Planning Guide
for
Infrastructure Development ✓ ✓ ✓

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PLANNING GUIDE

FOR

INFRASTRUCTURE DEVELOPMENT

by

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Southern Rural Development Center
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PLANNING GUIDE FOR INFRASTRUCTURE DEVELOPMENT

INTRODUCTION

Infrastructure acts as the foundation for economic development and activity. Without infrastructure, it is doubtful sustained economic growth can take place. Transportation, sewerage, sanitation, education systems, and other public facilities and infrastructure are magnets for industry and prosperity. Infrastructure is thought to give local firms a comparative advantage over rivals by increasing the efficiency of production and a higher standard of living for residents. Unfortunately, the loss of Federal Revenue Sharing and a dramatic slowdown in federal grants have contributed to serious capital funding gaps for local and state governments. This shifting of responsibilities leaves a definite need for capital improvement planning.

This guidebook is intended to help community development practitioners meet some of the challenges of planning. Most planning and budgeting manuals are generally packed with complex jargon and theory, which are useless to practical rural decision-makers. The Planning Guide for Infrastructure Development condenses current budget and planning research into an easy to use format, with an illustrative case study. The first section presents a brief review of the literature concerning various studies that attempt to link investments in infrastructure to economic development. The second section presents an overview of comprehensive strategic capital improvement planning. The last two sections, the focus of the guidebook, examines the principles of Budgeting and Benefit-Cost Analysis in evaluating alternative infrastructure projects, along with an applied hypothetical case study that illustrates each method.

REVIEW OF SELECTED INFRASTRUCTURE STUDIES

Many studies have attempted to document the linkages between infrastructure and economic growth. Most research reveals a high positive relationship, but because of statistical and empirical problems, no particular study is indisputably definite. Nevertheless, the totality of the literature suggest that public investment spurs private investment, thus promoting economic growth (Eberts, 1986a).

In general, the task of infrastructure is to generate a "minimum critical size of urbanization" that will act as a core for development (Hansen, 1965; Hirschman, 1958; as related by Eberts, 1986a, pp. 18-19). Once growth is underway, regions may need periodic injections of infrastructure to proliferate the expansion; otherwise, they may remain in a "low-level equilibrium trap" (Richardson, 1973, in Eberts, 1986a, pp. 16-17). Firms are attracted to regions where the cost of production are lower, and infrastructure is provided at a reasonable price (Helms, 1985, in McGuire, 1986, p. 10). Property tax rates and industrial sites don't seem to matter so long as other services are available. Factors attracting firms are excess sewer, sanitation and water capacity, and well-developed transportation and educational facilities (Kuehn et al., 1979).

Sewerage, Sanitation, and Water

Garcia-Mila and McGuire (1986) proposed that sewerage and sanitation were positively related to Gross State Product (GSP). Using GSP as the dependent variable and annual state infrastructure expenditure for all states, including the District of Columbia (1965-1983), as independent variables, their hypothesis was confirmed. However, the results were only preliminary (McGuire, 1986, pp. 11-12, 14). The availability of sewer services are extremely important to developers; hence, they're powerful mechanisms in economic development planning.
Nelson and Knapp (1987) tested the effects of a centralized sewer service on land development in Portland, Oregon. They found that developers were willing to pay more for land within a region having a centralized sewer system than for land having separate sewer agencies. Kuehn, Braschier, and Shonkwiler (1979) performed a statistical study, based on a sample of 115 rural Missouri communities, to determine factors that contributed to new plant locations between 1972-1974. The results showed that excess water capacity and excess sewer capacity were important factors, along with other infrastructures.

Transportation

Transportation infrastructure greatly affects economic growth (Mera, 1973; Antle, 1983; as related by Eberts, 1986a, pp. 14-15). Carlino and Mills (1987) studied the effects of economic, demographic, and climatic variables on population and employment. They collected data from 3,000 counties over a cross-section of the United States from the 1970's. Their results showed that if interstate highway density was doubled, total manufacturing employment would increase six percent over a ten year period. Similarly, it would lead to a 2.8 percent increase in population density. Thus, interstate highways have a significant effect on employment and population growth. In a study of small Missouri towns, highways and barge docks, among other things, contributed to income growth (CONSAD Research Corporation, 1969; in Eberts, 1986, p. 21). Dorf and Emerson (1978) tested manufacturing plant location (1960-1970) differences between 147 randomly sampled non-metropolitan communities. The sample was stratified by community population and states within the West North Central region of the United States. Multiple regression on 136 variables implied that distances to large urban areas, access to interstate highway or water transportation systems were not necessary for attracting small and average sized firms. But, they could be quite important in luring large manufacturing plants.

Education

Enterprises need skilled and educated work forces, in addition to readily accessible research facilities. Schools are acknowledged contributors to the ability to attract jobs; therefore, expenditures on education are positive factors in economic growth. Firms responding to questionnaires considered amenities such as schools important factors in plant location decisions, even though only ranking eighth out of twelve general factors (Binkman, 1975; in Dorf and Emerson, 1978, p. 110). Wasylenko and McGuire (1985) used regression analysis on 48 states in attempting to discover factors that explained differences between state employment growth rates (1975-1980). They found that differences in education expenditures seemed to be a factor in the diversity of employment growth rates (in McGuire, 1986, pp. 9-10, 14).

Although no study to date is absolutely conclusive, infrastructure is regarded as the economic foundation of a nation. Growth absorbing infrastructure provides many advantages to local residents, potential and existing firms. But, financially strapped communities can only provide these amenities by careful comprehensive planning and budgeting.

General

A comprehensive review of the literature of the research studies that looked at the relationship between infrastructure and economic development by McGuire concluded:

"The most striking aspect of this report is the paucity of empirical evidence specifically investigating the linkage between economic development and infrastructure investment. Several well-designed, informative empirical studies with varying degrees of relevance to the linkage were examined. Except for the study by Keeler (1986) on the trucking industry and the regional analysis by Hultan and Schwab (1984), the evidence appears to be that there is a positive and
perhaps strong relationship between infrastructure investment and economic development. The studies supporting this hypotheses are by Helms (1985), and Garcia-Mila and McGuire (1986). The studies are neither detailed enough nor designed to answer questions such as; which type of infrastructure is most productive? what is the optimal level of infrastructure investment? which industries are more dependent on traditional infrastructure?" (McGuire, 1986, pp. 24-25).

In fashioning economic strategy, policymakers should be aware that voters migrate to areas best meeting needs and preferences (Tiebout, 1965). Bergstrom and Goodman (1973) concluded that communities with high employment to residential ratios tended to have more economic activity. To support additional growth more public services would need to be provided. And "State fiscal policies can and do influence relative state per capita income levels" (Canto and Webb, 1987, p. 201).

In attempting to investigate whether public investment (i.e. infrastructure) causes private investment or the reverse, Eberts and Fogarty (1985) constructed a production function with inputs of private capital, labor, and public capital. Results showed that both public and private capital may work together in generating personal growth. Additionally, each may simultaneously cause the other (in McGuire, 1986, p. 11). An important requirement for economic growth is that public capital must complement private investment. If they are complements, infrastructure would provide a base for the expansion of private capital.

In summary, businesses locate where they can achieve increased productivity. Infrastructure provides necessary, though not sufficient, complementary inputs for increasing production. When public services provide a cost-savings, resources are freed and firms can afford to purchase other inputs and produce additional output. This in turn leads to a need for even more inputs. Over the long-run, these increases in returns should attract other investments. The causal linkages are not clearly understood. But, taken together, these studies lead to the conclusion that there is a positive linkage between infrastructure investment and economic growth (Garn and Ledebur, 1986; McGuire, 1986, p. 18).
AN OVERVIEW OF COMPREHENSIVE STRATEGIC CIP PLANNING

Capital Improvement Programs (CIPs) are critical for local economic development. Effective CIPs require a comprehensive strategic budget fashioned from long-range operating and capital budgets. For years, corporations have used strategic planning in developing their business programs. These methods are now being successfully applied within the public sector.

Comprehensive, strategic CIP planning is a management technique that is used to plan infrastructure. It is related to the Planning-Programming-Budgeting System (PPBS) introduced by the Hoover Commission in 1949 (Lewis, 1988, p. 6). PPBS is a logical, multi-year financial analysis program. Program budgeting utilizes the rational concept of relating the costs and benefits obtained from the public provision of services. PPPS is distinguished by two different levels of inquiry: the "less rigorous" analysis of budgeting analysis; and the more "in-depth" analysis of benefit-cost analysis (Hatry, 1969, pp. 96-97).

Comprehensive, strategic CIP planning encourages participation by all interested parties. Strategic planning emphasizes the external environment, while at the same time assessing a community's strengths and weaknesses given its opportunities and threats. Although it is well-developed in the private sector, local governments have just recently began experimenting with the process. Strategic CIP planning stresses long-term thinking and flexibility. A community's plans must be able to meet changing needs.

The strategic CIP planning process is a simultaneous and continuous process of combining capital and operating budgets into a long-range, strategic development plan. This process involves:

- the identification of interest needed to construct the local government's mission statement; the development of a capital program to form capital and operating budgets; and the integration of the capital program and budgets to form the strategic plan.

Decision-makers must identify everyone that has a legitimate interest in policy formulation. The mission of the local government should be clearly stated in a way that doesn't ignore the "wants" of residents. The mission statement is the guide for future policy-making. For example, local citizens, businesses, potential industry, and insurance companies need the protection of adequate fire and police services. Local governments must be responsive to these needs, if at all possible. Formally including the provision of fire and police services in the government's mission statement will remind future administrations of their service goals.

The capital program is shaped by the community's external and internal environment. Decision-makers become familiar with the strengths, weaknesses, and resource limitations by conducting a review and an analysis of all issues and problems that affect the community. This is facilitated by inventorying the town's infrastructure, forecasting development patterns, estimating needs, analyzing alternative project solutions, and prioritizing projects.

The strategic CIP plan is continuously updated from adjustments made to the capital program as a result of new information gathered while developing the budgets. Strategic planning is an iterative process of monitoring, feedback, and rethinking. Budgets allow a community to anticipate and control expenditures and revenues, while evaluating the quality and level of public services. It is important to understand that budgeting is a dynamic process. The failure of most CIPs can be contributed to static budgets and/or a general non-commitment to the process. Budgeting should be part of a long-term program. How long-term is at the discretion of the community and depends on the type of program.

Providing a particular service to the community involves a feasibility study of annual capital and operating costs and revenues. Given the financial and technical constraints rural communities are under, it is critical that decision-makers make the best choice possible among alternative
projects. Budget and benefit-cost analysis can help local decision-makers evaluate alternative systems within the realm of comprehensive strategic CIPs or even the less sophisticated planning methods common in so many communities.

BUDGET ANALYSIS

According to Hovey (1986) the steps in considering infrastructure projects are:

1. determining what needs to be done;
2. weighing alternative ways to do it;
3. estimating the best alternative ways to do it; and
4. choosing the best alternative.

Assuming local decision-makers have accomplished the first step, budgeting and benefit-cost analysis provide rational procedures to complete the others. A complete budget is a plan for the future in which all costs and returns are estimated so that it is possible to estimate the net income or loss expected for alternative plans. Budgets can be prepared by either survey or engineering methods; in any event, the important thing is that the budget is developed from the latest data, reflecting current prices and technology (Doeksen, 1988, p. 68).

This section examines the budgeting analysis process. Specifically, it introduces the principles involved in developing useful capital and operating budgets for comparing alternative projects. The process is applied to a hypothetical case study constituting the provision of an rural Emergency Medical Service.

Principles of Budgeting

To weigh, estimate, and choose the "best" project from among options, budget statements must be developed for each alternative. Actually, the idea is to derive projections of the annual profits (or losses) of the respective systems. To do this, several instruments are built for each proposal. These include:

1. capital cost budgets;
2. annual capital budget;
3. operating cost budget;
4. annual revenue estimate; and
5. annual profit or loss statement.

Capital Cost Budget. The capital cost budget lists the costs incurred in establishing or constructing a system. These costs typically include expenditures on land, labor, buildings, material, interest, professional services, and major outlays on equipment. They are sometimes thought of as "fixed" or "one time" expenditures. The objective is to accurately find the total capital costs for each respective alternative. For example, if three alternative are being compared, three total capital costs estimates are developed. For small projects, in which the costs are generally known, the analyst might be able to estimate the capital costs accurately enough without much help. But for larger complex projects, construction bids must be studied or professional consultants hired.

Annual Capital Budget. The capital cost budget provides a list of all capital items and their related costs. The annual capital budget provides an estimate of the amount of that capital item being used each year. For instance, if a police car costs $25,000 and has a five year life span,
then the annual capital costs are $5,000 ($25,000 divided by 5 years). This is the amount of the capital expense being used each year. The picture is slightly more complicated if the capital item is purchased with a loan. With a loan, the annual principle payment and interest payment are generally assumed to be the annual capital costs. An estimate of total annual capital costs is derived when all capital items are assigned an annual cost and then totaled. Some decision-makers like to think of this amount as being a sinking fund, since it is the dollars that need to be saved so that worn capital items can be replaced. Often decision-makers forget this and when a fire truck or police car breaks down, there are no funds available to purchase a replacement.

**Operating Cost Budget.** The operating costs budgets list the cost incurred in the daily operation and maintenance of a system. They usually include expenses such as wages, utilities, insurance, taxes, and other miscellaneous items. They are often referred to as "variable" or "recurring" expenditures. The decision whether to categorize an item as a capital or an operating expense is really not important. The purchase of a police car might be considered an operating expense in large cities; whereas, it is often a major purchase in smaller communities, thus grouped under capital expenditures and amortized over a lending period at a given interest rate. So precise definitions are not as important as consistency and logical judgement. Operating and maintenance costs can be estimated by examining audits of similar systems from state and federal agencies or by asking administrators of other similar systems. Research documents containing operating data for many services are available. For example, see Sloggett et. al. (1988) for emergency medical service operating costs or Knolwes (1987) for rural public transportation costs.

Once operating costs estimates are gathered, they are converted into annual expenses using routine mathematics. For example, if a truck is scheduled to receive oil and filter changes every 4,000 miles (at $25 per change) and it is to be driven 15,000 miles a year; the annual expense for the oil changes is approximately $94 (15,000/4000 x $25). Many expenses (i.e. wages, rent, and insurance) are straight forward and easy to convert into annual expenses.

**Annual Revenue Estimate.** The annual revenue estimate is calculated so that a profit or loss can be projected across alternatives. User fees are payments made by the direct users of the service. Examples include fees on water, sewer, trash, recreational, public health services, bus fares, and emergency medical service. These fees cover annual capital and operating costs only if they are correctly set. Unfortunately, users fees seldom cover all costs; as a result, services are often subsidized.

Techniques used to calculate annual charges will vary depending on the service. The easiest way is to divide the total annual cost by the estimated number of users. However, fee setting is highly influenced by political and socioeconomic considerations. Elected officials have incentives to keep fees low to enhance their popularity and to off-set fee regressiveness on lower income users. Therefore, decision-makers should make allowances for different rate schedules in calculating possible revenues for public services.

Revenue summation varies with the service (Goodwin, et. al., 1979). Where a flat rate per unit per month is charged, as in many water delivery and sewer systems, annual revenues are estimated by multiplying the number of users times the rate per unit times the number of units. The months are added to arrive at an estimate of annual revenue. Transportation services are unique in that ridership rather than users must be estimated. Ridership can be projected with mathematical models using variables such as the population within the origin and destination, distances traveled, frequency of runs, income levels, and the presence of other transport modes (Fountain, 1985). When the number of riders are determined, the revenue is simply a multiplication of the number of rides times the fee. Fire and emergency medical services are
sometimes sold on a membership basis. Annual revenues are figured by estimating the number of subscriptions plus allowances for possible non-member fees (Nelson and Doeksen, 1982).

In most cases, fee setting tends to be a rather subjective undertaking. Fee schedules start by objectively attempting to cover all costs (or only operating costs), and are then adjusted to suit political and social circumstances. Analyst should bare these possible changes in mind when estimating annual revenues. Once a fee is decided upon, it is a relatively simple matter to derive the annual revenues for each proposal considered. These revenue projections are used to determine the annual profit or loss of each alternative.

**Profit or Loss Statement.** The annual profit or loss statement determines the feasibility and preferences between the alternative systems. It should be emphasized that the bottom line figures do not make the actual selection for the analyst; they are only tools to help decision-makers decide on a course of action. Computing the projected profit or loss is straight forward. The analyst simply adds the annual capital and operating costs to obtains the total annual costs. These costs are subtracted from the annual revenue estimate. This is done for any number of alternative systems and situations that need to be analyzed. Once budgets are calculated for all the alternatives, the decision-makers can weigh the pros and cons of each alternative to arrive at a desired system.

To illustrate some decision rules, consider the following profit (+) and loss (-) possibilities between three alternatives over four revenue schemes:

<table>
<thead>
<tr>
<th>Revenue Schedule</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+16,000</td>
<td>+10,000</td>
<td>+12,500</td>
</tr>
<tr>
<td>2</td>
<td>-10,500</td>
<td>+9,000</td>
<td>+5,500</td>
</tr>
<tr>
<td>3</td>
<td>-3,000</td>
<td>-1,200</td>
<td>+8,000</td>
</tr>
<tr>
<td>4</td>
<td>-5,000</td>
<td>-7,000</td>
<td>-8,800</td>
</tr>
</tbody>
</table>

Under each revenue schedule, the decision rules are:

Revenue Schedule 1 - select Alternative A for the largest profit;
Revenue Schedule 2 - select Alternative B for the largest profit;
Revenue Schedule 3 - select Alternative C for the only profitable solution;
Revenue Schedule 4 - select Alternative A for the smallest loss, assuming the loss can be tolerated.

Decision rules are not set in stone. On the contrary, there are situations where a system having lesser profit might be preferred to higher yielding projects. The different alternatives reflect different delivery systems. A more expensive system that shows a loss might provide a much better quality of service than a cheaper system showing a profit. A community might be willing to subsidize an unprofitable project rather than implement a profitable alternative.

**Example of Budgeting**

To illustrate budgeting analysis, imagine a community considering implementing an Emergency Medical Services (EMS) system (Doeksen, 1988). This is a system of Emergency
Medical Technician (EMT) teams that provide emergency services to people living in rural areas. The benefits of such a system are readily apparent through the safety and well-being of rural residents; also economic development may be indirectly spurred through improvements in quality of life. Any public service project can be used to illustrate the analysis (i.e. transit, water, solid waste disposal, flood control systems, etc.). This system is chosen only to illustrate budgeting analysis.

**Determining What Needs To Be Done.** A first step in determining exactly what needs to be done in any project is to estimate the number of system users. For this particular example, the decision-maker is interested in the previous year’s EMS calls. If this information is not available, projections are made based on models developed for such purposes. This process is clearly expanded upon in previous reports (Sloggert et. al., 1988). For this example, the estimated number of annual calls is 566. Projects other than EMS systems also depend on historical data or research models developed to forecast service usage.

**Building Alternatives.** Depending on the needs and desires of the community, several alternative ways to establish an effective EMS system could be analyzed. Two alternatives will be considered here. The first is a hospital based system. The second is a totally independent system, in which a new building is constructed to house the entire operation. Other alternatives, such as a fire department based or volunteer system, could be developed.

**Alternative One (Hospital Based System).** Capital and operating costs information are estimated using the most recent cost figures. If current cost data are not available, the cost estimates must be adjusted to reflect current prices. This is accomplished by developing an inflation adjustment from the Consumer Price Index (CPI) published each month in the Survey of Current Business. For example, if the price of an ambulance is available for 1986, that price is adjusted by multiplying the 1986 price times the current CPI divided by the 1986 CPI. Appendix B contains historical consumer price indexes. Once the current capital costs are estimated, the next step is to estimate annual costs through a depreciation schedule, or through annual payments if a loan is used to finance the items. If a simple straight-line depreciation schedule is used, the annual costs are calculated by dividing the capital cost by the service life of the item. With a loan, the amount of principle and interest paid annually is determined by using the amortization table in Appendix A. The annual principle and interest payment is derived by multiplying the amortization factor for the appropriate interest rate and length of term of the loan by the amount of the loan.

The total capital costs for Alternative One are presented in Table 1 (pages 18 & 19). Since this is a hospital based system, land, labor for construction, building, and building material costs are not applicable. The capital items consist of two type II ambulances and two VHF radios. The vans cost $36,000 each, thus the total cost is $72,000 (2 times $36,000). Vehicle communication consist of the two VHF radio (listed under "miscellaneous"), priced at $900 (Dec. 1989) each for a total cost of $1,800 (2 times $900). Base communication, dispatching and building will be provided by the hospital, thus no cost are allocated for these services. The total capital costs for this Alternative is $73,800 ($7,200 plus $1,800).

Table 2 (pages 20 & 21) shows the annual capital cost budget for Alternative One. Following the above description, annual costs for land, labor, building, and materials are not applicable. The two vans would be financed at twelve percent interest over five years; therefore, the annual cost of the vans is $19,972. This is found by multiplying the total capital cost of the vans ($72,000) by an inflation factor of one, assuming the vans are priced at current cost (see appendix B). The adjusted cost ($72,000) is then multiplied by an amortization factor of 0.277410 (from Appendix A, five years for repayment and twelve percent interest rate), to arrive
at the annual cost of $19,972. The annual cost of the two VHF radios is found by multiplying the inflation factor of 1.03 (from Appendix B, 129.9 Divided by 126.1), times the capital cost to get an adjusted cost of $1,854 (1.03 times $1,800). The radios have a useful life of ten years, so the annual cost of the radios is calculated by multiplying the adjusted cost by 1/10 to arrive at $185 ($1,854 times 1/10). Therefore, the total annual capital cost is $20,157 ($19,972 plus $185).

Annual operating costs includes labor, vehicle expenses, office supplies, medical supplies, and miscellaneous items. These costs are shown in Table 3 (pages 23 & 24). The total annual operating cost is $62,287.

Consistent with the previous budget, building costs are not applicable. Labor would include the hiring of an EMS supervisor at $15,600 a year, one full-time Emergency Medical Technician (EMT) employee at $13,490 a year, and $5,910 to compensate the hospital's nurses and drivers for a labor cost of $35,000. The total annual labor cost is $40,722. This includes state unemployment of 1 percent of labor cost, 1.9 percent for Workman's Compensation, 7.5 for social security, and $2,078 for health insurance.

Vehicle operating expenses includes insurance, repairs, gasoline, oil, and tires, and other miscellaneous costs. Insurance is $2,100 per year per ambulance. Repairs are estimated as a function of miles driven. This is estimated to be 6.67 cents per mile or $1,000 per vehicle per year (0.0667 time 15,000 miles). Gasoline, oil, and tires are also estimated as a function of miles driven. Since these vans are to be driven about 15,000 miles each year and mileage is expected to be about ten miles per gallon, the estimated fuel cost is $1,500 per van if fuel is $1.00 a gallon (15,000 miles divided by 10 times 1.00), or ten cents a mile ($1,500 divided by 15,000 miles). The vans would be serviced (oil, filter, and grease) every 3,000 miles at a cost of $23, or $115 a year (15,000 miles divided by 3,000 miles times $23) or 0.77 cents a mile ($115 divided by 15,000 miles). Tires would be replaced every 20,000 miles at a cost of $100 each ($400 a set). The annual cost for tires is $300 (15,000 miles divided by 20,000 times $400) or two cents a mile ($300 divided by 15,000 miles). Therefore, gasoline, oil, and tire cost per vehicle can be stated as 12.77 cents per mile (10 cents plus 2 cents plus 0.77 cents), and gasoline, oil, and tires will cost $1,915 per vehicle (0.1277 cents times 15,000 miles). License fees (city and county) are $4.00 annually per vehicle. The operating cost for each vehicle radio is $144 via an annual service contract. So, vehicle operating cost is $10,326.

Office supplies are estimated to be $433, and telephone expenses are $410 for a total of $843 a year. Medical expenses are projected as $16.85 per call ($2.10 for linens plus $14.75 for disposable items), thus averaging $8,796 a year ($16.85 times 522 calls). Miscellaneous training costs are figured as $1,600 a year. In all, the total annual operating cost for Alternative One is $62,287.

**Alternative Two (Independent System).** This alternative involves the construction of a fully self-contained building to house employees and vehicles. A complete base station would be installed. A supervisor and four EMTs would be hired. Volunteers paid on a per call basis and overtime will be paid to insure that two EMT's respond to each call.

Table 4 (page 26 & 27) shows the related capital costs. Land and labor for the construction of a building are assumed as not applicable. Land is assumed available and labor for constructing the building is contained within the $25 per square foot construction cost. The building will be 2,250 square feet, thus its cost is $56,250 (2,250 sq. ft. times $25). The vans will cost $36,000 each for a total of $72,000 as in Alternative One. The service will now house a complete base station, including antenna, tower, lighting, and emergency power, for $13,750. VHF radios for the vans are again $900 each or $1,800 total and four pagers cost $400 each or $1,600 total at current prices. The total capital cost of Alternative Two is $145,400 ($56,250 for a building, $72,000 in vans, and $17,150 in miscellaneous communication costs.
The annual capital costs of Alternative Two are shown in Table 5 (pages 29 & 30). Land and building labor are, of course, zero. The building will be financed with a twelve percent, thirty year loan. So, from Appendix A, the amortization factor is 0.124144, and the annual cost, assuming $56,250 is a current price (inflation factor is one), is $6,981 (0.124144 times $56,250). Materials cost are assumed zero (included within the building cost). As in the previous alternative, vehicles are financed for five years with a twelve percent loan for an annual payment of $19,972. The base station will be paid for with a ten percent, ten year loan. Using Appendix A, the amortization factor is 0.162745, and the annual cost is $2,239 (0.162745 times $13,750). As before, the radios and pagers are depreciated using a ten year straight-line depreciation method, so these cost are $185 and $160, respectively. The annual miscellaneous communication costs are $2,584. The total annual capital cost are $29,537 ($6,981 plus $19,972 plus $2,584).

The annual operating cost are given in Table 6 (pages 31 & 32). Utilities and maintenance for the building are estimated to be about $1.42 per square foot per year or $3,195 ($1.42 times 2,250 sq. ft.). Insurance is $450 a year ($8.00 per $1,000 value). Hence, total building operating costs are $3,645 ($3,195 plus $450).

The salary of the EMS supervisor will be $22,500 a year plus taxes and health insurance. Four EMTs will be paid $6.00 per hour plus taxes and health insurance. As a result, the EMT wage bill will be $49,920 a year ($6.00 hr. times 40 hrs times 52 weeks times 7 EMTs). Volunteers pay and overtime will total $10,000. Taxes and insurance benefits will total $11,804. Therefore, the annual labor cost will be $94,224 ($22,500 plus $49,920 plus $10,000 plus $11,804). Vehicle, office, and medical supplies and training are the same as in Alternative One ($10,826, $843, $8,796, $1,600, respectively). Under this alternative, the annual operating costs are $119,934.

Estimates of Revenue. After capital and operating budgets are developed for each alternative, the amount of money that can be raised from different revenue sources must be estimated. User fees are a prevalent source of revenues for many projects. In this example, fees consist of a base rate fee. These fees, like most infrastructure fees, seldom cover all of the costs; hence, they are often supplemented. Two alternative often used to support EMS systems are the creation of EMS districts or sales taxes. Creating a special EMS district (if allowed by state law) allows a system to collect revenue via property taxes. An alternative source of revenue might be the use of earmarked sales tax.

In the present example, revenues are projected under several different conditions. Different base rates might be charged, in addition to a $2.00 per mile one way fee. Revenues are estimated over a variety of collection rates since the service will probably not be able to collect all fees. Then, the EMS system could be subsidized by either creating a district and collecting property taxes or by earmarking a sales tax. Any of these, or a combination, could be used. Estimated revenues from alternative sources are presented in Table 7 (page 34). For example, if the base fee were $100 per call (566 calls) and $2 were charged per mile (6,700 miles) and 70 percent of the charges were collected then $49,000 would be collected from user fees. Property taxes collected from the creation of a district would equal $104,510 and a one cent sales tax would generate $174,598.

Profit and Loss Statements. To make analysis easier, the "bottom-line" information for each alternative along with each revenue scenario needs to be compared. These are presented in Tables 8 and 9 (pages 36 & 37) for two different revenue scenarios.

For scenario I, annual profit or losses are calculated on the assumption that a $100 base fee is charged and collected at a seventy percent collection rate. The profit or loss statement is presented in Table 8. Under these conditions, no considered alternative is financially feasible. In fact, both alternatives yield considerable losses. Alternative one generates the least loss
Thus, if decision-makers do not want to raise the base rate and mileage charge, the system will need to be subsidized from some source.

Scenario II's profit or loss statement is presented in Table 9. The assumptions are that a $100 base fee is charged, the collection rate is sixty percent, and an EMS district is created. With these assumptions, $146,510 in revenue is generated. Under this condition, alternative one is financially feasible, but alternative three is not. Alternative 1 yields a sizeable profit ($64,066). Thus, if decision makers desired this alternative, they could reduce the amount of property tax collected. Alternative 2 shows a small loss ($2,966). If decision-makers desired this alternative, they could cut cost slightly and break-even.

Summary

It should be evident that budgeting analysis is a powerful tool in decision-making. It helps decision makers grasp complex situations and analyze a full range of possibilities with confidence. The "worst" and the most "advantageous" scenarios are exposed, enabling the decision-maker to narrow and shape a desired solution to meet the community's needs. However, it might be noted that the idea of "profits" in community projects may not be appropriate or, at times, user fees can't (or shouldn't) be charged. Elements other than money do influence choices. Therefore, since budgeting neglects many influential factors, practitioners may need to supplement it with the more "in-depth" analysis of benefit-cost.

BENEFIT-COST ANALYSIS

Budget analysis is usually applied to situations where a government entity is adding a service in which the revenues and costs are easily measured. If the project loses money, leaders must decide if they wish to subsidize the service from available funds or raise revenue from another source. For many governmental projects, the costs and benefits are not as clear as demonstrated with budget analysis. These projects also have direct and secondary costs and benefits and cost occurring over time. In addition, the government entity often has limited dollars, thus leaders must choose between competing projects. In these cases, an economic tool called benefit-cost analysis can be used. The principles of benefit-cost analysis will be reviewed, and then a simple example will be presented. Next, a suggested format for conducting benefit-cost studies is presented. Finally, examples of problems that benefit cost analysis has been applied to will be reviewed. With this tool, it may be necessary to work with an economist or planner experienced with the use of benefit-cost analysis. Cautions concerning the use of benefit-cost analysis will be discussed in the summary section.

Principles of Benefit-Costs Analysis

The basic economic principles of benefit-cost analysis are quite simple. The difficulty comes with applying the tool to specific problems. For illustrative purposes, assume the government has $100,000 to invest and is considering four projects. An economist measures the benefits and cost of each project. Assume that benefits from project A equal $200,000 and costs equal $100,000. The benefit-cost ratio is merely benefits divided by costs and, in this case, equals two. The data for projects B, C, and D are collected and all data are presented in Table 10 (page 41).

By comparing the benefit-cost ratios of the four projects, it is possible to determine which project yields the greatest benefits and should be undertaken by the government if they have limited dollars. Project C has a benefit-cost ratio of 3.6. This means that for each dollar of costs there are $3.60 worth of benefits. The above analysis appears simple, but often is complicated due to costs and benefits occurring over time and many projects having spillover effects. These
must be included in the measurement of benefit and costs. To account for costs and benefits occurring over time, the present value concept is used.

Present Value. A given cost incurred later is preferred to a cost incurred earlier, and a given benefit obtained now is preferred to a benefit obtained later because people desire funds now so that they can spend or invest them. All costs and benefits used for a project must be computed in current equivalent dollars. This is done with the present value formula. The present value (PV) of benefits (or costs), of dollars ($b_t$) going back into the past is:

$$PV = (1 + r)^t b_t + (1 + r)^{t-1} b_{t-1} + \ldots b_0$$

where $r$ is the discount rate and $t$ is the number of years past

The present value of benefits (or costs), of dollars ($b_t$) into the future is:

$$PV = \frac{b_0}{(1+r)} + \frac{b_1}{(1+r)^2} + \frac{b_2}{(1+r)^3} + \ldots + \frac{b_t}{(1+r)^t}$$

The application of these formulas will be illustrated in the example below. However, before this, it is necessary to introduce the concept of spillovers.

Spillovers. Spillovers are the incidental impacts of an action on those who had no decision control over the action. In other words, a project undertaken to benefit one party may influence the well-being of others. Spillovers are sometimes referred to as external or neighborhood effects; they may be positive or negative. Your neighbor might make substantial improvements to his property, which in turn benefits you. Spillovers often occur as effects on the environment (i.e. pollution).

Responsible decision-makers need to take into account the spillover effects of actions. In benefit-cost analysis, spillovers are often ignored, thus the actual or social costs (or benefits), may not be represented. It is difficult to place monetary values on environmental intangibles or educational endeavors. In any event, decisionmakers need to be aware of possible spillovers and their effect on social as well as private benefit and costs.

An Example of Benefit-Cost Analysis

To illustrate the use of benefit-cost analysis, a study is made concerning a hypothetical investment in a post-high school vocational-technical institute. The analysis is conducted by calculating both the benefit-cost of private (individual) investment and the benefit-cost of social investment in the Vo-Tech (Tweedon and Brinkman, 1976, Chapter 12).

Private Investment. The first step is to determine the investment in the buildings and equipment. These cost are then converted to an annual cost (as in budget analysis). This is also done for operating costs. Next, the appropriate discount (interest) rate is chosen. A rate often used is the rate at which the decisionmakers can borrow money. For this example, assume ten percent. Assuming the former steps are completed, the economic benefits and costs are completed.

In this hypothetical case, benefits are based on the difference between the earnings of individuals with and without the two years of post-high school vo-tech. The difference between the earnings of high school graduates and vo-tech graduates following graduation is, say, $650 in year 1, $685 in year 2, $740 in year 3, and by year 50, $0.

Assume that the students direct costs consist of supplies, miscellaneous items, and foregone earnings from delaying employment. The direct cost are $470 the first year and $435 the second year. Foregone earnings constitute $2,300 the first year and $2,575 the second, making the total private cost $2,770 the first year ($470 plus $2,300) and $3,010 the second year ($435 plus $2,525).
The present value of the private costs $C$ is:

\[ C = 2,770 \times (1.10)^2 + 3,010 \times (1.10) = 6,663. \]

where the costs are assumed to occur at the beginning of each of the two years, and the discount or interest rate is ten percent. Benefits (net of taxes) begin immediately upon graduation, (the base time) and continue for many years. The discounted value of benefits $B$ is:

\[ B = 650 + \frac{685}{(1.10)} + \frac{740}{(1.10)^2} + \ldots + \frac{0}{(1.10)^{\infty}} = 18,205 \]

Therefore, the private benefit-cost ratio is 2.7 ($18,205$ divided by $6,663$), see Table 11 (page 44). This says that for every one dollar of cost incurred by the individual student benefits are $2.70.

**Social Investment.** Social benefit-cost ratios are calculated in the same way except that they include both the public elements and the private benefits and costs. Like in the private case, society will want to consider funding projects yielding social benefit-cost ratios greater than one.

Suppose a social benefit-cost ratio is computed for the total public and private costs associated with two years of vo-tech schooling. The public cost is found to be $1,415 for each of the two years. Thus, the total cost is $4,570 ($1,800 public plus $2,770 private) the first year and $4,810 ($1,800 public plus $3,010 private) the second year. Therefore, the present value of the social costs $C$ is:

\[ C = 4,570 \times (1.10)^2 + 4,810 \times (1.10) = 10,821. \]

The social benefits is the private benefits plus any public benefits accruing to society, in this case, the taxes paid by the individual. Consequently, the discounted value of the social benefits $B$ is:

\[ B = 748 + \frac{788}{(1.10)^{\infty}} + \frac{851}{(1.10)^2} + \ldots + \frac{0}{(1.10)^{\infty}} = 20,936. \]

From this, the social benefit-cost ratio is 1.9 ($20,936$ divided by $10,821$), see Table 11 (page 44). For every one dollar invested by society, benefits are $1.90.

**Suggested Format for Conducting Benefit-Cost Studies**

To aid decision-makers organize collected estimates of benefits and costs of alternative projects, a format for conducting benefit-cost studies is suggested in Figure 1 (page 46) and applied to the former vo-tech schooling analysis. Depending on whether the effect is a direct (tangible monetary) or spillover (intangible, hard to quantify) effect, the present value of benefits and costs are listed in their respective column. Total benefits and costs are tallied, and the benefit-cost ratio can then be computed. This procedure is repeated for each alternative project; the project yielding the highest benefit-cost ratio will obviously rank closer consideration.

The discounted value of the benefits of the private investment is $18,205. And the discounted value of the costs are $6,663. Each benefit and cost calculation is inserted into its respective column. The spillover effects are the differences between the private and the social benefits (costs). Thus, the spillover benefit is $2,731 ($20,936 social less $18,205 private), and the spillover cost is $4,158 ($10,821 social less $6,663 private). Dividing the sum of the benefits ($20,936) by the sum of the costs ($10,821) yields a benefit-cost ratio of 1.9.

**Conclusion.** Table 11 (page 44) summarizes the preceding analysis. Including only private cost and subtracting taxes from earning differences, the private benefit-cost ratio for the individual’s investment is computed as 2.7. Considering both the private and public costs and including earnings with taxes paid as benefits, the social benefit-cost ratio for society's investment is 1.9. From this analysis, it can be concluded that vo-tech training is a highly profitable investment for the individual and somewhat profitable for society as a whole since both benefit-cost ratios are greater than one (Tweeten and Brinkman, 1976, Chapter 12).
Examples of Benefit-Cost Studies

The preceding benefit-cost study of an education alternative is only an example of the hundreds of studies made using benefit-cost analysis. Others include manpower training programs, land use, water projects, transportation projects, health programs, defense projects, and more. A study from each of the first four categories is highlighted as an example of the potential of benefit-cost analysis.

Manpower Training Programs. Borus (1964) performed a benefit-cost analysis on the returns from the Manpower Development and Training Act of 1962. This act provided funds to retrain up to 25,000 unemployed and underemployed workers in areas of substantial blight. It was found that for the private individual the benefit-cost ratio fell between 3.2 and 6.2 depending on the sample and specific area tested; whereas, society's benefit-cost ratio was between 73.2 and 103.8. Thus, the retraining of workers was found to be of great social value, eventhough of lesser value to the individual.

Land Use. A study by Williams and Schermerhorn (1968) computed benefits and costs of developing overnight camping facilities near major highways in Oklahoma. Pressure was being placed on the State to begin charging users fees for camping in state owned sites. The study analyzed four revenue schemes under three different potential occupancy levels was used to discover the returns from investment. Total annual costs (capital and operating expenses) and total annual returns (revenues from fees) were estimated over a range of fees ($1.50 to $3.00). At 25 percent occupancy, benefit-cost ratios were between 0.86 and 1.72; at 40 percent, 1.35 to 2.7; and at 55 percent occupancy the ratios were between 1.62 and 3.24. From this analysis, all scenarios were feasible except the first. A fee of $1.50 at a low occupancy rate (25 percent) yielded a ratio less than one (0.86); thus, if $1.50 was the fee to be used, the patronage level would need to be maintained nearer the 40 percent mark (ratio of 1.35).

Water Projects. Steiner (1959) published an analysis concerning alternative investments in water projects, specifically electricity generating dams. The question asked was: should the federal government have permitted the Idaho Power Company to develop the Hells Canyon project or should it have been developed as a public project? And if public, what size or number of dams would yield the greatest return? To answer these questions, an analysis was made over three alternatives (one large public dam, two small public dams, and three small private dams), and two discount rates (2.5 percent and 5.5 percent). Results showed that a large public dam or three small private dam would be unfeasible at the higher discount rate (benefit-cost ratio of 0.58 and 0.75 respectively). The greater returns would be from two small public dams (ratio of 4.0) or the private dams (ratio of 2.8) at the lower discount rate.

Transportation Projects. A classic paper by Foster and Beesly (1963) estimated the social benefits and costs of the Victoria Line, an underground railroad project in England. Although benefit-cost ratios were not specifically reported, the study is noted for its methodology in the estimation of certain hard to quantify benefits and costs. Direct effects (including capital and operating cost), and many spillover effects are computed as usual. But interestingly, estimates of benefits included such spillovers as comfort and convenience, fare and vehicle operating cost savings, time savings, and benefits from the reduced congestion in the city streets. As a result of this analysis, many transportation related benefit-cost studies now include or at least footnote some of these effects.
Summary and Cautions

Just as budgeting weighs the costs and revenues of projects, benefit-cost analysis systematically organizes project estimates into socially desirable and undesirable effects to determine the most feasible alternative. Direct and spillover effects include both benefits and costs. Benefit-cost ratios are computed from present value estimates of these benefits and costs. Ratios greater than one indicate positive returns, and decisionmakers will seek projects with the highest ratios. Benefit-cost analysis forces decisionmakers to quantify benefits and costs as much as possible, thereby reducing the role of personal hunches. However, justifiable criticism does exist, thus certain precautions need to be taken.

Decision-makers need to be cautious that the analysis is not biased toward a pet project. There are many diverse types of benefits and many different beneficiaries. Care must be taken not to double count benefits. At the same time, allowances must be made for spillover effects. If spillovers are difficult to quantify, as they often are, they should at least be footnoted. Choose an appropriate discount rate; to this end, the borrowing cost of money is often used. Make allowances for uncertainty by analyzing projects over a range of possible scenarios. If the user is aware of the potential problems and acts accordingly, benefit-cost analysis is a powerful decision making tool.

SUMMARY

Due to serious constraints on resources, local leaders need tools to help them meet the needs of infrastructure planning. This guidebook is intended to aid community development practitioners face this challenge. The complexities of planning analysis is, hopefully, refined into an easy to understand format by pointing-out the linkages between infrastructure and economic development, stressing the importance of strategic planning, and by introducing the fundamentals of budgeting and benefit-cost analysis.
Selected Bibliography - Alphabetical


Salkin, M. S., *Solid Waste Planning: Components and Costs for a Rural System in Southeast Oklahoma*, Agricultural Experiment Station, P-717, (Stillwater: Oklahoma State University), 1975.


Wacht, R. F., A New Approach to Capital Budgeting for City and County Governments (Atlanta: Georgia State University), 1980.


Williams, J.W., and Schermerhorn, R.W., Economic Analysis of the Potential For Developing Overnight Camping Facilities on or Near Major Highways in Oklahoma, Agricultural Experiment Station, Bulletin B-660, Oklahoma State University, Stillwater, September, 1968.

Selected Bibliography - By Topic

INFRASTRUCTURE AND ECONOMIC DEVELOPMENT


BUDGETING

Theory:


Wacht, R. F., A New Approach to Capital Budgeting for City and County Governments (Atlanta: Georgia State University), 1980.

Application:


Knowles, E. F., and Doeksen, G. A., A Guidebook for Rural Public Transit Services, Agricultural Experiment Station, MP-123, (Stillwater: Oklahoma State University), 1987.


Moak, L. L., and Gordon, K. K., Budgeting for Smaller Governmental Units (Chicago: Municipal Finance Officers Association), 1965.


Nelson, M. K., and Fessekaye, M., Central Wastewater Collection Conveyance, and Treatment in the Rural Ozarks: A Handbook for Local Decisionmakers, Department of Agricultural Economics Paper No. 8048, Oklahoma State University, April, 1980

Salkin, M. S., *Solid Waste Planning: Components and Costs for a Rural System in Southeast Oklahoma*, Agricultural Experiment Station, P-717, (Stillwater: Oklahoma State University), 1975.


BENEFIT-COST ANALYSIS

Theory:


Williams, J.W., and Schermerhorn, R.W., Economic Analysis of the Potential for Developing Overnight Camping Facilities on or Near Major Highways in Oklahoma, Agricultural Experiment Station, Bulletin B-660, Oklahoma State University, Stillwater, September, 1968.


Application:


Williams, J.W., and Schermerhorn, R.W., *Economic Analysis of the Potential For Developing Overnight Camping Facilities on or Near Major Highways in Oklahoma*, Agricultural Experiment Station, Bulletin B-660, Oklahoma State University, Stillwater, September, 1968.
Appendix A

Amortization Factors
## APPENDIX A

### Amortization Factors

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Calculated using the following formula:

\[
\text{Amortization Factor} = \frac{i}{1-(1+i)^{-n}}
\]

where \(i\) = interest rate; \(n\) = number of years
Appendix B
Indices Used to Adjust Cost to Reflect Current Prices
## APPENDIX B

Indices Used to Adjust Cost to Reflect Current Prices

Consumer Price Index (Urban)
(1982-84 = 100)

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1Examples Application of Index:
\[
\frac{(1985 \text{ Costs})}{1985 \text{ CPI}} \times \frac{\text{Current CPI}}{1985 \text{ CPI}} = \text{Adjusted Cost}
\]

Appendix C

Budget Analysis Forms
Form 1

Total Capital Costs Budget

Type of System: ________________________________

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<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td><strong>B. Labor (Construction)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td><strong>C. Building</strong></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td><strong>D. Materials</strong></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
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### Form 1 Continued

<table>
<thead>
<tr>
<th>System Description</th>
<th>Number</th>
<th>X</th>
<th>Cost/Unit</th>
<th>=</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E. Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F. Miscellaneous</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Capital Costs** \((A + B + C + D + E + F)\) = ______________
### Form 2

**Annual Capital Costs Budget**

<table>
<thead>
<tr>
<th>System Description</th>
<th>Total Costs</th>
<th>Inflat. Factor</th>
<th>Adjust Cost</th>
<th>Amortization Factor</th>
<th>Annual Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>b.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>c.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>___</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A = $</td>
</tr>
<tr>
<td>B. Labor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>b.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>c.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B = $</td>
</tr>
<tr>
<td>C. Building</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>b.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>c.</td>
<td>___</td>
<td>___</td>
<td>___</td>
<td></td>
<td>___</td>
</tr>
<tr>
<td>Subtotal (a+ b+c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C = $</td>
</tr>
<tr>
<td>System Description</td>
<td>Total Costs</td>
<td>Inflat. Factor</td>
<td>Adjust Cost</td>
<td>Amortization Factor</td>
<td>Annual Costs</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
<td>---------------</td>
<td>-------------</td>
<td>--------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>D. Materials</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td>(___ Yrs., ___%)</td>
<td>___</td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td>D = $________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Vehicles</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td>(___ Yrs., ___%)</td>
<td>___</td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal (a+b+c)</td>
<td></td>
<td></td>
<td>E = $________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Miscellaneous</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td>(___ Yrs., ___%)</td>
<td>___</td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>X __________</td>
<td>X __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td>F = $________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Annual Capital Costs** (A + B + C + D + E + F) = ________________
Form 3

Annual Operating Cost Budget

Type of System: __________________________________________

System Description

<table>
<thead>
<tr>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = $__________________</td>
</tr>
</tbody>
</table>

A. Building

| Utilities   | $_____ /sq. ft. | X | _____ sq. ft. | = | __________ |
| Insurance   | ____/1,000      | X | _____        | = | __________ |
| c. __________ |               |   |              |   | __________ |
| d. __________ |               |   |              |   | __________ |

Subtotal (a+b+c+d) A = $__________________

B. Labor

<table>
<thead>
<tr>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B = $__________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. __________</td>
</tr>
<tr>
<td>b. __________</td>
</tr>
<tr>
<td>c. __________</td>
</tr>
<tr>
<td>d. __________</td>
</tr>
</tbody>
</table>

Subtotal (a+b+c+d) B = $__________________

C. Vehicles

<table>
<thead>
<tr>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = $__________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Insurance</td>
</tr>
<tr>
<td>b. Repairs</td>
</tr>
<tr>
<td>c. Gasoline, Oil, Tires</td>
</tr>
<tr>
<td>i. Vehicle #1</td>
</tr>
<tr>
<td>ii. Vehicle #2</td>
</tr>
<tr>
<td>d. Miscellaneous</td>
</tr>
<tr>
<td>i. __________</td>
</tr>
<tr>
<td>ii. __________</td>
</tr>
</tbody>
</table>

Subtotal (a+b+c+d) C = $__________________

53
<table>
<thead>
<tr>
<th>System Description</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D. Office Supplies</strong></td>
<td></td>
</tr>
<tr>
<td>a. __________</td>
<td>=</td>
</tr>
<tr>
<td>b. __________</td>
<td>=</td>
</tr>
<tr>
<td>c. __________</td>
<td>=</td>
</tr>
<tr>
<td>d. __________</td>
<td>=</td>
</tr>
<tr>
<td>Subtotal (a+b+c+d)</td>
<td>D = $</td>
</tr>
<tr>
<td><strong>E. Medical Supplies</strong></td>
<td></td>
</tr>
<tr>
<td>a. __________</td>
<td>=</td>
</tr>
<tr>
<td>b. __________</td>
<td>=</td>
</tr>
<tr>
<td>c. __________</td>
<td>=</td>
</tr>
<tr>
<td>d. __________</td>
<td>=</td>
</tr>
<tr>
<td>Subtotal (a+b+c+d)</td>
<td>E = $</td>
</tr>
<tr>
<td><strong>F. Miscellaneous</strong></td>
<td></td>
</tr>
<tr>
<td>a. __________</td>
<td>=</td>
</tr>
<tr>
<td>b. __________</td>
<td>=</td>
</tr>
<tr>
<td>c. __________</td>
<td>=</td>
</tr>
<tr>
<td>d. __________</td>
<td>=</td>
</tr>
<tr>
<td>Subtotal (a+b+c+d)</td>
<td>F = $</td>
</tr>
<tr>
<td><strong>Total Annual Operating Cost</strong></td>
<td></td>
</tr>
<tr>
<td>(A + B + C + D + E + F)</td>
<td>= $</td>
</tr>
</tbody>
</table>
Form 4

Estimated Revenues

<table>
<thead>
<tr>
<th>BASE RATE</th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Base Rate X Use |   |   |   |   |
| Fixed Rate      |   |   |   |   |
| Total Revenues  |   |   |   |   |

| Collections at 40 percent |   |   |   |   |
| 50 percent                |   |   |   |   |
| 60 percent                |   |   |   |   |
| 70 percent                |   |   |   |   |

Other Revenues

a. ____________________________ $_____

b. ____________________________ $_____
Form 5

Annual Profit/Loss Statement

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Annual Revenue</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>B. Annual Capital Costs</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>C. Annual Operating Costs</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>D. Total Annual Costs (B+C)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Profit/Loss (A - D)</td>
<td>$</td>
<td>$</td>
<td>$</td>
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</tbody>
</table>
Appendix D
Benefit-Cost Worksheet
<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT EFFECTS</td>
<td>PV</td>
</tr>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>DIRECT EFFECTS</td>
<td></td>
</tr>
<tr>
<td>SUB-TOTAL DIRECT BENEFITS</td>
<td>A</td>
</tr>
<tr>
<td>Aesthetics</td>
<td></td>
</tr>
<tr>
<td>Water/Air Quality</td>
<td></td>
</tr>
<tr>
<td>Life</td>
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<td>Health</td>
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<td>Safety</td>
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<td>Education</td>
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<tr>
<td>Culture</td>
<td></td>
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<tr>
<td>Recreation</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>SPILOVER EFFECTS</td>
<td></td>
</tr>
<tr>
<td>SUB-TOTAL SPILOVER BENEFITS</td>
<td>B</td>
</tr>
<tr>
<td>TOTAL BENEFITS (A+B)</td>
<td></td>
</tr>
<tr>
<td>BENEFIT-COST RATIO (TOTAL BENEFITS/TOTAL COSTS)</td>
<td></td>
</tr>
</tbody>
</table>
The SRDC is one of four regional rural development centers in the nation. It coordinates cooperation between the Research (Experiment Station) and Extension (Cooperative Extension Service) staffs at land-grant institutions in the South to provide technical consultation, research, training, and evaluation services for rural development. This publication is one of several published by the Center on various needs, program thrusts, and research efforts in rural development. For more information about SRDC activities and publications, write to the Director.

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