A GOAL ORIENTED DECISION -- MAKING FRAMEWORK FOR HIGHWAY DEVELOPMENT

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ABSTRACT

A framework is developed that can be applied in selecting alternatives for highway development. The problem is not the budgeting process per se, but is the evaluation stage of possible projects. When the relative worth of each proposal has been determined, the budget can be spent so that the most "worthwhile" projects are constructed with priority until either the list of proposals or the budget is exhausted.

The framework developed in this thesis can be utilized, not only to budget for projects competing for the available resources, but also to compare possible solutions to one specific transport problem.

There are two main features of the framework; a listing of goals and a listing of possible types of results of the proposals. The goals are ideals the project is to fulfill. Many different types of results occur because of a project and to facilitate the examination of these results, they are separated into monetary, intangible and uncertain results. Use of the framework demands examining these types of impacts of the proposal upon each goal.

The application of the framework is demonstrated in a problem facing highway planners in Newfoundland. Two projects of considerable magnitude: upgrading and paving the Burin Peninsula Highway and ungrading and paving the Great Northern Peninsula Highway are examined in this thesis, using the framework. The framework demonstrated that the Burin Peninsula project is the most "worthwhile".

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CHAPTER 1

INTRODUCTION

Government spending in developing transportation facilities consist of about 16% of the total government budgets in Canada (1)[1] and total government expenditures in Canada continually constitute between 25% and 35% of the Gross National Product (2)[2]. Total expenditures for highway construction exceeded $860 million in Canada in 1968 (4). These expenditures are indeed of considerable magnitude.

Not all of these huge amounts have been invested wisely. For example, it has been estimated that 37 percent of all rail mileage in the U.S.A. is not returning sufficiently on the original investment (3). As well, the American Bureau of Public Roads estimate that 400,000 miles of local roads are nonessential.(5).

There occurs everywhere in society a problem of budgeting - a conflict between limited available resources and the many needs and wants. The economic problem of transport is defined clearly and concisely by Pegrum (6): it is "concerned with the efficient allocation of resources to the provision of transportation services and facilities". Peterson furthermore states (7), "An optimum allocation of economic resources exists when the economic value (which depends upon price) of the marginal product of a resource is the same in all possible uses, that is, when no increase in

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[1] Numbers in brackets refer to references at the end of the thesis.

[2] In developing countries the percentage is sometimes as high as 46% (3).

value can be obtained by a shift in resource use." From the foregoing statements a relationship between policy-making and budgeting can be seen. Governments cannot allocate resources until it is clear which policy and program they favour over others. In many transportation inadequacies conflicts have been observed (8) between accessability and environmental effects. When these are fully understood and decisions have been made as to the prevailing policy, budgets can be drawn up which reflect the decisions. In other words, it must be known what an investment decision is meant to accomplish. When we know this, and only when we know this, can we think about budgeting.

Traditionally, the idea of growth for prosperity; the notion that the GNP must continue to rise to greater heights has been prevalent. Recently many economists and even businessmen have begun to realize that the GNP is of doubtful value as a yardstick of "well-being". First of all the GNP gives the value of annual output in monetary terms only. As a result, inflationary growth and real growth are superimposed upon each other. This then makes the comparison of GNP's an inaccurate process. Furthermore, the "evils" produced by society, such as polutants, are not subtracted from the national output. Finally, the main objective against the use of GNP is that it does not include intangible gains. Beauty, convenience, and satisfaction are impossible to measure accurately and for that reason are not included in the GNP. However people are becoming more and more aware that these qualities are important, if not critical. John Kenneth Galbraith states simply, (9) "What counts is not the quality of our goods but the quality of life". These thoughts are important for highway building agencies because the intangible outputs of one transport system

must be compared to those of others so that optimum projects can be invested in. It must be kept in mind that the above statements apply to different areas in varying degrees. The intangible benefits and costs of a highway in Ontario are obviously far more important than those of a highway in Newfoundland. These differing value functions result from the different goals of each province. The goals of Newfoundland stress economic development and employment to a greater degree than the goals of Ontario as Ontario has achieved these goals to a certain level.

Difficulties often occur in decision making when intangible values are involved. It has been argued that these can be made tangible if enough effort is expended. This may be costly and time consuming and the resulting increases accuracy may not be significant. It seems easier and cheaper, and often more accurate to treat intangibles separately in project evaluations rather than trying to lump them with the economic benefits and costs.

All government agencies must spend their resources according to the general will of the people. The wants of the people determine objectives and goals which the government must endeavour to fulfill. The determination of the goals and their ranking of importance are presently causing a major obstacle in the path of efficient government investment. The Economic Council of Canada has stated, "What is required is a new and comprehensive framework of goals and objectives to serve as a basis for policy planning. . . . . the priorities will be established in any event. The real question is whether they will be established in a comprehensive, systematic and forward looking manner, or a wasteful, ad hoc, and frequently short-sighted manner" (10).

If it is believed that the only criteria for government action is the economic rate of return, analyses for highway plans would be quite

straightforward. The economic benefit and cost of the highway project are examined in a relatively simple manner. However, when the reasons for government activity include objectives of full employment and future economic growth, for example, the analyses of highway plans become rather complicated.

It is the objective of this research to present a framework which can be used as an aid in making decisions with respect to highway budgeting. The framework requires that governmental goals be ranked and individually analyzed. It can then be applied to derive a listing of priorities using an appropriate value function. It is hoped that this framework will be adaptable so that all functions of government activity can eventually be dealt with in an organized and profitable manner.

CHAPTER 2

THE MACRO OUTLOOK

2.1 The Rationale of Government

People have personal goals and objectives. Some have objectives of earning money, some of travelling, some of getting married. These individual objectives and their relative priorities compose an unordered set of goals. However, a macro outlook views the individual wants and needs as trends and, in this way, regional and national goals can be formed. In general, it can be said that the greatest desire is a maximization of satisfaction.

The basic purpose of government is to maximize this welfare function. The Western world has a traditional attraction to private enterprise and the recent growth of government activity can only be said to occur due to the lack of ability of private enterprise to deal with certain demands. Government programs can be classed into four categories: allocation of resources, efficiency of the allocation, economic stability and growth, and income redistribution.

2.1.1 Allocation Programs

Governments are involved in allocational activities because of two reasons: the nature of externalities and the nature of public goods. In some types of investment the buyers obtain benefits although some others also benefit and are not charged. These types of investments are externalities in consumption. The individual investor keeps in mind only the direct benefit he is to receive and therefore optimum allocation of resources does not occur. Examples of this are education and public health.

The primary benefitors of both programs are not the only benefitors and therefore pricing should not occur only for them. Externalities also occur in production. In can happen that a transport facility is not economically feasible until the production rate of a group of adjacent firms reaches a certain point. What occurs is basically that the cost of production for one company depends on the production rate of another. Finally, there can occur a diseconomy of consumption and production. In this case, the reverse of the above two situations occurs. When a large number of commuters use a transport system causing congestion, the cost for a pleasure traveller also increases. Pollution of the air causes disbenefit to other, water pollution makes processes more costly for subsequent users. In all the above cases the proper cost is not born by the primary user.

Public goods are those that are not easily divisible so that they cannot be sold to individuals. In other words, the amount used by an individual does not influence the amount used by another. Furthermore, one's rate of consumption of the goods cannot be regulated. It is obvious that these types of goods cannot be supplied by a strict private enterprise. Individuals will attempt not to pay and still gain the associated benefits. If the goods are supplied, no individual can be denied access to the benefits. The result is some sort of collective government commitment. This type of program started with co-operative community action. Early road building was done in this manner and fire fighting is still often provided by volunteer community action. In many cases an immediate difficulty was encountered. One individual could not be forced to contribute and he could still benefit from the efforts of the rest. This resulted in an increase of government programs. It was only the government which could provide a fair pricing system by ordering compulsory payments in the form

of taxes. The best example of a public good is national defense. All individuals benefit from the protection provided and no one can be excluded from the benefits. Further examples are police forces and many transport systems.

2.1.2 Efficiency in Resource Use Programs

Efficiency is usually considered to be the main characteristic of industry and not of government. However, there occur several instances where government investment is preferred to industrial investment.

For some programs collection costs from customers constitute a major portion of the total costs. Cases like this are usually not considered feasible for industrial investment. Sometimes the cost of collection is high and furthermore the collection can cause inconvenience and delay to the customers. In these cases it is preferred to have government action. Examples of this type of activity are collection of tolls for roads and collection of park charges.

In many programs a long term capital investment is needed to provide an efficient resource use. However, when the period of time before results become significant is extremely long, private industry, because of the inherent risks may be timid in committing the required resources. In these cases government involvement is desireable. Governments, because of their wide financial base, are more equipped to accept a large risk than an individual or an individual industrial concern. Usually the risks are taken by the complete society who are often the potential benefitors instead of having only a portion of the potential benefitors take the risk. Examples of this type of government activity are hydro-electric projects and transport facilities.

Industry in general sometimes is not in a position to utilize resources efficiently. Often, in developing areas, government initiative is needed to spur on industrial investment. Monopoly structures often tend to become static and a government stimulus may be needed. Sometimes a case of too much competition can cause a bad level of service and unprofitable existence for all the businesses. This occurs when it is very easy to start up the particular type of industry and in these cases government action is needed. A good example of this happening is garbage collection. Finally, sometimes firms are too small to support programs such as research. When this occurs for an entire industry, government aid is needed.

2.1.3 Economic Stability and Growth Programs

When unemployment occurs there is an idle supply of resources and this leads to a diseconomy which results in lower gross income and economic growth. Unemployment, itself, causes reductions in the standards of living which society judges as unfair. When a firm intends to eliminate unemployment the net cost to society is less than the cost to the firm. This is not so only because the unemployed must be given relief but also the lost income through a multiplier effect could have caused further incomes. Since these benefits do not come to the employer private enterprise may not hire workers, although the nation as a whole would benefit. Therefore, government should plan programs to help eliminate unemployment.[1] Governments can help provide economic growth by supporting programs which provide capital, introduce technological improvements, and increase the level of education. In all these activities externalities occur and it is

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[1]Full employment in the Keynesian sense is defined as 97% employment by the Economic Council of Canada.

up to the government to support them.

2.1.4 Income Redistribution Programs

It is difficult to say exactly when governments should intervene to ensure a fair distribution of income since a moral judgement is involved. However, when a great proportion of the total income is received by a minority of the people most people will agree that governments should intervene to minimize this occurrence.

2.2 General Goals of Government

In a country such as Canada it can be said that there are two types of government goals. National goals pertaining to desires of the people as a whole and regional goals which apply to only a specific area. The Federal Government has identified national goals (10): full employment, a high economic growth rate, a healthy balance-of-payments, and an equitable distribution of the national income. These goals can be studied to determine the desirability of highway investment but it seems that regional goals can be better applied. In Canada, the needs of Ontario and Newfoundland are so vastly different that it seems that the two cannot possibly attempt to fulfill common goals. Most provincial governments have written goals which they try to achieve. These goals can be used by the corresponding provincial highway authorities to choose the extent of highway development. For Newfoundland, regional goals have been identified (11):

1) to obtain a high rate of economic growth,
2) to provide for full employment
3) to provide a reasonable stability of prices for all public goods and services,
4) to provide for a reasonably equitable distribution of income, and

5) to achieve an environment that will encourage further economic development.

The identification of goals does not imply the complete analysis of these goals. In many cases goals compete, or at least one plan of action may satisfy one goal to some extent while it makes the achievement of another goal more difficult. In these cases a relative importance of goals must be found. Some method of ranking and comparison is the only method of organizing the relative importance of the goals.

Another point which must be noted is the difference between primary and secondary goals. If a goal of a person is to stay alive it cannot be said that another of his goals is to eat sufficiently in order to stay healthy. The achievement of the second goal is implied by the achievement of the first goal. A similar situation can occur in the budgeting problem. One goal may be to increase the per capita income of the population and a second goal may be to reduce the commuting time for employees of an area. The former goal is satisfied by the latter goal and in actuality the second goal is a secondary goal by which the primary goal is achieved.

The decision-making process of government does not involve only the achievement of government goals. Basically, the wants of the people must be satisfied and the goals of government must reflect these wants. For example, it may be wise from the government's point of view to institute a new program. However, if the proposal would also increase taxes significantly it is not feasible. Political pressures themselves may affect government decisions. The quest for power by individuals and groups may result in certain policy decisions.

It has been said (12) that "a good budget structure has no politics". This means that the politicians should be separate from the decision-making process although their point of view must be kept in mind. Politicians should, needless to say, retain their power of having the last say on the budget. Fiscal policy too has a say in proposed investments. Times of too slow and too rapid economic expansion demand different investment decisions and these impacts may be included as inputs into the budget structure. Finally, the wants of government employees must be considered. A decision to reduce a program and therefore also reduce the number of government employees is not favourably considered by the decision-making process. All of the above goals may somehow be included into the new framework.

It is easily seen that the decision-making process is not entirely systematic. Individuals' values are still utilized to come up with a ranking of goals. It seems at this point that total elimination of value judgement cannot be achieved; furthermore, the total elimination although it will make the process more exact is probably not desirable.

2.3 The Economic and Non-Economic Goals of Government

John Maynard Keynes has contributed a very considerable amount of work to the field of economics and introduced a whole new trend of thought in macro-economics (13). With some simplifying assumptions he introduced the following formulae:

$$Y = C + I + G$$

$$Y = C + S + T$$

where Y = the national output and income,

C = consumption expenditures (output of consumer goods and services),

I = investment expenditures (output of investment goods),

G = government expenditures for goods and services (output of community or collective goods),

S = savings, and

T = taxes

The Gross National Product is of course the same as Y. This is the value which has traditionally been maximized by society. Government's role in this maximization has been a direct one. Efficient investment by government (G) leads to more available resources for more programs. Therefore, study into the investment process of government is directly related to the national output.

Recently, many economists and concerned persons have expressed the idea that the GNP is not to be maximized. These thoughts spring from the fact that satisfaction is to be maxmized and this is not measured by the GNP. The problem is basically that the GNP takes a short-term point of view in many ways. Pollution is not discounted from the GNP calculations although it certainly can and does withdraw from future GNP totals. This short-term point of view is especially detrimental to planning of long-term investments in such fields as hydro-electric power and transportation.

GNP calculations totals the goods and services produced by a country at today's prices. In effect inflationary growth is part of the total GNP growth. This makes comparisons of GNP's of different years a difficult task. Secondly, the "bads" produced by society are not subtracted from the GNP. Pollution is the most obvious example of this.

Fertilizer from farms runs down into streams causing unsightly scums. Yet the value of the same fertilizer is added to the total production of the country. Finally, the GNP makes no provisions for intangible gains. Diseases have been wiped out and the quality of life in general has improved markedly for everyone - yet no mention of this is made in GNP calculations. This point is very important for transport planners. Taxpayers in many areas of the country are willing to pay more money for intangible benefits.

President Nixon of the U.S.A. recognized the mood of many of his people when he stated in his State-of-the-Union message in January 1970, "Government decisions as to where to build highways, locate airports, acquire land or sell land should be made with a clear objective of aiding balanced growth." He added, "The answer is not to abandon growth, but to redirect it." The balanced growth objective was to be "not a quest for a greater quantity of what we have but for a new quality of life in America." The President reiterated many ideas first argued by John Kenneth Galbraith (9, 14).

A recent paper by James Gillies, Dean of the Faculty of Administrative Studies, York University (15), presents the same opinions in concise form. "Simply working to make the size of the GNP increase is no longer sufficient. What is important is the way in which any increase is used to improve the general living standards of all Canadians.....This doesn't mean that growth is unimportant. Indeed, without it none of the things that people want can be provided..... In short, we have entered a decade where the quality of life, the elimination of unjust economic conditions and the improvement of the general quality of the environment are the things that more and more people are going to demand and economic growth which doesn't contribute to these ends, or which in any way detracts from their achievement, will not be satisfactory".

The problem is how to deal with these intangible values. A benefit-cost analysis can be devised for all proposed projects but how can the factors, which are not in monetary terms, be related to the feasibility of the plan? It has been stated that each intangible value can be made tangible by sufficient expended effort and time. This is certainly true. It seems, however, that it is more profitable to simply list the intangibles so that comparisons can be made. It can be seen then that an extra increment of beauty (for example) is worth a certain amount of money. A value judgement can then be made to decide whether or not the extra cost is worth the extra benefit.

2.4 The Total Outlook

Transportation systems influence and are influenced by the performance of both physical and organization systems. For example, maximum usuage of a ferry service may not occur until an adjacent road is upgraded or maximum transport usage may not occur unless government produces help for newly establishing industry in the region. Not only do external factors affect the transport system but the system usually influences its environment which in turn affects the system. This fact makes it very difficult to plan for transportation development and this of course makes budgeting difficult.

Pearson (16) visualized a horizontal arrangement of government programs (Figure 2.1). This chart gives the relative contributions of all government programs to both economic and quality of life development. Both types of programs complement and influence each other. Transportation falls close to the middle and influences heavily both extremes.

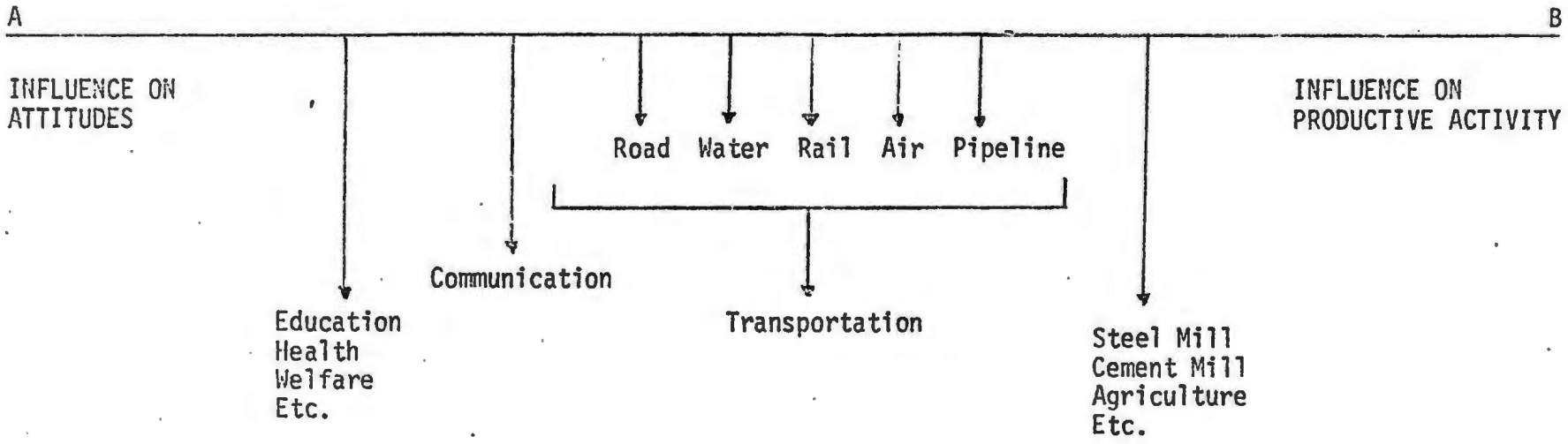

FIGURE 2.1: INVESTMENT OPTIONS AND ATTITUDES OF A REGIONAL GOVERNMENT

(Source: Reference 16)

The chart emphasizes that an interrelationship exists between all programs. This means that to accurately measure benefits and costs of a new proposal, the affects of the new program on adjacent programs should be measured. The new system of benefits and cost often becomes totally unmanageable and meaningless. A line must be drawn so that the effects of the plan will be considered only up to this line. Although this makes the analysis less accurate, the error is usually relatively small. Obvious large influences can be dealt with to reduce the error. This method of evaluating a plan is called sub-optimization. A component is optimized without regards to the effects it has on larger systems; secondary goals are met although primary goals are not. This problem occurs in many engineering endeavours and the solution is usually sub-optimization.

An example of sub-optimization occurs when a production foreman in the manufacturing industry wants to save orders until a large production run of similar items can be made. This action satisfies his aim of reducing the production cost but a higher goal of maximizing profit by sending the products to customers in a reasonable amount of time to retain the customers, is not satisfied.

It is realized at this point that budgeting resources among several highway plans is in fact part of a larger problem. The budgeting procedure in government begins with departmental allocations. This study should ideally begin at this point also. The problems become very extensive in this case and we shall consider this out of the scope of the research.

2.5 The Problem

Investment decisions are not made in a uniform and organized manner by governments but are often made in a haphazard way to solve

immediate political problems. Transport investment, especially in highway spending, typifies this type of action. The huge capital cost of highways makes it extremely necessary to do away with the existing haphazard approach. A new framework is needed to make a uniform evaluation of projects competing for the public dollar so that an efficient decision making process exists.

Perhaps the problem can most simply be stated by asking why do we want a highway? What is it that we gain from this investment and what will it cost us? The latter part of the question is more easily answered than the former. The cost of land purchases and capital expenditures is easily calculated. But the calculation of benefits is difficult because often the nature of the benefits is unknown. For example, in a province such as Newfoundland, highway development should be made with industrial development in mind. That is, the building of a road must make a positive contribution to the attraction of industry. A benefit such as this is difficult to measure. Direct benefits of a project such as beauty, comfort, and convenience can be determined but not measured and compared. A proposal list of costs and benefits is given in Table 2.1.

The main problem of choosing projects is still to determine the relationship between outputs of the projects to the goals of government. Basic wants of government must be established and then proposed highway programs must be compared in terms of these wants. Benefits and costs cannot be discussed alone; they must be discussed in terms of goals. A benefit can be a benefit only if it contributes to achieving a goal. For example, a reduced cost per passenger between two points is a benefit to the goal of economizing the total system and similarly beauty of a road is only a benefit if it is a goal of the project to beautify. This point is extremely important; the entire evaluation of plans hinges on the underlying goals.

TABLE 2.1

Benefits and Costs of Transport Systems for Public Projects

A. Potential costs associated with transport systems

1. Facility construction and land-acquisition costs
2. Dislocation and other social costs
3. Facility operation, maintenance and administration costs
4. User travel costs, including
   a. Vehicle ownership and maintenance (less taxes or fees[1])
   b. Vehicle operation (less taxes and fees[1])
   c. Access, egress and route fares for public carriers (in lieu of items a. and b. above)
   d. Time costs
   e. Discomfort costs
5. Accident costs
6. Terminal costs

B. Potential benefits associated with transport system

1. User travel benefits, to include:
   a. Perceived user costs
   b. Non perceived user costs
2. Facility associated non-user revenues (i.e. concession fees on property taxes)
3. Intergovernmental transfers (where other than a national viewpoint is taken)
4. Other non-user benefits

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[1] To include taxes and fees levied to recover facility costs

Source: Woil, M. & Martin B. "Traffic Systems Analysis for Engineers and Planners." McGraw-Hill Book Company, New York, 1967.

Finally, a few words are in order about the nature of the problem. Budgeting of highway projects must mean evaluation and comparison of all projects competing for the public dollar. This means a uniform system of comparison must be made. A parallel can be drawn between this system of comparison and a comparison of proposals to a specific problem. For example, if towns A and B must be linked, several alternatives can be constructed. These alternatives must be compared to each other. When an optimum link has been selected, it can be listed in the proposals to be budgeted. These proposals, if resources are insufficient to construct them all, can be compared to each other as can the alternatives of linking towns A and B. Therefore the budgeting procedure developed in this thesis will be applicable to plan evaluation as well. In the recent literature discussed in the next chapter, plan evaluation literature will be given as well as that concerning budgeting procedures.

CHAPTER 3

PRESENT ANALYSIS PROCEDURES

3.1 History of Benefit-Cost Analysis

A benefit-cost analysis of a project is basically a list of the beneficial and detrimental effects of the project with the purpose of facilitating the comparison and choosing of projects for implementation. Nothing is more important than a listing of the results of a proposed plan. However, no current standard method exists with which decision makers use the benefit-cost analysis in order to reach a decision. This analysis is a valuable tool to the decision making process but will never actually replace the latter. Goals and value functions must still be externally analyzed and used. The analysis plus the goals and value functions make up the decision making process.

The first seriously considered work on benefit-cost analysis was performed in the 1800's by Jules Dupuit (17). Among many new thoughts, he introduced the utility function of government and the concept of a consumer surplus.[1] The practical use of the analysis was first made in the U.S.A. in the 1930's in the water-resource field. The Great Depression caused the beginning of heavy government investment in order to stimulate the economy of the country.

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[1] See Figure 3.1

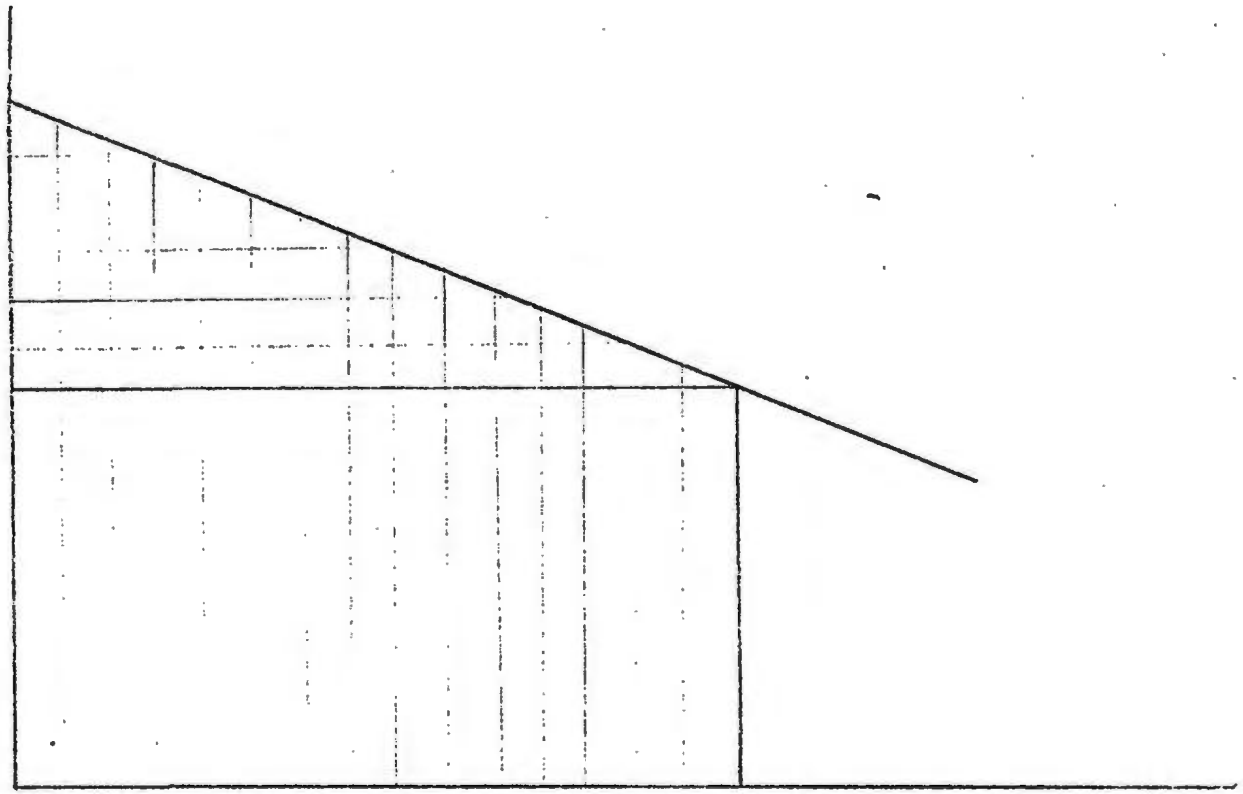

FIGURE 3.1 CONSUMER SURPLUS

The Flood Control Act of 1936 stated: "the benefit cost analysis may accure (be) in excess of the estimated costs". As a result, economic analysis of public projects became not only desireable but mandatory for the concerned agencies. However criteria for benefits and costs were not defined in the Act. This omission caused confusion between the several involved agencies and in 1950 a committee proposed common standards in the Green Book. This work was never officially adopted and in 1952, Budget Circular A-47 introduced the required common standards. This report was criticized constantly by the involved agencies and in 1961 a new Consultant's Report was produced. This was also not adopted and finally Senate Document Number 97 of the 87th Congress in 1962 was produced and is currently in use.

There are many technical arguments for and against particular types of economic benefit-cost analysis. The two types currently most popular are the Present Value Method and the Benefit-Cost Ratio. It is out of the scope of this study to present the above arguments, however, it seems that the Present Value Method is becoming the dominant tool in transport investment analysis.

Former Secretary of Defense of the U.S.A., Robert McNamara was a consistent proponent of benefit-cost analysis. He clearly defined the limitations of the analysis when he stated: "We still have to determine whether the greater speed (benefit) is worth the greater cost. This kind of determination is the heart of the planning - programming - budgeting or resources allocation problem within the Defense Department". (11)

3.2 Traditional Budgeting

There are seven main characteristics of a budget structure:

1) to measure cost of achieving objectives,
2) to compare alternative ways of achieving objectives,
3) to identify long term costs of short term investments,
4) to compare costs and achievements when projects are administered by different agencies,
5) to make the objectives operational so that significant analysis can be carried out,
6) to total related costs that occur in the complex government structure, and
7) to identify the role of the government in the national economy.

Furthermore, the budget serves many purposes. It is a financial report, a plan for the future, a request for legislation, an aid in the management and administration of government, and finally an economic document.

Traditional budgeting procedures have direct disadvantages:

1) alternative goals cannot be chosen when there are insufficient funds to achieve all goals,
2) total cost to achieve any goal cannot be estimated,
3) future costs of any program are not given,
4) total costs for future budgets are not given, and
5) programs are not evaluated by comparing costs with the achievement of goals.

Indirect handicaps of the management of public money are perhaps less easily seen but are undoubtedly just as important. First of all, the practise of omitting estimates of future costs leads to pressure to maintain current programs and projects to which substantial resources have been committed. The overall viewpoint of governments tend to remain constant

and serious defects in the system are overlooked. Secondly, without an effective yardstick of performance measurement or a relationship between government goals and results of investment, serious criticism of programs cannot exist. Even self-evaluation is hampered by this lack of knowledge. Finally, there is a lack in present budgeting procedures in that no stimulus is provided to begin operation of new programs designed to fulfill the wishes of the people.

In budgeting for transport facilities, a further problem often occurs in that the outputs (of the transport facility) are not measureable. Intangible value often plays a great part in decision making and when there is no standard method for dealing with them the possibility of inefficient investment increases. The above statements can also be made about uncertainties that occur in planning. Not only are numerical data in most cases uncertain but even the basic values are never known with certainty.

Finally, data banks are often lacking in many analysis procedures. As experience builds from more and more analysis, information of good and bad decisions can be used to guide future decision makers. The nature of government in North America is very stable and it would be relatively simple to organize the information system. To omit this valuable aid is to be very shortsighted indeed.

3.3 Program Budgeting

On August 25, 1965, President Johnson of the U.S.A. announced at a news conference that program budgeting was to be introduced into the entire American Federal Government establishment. The President said that a "staff of experts ... will define the goals of their department for the

coming year" and that the "system will permit us to find the most effective and the least costly alternative to achieving American goals". Essentially the program budgeting system is composed of the following steps: identification of goals, generation of alternatives, comparing the alternatives, choosing an optimum, and planning in all cases for a 5 - 10 year period. Program budgeting is further composed of three aspects. The structural phase means that all programs are oriented to an end-product or final objective and that a 5 - 10 year planning period is therefore used. The analytical phase is an effort to make systematic analysis of both benefits and costs of alternate courses of action so the available courses of action are clarified for decision makers. Finally, an information system exists which supports the first two phases. This system supplies progress reporting and management control to existing programs and serves as an aid to future decision making as a data bank.

Undoubtedly this new development in government analysis is worthwhile. However, in some ways the program budgeting procedure stops short of being a complete success. Intangible values and uncertainties compose a major part of the benefits and costs of proposed plans and program budgeting does not specifically deal with them. An important characteristic of program budgeting is that it relates proposed investments to department goals. In Canada, a highway agency is provincial and perhaps the goals of the provincial government should be used instead of artificially created departmental goals. The problem often occuring with department goals is that great care has not been taken to eliminate conflicting and overlapping goals for the various departments. Even when great care has been taken, the department boundaries create project boundaries so that although a plan will fulfill to some extent a department goal, it will not satisfy any regional goal. This problem has occured many times and should be eliminated.

The use of regional or sometimes, national goals is not as formidable as it sounds because many of the goals are economical in nature.

3.4 Recently Developed Procedures

Many authors have recently come to the conclusion (as has the U.S.A. Federal Government with program budgeting) that strict economic analysis is for many projects (especially in transportation) an inadequate. These authors, in general, prefer to study the basic goals underlying the investment decisions and comparing the impacts of various plans on these goals. The approach is referred to as effectiveness study. A review of some of the thoughts of interested researchers is here provided.

Jessiman, Brand, and Tummina, and Brussee (18) present a systematic analysis framework which gives more detail than the traditional benefit-cost analysis. The authors stress programming methods. Manheim and Hall (19) give an organized methodology which identifies goals, studies the inter-relationship of these goals, analysing impacts on the goals, and condensing the results into a preferred project order. Irwin (20) studies the importance of transportation plans on the field of economics, politics, sociology, philosophy, and engineering and argues that the impacts of the plan on all these areas must be studied and compared. He suggests that much further work must be done in this area. Alexander (21) stresses the achievement of basic goals and the criteria introduced by these goals to compare projects and stress social criteria as well as economic criteria. Johnson (23) stresses the relationship between information, probability theory, and transportation needs. The work includes a study in sequential order of receiving relevant information.

Some authors have treated the plan selection problem as a part of a larger research problem. Thomas and Schofer (24) discuss the planning process in terms of policy decision making and suggest statistical decision theory as a possible solution. Bruch, Manheim, and Schuldiner (25) attempt to structure the planning process so as to continually evolve as changing inputs and objectives come about.

All the above mentioned works are important contributions to the state of knowledge of evaluation of transport projects. The ideas presented stress that modern government does not invest in transport for example only to be profitable and that such goals as redistribution of income and increasing employment, should be definite concerns to public budgeting agencies.

CHAPTER 4

THE PLAN EVALUATION FRAMEWORK

4.1 Limitations

A problem inherent to all planning processes is the competing points of view of the long term and the short term. The short term point of view is more accurate because most factors have known values. For the planning to be meaningful and valuable, however, the planning period should be of considerable length. Not only are numerical values unknown when the planning period becomes large but also the basic assumptions upon which our understanding of the system is based becomes less reasonable. In a period of 25 years, for example, the entire transport technique may change so as to invalidate present studies. It is even possible that personal behaviour may change over the years so that people will not value trips as they now do. The present procedure is to use 10 - 20 years as a planning period in transportation studies. This time period is reasonable because it often coincides with facility lives of projects.

The framework is based on assumptions and these must be reasonable. The assumptions cannot be proven but can be discussed and kept in mind when the framework is applied. Assumptions do not invalidate a study based upon them; the entire body of knowledge gained by applying the scientific method has been obtained by using assumptions. The assumptions limit the results of the study but do not make them less valid. Some basic assumptions we make are:

1) the point of view is regional,

2) the wants of the people are known, and

3) forecasts of values, quantities, and qualities are sufficiently accurate for purposes of the study.

We assume a regional point of view because in this country, highway development is under the authority of provincial governments. When Federal money is used on a project we shall not consider this a cost. This point of view is restricted but when parallel evaluations of the same project are made by Federal authorities with their own separate point of view, a balanced investment will result. A similar outlook will be used to evaluate benefits. We are not concerned with the benefits to be gained by the nation but only with those to be gained by the province. As before, Federal benefits can be looked at by Federal agencies. The other two basic assumptions are more difficult to discuss. Separate studies can be made of just these assumptions but we shall consider them valid.

A few basic technical assumptions will be made. Again these assumptions will only be pointed out and explained. The assumptions are:

1) constant utility of income and unhampered profit realization,

2) payment of beneficiaries,

3) a competetive type of economy,

4) neglect of external effects, and

5) constant prices and costs throughout the economy.

The first assumption means that each part of an income is equal in worth to its recipient. That is the first $1,000 of a $20,000 annual earning is as valuable as the last $1,000. This assumption is very

dubious but must be made to make this and many other economic studies workable. Almost never do prices charged for a public facility accurately reflect true costs. Moreover usually many persons are charged who do not use the facility and also many users of the facility escape paying. This makes the second assumption seem unrealistic. Again the assumption is made to make the study workable. The third assumption is quite reasonable and will not distort the results of the study to a great degree. Neglecting external effects make a significant difference to the results but again this must be done because it is almost impossible to examine completely and accurately their effects. Finally, the fifth assumption is nearly true because of the competitive situation in the economy.

A considerable limitation of the framework is the selection of regional goals and their relative importance. The entire framework depends upon these goals and their selection must be made by impartial experts. In many cases there can be a realistic fear that political influences shape these goals.

The assumption of being able to neglect external effects is important in consequences. This factor is a major cause of inaccurate planning. It is noticed in transportation projects perhaps more than in any other type of public development. Because of external effects, one project cannot be evaluated but the project plus innumerable influences each in turn must be looked at. This causes a problem of great magnitude. To make the solution workable, all but the most important of the outside influences are disregarded. The error introduced by this action is considerable, however the technique does not exist to deal with too many alternatives simultaneously.

In conclusion, the assumptions made are either reasonable, with little effect on the results, or so necessary that no progress could be made without them.

4.2 The Framework Conceptually

A very important concept of this and many other evaluation techniques is the concept of interest and time. Money now is worth more than money in the future. This principle is valid for costs of money paid by beneficiaries and it is only normal to extend this principle to benefits as well. All benefits will be discounted to their present day value including those which are non-measurable and those which are uncertain. The formula used to discount monetary costs and benefits is:

$$P.V. = F.V. \times \left(\frac{1}{1 + i}\right)^{r}$$

where:

P.V. = Present Value

F.V. = Future Value

i = the appropriate interest rate

r = the number of years the future value is to be discounted

When tangible and uncertain values are to be discounted a formula cannot be applied. Note can be made of when the values are expected in time and greater or lesser weight can be carried by these values according to when they occur.

It is in the nature of transportation planning, because of the considerable time span involved, to have a certain amount of uncertainty in planning variables. This increases as the planning period increases

but even at a 15 - 20 year planning period, this uncertainty is considerable. A second characteristic of planning variables is that some are not in measurable units. This characteristic is especially noticeable in transportation projects where a wide range of possibilities exist for comfort and convenience. The normal, certain, measurable variables (usually dollars) can easily be discussed separately from these other variables. In effect three columns will be made for each project so that cost and benefits can be studied under the headings: dollars, intangibles, and uncertainties. This division of types of parameters will clarify the benefits and costs.

A typical benefit-cost analysis of a project is an analysis to see if the project will achieve the objective of maximizing profit. In effect the only government goal, dealt with is maximizing the return. This is a small minded outlook. Governments are also concerned with promoting industrial growth and increasing employment. Highway development therefore should not only be profitable but it should also contribute to these goals.

A final important point to bring up is that a complete listing of all projects competing for the public dollar must be made. An optimum solution cannot be found to a problem if this solution is not listed as a possible solution. An optimum budget allocation cannot be made when all reasonable proposals have not been made. A few suggestions are presented which aid in ensuring that as many proposals are considered as are feasible.

National standards and average values for design variables when rigidly adhered to often muzzle the creativity of the engineer. Many possible alternatives will not be considered when for example all highways are designed with specific speeds in mind. A second point is that the designer should think of the underlying problem and not the direct problem.

For example, a direct problem may be stated as: a new road is needed between points A and B. The underlying problem is: a new method of transport is needed between points A and B.

It is also distinctly possible to generate too many designs. A point is reached when further money and time spent to find more solutions is less than the average possible return. This point is easily described but is found difficult to locate in practice.

4.3 Department Goals

In the previous chapter, several types of goals have been identified. In this section these goals and their application to this study will be discussed. The following goals may be relevant to transportation planning.

1) regional goals of governments,
2) political goals of politicians,
3) fiscal policy and investment goals,
4) personal goals of civil servants, and
5) transportation goals.

The regional goals established by provincial governments are of definite concern to us. These constitute the reasoning behind all government activity and should directly relate to government investment. As mentioned before a direct relationship is difficult to find but when the regional goals are translated into department goals this may be possible.

A strong argument can be made to include political goals into the planning process. Politicians can be asked what they would like accomplished by the particular department during the planning period.

The obvious advantage is that the politicians should have an indication of the wants of their constituents. This process is not realistic in practice. First of all, politicians will not easily relinquish their right to be the final decision-makers. As such they can review all plans independently without reputations at stake. It is probably desirable to have the politicians involved only at the final planning stages so that they can be held responsible to the people instead of faceless civil servants. Finally, political maneuvering may be held to a minimum with a minimum of political involvement.

It seems very desirable to include fiscal policy objectives into the planning procedure. The greatest drawback to doing this is that transportation planning can be done for 15 - 20 year periods while fiscal policy cannot be predicted for more than 2 or 3 years. It is common for governments to try different fiscal policies to combat one problem. Even financial and economic experts do not have a ready solution to the inflation problem in North America today. The lack of planning of fiscal policy and the lack of knowledge when there is a problem, make fiscal policy an extremely difficult subject to include in the planning process. It seems easier, at this stage, to apply fiscal policy after the physical plans have been made.

The goals of the personnel of the Department should be noted. These goals do much to shape Department policy. These goals can be summed up by saying that the personnel will favour those plans which maximize their own personal satisfaction. For example, a program which calls for employing more people in the Department will tend to receive more support than one which calls for decreasing the number of staff.

The personnel goals cannot be included into the planning process, however, their effect must be kept in mind to minimize it. When these objectives are minimized there is more chance of accurate planning.

Finally, transportation goals such as increased safety and decreased commuting time may be used in the framework. These goals, however, are often secondary goals through which the primary goals of government are fulfilled. For example, the transport objective of reducing transport cost and time is actually another way of stating the goal of economic efficiency. The primary government goals are to be achieved not the often redundant secondary goals.

In conclusion the only objectives to which we are to strive are the regional goals. The regional goals for Newfoundland have been identified and are presented again:

1) to obtain a high rate of economic growth,
2) to provide for full employment,
3) to provide a reasonable stability of prices for all public goods and services,
4) to provide for a reasonably equitable distribution of income, and
5) to achieve an environment that will encourage further economic development.

These goals may be transferred into a set of operational goals. It is out of the scope of this thesis to test the validity of such new goals. Clearly a study must be made to ensure that these new goals would not differ significantly from the original goals.

The first goal: to obtain a high rate of economic growth, means that investments must be made in areas which seem likely to respond to the stimulus of the highway investment by becoming more industrialized. For example, in Newfoundland, more industry is liable to locate in the Avalon Peninsula where markets and labour exist than in Labrador where markets and labour are almost non-existent. Several factors combine to make an area attractive to industry:

1) availability of raw materials and resources,
2) availability of labour,
3) existence of parallel and related industry,
4) existence of a service industry,
5) adjacent markets for the products
6) availability of adjacent means of transporations and their condition.

This list is by no means complete and for a specialized industry many more factors may apply. The first goal is difficult to sum up in a few words. However, it may be said that an environment may exist in some areas where industrial expansion seems more likely than in other areas. Highway development should occur in these areas to achieve the first regional goal.

The second goal is difficult to distinguish from the first. Industrialization seems anonomous with new employment. However, there is a definite difference. Some types of industries employ more people per dollar of capital investment than others. For example hydro-electric projects rank high in capital investment but become virtually completely automated. The types of industries needed in an area such as Newfoundland may be low cost fish processing plants. Again highway facilities contribute to the construction of these industries, but a direct relationship cannot

be found. A judgement must be made to find the degree to which the goal is achieved by the proposal.

The third goal is of definite use to highway planners. A case may occur where a population is concentrated away from the general population. For example, the Labrador City-Wabush area is so isolated and any highway bringing this area closer ties to the Mainland or Newfoundland makes prices of goods in this area lower. Therefore, such a highway contributes to the goal of stabilizing the cost of goods and services.

The fourth objective is relatively easily used by highway planners because much of the data used in studying this objective is numerical. Incomes in each region can be studied quite easily. The rationale behind this objective has been discussed adequately in the previous chapters. In Newfoundland, an example of a highway of this type is an upgraded road in the Great Northern Peninsula. This road would help stimulate further development in a relatively depressed area along with the obvious benefit of the spending in that area for the highway.

The fifth goal is important but again is difficult to relate to proposed highways. The comments made for the first goal apply in this case. The resettlement program aims at concentrating populations to provide labour pools and markets to industry. This program contributes to the fifth goal. Highways may not contribute as clearly to this goal. Perhaps it may be said that any facility which brings market and labour sources closer to industrial locations aids in achieving the objective. It is unfortunate that few fundamental studies have been made in this area.

A final goal exists which has not been mentioned as yet because it is so fundamental to the existence of governments. This goal is to provide reasonable levels of service to the population in terms of the resources available. This goal includes such things as an economic benefit-cost analysis. This goal ensures that for example a road for 500 vehicles/day is built before one for 100 vehicles/day. Items such as demand, benefit, cost, money available are included in the study of fulfilling this goal.

4.4 The Ranking Procedure

The weighing of importance of the desired objectives is a critical step in the framework. Achieving all goals simultaneously is usually impossible and hence this process is necessary to judge which goals are most desired. The process described in this section is not the sole process which can be used to evaluate the relative importance of criteria, however it is judged by the author to be the simplest and most accurate.

The process begins with identifying the objectives and their order of importance as in Table 4.1.

Objectives	Order of Importance
1	5
2	3
3	2
4	4
5	1

TABLE 4.1

To simplify the process the most important objective can now be placed at the top the the table. An initial ranking value must be assigned to each objective this is best done by:

$$R_L \quad \frac{1.0}{\Sigma O.I.}$$

$$R_i = R_L\ (i)$$

where:

R_L = the ranked value of the objective of least importance

O.I = order of importance values

R_i = the ranked value of objectives i

i = 1 for least importance objective

i = 2 for second least important objectives, etc.

These values are calculated in Table 4.2

Objectives	Order of Importance	Initial Ranked Values
5	1	.33
3	2	.27
2	3	.20
4	4	.13
1	5	.07
	$\Sigma O.I. = 15$	

TABLE 4.2

$$R_L = \frac{1.0}{15} = .07$$

$$R_1 = .07$$

$$R_2 = .13$$

$$R_3 = .20$$

$$R_4 = .27$$

$$R_5 = .33$$

Up to this stage, the relationship between the goals is assumed to be linear. The second least important goals are twice as important as the least, the third, three times, etc. This is usually not the case in practice but provides us with a convenient starting place for further calculations. The next stage consists of making comparisons of one objective with the rest. Starting with the highest ranking objectives, we can ask is this goal more, equal, or less in importance than the rest considered together. The answer lets us scale the initial value to a new value. In the example, we may consider objective five to be as important as all the other four taken together. Therefore, we assign it the value 0.67. The third objective is considered three quarters as important as the effect of goals two, four, and one. Therefore, its value becomes 0.30. Similarly the second objective is given the value 0.15. The final two rankings are also assigned. The process must be repeated since some of the earlier values do not conform to our ranking. When the rankings are checked and each condition is fulfilled, each ranking is normalized. The process is shown in Table 4.3.

OBJECTIVES	ORDER OF IMPORTANCE	INITIAL RANKING VALUES	RANKING CALCULATIONS								NORMALIZED RANKING VALUES
5	1	.33	.67	.67	.67	.67	.65	.65	.65	.61	.50
3	2	.27	.27	.30	.30	.30	.30	.26	.26	.26	.213
2	3	.20	.20	.20	.15	.15	.15	.15	.15	.15	.123
4	4	.13	.13	.13	.13	.11	.11	.11	.11	.11	.09
1	5	.07	.07	.07	.07	.09	.09	.09	.09	.09	.074

TABLE 4.3

4.5 Interpreting the Analysis

The framework distinguishes between the several objectives of a government and examines the contributions of a proposed program under the heading monetary, intangibles, and uncertainties. A study can be preliminary or detailed using the same framework. The analysis must be correlated, compared, and examined to arrive at a judgement to show to what extent the particular objectives are achieved. A numerical method cannot be utilized to sum up the effects of the program upon the particular objective; however, a thoughtful judgement can be made which reflects accurately, to some degree the results of the plan on the government goal. The range of values which this measure of effectiveness can assume is from 0 to 1.0. If a goal is completely achieved, the measure of effectiveness is rated at 1.0 and if the proposal contributes in no way toward achieving the goal it is rated at 0.

The value of the proposal upon a particular goal is a combination of the degree to which the objective is achieved and the relative importance of the same objective. Therefore the product of the ranking and the measure of effectiveness is computed for each goal. A summation is taken of these quantities over all objectives to find an overall rating for the proposed plan. This rating is not the value of some physical quantity but merely gives a reflection of the plan in numerical terms so that it can be compared to other plans.

The entire process is very dependent upon judgements and limiting assumptions, resulting in a final rating which gives a broad indication of the relative desirability of the plan. This final rating cannot be given the tremendous importance which engineers particularly, like to associate with numbers. As is the case with benefit-cost ratios, the

GOALS	RANKING	MONETARY C	MONETARY B	INTANGIBLE B	INTANGIBLE C	UNCERTAIN B	UNCERTAIN C	MEASURE OF EFFECTIVENESS	PRODUCT OF RANKING AND MEASURE OF EFFECTIVENESS
g_1	r_1	b_{m1}	c_{m1}	b_{i1}	c_{i1}	b_{u1}	c_{u1}	m_1	$r_1 m_1$
g_2	r_2	b_{m2}	c_{m2}	b_{i2}	c_{i2}	b_{u2}	c_{u2}	m_2	$r_2 m_2$
g_3	r_3	b_{m3}	c_{m3}	b_{i3}	c_{i3}	b_{u3}	c_{u3}	m_3	$r_3 m_3$
g_4	r_4	b_{m4}	c_{m4}	b_{i4}	c_{i4}	b_{u4}	c_{u4}	m_4	$r_4 m_4$
g_5	r_5	b_{m5}	c_{m5}	b_{i5}	c_{i5}	b_{u5}	c_{u5}	m_5	$r_5 m_5$
g_6	r_6	b_{m6}	c_{m6}	b_{i6}	c_{i6}	b_{u6}	c_{u6}	m_6	$r_6 m_6$
									$\sum_i r_i m_i$

PROJECT EVALUATION FRAMEWORK FIGURE 4.1

comparison of plans with final ratings of for example 0.90 and 0.91 becomes a ridiculous exercise. Broad indications are reflected by these numbers not minute, detailed accuracy.

4.6 The Framework Physically

At this time it seems advisable to examine the overall framework. Figure 4.1 shows graphically the proposed framework. Each section of the framework has been previously discussed and therefore these components will only be reviewed.

Government goals in the first column of Figure 4.1 usually have been identified in previous studies conducted by governments. A separate study can be made to examine the goals in greater detail if this is thought necessary. This part of the framework, it is easily seen, is very critical since all future manipulations are based upon the accurate and realistic identification of goals.

The ranking procedure can be long and drawn out. However there is no easy method. The total sum of all ranking values is 1.0. This value is not absolutely necessary but a constant total must be used in the evaluation of all projects. At the end of the procedure the values are easily normalized.

The third through eight columns represent characteristics of the plan which contribute and detract from achieving each goal. Benefit and cost headings are used in a very loose sense to mean any result of a program which helps (benefit) and does not help (cost) achieve a particular objective. Benefits and costs are discussed under three headings: monetary, intangible, and uncertain. Although only a little

box is shown for each goal under each heading, a detailed discussion of the results of the program can be substituted for each b_{ij} and c_{ij}. Each of the 36 boxes can in fact be a separate study in its own right.

Column nine represents subjective judgements based on the analysis performed in columns three through eight. In a sense this judgement (for each goal) must be made on the equation.

$$m_j = \sum_i (b_{ij} - c_{ij})$$

Since the characteristics b_{ij} and c_{ij} are not in terms of each other, the judgement must be made. Finally, m_j values can range from 0 to 1.0.

The final column is merely the product of r_j and m_j values. Therefore, the degree to which each goal is achieved is multiplied by the relative importance of that goal. The sum of all the products is the rating given to the project which can then be related to the ratings of other projects.

CHAPTER 5

AN EXAMPLE USING A NEWFOUNDLAND PROBLEM

5.1 Introduction

The evaluation framework can best be described by an actual example. Two separate investment proposals will be analysed:

1) to pave the Burin Peninsula road from the Trans Canada Highway to Grand Bank - Fortune and St. Lawrence, and
2) to pave the Great Northern Peninsula road from the Trans Canada Highway to St. Anthony.

These proposals will be examined in terms of the Government's goals.

The Government goals for the Province of Newfoundland and Labrador have been previously stated in this thesis. They are:

1) to obtain a high rate of economic growth,
2) to provide for full employment,
3) to provide a reasonably stability of prices for all public goods and services,
4) to provide for a reasonably equitable distribution of income, and
5) to achieve an environment that will encourage further economic development.

A final Government goal has been identified in Chapter 4:

to provide a reasonable level of service in terms of efficient investments.

The next phase of the framework is to rank the identified goals. The method described in Chapter 4 will be utilized. The six objectives must, first of all, be rated in an order of importance. The author judges goal #2, providing employment, to be most important. Providing an equitable distribution of income is considered next in importance. Thirdly, a high rate of economic growth is desired. Next is rated the objective of an environment which encourages further development. An adequate level of service in public goods is desired next. Finally, the last goal should be to provide stability of prices for all public goods and services. Initial ratings will be assigned as was done in Chapter 4.

$$R_i = 1/6!$$
$$= 1/21$$
$$= 0.048$$

$R_1 = 0.286$

$R_2 = 0.238$

$R_3 = 0.191$

$R_4 = 0.143$

$R_5 = 0.095$

$R_6 = 0.048$

The procedure of Chapter 4 continues; each goal, starting with the most important, is compared with the sum of the ranking values of the remaining. The procedure is shown in Table 5.1.

The judgements made about the ranking of the objectives are:

1) the most important goal should rank 0.40 of the sum of the remaining values,

TABLE 5.1

GOALS	INITIAL RANKING VALUES	RANKING CALCULATIONS				
G_1 (Employment)	0.286	<u>0.286</u>	0.286	0.286	0.286	0.286
G_2 (Distribution of Income)	0.238	0.238	<u>0.239</u>	0.239	0.239	0.239
G_3 (Economic Growth)	0.191	0.191	0.191	<u>0.143</u>	0.143	0.143
G_4 (Further Development Env.)	0.143	0.143	0.143	0.143	<u>0.143</u>	0.143
G_5 (Level of Service)	0.095	0.095	0.095	0.095	0.095	<u>0.095</u>
G_6 (Stability of Prices)	0.048	0.048	0.048	0.048	0.048	<u>0.048</u>

TABLE 5.1 (CONT'D)

GOALS	RANKING CALCULATIONS					NORMALIZED RANKING VALUES
G_1 (Employment)	0.267	0.267	0.267	0.258	0.258	0.286
G_2 (Distribution of Income)	0.239	0.215	0.215	0.215	0.215	0.239
G_3 (Economic Growth)	0.143	0.143	0.143	0.143	0.143	0.159
G_4 (Further Development Env.)	0.143	0.143	0.143	0.143	0.143	0.159
G_5 (Level of Service)	0.095	0.095	0.095	0.095	0.095	0.105
G_6 (Stability of Prices)	0.048	0.048	0.048	0.048	0.048	0.048

2) goal #2 should have a ranking value 0.50 of the remaining values,

3) the third goal should rate 0.50 of the remaining three,

4) the fourth goals's rating should be equal to the sum of the remaining two, and

5) the fifth goal should have twice the ranking value of the final goal.

The next phase of the framework consists of an array of results of each proposed investment upon the goals, a total of 36 separate entries in the array will be examined for each proposal. The results of each proposal are divided into three headings: monetary, intangible and uncertain. These are further subdivided into positive and negative contributions to the goals. In all, 6 entries are made for each of 6 goals. This part of the framework is summed up by Table 5.2.

Monetary		Intangible		Uncertain	
b_{m1}	c_{m1}	b_{i1}	c_{i1}	b_{u1}	c_{u1}
b_{m2}	c_{m2}	b_{i2}	c_{i2}	b_{u2}	c_{u2}
b_{m3}	c_{m3}	b_{i3}	c_{i3}	b_{u3}	c_{u3}
b_{m4}	c_{m4}	b_{i4}	c_{i4}	b_{u4}	c_{u4}
b_{m5}	c_{m5}	b_{i5}	c_{i5}	b_{u5}	c_{u5}
b_{m6}	c_{m6}	b_{i6}	c_{i6}	b_{u6}	c_{u6}

TABLE 5.2

Each of these 36 entries will be individually examined.

5.2 The Burin Peninsula Highway Proposal

b_{m1}

The unofficial unemployment rate in the Burin Peninsula is 15.6%.[1] This figure is relatively high and both construction of the highway and the resulting development should reduce it. The highway is 154 miles in length and with an average cost of $30,000 per mile, the total cost is $4.62 million. It is estimated that 200 men will be directly employed for three years (75% of whom are from the area). A theoretical multiplier effect of 30 - 35% will cause further indirect employment.

c_{m1}, b_{i1}, c_{i1}, nil

b_{u1}

The possibility of future industrial development caused by the road is uncertain. The highway brings together labour and markets, so that theoretically, industry will come in to service the markets. Because of high unemployment in the area, the labour rate should be quite low. This increases the chance of industrial development. The highway can only quicken the rate of development of the area and therefore reduce unemployment.

c_{u1} nil

b_{m2}

The average weekly wage for the Burin Peninsula is $70.94 and for the entire Province is $81.40. This represents an average income difference of 12.8% - a considerable figure. This percentage, together with the high unemployment rate clearly shows that the area is highly

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[1] See Appendix A

undeveloped, even by Provincial standards. The cost of the highway is borne by the entire provincial population, while the benefits result mainly for the people of the area. This represents redistribution of wealth to poorer areas. Therefore, the highway will achieve to some extent, the goal of redistributing income.

$\underline{c_{m2}}$, $\underline{b_{i2}}$, $\underline{c_{i2}}$, nil

$\underline{b_{u2}}$

The possible industrial development of the area is uncertain. The area is poorer than the average of Newfoundland and the highway can help develop the area. For example, tourism (especially to St. Pierre) will definitely increase with a paved road.

$\underline{c_{u2}}$ nil

$\underline{b_{m3}}$

The paving of the highway increases the future wealth of the province because of savings in money and travel time. The economic status of the area can further increase if industrial development takes place due to the road.

$\underline{c_{m3}}$, $\underline{b_{i3}}$, $\underline{c_{i3}}$, nil

$\underline{b_{u3}}$

The industrial development of the Burin Peninsula is aided by the fact that there are four centres of population of more than 1500. This makes the people of the area a more accessable market and may stimulate development. It is to be stressed that economic growth of the area is not automatic. However, the paved highway should provide:

1) more efficient transport facilities and so cause the area to be desirable as a location for new industry,
2) better transport links so that existing industry can produce more goods cheaper, and
3) better facilities to spur tourism to the area.

c_{u3}, b_{m4}, c_{m4}, b_{i4}, c_{i4}, nil

b_{u4}

The four towns of Marystown, Fortune, Grand Bank and St. Lawrence (all over 1,500 population) possess 39.4% of the population of the Burin Peninsula. This concentration of population is usually a pre-requisite to industrial development. A paved highway which links these concentrated areas to the Trans Canada Highway should help new industry locate in the area and be a great aid to existing industry. For example, it seems likely that the Newfoundland Marine Works Limited will be able to work on larger projects, which can be shipped via road.

c_{u4} nil

b_{m5}

The paved highway will cause many monetary benefits. The benefits take the form of savings by users, due to less repairs to automobiles, less time in transit and increased safety. The average daily traffic over the entire highway has been computed to be 923[1]. Further benefits are caused by additional and increased property taxes and less maintainance cost. Federal money which may be granted to pave

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[1]See Appendix C

the highway can be examined as both perceived and non-perceived. Obviously, these figures must be calculated although this is considered out of the scope of this study.

c_{m5}

This discussion gives the total cost of the project, including land, construction, operation, maintainance and administration. The estimated cost for upgrading and paving is $30,000 per mile, resulting in a total cost for the project of $4.62 million. The cost per resident is computed to be $180. A more detailed study could result in a more accurate figure.

b_{i5}

Comfort and convenience are the main subjects in this paragraph. The paved road will end the discomfort of driving on a dusty surface. The paved road will also be far more comfortable because of the flat, smooth surface. More intangible benefits of an upgraded road, such as fewer curves and hills, causing a more pleasant ride, can be found. A complete list is difficult to compile.

c_{i5}

A main intangible disbenefit is the inconvenience caused by construction. This disbenefit is temporary and should not be given major consideration. The cost of moving people to build the highway should be an absolute minimum, since the road is to be only upgraded and paved.

b_{u5}

Many secondary benefits are uncertain. For example, the increased value of land along the road will increase taxes. Amounts of this type are difficult to determine. Further examples are amounts of

tourist spending and the amount of induced traffic and the resulting benefits.

c_{u5} nil

b_{m6}

The average cost of consumer goods in the Burin Peninsula is higher than that in St. John's, by an amount approximately equal to the difference in transport cost of these goods to the two areas. A realistic estimate would make these goods 2 to 3% more expensive in the Burin Peninsula. It is further estimated that a paved road will have this differential. The difference in cost of services is not thought to be considerable.

c_{m6}, b_{i6}, c_{i6} nil

b_{u6}

The cost of consumer items is not dependent only on the highway. For example, a new distribution outlet along the Trans Canada Highway could affect local prices to a great extent. The highway would still aid in stabilizing prices, however.

5.3 The Great Northern Peninsula Highway Proposal

b_{m1}

The per mile cost of paving this highway is assumed to be $30,000, as before. This makes the total project cost $8.16 million (the highway is 272 miles in length). The unofficial unemployment rate of the area is 20.1%[1].

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[1] See Appendix A.

This rate is extremely high and can be lowered considerably by construction of the road. The project, it is estimated, can directly employ 200 men for a period of five years. The usual multiplier effect can cause an additional 30% employment.

c_{ml}, b_{il}, c_{il}, nil

b_{ul}

Future employment can occur if private industry utilizes the new road to establish new industries in the area. The extent of this employment is uncertain. The road aids in bringing together labour, resources and markets, and therefore makes the area more liable to be industrialized. Low income in the area increases the chance of industrial development.

c_{ul}, nil

b_{m2}

The Great Northern Peninsula is one of the poorer areas of Newfoundland. The average weekly income in the area is $65.07, while the average weekly income for Newfoundland is $81.40.[1] The difference is very considerable - 20.1%. A very high unemployment rate further increases the discrepancy. The paving project will distribute the Province's wealth to the local area. The cost for the project is borne by the Province as a whole, while most users' benefits occur for the local people. This means obviously, a redistribution of wealth.

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[1] See Appendix B

c_{m2}, b_{i2}, c_{i2}, nil

b_{u2}

The extent of industrial development caused by upgrading and paving the road is uncertain, as is the case in the Burin Peninsula road. The employment caused by this development is therefore uncertain. Perhaps the most feasible development would be the development of fish processing facilities. This would have to be accompanied by parallel development in the fishing industry. The outlook for industrial development in the area is not optimistic.

c_{u2}, nil

b_{m3}

The area is richer by an amount equal to the cost of the project, $8.16 million. The overall Province has not become richer by this amount, although the Province will experience future savings because of the more efficient systems.

c_{m3}, b_{i3}, c_{i3}, nil

b_{u3}

The area may benefit from the highway in industrial development and increases in the tourism industry. The Peninsula stands a good chance of benefiting from tourism because of the scenic Bonne Bay area. The development of the area into a park may bring considerable outside money into the area.

c_{u3}, b_{m4}, c_{m4}, b_{i4}, c_{i4} nil

b_{u4}

The fact that Labrador is adjacent to the Great Northern Peninsula is important for the possible development of the Peninsula. The resources of that part of the Province should be oriented in the direction of the Island. They should not be exploited by outsiders but should contribute to developing the Island by creating employment for the population. A paved highway in the Great Northern Peninsula definitely contributes in connecting Labrador closer to the Island. Resources and labour will be able to be transported easier to and from the Labrador area when the Peninsula road is paved and the possible trans-Labrador highway is completed. It must be remembered, however, that the development of Labrador is a long term project and the Peninsula road will provide a meaningful Labrador-Island link only in the far future.

c_{u4}

The Peninsula is handicapped by the lack of concentrated populations. On the entire 272 mile highway, there is only one town with a population greater than 1,500, St. Anthony. Only 2,500 people out of 23,700 living in the Peninsula (10.5%) live in relatively urban areas. This means that industrial development has a smaller chance of taking place. Population in the area is very spread out and therefore difficult to service. The lack of urban areas also hamper the organization of labour pools.

b_{m5}

Benefits of the paved highway in this category are mainly user benefits. Saving for users are -

1) savings in time,
2) savings in vehicle operation and maintenance, and
3) savings due to increased safety

The benefits should be calculated as both perceived and actual benefits. The average daily traffic for the entire road has been computed from recent data to be 412 in value.[1] An additional benefit is the increased taxes due to the highway development.

c_{m5}

The total cost of the project is estimated at $8.16 million. This cost includes the costs of land and construction and all incidentals. The total cost per resident served is $343 per person. A more detailed study of cost should be undertaken to compute the total cost more accurately.

b_{i5}

Comfort and convenience to users is the obvious intangible benefit. The smoother, dust-free ride is non measureable in value. The dust-free surface is also a benefit to those living adjacent to the highway. Making scenic areas more accessible to the general population is also a benefit of this type.

c_{i5}

Intangible costs are very limited on an upgrading project of this type. Inconvenience to the user during construction is a temporary cost and is of limited value. An intangible cost for displacing residents should be an absolute minimum since the highway is not to change structurally to any great extent.

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[1] See Appendix C

b_{u5}

Future secondary benefits of the project are uncertain. Traffic on the highway, induced by the upgrading is very difficult to estimate. This type of traffic may be considerable in the Peninsula because a large proportion of it may be tourist traffic. Numerous other examples of secondary benefits can be listed. A few are:

1) amount of increased taxes,
2) amount of related service type industry due to possible industrial development, and
3) spending patterns of induced tourist traffic.

c_{u5} nil

b_{m6}

A detailed investigation must be made to discover the increased cost of consumer items in St. Anthony over that in other areas of St. John's. The transport cost may increase the cost of these goods by about 3 - 4% over the costs in St. John's. It is further estimated that paving the highway will lower the differential by 30 - 50%, because of reduced transport costs.

c_{m6}, b_{i6}, c_{i6}, nil

b_{u6}

The reduction of consumer prices is very dependent upon other factors, besides the paving of the highway. The location of trans-shipment areas, adjacent transport facilities and producing plants can both raise and lower the cost of consumer goods in the area.

TABLE 5.3

GOALS	NORMAILIZED RANKING VALUES	BURIN PENINSULA HIGHWAY		GREAT NORTHERN PENINSULA HIGHWAY	
		EFFECTIVENESS MEASURE	PRODUCT	EFFECTIVENESS MEASURE	PRODUCT
1 (Employment)	0.286	0.25	0.072	0.30	0.086
2 (Distribution)	0.239	0.50	0.120	0.75	0.179
3 (Economic Growth)	0.159	0.30	0.048	0.20	0.032
4 (Environment for Future Development)	0.159	0.80	0.127	0.30	0.048
5 (Adequate Level of Service)	0.105	0.90	0.095	0.30	0.032
6 (Stability of Prices)	0.048	0.30	0.014	0.50	0.024
Final Rating			0.476		0.401

5.4 Conclusions

The discussions of the previous two sections must be summarized into an effectiveness measure. Three rules are followed to arrive at an effectiveness measure:

1) the number must reflect an indication of $\sum_i (b_i - c_i)$,

2) the number must be somehow discounted when b_i and c_i occur at some future date, and

3) maximum and minimum values are 1.0 and 0.0, respectively.

An objective judgement is made by the author keeping the above rules in mind. The results are presented in Table 5.3. The product of the effectiveness measure and the normalized ranking value is calculated for each goal and the summation of these products is taken. This sum of the products is the final rating for a proposal and can be used to compare the proposal to other proposals. The final ratings for the Burin Peninsula project and the Great Northern Peninsula project are 0.476 and 0.401 respectively. The difference is considerable (18.7%). The results indicate that paving the Burin Highway satisfies the needs of the Province better than paving the Great Northern Peninsula Highway by about 20%. This margin indicates clearly that the Burin project should receive a priority rating and that that part of the budget allocated to highway improvement should be spent developing the Burin road before the Great Northern Peninsula road.

CHAPTER 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Summary

A framework has been developed in this thesis to evaluate highway development proposals in terms of the goals and objectives that the appropriate agency has set. The framework can be utilized in two distinct processes:

1) to evaluate different proposals for one problem, i.e. how best to link towns A and B, and
2) to budget available resources among competing projects, i.e. which projects best fit the needs set by the government goals.

Government goals may be translated into operational department goals. This step makes the achievement of goals more realistic. For example, a government objective may be to increase employment; the corresponding departmental standard may be to employ 10% of the unemployed in certain poorer areas by highway construction.

Each of the goals identified is ranked through a specified procedure. This step is necessary because in most cases the achievement of one goal will detract from achieving some other goal. The ranking of the goals establishes the degree of importance of the goals so that plans can be properly compared.

To facilitate the examination of the results of proposals on the identified goals, these results are separated into three columns: monetary, intangible, and uncertain results. These columns are further subdivided into contributions toward achieving the goal and results which detract from achieving the goal. This grouping organizes the impacts of the proposed highway plans so that it is more clearly seen whether or not a goal is achieved or to what degree it is achieved. In the monetary columns, the benefits and costs are discounted to their present value. The same process is to occur in the intangible and uncertain columns. These values are not mathematically discounted but the date of occurance of the results is noted and gives the results appropriate weights. For example, an intangible benefit is worth more when it occurs sooner.

This process of subdividing all results of a proposal causes a large amount of work. For example, if eight goals are identified, 8 x 6 = 48 separate discussions are needed for each project examined. Furthermore, each of the 48 results of the plan can be studied in detailed manner so that 48 separate studies can be made. Although this may amount to a large amount of work, it seems that this is the only accurate method of evaluating a proposal. Benefits and costs, it must be remembered, are only that in terms of goals; there is no benefit or cost without a goal.

The next process in the framework is a judgement which states to what degree each goal is achieved. If a goal is not achieved in the slightest degree, a value of 0 (zero) is entered and if a goal is completely achieved a value of 1.0 is entered. Any value between these extremes can also be entered. This judgement can be based on the imagined value

$$\sum_i (b_i - c_i)$$

b_i and c_i are not in similar units so this summation can only be made by a judgement.

The final step is to take the products of the ranking and the achievement judgement. The summation of these products over all the goals gives a final rating for the entire project in terms of the goals it was designed to fulfill.

The final rating is based upon many values which are judged rather than calculated. Therefore, minute differences in final ratings cannot distinguish substantially between the designs. The final ratings give only a broad indication of the relative value of the plan to society in terms of the government goals and objectives.

The problem of selecting an optimum proposal to a specific problem is solved by choosing the solution with the highest final rating. The budgeting procedure is performed by selecting those projects starting with the maximum final rating and continuing with projects until either all projects proposed were selected or all available resources have been allocated.

6.2 Conclusions

A framework is developed in this thesis for decision making in public investment in highways. The goals of the developing agency are identified, analyzed, and ranked and the results of a highway facility are examined in terms of these goals. Subjective judgements are made to identify the degree to which the goals are achieved and these result in a final rating which gives an indication of the relative worth of the project.

The application of the framework is demonstrated in a Newfoundland example. The example shows that the framework is workable although much research must be done particularly to find relationships between specific outputs of transport facilities and specific government goals.

Some conclusions which can be readily made after applying the framework are that the identified goals must be analysed deeply, the subjective judgements must be carefully made (by more than one individual if possible), and further research is needed to find an optimum manner of ranking goals. These three phases of the methodology were thought to be particularly important to finding appropriate results. It is thought that the underlying philosophy of the framework is correct but that the above three phases of the framework must be expanded upon to provide optimum results.

It is stressed throughout the thesis that goals must be identified and used as criteria for government investment and that non economic values must be included when determining the value or worth of projects. These two ideas provide the basis of the thesis. All other facets of the framework are included to make it workable.

Finally it is realized that the methodology presented is costly and time consuming. However, when extensive monies are to be invested, surely it is not unreasonable to invest a little more to ensure that the investment is optimum.

6.3 Recommendations

Much future research can be conducted into many phases of the framework. The following points are the main areas which require further analysis.

The identification of government goals is the basis of the entire framework. For this reason, government should engage in research to determine accurately what the wants and needs of society are. Only by knowledge in this area can governments invest in public facilities to please society. The Canadian Federal Government has taken a step in this direction by establishing the Economic Council of Canada which has a repeatedly spelled out desirable economic policy. It is obvious that this type of goal identification cannot stop with economic study. All types of public needs and wants must be researched. The very idea of conducting government business without knowing the underlying reason for this activity is absurd.

The government goals, having been identified, can be translated into specific department goals (in our case, Department of Highways). These department goals must not make policy different than the original goals would produce. Changing the goals is a delicate process and it is recommended that more research be done into this part of the framework. It may be the case that government goals are accurately identified but that the operational goals are altered so that the projects invested in are fulfilling the wrong goals.

The impacts of the plan upon each goal are analysed under the headings: monetary, intangible, and uncertain. This results in an array of impacts each of which must be carefully studied. Much research is needed in each entrie in the array. For example, a clear line is not drawn between monetary and intangible effects of a proposal. In effect, the array must be made more concrete.

Judgements must be made to give effectiveness measures. These judgements will be more reliable when a group of persons make individual judgements and the average value is used. The final rating is very sensitive to the effectiveness measures and the larger the base of the average, the more useful the value is.

REFERENCES

1. Canadian Tax Foundation. "National Finances, 1967-68 Provincial Finances, 1967".

2. Canada. "National Accounts and Expenditures". Various Years.

3. Owen, Wilfred. "Strategy for mobility". The Brookings Institute, Washington, D.C., 1964.

4. Dominion Bureau of Statistics, "Road and Street Mileage and Expenditure." Catalogue 53-201, 1968.

5. Owen, Wilfred. "Distance and Development". The Brookings Institute, Washington, D.C., 1967.

6. Pegrum, Dudley F. "Transportation Economics and Public Policy". Richard D. Irwin, Inc., Homewood, Illinois, 1968.

7. Peterson, Wallace C. "Income, Employment, and Economic Growth". W.W. Norton and Co., Inc., New York, 1967.

8. Report of the Steering Group. "Traffic in Towns". Her Majesty's Stationery Office, London, 1963.

9. Galbraith, John, Kenneth. "The New Industrial State". H. Hamilton, London, 1967.

10. Economic Council of Canada. "Sixth Annual Review - Perspective 1975". Queen's Printer, Ottawa, 1969.

11. "Report of the Royal Commission on the Economic State and Prospects of Newfoundland and Labrador". Office of the Queen's Printer, St. John's, Newfoundland, 1967.

12. Novick, David. "Program Budgeting". Harvard University Press, Cambridge, Massachusetts, 1965.

13. Keynes, John Maynard. "The General Theory of Employment, Interest, and Money." Harcourt, Brace, New York, 1936.

14. Galbraith, John, Kenneth. "The Affluent Society." H. Hamilton, London, 1959.

15. Gillies, James. "Background Paper." Toronto Stock Exchange Conference, Toronto, May, 1970.

16. Pearson, P. M. "A Preliminary Statement of Newfoundland's Transportation Problems". St. John's, Newfoundland, 1969

17. Dupuit, Jules. "On the Measurement of the Utility of Public Works". Annales des Ponts et Chaussees, 1844.

18. Jessiman, W.; Brand, D.; Tumminia, A.; Brussee, C. R. "A Rational Decision-Making Technique for Transportation Planning". Highway Research Record Number 180, 1967.

19. Manheim, M. L.; Hall, F. "Abstract Representation of Goals: A Method for Making Decisions in Complex Problems". Department of Civil Engineering, M.I.T., 1967.

20. Irwin, N. A. "Criteria for Evaluating Alternative Transportation Systems". Highway Research Record Number 148, 1966.

21. Alexander, C. "Notes on the Synthesis of Form". Harvard University Press, Cambridge, 1966.

22. Shimpler, C. C.; Grecco, W. L. "Systems Evaluation: An Approach Based on community Structure and Values". Highway Research Record Number 238, 1968.

23. Johnson, W. F. "Decision Theoretic Techniques for Information Acquisition in Transportation Planning". M.I.T. Research Record R-69-1, 1969.

APPENDIX A

UNOFFICIAL UNEMPLOYMENT RATE CALCULATIONS

Burin Peninsula	Employment[1] in	Great Northern Peninsula
2730	Service Industry	2265
1016	Manufacturing	144
1226	Fishing	1552
351	Mining & Forestry	723
56	Agriculture	22
5379	Total	4706

Total labour force to toal population ratio in Newfoundland = 24.85%[2]

25,672 x 0.2485 = 6370	Total Labour Force	23,762 x 0.2485 = 5890
6370 - 5370 = 991	Unemployed	5890 - 4706 = 1184
$\frac{991}{6370}$ = 15.6%	Unemployment Rate	$\frac{1184}{5890}$ = 20.1%

1. Source: Pearson, P.M. - "Development Programming for the Transport Sector in Newfoundland" St. John's, 1970

2. Source: Dominion Bureau of Statistics, "Census of Canada" Series 3.1, Catalogue 94-502, 1961

APPENDIX B

AVERAGE WEEKLY WAGE CALCULATIONS[1]

BURIN PENINSULA			GREAT NORTHERN PENINSULA		
Population (hundreds	Average Weekly Wage	Product	Population (hundreds)	Average Weekly Wage	Product
9.5	71.33	678.00	18	64.89	1,170.00
15	71.68	1,075.00	25	65.00	1,625.00
10	71.35	713.50	11	64.79	712.00
32	71.26	2,280.00	11	64.79	712.00
8	71.30	570.00	17	65.13	1,108.00
21	71.52	1,500.00	11	65.17	717.00
5	72.40	362.00	7.1	65.01	461.00
4	72.17	289.00	24	65.18	1,560.00
9	71.34	642.00	24	65.63	1,575.00
39	71.30	2,780.00	33	65.25	2,150.00
18	71.31	1,283.00	4.8	64.94	312.00
19	71.32	1.354.00	34	65.10	2,210.00
37	71.31	2,640.00	7.2	64.23	467.00
10	70.57	705.70	7	64.83	453.00
16	71.28	1,140.00	8.6	65.16	560.00
252.5		17,912.20	242.7		15,792.00

$\frac{17,912.20}{25,250}$ = 70.94 Average Weekly Wage $\frac{15,792.00}{24,270}$ = 65.07

1. Source: Pearson, P.M., "Development Programming for the Transport Sector in Newfoundland", St. John's, 1970.

AVERAGE WEEKLY WAGE CALCULATIONS

NEWFOUNDLAND

TYPE OF INDUSTRY	NUMBER OF PEOPLE EMPLOYED		AVERAGE WEEKLY WAGE (dollars)		PRODUCT
Agriculture	585	x	36.05	=	21,100
Mining and Forestry	10,829	x	61.50	=	667,000
Fishing	2,133	x	34.60	=	73,700
Manufacturing	11,521	x	80.60	=	929,000
Service Industry	69,996	x	86.50	=	6,050,000
	95,064				7,740,800

$$\text{Average Weekly Wage} = \frac{7,740,800}{95,064} = 81.40$$

APPENDIX C

AVERAGE DAILY TRAFFIC CALCULATIONS[1]

BURIN PENINSULA			GREAT NORTHERN PENINSULA		
a.d.t.	Length of Link (Miles)	Product	a.d.t.	Length of Link (Miles)	Product
288	15.9	4,580	1800	4.2	7,550
265	29.5	7,810	463	16.2	7,500
1000	21.4	21,400	384	23.5	9,030
1050	7.2	7,550	900	0.7	630
0	3.0	0	0	2.5	0
1542	11.6	17,900	419	26.4	11,080
900	8.9	8,010	471	26.5	12,480
4670	6.2	28,900	350	23.6	8,260
1200	1.7	2,040	692	22.1	15,300
513	3.9	2,000	900	4.2	3,780
720	13.0	9,360	300	30.2	9,060
1800	10.0	18,000	600	8.7	5,220
1100	7.8	8,580	0	1.7	0
300	5.2	1,560	333	12.0	4,000
450	4.1	1,843	675	14.0	9,450
720	7.6	5,470	164	59.4	9,740
			540	6.1	3,290
	157.0[2]	145,003		282.0[2]	116,370

$$\frac{145{,}003}{157.0} = 923 \qquad \text{Average Daily Traffic} \qquad \frac{116{,}370}{282.0} = 412$$

1. Source: Pearson, P.M., "Development Programming for the Transport Sector in Newfoundland". St. John's, 1970.

2. Error in Test Vehicle Mileage is cancelled by division of total mileage.