GUIDELINES

FOR THE

ECONOMIC ANALYSIS OF

TELECOMMUNICATIONS

PROJECTS

Economics and Development Resource Center
September 1997

FOREWORD

Over many years the Asian Development Bank has provided loans for the development of telecommunications in several developing member countries, and has provided loans for some transport and rural development projects where telecommunications was a significant component. However, in most cases the analysis of such projects has focused on the expected financial returns; the full economic benefits of the investment have not been identified and valued.

The telecommunications sector is undergoing significant change in relation to technology, demand, and the organization of services. However, the impact of these changes is uneven. Some people in developing countries have acquired access to a range of telephone and data services whilst others still lack access to a basic telephone service. These guidelines provide the basis for identifying and valuing the full economic costs and benefits of telecommunications projects. Such valuation is required in order to assess project design, and to identify the development impact of a project.

These guidelines have been prepared by the Economics and Development Resource Center with the cooperation of other departments in the Bank. They are consistent with the Bank's general Guidelines for the Economic Analysis of Projects. A background study was prepared by Mr. Andrew Dymond, staff consultant. The guidelines were completed by Stephen Curry, Senior Economist. They are based around a survey methodology for identifying the economic value of telephone services to different categories of users. They also require consideration of optimal network design and financial sustainability, as well as the poverty impact of particular interventions. In providing for a full elaboration of economic benefits, these guidelines allow a complete evaluation of the economic returns from public sector projects to be made, and also provide information to private sector investors on the willingness to pay of telephone users. The appendixes include an example calculation and sample survey questionnaires.

These guidelines are for use by consultants and Bank staff working on telecommunication projects, and the telecommunication components of other projects. They provide further guidance and illustration for the application of the general Guidelines in the telecommunication sector.

VISHVANATH V. DESAI
Director and Chief Economist
Economics and Development Resource Center
September 1997

ABBREVIATIONS

EIRR	-	economic internal rate of return
FIRR	-	financial internal rate of return
EVF	-	economic valuation factor
NPV	-	net present value
O&M	-	operation and maintenance
PCO	-	public calling office

CONTENTS

APPENDIXES

TABLES

GUIDELINES FOR THE ECONOMIC ANALYSIS OF TELECOMMUNICATIONS PROJECTS

I. INTRODUCTION

1. These guidelines provide a general approach for the economic evaluation of telecommunications projects.[1] They should be used in conjunction with the Bank's *Guidelines for the Economic Analysis of Projects*.

2. Economic analysis is directed at increasing social well-being, in terms of income or consumption, by encouraging efficient use of a country's resources. Since domestic resources and capability to borrow are limited relative to the needs of the population in most countries, economic analysis of infrastructure and other projects should accompany financial analysis to ensure the net economic benefit of a project is maximized and that the project yields a return greater than or equal to the economic opportunity cost of capital.

3. In practice the economic analysis of projects varies according to the feasibility of quantifying and valuing project costs and benefits. Basic analytic procedures include

- ?? defining project objectives and scope,
- ?? forecasting effective demand for project outputs,
- ?? choosing the least cost design for meeting demand or the most cost-effective way of attaining the project objectives,
- ?? determining whether economic benefits exceed economic costs,
- ?? assessing whether the project's net benefits will be sustainable throughout the life of the project,
- ?? testing for risks associated with the project,
- ?? identifying the poverty-reducing impact of the project, and
- ?? enumerating the nonquantifiable effects of the project that may influence project design and the investment decision.

---

[1] These guidelines have been prepared by the Project Economic Evaluation Division of the Economics and Development Resource Center, Asian Development Bank, with the cooperation of other departments. They are based on a study, requested and assisted by Transport and Communications Division, Infrastructure, Energy and Financial Sectors West Department, and completed in 1995, "Methodology for Economic Analysis of Tele-communications Projects", Intelecon Research and Consultancy, for the Project Economic Evaluation Division, Economics and Development Resource Center, Asian Development Bank.

Economic analysis provides a measure—the economic internal rate of return (EIRR)—against which to compare the economic opportunity cost of capital.

4. Characteristic features of telecommunications projects include

- ?? lumpy investment,
- ?? high levels of sunk cost,
- ?? economies of scale and scope,
- ?? mostly nontradable outputs,
- ?? a high degree of use as an intermediate input to other sectors of the economy,
- ?? a high proportion of imports in capital costs for most countries, and
- ?? a relatively short investment life resulting from rapid technological change.

In telecommunications, there are virtually always significant direct and indirect economic benefits and, as long as pricing is fairly efficient in the sense that tariffs are cost supporting, there is usually no need for subsidies at the sector level.

5. Although there is a strong economic rationale for investment in telecommunications infrastructure, policy analysis is also necessary to

- ?? encourage migration from public sector domination to a commercial mode of operation;
- ?? encourage development of a pricing and regulatory regime that facilitates efficiency and liberalization, where appropriate; and
- ?? identify areas, such as in rural regions or in establishing new international links for transitional economies, where lower financial returns may mask potentially high economic benefits and where some form of public sector leadership, or special development funding or subsidy, may be justified until the network builds up to a commercially attractive level of operation.

6. For economic analysis to meet the objective of informing project design to ensure maximum benefits, efforts must be aimed at

- ?? ensuring incremental supply resulting from a project does not exceed incremental demand,
- ?? ensuring appropriate user targeting within the demand pool, and
- ?? optimizing revenue and benefits.

One feature of rural telecommunications, in particular, is that revenue maximization and economic benefit maximization often go hand in hand. Projects should be designed with this in mind. This involves optimization, that is, careful selection of the least cost

design within a context of ensuring that both oversupply and undersupply are avoided, and establishing regulatory and commercial arrangements that lead to revenue maximization and growth in demand.

II. METHODOLOGY OVERVIEW

7. These guidelines provide a structure for bringing knowledge of the practices of telecommunications project analysis into a microeconomic framework that is useful for project definition, design, and appraisal. The methodology is based on minimal information requirements. Occasionally, these may not be achievable in the field, given time, information, and budget constraints. The analyst must decide whether the expense associated with gathering and analyzing primary data is warranted. In some instances, when information is scarce, it will be possible to utilize information drawn from other similar projects.

8. An essential feature of the proposed methodology is the building up of economic benefits useful to adjust revenue flows by

- ?? estimating the cost of alternative means of communications or user willingness to pay;
- ?? using this information to derive an economic valuation factor (EVF); and
- ?? using the EVF as a multiplier to convert the project's financial revenue streams into economic benefit streams.

The conversion of financial revenue to economic benefits in this way, though quite different from economic valuation in some other sectors, has been established for over a decade as the most plausible methodology for telecommunications projects. In addition, adjustments are made to costs using shadow prices for labor and other inputs.

9. The first step in the project economic analysis is to conceptualize the demand for communication by telephone and alternative forms, and the revenue flows and economic benefits occurring in the with project and without project scenarios. The project's output and benefits will include both a nonincremental component, where the telephone is substituting for alternative forms of communication, such as travel, and an incremental component, where additional communication is facilitated by the project. If the telecommunication taking place can be clearly identified as nonincremental, then the correct form of benefit evaluation would be from the estimation of the cost savings. If the telecommunication can be clearly identified as incremental, then a willingness-to-pay methodology would be the correct approach.

10. In practice, most telecommunications projects contain a mixture of nonincremental and incremental communication, which are difficult to separate from one another. Furthermore, the choice of valuation methodology depends primarily on the type of data available or the interview approach deemed to be most appropriate to the situation. This may not depend on whether the demand is specifically nonincremental or incremental. In all previously documented cases, the benefit evaluation methodology has used a predominantly cost savings approach as a proxy for both nonincremental and incremental output. For the sake of simplicity therefore, these guidelines do not distinguish between nonincremental and incremental benefits in the quantitative analysis. The first order EVF estimates should be considered to represent a weighted average of nonincremental and incremental valuations that are primarily based on the alternative cost methodology.

11. The user benefits are usually considered to comprise a consumer surplus that is derived from the users' willingness to pay more than the tariffed price for service, and call-related externalities derived from direct cost savings or from the economic value of other activities enabled by the telephone. Only direct benefits can be realistically valued and deemed to result in quantifiable project benefits. Identifying the project beneficiaries is a useful first step to summarizing the benefits to project beneficiaries in project preparation documentation. Using knowledge of the likely makeup and location of the user base for the telecommunications service, it is possible, at a qualitative level, to determine the distribution of the project benefits.

12. The direct benefits can, in principle, be estimated through one of several methods:

- ?? contingent valuation, where users are asked directly how much they would be willing to pay for first-time or improved service;
- ?? identifying and valuing cost savings, such as travel substituted for by the use of the telephone; and
- ?? identifying expenditures that users and potential users are willing to incur to obtain service.

13. Although contingent valuation has been widely used in willingness-to-pay analyses in other sectors, it has been rarely used in benefit evaluation of telecommunications. The other evaluation methodologies, which are more commonly used, are generally assumed to provide an indication, albeit a conservative one, of willingness to pay. During the course of a market survey, user willingness to pay for service, the opportunity cost of alternative communications, including cost of travel and

lost wages, and tariffs likely to be charged for the telecommunications services should be obtained or estimated. It may be necessary, in some instances, to use approximations or estimates developed elsewhere for similar projects.

14. An EVF is a ratio equal to the economic value of communication divided by the tariff charged for the telecommunications service. EVFs are used as multipliers to the project financial revenue streams to take account of consumer surplus. Cost streams also must be adjusted by shadow pricing domestic and foreign labor, materials, and other inputs. Both benefits and costs must be expressed in the same numeraire; conversion factors are provided by the Bank from time to time and can be used in this process.

15. It is important to ensure that the scale of a project is consistent with demand for the output. In the telecommunications sector, particularly in rural markets, it is unlikely that all demand can be satisfied on a commercially feasible basis. This is especially true when tariffs are unbalanced, causing distortions in market demand as measured by, for example, waiting list statistics. Analysis of current demand and demand projections supported by results of a market survey are necessary to ensure that supply does not overtake demand at cost-supporting prices. This information is also needed to identify project benefits and beneficiaries, and their distribution.

16. It should be noted that tariffs used in the analysis are implicitly assumed to be cost supporting. If tariffs do not allow cost recovery, then demand distortions will lead to over- or underconsumption of the telecommunications services, and tariffs charged will not support financial resource costs involved in the construction and operation of the telecommunications facilities. Consistent with Bank practice, if the tariff structure is unbalanced, some additional analysis may be desirable to determine the degree of tariff rebalancing required, while at the same time ensuring appropriate levels of debt service coverage and internal cash generation stipulated by the Bank for the borrower and project in question. In advance of detailed tariff studies, and during project preparation and appraisal, aggregate revenue per line must be high enough to compensate for the cost of capital and operation, administration, and maintenance. There must also be investment return during the useful life of the equipment.

17. As is standard practice, the EIRR should be evaluated under different assumptions. This is to determine how well project benefits will tolerate significant changes in key variables. If sensitivity analysis demonstrates that the project EIRR is sensitive to certain key variables or combinations of variables, then project management can closely monitor these. Examples of key variables are project capital cost, project completion dates, demand growth rates, subscriber proportions, and expected operating

costs. If the sensitivity analysis indicates that the project is economically viable under reasonable changes in the values of key variables, then the project and its benefits are likely to be sustainable.

18. The analyst must identify the information requirements needed to complete the research program involved in estimating the EIRR of the proposed project. For infrastructure projects involving telecommunications, it is likely that, apart from meeting requirements for completing a financial analysis, information requirements will include

- ?? a limited or full-scale market study,[2] including surveying existing and potential users;
- ?? a demand analysis and forecast;
- ?? knowledge of tariff levels;
- ?? knowledge of opportunity costs of alternative means of communication, such as travel and lost wages, as well as estimates of willingness to pay for telecommunications services, where practical;
- ?? knowledge of the opportunity cost of capital; and
- ?? appropriate factors useful to shadow price project inputs and outputs.

III. METHODOLOGY

19. These guidelines have been developed to describe the main features of an evaluation methodology that provides

- ?? a microeconomic framework useful for project definition, design, and appraisal;
- ?? a way of identifying who the beneficiaries are likely to be, as well as quantifying first order EVFs that can be used to calculate economic benefits from investments in telecommunications;
- ?? a step-by-step methodology for field verification of the EVFs at the time of the feasibility, fact-finding, and appraisal missions;
- ?? assistance with identifying the minimum data requirements for economic analysis, the kind of field research required, and the design of a survey approach;
- ?? specific guidelines for aggregating the data into a composite economic benefit stream for the purpose of the EIRR calculation; and
- ?? an illustration of the use of the EVF in a full project economic analysis and EIRR calculation.

[2] Whether a limited or full-scale market study is needed will be determined by the level of detail available from the administration regarding the existing user base and the makeup of the waiting list, if any, and the time and budget available for this and related components needed to complete the methodology.

20. The following sections provide details of a six-step procedure to carry out the benefit identification, evaluation, and calculation process. An example of a survey methodology and benefit measurement is included in Appendix 1. An example implementation of the methodology is given in Appendix 2. Sample user survey questionnaires are provided in Appendix 3.

A. Procedure

1. Step 1: Project Role, Demand Basis, and Supply Strategy

21. Identifying and verifying the project's role, the demand basis, and supply strategy places the project in the context of the country's development status, and its industrial and regional investment strategy. The analyst must be satisfied with the basic demand hypotheses, the supply strategy, the revenue potential, and the overall direction of the project.

22. The role of telecommunications projects is to support economic development by providing the additional communications infrastructure necessary to improve information flow and, therefore, efficiency and productivity in an economy. The demand analysis should identify the characteristics of current users and current revenue sources on a user-type, geographic, and service basis. Future demand must be forecast to demonstrate that the risk of oversupply as a result of the project is marginal.[3] Since the first lines supplied may not satisfy all the demand, the supply strategy should be to serve the users with the highest traffic potential per line. This supply strategy is particularly important in rural projects and can usually be counted on to maximize project revenues and benefits.

2. Step 2: Without and With Project Analysis

23. It is important to describe the without project situation and to identify whether the project will be

- ?? providing service in an area or to users previously unserved by a network of telecommunications services;
- ?? increasing penetration and, therefore, reducing the average cost or inconvenience of accessing the network; or
- ?? primarily improving the performance and quality of the existing network.

[3] Because telecommunications networks are complex systems that take time and investment to construct to provide national coverage, it is unlikely that individual projects can meet all of the demand. This is particularly the case in rural areas, where a single typical telecommunications project may increase supply relative to demand by only a small margin.

This provides additional information to inform the process of determining the incremental consumer surplus from the project.

24. Comparison of the without and with project situations can be done qualitatively in the first instance. Questions to be addressed include

- ?? How do people, farmers, enterprises, and institutions communicate without the project? For example, does the current low telephone penetration[4] mean that many have to travel to a neighboring or distant place to reach a phone? What is the existing evidence of this?
- ?? How will the project change their pattern of communication?
- ?? For villages that will be connected for the first time, what is the project's typical distance-reduction effect? What percentage of the population would still have to travel to reach the phone, and what is the average distance? What are the corresponding figures without the project?
- ?? To what extent will people experience telecommunications as a mode of communication for the first time? What segments, locations, sectors, or proportion of the population does this apply to?

3. Step 3: User Identification

25. ***Revenue estimates.*** Steps 1 and 2 should be backed up by demographic and economic data to identify the user quantities, their locations, and projected line penetrations by user classification and location. A reasonable estimate of the users' ability to generate the projected revenues must also be determined. One way this can be done is as a percentage of total community per capita income or as a percentage of regional gross domestic product or gross national product per capita. The appropriate percentage to use under the latter approach is 1 to 2 percent, unless there is strong evidence to the contrary.[5]

26. The analyst must attempt to statistically characterize the project users. An illustration of the type of information needed to estimate a weighted average EVF includes

---

[4] Penetration is measured by the penetration rate, the number of connected main lines divided by population and multiplied by 100.

[5] The world average expenditure on telecommunications services is between 1.5 and 2 percent of gross domestic product, and this can be extended to regional areas. There is, however, considerable variation from less than 1 percent in some low income countries to more than 3.5 percent in island economies dependent on international trade or with extensive labor migration. The relevant figure for each country should be consulted from statistics of the International Telecommunication Union.

- ?? 50 percent of lines will be in new villages where no telephone service currently exists;
- ?? 25 percent of locations will only have one line—a community line, pay phone, or public calling office (PCO);
- ?? 25 percent of new users will be business, government, and institutional users who previously had no line;
- ?? 25 percent of village calls are expected to involve people who travel to get to the phone; and
- ?? the average travel distance to access a phone will reduce from x km to y km.

27. A tabular demand profile showing locations and user classifications should be prepared. Often it will be too difficult to disaggregate each user category to the extent that is ideal. The analyst should attempt to achieve the maximum degree of detail feasible, given the demographic and economic data available, and the implementing agency's knowledge about the area and level of economic activity.

28. ***Location.*** The potential users should be considered according to their location. The locations should be grouped and categorized in a way that describes the likely EVF characteristics of telephone users. Table 1 illustrates the suggested use of a six-distance/economic activity band structure, comprising four bands for localities where service will be expanded, and two where telephones will be installed for the first time.

29. If the project can be defined clearly as just two or three discrete situations (for example, previously unserved villages receiving a pay phone or PCO, or small towns receiving several user lines), this could greatly simplify the benefit analysis, as long as the bands defined are sufficiently representative to capture the range of EVF relationships expected.

Table 1: Telephone User Bands

Category	Location	Characteristics
Service Expansion		
Band 1	National/state capital suburbs; cities and towns very close to the capital or with fast transport links	Service already exists in the area, and hence users have established a pattern of telephone use. Economic activity is high.
Band 2	Towns and villages at a short to intermediate distance from the capital; villages distant from the capital but with strong links to the regional/district center	Telephone penetration is lower, but there are multiple lines per community and a reasonably active local economy.
Band 3	Small towns and villages at an intermediate distance from the capital	There is a sparse telecommunications infrastructure, but more than one line per community; and there is, or potential for, economic activity. There is some business travel.
Band 4	Towns and villages at a long distance from the capital	As above except for longer distances.
Cases Receiving Very Few Lines or Having Public Telephones Only		
Band 5	Active and/or nearby villages	There are only a few lines or just one community pay phone or PCO, and a medium level of economic activity.
Band 6	Economically and/or geographically remote villages	There is only one community pay phone/PCO.

30. ***User type.*** Ideally, each category of user should be identified from the demand projection by location, as illustrated in Table 2. It is not expected that the analyst will necessarily be able to exactly profile the makeup of each user group. Also, it may be impossible to separate the small from larger businesses or institutional demand from government demand. However, when possible, due regard should be paid to the makeup of the user pool because this information strongly influences the potential EVFs.

31. ***Community telephones, pay phones, or PCOs.*** The expected user profile for publicly available telephones should be considered in relation to the project area. The profile will depend a great deal on whether the local government office and local businesses have their own phone or whether the pay phone/PCO is the sole community phone, how many businesses there are locally, and whether the area has market-based agriculture and commerce. To assist with estimating the potential EVF, a preliminary user percentage, for each different location band, should be attached to each of the following categories: government; institutions; businesses; farmers; residents not included in any of the other categories; students, schools, and colleges; and unemployed.

Table 2: Telephone User Types

Category	Type of User
Government	Government agent, ministry, police, post office, council office
Institution	School, clinic, hospital, development agency, nongovernment organization
Small Business	Retail, small enterprise, small bank/credit union office
Larger Business	Import/export trader, factory, hotel, transport company, marketing board
Agricultural	Farmer, commercial farm, processing plant
Residence	Professional, home business, landowner, family
Pay phone/PCO	Publicly available telephone

32. It will also be important to consider the specific business and access arrangements for the community telephones. Are they generally operated by the post office, are they coin phones, are they usually a business franchise, or are they operated semi-officially by businesses or landowners on behalf of the telecommunications administration? On balance, the most effective arrangement is usually either a private franchise or an add-on business arrangement between the operator and an existing business. The most important questions to consider are

- ?? Are they placed and operated in such a way as to encourage good public access and frequent use by all members of the community?
- ?? Are they operated in such a way that the individual/group responsible has the incentive to follow up on maintenance problems and ensure a high level of availability?

For projects including a major pay phone/PCO component, the answer to these questions will influence both the level of revenues achievable and the realizable benefits across the community spectrum. It is therefore a key factor to consider in optimizing project design.

33. The output of this step will be a matrix that identifies, from the demand analysis and supporting data available, the number of users in each of the categories by type of location, according to a minimum number of bands appropriate to the project (see Appendix 2, Spreadsheet 1).

4. Step 4: Segmentation of the Revenue Stream

34. The level of detail of the segmentation of the revenue stream into convenient user and service categories will be a compromise between the number of different revenue and potential benefit characteristics that would be ideal in a measurement of

this type and the degree of segmentation that is feasible given available data. The user lines and revenues should, at least, be distributed among business, government/ institutions, residential users, and pay phones and PCOs.

35. The composite EVF for the project will depend on knowing the proportion of revenue from the main user groups in the project's financial revenue stream. Per line revenue estimates are required because the number of users may not correspond to the proportion of the revenues contributed by each. For example, residential lines usually carry much less revenue than business or institutional lines. It is not uncommon for 20 percent of lines to generate 80 percent of revenues. Also, if the community phones are well placed and operated, they may generate a relatively high proportion of revenue. The model multiplies the user line percentages by the per line revenues to derive the user revenue percentages on which the final composite EVF is based.

36. The per line revenue averages should be requested from the tele-communications administration at the headquarters or district level, and be checked during the data collection of step 5 below. Thus step 4 may, in practice, be combined with step 5, where it is necessary to identify some information on the average revenues from different user groups and locations. Should it not be possible to estimate the per line revenues by user group in any meaningful way, then the user group proportions, that is, the user quantities, rather than the revenues, can be utilized as a proxy.[6]

37. The output from this step is a matrix of user percentages and revenues per line and calculation of the weighted composite revenue proportions for each type of location (see Appendix 2, Spreadsheets 2 and 3).

5. Step 5: Estimate the Economic Valuation Factors

38. EVFs will be needed for each user group and the main characteristics of their location. Analysis can begin, however, with the first order factors provided in Appendix 2, Spreadsheet 1. These factors can be confirmed or adjusted according to the specific economic and demographic conditions pertaining to the project. As noted above, these factors are equal to the ratio of the economic value of communication to the cost of telephone service at cost-supporting tariffs. The factors represent a synthesis of the relationships reported in many case studies, as summarized in the report of footnote 1.

[6] Note that using the user proportions to disperse the total revenue among different user groups assumes revenue per line is the same for all user groups. Every effort should be made to determine revenue per line for the different user groups, since the growth in traffic per line, whether positive or negative, will generally be sensitive to the relative proportions of business, government, residential, and pay phone and PCO users in the user pool.

They are conservative estimates that give greater weight to EVF results estimated for telecommunications systems with charges set close to, or above, full cost recovery levels.

39. Table 3 provides a summary of the first order EVFs, that range from 1.1 for the marginal residential user to 4.0 for a larger business operating in a relatively distant location (see Appendix 2, Spreadsheet 1). These ratios indicate that the economic value of communications is approximately 110 percent and 400 percent, respectively, of the cost of a telephone call. In some cases, benefits are reported to decrease with distance from the capital (as in one study in Thailand) or with the degree of rurality of infrastructure development (as in some areas of the Philippines). Most studies, however, have found an increased benefit with distance, especially for public telephones.

Table 3: First Order Economic Valuation Factors

Users	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6
Government	1.2	1.5	1.7	2.0	1.5	n/a
Institutions	1.3	1.7	2.0	2.3	1.7	n/a
Small Business	1.2	1.5	1.7	2.0	1.5	n/a
Larger Business	1.5	2.0	3.0	4.0	2.0	n/a
Agriculture	1.5	2.0	3.0	3.5	2.5	n/a
Residential	1.3	1.3	1.2	1.1	1.1	n/a
Pay phones/PCO						
- Sole phone	n/a	n/a	n/a	3.0	2.5	3.0
- Other phones exist	1.3	1.5	1.7	2.0	2.0	n/a

40. For the purpose of project analysis, the work required to investigate, validate, or modify the value of the EVFs should consist of a limited amount of data collection or field study, typically 4-5 days, focused on the user groups and types of location that predominate in the project revenue stream. This should include both general sectoral data collection and specific user interviews. For a representative user, such as a government office, numerical data could include

- ?? number of telephones;
- ?? total telephone expenditure per year—to avoid seasonal variations;
- ?? distribution of locations to which calls were made—to determine average distances that would need to be traveled and the likely time such travel would take; and
- ?? average wages of the people making the calls.

6. Step 6: Calculating a Weighted Average Economic Valuation Factor

41. The weighted average EVFs can be calculated once the segmented EVFs have been estimated using the ratio of economic value of communication to the price paid for the telephone service, and the proportion of each user classification has been estimated. In an intermediate step, one weighted average EVF is prepared for each user classification. The weighted average EVFs for each user type are then weighted according to location bands and totaled to provide the composite weighted average EVF (see Appendix 2, Spreadsheets 2 and 3). The composite EVF is the multiplier used to adjust financial revenues to economic benefits.[7]

B. Cost, Benefit, and the EIRR

42. This section is concerned with the adjustments that must be made to financial cost and revenue streams to convert financial values into economic values to estimate the project EIRR.

1. Costs

43. At a high level of aggregation, project costs include capital, and operation and maintenance (O&M) costs. Capital cost components for a telecommunications project should be disaggregated into traded goods, nontraded goods, foreign labor, local labor, and taxes. This disaggregation is necessary to assist in the process of converting financial costs to economic costs. The economic analysis should include all additional capital costs to make the project effective. This may include supporting investments in the existing network to accommodate additional calls from, and to, an area of expansion, particularly for larger projects.

44. A typical operator spends around 10 percent of capital investment costs per annum on personnel and miscellaneous expenditures related to administration, marketing and sales, network operation, repair, and maintenance. These items are the O&M costs. The marginal level of expenditure necessary to approximate the O&M costs of the new investments may be lower than 10 percent, but should be above 5 percent, otherwise the new investment is likely to be undersupported. In the calculation of the

[7] The use of different estimated EVFs for each user classification implicitly assumes that demand curves, one for each user type, have different shapes (slopes and elasticity of demand). When different user types face the same tariff and have a similar EVF, the demand curves are assumed to have similar shapes. If all demand curves are assumed to have the same shape and therefore the same slope and elasticity, the estimated consumer surplus can be incorporated in an EVF through sector revenue per line divided by $2 \times e$ where e is the elasticity of demand in absolute terms. When the analyst has no country-specific information, a value of -0.75 may be used as the elasticity of demand based on figures from country surveys completed or compiled worldwide by the Inter-national Telecommunication Union.

financial internal rate of return (FIRR) presented in the example in Appendix 2, O&M costs are set at 7.5 percent of the total capital cost.

45. In the measurement of the EIRR, the above costs must be adjusted to reflect the opportunity cost to the national economy of drawing the resources to the project away from alternative uses and for differences between domestic and world prices. See Spreadsheet 4 of Appendix 2 for a sample breakdown of capital costs, operating costs, and incremental revenues. Spreadsheet 5 contains the conversion factors. For capital costs, the aggregate conversion factor, 0.85, is equal to the percentages of traded goods, nontraded goods, foreign labor, local labor, and taxes, each multiplied by their national economic parameter value and summed. The aggregate conversion factor for operating costs, 0.79, is obtained in the same way. In this example, all economic values are expressed in the world price numeraire.

2. Revenues

46. Revenues are calculated by multiplying price and quantity demanded. In calculating an FIRR, consumption taxes are not included because this revenue is merely collected by the operator and given to the government. However, when measuring the EIRR, the revenue stream should include the consumption taxes because they are part of the market price faced by the consumer, and demonstrates willingness to pay.

47. In our example, revenue per line for the operator is known to change according to user type. For example, larger businesses generate a revenue per line equal to or higher than all other user types regardless of whether they are located in the capital, or in a village a medium distance from the capital. Overall revenue per line, $707 in the example, is the weighted average of revenue per line for each user type in each location band.

48. The revenue is calculated by multiplying the weighted average revenue per line for the operator by the number of lines for each year during the life of the project. To adjust revenue to benefit for the EIRR calculation, financial revenue is multiplied by 1.08, or one plus the consumption tax rate (8 percent); then by 2.19, the composite EVF; and then by 0.8, the standard conversion factor, to express the benefits in the world price numeraire (see Appendix 2, Spreadsheet 6).

3. Rate of Return

49. After capital costs, O&M costs, revenues and net revenues are estimated, the FIRR is calculated as the discount rate at which the project net present value of the net revenue stream for the operator equals zero. After adjustments to these flows have been made, the EIRR is calculated as the discount rate at which the net present value of the net economic benefits stream equals zero. If the net present value (NPV) is wanted, then Bank practice is to use 12 percent for the financial NPV and for the economic NPV.

50. In summary, Spreadsheets 1 through 6 in Appendix 2 provide example calculations of the following:

1: Individual First Order EVFs
2: User base distributed among classifications and location bands, weighted average EVFs, and aggregate or composite EVF
3: Revenue per line estimates and aggregate EVFs
4: Project capital and O&M costs, incremental revenues, and schedule of disbursements
5: Conversion factors—to convert financial prices to shadow prices
6: FIRR and EIRR

51. The base case FIRR for the illustration is 5.1 percent. The base case EIRR is 24.5 percent. Economic capital costs and economic O&M costs are significantly lower than their financial values. When the project financial revenues are converted into a world price equivalent value using the standard conversion factor, they also are reduced significantly. However, the full economic benefits are greater than the financial revenues when the composite EVF is also applied, representing the external economic benefits derived by the users.

C. Sensitivity Analysis

52. In any project, a sensitivity analysis is needed to identify project risks that need to be watched carefully as part of project management. Several scenarios, covering both the traditional cost and revenue risks (see Table 4), and variations in the user mix (see Table 5) as developed for the benefit calculation, have been simulated.

53. In Table 4, it will be noted that the FIRR and EIRR are most sensitive to changes in benefits. The base case FIRR is relatively low, and therefore a 20 percent reduction in benefits brings the FIRR virtually to zero. However, the EIRR is more robust. Under a scenario where the FIRR reduces to approximately zero, the EIRR is still more than 18 percent. If this figure exceeds available estimates of the economic opportunity cost of capital, the results may be interpreted as (i) the project involves a financial risk, and (ii) the project is economically beneficial because the economic return exceeds the economic opportunity cost of capital. The analyst should consider whether the project can be adjusted to improve the commercial conditions, thereby

adjusting revenues and economic benefits. This could involve changing the targeted user mix, adjusting tariffs, or other measures to achieve a more optimal design.

Table 4: Traditional Risk Scenarios

Variable	**Change**	**Value of FIRR** (percent)	**Value of EIRR** (percent)
Base Value	-	5.1	24.5
Delay to Revenue/Benefits	1 Year	3.7	20.2
Higher Capital Cost	+10%	3.8	22.4
Higher Operating Cost	+10%	3.8	23.9
Lower Revenues	- 10%	2.6	21.6
	- 20%	0.2	18.6

54. It will be noted, from scenario A of Table 5, that if the proportion of public telephones is reduced to around 10 percent and the proportion of small business and residential lines increased (more typical of a project focusing on small regional towns rather than villages), then both the FIRR and EIRR fall, assuming costs remain constant. The sharp fall in the EIRR is a result of the composite EVF falling from 2.19 to 1.6 with the new user mix.

Table 5: User and Revenue Structure (Alternative Scenarios)

Scenario	**Value of FIRR** (percent)	**Value of EIRR** (percent)
Base Value	5.1	24.5
A. Public Telephones Down to 10% of Total	4.1	16.3
B. Public telephones Up to 60% of Total	5.4	27.7
C. Sole Public Telephone Revenues Increased to $1,500 in Band 5 villages (from $1,200), & $1,200 in Band 6 villages (from $750)	7.9	29.8
D. Achievement of B + C together	10.7	37.4

55. On the other hand, a heavier focus on public telephones, as in scenario B, may improve both the financial and economic performance. A more significant improvement, however, is achieved in scenario C, which assumes higher revenues from village pay phones because of optimization of their physical placement and improvement of the commercial and operational arrangements. Such improved public access and usage results in significant increases in both the FIRR and EIRR.

IV. SUSTAINABILITY AND OPTIMIZATION

A. Financial Sustainability

56. Through careful project planning and optimization, using sensitivity analysis as an analytical guide, a marginal or loss-making project can sometimes be brought into commercial viability, with an FIRR greater than 12 percent. This could be achieved through an adjustment in the user mix, as well as some increase in tariff charges. Both would help to increase financial viability. Economic viability would be assisted by the first, but reduced by the second. In general, financial subsidies should be avoided in the telecommunications sector; tariff charges should be raised to full cost recovery levels. With appropriate project design, financial sustainability should be ensured while maintaining economic viability.

57. There is one circumstance in which a subsidy may be justified. This is where supply is characterized by decreasing costs, so that setting tariffs equal to marginal production costs does not generate sufficient revenue to cover full average costs of production. However, even in these circumstances, it is better to adopt a tariff structure that ensures financial sustainability even at the cost of a small decline in economic efficiency. Estimates of the financial and economic subsidies for a project can be quickly estimated through changes to sensitivity parameters.[8] Project design should then seek to eliminate the need for subsidies.

58. Sectoral cross subsidization may be justifiable where significant tariff imbalances exist; where tariffs are nationally averaged, which is the norm internationally; or where tariffs are suppressed to subcost levels by government or operator policy. One way to

[8] Estimates of subsidies can be based on long run average incremental cost and revenue comparisons as noted in the Guidelines for the Economic Analysis of Projects, Project Economic Evaluation Division, Economics and Development Resource Center, 1997. The justification for using average incremental cost in telecommunications is the lumpy nature of capital investments. Estimates of financial and economic subsidies should be made according to the methods provided in the Board Information Paper, Bank Criteria for Subsidies, September 1996, which also outlines the general Bank policy on subsidies, including subsidies in the telecommunications sector.

implement cross-subsidization is to allocate a share of the urban-to-rural calling revenue to the rural operation. This asymmetric revenue allocation, in which a portion of the urban generated revenues is allocated to support the rural network operation, provides a rational means of compensating for the higher per line cost experienced by rural operators, and the often high proportion of incoming and reverse charge revenues that are generated by incremental rural telecommunications investments.

59. Scenario D in Table 5 illustrates that increased concentration on public pay phones plus revenue improvement from the village pay phones brings the project close to commercial viability. When combined with incoming revenues, the project's FIRR rises to more than 16 percent. It should also be noted that the higher FIRRs in these different scenarios arise from a change in the user mix, improved accessibility, and a proportion of incoming revenues, and not from an increase in telephone charges. By these means, higher financial returns can be achieved without any reduction in use or in economic benefits.

B. Least Cost Analysis

60. Optimization of a telecommunications project can also be seen to depend upon the technologic solutions chosen—the overall least cost system design—including the relative proportions of switching, outside plant, and transmission. Technology choices will involve a detailed planning/engineering review, which will include such issues as operator policies, network technical standards, and operations and maintenance considerations. The choice of the most appropriate technology—the least cost for the particular application, including the flexibility for "build out" to accommodate long-term growth—will also depend upon several project-specific factors, such as geography, topography, user density, local costs, and the scale of the project. Once the most cost-effective technological approach has been selected, international competitive bidding for equipment, including training and installation, is recommended to obtain the most competitive price.

C. Environmental Impact

61. The environmental effects of telecommunications projects usually are considered to be neutral. Inasmuch as use of the telephone and other forms of telecommunications substitute for physical communication, such as travel, the effects could be considered positive, though indirect, in terms of fuel savings. However, by contributing to overall economic activity and facilitating growth, telecommunications could also be an indirect or secondary contributor to adverse environmental impacts from industry and rapid

economic growth. Usually, however, the only environmental impacts that are practical to consider are direct ones, such as the land required for, and visual impact of, site development for telephone exchanges or radio stations; the rights of way for the construction of site access roads, and installation of linear facilities, such as cable or fiber optic routes; plus any related environmental or resettlement impacts. In general, these are much smaller than for other infrastructure projects.

D. Emergency Communication

62. The user survey can be used to identify the reasons for communicating by telephone. An important reason that may not be given sufficient weight in the financial and economic calculations is the use of the telephone in relation to emergencies, for example, urgent illness, accidents, fires, or crime. Most telephone services include free access to emergency numbers. There is no charge to those reporting an emergency. However, even when a charged call has to be made for emergency purposes, it may not be possible to estimate the economic benefits of such use. The value of a life preserved or damage minimized, or the willingness to pay for service only for emergency purposes, is difficult to derive. This important use of telephone service generally is not represented in the economic benefits of a project.

V. POVERTY IMPACT

63. Improving the social well-being and standard of living of the poor, disabled, minorities, and other vulnerable groups is a prime objective of Bank lending. The determination of the impact on poverty alleviation is an objective of project analysis. At the project preparation stage, identifying the positive impacts of a telecom-munications project on poverty alleviation is a difficult and complex task, and determination will often be qualitative in nature. To shed light on the impact of a project on poverty alleviation, it will be useful to address several questions.

64. **Targeting.** How will the project affect access to the telecommunications network for populations in the project area? Is the project targeted to provide access to low income groups or to enable or enhance activities, institutions, and businesses that impact the poor? How are the project beneficiaries targeted? What is the relationship between user targeting, and project viability and sustainability? How can access to communications for the poor without the project be described?

65. **Benefits.** What are the direct, indirect, and external benefits that are expected to occur within the target population areas? What information is available on the likely magnitude of the benefits? It may be particularly relevant to attempt to describe the process whereby the telecommunications-related benefits to business and to social infrastructure agencies create benefits to lower income groups, for example through employment generation and higher quality, more responsive social services; and to estimate what proportion of the project's output is expected to create such impacts.

66. **Beneficiaries.** Who are the beneficiaries of the direct and indirect impacts? How are the direct and indirect benefits distributed? Are the project outcomes consistent with project objectives? The user survey in Appendix 3 has been framed to address some of these questions, especially for PCOs. Is it possible to estimate what proportion of the users of public pay phones and PCOs are below the poverty line, or what proportion of the external beneficiaries from improved social services are likely to be below the poverty line? What percentage of PCO users are expected to be (i) from low income groups, (ii) farmers, and (iii) women?

67. For each telecommunications project, use on a gender basis should be considered. What are the economic activities in which most women are involved and how would improved communication help them to expand these activities? What communication is necessary to maintain family life on a day-to-day basis, and how can access to telephones for this purpose be ensured? Can telephone service be targeted specifically at women's cooperative groups or associations? Can women, in particular, afford to use the telephone? In some projects, it has been shown that specific targeting of services to women generates considerable benefits and revenues, even for women who are poor.

68. **Agricultural beneficiaries.** If there is an agriculture component in the project, what share of the project is for agriculture? Is the project complementary to an agriculture project? How do supply prices in the project area compare with demand prices in the main markets for the major agricultural goods and services produced in the project area? How do regional consumer price index changes, especially for foodstuffs and other agricultural products, compare with inflation in producer prices? Are there opportunities for arbitrage of farm goods between the producers and the main markets? How can the proposed project be expected to help in addressing these issues? How do the agricultural incomes per capita compare with urban incomes in the project area? How do they compare with the regional, provincial, or national average? What share of

the regional income, output, and employment is agricultural? How does this compare with the penetration rate? Are PCOs to be placed in agricultural areas? How will the PCOs improve access to the telecommunications network for the beneficiaries?

69. **Social services.** What level of social services is available in the project area? How are they delivered? How can access to them be characterized, and how does it compare with the quality and availability of the same services in other areas that are (i) more wealthy; (ii) more densely populated; or (iii) closer to waterways, roadways, and other transportation corridors? How easily can populations in the project area access information from government about (i) methods and techniques to organize and run agricultural and small manufacturing concerns; (ii) family planning, disease control, and other health care matters; or (iii) early warning and emergency response plans for natural disasters?

70. **Labor market and migration impacts.** How do labor force participation and unemployment rates in the project area compare with regional urban, rural, and national statistics? What is the regional distribution of the labor force and the employed? What are the gaps between the regional and sectoral value of marginal product of labor and corresponding wage rates? Is there a role for the project in the distribution of labor market information? What impact might the project have on migrant populations?

71. It is likely that answers will be available for only some of these questions. The interrelationships between telecommunications services and poverty are complex. The analyst must attempt to address questions such as these to inform under-standing of how the telecommunications project may be expected to benefit the population in the project area. Some of these issues and questions should find their way into any field survey methodology as described in Appendix 1. If these questions are addressed, the probability will increase that specific knowledge of the positive impacts of the project on poverty alleviation will emerge. This type of information is invaluable to all observers and will demonstrate the importance of the project to the Bank's primary objectives, as well as add to the body of knowledge concerning the role of telecommunications in economic development.

APPENDIX 1
BENEFIT MEASUREMENT IMPLEMENTATION

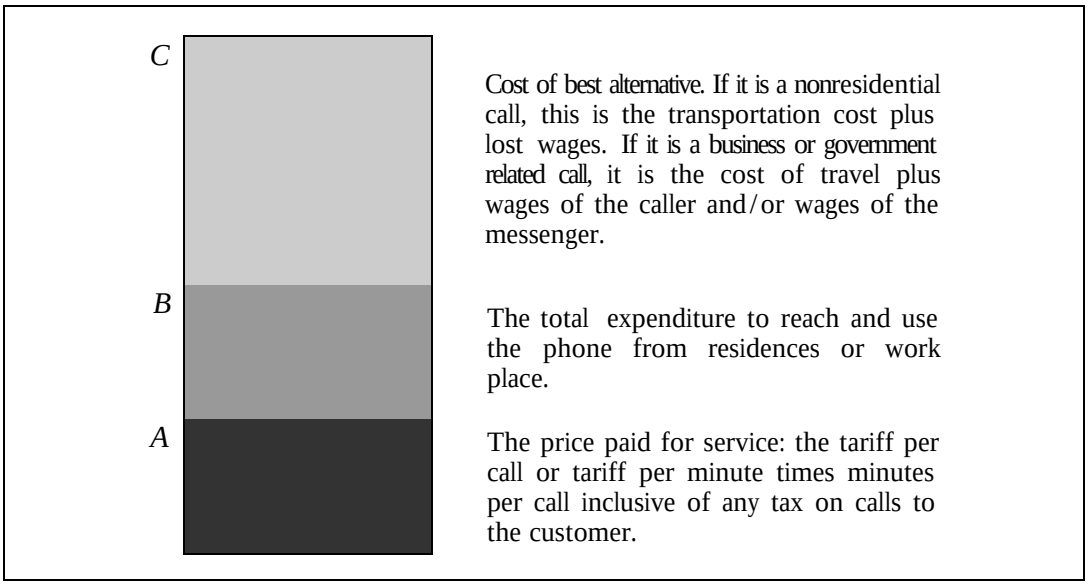
1. This Appendix provides an explanation and instructions on how to implement the method proposed for measurement of economic benefits. Included are instructions on how to carry out a survey to estimate or confirm economic valuation factors (EVFs).

2. The research program to investigate, validate, or modify the value of the EVFs should consist of a limited amount of data collection or field study focused on the subscriber groups and types of locations that predominate in the project revenue stream. The research should include both general sectoral data collection and specific user interviews.

A. Public Telephone User Survey

3. Project analysts should sample and interview (i) public telephone users in a representative number of locations in similar situations to those of the proposed project that have public telephones, and (ii) nonusers in villages that do not currently have a telephone but will receive one in the project. Ideally, business private calling offices (PCOs), those operated by a person or business for a commission, and publicly operated PCOs, either a coin phone or public calling office in an official location, should be included in the user interview schedule.

Figure 1: Estimating the Benefits for the Average User



4. Where the telephones will be sparsely distributed to key locations, with the inhabitants of surrounding communities having to travel to these centers, then the average user benefits will be estimated according to the diagram in Figure 1. Here the cost of the best alternative form of communication is used as an estimate of willingness to pay for telephone service.

5. An EVF should be calculated on a call-by-call basis and then averaged to provide a value for all callers on the same telephone line. For this, expenditures and lost wages must be converted into their economic value. For users who live in a location with a telephone, their EVF will usually be *C* divided by *A*. For users who must travel to make a call, their EVF will be *(C-B)/A*, since they are already expending an additional amount beyond the cost of the call to access the phone.

6. When interviewing a sample of users over a one or two day period, users should be asked, immediately after making the call, to describe the purpose, length, cost, and destination of their last call. Callers should also be asked to describe their occupation and what their next best alternative to phoning would be. The categories and results that the analyst is seeking to identify from the survey are shown in the draft questionnaire presented in Appendix 3.

7. The cost of traveling to the telephone or of the alternative means of communication, for example, travel to a neighboring phone or to the destination, must be estimated according to the following principles.

- ?? Ask the caller if the travel would be solely for the purpose of the communication or whether other motivations and purposes would contribute to the travel, for example, seeing other friends or contacts, or picking up supplies, thus fitting in with a regular trip. In the latter case, either divide the cost between the number of other purposes or ignore the cost of travel completely.
- ?? Include the cost of a bus ticket, taxi fare, or fee as appropriate and in accordance with the preceding principle.
- ?? Calculate an estimate for the opportunity cost of the caller's time for cases where the required travel is above a minimum time limit; some researchers have used three hours or half a day as the minimum. The opportunity cost of the time is the cost of the person's marginal productivity, which can be approximated through the wage or net income.
- ?? The value of the caller's time should be estimated conservatively. If there are clear options, take the lower. For example, in a slack period, the opportunity cost

of a farmer's time may be lower than that of a wage laborer, but higher in the planting or harvesting season. It may be a good idea to ask agricultural wage laborers and farmers if they are more likely to make a call in a slack period or in their busy period. The answer may influence the time/cost estimate.

8. The results of the survey may be analyzed, reported, and used in one of two ways:

- ?? calculate a weighted average value of *(C-B)/A* for the whole user community in each phone location studied, or
- ?? calculate a separate factor for local, *C/A*, and out-of-neighborhood, *(C-B)/A*, callers.

9. As can be seen from Figure 1, the economic value/price relationship for the local neighborhood telephone callers is considerably higher than the out-of-neighborhood callers because an access travel cost is not incurred. This demonstrates that the per call economic benefit to users increases as the radial distance between phones is reduced, or as every location is covered for the first time.

1. Interpreting the Results

10. ***Economic value/price versus distance.*** The analyst should attempt to estimate from the results of the survey how the economic value/price relationship varies with distance of the community from the economic center of influence. Some relevant studies showed that in the case of Thailand, there was a tendency for this relationship to decrease with distance from Bangkok, though possibly in a less marked way for public telephones than for business and residential lines. The reason was that the propensity to travel was higher for the generally higher income users who live close to the capital than for those who live more distant. In Senegal, on the other hand, the economic value/price relationship clearly increased, though at a declining rate, with distance from the capital. In Andhra Pradesh, India, longer distance calls carried an increasing economic value/price relationship.

11. ***Economic value/price versus call pattern.*** The propensity to travel, measured as a proportion of their total calls, may depend on whether a user's most frequent or economically important calls are concentrated in the national capital or in a district center. This is influenced by the geographic and economic structure of the society, for example whether production and marketing are strongly focused in the national capital, as in Thailand, or in state capitals and district centers, as in India.

12. ***Economic value/price versus income.*** One important point to consider when interpreting results is how the cost of travel time and transportation are estimated. Using the opportunity cost of time tends to value the benefits to high income users higher than those to low income people, whereas the relative importance and impact of the communication may be at least as great for the lower income person. A Costa Rican case study provided a clear example of how much the economic value/price relationship can vary depending on whether the valuation of time is included. In this case the average economic value/price relationship for village pay phones varied from 1.66, omitting the value of time entirely, to 5.65 including time.

13. ***Economic value/price versus tariffs.*** The variation of economic value/price with distance can be strongly influenced by the call charges. A flat tariff structure that allows calls nationwide for approximately the same price is more likely to provide increasing economic value/price with distance than one that is highly graduated. Fundamentally, the economic value/price ratio is likely to be lower when tariffs are set at full cost recovery levels than when they are below such levels. For this reason, conservative estimates of the ratio should be used, especially where tariff policy requires full cost recovery for public or private provision.

14. The analyst should reflect on the results obtained and develop an explanation before deciding how to confirm or revise the first order EVFs.

2. Applying the Results to Project Definition and System Design

15. In cases where a defined project is being appraised, the analyst is attempting to calculate the average economic value/price per public telephone. However, where these guidelines are being used at the project definition and design stage, the analyst should seek to use the data to assist with design optimization. For example, a similar survey could be used to identify the propensity of villagers to travel to make calls, and to calculate the average travel cost per kilometer, the average value of the without project alternative communication, and the expected total per-line financial revenues. From this, an optimal situation can be defined.

16. A saturation policy, putting one or more public telephones in every village, may not necessarily optimize the overall project economic performance, since the per-line financial revenues (the basic benefit stream from which the economic evaluation is derived) may be reduced below the marginal cost of supply as the phone density is increased. For this reason, it is essential that, first of all, the analyst makes every effort to define the total revenues available from the whole region. The project design objective should be to distribute this total revenue by optimizing the average distance between

phones, to achieve a maximum overall economic value/price relationship for the project as a whole.

17. One way this can be conceptualized in a region where population density is fairly even would be to assume the travel band for each phone as a circle with radius *r*. The density of telephone distribution can increase to the point where the overall economic value/price relationship reaches a maximum. If this gives a value of *r* that is higher than the point of marginal cost recovery then the size of *r* can be decreased further, down to the point where the present value of economic benefits is equal to the present value of economic costs.

B. Enterprise, Institution, and Government Subscriber Survey

18. Project analysts should conduct a survey of businesses, government offices, and institutions (health, education, and nongovernment agencies) in the region, to evaluate the size of the expected benefits to be derived from improved or expanded telecommunications services. This can be used for either a rural expansion or for a national network enhancement project.

19. The analyst interviews and estimates the economic value/price relationships in a sample of the business community and calculates values of the EVF for identifiable subscriber blocks, such as government, institutions, small and large business, and agriculture. The sample should be selected to include the categories of enterprises presented in Table 2 (main text, page 9) and should be representative of the relevant location bands. The results are tabulated and used to make comments on the first order EVFs identified in Spreadsheet 1 of Appendix 2.

20. The potential direct benefits to be identified and evaluated may include

- ?? direct travel savings of staff or messengers calculated, as in the public telephone case, using conservative estimates of the economic value of the time of relevant personnel;
- ?? savings from more efficient operation or reduction of an enterprise's transport fleet;
- ?? savings from the wastage of staff time trying to make a call if the current system available to the enterprise is a less effective manual or private radio system;
- ?? savings from potential immediate organizational improvements or better distribution of the business's inputs and outputs because of better communication;
- ?? any immediate buy/sell price impacts;

- ?? elimination of the need for an alternative, private form of telecommunications, for example, a high frequency radio system;
- ?? elimination of the need to subscribe to a cellular system to fulfill basic telephone requirements; and
- ?? elimination of other official or hidden costs associated with getting a subscriber line or gaining access to someone else's phone.

21. A sample survey form is provided in Appendix 3. This should be used as a guide and adapted according to the situation. In many cases, a considerable amount of information about enterprises and institutions in a certain area may be available centrally. Data regarding use of private radio systems may all be collected in the capital where the license records can be secured and personnel of the headquarters of many of the organizations operating these systems can be interviewed.

22. Potential cost savings from the use of the telephone must be calculated as net benefits after deduction of operating and annualized capital costs. Also, the benefits must be a result of the incremental impact of the project. Thus, depending on the scenario, the benefits may be result from

- ?? the acquisition and use of a subscriber line, fax, or data line for the first time;
- ?? conversion from one mode to another, for example, from a private system to the public network;
- ?? conversion from manual to automatic service;
- ?? the addition of more lines that would be unavailable without the project; or
- ?? the intended use of a community phone or someone else's phone (this may need to be reported differently or added to a public telephone survey).

23. An example of the use of a brief survey, by the Bank, in major regional cities is given in the report of the Appraisal Mission for the Mongolia Telecommunications Project. The results were reported as anecdotal statements and were not used systematically to provide a quantitative consumer surplus. It should be noted that if very large benefits are identified, as in this case, but are believed to apply only to, say, 1 to 2 percent of businesses, then this could be created as one subscriber group, with other groups having smaller economic value/price relationships.

C. Network Upgrades and Quality of Service Improvements

24. The upgrading of a trunk transmission system, the increasing of switching capacity, replacement of an obsolete cable plant, or other service quality improvements

result in less congestion for existing traffic and the facilitation of new growth. The foregone cost of call congestion can be valued in terms of time savings, since in the without project situation each communication event is associated with wasted time in unsuccessful call attempts.

25. The business and institutional survey technique can be adapted to focus on the cost to existing subscribers of this wasted time or on other benefits related to service quality. For example, if one telecommunications project objective is to reduce call congestion from 50 percent of failed call attempts to 25 percent, then the cost of time wasted by the average enterprise will be reduced and this can be evaluated based on the opportunity cost of the people most affected.

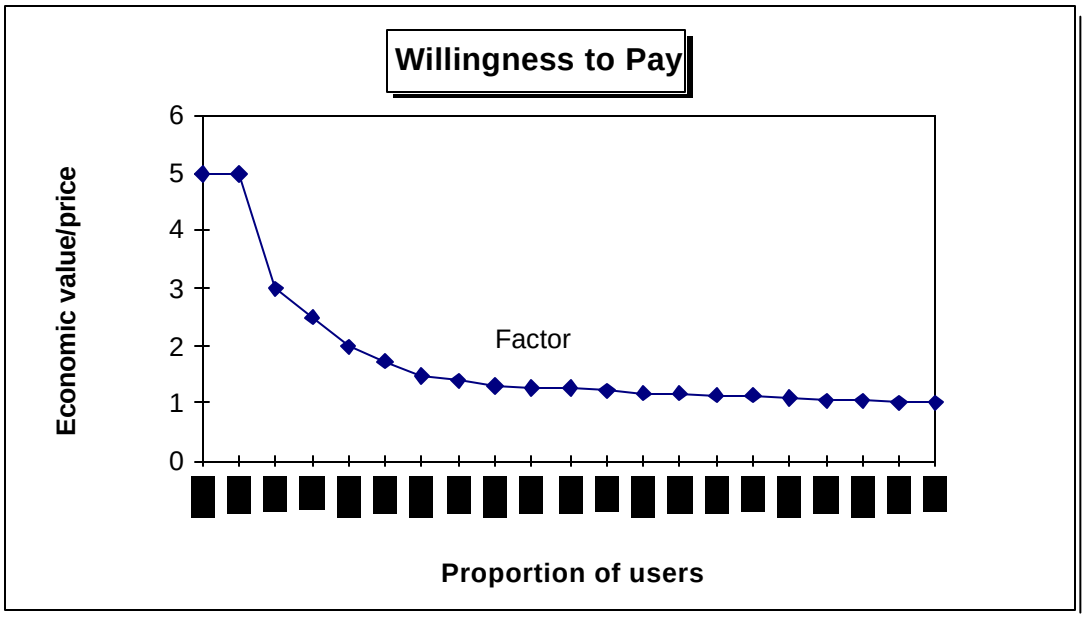
26. It should be noted that a network improvement project will also generate the subscriber and call-related benefits described here by facilitating subscriber and traffic growth. The growth will be incorporated in the project revenue stream and will have its own associated economic valuation factor for the new users and traffic. The most appropriate way of deciding on a consumer surplus for new traffic could be to ask if the telecommunications administration has any recent measure of long distance price elasticity. The basic methodology to estimate elasticity is to examine the traffic records of the telecommunications administration for a period before and after a recent price change to identify whether there was a perceptible change in volume that can not be attributed to other factors.

27. The elasticity approach is most appropriate in the case of a mature network, where demand and supply are basically in balance and where major year-on-year or month-on-month traffic volume changes are not taking place because of external events such as new exchange commissioning.

D. Composite EVF Estimates

28. Based on the assumption that the top 5 percent of users derive an economic value/price relationship of 5.0, the next five percent derive a factor of 3.0, then 2.0, 1.5, and 1.3 for each additional 10 percent, with the majority (60 percent) between 1.2 and 1.0 (zero consumer surplus), then the composite EVF for the willingness to pay curve shown in Figure 2 would be approximately 1.90.

Figure 2: The Willingness to Pay Curve



29. Based on many case studies, such a scenario would be a conservative estimate for long distance telephone service that involves regional cities and towns, or for the combination of local and long distance service in regional and rural communities. The analyst should seek to verify the hypothesis that the EVFs illustrated by the curve in Figure 2 and detailed in Spreadsheet 1 of Appendix 2 are plausible. The methodology should be based on the same principles for valuing travel time and expenses as in the public telephone survey in Appendix 3, plus the estimation of additional time wastage on communication inefficiencies and of amounts paid to third parties as a result of not having an effective telecommunications service, for example, messengers. In all cases, it may be justifiable to use higher factors than shown in Appendix 2 or, based on the survey, to make an adjustment between the various distance band locations. However, the objective is to ensure that the factors used are minimums that are conservatively estimated.

30. Using the first order EVFs identified in Spreadsheet 1 of Appendix 2 and the typical subscriber distributions for each location band shown in Spreadsheet 2, the composite EVF varies from

?? 1.6 for a relatively urban project with 60 percent of the lines in location bands 1-2, 10 percent in band 3, and 30 percent in bands 4-6; to

?? 2.3 for a fully rural project with 20 percent in band 3, 40 percent in band 5, and 40 percent in band 6 (with the majority of the latter two representing PCOs)

31. On balance, except for some situations in archipelagoes where distances are not continuous, this range will be typical for the type of project supported by the Bank.

APPENDIX 2
SAMPLE SPREADSHEETS FOR A TELECOMMUNICATIONS PROJECT

Spreadsheet 1: First Order Economic Evaluation Factors

User Types	Improve Penetration				First Time / Private Calling Offices Only	
	Band 1	**Band 2**	**Band 3**	**Band 4**	**Band 5**	**Band 6**
	Capital Suburbs	**Town / Village (Short Distance)**	**Town / Village (Medium Distance)**	**Town / Village (Long Distance)**	**Village (Short / Medium)**	**Village (Remote)**
Government	1.2	1.5	1.7	2.0	1.5	n / a
Institutions	1.3	1.7	2.0	2.3	1.7	n / a
Small Business	1.2	1.5	1.7	2.0	1.5	n / a
Larger Business	1.5	2.0	3.0	4.0	2.0	n / a
Agricultural	1.5	2.0	3.0	3.5	2.5	n / a
Residential	1.3	1.3	1.2	1.1	1.1	n / a
Private Calling Offices						
- Sole phone	n / a	n / a	n / a	3.0	2.5	3.0
- Other phones exist	1.3	1.5	1.7	2.0	2.0	n / a

Spreadsheet 2: User Group Proportions and Composite Economic Valuation Factors

User Types	Improve Penetration				First Time / Private Calling Office Only		Calculation of Composite Factor		
	Band 1	**Band 2**	**Band 3**	**Band 4**	**Band 5**	**Band 6**	**Weighted Average Factor**	**% of Total Users**	**Contribution to Composite Factor***
	Capital Suburbs	**Town / Village (Short Distance)**	**Town / Village (Medium Distance)**	**Town / Village (Long Distance)**	**Village (Short / Medium)**	**Village (Remote)**			
Weights *(%)*	**0**	**10**	**20**	**20**	**30**	**20**	**100**		
Government	3.0	5.0	10.0	18.0	10.0		1.7	9.1	0.16
Institutions	10.0	15.0	15.0	15.0	15.0		1.9	12.0	0.23
Small Business	20.0	20.0	20.0	20.0	13.0		1.7	13.9	0.24
Larger Business	15.0	15.0	5.0	3.0	2.0		2.6	3.7	0.10
Agricultural	0.0	10.0	10.0	10.0	5.0		2.9	6.5	0.19
Residential	50.0	30.0	20.0	10.0	5.0		1.2	10.5	0.13
Private Calling Offices									
- Sole phone	0.0	0.0	5.0	0.0	20.0	100.0	2.8	27.0	0.75
- Other phones exist	2.0	5.0	15.0	24.0	30.0	0.0	1.9	17.3	0.33
Total Users (%)	**100**	**100**	**100**	**100**	**100**	**100**		**100**	***composite 2.12***

* Based on users' percentage.

Spreadsheet 3: Annual Revenues Per Line And Revenue-Based Composite Economic Valuation Factor

	Improve Penetration				First Time / Public Calling Offices Only		Calculation Of Composite Economic Valuation Factor			
	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6				
User Types	Capital Suburbs	Town/Village (Short Distance)	Town/Village (Medium Distance)	Town/Village (Long Distance)	Village (Short/Medium)	Village (Remote)	Weighted Average Factor	Total Revenue Contribution	Total Revenue (%)	Contribution To Composite Factor *
Government	1,200	1,000	900	750	600	n/a	1.8	68	9.6	0.17
Institutions	1,200	1,200	1,000	900	600	n/a	1.9	102	14.4	0.28
Small Business	420	420	420	360	240	n/a	1.7	49	6.9	0.12
Larger Business	1 200	1,200	1,200	1,200	1,200	n/a	2.6	44	6.3	0.16
Agricultural	480	600	480	360	300	n/a	2.8	27	3.9	0.11
Residential	180	180	180	150	120	n/a	1.2	17	2.5	0.03
Public Calling Offices										
- Sole phone	n/a	n/a	1,800	1,800	1,200	750	2.6	240	34.0	0.89
- Other phones exist	3,000	2,400	1 200	900	750	n/a	1.9	159	22.5	0.43
								$707	**100.0**	***Composite 2.19***

* Based on revenue percentage.

Spreadsheet 4: Basic Project Data

Items	Total Amount	Percent	Traded	Non-Traded	Taxes	Foreign Labor	Local Labor
Capital Costs ($mn)							
Telecommunications Equipment	97.5	65.0	65.0	21.0	11.5	0.0	0.0
Spares & Test Equipment	6.8	4.5	5.5	0.8	0.5	0.0	0.0
Training	0.7	0.5	0.1	0.0	0.0	0.5	0.1
Installation & Project Management	15.0	10.0	0.0	0.0	0.0	8.0	7.0
Land, Buildings & Civil Construction	30.0	20.0	4.0	3.0	0.0	3.0	20.0
Total	150.0	100.0	74.6	24.8	12.0	11.5	27.1
Operation & Maintenance							
Percentage of accumulated capital costs (guide only)	7.5						
Annual amount for incremental operations (including marketing, account administration, network management, & maintenance ($mn))	11.25						
Total Number of Lines (number)	35000						
Revenue per Line (from Sheet 3)	707						
Total Annual Revenues ($mn)	24.7						
Disbursements and Build-up (Percentages)	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Capital Costs	25	50	25	0	0	0	
Operating Costs	0	0	60	80	100	100	
Revenues	0	0	50	80	90	100	

Spreadsheet 5: Conversion Factors

Items	Standard Conversion Factor	Cost Proportions (percent)					Conver-sion Factor
		Traded	Non-traded	Taxes	Foreign Labor	Local Labor	
National Parameter Value	0.80	1.00	0.80	0.00	1.00	0.80	
Capital Investment							
Telecommunications Eqpt.		66.70	21.50	11.80	0.00	0.00	0.84
Spares & Test Equipment		80.90	11.80	7.40	0.00	0.00	0.90
Training		14.30	0.00	0.00	71.40	14.30	0.97
Installation & Project Mgt.		0.00	0.00	0.00	43.30	46.70	0.91
Land, Buildings & Civil Const.		13.30	10.00	0.00	10.00	66.70	0.85
Total		**49.70**	**16.50**	**8.00**	**7.70**	**18.10**	**0.85**
O&M Costs		**5.00**	**10.00**	**3.00**		**82.00**	**0.79**

Spreadsheet 6: Financial and Economic Rates of Return

Financial Rate of Return

Year	Capital Costs	O&M Costs	Revenues	Net Cash Flow
0	3,750.0	—	—	(3,750.0)
1	7,500.0	—	—	(7,500.0)
2	3,750.0	675.0	1,236.8	(3,188.2)
3		900.0	1,978.8	1,078.8
4		1,125.0	2,226.3	1,101.3
5		1,125.0	2,473.7	1,348.7
6		1,125.0	2,473.7	1,348.7
7		1,125.0	2,473.7	1,348.7
8		1,125.0	2,473.7	1,348.7
9		1,125.0	2,473.7	1,348.7
10		1,125.0	2,473.7	1,348.7
11		1,125.0	2,473.7	1,348.7
12		1,125.0	2,473.7	1,348.7
13		1,125.0	2,473.7	1,348.7
14		1,125.0	2,473.7	1,348.7
15		1,125.0	2,473.7	1,348.7
16		1,125.0	2,473.7	1,348.7
17		1,125.0	2,473.7	1,348.7
18		1,125.0	2,473.7	1,348.7
19		1,125.0	2,473.7	1,348.7
20		1,125.0	2,473.7	1,348.7
Financial Rate of Return				**5.1%**

Economic Rate of Return

Year	Capital Costs	O&M Costs	Benefits	Net Benefits
0	3,190.5	—	—	(3,190.5)
1	6,381.0	—	—	(6,381.0)
2	3,190.5	530.6	2,337.1	(1,384.0)
3		707.4	3,739.3	3,031.9
4		884.3	4,206.7	3,322.4
5		884.3	4,674.2	3,789.9
6		884.3	4,674.2	3,789.9
7		884.3	4,674.2	3,789.9
8		884.3	4,674.2	3,789.9
9		884.3	4,674.2	3,789.9
10		884.3	4,674.2	3,789.9
11		884.3	4,674.2	3,789.9
12		884.3	4,674.2	3,789.9
13		884.3	4,674.2	3,789.9
14		884.3	4,674.2	3,789.9
15		884.3	4,674.2	3,789.9
16		884.3	4,674.2	3,789.9
17		884.3	4,674.2	3,789.9
18		884.3	4,674.2	3,789.9
19		884.3	4,674.2	3,789.9
20		884.3	4,674.2	3,789.9
Economic Rate of Return				**24.5%**

APPENDIX 3
SAMPLE SUBSCRIBER SURVEY QUESTIONNAIRES

A. Public Telephone Survey Questionnaire

Name of Town/Village		District
Type of phone	Franchised Private Calling Office (PCO)	
	PCO at post office/other government location	
	Pay phone operated by a shop	
	Landlord-owned phone	
	Other (explain)	
Is this your first call this week?		Have you been interviewed by us before?
Where did you call?		Distance away (km)
How long did you speak?	Note if no contact was made and state reason	
Purpose of this call	Personal/family - nonurgent	
	Urgent personal/family	
	Financial	
	Business	
	Dealings with government	
Where do you live?	Same town/village	
	Neighboring community (how many km away?)	
	Further (name and distance)	
Is this the closest phone to where you live/work?	If not, explain	
How did you come to the telephone today?		Walking
		Bus
		Taxi
		Other (describe)
How long did it take?		
How much did it cost?		
Did you come here solely to make a phone call?	If not, list the other purposes	
How did you decide it was important enough to come?		
If the phone was not here, what would you have done?	Not bothered to communicate	
	Sent a letter	
	Sent a telegram	
	Traveled to the next phone (location and distance)	
	Traveled to the destination	
	Sent a message with someone else travelling	
	Sent a messenger specifically	
PATTERN OF TELEPHONE USE		
How often do you use this phone?		Number of times per month or year
Where do you usually call?		% national capital

	% state capital
	% provincial capital
	% district center
	% other major city
	% other town/village

How many calls a year are for	Personal & family
	Business
	Other
How many of these calls are important enough for you to travel if you didn't have access to a phone?	
Are you more likely to make calls during a particular season of the year?	Explain
Before the phone was here did you have an alternative phone you could use?	Where?
How often did you use it?	Number of times per year
How has your pattern of use changed since this telephone was installed?	
Do you ever receive incoming calls at this phone?	How often and from whom?
Do you ever reverse the charges to the called person?	Explain

COST OF TRAVEL (for those who said they would travel to their call destination)		
Bus or taxi fare		
How would you value the time it took you to get there and back?		
Would you go just for the purpose of delivering the message, or would you need another reason to go?		Main or secondary reason for going (explain)
For sending a messenger, would you pay them?		How much?
CALLER'S OCCUPATION & PROFILE		Male/Female
Would you please tell me what you do?	Farmer	
	Business person	
	Professional	
	Technical	
	Artisan	
	Employed by government	
	Employed in nongovernment service sector	
	Housewife (not active in agriculture)	
	School/college student	
	Unemployed	
Age (Either ask or judge after interview)		
Education level	No formal education	

	Primary (number of years)
	Middle (number of years or certificate level)
	Secondary (number of years or certificate level)
	College/technical
	Some university
	Degree & postgraduate study
Does your household own land?	Explain if relevant
WILLINGNESS TO PAY	
Do you think telephone service is expensive or cheap?	Explain
Do you have any complaints about the service?	Explain
Would it be worth paying more for?	Explain

How much would you pay?	Prompt "would you pay double?"
	More?
	How much?
If you did have to pay more, would you make fewer calls?	(If yes) ... Which calls would you cut out?
(If they think the service isn't very reliable or is not good for some other reason) ... Would you pay more for a better service?	
(If from neighboring community) ... How much would you pay to have the phone in your village?	
VALUE OF SERVICE / PERCEPTION OF THE BENEFITS	
Is the value of your phone call worth more than you pay for it?	Could you value it?
Further comments	

B. Enterprise, Institution, and Government Survey Questionnaire

ORGANIZATION	Address	
Contact/interviewee	Telephone/Fax	
Sector	Main Business/Activity	
Size of organization		Number of employees
		Gross annual/monthly turnover
Location of interview		Headquarters
		Regional head office
		Branch
Telephone facility at present (Check opposite or describe if necessary)		Number of public telephone lines
		Private Automatic Branch Exchange/ Key system
		Manual/automatic long distance
		Cellular
		Private system only
		Modem/data line
		Fax–dedicated or on phone line
		Other/None
Monthly phone/telecom bill		Local
		Long distance
Problems with telecoms (unprompted)		

If the organization has no phone ... how does it communicate?	
How much time does it take?	Describe problems & costs
COMMUNICATION ACTIVITIES - GENERAL & MANAGEMENT	
Who in the organization uses the phone most often?	
For what purpose is the phone used? (explain or check categories opposite)	Management - interoffice Marketing Sales/selling Buying/purchasing Production, operation, & maintenance Arranging travel Accounts Other (explain)
What part of your business/ activity depends most on communication?	Explain (how critical is it?)
What is having phone service worth to your organization? (put a value if possible)	
What do you think is the single most valuable thing about the telephone?	

How much difference do you think it makes to your organization's profits or costs? (How much worse off would your organization be without it?)	Explain
What are/would be the consequences of not being able to use the phone?	
How many times per day do you use the telephone?	
Do others use it more than you? (Decide whether you should be speaking with someone else)	
How many times do you usually have to dial to get through?	
How much would it save you or someone else if you got through the first time on all your calls?	Verify the costs, e.g. self or support person spends the time
Do you ever give up trying?	
Do you have other problems with the phone?	E.g. how often is it not working at all, and for how long?
TRAVEL AND POTENTIAL SAVINGS	
How much travelling do you or others in your organization do?	No. of trips per week/month
Why do you/they travel?	

How did/would the travel pattern change with getting/improving the telephone service?	
How much do you value your or others' time spent travelling (or saved)?	Use wage comparison if necessary
Does this really make a difference to how much it costs to run the organization?	Explain
Does time cost the organization more (or less) at certain times of the year?	Why?
Do you or others travel more at some times of the year than others?	Explain
COMMUNICATION ACTIVITIES – BUYING/SELLING & TRADE	
How many customers do you have?	Who, what type?
How many suppliers do you have?	Who, what type?
How many service/business contacts do you have to deal with in a day?	Describe
How do you contact them (customers, suppliers, or contacts)?	
How do they contact you?	
Does the telephone make any difference to the number of customers or contacts you have?	Explain (try to identify the business costs of limited telephone service)

If the telephone system were not there, what would you do?	
If the telephone system were available, worked better, or was more accessible (choose as appropriate), how would it affect you?	
Would it make any difference to the price you pay for supplies/services or the price you get for your product?	Explain how, e.g. does it make any difference to market position?
How else does/could the telephone affect your costs or business bottom line?	
How representative of other similar organizations do you think your answers are?	Explain

COMMUNITY ISSUES (FOR CASES WHERE LOCAL SUPPLY IS VERY LIMITED)	
How much do people in the organization use the telephone for personal communication?	
Is it for purely personal/family or financial business?	% general % personal emergency % financial
Who else (from outside the organization) uses your phone?	
What do they use it for?	% general % emergency % business/financial
How often?	
Do you charge for use?	How much – normal tariffs?
What value do they attach to having access to the phone?	Explain
What would they do if they didn't have access to your phone?	% travel (where)
How typical are these arrangements of other organizations?	