=4).

Matrix 5. The Significance of the h-th Component in Furthering the Provision for Nourishment (v=1)($\underline{C}_h^1$)

$$\begin{array}{cc} & \begin{array}{cccc} h=1 & h=2 & h=3 & h=4 \end{array} \\ v=1 & \begin{bmatrix} .816 & .176 & .218 & .172 \end{bmatrix} \end{array}$$

Matrix 6. The Significance of the h-th Component in Furthering the Provision for Shelter (v=2) ($\underline{C}_h^2$)

$$\begin{array}{cc} & \begin{array}{cccc} h=1 & h=2 & h=3 & h=4 \end{array} \\ v=2 & \begin{bmatrix} .734 & .280 & .203 & .045 \end{bmatrix} \end{array}$$

Matrix 7. The Significance of the h-th Component in Furthering the Provision for Clothing (v=3) ($\underline{C}_h^3$)

$$\begin{array}{cc} & \begin{array}{cccc} h=1 & h=2 & h=3 & h=4 \end{array} \\ v=3 & \begin{bmatrix} .748 & .185 & .238 & .108 \end{bmatrix} \end{array}$$

Matrix 8. The Significance of the h-th Component in Furthering the Provision for Health (v=4) ($\underline{C}_h^4$)

$$\begin{array}{cc} & \begin{array}{cccc} h=1 & h=2 & h=3 & h=4 \end{array} \\ v=4 & \begin{bmatrix} .669 & .027 & .207 & .140 \end{bmatrix} \end{array}$$

2) Component/Function Demand Matrix ($\underline{\underline{D}}_{hp}^v$): The experts' evaluation on the demands for the specific technical functions for promoting the P, E, F, J components of Nourishment, Shelter, Clothing, and Health are given in Table 10, 11, 12, 13 in Chapter 4. We retabulated each of Table 10, 11, 12, 13 in a 4 x 6 matrix form with four rows to represent the P-Component (h=1), E-Component (h=2), F-Component (h=3), and the J-Component (h=4); and with six columns to represent Specific Instruction (p=1), Marketing Information (p=2), News and Weather Service (p=3), Entertainment (p=4), Opinion Formation (p=5), and Personal Correspondence (p=6).

Matrix 9. Demands for the p-th Technical Function to Promote the h-th Component of Nourishment (v=1) ($\underline{\underline{D}}_{hp}^1$)

$$\begin{array}{cc} & \begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\ \begin{array}{c} h=1 \\ h=2 \\ h=3 \\ h=4 \end{array} & \begin{bmatrix} 4.29 & 3.86 & 4.29 & 1.49 & 2.43 & 1.43 \\ 2.43 & 1.29 & 1.43 & 1.57 & 3.00 & 1.14 \\ 1.71 & 4.29 & 1.14 & 1.86 & 1.57 & 2.00 \\ 1.14 & 2.00 & 1.00 & 1.26 & 3.86 & 1.86 \end{bmatrix} \end{array}$$

Matrix 10. Demands for the p-th Technical Function to Promote the h-th Component of Shelter (v=2) ($\underline{\underline{D}}^2_{hp}$)

$$
\begin{array}{c} \\ h=1 \\ h=2 \\ h=3 \\ h=4 \end{array}
\begin{array}{c}
\begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\
\begin{bmatrix}
3.71 & 3.86 & 1.57 & 1.29 & 2.14 & 2.14 \\
2.28 & 1.43 & 1.86 & 1.14 & 2.86 & 1.14 \\
1.57 & 1.71 & 1.71 & 1.43 & 1.71 & 1.43 \\
1.43 & 2.14 & 1.86 & 1.29 & 3.57 & 1.77
\end{bmatrix}
\end{array}
$$

Matrix 11. Demands for the p-th Technical Function to Promote the h-th Component of Clothing (v=3) ($\underline{\underline{D}}^3_{hp}$)

$$
\begin{array}{c} \\ h=1 \\ h=2 \\ h=3 \\ h=4 \end{array}
\begin{array}{c}
\begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\
\begin{bmatrix}
2.14 & 3.29 & 1.14 & 1.29 & 1.86 & 1.29 \\
1.43 & 1.43 & 1.10 & 1.14 & 1.29 & 1.49 \\
1.43 & 4.29 & 1.14 & 2.57 & 1.43 & 1.71 \\
1.00 & 2.86 & 1.43 & 1.29 & 1.71 & 2.86
\end{bmatrix}
\end{array}
$$

Matrix 12. Demands for the p-th Technical Function to Promote the h-th Component of Health (v=4) ($\underline{\underline{D}}^4_{hp}$)

$$
\begin{array}{c} \\ h=1 \\ h=2 \\ h=3 \\ h=4 \end{array}
\begin{array}{c}
\begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\
\begin{bmatrix}
3.86 & 2.43 & 1.86 & 1.29 & 2.57 & 1.57 \\
3.71 & 1.57 & 2.00 & 1.43 & 3.14 & 2.14 \\
2.28 & 4.14 & 1.43 & 1.86 & 1.71 & 1.86 \\
1.29 & 2.14 & 2.00 & 1.14 & 4.43 & 1.71
\end{bmatrix}
\end{array}
$$

3) Function/Characteristic Demand Matrix ($\underline{\underline{D}}^q_p$): The demands for the specific technical characteristics with respect to each of the technical functions are specified in Table 14 in Chapter IV. Table 14 was retabulated in a 6 x 7 matrix form that has six rows to represent Specific Instruction (p=1), Marketing Information (p=2), News and Weather Service (p=3), Entertainment (p=4), Opinion Formation (p=5), and

Personal Correspondence (p=6); and seven columns to represent Promptness (q=1), Effective Bit Rate (q=2), Cheapness (q=3), Reliability (q=4), Accessibility (q=5), Storage/Retrieval Capacity (q=6), and Confidentiality (q=7).

Matrix 13. Demands for the q-th Technical Characteristic to Activate the p-th Technical Function ($\underset{=}{D}{}^{q}_{p}$)

$$
\begin{array}{c|ccccccc|}
 & q=1 & q=2 & q=3 & q=4 & q=5 & q=6 & q=7 \\
p=1 & 3.00 & 4.00 & 4.00 & 4.00 & 5.00 & 4.00 & 1.00 \\
p=2 & 4.00 & 4.00 & 4.00 & 4.00 & 5.00 & 2.00 & 2.00 \\
p=3 & 5.00 & 4.00 & 4.00 & 5.00 & 5.00 & 1.00 & 1.00 \\
p=4 & 3.00 & 5.00 & 2.00 & 2.00 & 3.00 & 1.00 & 1.00 \\
p=5 & 2.00 & 4.00 & 5.00 & 4.00 & 5.00 & 3.00 & 1.00 \\
p=6 & 2.00 & 3.00 & 3.00 & 4.00 & 5.00 & 2.00 & 5.00
\end{array}
$$

4) Characteristic/Mode Supply Matric ($\underset{=}{S}{}^{m}_{q}$): The seven technical characteristics supplied by each of the ten telecommunication modes are specified in Table 9 in Chapter IV. Again, Table 9 was retabulated in a 7 x 10 matrix form that has seven rows to represent Promptness (q=1), Effective Bit Rate (q=2), Cheapness (q=3), Reliability (q=4), Accessibility (q=5), Storage/Retrieval Capacity (q=6), and Confidentiality (q=7); and ten columns to represent Postal Service (m=1), Telegraph (m=2), Telephone (m=3), Audio-Cassette (m=4), Loudspeaker (m=5), Theatrical Film (m=6), Radio (m=7), Television (m=8), Newspaper (m=9), and Magazine (m=10).

Matrix 14. Supply of the q-th Technical Characteristic by the m-th Telecommunication Mode ($\underline{\underline{S}}_m^q$)

$$
\begin{array}{c}
\\
q=1 \\ q=2 \\ q=3 \\ q=4 \\ q=5 \\ q=6 \\ q=7
\end{array}
\begin{array}{c}
\begin{array}{cccccccccc}
m=1 & m=2 & m=3 & m=4 & m=5 & m=6 & m=7 & m=8 & m=9 & m=10
\end{array} \\
\left[\begin{array}{cccccccccc}
2.00 & 4.00 & 5.00 & 1.00 & 5.00 & 1.00 & 5.00 & 5.00 & 3.00 & 1.00 \\
2.00 & 2.00 & 4.00 & 4.00 & 4.00 & 5.00 & 4.00 & 5.00 & 3.00 & 3.00 \\
5.00 & 5.00 & 1.00 & 2.00 & 5.00 & 4.00 & 2.00 & 1.00 & 3.00 & 3.00 \\
4.00 & 2.00 & 3.00 & 2.00 & 4.00 & 4.00 & 5.00 & 4.00 & 2.00 & 3.00 \\
3.00 & 3.00 & 3.00 & 4.00 & 5.00 & 2.00 & 5.00 & 5.00 & 4.00 & 2.00 \\
4.00 & 4.00 & 1.00 & 5.00 & 1.00 & 2.00 & 1.00 & 1.00 & 5.00 & 5.00 \\
5.00 & 4.00 & 4.00 & 3.00 & 1.00 & 1.00 & 1.00 & 1.00 & 1.00 & 1.00
\end{array}\right]
\end{array}
$$

With these data bases, the effectiveness of the telecommunication modes was obtained through three stages of mathematical operations: estimation of the demands for the technical functions to facilitate the provision for the basic human needs; estimation of the demands for the technical characteristics to facilitate the provision for the basic human needs; and assessment of the effectiveness of the telecommunication modes to facilitate the provision for the basic human needs.

1. Demands for the Technical Functions

The demands for each of the six technical functions to facilitate the provision for Nourishment, Shelter, Clothing, and Health were estimated by integrating the significance-Component Matrix ($\underline{C}_h^v$) with the Component/Function Demand Matrix ($\underline{\underline{D}}_{hp}^v$). The matrix multiplication was conducted through the formula:

$$\underset{(1\times6)}{\underline{D}_p^v} = \underset{(1\times4)}{\underline{C}_h^v} \cdot \underset{(4\times6)}{\underline{\underline{D}}_{hp}^v} \quad \ldots(5)$$

in which $D_p^v$ refers to the Demand for the p-th technical function in facilitating the provision for the v-th basic need. With this formula, the demands for the technical functions with respect to Nourishment (v=1) were computed by multiplying Matrix 5 ($\underset{\sim}{C}_h^1$) that specifies the significance of the h-th component of Nourishment, by Matrix 9 ($\underset{\approx}{D}_{hp}^1$) that gives the demand for the p-th technical function to promote the h-th component of Nourishment. The matrix-multiplication procedure is:

$$
\underset{\text{Matrix 5}}{\begin{array}{c} \\ v=1 \end{array}\begin{array}{c} \begin{array}{cccc} h=1 & h=2 & h-3 & h=4 \end{array} \\ \begin{bmatrix} .816 & .176 & .218 & .772 \end{bmatrix} \\ \underset{\sim}{C}_h^1 \end{array}}
\qquad
\underset{\text{Matrix 9}}{\begin{array}{c} \\ h=1 \\ h=2 \\ h=3 \\ h=4 \end{array}\begin{array}{c} \begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\ \begin{bmatrix} 4.29 & 3.86 & 4.29 & 1.49 & 2.43 & 1.43 \\ 2.43 & 1.29 & 1.43 & 1.57 & 3.00 & 1.14 \\ 1.79 & 4.29 & 1.14 & 1.86 & 1.57 & 2.00 \\ 1.14 & 2.00 & 1.00 & 1.26 & 3.86 & 1.86 \end{bmatrix} \\ \underset{\approx}{D}_{hp}^1 \end{array}}
$$

$$
= \begin{array}{c} \\ v=1 \end{array}\begin{array}{c} \begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\ \begin{bmatrix} 4.50 & 4.67 & 4.17 & 2.11 & 3.52 & 2.12 \end{bmatrix} \end{array} \quad \underset{\sim}{D}_p^1
$$

The results of the matrix multiplication consist of six vectors, each of which represents the demand for the p-th technical function to facilitate the provision for Nourishment (v=1).

In the same manner, the demands for the technical functions to facilitate the provision for Shelter (v=2) are computed by multiplying Matrix 6 ($\underset{\sim}{C}_h^2$) that specifies the significance of h-th component with respect to Shelter, by Matrix 10 ($\underset{\approx}{D}_{hp}^2$) that specifies the demand for the p-th technical function to promote the h-th component of Shelter. For Clothing (v=3), Matrix 7 ($\underset{\sim}{C}_h^3$) is multiplied by Matrix 11 ($\underset{\approx}{D}_{hp}^3$). For Health (v=4), Matrix 8 ($\underset{\sim}{C}_h^4$) is multiplied by Matrix 12 ($\underset{\approx}{D}_{hp}^4$).

The results of matrix multiplication for each of Nourishment, Shelter, Clothing, and Health are given in the following four matrices.

Matrix 15. Demand for the p-th Technical Function to Facilitate the Provision for Nourishment (v=1) ($\underline{D}_p^1$)

| | p=1 | p=2 | p=3 | p=4 | p=5 | p=6 |
|---|---|---|---|---|---|---|
| v=1 | 4.50 | 4.67 | 4.17 | 2.11 | 3.52 | 2.12 |

Matrix 16. Demand for the p-th Technical Function to Facilitate the Provision for Shelter (v=2) ($\underline{D}_p^2$)

| | p=1 | p=2 | p=3 | p=4 | p=5 | p=6 |
|---|---|---|---|---|---|---|
| v=2 | 3.74 | 3.64 | 2.10 | 1.61 | 2.88 | 2.26 |

Matrix 17. Demand for the p-th Technical Function to Facilitate the Provision for Clothing (v=3) ($\underline{D}_p^3$)

| | p=1 | p=2 | p=3 | p=4 | p=5 | p=6 |
|---|---|---|---|---|---|---|
| v=3 | 2.31 | 4.06 | 1.48 | 1.93 | 2.15 | 1.96 |

Matrix 18. Demand for the p-th Technical Function to Facilitate the Provision for Health (v=4) ($\underline{D}_p^4$)

| | p=1 | p=2 | p=3 | p=4 | p=5 | p=6 |
|---|---|---|---|---|---|---|
| v=4 | 3.34 | 2.82 | 1.82 | 1.45 | 2.78 | 1.73 |

## 2. Demands for the Technical Characteristics

The demands for each of the seven technical characteristics to facilitate the provision for Nourishment, Shelter, Clothing, and Health were determined by integrating the Need-Function Demand Matrix ($\underline{D}_p^v$) with the Function/Characteristic Demand Matrix ($\underline{\underline{D}}_p^q$). In an attempt to represent the outcomes of matrix multiplication on a 1 - 5 scale, the following formula was adopted:

$$\underset{(1\times7)}{\underline{D}_q^v} = \frac{\sum_{p=i}^{6} \sqrt{(\underset{(1\times6)}{\underline{D}_p^v} \cdot \underset{(6\times7)}{\underline{\underline{D}}_p^q})}}{6} \quad , \quad \ldots\ldots\ldots(6)$$

in which $D_q^v$ refers to the Demand for the q-th technical characteristic to facilitate the provision for the v-th basic human need.

To determine the demands for the technical characteristics for Nourishment (v=1), the Matrix 15 ($\underline{D}_p^1$), which specifies the demands for the p-th technical function for Nourishment, is multipled by Matrix 13 ($\underline{\underline{D}}_p^q$), which identifies the demand for the q-th technical characteristic to activate the p-th technical function, under the conditions implicit in formula (6). Specifically, the computation procedure to obtain the demand for the first technical characteristic, Promptness (q=1), is shown as:

Matrix 15.

$$\begin{array}{c} \\ v=1 \end{array} \begin{array}{c} \begin{array}{cccccc} p=1 & p=2 & p=3 & p=4 & p=5 & p=6 \end{array} \\ \begin{bmatrix} 4.50 & 4.67 & 4.17 & 2.11 & 3.52 & 2.12 \end{bmatrix} \end{array}$$

$$\underline{C}_p^1$$

First Column of Matrix 13

$$\begin{array}{c} \\ p=1 \\ p=2 \\ p=3 \\ p=4 \\ p=5 \\ p=6 \end{array} \begin{array}{c} q=1 \\ \begin{bmatrix} 3.00 \\ 4.00 \\ 5.00 \\ 3.00 \\ 2.00 \\ 2.00 \end{bmatrix} \end{array}$$

$$\underline{D}_p \ (q=1)$$

$$= \frac{1}{6}\,[\sqrt{(4.50).(3.00)} + \sqrt{(4.67).(4.00)} + \sqrt{(4.17)\cdot(5.00)} + \sqrt{(2.11)\cdot(3.00)} + \sqrt{(3.52)\cdot(2.00)} + \sqrt{(2.12)\cdot(2.00)}]$$

$$= \underline{3.30}$$

The same procedure applies to the six other technical characteristics--Effective Bit Rate (q=2), Cheapness (q=3), Reliability (q=4), Accessability (q=5), Storage/Retrieval Capacuty (q=6), and Confidertiality (q=7). The results of the matrix-multiplication scheme are composed of seven vectors each of which specifies the demand for the technical characteristic to facilitate the provision for Nourishment.

The demands for the technical characteristics for Shelter (v=2) are obtained through multiplying the elements of Matrix 16 ($\underline{D}_p^2$) with those of Matrix 13 ($\underline{\underline{D}}_p^q$), following the specification of formula (6). For Clothing (v=3), the demands for the technical characteristics are estimated by multiplying Matrix 17 ($\underline{D}_p^3$) by Matrix 13 ($\underline{D}_p^q$). For Health (v=4), Matrix 18 ($\underline{D}_p^4$) is multiplied by Matrix 13 ($\underline{\underline{D}}_p^q$). The results of the matrix multiplication are given in the following four matrices.

Matrix 19. Demand for the q-th Technical Characteristic to Facilitate the Provision for Nourishment (v=1) ($\underline{D}_q^1$)

$$\begin{array}{cc} & \begin{array}{ccccccc} q=1 & q=2 & q=3 & q=4 & q=5 & q=6 & q=7 \end{array} \\ v=1 & \left[\begin{array}{ccccccc} 3.30 & 3.52 & 3.61 & 3.64 & 3.93 & 2.68 & 2.30 \end{array}\right] \end{array}$$

Matrix 20. Demand for the q-th Technical Characteristic to Facilitate the Provision for Shelter (v=2) ($\underline{D}_q^2$)

$$\begin{array}{cc} & \begin{array}{ccccccc} q=1 & q=2 & q=3 & q=4 & q=5 & q=6 & q=7 \end{array} \\ v=2 & \left[\begin{array}{ccccccc} 2.85 & 3.09 & 3.13 & 1.19 & 3.53 & 2.39 & 2.07 \end{array}\right] \end{array}$$

Matrix 21. Demand for the q-th Technical Characteristic to Facilitate the Provision for Clothing (v=3) ($\underline{D}_q^3$)

$$\begin{array}{cc} & \begin{array}{ccccccc} q=1 & q=2 & q=3 & q=4 & q=5 & q=6 & q=7 \end{array} \\ v=3 & \left[\begin{array}{ccccccc} 2.64 & 2.99 & 2.86 & 2.91 & 3.24 & 2.17 & 1.93 \end{array}\right] \end{array}$$

Matrix 22. Demand for the q-th Technical Characteristic to Facilitate the Provision for Health (v=4) ($\underline{D}_q^4$)

$$\begin{array}{cc} & \begin{array}{ccccccc} q=1 & q=2 & q=3 & q=4 & q=5 & q=6 & q=7 \end{array} \\ v=4 & \left[\begin{array}{ccccccc} 2.64 & 3.00 & 2.90 & 2.95 & 3.27 & 2.22 & 1.89 \end{array}\right] \end{array}$$

3. Effectiveness of the Modes

The effectiveness of the telecommunication modes in facilitating the provision for Nourishment, Shelter, Clothing, and Health, is estimated on the basis of the supply-demand schedules of the technical characteristics. Here the demands for the q-th technical characteristic as given in Matrix 19 ($\underline{D}_q^1$ for Nourishment), Matrix 20 ($\underline{D}_q^2$ for Shelter), Matrix 21 ($\underline{D}_q^3$ for Clothing), and Matrix 22 ($\underline{D}_q^4$ for Health), are directly compared with the supply of the q-th technical characteristic provided by the m-th mode as given in Matrix 14 ($\underline{\underline{S}}_m^q$). The effectiveness of the m-th mode in facilitating the provision for the v-th basic human need ($E_m^v$) was obtained through the following formulas:

$$E_m^v = \sum_{q=1}^{7} E_{m(q)}^v \quad \ldots\ldots\ldots\ldots\ldots\ldots(7)$$

$$E_{m(q)}^v = D_q^v \text{ or } S_m^q \text{ (when } D_q^v = S_m^q) \quad \ldots\ldots(8)$$

$$E_{m(q)}^v = D_q^v \text{ (when } D_q^v < S_m^q) \quad \ldots\ldots\ldots(9)$$

$$E_{m(q)}^v = S_m^q \text{ (when } D_q^v > S_m^q) \quad \ldots\ldots\ldots(10)$$

In formula (7), $E_m^v$ is the sum of the seven values $E_{m(q)}^v$, each of which refers to the effectiveness of the m-th mode in facilitating the provision for the v-th basic human need with respect to the q-th technical characteristic.

In formula (8), supply and demand with respect to the q-th technical characteristic show identical values, reflecting a condition of a perfect match. The effectiveness of a telecommunication mode with respect to the q-th technical characteristic can, therefore, be taken from either the supply value or the demand value. The underlying

assumption of formula (8) is that the effectiveness of a given technological choice is controlled by the magnitude of the values in supply and demand. In other words, if both the values in supply and in demand are 1, the effectiveness of a telecommunication mode is 1, reflecting a perfect match, but with a low degree of magnitude. On the other hand, if both values in supply and in demand are 5, the effectiveness of a telecommunication mode is 5, reflecting a perfect match, and with a high degree of magnitude.

The formulas (9) and (10) apply when there is a mismatch between supply and demand. In formula (9), the value of supply with respect to the q-th technical characteristic is greater than that of demand. In such a case, the effectiveness of a mode is the value of demand, since additional capacity in supply after meeting the demand is superfluous. In formula (10), the value of supply with respect to the q-th technological characteristic is smaller than that of demand. In such a case, the effectiveness of a mode is the value of supply, since the maximum capacity of a mode meeting the demand is limited by its supply.

With these four formulas, the effectiveness of Postal Service in facilitating the provision for Nourishment ($E_1^1$) is determined. First, the demands for the seven technical characteristics for Nourishment as given in Matrix 19 ($\underline{D}_q^1$) are examined against the supplies of the seven technical characteristics by Postal Service as given in first column of Matrix 14 ($\underline{S}_q^1$).

Demand (Matrix 19 for Nourishment)

| | q=1 | q=2 | q=3 | q=4 | q=5 | q=6 | q=7 |
|---|---|---|---|---|---|---|---|
| v=1 | [3.30 | 3.52 | 3.61 | 3.64 | 3.93 | 2.68 | 2.30] |

Supply (first column of Matrix 14 for Postal Service)

| | q=1 | q=2 | q=3 | q=4 | q=5 | q=6 | q=7 |
|---|---|---|---|---|---|---|---|
| m=1 | [2.00 | 2.00 | 5.00 | 4.00 | 3.00 | 4.00 | 5.00] |

Second, comparison is made between values of supply and those of demand with respect to each technical characteristic. In q=1 (Promptness), q=2 (Effective Bit Rate), and q=5 (Accessibility), the values of demand are bigger than those of supply. Hence, formula (10) is applied, and effectiveness of Postal Service in terms of q=1, q=2, and q=5 is taken from values of supply-side: $E^1_{1(1)} = 2.00$, $E^1_{1(2)} = 2.00$, and $E^1_{1(5)} = 3.00$. In the remaining four technical characteristics q=3 (Cheapness), q=4 (Reliability), q=5 (Storage/Retrieval Capacity), and q=7 (Confidentiality), the values of demand are smaller than those of supply. Hence, formula (11) is applied, and the effectiveness of Postal Service with respect to q=3, q=4, q=6, and q=7, is taken from the values of demand-side: $E^1_{1(3)} = 3.61$, $E^1_{1(4)} = 3.64$, $E^1_{1(6)} = 2.68$, and $E^1_{1(7)} = 2.30$.

Third, the effectivenss of Postal Service in facilitating the provision for Nourishment ($E^1_1$) comprising the seven technological characteristics is obtained by summing the properties of $E^1_{1(q)}$'s:

$$E^1_1 = 2.00 + 2.00 + 3.61 + 3.64 + 3.00 + 2.68 + 2.31 = \underline{19.23}.$$

As a result, the effectivenss of Postal Service in facilitating the provision for Nourishment is determined as 19.23.

The same logic presented in formula (7), (8), (9), and (10), applies to the nine other telecommunication modes; hence the effectiveness of the

ten telecommunication modes under assessment in facilitating the provision for Nourishment is estimated as:

$E_1^1 = 19.23$ (m=1, Postal Service)

$E_2^1 = 18.89$ (m=2, Telegraph)

$E_3^1 = 17.12$ (m=3, Telephone)

$E_4^1 = 17.43$ (m=4, Audio-Cassette)

$E_5^1 = 16.43$ (m-5, Loudspeaker)

$E_6^1 = 16.77$ (m=6, Theatrical Film)

$E_7^1 = 18.59$ (m=7, Radio)

$E_8^1 = 17.39$ (m=8, Television)

$E_9^1 = 18.61$ (m=9, Newspaper)

$E_{10}^1 = 17.45$ (m=10, Magazine)

The effectiveness of the ten telecommunication modes in facilitating the provision for Shelter ($E_m^2$) is estimated by comparing the demand-side as given in Matrix 20($\underline{D}_q^2$) with the supply-side as given in Matrix 14 ($\underline{\underline{S}}_m^q$). To estimate the effectiveness of each mode in facilitating the provision for Clothing ($E_m^3$), the demand-side as given in Matrix 21 ($\underline{D}_q^3$) is compared with the supply-side as given in Matrix 14 ($\underline{\underline{S}}_m^q$). For Health (v=4), the effectiveness of the telecommunication modes ($E_m^4$) is estimated from the difference between the demand-side as given in Matrix 22 ($\underline{D}_q^4$) and the supply-side as given in Matrix 14 ($\underline{\underline{S}}_m^q$).

The outcomes of Phase III that identify the effectiveness of the ten telecommunication modes under consideration in facilitating the provision for each of Nourishment, Shelter, Clothing, and Health are

tabulated in the following four matrices.

Matrix 23. Effectiveness of the m-th Mode in Facilitating the Provision for Nourishment (v=1) ($\underline{E}_m^1$)

| | m=1 | m=2 | m=3 | m=4 | m=5 | m=6 | m=7 | m=8 | m=9 | m=10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v=1 | [19.23 | 18.89 | 17.12 | 17.43 | 16.36 | 16.77 | 18.59 | 17.39 | 18.61 | 17.45] |

Matrix 24. Effectiveness of the m-th Mode in Facilitating the Provision for Shelter (v=2) ($\underline{E}_m^2$)

| | m=1 | m 2 | m=3 | m=4 | m=5 | m=6 | m=7 | m=8 | m=9 | m=10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v=2 | [17.80 | 17.46 | 16.03 | 18.42 | 17.79 | 15.41 | 16.66 | 15.66 | 17.77 | 15.39] |

Matrix 25. Effectiveness of the m-th Mode in Facilitating the Provision for Clothing (v=3) ($\underline{E}_m^3$)

| | m=1 | m=2 | m=3 | m=4 | m=5 | m=6 | m=7 | m=8 | m=9 | m=10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v=3 | [16.87 | 16.60 | 15.47 | 15.33 | 16.64 | 14.76 | 15.78 | 14.78 | 17.83 | 14.93] |

Matrix 26. Effectivenss of the m-th Mode in Facilitating the Provision for Health (v=4) ($\underline{E}_m^4$)

| | m=1 | m=2 | m=3 | m=4 | m=5 | m=6 | m=7 | m=8 | m=9 | m=10 |
|---|---|---|---|---|---|---|---|---|---|---|
| v=4 | [16.96 | 16.92 | 15.75 | 15.38 | 16.76 | 14.85 | 15.86 | 14.86 | 17.03 | 15.07] |

## Phase IV

The fourth phase of the measurement scheme is designed to derive the final outcomes of the Socio-Technical Assessment Model. At this phase, the concern is focused on how much the overall quality of life of all societal sectors can be increased by the expansion of the specific telecommunication modes. The objective of Phase IV is formulated as:

Objective: To derive the net contribution rates of the ten telecommunication modes under assessment to incrementing the overall quality of life of the village society as a whole from the provision for the four basic needs under investigation--Nourishment, Shelter, Clothing and Health.

In the earlier part of Phase IV, the second criterion of the Maximum Expected Value (MEV) technique--compute the expected value of each action by multiplying each value [of each consequence] by its corresponding products and summing these products--is in operation. Here, the Socio-Technical Assessment Model assumes that the net contribution rates of the telecommunication modes to enhancing the overall quality of life are controlled by two elements: first, the extent to which the telecommunication modes can facilitate the provision for the specific basic human needs; second, the degree to which the specific basic human needs can contribute to increasing the overall quality of life of the villagers. Based on this assumption, the net contribution rates of the telecommunication modes are derived from integrating the outcomes of Phase III with those of Phase II. The outcomes of Phase III are 40 scalars, tabulated in four matrices, each of which represents the effectiveness of the m-th telecommunication mode in facilitating the provision for the specific basic needs--Nourishment, Shelter, Clothing, and Health (Matrix 23, 24, 25, and 26). The outcomes of Phase II consist of four scalar values (Scalar 1, 2, 3, and 4) which designate the potential contributing rates of Nourishment, Shelter, Clothing, and Health, to enhancing the overall quality of life of the villagers as a whole. The mathematical operation was handled through a formula:

$$\Delta \underline{S}_m^v = \Delta \underline{S}^v \cdot \underline{E}_m^v, \; \ldots\ldots (11)$$

in which $\Delta \underline{S}_m^v$ refers to the net <u>contribution rate</u> of the m-th telecommunication <u>mode</u> in enhancing the overall quality of life of the village society as a whole from the provision for the v-th basic human <u>need;</u>

$\Delta\underline{S}^{v}$ refers to the potential contributing rate of the v-th basic human need to enhancing the overall quality of life of the village society; and $\underline{E}_{m}^{v}$ refers to the effectiveness of the m-th mode in facilitating the provision for the v-th basic human need.

With formula (11), the net contribution rates of the ten telecommunication modes from the provision for Nourishment are calculated with Matrix 23 ($\underline{E}_{m}^{1}$, which identifies the effectiveness of the m-th mode in facilitating the provision for Nourishment), and with Scalar 1 ($\Delta\underline{S}^{1}$=0.153), which represents the potential contributing rate of Nourishment to increasing the overall quality of life of the village. The final outcomes of the mathematical operations consist of 10 scalar values, which were obtained through:

$$\underset{\Delta\underline{S}^{1}}{.153} \quad \times \quad \underset{\underline{E}_{m}^{1}}{\begin{array}{c|c|} & v=1 \\ m=1 & 19.23 \\ m=2 & 18.89 \\ m=3 & 17.12 \\ m=4 & 17.43 \\ m=5 & 16.36 \\ m=6 & 16.77 \\ m=7 & 18.59 \\ m=8 & 17.39 \\ m=9 & 18.61 \\ m=10 & 17.45 \end{array}} \quad = \quad \underset{\Delta\underline{S}_{m}^{1}}{\begin{array}{|c|c} v=1 & \\ 2.94 & m=1 \\ 2.89 & m=2 \\ 2.62 & m=3 \\ 2.67 & m=4 \\ 2.50 & m=5 \\ 2.57 & m=6 \\ 2.84 & m=7 \\ 2.66 & m=8 \\ 2.85 & m=9 \\ 2.67 & m=10 \end{array}}$$

The net contribution rates of the telecommunication modes from the provision for Shelter (v=2) are obtained through multiplying Scalar 2

($\Delta \underline{S}^2$ = 0.114), which represents the potential contributing rate of Shelter to enhancing the quality of life of the village society as a whole, by the elements in Matrix 24 ($\underline{E}_m^2$).

The net contribution rates of the telecommunication modes from the provision for Clothing (v=3) are obtained from multiplying the elements in Matrix 25 ($\underline{E}_m^3$) by Scalar 3 ($\Delta \underline{S}^3$ = 0.185), which represents the potential contributing rate of Clothing to enhancing the overall quality of life of the village.

The net contribution rates of the telecommunication modes from the provision for Health (v=4) are obtained from multiplying the elements in Matrix 26 ($\underline{E}_m^4$) by Scalar 4 ($\Delta \underline{S}^4$ = 0.143), which designates the potential contributing rate of Health to enhancing the overall quality of life of the village).

The final outcomes that represent the net contributing rates of the specific telecommunication modes to incrementing the overall quality of life of the village society as a whole from the provision for Nourishment, Shelter, Clothing, and Health, are tabulated in Table 42. In Table 42, all of the 16 basic needs are included, recalling the need for analysis for all of the basic human needs that constitute the quality-of-life scheme of the Socio-Technical Assessment Model.

The desirability of a telecommunication mode can then be estimated by the summing of the products across each column in Table 42. If we confine ourselves to the four basic needs examined in the present study--Nourishment, Shelter, Clothing, and Health--the desirability of each of the ten telecommunication modes is estimated as:

| Mode | Desirability | Rank |
|---|---|---|
| Postal Service | 10.52 | 2 |
| Telegraph | 10.37 | 3 |
| Telephone | 9.56 | 7 |
| Audio-Cassette | 9.81 | 6 |
| Loudspeaker | 10.01 | 4 |
| Theatrical Film | 9.18 | 10 |
| Radio | 9.95 | 5 |
| Television | 9.33 | 9 |
| Newspaper | 10.65 | 1 |
| Magazine | 9.37 | 8 |

The most desirable telecommunication mode, with respect to Nourishment, Shelter, Clothing, and Health, is found to be Newspaper; whereas the least desirable telecommunication mode is found to be Theatrical Film. Overall, the telecommunication modes that deliver messages through languages such as Newspaper, Postal Service, and Telegraph appear to be the attractive choices for this particular case. In view of the facts that literacy rate reaches almost 100 percent in Wa-Bu, and that the telecommunication modes relying on printed matters are relatively underutilized, the results of the Socio-Technical Assessment Model seem plausible. The particularly low desirability rate for Theatrical Film and Television may stem from the entertainment-dominated content of these audio-visual telecommunication modes. So long as the information content provided by these modes is not changed, these seemingly glamorous telecommunication modes would offer little for the betterment of the villagers in Wa-Bu.

TABLE 42

Expected Rate of Increment of the Overall Quality of Life of the Villagers Attributed to the Telecommunication Modes from the Provision for the Basic Human Needs

| Need | Telecommunication Mode | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Postal Service | Tele-graph | Tele-phone | Audio-Cassette | Loud-speaker | Film | Radio | TV | Newspaper | Magazine |
| Nourishment | 2.94 | 2.89 | 2.62 | 2.67 | 2.50 | 2.57 | 2.84 | 2.66 | 2.85 | 2.67 |
| Shelter | 2.03 | 1.99 | 1.83 | 2.10 | 2.03 | 1.76 | 1.90 | 1.79 | 2.03 | 1.75 |
| Clothing | 3.12 | 3.07 | 2.86 | 2.84 | 3.08 | 2.73 | 2.91 | 2.73 | 3.30 | 2.76 |
| Health | 2.43 | 2.42 | 2.25 | 2.20 | 2.40 | 2.12 | 2.30 | 2.15 | 2.47 | 2.19 |
| Physical Security | | | | | | | | | | |
| Unpolluted Air, Water, Soil | | | | | | | | | | |
| Pleasant Living Condition | | | | | | | | | | |
| Public Safety | | | | | | | | | | |
| Opportunity for Education | | | | | | | | | | |
| Opportunity for Profession | | | | | | | | | | |
| Political Freedom | | | | | | | | | | |
| Entertainment and Culture | | | | | | | | | | |
| Judicial Justice | | | | | | | | | | |
| Social Justice Economic Justice Communal Solidarity | | | | | | | | | | |

If all of the 16 basic needs had been included in the operation of the Model, the desirability of the telecommunication modes would have been somewhat different. Nevertheless, considering the dominating effects of Nourishment, Shelter, Clothing, and Health which relate strongly to the Individual-Material P Goal as it contributes to the overall satisfaction level of the villagers (as confirmed in Chapter V), the final outcome of the Socio-Technical Assessment Model can serve as rational guideline in allocating public resources into the specific telecommunication modes. The quantified values derived from operation of the Socio-Technical Assessment Model take into account the three most important elements in public-policy planning: the potential beneficiaries of expansion of technological options; the experts who have specific knowledge on the direct areas of application; and most importantly, the decision-makers of a given society whose value systems will affect the lives of the villagers.

## Overview

This chapter presents a detailed explanation on the operation of the Socio-Technical Assessment Model. The operation was divided into the four phases. All of the elements included in the mathematical operations were systematically treated through a number of matrix manipulations. The final outcome of the Model gives quantified values that specify the "desirability" of each given telecommunication mode in Wa-Bu. The operation of the Model can serve as a realistic and scientific basis in planing allocation of public resources into the telecommunication sector.

A full operation of the Model would, of course, require major amounts of data and resources. Within the limited scope of analysis confined to the four basic needs that affect the rural populations of the developing countries significantly, the present study attempted to suggest the ways by which policy guidelines for technology application can be set forth. The actual merits of the Socio-Technical Assessment Model are to be determined through some sort of longitudinal studies by means of which changes over time can be detected. Nonetheless, the application of the Socio-Technical Assessment in the present study is believed to be a pioneering attempt in devising practical guidelines for planning the allocation of public resources into telecommunications.

# CHAPTER VII

# CONCLUSIONS AND FUTURE DIRECTIONS

This study applies a Socio-Technical Assessment Model to explore the potentialities of various telecommunication technologies for raising the quality of life in the developing countries. With data obtained from a field study in a rural village in South Korea, the present work attempts three tasks: 1) to aid policy-makers of the developing countries in allocating public resources in the telecommunication sector; 2) to expand the traditional scope of telecommunication policy studies by introducing an analytically-oriented methodological tool; and 3) to test the validity and usefulness of the Model.

Taking into account the reciprocal impacts of technologies and elements of society with changes of time, our study offers a foundation for initial policy alternatives in long-range telecommunication planning. This chapter presents the implications of empirical findings obtained from the Model operation, as well as tentative conclusions about promises and threats of various telecommunication technologies in the developing countries. The chapter concludes with suggestions for future research that would apply the Socio-Technical Assessment Model to the study of telecommunication policies in the industrialized nations.

## Conclusions

The implications of empirical findings will be discussed in focusing on three major aspects: a scheme for defining the quality of

life; the effects of telecommunication technologies; and the operation of the Model.

## Quality-of-Life Scheme

Schemes for assessing the impact of technology on a society initially had high promise as an aid to decision makers, but the acceptance of the schemes has been disappointing. We believe that the chief reason for the nonacceptance has been the insufficient attention paid to formulating a decision criterion. Ostensibly the purpose of the assessment is to make life better, but scant attention has been given to what "better" means--better in what ways, and for whom? Usually the "quality of life" is understood to serve as the criterion, but the definition is left implicit or is conceived too narrowly or nonoperationally.

In the present methodology the quality of life is determined by the degree of fulfillment of four canonical human goals. The degree of fulfillment is inferred from the people's degree of satisfaction from a set of 16 basic human needs. Although there is considerable theoretical justification for the kind and number of the canonical goals, there is considerable arbitrariness for the choice of basic needs. The important condition is that the basic needs cover a representative set of major needs, the satisfaction of which contributes substantially to all of the canonical goals. Our results justify our particular choice of human needs; the conclusions must remain tentative, however, until other populations and other technologies are investigated. The results focusing on the first major aspect are the following:

First, the degree of satisfaction for the 16 basic needs can be resolved into components of fulfillment along the four canonical goals: P, individual-material; E, group-material; F, individual-spiritual; J, group-spiritual. As expected, each canonical goal is closely related to a set of four basic needs: P, most closely to Nourishment, Shelter, Clothing, and Health; E, by Physical Security, Unpolluted Air, Water, Soil; Pleasant Living Conditions, and Public Safety; F, by Opportunity for Education, Opportunity for Profession, Political Freedom, and Entertainment and Culture; J, by Judicial Justice, Social Justice, Economic Justice, and Communal Solidarity. Among the 16 basic human needs, four--Physical Security, Entertainment and Culture, Judicial Justice, and Communal Solidarity--are found to contribute relatively little to the P, E, F, J goals in the society studied. Nevertheless, those needs are not to be eliminated from the quality-of-life scheme, because they may have an important effect in other societies. In the absence of comparative results obtained from those, the appropriateness of the 16 basic needs remains undecided.

Second, the overall satisfaction level of the sample subjects was explained by the degree of fulfillment for the P, E, F, J goals. The Model avoids a common methodological weakness of social-science research by postulating the relationship between the observed variables and <u>all</u> of the underlying constructs. In other words, the degree of fulfillment for each canonical goal was inferred from not only those basic needs that relate most strongly to the specific canonical goal variable, but also the other needs even though they show low degree of association with that goal. With the degree of fulfillment of each P, E, F, J goal

incorporated in all of the basic needs, the overall satisfaction level of the villagers was fully explained by the linear composition of the fulfillment of P, E, F, J goals. The contribution rate of each of P, E, F, J goals to the overall satisfaction level was found to be significant, suggesting that categorization of human goals into the P, E, F, J scheme is valid.

Third, the ordering of canonical human goals in affecting the overall satisfaction level is consistent with the socioeconomic patterns prevailing in the developing countries, especially in those countries that follow a laissez-faire economy. In the case under study, the Individual-Material Goal (P) has the greatest influence on the overall satisfaction level, followed by the Individual-Spiritual Goal (F), Group-Material Goal (E), and Group-Spiritual Goal (J). The predominance of individual concerns over group ones perhaps reflects a propensity toward an individualistic society as typified in many capitalistic economic systems. The stronger influence of material concerns over spiritual ones suggests a trend easily found in those developing countries that tend to emphasize growth in the Gross National Product (GNP) as the primary goal of development.

In conclusion, although the validity of the Socio-Technical Assessment Model needs to be explored further with empirical results obtained in other developing countries as well as in the industrialized nations, we can state that the quality-of-life scheme proposed in the Socio-Technical Assessment Model appears to be a promising tool for aiding public-policy formulation.

Effects of Telecommunication Technologies

Most of the studies dealing with potentialities of telecommunication technologies fail to present a concrete scheme with which performance as well as demands for various telecommunication modes can be estimated. This study differs from such studies in two aspects: 1) it prsents a holistic framework in which various technological choices can be evaluated in a single frame; and 2) the performance rate of telecommunication modes is estimated directly from their effects on the overall satisfaction level of the people, not from abstract--or sometimes even misleading--indexes such as economic productivity or Gross National Product (GNP).

In total, ten telecommunication modes--Postal Service, Telegraph, Telephone, Audio-Cassette, Loudspeaker, Theatrical Film, Radio, Television, Newspaper, Magazine--were considered. The empirical findings suggest several interesting points that can be of significance in studying the roles of telecommunication in the development process.

First, access to, and frequency of usage for, the telecommunication modes do have significant effects on the overall satisfaction level of the rural populace. This result supports a view advanced by Wellenius (1972), Hudson and Parker (1975), and Clippinger (1980), who speculated that telecommunication may indeed play an important role in facilitating the development process.

Second, the effects of the telecommunication modes are much more clearly delineated when the modes are treated collectively rather than individually. This finding seems to suggest that a collective approach in which a variety of telecommunication modes are evaluated and planned

for in a larger frame might be more fruitful than the piecemeal approach that treats broadcasting technologies, print media, and point-to-point technologies separately.

Third, the modes representing the mass-media form, notably radio and television, have far smaller effect on the overall satisfaction level than do the point-to-point modes. The effects of television draw special attention because those who watch television more frequently have a much higher dissatisfaction in their daily lives than those who watch it less frequently. Although causality cannot be established, the results are at variance with the contentions of Lerner (1958), Schramm (1964), and Rogers (1963), who assumed that the mass media necessarily brings a better life for the rural population in the developing countries. Rather, the findings appear to be consistent with the claims of Golding (1977), Schiller (1975-1976), and Singh (1977), who cautioned about negative impacts of the mass media, particularly television, in the developing countries.

In conclusion, the policy implications of the empirical results with respect to the effects of telecommunications technologies can be summarizedas: 1) The developing countries indeed can find an effective development tool in telecommunication technologies; 2) In planning allocation of public resources into the telecommunication sector, a collective approach is likely to be more effective than a piecemeal approach; and 3) Potentialities of point-to-point modes such as Telephone, Postal Service, and Telegraph need to be investigated more thoroughly.

Operation of the Model

A full operation of the Model would require massive data bases and lengthy mathematical processes. Confining the investigation to the four basic human needs that relate most strongly to the Individual-Material Goal (P)--which happen to produce the greatest influence on the overall satisfaction level of the villagers--the present study demonstrated the ways with which the desirability of a given telecommunication mode can be estimated. For the sake of clarity, the Model operation procedure was divided into four phases, each of which bears a specific policy implication.

The first phase explored the degree of association of the four [concrete] basic needs--Nourishment, Shelter, Clothing, and Health--with each of the four [abstract] canonical goals, for each of the five societal sectors within the village--Professionals, Clerical Workers, Commercial Sector, Non-Agricultural Laborers, and Farmers. Except for one societal sector (Professionals), the four basic needs are found to have the strongest association with the Individual-Material Goal (P). In case of the Professionals, the four basic needs showed a higher degree of association with the Individual-Spiritual Goal (F) than with the Individual-Material Goal (P). The results seem to suggest that although the Professionals demonstrate the highest degree of satisfaction for all of the four basic human needs among the five societal sectors (Refer to Table 6 of Chapter IV), they may still feel deprived of the qualitative aspects of the four basic human needs. The outcome of Phase I reflects that even within a small and fairly homogeneous village society, a distinct difference in living conditions exists

between social groups. Therefore, we can conclude that it is necessary to classify the population into a workable set of social groups in applying impact-assessment schemes.

In the second Phase, the potential contributing rate of each of Nourishment, Shelter, Clothing, and Health, to raising the overall quality of life of the villagers was investigated. The concept of potential increment of the quality of life overcomes a common weakness in a policy-making frame which tends to rely on single-dimensional thinking. In a simple frame, one can easily conclude that the most urgent basic human need to be provided for is Health, since the mean satisfaction level for Health (3.77 in a 1 - 7 scale) is lower than that of Nourishment (4.49), Shelter (4.36), and Clothing (4.33). In this Model, we postulated that the potential increment of the overall quality of life with respect to the specific basic human needs is controlled by two important elements: 1) underlying relationship between the basic human needs and the canonical human goals; and 2) the decision-makers' weighting functions. After incorporating these two elements into the mathematical operation, we found that Clothing is likely to play the most important role in raising the overall quality of life of the villagers among the four basic human needs. Again, the Model presents a new insight in policy-making processes by suggesting a means to incorporate various dimensions which otherwise could be easily overlooked.

In Phase III, the effectiveness of the telecommunication modes in terms of facilitating provision for the basic human needs was determined. The dimensions included in the operation are: significance of the P, E,

F, J components of each of Nourishment, Shelter, Clothing, and Health; demands for the specific technical functions to promote the P, E, F, J components of those basic human needs; demands for the specific technical characteristics required to activate the specific technical functions; and supplies of the technical characteristics provided by each of the ten telecommunication modes. The results of the investigation showed that the effectiveness of the telecommunication modes differs considerably depending upon the specific tasks they are to perform. Nonetheless, the effectiveness of the modes may not necessarily be equivalent to the desirability when all other operating elements in the Model are considered. How, then, can the desirability of the particular telecommunication modes be estimated?

The fourth and last Phase gives the final numerical values which represent the desirability of each telecommunication modes for the village under study. At this stage, we integrated the potential contributing rate of each of Nourishment, Shelter, Clothing, and Health, to raising the overall quality of life of the villagers (outcomes of Phase II), with the effectiveness of the ten telecommunication modes in facilitating the provision for Nourishment, Shelter, Clothing, and Health respectively (outcomes of Phase III). The final outcomes of the Model operation designate the desirability of each of the telecommunication modes by specifying how much each mode can contribute to raising the overall quality of life of the village society as a whole, given that each mode will be used to facilitate the provision for the specific basic needs.

With the scope of assessment confined to the four basic needs, among the ten telecommunication modes, Newspaper is found to be the most desirable choice for the village society, followed by Postal Service, Telegraph, Loudspeaker, Radio, Audio-Cassette, Telephone, Magazine, Television,and Theatrical Film. If all the 16 basic human needs had been included in the Model operation, the final outcomes of the Socio-Technical Assessment Model could well be quite different. Restricting the scope of analysis to Nourishment, Shelter, Clothing, and Health, whose provision is most urgent in the developing countries, the Model identified as the optimal choices, the telecommunication modes that transmit printed messages without unreasonable delay. This result seems logical in view of the several facts. First, all the four basic needs under investiagion associate most strongly with the Individual-Material Goal (P) aspects. Second, in terms of producing foodstuffs (P component of Nourishment), providing housing facilities (P component of Shelter), manufacturing clothes (P component of Clothing), and furnishing basic health-care services (P component of Health), the most strongly needed information content may be the instructional messages and/or marketing information. Third, to provide the instructional messages and marketing information, telecommunication modes do not have to be instantaneous or costly. Rather, the modes that can transmit messages at low cost to the majority of people within a reasonably short period of time can be most effective. Moreover, for instructional purposes in particular, storage/retrieval capacity constitutes another important aspect. With respect to these criteria, Newspaper and Postal Service appear to be most plausible candidates with their low cost, high

reliability, wide accessibility, adequate storage/retrieval capacity, and tolerable delay.

The desirability of Telegraph is found to be fairly high, primarily because it can easily supply those technical characteristics required for transmitting instructional messages and marketing information. Nonetheless, the kinds of information that Telegraph delivers is restricted to personal messages, and hence little incentive to expand Telegraph services exists. The desirability of Telephone, which receives increasing attention in recent years (Saunders, 1979; Hudson, 1982), is found to be unimpressive. The prime reason for the low desirability of Telephone may stem from the prohibitively high cost of telephones within the village. Loudspeaker and Radio, which can transmit a variety of messages with little cost, showed a modest degree of desirability. The relatively low desirabilities of Loudspeaker and Radio, despite their capacities to transmit instructional or marketing information, may be attributed to their low storage/retrieval capacity. Television and Theatrical Film, which have long been acclaimed as efficient tools for accelerating the development process, are found to have the lowest desirability among the ten modes. The low desirability of Television and Theatrical Film seems to coincide with the other findings of the study in that the heavy viewer tends to show higher dissatisfaction with his/her daily life. The underlying reason for the low usefulness of Television and Theatrical Film can be found in their heavily entertainment-dominated messages in which an unattainably high standard of living is portrayed. Judging from these findings, one can conclude that further expansion of Television and Theatrical Film may

well present more threat than promise in raising the quality of life of the villagers so long as the information content transmitted by these two modes remain unchanged.

Finally, in presenting the application of the Socio-Technical Assessment Model, one thing has to be emphasized. In the present study, we are not immediately so much concerned with rigor in scaling or the preciseness of the outcome values. Rather, the prime objective of this study is to illustrate the ways with which a number of variables and dimensions involved in complex decision-making processes can be systematically treated, balanced, and incorporated, to find the optimal policy alternatives in a given situation. As the state of the art of impact-assessment schemes as well as of telecommunication policy studies stand, the present study deserves special attention since it shows the framework upon which future researches can be built.

## Future Directions

The application of the Socio-Technical Assessment Model is by no means restricted to the developing countries. With appropriate modifications, the Model can be applied to various kinds of technological undertakings, and to diverse kinds of society. The Model appears to be adequate for aiding the telecommunication policy planning in the industrialized or post-industrial states in Bell's term (1973).

Many studies have attempted to project the likely impacts of telecommunication technologies on various elements of society (Masuda, 1972; Engberg, 1977; Moss, 1981), but no systematic framework has evolved to guide public-policy planning in telecommunication. The following section gives a few suggestions for future research, primarily for the

application of the Model in analyzing and formulating telecommunication policy in industrialized nations. The weaknesses of the Model, as well as possibilities for refinement and expansion, will be discussed along with the suggestions.

Technological Realm to be Considered

The developments in individual information-related technologies such as computers, telephone, cable, fiber optics, and communication satellites, are in themselves impressive. But the most pervasive, perhaps revolutionary, impacts on the society will occur when combinations of some of these technologies are in operation. Notable among these are the combinations involving telephone, cable, and computers. With the high degree of attention and innovation in these technologies, the capability of these modes can be expanded phenomenally. Unlike the practices in earlier years when these technologies operated relatively in isolation, today's methods are to combine two or more of these technologies. If we restrict ourselves to these three modes, the candidates for assessment can be decided as (m=1,2,....7):

1. Telephone
2. Computer
3. Cable
4. Telephone/Computer
5. Computer/Cable
6. Cable/Telephone
7. Telephone/Computer/Cable

These technological modes will be evaluated with respect to two properties introduced in the present study: the technical functions and the technical characteristics.

The technical functions will differ somewhat from those listed in the present study because of the differences of prevailing social

environment between the developing countries and the industrialized ones. The technical functions applicable to the industrialized states appear to be (p=1,2,...10):

1. Instruction, one-way
2. Instruction, interactive
3. Marketing Information, one-way (shopping guides, stock price index, classified ads, etc.)
4. Marketing Information, interactive (banking, other transaction)
5. Entertainment, one-way (music, drama, sports, etc.)
6. Entertainment, interactive (videogames, quiz games, audience participation, etc.)
7. Public messages, one-way (news, public announcement, political addresses)
8. Public messages, interactive (polling, question-and-answer forums)
9. Home Management, one-way (fire alarm, burglar alarm, meter reading)
10. Home Management, interactive (verbal and visual correspondence)

Here, interactive refers to instant exchange of information between senders and receivers. The interaction may not necessarily be symmetrical, as in telephone, but may be quite asymmetrical, as in interactive cable television. The critical element is that sampling or polling proceeds with such a small delay that access is virtually continuous.

The technical characteristics are nearly the same as those considered in the present study. These are (q=1,2,...8):

1. Promptness
2. Effective Bit Rate
3. Economy
4. Accessibility to Senders
5. Accessibility to Receivers
6. Reliability (Robustness, Accuracy)
7. Storage/Retrieval Facility
8. Confidentiality and Security

Society

For the sake of discussion, the United States is selected as an example. The identification of societal sectors will be conditioned by the function of the technology under consideration. If the focus of interest is given to the provision of information to the "public," as contrasted to other commercial services to special groups or governmental services, suitable dimensions for classification can be sought among the following (j=1,2,....n):

Societal Sectors

Transmitting Ends

1. Equipment and service vendors
2. Operation staff
3. Information producers
   - Program producers
   - Advertisers
   - Service producers

Receiving Ends

1. Division by Geographic Factors (location, terrain, population density, etc.)
2. Division by Demographic Factors (age, income, occupation, sex, race, etc.)

Obviously, the categories could be added to, or more finely divided. It will be a matter of judgment to make an efficient choice, taking into account the importance of the subject of the analysis, and the extent of the resources available for the study.

Areas of Application

There is nothing sacred about the number 16 for the basic human needs in determining the quality of life in a given society. Depending on the circumstances, some needs can be ignored, and some needs can be added. To make sure that each canonical goal is adequately sampled

it will be desirable to include at least three basic human needs that produce particularly strong effects in each of P, E, F, J canonical goals. Again, each basic human need is to be resolved into the P, E, F, J components. The areas to which telecommunication technologies will be directly applied will be the P, E, F, J component (h-th component) of each basic human need (v-th need).

## Decision-Makers

The decision-makers encompass governmental officials for each society under study. If the resources will permit conducting a nationwide study, it is advisable to include both legislative and executive circles at three levels: federal, state, and local. Since the regulatory functions of telecommunication are rather clearly defined at each governmental level, the telecommunication policy-makers at federal, state, and local government might have to be included.

## Experts

The experts to be included in the Model are to include two groups: first, discipline specialists who have special knowledge in the v-th basic human need; second, telecommunication specialists who demonstrate competence in engineering aspects or social consequences of telecommunication technologies.

## Operation Procedure of the Model

With the conditions specified above, the Model would be operated in a manner similar to that suggested in the present study. A possible Model operation procedure consists of four phases. A few steps of

mathematical operation and scaling measures have been modified. (For a detailed explanation of mathematical operation procedure, see Appendix H.)

Phase I: The objective of Phase I is two-fold: 1) to determine the degree of association between the level of satisfaction for the v-th need with each of P, E, F, J goals in the j-th societal sector; 2) to estimate the conversion rate of the v-th need in raising the degree of fulfillment of each P, E, F, J goal for the j-th societal sector.

Stratified sampling across all societal sectors is to be conducted. Each sample subject will be asked two sets of questions concerning: 1) the degree of satisfaction for the v-th need; 2) the degree of importance of the v-th need in raising one's overall quality of life.

For the first question, a 7-point scale from -3 to +3 is suggested, and for the second, a 5-point scale ranging from +1 to +5.

The outcome of Phase I will consist of two sets of matrices: Matrix A, which specifies the degree of association the v-th need with the i-th human goal in the j-th sector (4 x j); Matrix B, which specifies relative importance of the v-th need in raising the fulfillment for the i-th need in the j-th sector (4 x j).

Phase II: The objective of Phase II is to determine the potential contributing rate of the v-th need to increasing the overall quality of life of the society as a whole.

As suggested in the present study, the decision-makers' value systems will be incorporated in the form of the weights assigned by them to the i-th canonical human goal, and to the j-th societal sector.

The decision-makers' weights assigned to the i-th canonical will be represented in Matrix C (1 x 4), the weights attached to the j-th sector in Matrix D (j x 1).

The potential contributiong rate of the v-th need is to be determined through:

$$\underset{(1 \times 4)}{\text{Matric C}} \times [\underset{(4 \times j)}{(\text{Matrix A})} * \underset{(4 \times j)}{(\text{Matrix B})}] \times \underset{(j \times 1)}{\text{Matrix D}}.$$

The outcome of Phase II consists of v number of scalars for all the basic needs included in the Model.

Phase III: The objective of Phase III is to estimate the effectiveness of the m-th mode in facilitating the provision for the v-th need.

The mathematical operation follows the procedure suggested in the present study. The dimensions to be included are: 1) Significance-Component Matrix (Matrix E, 1 x 4) that specifies the significance of the h-th component for the v-th need. Estimate of the significance-component matrix is to be made by a group of experts who have special knowledge with respect to the v-th basic need.

2) Component-Function Demand Matrix (Matrix F, 4 x 10) that identifies the demands for the p-th information function to promote the h-th component of the v-th need. In estimating the Component-Function Demand Matrix, a joint discussion between the human-need experts and the telecommunication experts is recommended. A 5-point scale ranging from 1 to 5 can be used.

3) Function-Characteristic Demand Matrix (Matrix G, 10 x 7) that specifies the demand for the q-th characteristic to perform the p-th function. Estimation of the Function-Characteristic Demand Matrix is to be made by the telecommunication experts. A 5-point scale ranging from 1 to 5 can be used.

4) Characteristic-Mode Supply Matrix (Matrix H, 7 x 6) that identifies the supply of the q-th characteristic by the m-th mode. Here, instead of relying on a relative scale, it is desirable to establish a scale that can measure the characteristics of the modes on an absolute scale. Estimates of the Characteristic-Mode Supply Matrix will be made by the telecommunication experts.

The effectiveness of the m-th mode relative to the v-th need is then determined by:

(Matrix E) x (Matrix F) x (Matrix G) = Demand for the q-th characteristic for the v-th need (Matrix I). Here, some adjustment has to be made to make the scale consistent with the ones used in Matrix H.

Direct Comparison between Matrix I and Matrix H with respect to each of the q-th characteristic and the sum of those products will give the effectiveness of the m-th mode in facilitating the provision for the v-th need.

Phase IV: The objective of Phase IV is to extract the net contributing rate of the m-th mode toward increasing the overall quality of life in society as a whole, from the provision of the v-th basic need.

> As in the present study, the outcome of Phase IV is derived from the multiplication scheme between: 1) the potential contributing rate of the v-th need to increasing the overall quality of life in the society as a whole; 2) the effectiveness of the m-th mode in facilitating the provision for the v-th need.
>
> The desirability of the m-th mode is to be determined by summing the products that specify the expected rate of increment in the overall quality of life attributed to the m-th mode from the provision for the v-th need.

One can easily be overwhelmed by the complexity of the Socio-Technical Assessment Model and enormous sets of data required to operate it. Yet, the Model simply reflects the nature of public-policy making. This process, like life itself, is characterized by complexity, ambiguity, and a need to find a balance among many conflicting interests. This Model shows a new way to aid public policy-makers who might easily be misled by heavy lobbying forces of telecommunication-related industries or other special pleaders. The current trend in the United States telecommunication sphere, where massive scale of deregulation is implemented, has to be viewed with caution. Despite a common belief that the deregulatory policies will spur growth of the telecommunication industry, whose growth will in turn serve the common users more effectively, the U.S. telecommunication fields suffer from many entangled issues most of which require government action (Chisman, 1982). If the constitutional provision to promote the general welfare is to be recognized, the prime responsibility of telecommunication-policy makers appears to be to encourage the technologies which will bring the maximum benefit for the public at the lowest cost, and to restrain those technologies which flourish at unjustified expense to the public. With the proposed Socio-Technical Assessment Model, some of the most significant public-policy issues can be effectively addressed by refining the concept of public interest, and by identifying ways by which conflicting interests of many sectors can be balanced in order to find optimal policy decisions.

## Final Discussion

Finally, we need to put into perspective the limits and the scope of the present study. With regard to the limits, there are purely technical shortcomings on one hand, and fundamental conceptual problems on the other. As to the former, the restricted resources in time and manpower forced coalescence of several separate steps of analysis into a single one, and forced the author and her adviser to serve as proxies for experts in providing intuitive common-sense estimates. As to the latter, the validity of scaling for various concepts has not yet been independently established. As suggested earlier, it will be desirable to establish absolute scales in estimating attributes of many technical functions and characteristics.

With regard to the scope of the present study, the qualitative aspects of the Socio-Technical Assessment Model, particularly the quality-of-life indicator has been validated with various quantitative measures. Though the usefulness of the Model outcome values cannot be assessed without actual implementation of the results, the analytic framework for the Model operation, nevertheless, appears consistent and logical. If the actual merits of the Model can be substantiated by further study, we can then offer a more refined methodology for identifying the desirabilities of alternative technological strategies for improving the quality of life in a society by identifying major interactions between technical and social factors, and by placing them in a format to aid telecommunication policy-makers.

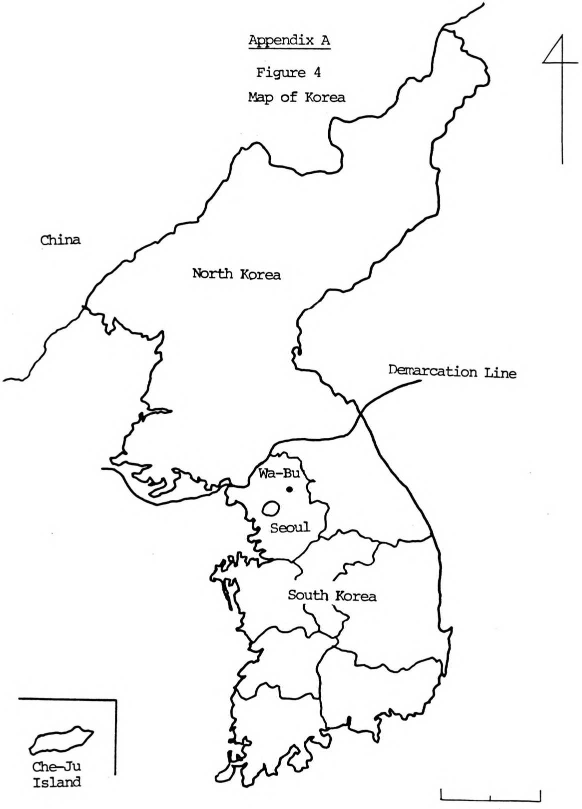
The ways for improving the Model are clear, because the major shortcomings of the present study are the consequences of the constraints on resources available for the investigation, not by the inadequacies of the theoretical framework. The most important aspect of the present study is its methodology that forces systematic and consistent incorporation of the multiplicity of variables in the search for optimal policy decision values. It is hoped that future studies--not only in telecommunication policy research, but also in other areas where technology-society relationship is of critical concern--can be built upon the experiences obtained in the present study.

APPENDICES

Appendix A

Figure 4

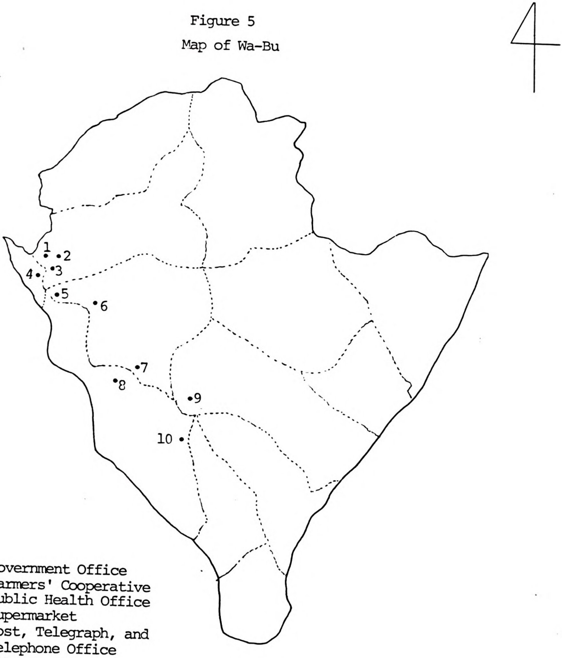
Map of Korea



Appendix A

Figure 5

Map of Wa-Bu




1. Government Office
2. Farmers' Cooperative
3. Public Health Office
4. Supermarket
5. Post, Telegraph, and Telephone Office
6. Film Theatre
7. Railroad Station
8. Professional High School
9. Military Post
10. Liason Office of the Farmers' Coopeative

1 mile

## APPENDIX B

## BACKGROUNDS OF THE SAMPLE SITE

Table 1. Employment by Occupation in South Korea and Wa-Bu

| Occupation | South Korea (percent) | Wa-Bu Village (percent) |
|---|---|---|
| Professionals | 6.03 | 5.00 |
| Clerical Workers | 10.60 | 7.50 |
| Sales Workers | 17.54 | 7.00 |
| Service Workers | 9.34 | 3.00 |
| Agriculture (including forestry, fishing, hunting) | 21.87 | 50.00 |
| Industrial Workers | 34.62 | 15.00 |

Sources: Korea Statistical Yearbook, 1981. Seoul, Korea: National Bureau of Statistics, Economics Planning Board, 1982, pp. 72-73. Information given by the Census Bureau, Wa-Bu Village, June, 1982. Occupational Breakdown for Wa-Bu is a rough estimate.

Appendix B

Table 2. Increase of GNP per cap. in South Korea (1974-1980)

| Year | G.N.P. per cap. (in U.S. $) | Annual Growth Rate (percent) |
|---|---|---|
| 1974 | 523.00 | -- |
| 1975 | 573.00 | 9.56 |
| 1976 | 765.00 | 33.51 |
| 1977 | 965.00 | 25.14 |
| 1978 | 1,279.00 | 32.54 |
| 1979 | 1,597.00 | 23.46 |
| 1980 | 1,508.00 | -5.63 |

Source: Korea Statistical Yearbook, 1981.
Seoul, Korea: National Bureau of Statistics, Economics Planning Board, 1982, p. 457.

Appendix B

Table 3. Penetration Ratio of Telephone in South Korea, Seoul, and Wa-Bu (1981)

| Area | Total # of Subscribers | Business Use | Residence Use | No. of Telephones per 100 persons (residence only) | No. of Telephones per 100 households (residence only) |
|---|---|---|---|---|---|
| South Korea | 2,704,498 | 971,098 | 1,733,400 | 4.48 | 21.72 |
| Seoul | 1,002,446 | 348,204 | 654,242 | 7.82 | 35.52 |
| Wa-Bu | 700 | 100 | 600 | 2.40 | 11.04 |

Sources: Korea Statistical Yearbook, 1981. Seoul, Korea: National Bureau of Statistics, Economics Planning Board, 1982, p. 44, 300.
The Post, Telegraph and Telephone Office of Wa-Bu, June, 1982.

# APPENDIX C

## QUESTIONNAIRE ITEMS USED IN STRATIFIED SAMPLING

Coding

1. In general, how would you rate your degree of satisfaction for Nourishment in a 7-point scale from -3 to +3?

   | -3 | -2 | -1 | 0 | +1 | +2 | +3 | Same from Question |
   |---|---|---|---|---|---|---|---|
   | (1) | (2) | (3) | (4) | (5) | (6) | (7) | 1 to Question 17 ______ |

2. How would you rate your degree of satisfaction for Shelter in a 7-point scale from -3 to +3? ______

3. How would you rate your degree of satisfaction for Clothing in a 7-point scale from -3 to +3? ______

4. How would you rate your degree of satisfaction for Health in a 7-point scale from -3 to +3? ______

5. How would you rate your degree of satisfaction for Physical Security in a 7-point scale from -3 to +3? (Physical Security refers to protection against natural disasters.) ______

6. How would you rate your degree of satisfaction for Unpolluted Air, Water, Soil in a 7-point scale from -3 to +3? ______

7. How would you rate your degree of satisfaction for Pleasant Living Conditions in a 7-point scale from -3 to +3? (Pleasant living conditions refer to low noise level, freedom from unpleasant odors, and pleasant sceneries.) ______

8. How would you rate your degree of satisfaction for Public Safety in a 7-point scale from -3 to +3? (Public Safety refers to safety provided by the public administration units against fire, burglary, and other criminal acts.) ______

9. How would you rate your degree of satisfaction for Opportunity for Education in a 7-point scale from -3 to +3? ______

10. How would you rate your degree of satisfaction for Opportunity for Profession in a 7-point scale from -3 to +3? ______

Appendix C

Coding

11. How would you rate your degree of satisfaction for Policical Freedom in a 7-point scale from -3 to +3? _______

12. How would you rate your degree of satisfaction for Entertainment and Culture in a 7-point scale from -3 to +3? _______

13. How would you rate your degree of satisfaction for Judicial Justice in a 7-point scale from -3 to +3? (Judicial Justice refers to just and equal treatment under law.) _______

14. How would you rate your degree of satisfaction for Social Justice in a 7-point scale from -3 to +3? (Social Justice refers to justice against ethnic, geographic, sexual, and professional prejudices.) _______

15. How would you rate your degree of satisfaction for Economic Justice in a 7-point scale from -3 to +3? (Economic Justice refers to equitable redistribution of wealth and other economic products.) _______

16. How would you rate your degree of satisfaction for Communal Solidarity in a 7-point scale from -3 to +3? (Communal Solidarity refers to preservation of social ties, benevolence, and hospitality among members within a community.) _______

17. In the light of the basic human needs we discussed earlier, how would you rate your overall satisfaction level in a 7-point scale from -3 to +3? _______

Thank you very much for your cooperation. Now, I would like to ask a few questions concerning the usage of telecommunication technologies in your daily life.

18. How easy is it for you to receive and send messages through Postal Service, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest?

    1 2 3 4 5 Same scale for Question 18 to Question 27 _______

19. How easy is it for you to receive and send messages through Telegraph, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? _______

20. How easy is it for you to receive and send messages through Telephone, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? _______

Appendix C

Coding

21. How easy is it for you to use Audio-Cassette, at any time you desire to, in a 5-point scale, from 1 to 5, 1 for least easy and 5 for easiest? ________

22. How easy is it for you to listen to Loudspeaker, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

23. How easy is it for you to watch Theatrical Film, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

24. How easy is it for you to listen to Radio, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

25. How easy is it for you to watch Television, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

26. How easy is it for you to read a Newspaper, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

27. How easy is it for you to read a Magazine, at any time you desire to, in a 5-point scale from 1 to 5, 1 for least easy and 5 for easiest? ________

28. How many times per month do you use Postal Service? (receiving as well as sending) ________

29. How many times per year do you use Telegraph? (receiving as well as sending) ________

30. How many times per week do you use a Telephone? (receiving as well as sending) ________

31. How many times per month do you use Audio-Cassette? ________

32. How many hours per day do you listen to Loudspeaker? ________

33. How many times per month do you watch Theatrical Film? ________

34. How many hours per day do you listen to Radio? ________

35. How many hours per day do you watch Television? ________

Appendix C

Coding

36. How many hours per day do you read a <u>Newspaper</u>? ________

37. How many hours per month do you read a <u>Magazine</u>? ________

Just a few more questions.....

38. What is your highest level of education?

| | |
|---|---|
| No Schooling | (0) |
| Graduate of Elementary School | (1) |
| Graduate of Junior-High | (2) |
| Graduate of Senior-High | (3) |
| Graduate of College or Higher | (4) |

________

39. What is the annual income of your household? ____________
(in Korean currency)

40. What is your age? ________

41. What is your religion? ________

42. Sex: Male (1) Female (2) ________

Thank you very much for your cooperation.

# APPENDIX D

## RELIABILITY ESTIMATE OF THE QUALITY-OF-LIFE SCHEME

Table 20. Analysis-of-Variance Test for the Quality-of-Life Scheme with 17 Items

| Source of Variation | Sum of Squares | Degrees of Freedom | Mean Square | F | Significance Level |
|---|---|---|---|---|---|
| Between People | 1059.84 | 199 | 5.33 | | |
| Within People | 7702.35 | 3200 | 2.41 | | |
| Between Items | 1306.45 | 16 | 81.65 | 40.65 | .0001 |
| Residual | 6395.90 | 3184 | 2.01 | | |
| Nonadditivity | 4.44 | 1 | 4.44 | 2.21 | .1372 |
| Balance | 6391.46 | 3183 | 2.01 | | |
| Total | 8762.20 | 3399 | 2.58 | | |

Note: 17 Items include 16 basic human needs and the Overall Satisfaction Index _S_.

Appendix D

Table 21. Hotelling's T-Squared Equality-of-Means Test for the Quality-of-Life Scheme with 17 Items

| | |
|---|---|
| Hotelling's T-Squared: | 389.07 |
| Overall F: | 22.48 |
| Degrees of Freedom | (16, 184) |
| Significance Level: | .0000 |

Note: 17 Items include 16 basic human needs and the Overall Satisfaction Index S.

# APPENDIX E

## CORRELATION AMONG THE BASIC HUMAN NEEDS

Table 24. Correlation Matrix of the 16 Basic Human Needs

| | V=1 | v=2 | v=3 | v=4 | v=5 | v=6 | v=7 | v=8 | v=9 | v=10 | v=11 | v=12 | v=13 | v=14 | v=15 | v=16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nourishment(v=1) | 1.00 | | | | | | | | | | | | | | | |
| Shelter(v=2) | .703 | 1.00 | | | | | | | | | | | | | | |
| Clothing(v=3) | .720 | .664 | 1.00 | | | | | | | | | | | | | |
| Health(v=4) | .622 | .546 | .550 | 1.00 | | | | | | | | | | | | |
| Physical Security (v=5) | -.021 | -.007 | -.047 | .053 | 1.00 | | | | | | | | | | | |
| Unpolluted Air-Water-Soil(v=6) | -.250 | -.142 | -.287 | -.327 | .379 | 1.00 | | | | | | | | | | |
| Pleasant Living Conditions(v=7) | -.240 | -.167 | -.212 | -.288 | .335 | .658 | 1.00 | | | | | | | | | |
| Public Safety(v=8) | -.262 | -.253 | -.234 | -.323 | .475 | .458 | .508 | 1.00 | | | | | | | | |
| Opp. Education (v=9) | .154 | .155 | .200 | .195 | .116 | -.249 | -.349 | -.184 | 1.00 | | | | | | | |
| Opp. Profession (v=10) | .136 | .135 | .162 | .138 | .053 | -.274 | -.321 | -.090 | .630 | 1.00 | | | | | | |
| Political Freedom(v=11) | .174 | .128 | .173 | .122 | .103 | -.247 | -.265 | -.104 | .560 | .870 | 1.00 | | | | | |
| Entertainment and Culture(v=12) | .151 | .110 | .173 | .183 | -.022 | -.215 | -.123 | -.101 | .314 | .518 | .473 | 1.00 | | | | |
| Judicial Justice (v=13) | -.102 | -.105 | -.046 | -.067 | .122 | .196 | .212 | .090 | -.206 | -.186 | -.155 | .013 | 1.00 | | | |
| Social Just(v=14) | .065 | -.066 | .006 | .050 | .103 | .084 | .091 | .180 | -.099 | -.094 | -.110 | .047 | .367 | 1.00 | | |
| Economic Just(v=15) | .028 | -.073 | -.033 | .041 | .151 | .030 | .061 | .143 | -.196 | -.069 | -.072 | .052 | .378 | .752 | 1.00 | |
| Communal Sol(v=16 | -.116 | -.156 | -.089 | -.124 | .175 | .163 | .234 | .133 | -.080 | -.099 | -.116 | -.132 | .415 | .336 | .332 | 1.00 |

## APPENDIX F

## TELECOMMUNICATION USAGE AMONG THE SUBJECTS

Table 30. Mean of the Total Access Score by Education, Income, and Profession Breakdown

| Level of Education | Mean of Total Access Score (1-5 scale) |
|---|---|
| No Schooling (n=2) | 2.10 |
| Graduate of Elementary School (n=81) | 2.35 |
| Graduate of Junior-High (n=52) | 3.00 |
| Graduate of Senior-High (n=45) | 3.41 |
| Graduate of College or More (n=19) | 4.57 |
| **Level of Income** | |
| Extremely Poor ($2,000 or less, n=40) | 1.92 |
| Relatively Poor ($2,001-$3,500, n=69) | 2.45 |
| Average ($3,501-$5,000, n=30) | 2.78 |
| Relatively Well-Off ($5,001-$7,000, n=52) | 3.38 |
| Rich ($7,001 or Higher, n=9) | 3.79 |
| **Profession** | |
| Professionals (n=24) | 4.02 |
| Clerical Workers (n=26) | 3.48 |
| Commercial Sector (n=29) | 3.12 |
| Non-Agricultural Laborers (n=21) | 3.10 |
| Farmers (n=99) | 2.49 |

Appendix F

Table 35: Mean of the Total Frequency by Education, Income, and Profession Breakdowns

| Level of Education | Mean of Total Frequency Score (1-5 scale) |
|---|---|
| No Schooling (n=2) | 2.70 |
| Graduate of Elementary School (n=81) | 3.05 |
| Graduate of Junior-High (n=52) | 3.18 |
| Graduate of Senior-High (n=45) | 3.64 |
| Graduate of College or More (n=19) | 4.59 |
| **Level of Income** | |
| Extremely Poor (n=40) | 2.83 |
| Relatively Poor (n=69) | 3.14 |
| Average (n=30) | 3.53 |
| Relatively Well-Off (n=52) | 3.87 |
| Rich (n=9) | 4.03 |
| **Profession** | |
| Professionals (n=24) | 3.83 |
| Clerical Workers (n=26) | 3.87 |
| Commercial Sector (n=29) | 4.06 |
| Non-Agricultural Laborers (n=21) | 2.96 |
| Farmers (n=19) | 3.00 |

## APPENDIX G

## RELATIONSHIP BETWEEN THE BASIC HUMAN NEEDS AND THE CANONICAL HUMAN GOALS IN EACH SOCIETAL SECTOR

Table 37. Factor Matrix of the Basic Human Needs for the Professionals: Maximum-Likelihood Non-Rotated Solution

(n=24)

| Need | Factor 1 (F) | Factor 2 (J) | Factor 3 (P) | Factor 4 (E) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | -.364 | -.072 | .923 | .102 | 1.00 |
| Shelter | -.609 | .018 | .451 | .203 | .615 |
| Clothing | -.443 | -.084 | .147 | .261 | .213 |
| Health | -.213 | -.218 | .781 | .124 | .718 |
| Physical Security | -.358 | -.160 | .091 | .803 | .806 |
| Unpolluted Air-Water-Soil | -.405 | -.246 | .347 | .077 | .351 |
| Pleasant Living Conditions | -.475 | -.347 | .236 | .458 | .612 |
| Public Safety | -.464 | -.051 | .198 | .748 | .827 |
| Opportunity for Education | .845 | -.098 | -.102 | .007 | .738 |
| Opportunity for Profession | .969 | -.002 | -.059 | .030 | .934 |
| Political Freedom | .969 | -.040 | -.039 | .033 | .941 |
| Entertainment and Culture | .860 | -.070 | .214 | -.150 | .813 |
| Judicial Justice | .037 | .888 | .020 | .089 | .799 |
| Social Justice | .006 | .950 | -.076 | -.203 | .950 |
| Economic Justice | .060 | .950 | -.004 | -.210 | .948 |
| Communal Solidarity | -.011 | .914 | -.146 | .073 | .863 |
| Variance Components | 6.01 | 3.66 | 1.43 | 1.10 | |
| Percentage of Variance Explained | 37.6 | 22.9 | 8.9 | 6.8 | |

(Note: Owing to the small sample size, stability of factor loadings may be weak.)

Appendix G

Table 38. Factor Matrix of the Basic Human Needs for the Clerical Workers: Maximum-Likelihood Non-Rotated Solution

(n=26)

| Need | Factor 1 (F) | Factor 2 (J) | Factor 3 (P) | Factor 4 (E) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | .036 | .021 | .772 | -.273 | .672 |
| Shelter | .416 | -.153 | .642 | -.208 | .653 |
| Clothing | .389 | -.069 | .731 | -.011 | .690 |
| Health | -.032 | -.158 | .857 | .017 | .760 |
| Physical Security | -.046 | .304 | -.129 | .613 | .488 |
| Unpolluted Air-Water-Soil | -.069 | .293 | -.456 | .652 | .723 |
| Pleasant Living Conditions | -.448 | .306 | -.014 | .696 | .780 |
| Public Safety | -.386 | .027 | -.171 | .892 | .975 |
| Opportunity for Education | .837 | -.378 | .154 | -.151 | .890 |
| Opportunity for Profession | .833 | -.280 | .205 | -.215 | .947 |
| Political Freedom | .842 | -.291 | .199 | -.209 | .945 |
| Entertainment and Culture | .110 | -.301 | .146 | -.069 | .129 |
| Judicial Justice | -.198 | .866 | -.107 | .012 | .802 |
| Social Justice | -.359 | .733 | .217 | .303 | .805 |
| Economic Justice | -.320 | .756 | .210 | .299 | .805 |
| Communal Solidarity | .018 | .583 | -.263 | .058 | .413 |
| Variance Components | 6.62 | 2.36 | 1.30 | 1.21 | |
| Percentage of Variance Explained | 41.4 | 14.8 | 8.1 | 7.6 | |

(Note: Owing to the small sample size, stability of factor loadings may be weak.)

Appendix G

Table 39: Factor Matrix of the Basic Human Needs for the Commercial Sector: Maximum Likelihood Non-Rotated Solution

(n=29)

| Need | Factor 1 (F) | 2 (J) | 3 (P) | 4 (E) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | .201 | .813 | .058 | -.169 | .734 |
| Shelter | -.237 | .679 | -.125 | .066 | .538 |
| Clothing | -.015 | .839 | .115 | .112 | .730 |
| Health | -.096 | .704 | .171 | -.163 | .560 |
| Physical Security | .186 | -.070 | .492 | .511 | .542 |
| Unpolluted Air-Water-Soil | -.287 | .038 | -.055 | .703 | .581 |
| Pleasant Living Conditions | -.147 | .043 | -.112 | .865 | .784 |
| Public Safety | .142 | -.150 | .358 | .619 | .553 |
| Opportunity for Education | .870 | .079 | -.052 | -.102 | .775 |
| Opportunity for Profession | .981 | -.050 | .081 | .045 | .972 |
| Political Freedom | .993 | -.030 | .070 | .007 | .992 |
| Entertainment and Culture | .451 | -.208 | .105 | -.019 | .258 |
| Judicial Justice | -.300 | -.147 | -.139 | .227 | .183 |
| Social Justice | -.018 | .028 | .958 | .080 | .924 |
| Economic Justice | .056 | .007 | .952 | .036 | .911 |
| Communal Solidarity | .281 | -.107 | .263 | .349 | .282 |
| Variance Components | 3.59 | 2.83 | 2.30 | 1.60 | |
| Percentage of Variance Explained | 22.4 | 17.7 | 14.4 | 10.0 | |

(Note: Owing to the small sample size, stability of factor loadings may be weak.)

Appendix G

Table 40. Factor Matrix of the Basic Human Needs for the Non-Agricultural Laborers: Maximum Likelihood Non-Rotated Solution

(n=21)

| Need | Factor 1 (F) | 2 (J) | 3 (P) | 4 (E) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | .695 | -.144 | -.264 | -.082 | .581 |
| Shelter | .744 | .022 | .235 | -.150 | .632 |
| Clothing | .845 | .189 | -.156 | .172 | .872 |
| Health | .677 | .195 | -.252 | -.141 | .580 |
| Physical Security | .129 | -.047 | .619 | -.210 | .444 |
| Unpolluted Air-Water-Soil | -.127 | -.203 | .882 | -.053 | .838 |
| Pleasant Living Conditions | -.137 | -.332 | .489 | -.017 | .368 |
| Public Safety | -.333 | -.003 | .869 | .083 | .873 |
| Opportunity for Education | -.148 | .711 | -.081 | -.149 | .555 |
| Opportunity for Profession | .103 | .884 | -.162 | -.025 | .818 |
| Political Freedom | .205 | .870 | -.178 | -.135 | .848 |
| Entertainment and Culture | .062 | .663 | .016 | .271 | .506 |
| Judicial Justice | .444 | -.008 | .054 | .604 | .565 |
| Social Justice | -.262 | -.149 | -.280 | .736 | .711 |
| Economic Justice | .081 | .093 | -.007 | .999 | .333 |
| Communal Solidarity | -.115 | -.013 | -.021 | .271 | .087 |
| Variance Components | 3.96 | 2.37 | 2.25 | 1.74 | |
| Percentage of Variance Explained | 24.8 | 14.8 | 14.1 | 10.9 | |

(Note: Owing to the small sample size, stability of factor loadings may be weak.)

Appendix G

Table 41. Factor Matrix of the Basic Human Needs for the Farmers: Maximum Likelihood Non-Rotated Solution

(n=99)

| Need | Factor 1 (F) | 2 (J) | 3 (P) | 4 (E) | Estimated Communality ($h^2$) |
|---|---|---|---|---|---|
| Nourishment | -.143 | .223 | .824 | .165 | .712 |
| Shelter | -.227 | .178 | .733 | .285 | .685 |
| Clothing | -.166 | .203 | .730 | .273 | .727 |
| Health | -.112 | .153 | .803 | .158 | .705 |
| Physical Security | .173 | -.114 | -.393 | .580 | .529 |
| Unpolluted Air-Water-Soil | .131 | -.389 | -.468 | .504 | .637 |
| Pleasant Living Conditions | .149 | -.433 | -.363 | .570 | .625 |
| Public Safety | .287 | -.245 | -.511 | .520 | .653 |
| Opportunity for Education | -.290 | .780 | -.021 | -.029 | .759 |
| Opportunity for Profession | -.211 | .370 | -.029 | .013 | .983 |
| Political Freedom | -.229 | .570 | -.011 | .002 | .384 |
| Entertainment and Culture | -.006 | .585 | .039 | -.054 | .515 |
| Judicial Justice | .533 | -.127 | -.049 | .068 | .456 |
| Social Justice | .929 | .023 | .050 | -.036 | .875 |
| Economic Justice | .998 | .052 | .002 | -.000 | .890 |
| Communal Solidarity | .443 | -.011 | -.270 | .053 | .492 |
| Variance Components | 5.62 | 2.54 | 2.24 | 1.61 | |
| Percentage of Variance Explained | 35.1 | 15.9 | 14.0 | 10.1 | |

APPENDIX H

## MATHEMATICAL PROCEDURE FOR THE SOCIO-TECHNICAL ASSESSMENT MODEL

First, the potential contributing rate of the v-th basic human need in raising the overall quality of life of all societal sectors is to be estimated by incorporating Matrix A, B, C, and D.

$$\underset{\substack{\text{Matrix C}\\(1 \times 4)}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot \end{bmatrix}} \left[ \underset{\substack{\text{Matrix A}\\(4 \times j)}}{\begin{bmatrix} \cdot & & \\ \cdot & & \\ \cdot & & \\ \cdot & & \end{bmatrix}} * \underset{\substack{\text{Matrix B}\\(4 \times j)}}{\begin{bmatrix} \cdot & & \\ \cdot & & \\ \cdot & & \\ \cdot & & \end{bmatrix}} \right] \underset{\substack{\text{Matrix D}\\(j \times 1)}}{\begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix}} = S^{v}$$

Matrix A: The degree of association of the v-th need with the i-th canonical human goal in the j-th societal sector, inferred from the level of satisfaction for the v-th need.

Matrix B: The underlying relationship between the v-th need with the i-th canonical human goal in the j-th societal sector, inferred from the perceived importance of the v-th need.

Matrix C: The decision-makers' weight assignment to the i-th canonical human goal.

Matrix D: The decision-makers' weight attachment to the j-th societal sector.

$S^{v}$: The potential contributing rate of the v-th need to raising the overall quality of life of all societal sectors.

Second, to determine the effectiveness of the m-th telecommunication mode in facilitating the provision for the v-th basic human need, Matrix E, F, and G are to be multiplied together to produce Matrix I.

Matrix G
(10 x 7)

Matrix F
(4 x 10)

Matrix E: The significance of the h-th component in promoting the provision for the v-th need.

Matrix F: The demand for the p-th technical function to activate the h-th component of the v-th need.

Matrix G: The demand for the q-th technical characteristic to facilitate the p-th technical function.

Matrix I: The demand for the q-th technical characteristic to facilitate the provision for the v-th need.

Matrix E
(1 x 4)

=

Matrix I
(1 x 7)

Each element within Matrix I will then be compared with its corresponding element within Matrix H.

$$\underset{\substack{\text{Matrix I}\\(1 \times 7)}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix}} \underset{\substack{\text{Matrix H}\\(7 \times 6)}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \end{bmatrix}} = \underset{\substack{\text{Matrix J}\\(6 \times 1)}}{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix}}$$

Matrix H: The supply of the q-th technical characteristic provided by the m-th telecommunication mode.

Matrix J: The effectiveness of the m-th telecommunication mode in facilitating the provision for the v-th need. Each element of Matrix J is the sum of the effectiveness with respect to seven technical characteristics.

Third, the expected rate of increment in the overall quality of life of all societal sectors attributed by the m-th telecommunication mode from the provision for the v-th need is computed from $S^v$'s and Matrix J.

$$S_v \underbrace{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix}}_{\substack{\text{Matrix J} \\ (1 \times 6)}} = \underbrace{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix}}_{\substack{\text{Matrix K} \\ (1 \times 6)}}$$

Matrix K: The expected rate of increment in the overall quality of life of all societal sectors attributed by the m-th mode from the provision for the v-th need.

The final outcome of the Model operation can be represented in a matrix (Matrix L) the elements of which will specify the expected rate of increment in the overall quality of life of all societal sectors attributed by the m-th mode from the provision for the v-th need.

$$\begin{array}{c} \\ v=1 \\ v=2 \\ v=3 \\ v=4 \\ \\ \\ \\ \\ \\ v=16 \end{array} \begin{pmatrix} m=1 & m=2 & m=3 & m=4 & m=5 & m=6 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ \cdot & & & & & \\ & & & & & \end{pmatrix}$$

Matrix L
(16 x 6)

# LIST OF REFERENCES

## LIST OF REFERENCES

### General References


Abramson, N. Information Theory and Coding. New York: McGraw-Hill Book Co., 1963.

Adelman, I. and C.T. Morris. Economic Growth and Social Equity in Developing Nations. Stanford, Calif.: Stanford University Press, 1973.

Almond, G.A. "A Functional Approach to Comparative Politics." In G.A. Almond and J.S. Coleman (Eds.) The Politics of Developing Areas. Princeton, N.J.: Princeton University Press, 1960, 3-64.

Alwin, D.F. "The Use of Factor Analysis in the Construction of Composites in Social Research." Sociological Methods, 1973, 191-214.

Armstrong, J.C. and P. Soelberg. "On the Interpretation of Factor Analysis." Psychological Bulletin, 1968, 70(5), 361-364.

Ayres, R.U. "A Material-Process-Product Mode." In A.V. Kneese and B.T. Bower (Eds.) Environmental Quality Analysis. Baltimore: Johns Hopkins University Press, 1972.

Barnet, R.J. and R.D. Muller. Global Reach: The Power of the Multinational Corporations. New York: Simon and Schuster, 1974.

Bartlett, M.S. "Tests of Significance in Factor Analysis." British Journal of Psychology, 1950, 3, 77-85.

Bell, D. "Technology, Nature, and Society." In L. Hickman and A. Al-Hibni (Eds.) Technology and Human Affairs. St. Louis: The C.V. Mosby Co., 1981.

Bell, D. The Coming of Post-Industrial Society: A Venture in Social Forecasting. New York: Basic Books, 1973.

Bendix, R. "What is Modernization?" In W.A. Beling and G.O. Totten (Eds.) Developing Nations: Quest for a Model. New York: Van Nostrand Reinhold Co., 1970, 3-20.

Campbell, A. and P. Converse. The Human Meanings of Social Change. New York: Russell Sage Foundation, 1972.

Cetron, M.V. and B. Bartocha, (Eds.) Technology Assessment in a Dynamic Environment. New York: Gordon and Breach, Science Publishers, Inc., 1973.

Chasia, H. "Choice of Technology for Rural Telecommunication in Developing Countries." IEEE Transactions on Communication, 1976, 24(7), 732-736.

Chisman, F.P. "Beyond Deregulation: Communications Policy and Economic Growth." Journal of Communication, 1982, 32(4), 69-83.

Christian, D.E. "International Social Indicators: The OECD Experience. Social Indicators Research, 1974, 1(2), 169-186.

Clippinger, J.H. "A Framework for Needs Assessment in Communications Development." Telecommunications Policy, 1980, 4(3), 208-214.

Coates, V.T. Technology and Public Policy, Vol. 1. Washington, D.C.: Program of Policy Studies in Science and Technology, The George Washington University, 1972.

Cronbach, L.J. "Coefficient Alpha and Internal Structure of Tests." Psychometrika, 1951, 16, 297-334.

Dalkey, N.C. Studies in the Quality-of-Life: Delphi and Decision-Making. Lexington, Mass.: D.C. Heath & Co., 1972.

Daneke, G.A. and D.J. Priscoli. "Social Assessment and Resource Policy: Lessons from Water Planning." Natural Resources Journal, 1979, 19, 359-375.

Dickens, R.S. Jr. and C.E. Hill, (Eds.) Cultural Resources--Planning and Management. Boulder, Colo.: Waterview Press, 1978.

Duckstein, L. et al. "Practical Use of Decision Theory to Assess Uncertainties about Actions Affecting the Environment." Tucson, Ariz.: Department of Systems and Industrial Engineering, University of Arizona, 1977.

Dziuban, C.D. and E.C. Shirkey. "When is a Correlation Matrix Appropriate for Factor Analysis? Some Decision Rules." Psychological Bulletin, 1974, 81(6), 358-361.

Eckaus, E.F. Appropriate Technologies for the Developing Countries. Washington, D.C.: The National Academy of Sciences, 1977.

Engberg, O. "What Systems Do We Need in the Future?" In R. Buckingham (Ed.) Education and Large Information Systems. Amsterdam: North Holland, Inc., 1977.

Finsterbush, K. Understanding Social Impact: Assessing the Effects of Public Projects. Beverly Hills, Calif.: Sage Publications, 1980.

Finsterbush, K. and C. P. Wolf. The Methodology of Social Impact Assessment. Stroudsberg, Penn.: Dowden, Hutchinson & Ross Publishing Co., 1977.

Frank, A.G. "The Development of Underdevelopment." Monthly Review, 1966, 1(4), 17-31.

Golding, P. "Media Role in National Development: Critique of Theoretical Orthodoxy." Journal of Communication, 1974, 24(3), 39-53.

Golding, P. "Media Professionalism in the Third World: The Transfer of Ideology." In J. Curran, M. Gurevitch & J. Woollacott (Eds.) Mass Communication and Society. London: Edward Arnold, 1977, 291-308.

Goldschmidt, D. "Telephone Communications, Collective Supply and Public Goods: A Case Study of the Alaskan Telephone System." Unpublished Ph.D. dissertation, University of Pennsylvania, 1978.

Gorsuch, R.L. Factor Analysis. Philadelphia: W.B. Saunders Co., 1974.

Goulet, D. The Crucial Choice: A New Concept in the Theory of Development. New York: Atheneum, 1973.

Harman, H.H. Modern Factor Analysis. 2nd Ed., Chicago: The University of Chicago Press, 1967.

Haq, M.U. The Poverty Curtain: Choice for the Third World. New York: Columbia University Press, 1976.

Horn, J.R. "An Empirical Comparison of Methods for Estimating Factor Scores." Educational and Psychological Measurement, 1965, 25(2), 313-322.

Huddle, F.P. "The Social Function of Technology Assessment." In R.G. Kasper (Ed.) Technology Assessment: Understanding the Social Consequences of Technological Applications. New York: Praeger Publishers, Inc., 1972, 149-173.

Hudson, H.E. and E.B. Parker. "Telecommunication Planning for Rural Development." IEEE Transactions on Communication, 1975, 23(10), 1177-1195.

Hudson, H.E. "Toward a Model for Predicting Development Benefits from Telecommunication Investment." In M. Jussawalla & D.M. Lamberton (Eds.) Communication Economics and Development. Elmsford, N.Y.: Pergamon Press, Inc., 1982, 159-189.

Inayatullah. "Reconsideration of Western Model." In W.L. Schramm and D. Lerner (Eds.) Communication and Change: The Last Ten Years and the Next. Honolulu: University of Hawaii Press, 1976, 57-59.

Inkeles, A. and D.H. Smith. Becoming Modern: Individual Changes in Six Developing Countries. Cambridge, Mass.: Harvard University Press, 1974.

Jantsch, E.C. Technological Forecasting in Perspective. Paris: The Organization for Economic Cooperation and Development (OECD), 1966.

Joreskog, K.G. "Computer Program for Estimating and Testing a Simple Structure Hypothesis in Factor Analysis." Research Memorandum-65-3. Princeton, N.J.: Educational Testing Service, 1966.

Kahl, J.A. The Measurement of Modernism: A Study of Values in Brazil and Mexico. Austin: University of Texas Press, 1968.

Kash, D.E. "Impact Assessment Premises--Right and Wrong." Impact Assessment Bulletin, 1982, 3(1), 5-14.

Katz, E. and G. Wedell. Broadcasting in the Third World: Promises and Threats. Cambridge, Mass.: Harvard University Press, 1977.

Kautsky, J.H. The Political Consequences of Modernization. New York: John Wiley & Sons, Inc., 1972.

Leistritz, L.F. and S.H. Murdock. The Socio-Economic Impacts of Resource Development: Methods for Assessment. Boulder, Colo.: Westview Press, 1981.

Lent, J.A. "The Price of Modernity." Journal of Communication, 1975, 25(2), 128-135.

Lerner, D. The Passing of Traditional Society. Glencoe, Ill.: The Free Press, 1958.

Martin, J. Telecommunications and the Computer. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1969.

Maslow, A.H. Toward a Psychology of Being. 2nd Ed. New York: Van Nostrand, Reinhold, Co., 1968.

Masuda, Y. "Social Impact of Computerization--An Application of the Pattern Model for Industrial Society." Proceedings of International Future Research Conference. Kyoto, Japan: Institute for Future, 1972.

McCormick, E.J. Human Factors in Engineering. 3rd Ed. New York: McGraw-Hill, Inc., 1970.

McHale, J. and M.C. McHale. Basic Human Needs: A Framework for Action. New Brunswick, N.J.: Transaction Books, 1978.

Meadows, D.H., D.L. Meadows, J. Randers, and W.H. Behrens, III. The Limits to Growth. New York: Universe Books, 1972.

Mesthene, E.G. "The Role of Technology in Society." Technology and Culture, 1969, 10(4), 489-513.

Mitchell, A., T.J. Logothetti, and R.E. Kanton. An Approach to Measuring Quality of Life. Stanford, Calif.: Stanford University Press, 1971.

Montgomery, D.J. "A Criterion for Characterizing the Quality of Life in Assessing Social Impacts of Technology." Research Paper, The Group for the Analysis and Assessment of Technology, College of Engineering, Michigan State University, 1980.

Moscowitz, H. and G.P. Wright. Operations Research Techniques for Management. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1979.

Moss, M.L. (Ed.) Telecommunications and Productivity. Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1981.

Myrdal, G. The Challenge of the World Poverty. New York: Pantheon Books, 1970.

Nader, R. Unsafe at Any Speed: The Designed-In Dangers of the American Automobile. New York: Grossman Co., 1972.

The National Academy of Sciences. Technology: Processes of Assessment and Choice. Washington, D.C.: U.S. Government Printing Office, 1969.

Nie, H.N., C.H. Hull, J.C. Jenkins, K. Steinbrenner, and D.H. Bent. Statistical Package for the Social Sciences. 2nd Ed. New York: McGraw-Hill, Inc., 1975.

Nunnally, J.C. Psychometric Theory. 2nd Ed. New York: McGraw-Hill, Inc., 1978.

Nyere, J. African Democracy. In F. Tacahu (Ed.) The Developing Nations: What Path to Modernization? New York: Dodd, Mead and Co., 1972, 173-180.

The Organization of Economic Cooperation and Development. List of Social Concerns Common to Most OECD Countries. OECD Social Indicator Programme, Vol. 1., Paris: OECD, 1973.

Parker, E.B. Background Report. Proceedings on Conferences on Computer/ Telecommunication Policy. Paris: OECD, 1975.

Philips, K.J. and J.A. Defilippi. "Matrix Approach for Determining Waste Water Management Impacts." Journal of Water Pollution Control Federation, 1976, 48, 1759-1765.

Pierce, J.R. "Communication." Scientific American, 1972, 227(3), 31-41.

Pool, I. "The Mass Media and Politics in the Modernization Process." In L.W. Pye (Ed.) Communications and Political Development. Princeton, N.J.: Princeton University Press, 1963, 234-253.

Pool, I., P. Steven, A. Kamal, and A.H. Dessouki. "Appropriate Telecommunications for Rural Development." Research Paper, Program on Communications Policy, Massachusetts Institute of Technology, 1981.

Prebisch, R. Nueva Politica Comercial para el Desarrollo. Mexico: Foundation of Cultural Economy, 1964.

Pye, L.W. (Ed.) Communications and Political Development. Princeton, N.J.: Princeton University Press, 1963.

Rao, M.V.S. Socio-Economic Indicators for Development Planning. International Social Science Journal, 1975, 37(1), 121-150.

Reich, C.A. The Greening of America. New York: Bantam Books, 1971.

Riggs, F.W. "Modernization and Political Problems: Some Development Prerequisites." In W.A. Beling and G.O. Totten (Eds.) Developing Nations: Quest for a Model. New York: Van Nostrand Reinhold Co., 1970, 60-82.

Rogers, E.R. Diffusion of Innovations. New York: The Free Press, 1963.

Rostow, W.W. The Stages of Economic Growth. Cambridge, England: Cambridge University Press, 1960.

Rubinstein, S. and R.L. Horn. Risk Analysis in Environmental Studies. Richland, Wash.: U.S. Department of Energy, 1978.

Saunders, R.J. and J.J. Warford. Evaluation of Telephone Projects in Less Developed Countries. Telecommunications Journal, 1979, 46(1) 22-28.

Scheaffer, R.L., W. Mendenhall, and L. Ott. Elementary Survey Sampling. 2nd Ed. North Scituate, Mass.: Duxbury Press, 1979.

Schiller, H.I. "Communication and Cultural Domination." International Journal of Politics, 1975-1976, 4, 1-125.

Schramm, W.L. Mass Media and National Development: The Role of Information in Developing Countries. Stanford, Calif.: Stanford University Press, 1964.

Schumacher, E.F. Small Is Beautiful: Economics, As If People Mattered. New York: Harper and Row, Inc., 1975.

Shannon, C.E. and W. Weaver. The Mathematical Theory of Communication. Urbana, Ill.: The University of Illinois Press, 1963.

Shapiro, P.D. "Telecommunications and Industrial Dvelopment." IEEE Transactions on Communication. 1976, 24(3), 305-311.

Singh, K. "Elite Control and Challenge in Changing India." In G. Gerbner (Ed.) Mass Media Policies in Changing Cultures. New York: John Wiley & Sons, Inc., 1977, 147-158.

Skolimowski, H. "Technology Assessment in a Sharp Social Focus." Technological Forecasting and Social Change, 1976, 8, 421-425.

Smith, D.H. and A. Inkeles. "The OM Scale: A Comparative Socio-Psychological Measure of Individual Modernity." Sociometry, 1966, 29(4), 353-377.

Susskind, C. Understanding Technology. Baltimore: The Johns Hopkins University Press, 1973.

Technology Assessment Act of 1972, Public Law 92-484, 92nd Congress, H.R. 10243, Oct. 13, 1972.

The United Nations. "Reports on International Definition and Measurement of Standards and Levels of Living," 1954.

The United Nations. "The Cocoyac Declaration." Development Dialogue, 2, 1974.

Vancott, H.P. & R.G. Kinkade, Human Engineering Guide to Equipment Design. Washington, D.C.: Institutes for Research, 1972.

Vineogradov, V. et al. "Towards an International Information System." International Social Science Journal, 1981, 33(1), 10-49.

Ward, B. "The Decade of Development--A Study of Frustration?" London: The Overseas Development Institute, Ltd., 1965.

Wellenius, B. "On the Role of Telecommunications in Development of Nations," IEEE Transactions on Communication, 1972, 20(1), 3-7.

Zeller, R.A. and E.G. Carmines. Measurement in the Social Sciences. New York: Cambridge University Press, Press Syndicate of the University of Cambridge, 1980.