
***A Primer on
Transportation Investment
and Economic Development***

Transportation Association of Canada 1994
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FOREWORD

In 1992 the Board of Directors of the Transportation Association of Canada (TAC) began to consider the role of transportation in maintaining and enhancing Canada's competitiveness in the face of rapidly changing continental and global economic environments. The Board concluded that Canada would be best served by pursuing new directions in transportation regulation, taxation, investment decision making, productivity and other areas. To provide a framework for desirable change, the Board prepared and endorsed A NEW VISION FOR CANADIAN TRANSPORTATION.

The vision, published as a TAC briefing paper in September, 1993, sets forth a variety of goals to be reached before the year 2003. One of the actions necessary to achieve those goals is to develop and implement new Canadian methodologies for multi-modal transportation investment decision making based on benefit/cost analysis. Responsibility for action on this subject was assigned to the TAC sponsored Multi-Modal Council.

This Primer represents one step in the Council's long term benefit/cost analysis program. It is an introductory document designed to provide background information to decision makers and practitioners. It describes the relationship between capital investment in transportation infrastructure on the one hand, and productivity and economic growth on the other. The valuable role of benefit/cost analysis in capital investment decision making is also presented.

This Primer is offered now to stimulate discussion and interest in the latest economic analysis methodologies, as useful tools to assist in multi-modal transportation investment decision making. It is intended to provide a starting point from which improved decision making practices may evolve, to the benefit of the Canadian transportation community and the nation's economy.

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Prior to publication, inputs were provided and drafts were reviewed by members of the TAC Multi-Modal Council and others knowledgeable in the field.

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PRIMER ON TRANSPORTATION AND ECONOMIC DEVELOPMENT

I. Introduction

Economic growth is a fundamental ingredient to an ever improving standard of living. The scale and efficiency of our transportation infrastructure plays an integral role in the performance of the Canadian economy by allowing Canadians to compete in the international marketplace, to move goods and people in a safe, efficient manner, and by allowing for the strategic location of industries. The purpose of this document is to summarize the relationship between transportation infrastructure and the rate of economic growth and promote an evaluation framework in which impacts of transportation investments can better be assessed in the context of economic growth. As such, investment, technological change, and the organization of economic activity are analyzed with respect to transportation investments in the context of a changing global marketplace. The cumulative effect of these variables is the potential for incremental productivity gains in the economy.

There are other forces which impact the timing and scale of investment decisions. National boundaries are becoming less relevant to business decisions as investment flows and production facilities move in quest of the highest possible return on market share. Globalization is breaking down the old distinction between industrialized and developing nations. These shifts have combined to alter the competitive advantage enjoyed by Canada over the past half century.

As some competitive advantages deteriorate, shifts in industrial activity interact with fiscal policies to produce recessionary cycles that make it difficult for the economy to fully recover. The impact is often persistently high and climbing structural unemployment, reduced tax revenues, growing deficits, and a general lack of confidence in the economy by consumers, industry, and the private sector.

To maximize the role of private enterprise as the driving force behind our economy, fiscal and monetary policies must be designed to promote growth in output and employment while holding prices relatively stable. Monetary policies have provided an environment of relative price stability so that inflation no longer limits investment decisions over the short term. Over the longer term, fiscal policies designed to stimulate the economy and encourage private sector restructuring and investment must now be pursued and encouraged in order to better meet changing markets.

Investment in transportation infrastructure is one fiscal tool which can provide a critical link in achieving high rates of economic growth fundamental to the economic well being of Canada. Investment in transportation infrastructure combines with other investments to provide a key boost to the nation's economy. Investments in transportation infrastructure are an important determinant

of domestic demand and positively impact the competitiveness of Canadian goods and services in world markets. The recent failure of transportation investments to maintain pace with growing demand renders the provision of infrastructure more expensive than it otherwise would have been both in terms of the time value of money and the competitive nature of Canadian products competing in the global marketplace.

While there are short term transitory employment and consumption benefits, real economic gains can accrue from making better and more timely investment decisions. Over the longer term, market opportunities created by infrastructure investments promote research and development, stimulate technological change, and increase productivity. Improved infrastructure lowers transportation costs and positively impacts the competitiveness of Canadian goods in both domestic and foreign markets. This combination of reduced costs and increased productivity should encourage or facilitate economic growth, and present positive signals required to attract new industrial investment in Canada.

II. Productivity: The Key to Economic Vitality

The conventional approach to analyzing the sources of economic growth has been to focus on increases in the quantity and the quality of the inputs used to produce outputs. Gross Domestic Product (GDP) is the most common proxy of this measure. GDP is the sum of all goods and services produced within Canadian borders, measured as the number of workers times the output, or production, per worker. Growth in GDP will come from three sources: changes in population, growth of the labor force, and growth in productivity.

The sources of growth which fueled Canada's 20th century rise in world markets are now changing in their relative importance to our future economic vitality. Population growth peaked at an average growth rate of 2.7 per cent between 1951 and 1961, fell to an average annual rate of 1.7 per cent between 1961 and 1971 and decreased further to 1.2. percent over the next decade. Labour force participation rates reflect trends in population growth, rising through the 1960s and 1970s to coincide with the aging of the baby-boom generation. Participation rates have stabilized and in some areas are now declining, reflecting an aging demographic structure and declining fertility rates. Population and labour force growth are constrained and can no longer be relied upon to provide their historical contribution to economic growth.

There is now widespread consensus that productivity growth must shoulder Canada's economic development and expansion into the 21st century. Yet Canadian manufacturing productivity growth over the last decade ranks last among the G-7 group of nations. This productivity decline, combined with adverse shifts in Canadian industrial structure, has resulted in a significant decline in Canadian per capita income relative to other industrialized countries.

Figure 1 illustrates Canadian per capita income has followed a downward trend since the mid 1970's and is now below the average of Japan, France, Germany, Italy and the United States.

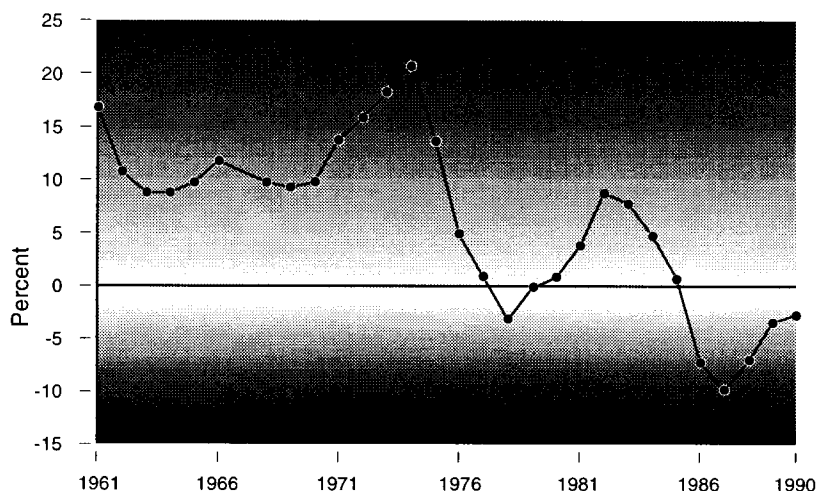


Figure 1
National Income Per Capita

National income per capita in Canada as a percentage of the average national income per capita of France, Japan, Germany, Italy and the United States
Source: World Bank (1992)

Growth in GDP is not to be regarded as a good thing regardless of its cost. Growth has implications for environmental and other living standards that are not measured by GDP which have significant economic implications of their own. The way in which economic expansion is shared between regions and individuals requires examination. Growth for growth's sake has never been the center-piece of Canadian public policy. Nevertheless, growth, through acceptable means and at acceptable costs - "sustainable development" - is the only means available to recover and sustain Canadian living standards. Most of the increase in future growth can be achieved only through increased levels of productivity.

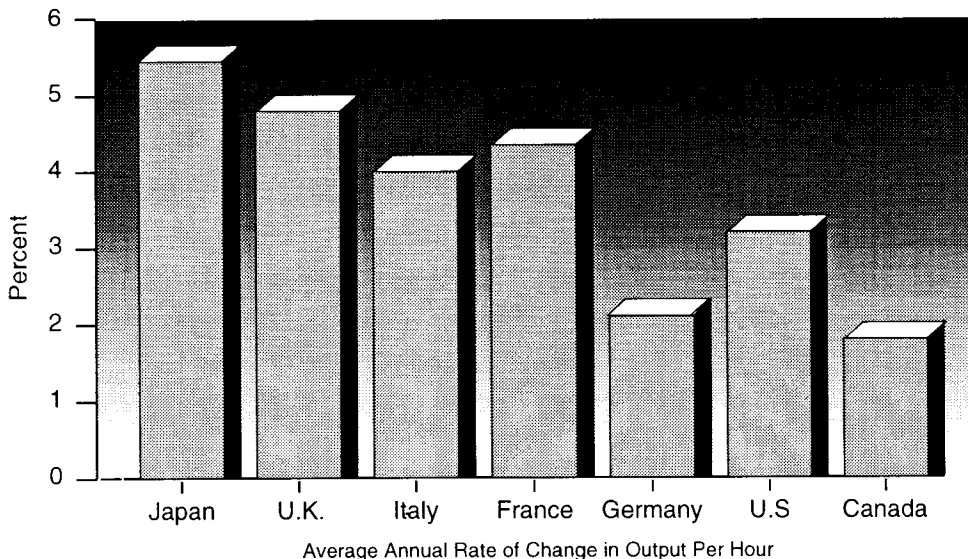
III. The Key Role of Capital Investment in Promoting Productivity Growth

III.1. The Rate of Capital Investment

Whereas productivity is the key to economic growth, the rate of capital investment - all investment, both private and public - is key to improved productivity. The productivity of labor depends to a large extent upon the total quantity and quality of capital per worker. Capital can take the form of investing in fixed plant and machinery or investing in human capital. Education is investment in human capital. Unlike fixed investment, investment in human capital is adaptable and can be molded to fit changing production requirements over time. Education contributes to technological change and the innovations required by industries to compete in the marketplace. Research has documented a strong relationship between the growth rate in capital investment per worker (both in fixed plant and education) and the growth rate in labor productivity. The more capital per unit of labour, the higher the productivity of labour. Nations with high capital formation display high growth rates in labor productivity and vice versa.

Private capital investment per worker has declined in Canada since 1979, resulting in Canada having the lowest rate of labor productivity growth of the G-7 nations. (Figure 2) In contrast, investment and its subsequent impact on productivity in the United States and Canada's other major trading partners is sharply higher.

Figure 2
Growth of Manufacturing Productivity
G-7 Countries 1979-1990



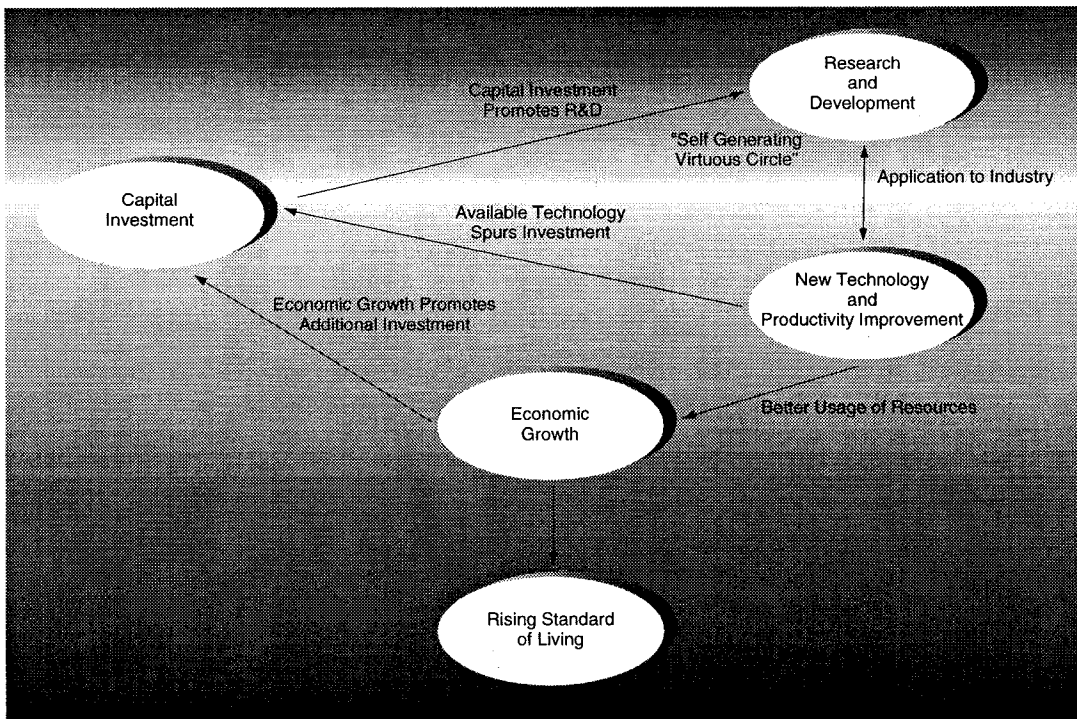
Source: Neef and Kask, *Monthly Labour Review*, U.S. Department of Labour, 1991.

III.2. Technological Change

According to recent economic research, capital investment stimulates technological change through its incorporation into capital equipment and facilities. Technological change is defined as any innovation that improves the way we do things, encompassing a broad process of improvements in products and methods of production.

Discussions of technological change concentrate on improvements on products or processes, and on formal research and development. To this end, there is a frequently voiced concern in Canada that far too few resources are devoted to research and development. Except for a small part devoted to basic science, research and development is seldom undertaken unless its results are expected to be applied in new facilities and superior operating modes that can improve productivity, reduce costs or raise the quality of goods and services. A high rate of capital investment creates a market conducive to technological improvements, which in turn spurs technological advances and improves productivity (see Figure 3).

Figure 3
Capital Investment acts as a Catalyst to
Set Off a Virtuous Circle



IV. The Special Role of Public Investment in Transportation

There is wide-spread consensus that higher rates of capital investment are key to the future growth of productivity and living standards. What is the specific role of investment in transportation infrastructure?

Public works are fundamental and necessary components of the nation's total capital stock. Chosen and planned carefully, transportation investments can generate time savings and reductions in vehicle operating expenses that yield productivity and safety gains well in excess of the investment and environmental costs. In addition, recent studies of industrial logistics show how retail businesses and many other sectors of industry and commerce explicitly incorporate transportation improvements into their production and distribution technology, often "substituting" the transportation system for expensive storage facilities and heavy inventories to reduce overheads and improve competitiveness. International capital, a necessary component of incremental economic growth, views the combination of a highly skilled labour force and a highly efficient transportation system as a necessary component in the decision to invest.

Any strategy to boost productivity through reduced transportation time and increased efficiency to achieve higher economic growth for the provinces and the nation as a whole can recognize a legitimate and increasingly significant role for public infrastructure. Transportation infrastructure is a vital component of industrial policy, designed to enhance Canada's productivity growth and overall competitiveness.

To say that more infrastructure investment is necessary, however, is partly to miss the point. In the private sector, profit seeking market forces help executives and decision makers ensure that investment will be good investment. In the public sector, where market forces are weak and objectives multi-faceted, executives and decision makers need to make special efforts to ensure transportation investments yield productive gains to the economy and that the value of these gains exceed the costs of achieving them. The challenge is two-fold:

- The executive must ensure that the objectives assigned to transportation policies and investment programs are properly targeted; policies should not aim to influence aspects of the economy over which transportation has little effect or to achieve aims that are better served by non transportation initiatives; and
- The executive must ensure transportation policy and investment opportunities are appraised, quantified and qualified through methodologies appropriate to the objectives at hand. Externalities, both positive and negative, must be explicitly identified in order estimate the dollar value of project revenues or required subsidies relative to the initial goals and objectives of the project.

CASE STUDY 1

Infrastructure Investment and Productivity Gains The National Highway System

In 1987, the provinces and the federal government began a process to define and implement a national highway policy. Approximately 25,000 km of highways in Canada were determined to be of national significance. These highways are defined as the national highway system (NHS) and serve as the focus for national highway policy.

In 1988, the federal and provincial governments estimated that 38% of the NHS was below recommended operating standards. The cost of meeting these standards was estimated at \$14 billion (1992 constant \$).

Benefits from upgrading the NHS to standard will accrue long after completion of the project. NHS benefit assessment studies assume a twenty-five year project life span for user benefits assessment. Due to a lack of reliable estimates only the ten year construction period is assessed for macroeconomic benefits.

User Benefits

Benefits to highway users are expected to range from \$10.561 billion (10% social discount rate) to \$17.863 billion (5% social discount rate). They comprise:

- a) Safety improvements would result in savings of \$20 million annually (1989 constant \$).
- b) Reduced vehicle operating costs estimated at \$360 million annually (1989 constant \$).
- c) Travel time savings estimated at \$717 million annually (1989 constant \$).

Macroeconomic Benefits

The importance of the NHS to local, provincial and national economies is significant. The movement of people and goods on the NHS is a key to national competitiveness in global export markets. While there may be significant regional expansion (e.g. In 1993, New Brunswick reported 64% of their portion of the National Highway System was below minimum standards), regional economic benefits of construction are excluded from the national cost-benefit analysis. Construction expenditures do not necessarily provide a net benefit when resources must be diverted from employment in alternative sectors. Only when resources are unemployed or the opportunity cost of redeploying resources is less than the benefits generated by diverting the resources would there be a positive impact.

Macroeconomic benefits were estimated using econometric and input-output analysis. Estimated productivity gains are as follows:

- a) The estimated incremental impact on total real output in Canada will range from 0.15% to 0.22% of GDP (approximately \$1.2 to \$1.9 billion) per year over the construction period.
- b) The project would add, increasingly over time, to aggregate labour productivity. NHS improvements would have an approximate 0.2% positive impact on aggregate labour productivity.

In conclusion, upgrading the NHS to minimum standards boosts private sector productivity. Firms can reduce transportation costs and impact relative competitiveness in the international marketplace. Induced impacts may include expanded output and increased employment as firms adjust to meet increased demand.

V. Appropriate Objectives for Transportation Investment

The economic objectives of transportation policies and investments can relate to the distribution of economic activity (how the pie is shared), to growth in the volume of economic activity (the size of the pie), or to both. In general, transportation policies and investments are far more effective in promoting productivity, economic growth, or improvements in living standards than they are as instruments of redistribution.

The weight of available evidence indicates that transportation policies and investments make little difference to total employment and income in a region. While studies often report large numbers of jobs either directly or indirectly associated with transportation facilities, more in-depth investigations find virtually all employment associated with transportation investments would be absorbed elsewhere in the labor market if the investment were not to take place. Only where a regional economy displays long-term structural unemployment can regional net gains in employment and income stem from transportation policies and projects.

While productivity gains alone can often justify economic costs of transportation investments, this is rarely (if ever) the case with the employment, income, and other targets of regional redistribution. Shifting the uneven distribution of economic prosperity, both nationally and among the regions and localities of individual provinces, has long been a priority of national and local policy makers. More often than not, national and provincial transportation investments claim employment impacts as their main objective.

This emphasis needs to shift. If one region grows at the expense of others with-

out generating a net addition to the sum of all economic activity, there will be no contribution to economic growth and living standards overall will stagnate and decline. Transportation executives need to emphasize productivity and growth over the redistribution of economic activity as the principal objectives of transportation policies and investment programs.

VI. Appropriate Methodologies for Transportation Investment

To the transportation executive, a methodology is simply a means of obtaining information to help guide policy and investment decisions towards the achievement of their objectives. Information is, without doubt, the decision maker's most important resource. Accurate information fosters good decisions while poor, incomplete, or inappropriate information fosters bad decisions.

Most of the analysis or review of public transportation investments in Canada conducted over the past twenty years did not consider growth in productivity, output, or living standards as an integral component of the benefit stream associated with a given project. Instead, almost all concentrated on employment creation and income redistribution. Without growth-related tests, public sector decision makers could not, and did not, determine whether proposed policies would yield increases in productive economic activity and living standards. Growth, whether defined in terms of productivity, gross output or the standard of living, can only occur if more value is put into the economy than is taken out (spent). An appropriate methodology to assess this value is discounting benefit and cost streams to ascertain the net benefit of a proposed project. In contrast, private sector transportation investments, such as Canadian Pacific's massive project to reduce rail grades through the Mount MacDonald Tunnel located in the Rogers Pass of British Columbia had detailed benefit/cost and revenue/profitability analyses done prior to approval.

CASE STUDY 2

Infrastructure Investment and Productivity Gains Canadian Automated Air Traffic Control System

In 1989, Transport Canada evaluated the benefits and costs of a proposal to modernize flight data processing infrastructure. The Canadian Automated Air Traffic System (CAATS) proposal would be adopted in the primary Canadian airspace control centres.

Implementation of the CAATS system will yield significant productivity gains for air traffic control staff, the Canadian air industry and foreign air carriers operating in Canadian airspace.

Initial project functions include improvement of data distribution and reducing labour intensive tasks performed in area air traffic control centres. Subsequent project functions include conflict prediction and conflict resolution to assist air traffic controllers.

Benefits have been classified as:

- a) Efficiency improvements accruing to Transport Canada and other government departments. Air traffic control personnel will increase productivity under this system as they will be freed from labour intensive manual tasks to increase efficiency in other operations. The largest of efficiency gains will be in labour cost and labour training savings. Other efficiency improvements will accrue through reduced storage and retrieval time for air traffic and flight operations data.
- b) Cost reductions and time savings accruing to users. Benefits to air carriers and passengers will be reduced arrival and departure delays and reduced flight times due to optimized route selection capability.

Transport Canada views all benefits as improvements in the efficiency of Canada's transportation system. Project benefits and costs are summarized as follows:

Overall Project Net Present Value (1988 constant dollars)

Benefit		Costs	
Efficiency Improvements			
Labour Cost Savings	\$279 million	Capital	\$285 million
Other	\$ 2 million		
User Benefits			
Route Savings	\$257 million	Operations & Maint	\$ 51 million
Delay Savings	\$238 million		
Total Net Benefits	\$776 million	Total Costs	\$336 million

Net Present Value \$440 million

VII. Investment Decision - Net Present Value, Rate of Return, Benefit-Cost Ratio

VII.1. Investment Decision Criteria

The net present value test permits decision makers to discern whether transportation policies and investments make a worthwhile contribution to productivity and economic growth. This requires the use of a procedure called "discounting" to account for the significance of the time value of money. Money received or paid today is worth more than money received or paid sometime in the future since future purchasing power is reduced because of inflation. The discount rate is the amount, usually expressed as an annual percentage, that forecast costs and benefits must be reduced to generate their present values. Inflation plus risk premiums, long term borrowing rates, or social opportunity cost are among the rates commonly used for discounting. The social opportunity cost is the rate of return that funds utilized in the public sector project could have earned if the funds were left in the private sector and probably represents the best choice for analyzing public sector projects. The net present value is the summation of the cost and benefit stream. Even in the case of an economy with zero inflation, investors need for a real rate of return on their investment or the preference of consumers for consumption today rather than consumption in the future will create a positive discount rate. These discounted values then account for the fact that different policies produce costs and benefits at different times over their service lives.

There are three decision criteria widely used in investment decision making: net present value (NPV), the benefit cost ratio (B/C) and the internal rate of return (IRR). NPV is measured as the present value of benefits (PVB) less the present value of costs (PVC), where both benefit and cost streams are discounted using the minimum return requirement (MRR) or the opportunity cost of resources employed by the project. The Benefit-Cost Ratio (BC) is measured as the present value of benefits over the present value of costs expressed as a ratio. It represents the dollars of benefits generated by the investment for each dollar of cost. The internal rate of return (IRR) indicates the extent to which the expected return on investment exceeds or falls short of the minimum-required rate of return. The IRR may generate more than one solution if the cost stream varies more than once between negative and positive values. Failure to account for this possibility may lead to project approval when the project is not economically or financially viable over the longer term. Net present value provides the most accurate basis for establishing whether a prospective investment is economically worthwhile.

As shown in Table 1, there is a direct, simple relationship between rate of return and net present value. Net present value is the appropriate yardstick for comparing the economic merits of alternative projects. If the net present value of an

investment is greater than zero, it may be considered a worthwhile contribution to productivity and well worth funding. The net present value criterion also permits alternative policies and investments to be ranked in order of merit. In the case of mutually exclusive alternatives, such as different alignments for a new corridor, the decision rule may be to select the alternative which maximizes the NPV subject to budget constraints. When there are a number of independent projects and a fixed budget, the decision rule could be to select the combination of projects which maximize the total NPV within the budget constraint. Policies and programs with higher net present values promote more productivity and growth than those with lower results given the same discount rate.

In addition to net present value, there are other popular measures that provide interesting supplemental growth-related information for use in decision making. Some of these are shown in Table 1.

Table 1

Key Measures of Productivity and Economic Growth

Measure of Worth	Definition	Interpretation
Net Present Value	Present-day value of benefits minus present-day value of costs	NPV greater than zero means project is economically efficient. Projects are ranked according to NPV
Internal Rate of Return	The discount rate at which NPV=0	Rate of return should exceed pre-set hurdle rate to qualify for consideration.
Benefit-Cost Ratio	Present value of benefits divided by the present value of cost.	A ratio greater than one means that the project qualifies for consideration.
Measures of Timing	Definition	Interpretation
First-Year Benefit	Benefits in the first year after construction divided by costs to date, including interest paid during construction, expressed as a percent.	A ratio equal to the hurdle rate means the project is optimally timed. A ratio below the hurdle rate means the project is premature. A ratio above the hurdle rate means the project is overdue.
Pay-Back Period	Number of years until capital recouped through the flow of benefits	A short pay-back period means less risk.

VII.2. Externalities

In assessing transportation policies, rate of return computations must embody impacts beyond those of direct consequence to the transportation executive's responsibility area. Specifically, monetary and non monetary costs and benefits must both be accounted for, wherever possible, even if it is difficult to do. For example, costs associated with a new highway project through a populated area should include the cost of noise and air pollution on the local environment. Costs such as these can be assessed using a concept called shadow pricing, a technique commonly used to attach a monetary value to a non-monetary externality. Where monetary values cannot be reasonably be assigned, then the impact should be quantified in other units.

Accounting for negative and positive "spillovers" in social rate of return calculations ensures that transportation-related productivity and growth strategies are not at odds with the higher aim of improved living standards. With these modifications to the traditional rate of return principle, transportation executives can use rate of return as an index of transportation's contribution to productivity, economic growth and the standard of living.

This Primer demonstrates that decision makers can be assured that policies based on social rate of return will not cause reduced economic competitiveness even where output-enhancing programs are rejected because of environmental costs.

VII.3. Net Present Value, Sufficiency Ratings and Cost-Effectiveness Analysis

Many transportation authorities use pavement sufficiency ratings, volume-to-capacity criteria and various forms of cost-effectiveness analysis to judge the merits of alternative investment policies, programs and projects. The transportation executive needs to know whether these approaches will lead decision makers to the most economically productive projects.

Evidence, both theoretical and actual, indicates that sufficiency ratings, volume-to-capacity criteria and cost-effectiveness tests are narrower than cost-benefit analysis and therefore provide less useful information to decision makers in assessing the most productive transportation policies and projects. When the economic aims of transportation policies include diminished vehicle operating costs, reduced congestion and delay, enhanced safety and environmental conditions, and stronger business and industrial productivity, the net present value evaluation criterion should be applied. Net present value leads to different and substantially better investment decisions than sufficiency ratings or cost-effectiveness analysis.

CASE STUDY 3

Net Present Value versus Sufficiency Ratings and Cost-Effectiveness Analysis as a Basis for Highway Investment Decisions

The Texas Transportation Institute compared three techniques for ranking and selecting highway construction projects under a budget constraint. Net present values attributable to each of 1,942 highway projects were calculated using benefit cost analysis. Sufficiency ratings (basically engineering criteria) and cost-effectiveness analyzes were also done for each project. From this list, projects were selected to meet a ten year budget target of \$5.7 billion. For each analytic method, the highest ranking projects were selected. Comparing the net present value of each package of projects clearly showed the highest economic impact resulted from projects selected by benefit cost analysis.

The table below shows cumulative estimated benefits in the form of vehicle cost savings, time savings, safety, environmental benefits, and business and industrial productivity gains. For a ten-year budget of \$5.7 billion, decisions based on cost benefit analysis yielded over \$22 billion more benefits than decisions based upon sufficiency ratings and some \$7.8 billion more than cost-effectiveness.

Ranking and Decision Criterion	Economic Impact \$5.742 Billion (10-year program)
Texas Sufficiency Rating	\$ 36.512
Texas Cost Effectiveness	51.618
Net Present Value	59.202

SOURCE: Texas Transportation Institute, 1987

VIII. Optimal Timing - Net Present Value & First-Year Benefit Ratio

Though critical to economic success, the right timing for policies and investments is often overlooked in transportation investment planning. In practice, the net present value principal should be applied to establish both whether a policy or investment proposal promotes productivity and growth and when the economically appropriate time to invest occurs.

Some transportation projects yield rates of return of up to ten times the yield on typical private sector investments. Many of these high return investments are long overdue, as much as ten years in some cases, from the viewpoint of spurring productivity and economic growth.

Transportation executives need to be aware that the optimal year to commission an investment is the start-date that maximizes the projects net present value. Alternatively, the first year benefit ratio, defined as the sum of all benefits accruing after construction divided by all costs incurred to date including the interest paid during the construction period, expressed as a percent, could be used to indicate timing. If the value is more than the minimum required rate of return, then the project could be considered overdue. Alternatively, if the ratio is less than the minimum-required rate of return, then the policy or investment may be said to be premature.

The first year benefit ratio rule is particularly applicable for major projects where the bulk of investment is in property, earthwork and structures which have a long or indefinite life. The application of this test to recent major transportation investment proposals (including the Vancouver International Airport expansion) indicate that many infrastructure investments are overdue from the viewpoint of maximizing the rate of growth (both regionally and nationally) in productivity, output and living standards. Other measures of timing, such as the number of years an investment needs to break even (i.e. for the value of productivity gains to match the investment cost), provide useful information to decision makers. A faster investment pay back period means less reliance upon relatively distant and uncertain forecasts. This is obviously an attractive trait of any prospective investment but, again, the net present value should be maximized

CASE STUDY 4

Investment Timing - The Case of Fast Ferries

The British Columbia Ferry Corporation is using net present value in the economic evaluation of new ferry terminal options. Existing terminal facilities are at capacity and expansion is required.

The evaluated options include:

- a) closing the existing terminal and building a larger new terminal (option 1);
- b) maintaining the existing terminal but adding a new terminal for particular classes of vehicle traffic (option 2);
- c) immediate integration of fast car ferry technology (in conjunction with option 1 or 2) to supplement conventional ferries and improve capacity.

A fast ferry has the potential to reduce route travel times and operating costs. A fast ferry terminal would cost less to build than a conventional ferry terminal. Fast ferry berth structures are smaller and less expensive than for a conventional ferry as berthing forces are smaller.

Since fast ferries carry fewer cars than conventional ferries, project analysts considered impacts of disembarking traffic on the local road network. It was concluded that fast ferry arrivals would have a smaller impact on the existing road network because fewer vehicles disembark than from a conventional ferry.

The analysis found that net present value would not be maximized by immediate investment in fast ferries. The opportunity cost of replacing conventional ferries is high. The remaining life and associated operating and capital costs of the existing conventional ferry fleet limit the effectiveness of immediate fast ferry investment. As well, benefits in the form of travel time and operating cost savings are small relative to the cost of investment.

Investment timing is key. Until the existing conventional fleet requires replacement or a longer route is considered, fast ferry investment would not maximize net present value.

Adoption of fast ferry technology on the routes under consideration would not increase the output of ferry service as loading and unloading times could be longer than for conventional vessels.

Though maintaining the existing fleet is favoured over immediate replacement, the report states that conventional ferries are not necessarily financially superior to fast ferry technology when additions to ferry fleet capacity are required. Fast ferry investment will be evaluated at that time.

IX. Industrial Restructuring Analysis

In appraising the rate of return of many prospective transportation policy and investment possibilities it is sufficient to estimate the savings in vehicle operating costs and the value of time savings as the principal investment benefits only when there is no significant change in the production processes and logistics of firms in response to the investment. Where changes in production logistics are to be expected, the conventional yardstick of user-benefit may fail to measure all significant economic benefits. All infrastructure projects approved according to conventional user benefit approaches in estimating the rate of return and net present value maximization will fail to achieve the level and mix of transportation investments that maximizes transportation's contribution to productivity, economic growth and living standards if the full impact of transportation improvements are not recognized.

For example, major network improvements can lead firms to substantially restructure their logistics and distribution networks. Reduced congestion improves the reliability of delivery schedules so smaller and more frequent deliveries are made, facilitating reduced inventory, handling and packaging costs. Firms may eliminate distribution centers and cluster fewer depots around key points in the improved transportation network, such as occurs in "just in time" inventory management. Failure to account for such economies or operational changes can lead to an understatement of the impacts of transportation investment on productivity and economic growth.

Industrial Restructuring Analysis is emerging as a way to help measure and quantify these impacts. This technique, and the questions addressed are in their infancy. Transportation executives must approach the technique with care. An awareness of the question, however, should open up productive new lines of research.

X. Investment Appraisal, Living Standards and Sustainable Development

Infrastructure projects are often delayed, sometimes indefinitely, because of local environmental concerns. Transportation investments can create measurable environmental costs, however new methods of evaluation reveal that the economic benefits are often far larger. The economic benefits may be large enough to cover environmental mitigation costs (insulating homes against highway or aircraft noise, or replacing wildlife habitat, for example) while still earning a strong economic return.

This "sustainable development" aspect of transportation infrastructure is rarely conveyed to the public through the investment appraisal process. Typical appraisals do not at present include mitigation and compensation programs within the range of alternatives and implementation plans considered even though the existence of negative impacts is known. Negative impacts should not necessarily mean the project is not worthwhile. Its worth should depend on the net present value of all costs and benefits.

As pressures mount for environmentally stable public investment planning, transportation executives will need to present investment plans demonstrating economic gains sufficient to cover the costs of mitigation.

XI. The Executive's Good-Practice Check List

Although transportation executives are dependent on technical experts for the correct application of techniques and procedures, careful monitoring at periodic intervals throughout the evaluation process can ensure sound results. As every good manager knows, monitoring and challenging technical assumptions are critically important. It is also critical for transportation executives to question eight key methodological attributes of any economic evaluation of transportation policies and investments:

Objectives

Transportation executives should insist that investment objectives be displayed first in terms of productivity, growth, and living standards and secondly in terms of distribution and other objectives. This promotes the search for productive transportation investments while still exposing opportunity to influence employment levels and other redistributive aims.

Methodology

Methods of investment appraisal should emphasize social rate of return, net present value, and benefit/cost ratio techniques. Assessments of the regional employment, income, and output implications of policy and investment proposals need to be expressed as differences from the "without" investment case (i.e., incrementally) in order to draw valid conclusions regarding distributional implications.

The Base Case

It is rarely adequate to treat the status quo as the basis of comparison for major investment proposals. Steps, including congestion pricing, to redress existing problems without the need for major capital investments can liberate scarce capital resources for even more productive transportation uses. The Base Case should represent, as closely as possible, the most efficient and productive use of existing assets, even if expenditures are required to achieve a stated goal. The Base Case should include any costs that will be incurred in the event all other options are rejected.

Selection of Alternatives

Options or alternatives to be considered should be as broadly based as possible. Public sector analysis has often restricted consideration of alternatives to those within the mandate of the organization doing the analysis. Thus a highways department tends to see road solutions rather than transit or rail ones, and airport operators see airport solutions rather than rail or highway ones. The options should fit the fundamental issue, i.e. moving people or goods between two points.

Benefits

All monetary and non-monetary benefits should be identified. Where major network improvements are contemplated (in all modes), benefits associated with industry restructuring and related logistics and productivity gains should be explored and quantified.

Costs

All direct and indirect costs should be included in the economic appraisal. All environmental costs should, to the fullest possible extent, be quantified and incorporated in the rate of return and net present value calculations.

Discounting

All benefits and costs must be projected over the expected service life of the longest-lived option under review and expressed in terms of their present-day values using the technique of discounting. Failure on either count can lead to very poor economic choices such as policies favoring annual pot-hole repair over long-term pavement reconstruction.

Risk and Public Involvement

The economic evaluation of public investments involves judgments, forecasts and assumptions, all of which are uncertain and subject to public controversy. Appraisals should be conducted with public involvement; they should expose all risk and uncertainty and quantify the implications for decision making to the fullest extent feasible.