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AIR TRANSPORTATION AND THE HUMAN ENVIRONMENT

by

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ABSTRACT

The objective of this study is to investigate the existing air and noise pollution abatement legislation in Canada as it relates to the air transportation industry, and suggest methods of improving this legislation to meet the future needs and demands of the human environment. A second objective is to provide guidelines for business and government action in the future, and to acquaint the individual with some of the issues of the "environmental era of air transportation."

Based on personal interview, an extensive literature search, and the application of business principles, this study addresses the technical, economic and social problems associated with the formulation and implementation of effective environmental legislation. In addition, it discusses the roles of business and government in each of these problem areas.

The thesis concludes that the Canadian legal system must undergo structural change to accommodate environmental issues; a 1973 Noise Control Act should be passed; and a federally supported environmental education program should be instituted. Other conclusions include recommendations for increased research on the effects of the sonic boom and inadvertent climate modification, increased international participation in environmental affairs, and an improved market system to reflect environmental goods as scarce

resources. This thesis also recommends increased government-industry cooperation in the formulation of technical and non-technical standards and legislation, to ensure that reasonable and specific criteria are established for noise and air pollution abatement.

The most important recommendation of this thesis is that a macro system approach be adopted in environmental management. This approach, which recognizes interactions and feedback in the social, economic and political environment, is vital to the future of Air Transportation and the Human Environment.

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The final product of the research undertaken, as represented in this thesis, is totally my own and I remain solely responsible for any errors or omissions.

I would like to express my appreciation to the Transportation Development Agency, whose financial support enabled me to carry out this research. I would also like to thank my mother for typing this thesis and my wife, Margaret, and daughter, Paula, for their kindness, encouragement, and understanding during the last two years at graduate school.

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CHAPTER I

INTRODUCTION

1.1 The Human Environment

No human activity is more affected by its environment than transport. Probably, also, no other human activity, with the exception of war, has more effect on the environment of human beings.¹

There is no greater challenge to transportation today than the human environment. The "tragedy of the common"--the exploitation of resources that everyone owns, but no one cares for--is not peculiar to Canada. It is an international attitude.²

Only recently has man begun to think in terms of a single complex ecosystem--spaceship earth--and realize that "man and his environment" are not separate entities.³ Even more recently man has come to the realization that his "... apparent dominion over the environment is but a license from

¹H.W. Mander, "The Quality of British Transport" in Transpo '69 The Environmental Aspects of Transportation (London: Imperial College, Society of Environmental Engineers, 1969), p. 1.

²Department of the Environment, Canada and the Human Environment (Ottawa: Information Canada, 1972), p. 20.

³John A. Day, Frederic F. Fost, and Peter Rose, Dimensions of the Environmental Crisis (New York: John Wiley and Sons, Inc., 1971).

nature with a fee yet to be paid."⁴ Just yesterday the average citizen in Canada was not interested in theories of environmental management beyond the occasional lip-service to conservation.⁵ But today, with his water tasting bad and discolored, his air smog-filled, and his countryside disfigured, he is getting the message. It is not only the "average citizen" who is reacting to environmental degradation but also the heads of airlines, governmental leaders, citizens about to have their property expropriated and community planners.

Airlines are accused of eroding the natural environment through air pollution and noise, yet when pollution obscures visibility, no one can be more immediately concerned than the captain of the airliner. Similarly when noise reaches certain levels, the impact is unfavorable to the airline's customers and its employees.⁶

The term "human environment" can be defined in a number of ways, perhaps the best being simply the world we live in.

⁴Victor John Yannacone, Jr. and Patrick Frangella, "Environmental Concern--The Law and Aviation," in Master Planning the Aviation Environment, ed. by Angelo J. Cerchione, Victor E. Rothe, and James Vercellino (Tucson, Arizona: The University of Arizona Press, 1970), p. 368.

⁵Christian de Laet, "The Pollution Problem," in Economic Thinking and Pollution Problems, ed. by D.A.L. Auld (Toronto: University of Toronto Press, 1972), p. 125.

⁶Stuart G. Tipton, "Aviation's Three Environments," in Master Planning the Aviation Environment, ed. by Angelo J. Cerchione, Victor E. Rothe, and James Vercellino (Tucson, Arizona: The University of Arizona Press, 1970), p. 23.

1.2 A Conceptual Framework for Analysis

Air transportation systems can be defined on at least three levels of complexity. The first is defined by technology, and includes such variables as physical and performance characteristics of the aircraft, cost, duty cycle, and reliability/maintainability. In the earliest days of aviation this level of complexity was a suitable mode of operation and represented a co-alignment of the barnstorming pilot with his relatively unspoiled physical environment and unexplored business environment.

The second level is a more complex operating system level defined in terms of aircraft fleet, ground facilities, and operating policies and procedures. An analysis at this level would reveal network schedules, capacities, trip times, fares, fleet size optimization, the economic aspects of capitalization and revenue, and perhaps the impact of specific economic and social segments of the environment.⁷ Within this framework one might analyze the environment of radar, runways, and terminals.⁸

The third level is the social system level of analysis. This is the level I shall use for my study. In order to study the complex of air transportation services within regional, national, and international boundaries one must look at inter-

⁷E.S. Diamant, "Earth-Transportation Macro Systems," (one lecture in a series on Macro Systems, Analysis and Synthesis of Complex Systems, presented at the University of California Extension, San Francisco, California, November, 1968), pp. 1-6.

⁸Tipton, "Aviation's Three Environments," p. 23.

actions and feedback effects both within and in the environment around the operating system. The operating system shapes and in turn is shaped by the social, economic, and political environment within which it operates.⁹ These environmental complexities have a direct impact on the decision-making function of an airlines organization and the airlines must seek to understand them for survival. As J.D. Thompson points out:¹⁰

Survival rests on the co-alignment of technology and task environment with a viable domain, and of organizational design and structure appropriate to that domain.

Thompson's emphasis on organizational design and structure is important and, as we shall see later, underlies a successful strategy for dealing with environmental problems such as noise abatement and reduction of air pollution.

To understand a dynamic air transportation system, one must understand all of the elements, their functions and interrelations. From such an understanding stems rational operation and regulation procedures which are tuned in to the changing demands of the market and social environment. From such understanding also stems rational planning for new systems with a view to meeting present needs and shaping the characteristics of future demands. The main difficulty in achieving such an understanding is the higher uncertainty

⁹Diamant, "Earth-Transportation Macro Systems," pp. 2-3.

¹⁰James D. Thompson, Organizations in Action (New York: McGraw-Hill, Inc., 1967), p. 145.

encountered as one progresses in complexity from technical problems to socio-political problems.¹¹

Obviously, the system is too complex to provide a unique picture to all who are involved with it, be it as users (travellers or shippers), operators, pilots, passive or active observers (e.g. residents under the flight approach and take-off patterns at almost every major airport), planners and regulators (local or federal agencies), economists, or concessionaires. From each separate viewpoint the system's elements rank differently. So, while all are willing to admit the complexity of the system, each will recognize a different

¹¹As Dr. Karl M. Ruppenthal points out, "Technological problems we can solve. All they require is technical skill, adequate money, and a little time." Karl M. Ruppenthal, "Some Socio economic Considerations," in Air Transportation--A Forward Look, ed. by Karl M. Ruppenthal (Stanford, Calif.: Graduate School of Business, Stanford University, 1970), p. 160. It is the socio-political problems which give rise to the most difficulty. The relevancy of the entire quantitative methodology used in the exact sciences may no longer be valid. It may well be that the primary emphasis needs to be placed on research methodologies specially developed for social system problems. See for instance Olaf Helmer, Social Technology (New York: Basic Books, 1966), and Olaf Helmer and Nicholas Rescher, "On the Epistemology of the Inexact Sciences," Management Science, VI, 1959.

set of elements as being most important.¹² In the text that follows I have attempted to objectively present some of the technical, economic, and social factors influencing air and noise pollution abatement legislation in Canada. I have also tried to relate these factors to the determination of the appropriate roles of government and the business enterprise. Throughout my thesis I will adopt a "macro" viewpoint and deal with the problems presented on a social system level of analysis.

¹²In 1969, Straszheim pointed out that, "The various market and nonmarket consequences of international air service include impacts on the travelling public, airline owners and management, suppliers of aircraft and other commodities, and governments and their constituent taxpayers. The formulation of an objective function which reflects these effects is a complex task involving a variety of economic and political issues." Mahlon R. Straszheim, The International Airline Industry (Washington, D.C.: The Brookings Institution, 1969), pp. 16-17. This interaction, suggested by Straszheim, is further complicated by the complexities of the human environment, including pollution, a topic which he completely ignores in his otherwise informative book.

1.3 Air and Noise Pollution by Transportation Mode

Canada has a very transport-oriented society and economy. In 1967, the "average" Canadian travelled no less than 15 miles a day and generated no less than 30 ton-miles of freight per day, the highest figures for any nation in the world.¹³ Annual expenditures for both capital and operating costs by private and public transportation, including goods, amount to over 20% of Canada's Gross National Product.¹⁴

During the 1960s the number of air passengers in Canada tripled, substantially exceeding the growths in population and Gross National Product.¹⁵ In their study on transportation pollution Braithwaite, Clarke, Gunderson and Hornsby stated:¹⁶

Present indications are that by the year 2000, passenger traffic by road will double, by rail and bus combined will triple, and by air will increase by a factor of 15. Similarly freight is expected to double by water, triple by road, quadruple by rail and truck, and again increase by a factor of 15 for air (albeit still a small proportion).

As the air travel industry matures it is projected that it will cease to enjoy the disproportionate growth of the 1960s and that the rate of growth will gradually decrease to approximately the long-term forecast growth rate of the economy, that

¹³D.J. Reynolds, The Urban Transport Problem, Urban Canada, Problems and Prospects, Research Monograph 3 (Ottawa: Central Mortgage and Housing Corporation, 1971), p. 24.

¹⁴E. Braithwaite, et al., Transportation Pollution (Sydney, N.S.: Canadian Coast Guard College, 1972), p. 3.

¹⁵Canadian Air Transportation Administration, Pacific Region, Vancouver International Airport Proposed Expansion, Public Information Kit (Vancouver, B.C.: Transport Canada, 1973), p. 3.

¹⁶Braithwaite, et al., Transportation Pollution, p. 4.

is, about five percent increase per annum in G.N.P. in real terms.¹⁷ The new wide-bodied jets can carry a considerable quantity of air cargo even with full passenger loads, and airlines predict that seventy percent of all cargo will be carried in passenger aircraft.¹⁸ If this prediction comes true the prospects for increased air freight are extremely bright. The table below indicates where air transportation ranks in terms of freight and passenger miles compared to other transportation modes:

TABLE I
A COMPARISON OF TRANSPORTATION MODES

Mode	Freight (ton-miles)	Passenger (miles)
Road	12%	~87%
Pipe	23%	-
Rail	35%	<4%
Air	<1%	9%
Water	30%	-

Source: E. Braithwaite, et al., Transportation Pollution, Transportation Management Course, July-August 1972, p. 4.

A comparison of this table with data gathered in 1967,¹⁹ some six years earlier, indicates an increase in road freight from 9 to 12%, and a decrease in road passenger miles from 91 to 87%. Rail freight has decreased from 41 to 35%, and water freight has increased from 25 to 30%. The only other significant

¹⁷Canadian Air Transportation Administration, Public Information Kit, p. 4, 9.

¹⁸Ibid., p. 5.

¹⁹Reynolds, The Urban Transport Problem, pp. 22-24.

change has been an increase in air passenger miles from 4 to 9%.

With this background one can analyze the air pollution and noise pollution produced by the various modes of transportation to determine problem areas.

1.3.1. Air Pollution

The most serious elements in air pollution are toxic sulphur compounds and carbon monoxide produced by automobiles and industrial plants. Jet engines produce no sulphur compounds and very little carbon monoxide. Jet engines, however, do produce nontoxic but highly visible particulates. These are the small particles of unburned carbon forming the smoke plumes trailing jet engines.²⁰ A Ministry of Transport statement on February 12, 1973 said U.S. studies show on a nationwide basis "... less than two percent of that country's total air pollution comes from commercial aircraft and that comparable studies in Canada indicate this figure to be lower."^{21,22} While there is reason to conclude that air transportation is not contributing more than its "share" to air pollution, there is an increasing

²⁰Tipton, "Aviation's Three Environments," p. 23.

²¹Bill Bachop, "Noise no problem, airport foes told," Vancouver Sun, February 13, 1973, p. 148.

²²U.S. Department of Health, Education and Welfare, Report of the Secretary to the U.S. Congress, December 1968, on The Nature and Control of Aircraft Engine Exhaust Emissions (Washington, D.C.: Department of Health, Education and Welfare, 1969) attributed only 1.2% CO, 0.7% HC, 0.1% Nitrogen Oxides and 0.1% Particulates of the total U.S. output of pollutants to U.S. civil aircraft. One would expect that Canada would produce about 10% of the U.S. total if a direct relationship exists between air pollution and population.

awareness of the potential hazard at every major airport in the world due to pollution caused by the operation of jet aircraft. In a study conducted last summer at Los Angeles International Airport (LAX), for example, the Los Angeles County Air Pollution Control District concluded that:²³

1. LAX is a significant area source of air contaminants, generally upwind of metropolitan Los Angeles. The 6.7 tons of particulate matter emitted daily in the 4.7 square mile LAX source exceeds the atmospheric loading rate of particulates from any area of comparable size in Los Angeles County.
2. About 70% of total jet aircraft operation time, to and from 3500 feet altitude, is spent in the idle and taxi mode, which accounts for 55% of total aircraft emissions.²⁴
3. The new "smokeless" JT9D turbofan engine, which powers the 747 superjet, emits less visible emissions and about the same total weight of air contaminants per flight as the lower thrust JT4A turbojet and JT3D turbofan engines used on Boeing-707 and Douglas DC-8 aircraft, and one-half of the total for the unmodified JT8D turbofan engine mounted on the short-haul Boeing-727, -737 and Douglas DC-9 aircraft.

This research demonstrates first of all that air pollution must be thought of in terms of concentrations, both of contaminants and of people. Urban areas presently contain about 75% of the Canadian population and by the year 2000 may contain 94% of the total population.^{25,26} With the notable exception of Ste.

²³R.E. George, J.S. Nevitt, and J.A. Verssen, "Jet Aircraft Operations: Impact on the Air Environment," Journal of the Air Pollution Control Association, XXII, No. 7, (July 1972), 508, 515.

²⁴This conclusion is supported by Sawyer who tested emissions for each operating mode for turbojet and automotive piston engines. R.F. Sawyer, "Reducing Jet Pollution Before It Becomes Serious," Astronautics and Aeronautics, VIII, No. 4 (1970), pp. 62-67.

²⁵Reynolds, The Urban Transport Problem, pp. 85-86.

²⁶Braithwaite, et al., Transportation Pollution, p. 7.

Scholastique (the new Montreal International Airport which will be discussed later) nearly all of Canada's major airports are near or in urban areas. Although jet aircraft contribute little to the overall air pollution on a national scale, they may contribute a considerable amount in a specific urban setting.

The other aspects of the Los Angeles airport study which are worth noting are (1) an emphasis on the gains that could be achieved by minimizing engine running time on the ground and (2) the technological advances possible in air pollution reduction.²⁷ Through actual field testing and pollutant monitoring some meaningful results are being obtained. The visibility of air pollution from jet aircraft cannot be ignored. It is as apparent to the observer as the plume of the early railroad steam engine and the smoke from a bee-hive sawdust burner, and despite the small contribution it makes to overall air pollution it will be eliminated by public demand.²⁸

1.3.2 Noise Pollution

Social surveys indicate consistently that the noise from surface automotive traffic gives rise to more neighborhood dis-

²⁷The smokeless combustors mentioned not only reduce the offensive smoke output but also decrease the total emissions by 24 percent. The jet engines of a decade ago produced nearly three times the emissions of these improved engines. It is anticipated that improvements will continue even further.

²⁸The December 1968 report of the U.S. Secretary of Health, Education and Welfare to the U.S. Congress on The Nature and Control of Aircraft Engine Exhaust Emissions in regard to public reaction states, "The sight of smoke plumes from any source seems to suggest to many people that officials charged with controlling air pollution are guilty of inaction."

satisfaction than the noise from aircraft does.²⁹ This is probably because the surface automotive traffic noise is not restricted to areas near airports but pervades almost every spot in our modern society. Future sonic booms may follow a similar pattern. Although the air transportation industry only handles 9% of the passengers and less than 1% of the country's freight, it certainly contributes a great deal more to the problem of noise pollution in Canada. As early as 1967, John O. Powers of the U.S. Federal Aviation Administration's Office of Noise Abatement told a meeting of the Acoustical Society of America:³⁰

Noise now threatens to choke the orderly development of commercial air transportation and if the increase in noise is permitted to continue unabated the air transportation system will not realize its full potential...there will not be in the foreseeable future a simple, single solution by which the noise problem can be reduced to acceptable dimensions.

Unlike air pollution, noise pollution in the air industry contributes far more than its "fair share" of today's transportation pollution. As Theodore Berland states,³¹ "In the annals of racket, airplanes have a chapter all to themselves."

A comparison of the environmental sounds produced by several transportation modes illustrates why the quieting of aircraft, especially in communities surrounding airports, has

²⁹Peter A. Franken, "A Panel Discussion-Approaches to Noise Control" in A Conference on Noise in the Environment (Toronto: The Conservation Council of Ontario, 1971), p. 71.

³⁰Theodore Berland, The Fight for Quiet (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1971), p. 172.

³¹Ibid., p. 171. Berland devotes Chapter 12 of his book to this subject.

been the focus of the most attention to date. Table II shows such a comparison:

TABLE II

A COMPARISON OF NOISE LEVELS BY TRANSPORTATION VEHICLE

Transportation Vehicle	Sound Level (PNdB) ³²
Average car (15 feet)	70 dB
Average truck (15 feet)	80 dB
Sports car, heavy truck	90 dB
Subway (inside)	90-100 dB
Snowmobile	100 dB
Heavy traffic	100 dB
Motorcycle	100 dB
Jet airplane	120 dB
Jet airplane (100 feet)	130 dB

Sources:

1. R. Murray Schafer, The Book of Noise (Vancouver, B.C.: Price Printing Ltd., 1970), p. 2.
2. Theodore Berland, The Fight for Quiet (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1971), p. 181.
3. Clifford R. Bragdon, Noise Pollution, the Unquiet Crisis (Philadelphia, Pa.: University of Pennsylvania Press, 1971), p. 52.

One of the more active critics of the very high noise levels from jet and other aircraft, Berland, believes that:³³

The worst noise offender of our generation, as far as the general public is concerned, the aviation industry, has never tried to Think Quiet. Never, that is, until public, regulative, and legislative pressure was applied.

³²The decibel is a unit for measuring the intensity of sound. It is used to express the relationship between the faintest sound man can hear and other sounds in the environment. It is logarithmic, so that an increase of 10 decibels means a tenfold increase in sound intensity, a 20-decibel rise a hundredfold increase, a 30-decibel rise a thousandfold increase. The values in Table II are in Perceived Noise Decibels (PNdB), a measure of noise as it is perceived by man.

³³Berland, The Fight for Quiet, p. 240.

This statement could equally well be applied to the railroad industry regarding air pollution or the shipping industry regarding oil spills. Public, regulative, and legislative pressure is required especially in transportation industries which do not enjoy excess profits.

The application of regulative (FAA) pressure has succeeded in making the new Boeing 747, Lockheed 1011, and McDonnell-Douglas DC-10 quieter than the Boeing 707 or McDonnell-Douglas DC-8.³⁴ Estimates to "retrofit" existing four-engine aircraft with such "quiet" engines run in the neighborhood of \$650,000. per aircraft,³⁵ a cost many airlines are not willing to pay without legislation. Public pressure is being applied in many areas. As recently as February 27, 1973, a \$0.66 per passenger noise tax was levied at Paris airport to enable hospitals and schools to soundproof and enable disgruntled home-owners to move away.³⁶

The problem of the sonic boom³⁷ is on the not too

³⁴Bachop, "Noise no problem," p. 148. See also Franken, "Approaches to Noise Control," p. 71, and Canadian Air Transportation Administration, Public Information Kit.

³⁵Franken, "Approaches to Noise Control," p. 71.

³⁶Canadian Television News, Vancouver, B.C., 11:30 p.m., February 27, 1973.

³⁷The sonic boom is, in effect, the shock wave of the aircraft flying at supersonic speed, forcing its way through the air masses gathered in front of it. Normal atmospheric pressure is 14.7 psi, varying slightly with elevation above sea level. As the cone of the shock wave strikes an object, the pressure increases sharply--in about .003 second. Within approximately .02 second the pressure decreases smoothly to something less than normal, then rises again to normal. This "overpressure" is generally accompanied by the release of energy manifested in a sharp explosion or loud clap of thunder overhead called a "sonic boom". A typical boom is an over

distant horizon. We do not know as yet what the commercial sonic boom will be like, but we have reason to believe the problems associated with this form of noise pollution will be much more difficult to solve than those associated with airport noise or air pollution. The projected damage due to the sonic boom first became a reality to Canadians when a Canadian military pilot flew an F-104 jet fighter at supersonic speed at an altitude of 500 feet causing \$300,000. damage to Ottawa airport.³⁸ Closer to home, in 1969, "a U.S. Navy F 4 acrobatic plane accidentally exceeded the speed of sound while flying at three hundred feet over Kelowna, B.C., and reduced 75% of the windows in an eight-block area of downtown Kelowna to smashed shards."³⁹ These rather dramatic events, like the Oklahoma City sonic boom tests, tend to over-emphasize the sonic boom by measuring the effects of low altitude flight. On the other hand, the matter deserves detailed study before large segments of the world's population are subjected to the adverse effects of the sonic boom. In Chapter III we will take a closer look at the technical problems associated with noise pollution in the air transportation industry.

pressure of 2-3 pounds per square foot. An early paper by Roth gives more detail, see Roth, "Sonic Boom: A Definition and Some Legal Implications," Journal of Air Law and Commerce, XXV (1958), 25, 68. In addition, Theodore Berland goes into great detail on the subject on a technical level in Berland, The Fight for Quiet, pp. 182-185.

³⁸Robert Alex Baron, The Tyranny of Noise (New York: St. Martins Press and The MacMillan Company, 1970), p. 103.

³⁹John Fisher, What You Can Do About Pollution Now (Don Mills, Ont.: Longman Canada Ltd., 1971), p. 263.

1.4 Characteristics of the Canadian Air Transportation Industry

This thesis deals specifically with the Canadian air transportation industry. In areas such as pollution legislation considerable differences exist between Canada and other nations. In other areas, such as operating problems and long term goals, Canada's participation in the international aviation organizations, the International Air Transportation Association (IATA) and the International Civil Aviation Organization (ICAO), emphasizes the common nature of the air transportation industry. In general, I would say that the common characteristics are based on economic and business decision-making aspects of operating in the international aviation field, whereas the unique characteristics are based on the environmental, political and social climate of the country under review. In order to set a course of action for the Canadian aviation industry one must consider both aspects, internal and external.

1.4.1 Common Characteristics

Some of the common characteristics of the air transportation industry are listed below:⁴⁰

1. It is a service industry with high costs, notably in labor, that render it specially vulnerable to inflation.⁴¹

⁴⁰Air Transport Association of America Economics of Air Transport: An Overview (Washington, D.C.: Air Transport Association of America, 1971), p. 2.

⁴¹The breakdown of operating expenses given by the ATA Major U.S. Airlines, Economic Review and Financial Outlook 1969-1973 (Washington, D.C.: Air Transport Association of

2. It is closely regulated by the government.⁴²
3. It is extremely competitive on an international scale.
4. Its demand is highly seasonal.
5. It has grown very rapidly.
6. It is extremely sensitive to fluctuations in the economy.⁴³
7. It has high technological turnover and is therefore a large user of capital.

Rising costs are particularly evident with the average landing fee increasing 20% from 1969 to 1970 (105% greater than 1965) in comparison to a 23% increase in the consumer price index between 1965 and 1970. Jet fuel costs increased 15% between 1965 and 1970. Interest costs for airlines in the U.S. totaled

America, 1969), slide 22, indicates the high labor cost common in the aviation industry, as shown below:

Criteria for Historical Airline Inflationary Index for Cash Operating Expenses

<u>Expense Item</u>	<u>Approx. % of Total</u>	<u>Indicator Used</u>
Wages and Salaries	45%	Cost/Employee
Fuel	15%	Cost/Gal. of Fuel
Maintenance Materials	5%	Cost/Hour Flown
Miscellaneous (Insurance, Communication Services, etc.)	35%	GNP Deflator

⁴²One major complaint of airlines is that because airline prices are regulated and airline costs are not, in times of sustained inflation, costs keep going up faster than the regulators can get around to adjusting fares.

⁴³R.E.G. Davis, Airlines of the United States Since 1914 (London: Putnam & Company Ltd., 1972), p. 576, points out that, oddly enough, the development of each successive major generation of transport aircraft has occurred when either the economic or political climate in the world has been far from auspicious. The Boeing 707/Douglas DC-8 jets entered service when the world air traffic growth curve experienced a distinct hiccup. Now the Boeing 747, DC-10, L-1011, and A-300B are entering service when experts are looking gloomily at the air traffic curve once again. Fluctuations in the economy are particularly significant to both airlines companies and aircraft manufacturers.

\$384 million in 1970--a 35.5% increase over 1969 and six times the 1960 level.⁴⁴ Due to the nature of the industry these U.S. figures are reflected in the Canadian air transportation industry. Domestic competition is not as keen in Canada as in the United States due in part to a smaller travelling public and in part to governmental regulation. On an international scale Canada's position can be illustrated by the percentage share of world airline traffic shown in Figure 1.1 and the market share of the North Atlantic Route shown in Figure 1.2. As can be seen from Figure 1.1, Canada has a 3-4 percent share of world airline traffic, a figure which will likely increase with future increased participation in the charter business⁴⁵ and increasing air route miles to such locations as mainland China. Active participation on the North Atlantic Route is indicated by an eight percent share of this market, about twice the U.S. per capita market share.

Common characteristics of governmental agencies with respect to aviation include unified action on banning SST traffic over land areas, attitudes toward non-scheduled air carriers, trade-offs between government owned airlines concerning international routes and landing rights, and other negotiated agreements between nations and between air carriers. The similarities in operating methods, equipment, and procedures necessitate fierce non-price competition. (although one

⁴⁴Air Transport Association of America, Major U.S. Airlines, pp. 3-5.

⁴⁵Ibid., p. 7. In 1963 less than 5% of the airlines passenger market was served by "non-skeds"; by 1971 this figure rose to nearly 30%.

FIGURE 1.1

PERCENTAGE SHARE OF WORLD AIRLINE TRAFFIC 1970
BY MAJOR AIRLINES AND GROUPS

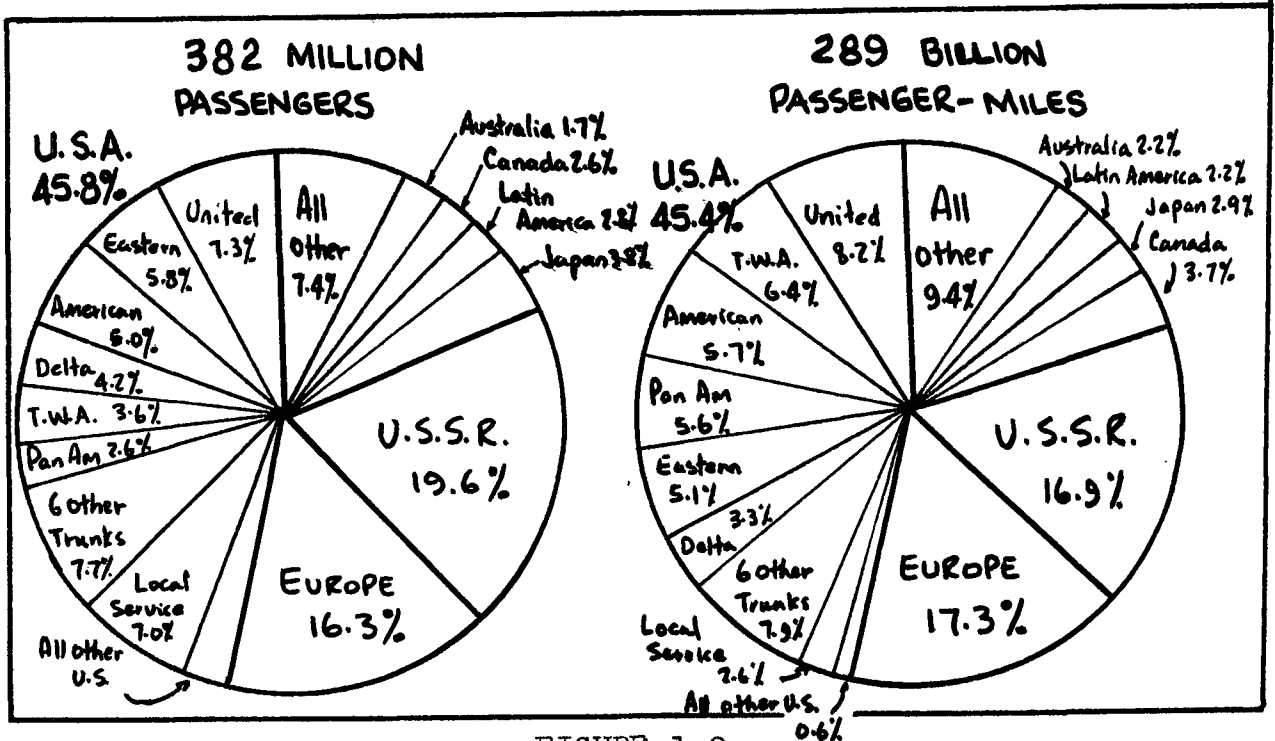
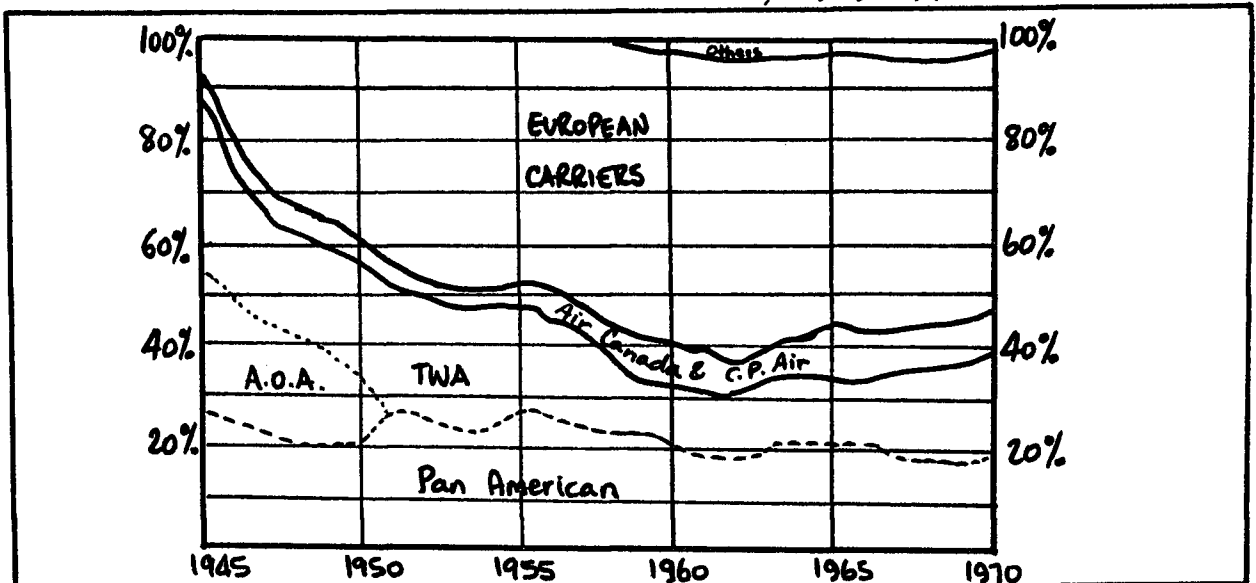


FIGURE 1.2

NORTH ATLANTIC ROUTE: MARKET SHARE
BY MAJOR AIRLINES OR GROUPS, 1945-1970



Source: R.E.G. Davis, Airlines of the United States Since 1914 (London: Putnam and Company Ltd., 1972), pp. 672-673.

could certainly argue the existence of price competition during the last two years). The economic and business decision-making aspects of the air transportation industry are particularly relevant in the international competitive environment.

1.4.2 Unique Characteristics

With the competitiveness of the international air industry in mind, one might well wonder if national standards and regulations could create a competitive advantage. One major airline in the United States, for example, spent \$112 million over the past 10 years on air pollution and noise abatement--a figure equivalent to 43 percent of its profit during the same period.⁴⁶ Another major airline flying the same route may have spent very little.⁴⁷

Governmental expenditures on transportation may reflect different objectives such as:

- (1) The objective of efficiently providing transportation for goods which are desired by the public or which may promote regional or national development.⁴⁸
- (2) An objective of stabilizing the economy through manipulation of government expenditures on large, labor-intensive items such as aircraft.
- (3) A long-run development program with a steady path of transportation expenditure.

⁴⁶Ibid., p. 4.

⁴⁷The topic of environmental quality and international trade is dealt with in Chapter Four, Section 5.

⁴⁸John B. Beare, "Investment Policies and Economic Stabilization Policies: A Case Study of Transport," (paper presented at the University of Toronto, York University Joint Program in Transportation, Toronto, 1969).

Each objective or development policy has a different effect on the aviation industry and may lead to a competitive advantage in international competition.

I stated earlier that unique characteristics of the air industry in a particular country are based on the environmental, political and social climate. To expand on this, most of Canada's domestic trade, commerce, population, and transportation network has been confined to within 400 miles of the U.S. border. Recently, with an increased emphasis on frontier development of natural resource areas such as the Beaufort Basin and the MacKenzie Delta, the Arctic Islands, the Newfoundland-Labrador coast and the Northwest Territories, the role of the regional carrier will likely change. The use of helicopters, Beaver aircraft, STOL/VTOL, and others will no doubt increase. Along with this increase will come an emphasis on environmental protection and an orderly, planned development. The environmental climate for aviation development in Canada will, except for the existing 400 mile wide transportation network, be much different from the United States. On an international basis, the environmental climate for aviation development will be much more uniform, especially with regard to populated areas.

The political climate of a particular nation is another unique characteristic worth noting. The degree of government control of airlines varies between nations, providing an interesting mix of private enterprise motivated by profit and public ownership motivated to provide low cost public transpor-

tation. The degree of federal, provincial, and municipal control over commercial aviation varies from nation to nation, compounding the problem of agreement on goals, priorities, and direction in the air transportation industry.

The social climate of a nation refers mainly to the "way of life" of its people. As mentioned in Section 1.3, Canada is a very transport-oriented society. To what extent is the "average" Canadian willing to sacrifice quiet and clean air for the privilege of using air transportation. This balance or "trade off" decision is not easily made and, I suggest, may not be the same in Canada as in another nation. The determination of international standards by IATA, the United Nations, or any other supra-national body rests upon agreement of all nations involved. The mixed reaction of nations toward the SST indicates some degree of latitude in this "trade off" decision.

1.4.3 Summary

This section briefly discussed common and unique characteristics of the air transportation industry in Canada. The agreement on international standards with respect to environmental quality must recognize the individual differences of each nation with respect to physical environment, social and political systems, and attitude towards a desirable balance of costs and benefits. It was also pointed out that a competitive advantage could be enjoyed by some nations if international agreement was not reached on regulations and standards.

1.5 International Implications of Domestic Legislation

In August 1972, Richard Nixon made the statement that, "Environmental problems do not distinguish between national boundaries or differing social and economic systems."⁴⁹ What does differ is the way in which nations and differing social and economic systems presently deal with environmental problems. The international implications of domestic legislation which reflects one nation's attitudes toward appropriate environmental control may be the imposition of that country's goals on others.⁵⁰ This is demonstrated by the achievement of nearly every goal, including nearly all the U.S. proposals, established for the U.N. Conference on the Human Environment in June, 1972, despite opposition from several developing countries.⁵¹

What are some of the negative aspects of imposing one nation's domestic legislation on other nations? The first drawback is that very few individuals, or groups, or nations, can divorce themselves from "their own" problems and look at the over-all problem of environmental degradation. Another drawback is that each nation has a unique combination of geograph-

⁴⁹The President's Message to Congress, August 1972, quoted in Environmental Quality-1972, Third Annual Report of the Council of Environmental Quality (Washington, D.C.: U.S. Government Printing Office, 1972).

⁵⁰Mahlon R. Straszheim states in The International Air-line Industry, p. 17, "Various nations differ in their attitudes with regard to international air transport objectives. This can be explained in part by fundamental differences in social and economic institutions and ideologies."

⁵¹U.S. Council on Environmental Quality, Environmental Quality--1972 (Washington, D.C.: United States Government Printing Office, 1972), p. 80.

ical areas with different ecological tolerances (and even human tolerances) which will be reflected in domestic legislation. Finally, some nations are better prepared to bear the financial burden of the fight against pollution.

What are some of the positive aspects of imposing one nation's domestic legislation on other nations? One definitely positive aspect is that of saving time. If nations can agree to adopt policy already formulated and accepted by one or more nations, the speed of achieving uniform regulations may far outweigh the disadvantages mentioned above. A second advantage is that in the case of jet engine air pollutants and noise, the degree of latitude in establishing regulations is set more by safety considerations than by the physical environment. The third factor is that once a "spaceship Earth" closed system point-of-view is adopted, it is the total of all pollutants that is the important consideration. Nations putting forth legislation for world-wide acceptance are likely to be motivated to do so because of their high percentage of this total rather than any ulterior motive such as preserving economic disparity between nations.

The lead taken by the United States Federal Aviation Administration has been most fortunate for the international air industry. Stuart G. Tipton reports that:⁵²

The net result of both the new engine technology of wide-body jets and the improved burner cans developed for present jets is that jets should be virtually smokeless by the mid-1970s.

⁵²Tipton, "Aviation's Three Environments," p. 24.

Advances in noise-suppression are slower; however, in late 1969 the FAA announced improved noise standards and the quieter engines of the Boeing 747, Lockheed 1011 and McDonnell-Douglas DC-10 --- a sign of progress.

1.6 Summary

A social system approach which recognizes interactions and feedback in the social, economic and political environment is required for an understanding of air transportation and the human environment. Gabriel Bouladon made a technological forecast at the October 1968 IATA meeting which included the statement that:⁵³

The future of aviation is bright, but on one condition: it must be realized that its limitations are human and not technical. Administrators must tackle the difficult problem of airports with imagination and courage, and scientists must try to introduce their techniques into human life in such a way as to respect man's nature and environment.

Similar thoughts were conveyed by Alan S. Boyd, who stated:⁵⁴

The future not only of aviation but of all transportation will depend also on how well we are able to soften the impact of transportation on a world whose people are increasingly vulnerable to noise, pollution and disruption of their neighborhoods and lives.

In this chapter I have introduced the subject of Air Transportation and the Human Environment and have related it to the Canadian and international scenes. Many of the problems of

⁵³Gabriel Bouladon, "A Technological Forecast," in Aviation's Role in Future Transportation (Munich: International Air Transport Association, 1968), p. 25.

⁵⁴Alan S. Boyd, "The Situation in North America," in Aviation's Role in Future Transportation (Munich: International Air Transport Association, 1968), p. 212.

noise and air pollution are dealt with through municipal channels at the source of the pollution. Although one cannot criticize those involved in the imposition of city bylaws and ordinances, there appears to be a definite need to address this difficult problem on a national, or better still on an international, level. The next chapter introduces some of the problems met in the human environment and reviews Canadian legislative attempts to solve these problems.

CHAPTER II

AIR AND NOISE POLLUTION ABATEMENT LEGISLATION IN CANADA

2.1 State of the Art

This section presents the existing air and noise pollution laws regarding air transportation in Canada. Some claim that, "In Canada the sky is exclusively a federal matter."¹ On the other hand the general list of powers in the British North America Act makes clear the intention that local matters should be dealt with locally, while national matters are dealt with nationally.² It appears that the net result has been an absence of comprehensive jurisdiction at either level of government over all aspects of environmental management.³ Less than three years ago a survey conducted by Canadian Industries Limited for the Canadian Council of Resource Ministers came to the conclusion that:⁴

¹R. Murray Schafer, The Book of Noise (Vancouver, B.C.: Price Printing Ltd., 1970), p. 17.

²A good summary of proprietary and legislative rights of provincial and federal governmental bodies is given in E. Roy Tinney and J.G. Michael Parkes, "Enhancing the Quality of the Environment: Current Federal Legislation and Programs," Habitat, XIII, Nos. 5 & 6 (1970), 16-18.

³Stanley S. Stein, "Environmental control and different levels of governments," Canadian Public Administration, Vol. XIV, No. 2 (Spring, 1971), 142.

⁴Canadian Council of Resource Ministers, A Digest of Environmental Pollution Legislation in Canada, Air and Soil (Montreal, P.Q.: Canadian Council of Resource Ministers, 1970), p. F-1. At this time "nuisance" provided a broad avenue

There is very little federal legislation on air pollution. The subject has not yet been treated in specific, comprehensive legislation. Among the enactments where the problem of air pollution has been treated incidentally, the Criminal Code and Canada Shipping Act must be mentioned. As to the Criminal Code, its provisions on common nuisances would appear to extend to circumstances amounting to air pollution.

In 1970 air quality was mainly under the control of provincial authorities with pollution control legislation in six provinces, little or no legislation in four Atlantic provinces and Nova Scotia leaving it to the municipalities to make local bylaws governing air pollution control.⁵

The first major step toward comprehensive air pollution legislation came on October 9, 1970 when Prime Minister Trudeau announced Canada's new Department of the Environment which officially came into being June 11, 1971, following proclamation of the Government Organization Act, 1970.⁶ The new Department of the Environment,⁷ also known by the short-form

of legal action requiring lighter proof requirements than other common law doctrines. The Canadian Council of Resource Ministers predicted that "nuisance" would be the basis for battles waged against pollution in all its forms (see p. CL-1).

⁵Frank Morgan, Pollution, Canada's Critical Challenge (Toronto, Ont.: The Ryerson Press and MacLean-Hunter Ltd., 1970), p. 24.

⁶Department of the Environment, Environment Canada, Its Organization and Objectives (Ottawa: Information Canada, 1971).

⁷According to a recent publication of the Department of the Environment, Canada and the Human Environment, p. 33, the new Department of the Environment was built around the former Department of Fisheries and Forestry, and now includes the Meteorological Service from the Ministry of Transport, the Air Pollution Control and Public Health Engineering Divisions from the Department of National Health and Welfare, the Water Sector from the Department of Energy, Mines and Resources, the Canadian Wildlife Service from the Department of Indian Affairs and Northern Development, and the Canada Land Inventory from the Department of Regional Economic Expansion.

Environment Canada, was to:⁸

...spearhead the attack on pollution and ensure the proper management and development of the country's renewable natural resources. It has the responsibility to initiate Government-wide programs and to coordinate efforts related to environmental protection. It also provides specialist advisory services to other departments, both in the formulation of programs and the development of regulations under Federal Acts assigned to other Ministers.

It is apparent that the formation of the Department of the Environment is not a "cure-all"; however, the depth of environmental concern in Canada is reflected in its formation. Today certain Acts embrace many facets of environmental control, whilst in other cases the legislation is divided among many Acts.⁹ The problems of mixed jurisdiction are dealt with in Section 2.4.

2.2 The 1971 Clean Air Act

On June 23, 1971, Federal Parliament assented to the Clean Air Act which established air quality objectives for five major air pollutants: sulphur dioxide, particulate matter, carbon monoxide, photochemical oxidants and hydrocarbons.¹⁰ The national air quality objectives were developed in coopera-

⁸Department of the Environment, Environment and the Law, A Summary of Environmental Jurisdictions and Recent Federal Anti-Pollution Legislation in Canada (Ottawa: Information Canada, 1972).

⁹Department of the Environment, Environment Canada, Its Organization and Objectives, pp. 88-89.

¹⁰Clean Air and Water News, III, No. 45 (1971), 687. Air quality objectives for nitrogen oxides, the sixth major air pollutant were under consideration but not announced at this time.

tion with provincial authorities and were based upon a review of current scientific knowledge.¹¹ Figure 2.1 below shows how these objectives were set up.

FIGURE 2.1
NATIONAL AIR QUALITY OBJECTIVES

DESIRABLE RANGE	ACCEPTABLE RANGE	TOLERABLE RANGE	INTOLERABLE RANGE
Spot Air Quality Measurements	Continuous Monitoring Starts	Control Action Starts Increased Surveillance	
Detectability Level	Maximum Desirable Limit	Maximum Acceptable Limit	Maximum Tolerable Limit

Source: Department of the Environment, Environment Canada, Its Organization and Objectives (Ottawa: Information Canada, 1971).

In establishing "desirable", "acceptable", and "tolerable" levels for each major pollutant, recognition is given to differences between urban and rural settings. The use of three ranges enables the setting of priorities in tackling the pollution problem in Canada. Environment Canada projects that "immediate control and abatement action would be taken in areas where the maximum tolerable limit is exceeded and high priority would be placed on other areas in the 'tolerable' range."¹²

¹¹Canada, Clean Air Act, 1971, 19-20 Eliz. 2, ch. 47, section 20 (2), Ottawa: Queen's Printer, 1971, p. 967.

¹²Department of the Environment, Environment Canada, p. 37.

The main drawback with this scheme is that in those areas where information is plentiful, for example Hamilton, Sarnia, and Montreal East, realistic standards can be set, but in those areas such as the MacKenzie Delta and the Arctic Islands where information is scarce, realistic standards cannot be set with any degree of certainty. The danger, as I see it, is to define a level of pollution as "tolerable" only to find out in the long run this level was actually "intolerable".

The Clean Air Act may be summarized as having the following objectives:¹³

- a) To ensure by defining various levels of pollution, common standards which will permit a unified response nationally.
- b) To support and complement existing provincial legislation, but permit federal action when necessary to protect health.
- c) To create an inventory of source emission data, establish a national surveillance network,¹⁴ control the composition of fuels, etc.

Perhaps the most impressive factor in the Clean Air Act is its abilities to order polluting businesses to cease operations and to levy fines, on summary conviction up to \$500,000.¹⁵

¹³Braithwaite, et al., Transportation Pollution, p. 10.

¹⁴The national surveillance network ties nicely into U.N. World Meteorological Organization (WMO) international surveillance program (the Earthwatch Program) set up by the United Nation's Conference on the Human Environment held June 5-16, 1972 in Stockholm, Sweden. A rare example of coordinated action on pollution abatement and control.

¹⁵A fine of up to \$200,000. can be levied under Section 9 of the Clean Air Act (contravention of emission standards) and up to \$500,000. under Sections 17 (failure or refusal to comply with an order to cease operations) and 22 (sale and use of contaminated fuel) of the Act.

Although these abilities have been created, the onus still rests with the population to use the legislative framework that has been provided. At Vancouver International Airport, for example, there are no air pollution monitoring devices. The general attitude is that air transportation contributes less than two percent to the total of all air pollutants emitted to the atmosphere and no problem exists.¹⁶ The fallacy of this argument is pointed out by Ruppenthal, who states:¹⁷

The people in the world are demanding a stop to the ever increasing levels of noise, smog, pollution, and stench. Unless the aviation industry recognizes that fact, and recognizes it squarely, it may well be faced with legislation that will be unduly restrictive and perhaps punitive. Far better that the industry admit the problems of noise, vibration, and smog for what they really are and begin to attack them realistically.

The details released by the Los Angeles County Pollution Control District (see page 10) illustrate the fact that particulates from jet aircraft can be a serious problem. The Clean Air Act provides the following definition:¹⁸

"air pollution" means the condition of the ambient air, arising wholly or partly from the presence therein of one or more air contaminants, that endangers the health, safety or welfare of persons, that interferes with normal enjoyment of life or property, that endangers the health of animal life, or that causes damage to plant life or to property.

In the case of the Canadian air transportation industry, certainly the unique characteristics of Canadian northern

¹⁶Daryll Smith, Canadian Air Transportation Administration, Pacific Region, telephone conversation at Vancouver International Airport, Vancouver, B.C., February 19, 1973.

¹⁷Karl M. Ruppenthal, "Some Socioeconomic Considerations" in Air Transportation--A Forward Look (Stanford, Calif.: Stanford University, 1970), p. 159.

¹⁸Clean Air Act, Chapter 47, Section 2(1)(b), p. 951.

development and the dangers of upsetting the ecological balance and social patterns in low population density areas must be considered. The inadvertent modification of climate and the problems of particulate concentration in urban areas provide other challenges which may be categorized under the heading "air pollution".

The Clean Air Act of 1971 has set up a framework for effective legislative action in the control of air pollution. This represents a positive step in the direction of an overall environmental management program, a step in keeping with a social system approach to the problem of Air Transportation and the Human Environment.

2.3 Noise Pollution and the Law

At the federal level the control of noise in Canada is covered by Chapter 14 of the 2nd Supplement of the Revised Statutes of Canada 1970, which states:¹⁹

Section 6. The Minister of the Environment, in exercising his powers and carrying out his duties and functions under Section 5, shall (a) initiate, recommend and undertake programs, and coordinate programs of the Government of Canada, that are designed to promote the establishment or adoption of objectives or standards relating to environmental quality, or to control pollution; and (b) promote and encourage the institution of practices and conduct leading to the better protection and enhancement of environmental quality, and co-operate with provincial governments or agencies thereof, or any bodies, organizations or persons, in any programs having similar objects.

¹⁹Revised Statutes of Canada, 1970, Chapter XIV (2nd Supplement), Government Organization Act, 1971, Part I, Department of the Environment Act (Ottawa: Queen's Printer, 1971), p. 177.

Although this statute gives the Minister of the Environment the power to enact laws on noise pollution, this power has not been used and most noise pollution law is in the form of civic bylaws. Mr. J.W. MacNeill outlined the federal government contribution to solution of the noise problem in two areas during a Conference on Noise in the Environment held in Toronto in April, 1971. He stated:²⁰

Generally, the work falls into one of two categories:

1. Research on the physics or the physiology of noise; and the measurement of noise. (National Research Council, the Defence Research Board, and the Occupational Health Division of the Department of National Health and Welfare handled this research until the Department of the Environment incorporated it under the Assistant Deputy Minister, Atmospheric Environment (noise pollution research group)).²¹
2. Development and application of regulations or guidelines concerning noise and its control. (now incorporated under the Assistant Deputy Minister, Environmental Protection (noise control group)).²²

MacNeill also stated that the Civil Aviation Branch of the Department of Transport, "has been devoting a great deal of attention, particularly during the past two or three years, to noise in connection with airports."²³ The fact of the matter is that, at the present time, noise abatement policy for aircraft covers take-off and landing procedures under certain

²⁰J.W. MacNeill, "Legislation and Administration for Noise Control, The Federal Role" in A Conference on Noise in the Environment (Toronto: The Conservation Council of Ontario, 1971), p. 117.

²¹Department of the Environment, Environment Canada.

²²Ibid.

²³MacNeill, "Legislation and Administration," pp. 117-118.

circumstances only, and there are no regulations governing the noise of small planes and helicopters of any kind. R. Murray Schafer provides a picture of the situation in 1970 by stating:²⁴

At some of the larger airports there are certain procedures for larger aircraft...These procedures include the use of preferential runways, special climb and approach profiles for jets designed to reduce engine noise as much as possible consistent with safe operation of the airplane, and partial curfews of flights between midnight and 7 a.m. ...no regulations exist regarding the maximum permissible noise levels (in dB or some other acceptable quantified system) and thus no legal penalties for infractions could possibly exist. Canada is behind many other airport authorities where fixed limits are in force and computerized monitoring systems exist.

This situation has not changed appreciably in the last three years. Conversations with Mr. W.L. Inglis, Airport General Manager for Vancouver International Airport, and Operations Officer Mr. Ken Simpson on February 19, 1973 revealed an absence of continuous noise monitoring devices at Vancouver International Airport and only one mobile unit to measure noise levels "in the event of a complaint".²⁵ A single page Noise Abatement Procedures guide²⁶ issued in November 1971 by the Department of Energy, Mines and Resources provided flight procedures based on avoiding low level flight over residential areas. A survey of noise abatement procedures for Edmonton

²⁴Schafer, The Book of Noise, pp. 17-18.

²⁵Daryll Smith, Canadian Air Transportation Administration, Pacific Region, telephone communication, Vancouver, B.C., February 19, 1973.

²⁶Canadian Air Pilot Publication, Noise Abatement Procedures, Vancouver International Airport, Vancouver, B.C. (Ottawa: Department of Energy, Mines and Resources, 1971), p. L-4.

International, Edmonton Industrial, Winnipeg International, Toronto International, and Montreal International airports²⁷ revealed an emphasis on minimum circuit heights, preferential runways, maximum climb rates to 3,000 ft. ASL, and restricted hours of non-emergency airport use. Only in the case of Montreal International Airport was "fully automatic noise monitoring" installed (on the approaches to runways 06L, 06R and 24L), although several airports had mobile equipment for monitoring aircraft noise in any area around the airport.²⁸

The legislative power of the provincial government vis-à-vis noise pollution has been in the past and will continue to be nil. As Cummings and Mastomatteo put it, "Aircraft noise and its control comes under the jurisdiction of the Federal Ministry of Transport."²⁹ Yet this really oversimplifies the question of jurisdiction. Certainly the majority of noise pollution legal cases have been the result of municipal bylaws. This method of handling environmental disputes has been criticized, by both those involved in the disputes and the Municipal judges themselves. Mr. D. Hambling, Municipal

²⁷Ministry of Transport, Civil Aviation Branch, 1971 Flight Information Manual (Ottawa: Information Canada, 1971), PP. 5-21 to 5-39.

²⁸Ibid., p. 5-36.

²⁹L.T. Cummings and E. Mastomatteo, "Legislation and Administration for Noise Control, The Provincial Role," in A Conference on Noise in the Environment (Toronto: The Conservation Council of Ontario, 1971), p. 126.

Solicitor for the City of Ottawa states:³⁰

The court is not the least bit concerned with expert scientific evidence that noise at a certain level is objectionable and disturbs the community, unless the evidence can be proved beyond a reasonable doubt and within the principles of law as contained in the strict rules of evidence. In this connection difficulties are encountered with the courts, who before they will register a conviction under the anti-noise bylaw must be satisfied that in law the noise constitutes a public nuisance ... what may constitute nuisance to one person is not necessarily nuisance to another.

West Vancouver's Noise Abatement Bylaw (No. 2141), passed in 1967, reads as follows:

No hawker, huckster, pedler, petty chapman, news-vendor or other person shall by his intermittent or reiterated cries disturb the peace, order, quiet, or comfort of the public.

Clearly legislation of this nature cannot be the basis for a serious protection of our environment.³¹ As Victor Yannacone, one of the foremost researchers in the legal aspects of

³⁰D. Hambling, "Legislation and Administration for Noise Control, The Municipal Role", in A Conference on Noise in the Environment (Toronto: The Conservation Council of Ontario, 1971), pp. 130-131.

³¹According to "Survey Blames Public, Few Anti-Noise Laws Found," Vancouver Sun, March 6, 1973, p. 2.

A recent survey carried out on 90 communities entitled Survey of Community Noise Bylaws in Canada (1972) found only 3 to have effective legislation. Citizens' complaints lists motor vehicles as the No. 1 noise-maker, with construction second, surpassing barking dogs and late-night parties. The survey finds that Quebec City and Calgary have the most effective enforcement practices, and Burnaby has an explicit plan to reduce noise by reducing permitted levels over a period of time. While 4 municipalities are enacting their first anti-noise pollution legislation and 7 are reviewing their current bylaws, 12 are awaiting reports of studies, 16 are awaiting provincial legislation, and 48 have no plans for the future. Aircraft noise has not been comprehensively attacked in existing Canadian municipal bylaws.

environmental protection, states:³²

And now when we look to the law for answers to many of our social and environmental problems, we find that the law itself is the cause of many of those problems.

There are three avenues of appeal to the law for protection of the environment--judicial, administrative, and legislative. Judicial is basically an appeal to the federal, provincial, and municipal courts in which litigation is based upon statutory interpretation, and the common law of nuisance, negligence, and trespass. This emphasis on the "basic rights" of people and equity under the law does not represent a realistic approach to noise and air pollution in the aviation field. The administrative approach relies upon federal and regional regulatory agencies such as the Environmental Protection branch of the Department of the Environment and the Greater Vancouver Regional District. This approach can be particularly useful if the district serves a complete environmental region and not just a political region. Pollution recognizes only physical boundaries and should be handled within these boundaries. The third avenue, legislative, in my opinion comes closest to the macro-system approach required for environmental planning and control. Yannacone refers to this level as, "Developing new legislation that is ecologically sophisticated, environmentally relevant, socially responsible, and politically feasible."³³

³²Victor J. Yannacone, Jr., "Environment and the Law," in Environment--Resources, Pollution and Safety, ed. by William W. Murdoch (Stamford, Conn.: Sinauer Associates, Inc., 1971), p. 369.

³³Ibid.

By developing statutory law on the federal level, fully recognizing regional differences and accomodating such differences, considerable gains can be made.

The Clean Air Act of 1971 has started in the legislative direction concerning air pollution. On the other hand, a great deal of foresight and planning has gone into the development of plans for Ste. Scholastique Airport (Montreal II) without the benefits of specific noise legislation at the federal level. Perhaps it is time to put the cart back behind the horse on noise abatement legislation and pass a Noise Control Act of 1973!

2.4 Problems of Mixed Jurisdiction

The problems of mixed jurisdiction over responsibilities for the preservation and enhancement of our surroundings are most evident in the handling of noise and air pollution from jet aircraft. Malton, Toronto's International Airport, is the second busiest in Canada and already overloaded. John Skells, chairman of the Etobicoke Planning Board in whose area the airport lies, has claimed that ... "large jets discharge 70 pounds of pollutants each time they land. But techniques for measuring the degree and kinds of pollution are too unsophisticated to be used as a basis for realistic control legislation."³⁴ Although measuring techniques are, in fact, available the main problem lies in jurisdiction. The Federal government adopts the attitude that, "Effective response to the challenge of

³⁴Frank Morgan, Pollution, Canada's Critical Challenge, p. 50.

pollution depends, in the last analysis, not simply on a fixed jurisdictional framework, but on a flexible cooperation between the federal and provincial government, working together in programs of joint interest and concern."³⁵ To the municipal planner such phrases as "flexible cooperation" must be synonymous with inefficiency and lack of responsibility. Jurisdictional uncertainty presents real obstacles to the satisfactory integration of environmental management programs.³⁶

"Canadians," said Ron Harding (NDP--Kootenay West) recently, addressing the House of Commons, "are sick and tired of having the solution of pollution problems delayed because of mixed jurisdictions."³⁷ The fragmented approach used in Canada is inherent in the BNA Act, which does not facilitate a social system approach to problem solving. J.W. MacNeill describes the jurisdictional problem thus:³⁸

At present, all orders of government have substantial roles to play in managing the environment--federal and provincial authorities by virtue of a wide variety of powers, and municipal authorities with the powers and responsibilities assigned them by provincial legislatures. ... There is considerable disagreement, however about where the boundaries lie between the jurisdictional spheres of each government. This jurisdictional uncertainty presents real obstacles to the satisfactory integration of environmental management programs. It also makes it difficult to describe the existing jurisdictional framework.

³⁵Department of the Environment, Environment and the Law.

³⁶J.W. MacNeill, Environmental Management, A Constitutional Study Prepared for the Government of Canada (Ottawa: Information Canada, 1971), p. 9.

³⁷The Vancouver Sun, "Clean Air Bill Challenged as Anti-Pollution Weapon," February 20, 1971.

³⁸J.W. MacNeill, Environmental Management, pp. 8-9.

The truly short-sighted and unrealistic approach to this problem is, in my opinion, reflected by Tinney and Parkes' recommendation. They state:³⁹

To be effective and efficient, joint Federal-Provincial consultation, negotiations and cooperation are essential. In the past this has sometimes meant interminable wrangling, bickering and little action. Yet the urgency of the environmental pollution problem, its crisis significance for all Canadians, and its effect on the very quality of our way of living provide the catalyst for the cooperation missing in the past.

The difficulties with this approach are the following:

- 1) There is no reason to believe that those concerned with the "wrangling" and "bickering" do, in fact, either realize or care about environmental protection, except in a very peripheral way as a plank in their political platforms.
- 2) The tremendous back-log of failures in Federal-Provincial negotiation certainly argues in favor of continued failure in the future, especially on matters involving governmental expenditures.
- 3) It deals with the effects of mixed jurisdiction and not the cause, a point I will expand upon.

If Canadians are to restore and enhance the quality of their environment the legislative structure must change. Any attempt to coordinate a program of action within the existing legislative framework will meet with internal, structural problems. The resulting inefficient legislation produced by such an attempt will reflect these inherent weaknesses.

To chart a course of action which will be responsive to a changing, dynamic environment and simultaneously respon-

³⁹Tinney and Parkes, "Enhancing the Quality of the Environment," p. 18.

sible to the people of Canada the underlying rule-making structural framework cannot be divided. One might compare this to a business organization. If the underlying structural components --the unity of command, chain of command and communications network--are weak, the organization's chances for survival in the business environment are weak. In my opinion, the best way around the problems of mixed jurisdictions in Canada, the resulting inefficiency, and the difficulties in dealing with the complexities of the human environment of the 1970s is to structurally upgrade the legislative framework of the 1860s. The British North America Act was passed by British Parliament in 1867 and stands virtually unchanged today, 106 years later.⁴⁰ Modern day technology creates modern day problems. In the social sciences these problems are becoming increasingly complex and difficult to solve. By starting at the structural cause of the problem rather than blindly attempting to design around its effects perhaps these social science problems will be reduced to a reasonable size and eventually solved.

2.5 Law as Social Policy

The rights of property holders near airports to a quiet and clean environment have increasingly come into conflict with whatever rights the public has to relatively unrestricted air

⁴⁰Provincial legislative rights over resources (Section 92, BNA Act) and Federal legislative rights under the BNA Act, International treaties and the Criminal Code are particularly confused. Similarly provincial proprietary rights over resources (Section 92, BNA Act) overlap to some extent with Federal proprietary rights over resources (Sections 108 and 117, BNA Act).

travel.⁴¹ The air traveler is entitled--as a matter of absolute right--to the safest possible flight which the state-of-the-art in modern aviation technology is capable of providing. The homeowner and the man on the street are entitled to protection from the hazards of aircraft operations.⁴² Environmental law is not new. There have been suits for many years, but they have usually revolved around damage to an individual or his property, and seldom have dealt with such intangibles as the desecration of a community or a region.⁴³ This basic issue of individual rights and community rights poses a difficult balancing process for the government and results in the formation of social policy. Figure 2.2 illustrates this process.

Dudley F. Pegrum states,⁴⁴ "It is the task of the law, as it is concerned with economic policy for private business, to develop formal controls or rules that will set the limits within which private enterprise can be left free to use its own discretion." The desirable degree of discretion should be

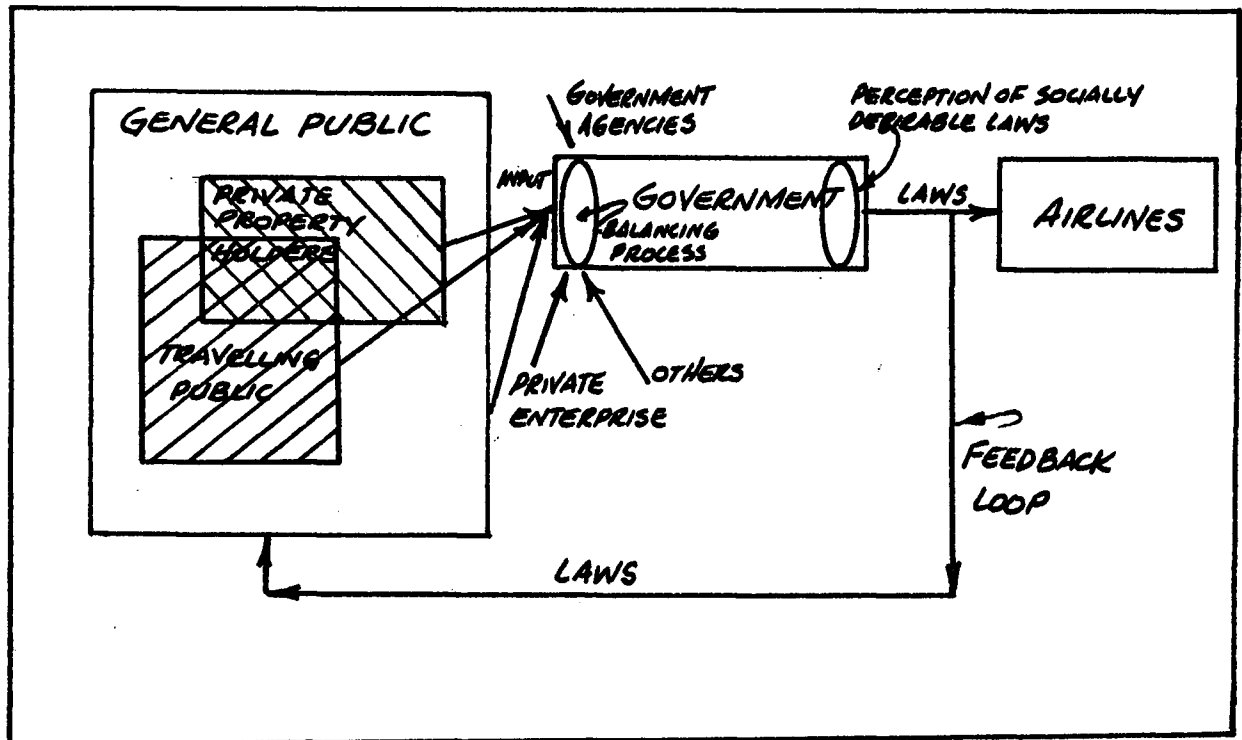
⁴¹Michael B. Meyer, "Air and Noise Pollution Surrounding Airports: East Haven v. Eastern Airlines, Inc." in Environmental Affairs (Brighton, Mass.: Environmental Affairs, Inc., Boston College Law School, 1972), p. 862.

⁴²Victor J. Yannacone, Jr., "Aviation and the Law" in Master Planning the Aviation Environment (Tucson, Arizona: University of Arizona Press, 1970).

⁴³Thomas W. Wilson, Jr., International Environmental Action, A Global Survey (Cambridge, Mass.: Dunellen, University Press of Cambridge, Mass., 1971), p. 81.

⁴⁴Dudley F. Pegrum, Transportation Economics and Public policy (Homewood, Illinois: Richard D. Irwin, Inc., 1963), p. 251.

FIGURE 2.2
THE FORMATION OF SOCIAL POLICY



based on the concept of social responsibility of business, a topic to be discussed later. Pegrum's remarks prompt one to investigate several questions, the first being which governing body should develop the formal controls or rules he mentions. As shown in Figure 2.2 the inputs to government consist of the vested interests of the travelling public, property holders (which may not be mutually exclusive of the travelling public), and the remainder of the electorate. Other input may include the recommendations of governmental agencies, private enterprise, and experience of other decision-making bodies address-

sing environmental policy issues. Several factors favor a federal government formulation of social policy concerning noise and air pollution associated with airport location.

These factors include:⁴⁵

1. Provincial and municipal authorities are loath to enforce anti-noise ordinances due to a variety of reasons including the fear of losing an important industry to another province. On the municipal level this may take the form of fear of lost employment for area residents.
2. Federal authority transcends political boundaries and thus can be more objective and provide consistent policy between airports within Canada.
3. The federal government is in the best position to conduct research, to obtain feedback, and to build upon the knowledge gained in sequential installation.
4. The federal government must make decisions representing Canada on the international scene in such areas as landing rights for the SST and should therefore have a good feeling of national purpose and development.

If the federal government is the body best suited to develop the formal controls or rules governing environmental problems it must be prepared to consider all relevant input streams and perform a balancing process. How is this accomplished in fact?

On August 2nd, 1968, the Federal Minister of Transport announced, "plans for early discussions with provincial and municipal authorities and airlines regarding the major expan-

⁴⁵Several of these factors are discussed at greater length by James M. Kramon, "Noise Control: Traditional Remedies and a Proposal for Federal Action," Environment Law Review--1971 (Albany, N.Y.: Sage Hill Publishers, Inc., 1971), p. 298.

sion of airport facilities to serve Toronto and Montreal and the metropolitan region surrounding each.⁴⁶ This announcement not only brought into sharp focus the serious complaints of home owners in the vicinity of the Toronto and Montreal airports regarding existing noise and particulate levels, but also made existing home owners realize the possible impact of future air traffic on thousands of home owners in other areas. Pierre J. Levasseur outlined the federal government's balancing of input factors and resulting perception of socially desirable policy with respect to Montreal's problems as follows:⁴⁷

The problem of noise can be met by three actions: control of flight procedures, reduction at source and, most drastically, control of residential development in the immediate proximity of the airport. The third method is the most efficient at this time, although future developments may be expected to reduce aircraft noise. But, it is also costly, financially and socially, if a great number of people live in close proximity to the proposed installation. This course of action also requires a proper zoning system and legislation to guarantee the results desired. After considering all these factors, the Canadian Government decided to take a bold course of action and expropriated 90,000 acres of land, comprising an operational zone of 20,000 acres and 70,000 acres of land within noise zones.

A second, and equally important, step taken by the Canadian Government was the formation of a seven discipline team to study the impact of the airport on the ecological system, from its effects on the environment to its effects on the population.

⁴⁶A.B. Rosevear, "Noise in the Vicinity of Airports and Sonic Boom," Chitty's Law Journal (January 1969), 3.

⁴⁷Pierre J. Levasseur, "Aviation and the Human Environment, Land-use planning protects airport and community," ICAO Bulletin (April, 1972), 2-3.

One of the major causes of environmental problems facing society has been a lack of appreciation and understanding of the "intimate linkages existing between the physical and the social environments."⁴⁸

Another point made by Pegrum is that "... law is really social policy expressed in legal rules."⁴⁹ Referring once more to Figure 2.2 it is only when the government has balanced the input components and arrived at its perception of a socially desirable policy that it is ready to enact laws to ensure a particular course of action. This final step is required to provide feedback to the public and to industry.

The Clean Air Act and the Expropriation Act set up such a feedback network. From the point-of-view of the airlines such a legal framework is necessary to provide guidance in areas that otherwise would be directed by the profit motive. It is only when a complete network has been formally set up that both the air traveller and the home owner can be satisfied, and that private enterprise can be receptive to the wishes of government and the people. It is only when social policy has been expressed in legal rules that it is adequately expressed. William Baxter suggests that:⁵⁰ "The basic test of

⁴⁸Thomas W. Thompson, et al., "Biophysical Environment and Human Behaviour: Linkages and Feedback Systems," in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisconsin: University of Wisconsin, 1972), pp. 53-54.

⁴⁹Pegrum, Transportation Economics and Public Policy, p. 252.

⁵⁰William Baxter, "Noise: Legal and Economic Implications," in Air Transportation--A Forward Look, ed. by Karl M. Ruppenthal (Stanford, Calif.: Stanford University, 1970), p. 107.

the soundness of any legal rule is whether it encourages the type of behavior the community wishes to encourage." Without legal rules one may never have the opportunity to make this basic test.

2.6 Landmarks in Environmental Law--Air Transportation

There are very few Canadian cases reported on the subject of noise and air pollution created by aircraft. A survey of Canadian cases augmented by a few of particular interest in the United States reveals that the "landmarks" in environmental law are scarce indeed. This section outlines a few cases to provide a framework for future environmental legislation and litigation.

The case of Nova Mink v. Trans-Canada Air Lines ((1951) a D.L.R., 241) was one of the earliest cases to reach Provincial Supreme Court. In that case the Supreme Court of Nova Scotia decided, on appeal, that the pilot of the aircraft in question, "did not have a duty to ascertain the location of the plaintiff's mink farm and then to fly above it to avoid disturbing the mink and thus causing them to devour their young." The case was founded on negligence and the plaintiff failed.⁵¹ A similar judgment was handed down by the judge in a United States case. East Haven v. Eastern Airlines, Inc. (331 F. Supp. 16),⁵² wherein the court ruled in favor of the

⁵¹Rosevear, "Noise in the Vicinity of Airports and Sonic Boom," p. 4. See also Daroway v. The Queen (1956) Ex. C.R., 340.

⁵²Reported in Meyer, "Air and Noise Pollution Surrounding Airports," p. 862.

public's right to unrestricted air travel. Cedarhurst, New York, near Idlewild Airport, was the scene of yet another conflict in which aviation interests won.⁵³

On the other side of the coin, an increasing social awareness of the problem of noise pollution from jet aircraft has more recently prompted action favorable to the land-owning public. Ruppenthal gives the following example:⁵⁴

Early in 1970, a Superior Court in Los Angeles ruled that 539 property owners near the Los Angeles International Airport were entitled to damages because of jet aircraft noise. Damages in the amount of \$740,000. were awarded against the Los Angeles Airports Department. The court found jet noise interrupted normal conversations, radio and television reception, and sleep; that it interfered with personal comfort, enjoyment, and the convenience of living. Shortly after the Superior Court decision, the City of Los Angeles announced that it would appeal the decision.

Despite a history of limited success, "The courtroom is the last arena where the individual citizen can meet big business or government bureaucracy and hope to survive."⁵⁵ More success has been enjoyed by citizens' groups and entire municipalities whose concern is the overall region in which they live than on an individual citizen basis. Santa Monica,

⁵³Karl M. Ruppenthal, "Some Socioeconomic Considerations" in Air Transportation--A Forward Look (Stanford, Calif.: Stanford University, 1970), p. 158.

⁵⁴Karl M. Ruppenthal, "Problems of Aircraft Noise and Exhaust," Faculty of Commerce and Business Administration, University of British Columbia, Vancouver, B.C., 1972. (Mimeographed.)

⁵⁵Victor J. Yannacone, Jr., Bernard S. Cohen, and Steven G. Davison, Environmental Rights and Remedies (Rochester, New York: The Lawyers Cooperative Publishing Co., 1972).

California,⁵⁶ and Morristown, New Jersey,⁵⁷ for example, have established permissible noise levels for takeoff operations,⁵⁸ and the City of Inglewood, which adjoins Los Angeles International Airport, specifies in their ordinance:⁵⁹

It shall be unlawful for any person to operate, run up or test or cause to be operated, run up or test an aircraft jet engine which creates a noise level of 50 dBA or more at any place within an inhabited residential zone of the City of Inglewood between the hours of 10:00 p.m. and 7:00 a.m.

Such action may not be legally binding from a jurisdictional point-of-view,⁶⁰ but it does reflect the underlying "trade-

⁵⁶Santa Monica and Morristown are general aviation airports very close to populated areas. See Stagg v. Municipal Court of Santa Monica, California Court of Appeal, Second District, December 4, 1969, cited by Clifford R. Bragdon, Noise Pollution, the Unquiet Crisis (Philadelphia: University of Pennsylvania Press, 1971).

⁵⁷Township of Hanover v. The Town of Morristown, New Jersey Superior Court, Chancery Division, December 10, 1969, cited by Clifford R. Bragdon, Noise Pollution, the Unquiet Crisis (Philadelphia: University of Pennsylvania Press, (1971).

⁵⁸Clifford R. Bragdon points out, in Noise Pollution, The Unquiet Crisis (Philadelphia: University of Pennsylvania Press, 1971), p. 182, that airports have avoided establishing noise limits for landing jet aircraft due to safety considerations. Up until 1968 all U.S. aircraft had federal permission to make as much noise as they cared. The United States' first federal regulation limiting the noise of new commercial and civil aircraft was promulgated by the FAA in late 1969 (see Robert Lindsey, "FAA Acts to Cut Noise of Jetliners," New York Times, November 13, 1969). Canada's regulations are yet to appear.

⁵⁹Noise Regulation, Section 4622, Noises--Jet Engine Testing, Ordinance Number 2018, Chapter 6, City of Inglewood, California, 1969, cited by Clifford R. Bragdon, Noise Pollution, The Unquiet Crisis (Philadelphia: University of Pennsylvania Press, 1971). See also, The Ten Point Action Program for the Alleviation of Noise Pollution in Inglewood, January 1, 1970, cited by Bragdon, Noise Pollution, The Unquiet Crisis.

⁶⁰Municipal ordinances which attempt to ban excessive

offs" acceptable to the general public and gives clear warning to the federal government and to the aircraft industry that the public is very much disturbed by the problem and demands a solution. It is obvious from the time period (10 p.m. to 1 a.m.) mentioned in the City of Inglewood's municipal ordinance that the public is willing to forego any benefits which might accrue from increased commerce during this time period for the benefits of a good night's sleep. The inhabitants of Inglewood are not concerned about the problems of airline scheduling (i.e. a plane leaving at 10 p.m. may arrive at its destination at 3 a.m.), they are concerned about their own perceived self-interest. This gets back to a point made in the Introduction, from each separate viewpoint the system's elements rank differently. A systems analysis approach to the problems of air and noise pollution in the air transportation industry is required.

A 1969 case, under the Federal Aviation Act in the United States, reemphasizes a macro approach to environmental planning.⁶¹

In Palisades Citizens Association v. CAB
(420 F. 2d 188 (D.C. Cir. 1969)), citizens concerned

jet noise and sonic booms caused by airplanes flying over their territory, may be invalidated, as was the case in American Airlines, Inc. v. Hampstead, as discussed in the New York Times, July 1, 1967, p. 48), and in Yannacone, Jr., Cohen, and Davison, Environmental Rights and Remedies, Vol. II, Ch. xi, p. 408.

⁶¹John Y. Pearson, "Toward a Constitutionally Protected Environment," Environment Law Review--1971, (Albany, N.Y.: Sage Hill Publishers, Inc., 1971), p. 67.

about the "environmental impact"⁶² of a proposed helicopter service attempted to intervene in Civil Aeronautics Board hearings. Although the District of Columbia Circuit upheld the CAB's denial of intervention, the court cautioned that the Federal Aviation Act's standard for CAB certification of carrier service -- "The promotion, encouragement and development of civil aeronautics" (49 U.S.C. § 1302(f) (1964)) -- requires consideration of the impact of proposed activities upon the public interest in environmental protection. The court concluded that (T)he public interest in the "promotion, encouragement, and development of civil aeronautics" demands consideration by the Board of the extent to which a grant will affect persons and property on the ground below the route. A certificate to a carrier (or the institution of a service) which would substantially increase the intensity of noise (or the) degree of air pollution ... would be contrary to the spirit and the letter of the Federal Aviation Act.

This case, while finding in favor of the Civil Aeronautics Board, worded its cautionary notice to clarify and extend the Federal Aviation Act and to emphasize the importance of due consideration of the public affected by its actions.

The landmarks in environmental law vis-à-vis aviation are slowly being formed, but many citizens are starting to question the ability of the present structure to keep up with the present rate of environmental degradation. U.S. Senator Edmund S. Muskie, Chairman of the U.S. Subcommittee on Air and Water Pollution expresses these doubts. He asserts:⁶³

Because environmental law is inseparable from other areas of the law, notably tort law and transportation law, our work cannot be limited in its scope only to pollution. Our environmental problems stem largely

⁶²They were specifically concerned that helicopter traffic above their property would cause noise, air pollution and safety hazards.

⁶³Edmund S. Muskie, "Torts, Transportation, and Pollution: Do the Old Shoes Still Fit?", Environment Law Review--1971 (Albany, N.Y.: Sage Hill Publishers, Inc., 1971), p. 463.

from a pressing need to emerge from the entire system of legal theory and precedent that guided us during the first century of industrialization in this country. Much of this theory and precedent will remain viable in the years ahead, but more must be reexamined and changed as we move into the final third of this century.

In Canada, demand for environmental impact studies and responsible action by government officials is increasing and with such demand an increasing emphasis on long-term strategy. Is the Canadian government accepting the challenge? On one hand the Minister of the Environment for Canada, Mr. Jack Davis, shows true recognition of the problem at hand. He asserts:⁶⁴

Obviously, we need new attitudes and new laws to protect our fragile environment from our depredations. These laws, like nature's laws, must be universal. They must be more than local, more than regional, more than national. They must be global.

On the other hand; however, he indicates a refusal of the federal government to accept the challenge, stating:⁶⁵

Although the federal government will play a leading role in working toward a cleaner environment, legal responsibility for preservation and enhancement of our surroundings is shared in varying degrees by the governments at the federal, provincial, and municipal levels.

The most significant landmark in environmental law, a national unified approach to solving pollution problems, is yet to come. The human environment may get a lot worse before it gets better.

⁶⁴Department of the Environment, Canada and the Human Environment, p. 6.

⁶⁵Ibid., p. 21.

2.7 International Agreement on Noise Levels and Air Pollution Standards

International air travel has grown substantially in the last decade due to a number of key, interacting considerations: (1) greater discretionary income, (2) greater propensity to travel by air, (3) reduced travel costs, (4) shorter travel times with the advent of longer range and faster aircraft, and (5) improved service through extended bilateral agreements.⁶⁶ With this increased air travel an integration of business and transportation on an international level has developed. It is obvious that international treaties and conventions are needed to resolve international environmental conflicts. There is growing concern over our global environment which transcends purely national interests, and it is foreseeable that in the near future a body of transnational environmental law will be developed.⁶⁷

To date, no survey of noise pollution has been made on an international scale, however the 22-nation Organization for Economic Cooperation and Development (OECD) has announced its intention to establish international tolerance limits for environmental pollutants.⁶⁸ Richard Gardner does not feel that

⁶⁶Canadian Air Transportation Administration, Pacific Region, Public Information Kit.

⁶⁷Yannacone, Jr., Cohen, and Davison, Environmental Rights and Remedies, Vol. II, Ch. xi, p. 442.

⁶⁸Farnsworth, "O.E.C.D. Will Set Pollution Limits," New York Times, February 19, 1970, p. 11. Under this plan countries who exceed the limits would pay indemnities. Members of OECD include Canada, the United States, Japan and 19 Western European countries. The major drawback is that the organization operates by voluntary compliance and there

this is enough. He states:⁶⁹

The United Nations is the only framework available for cooperation on both an East-West and a North-South basis. While environmental cooperation through forums like the North Atlantic Treaty Organization (NATO) and the Organisation for Economic Cooperation and Development (OECD) can be a useful supplement to United Nations efforts, it is no substitute for them.

One would certainly have to agree that action at the U.N. level is most appropriate in air transportation. Some work is presently taking place conducted by the World Meteorological Organization (WMO). This work consists of monitoring air pollution of global significance and standardizing national data (the Earthwatch program). The International Civil Aviation Organization (ICAO) has held a conference at which the development of international standards and recommended practices for aircraft noise abatement and the study and measurement of sonic booms were discussed.⁷⁰

is no way of enforcing action on the independent governments. It cannot be assumed that all the members will adhere to the standards of environmental controls.

⁶⁹Richard N. Gardner, "The role of the U.N. in Environmental Problems," in World Eco-Crisis, International Organizations in Response, ed. by David A. Kay and Eugene Skolnikoff (Madison, Wisconsin: The University of Wisconsin Press, 1972), p. 71.

⁷⁰Brian Johnson, "The United Nations' Institutional Response to Stockholm: A Case Study in the International Politics of Institutional Change," in World Eco-Crisis, International Organizations in Response, ed. by David A. Kay and Eugene Skolnikoff (Madison, Wisconsin: The University of Wisconsin Press, 1972), p. 89.

The principles, adopted at the United Nations Conference on the Human Environment held June 5-16, 1972 at Stockholm, Sweden, emphasize a true concern over international agreement on environmental protection. Principles 5 and 25 in particular are idealistic but necessary goals for the nations of the world.

Principle 5. The non-renewable resources of the earth must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that benefits⁷¹ from such employment are shared by all mankind.

Principle 25. States shall ensure that international organizations play a coordinated, efficient and dynamic role for the protection and improvement of the environment.⁷²

The Stockholm Conference provided three main contributions to environmental improvement:⁷³

(1) A declaration of principles, which was an "aspirational" document to commit government to a common direction for action.

(2) An "Action Plan", which covered 109 recommendations including 110 Earthwatch stations, a nuclear body, a special environmental fund, energy considerations, and preliminary ground rules for the 1974 World Population Conference.

(3) The setting up of an institutional framework for further conferences and an Environmental Secretariat (physically located in Nairobi, Kenya) reporting to the U.N. General Assembly.

These are major steps forward as far as international action

⁷¹U.S., Congress, Senate, Committee on Foreign Relations, Report on the United Nations Conference on the Human Environment. 92nd Cong., 2nd sess., 1972 (Washington, D.C.: Government Printing Office, 1972), p. 16.

⁷²Ibid., p. 18.

⁷³This section draws in part from Dr. Hugh Keenleyside's January 26, 1973 Westwater Lecture presented at the University of British Columbia, and entitled, "The Stockholm Conference on the Environment: An Assessment."

is concerned; however, there are some difficult problems to overcome to change general agreements into binding legislation. Among these are the problems of economic development of the developing nations,⁷⁴ the time factor involved in developing formal system analysis tools,⁷⁵ the problem of bringing our patterns of consumption into line with the realities of ecology and the world resource situation⁷⁶ and the tremendous amount of money required to finance an international effort of this magnitude.⁷⁷

⁷⁴Miguel A. Ozorio de Almeida expands upon this factor, claiming that, "Any efforts in the direction of a solution of the pollution of poverty unconnected to the process of resource accumulation through development would be self-defeating, because resources thus would be diverted to compensate for effects instead of tackling the real causes of the problem." He states, "If the Stockholm Conference is to tackle this problem, then it must also be an economic development conference." From, Miguel A. Ozorio de Almeida, "The Confrontation Between Problems of Development and Environment," in Environment and Development, Carnegie Endowment for International Peace, No. 586 (New York: Carnegie Endowment for International Peace, 1972), pp. 37-56.

⁷⁵Dennis L. Meadows and Jorgen Randers, "Adding a Time Dimension to Environmental Policy," in World Eco-Crisis, International Organizations in Response, ed. by David A. Kay and Eugene Skolnikoff (Madison, Wisconsin: The University of Wisconsin Press, 1972), p. 50.

⁷⁶Paul R. Ehrlich and Anne H. Ehrlich, Population Resources Environment: Issues in Human Ecology (San Francisco: W.H. Freeman and Company, 1970), p. 323.

⁷⁷The amount of money allotted the special Environmental Agency of the U.N. Secretariat was 100 million dollars for five years, whereas estimates to clean up the United States alone range up to \$164 billion. The United States has also reduced their annual contribution from \$800,000. to \$250,000.

Speaking only of jet aircraft for a moment, there are several factors which favor a solution to air and noise pollution problems within a relatively short time horizon. The most evident factor is that commercial jet aircraft are produced in large quantities by relatively few manufacturers. Seven engines presently account for most of the North American noise and air pollution; these are the JT3C-6 (Boeing 707), JT3D (Boeing 720, Douglas DC-8, and Boeing 707), JT4A (Boeing 707 and Douglas DC-8), JT8D (Boeing 727, Boeing 737 and Douglas DC-9), JT9D (Boeing 747), CJ805 (Convair 880), and 501-D (Lockheed L-100). One single engine, the JT8D engine, emits total air contaminants at a rate about twice that of the other six models.⁷⁸ The major aircraft manufacturers such as Boeing, McDonnell-Douglas, Convair, Hawker-Siddley and Lockheed may hold the key to a cleaner and quieter environment. The positive effects of pressure on these manufacturers has already been seen in the installation of quieter engines in the wide-bodied Boeing 747, Lockheed 1011 and McDonnell-Douglas DC-10 aircraft and the installation of burner cans to reduce particulates on earlier models. This pressure toward quieter engines and cleaner engines has international significance because all of the major airlines are flying aircraft produced by the major aircraft manufacturers. The cost of retrofitting existing engines is high, and effective legislation is required to enforce it; however, the rate of technological obsolescence in the highly competitive airlines business

⁷⁸George, Nevitt, and Verssen, "Jet Aircraft Operations", p. 515.

certainly favors the replacement of noisy, polluting engines with quiet, clean engines within 5 years.⁷⁹ Table III indicates the major changes in commercial aviation from 1936 to the present.

TABLE III
MAJOR CHANGES IN AVIATION 1936-1973

Year	Aircraft	Passengers	Speed
1936	DC 3	21	180 MPH
1947	Constellation	80	300
1958	B-707	189	600
1970	B-747	300-400	640
1973*	Concorde, TU-144	128,120	1350,1550

*not included in ATA data

Source: Air Transport Association of America, Major U.S. Airlines, Economic Review and Financial Outlook 1969-1973 (Washington, D.C.: Air Transport Association, 1969), p. 7.

In summary, international agreements on noise levels and air pollution standards are essential for the resolution of international conflicts and the careful monitoring of our delicate environment. Realizing the time lag required to implement specific international regulation, however, much can be done by the industry itself with appropriate incentives from national government bodies. In the short run, at least, the

⁷⁹Improvements in fatigue and corrosion resistance as well as bonding technology has allowed Boeing Co. to increase durability of its jet transports and extend service life warranties from 30,000 hours (on new 707, 727 and 737 transports) to a flat 10-year policy (which the 747 has had from the start). The life of a jet engine is somewhat less than that

recognition of the problems of clean air and a quiet neighborhood must be inputs to the designers' considerations for new aircraft. The economic balance must be such that the additional cost of designing in these factors does not prevent this from happening. The problem of who should bear the cost of pollution will be dealt with in Chapter V; however, it is certain that this cost will be less if considered originally, through national regulations in the short run and international agreement in the long run, than if added on to an existing design.

2.8 Summary

In this chapter I have attempted to provide a background of air and noise pollution legislation in Canada. My conclusion is very similar to that of Joseph Brecher:⁸⁰

It would be an unconscionable waste of resources if every issue of environmental policy had to be fought out in court. What is needed is a new ethic emphasizing harmony between man and nature, and a new, workable institutional framework to implement such a policy.

The considerations provided in this chapter have reemphasized the concern and need for a revised and effective legal structure which is consistent with the state of technology in 1973. I see the Canadian Federal Government "carrying the ball" on environmental issues, not merely "playing a leading

of the major structural components under warranty. See Aviation Week and Space Technology, XCVII, No. 22 (1972), 50.

⁸⁰ Joseph J. Brecher, "Environmental Litigation: Strengths and Weaknesses," in Environmental Affairs, I, No. 3 (1971), 575.

role". I have suggested revisions to the BNA Act, a new 1973 Noise Control Act, and structural change at the federal level which will ensure that the law reflects society's demands and needs.

The following table summarizes changes in the jurisdictional pattern required to meet the challenge of pollution in the human environment:

TABLE IV
PROPOSED REVISIONS TO PRESENT LEGISLATIVE STRUCTURE

Major Problem	Group Effectuated	Present Legislative Structure	Proposed Future Legislative Structure
<u>Air Pollution</u>			
1. Particulates from jet aircraft	Area residents and ecology	Municipal, Provincial, and Federal	Federal and International
2. Climate modification due to jet contrails	Large zones beneath flight paths (possibly entire earth)	None	International
<u>Noise Pollution</u>			
1. Take-off and landing of jet aircraft	Area residents and ecology	Some City Bylaws ⁸¹ Common Law of Nuisance	Federal and International
2. Sonic boom from SST aircraft	Large zones beneath flight paths	Common Law of Nuisance	International

⁸¹Private law suits are usually based on public nuisance statutes, or on the common law of nuisance, or on the constitutional theory of the "taking" of property. (see Juergensmeyer, "Control of Air Pollution Through the Assertion of Private Rights," Duke Law Journal, (1967) 1126). Generally, these solutions, based as they are on economic and political theories developed during a period less technological and less complex than today, have proved inadequate to solve today's problems.

The problem of particulates from jet aircraft is presently handled under the Clean Air Act of 1971. Mr. J.W. MacNeill identifies four jurisdictional situations under the existing political structure with regard to air pollution:⁸²

1. Pollution within a province which has its source and its effects contained within the province.
2. Pollution in a province or territory which has its source in another province or territory or which affects another province or territory.
3. Pollution in Canada which has its source in another country or which affects another country.
4. Pollution within a province which originates on lands or from facilities under federal ownership or jurisdiction.

I would suggest that only the third jurisdictional situation is relevant. Within the federal jurisdiction suggested one could admit the necessity for sub-division by ecological region or water-sheds, for example, but a political sub-division below the federal level defeats the purpose of a systems approach to environmental planning and legislation. International regulation of air pollution in relatively unknown areas such as climate modification, is best handled by international fiat since global monitoring and evaluation is required.

In the field of noise pollution the Canadian Federal Government has taken a positive step through planning of new airport installations (such as Pickering and Ste. Scholastique). Legislation reflecting this approach is required to eliminate noise as a variable in the decision making process of airlines

⁸²MacNeill, Environmental Management, p. 175.

and aircraft manufacturers. Federal or international legislation requiring specific PNdB noise levels to be met is far superior to the present approach of litigation and common law interpretation.

The sonic boom poses a difficult legal problem. In the past this problem has been handled more as a political game than as a serious threat to the future of aviation. A number of nations have taken unilateral moves to serve notice that they will not allow SST aircraft to fly over their countries.⁸³ The legality of such a position has not been tested in any court. This dilemma strengthens the need for an international legal system to deal with environmental issues.

⁸³In Canada the only section dealing with this problem is in the Air Regulations and Aeronautics Act (5th Edition). This is a general statement that, "No aircraft shall be flown in such a manner as to create a hazard to other aircraft or to persons or property on the ground." In New York a bill is being proposed to prohibit any commercial SSTs from using existing airport facilities (see David Bird, "Rickles Asks Noise Limits to Ban Jets from City," New York Times, December 30, 1970). Five European governments: Sweden, Switzerland, West Germany, Netherlands and Norway, have indicated that they intend to ban overland flights but have not passed specific legislation. (see Clyde H. Farnsworth, "Conference on Sonic Boom Told Noise Can't Be Designed Away," New York Times, February 4, 1970.

CHAPTER III

THE EXISTING LEGISLATION: TECHNICAL PROBLEMS AND IMPACT

3.1 Environmental Alteration, Weather and Climate

One area which is not covered by existing legislation and cannot be considered pollution in the normal sense is the area of inadvertent climate modification. This is a subject which is critically important to air transportation and the human environment. Evidence continues to mount showing that human activities are changing the state of the atmosphere but the mechanisms of change are not well known. Table V summarizes some early data showing the relative climate of cities compared with the adjacent countryside.¹

From these findings, and the later extensive Study of Man's Impact on Climate (SMIC)² published in 1971, a considerable amount of conjecture and theorizing has ensued. For example, some feel that our high-speed air transportation system has already begun to alter our weather patterns, and climatolo-

¹Gordon J.F. MacDonald, "Pollution, Weather and Climate," in Environment--Resources, Pollution and Safety, ed. by William Murdoch (Stamford, Conn.: Sinauer Associates, Inc., 1971), pp. 326-27.

²SMIC, Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate (Cambridge, Mass.: MIT Press, 1971), see also Man's Impact on the Global Environment, Report of the Study of Critical Environment Problems (SCEP) (Cambridge, Mass.: MIT Press, 1970).

TABLE V
CLIMATIC CHANGES PRODUCED BY CITIES

<u>Parameter</u>	<u>City as Compared with Rural Surroundings</u>
Temperature	
Annual mean	0.5 to 1.0° C higher
Winter minima	1.0 to 2.0° C higher
Cloudiness	
Clouds	5 to 10% more
Fog, winter	100% more
Fog, summer	30% more
Dust particles	10 times more
Wind speed	
Annual mean	20 to 30% lower
Extreme gusts	10 to 20% lower
Precipitation	5 to 10% more

Sources:

1. H. Landsberg, Man's Role in Changing the Face of the Earth (Chicago, Ill.: University of Chicago Press, 1956).
2. R. Geiger, The Climate Near the Ground (Cambridge, Mass.: Harvard University Press, 1965).

gical cycles. Some believe that high altitude clouds from commercial jet contrails have begun to reduce the amount of incident solar radiation received by green plants on the ground.³ Meteorologists Dr. Reid A. Bryson and Dr. W.M. Wenland indicate that under certain conditions SSTs might generate

³Yannacone, Jr. and Frangella, "Environmental Concern--The Law and Aviation," p. 122.

almost total cloud cover in their regions of operation.⁴

Meteorologist Dr. Louis J. Battan, on the other hand, rejects this theory feeling that formation of persistent SST contrails is unlikely because of the low humidity of the stratosphere.⁵

The SST debate, primarily centered on the issues of climate modification and the sonic boom, has taken place on the technical level, the governmental level (including U.S. Senate Subcommittee hearings), and the international level. Until recently a stalemate has occurred with most parties concerned polarized either for or against the SST development in North America, without sufficient technical facts to support their positions.⁶

The first breakthrough toward a solution of the problem and the first step toward a macro system approach has been the United States Government's Climatic Impact Assessment Program (CIAP). The explicit goal of this program is to obtain, "data necessary for the Administration and Congress to reach decisions on operating regulations for supersonic

⁴Fisher, What You Can Do About Pollution Now, p. 247.

⁵Ehrlich and Ehrlich, Issues in Human Ecology, p. 147. Information has not been available giving the humidity at which cirrus clouds form and the formation mechanism (i.e. sublimation or liquid-phase change). It is apparent that facts, rather than opinions, are required for decision making and policy formation purposes.

⁶I have not mentioned the economics of the Boeing SST development which no doubt had the most significant effect on the cancellation of this project in March, 1971. Whether or not the environmental issue provided a smokescreen for some congressmen to hide behind, with priority of government spending the real issue, is a moot point.

transports."⁷ Scheduled to be complete by the end of 1974, the CIAP program is presently underway. Its aims are to provide the following:⁸

1. Technical facts needed to prepare the way for world acceptance of its conclusions.
2. Definition of specific problems that may be revealed and development of data necessary to provide a basis for technical solutions.
3. Determination of whether adequate research programs are under way in the U.S. or foreign countries, to cover subjects for which inadequate information exists.

Figure 3.1 shows the major steps and timing of the CIAP project.

The thrust of the CIAP project is to learn immediately if supersonic aircraft will create significantly increased world weather and climatic hazards. The emphasis is directed toward determining if there could be an increase in upper air water content, a decrease in upper air ozone (with subsequent increase in ultraviolet radiation) and an increase in cloud cover through jet contrails.

Mr. Najeeb Halaby, former president of Pan American Airlines and former head of the FAA, says flatly, "The supersonics are coming--as surely as tomorrow. You will be flying one version or another by 1980 and be trying to remember what the great debate was all about."⁹

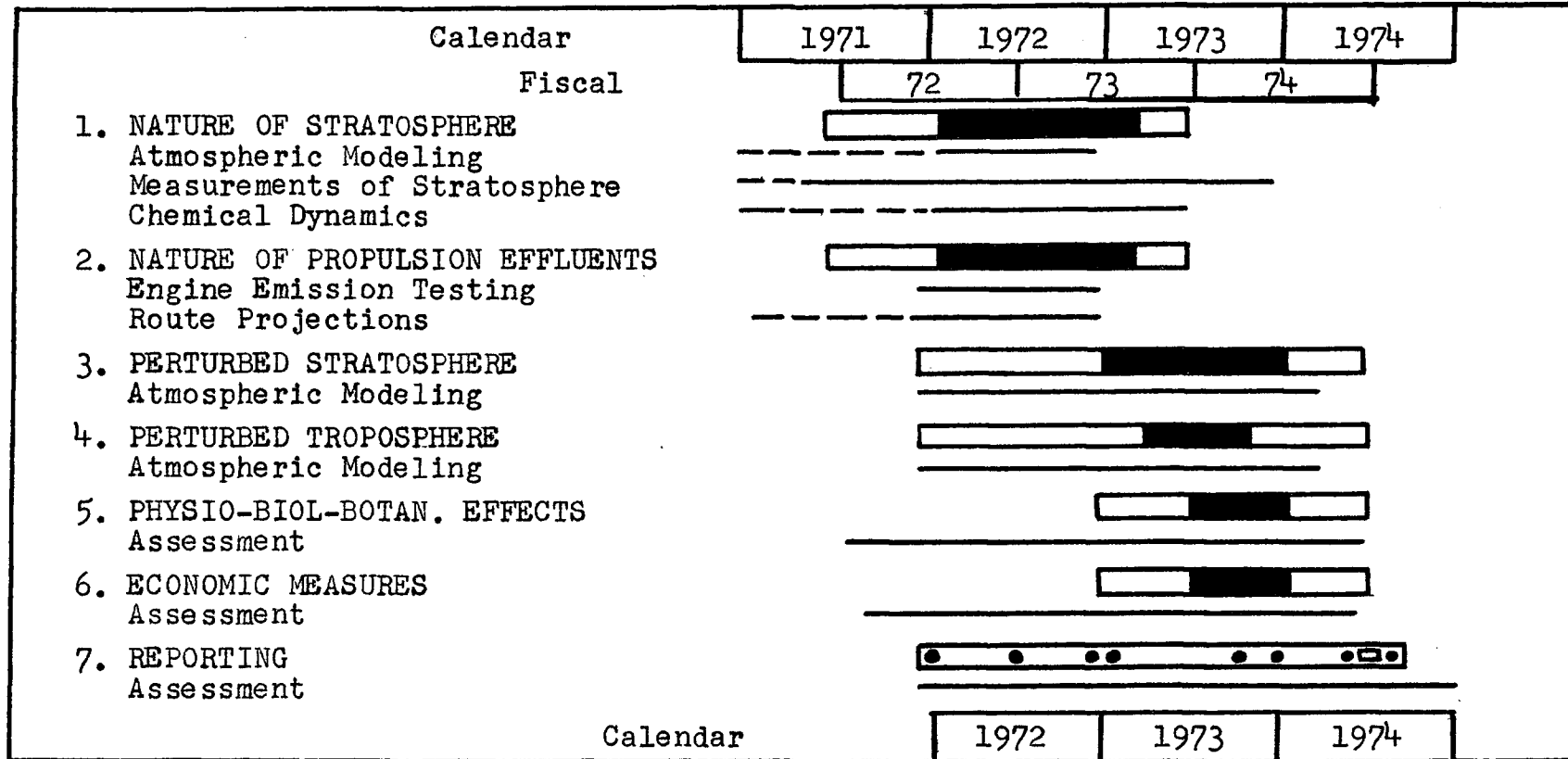
⁷Clarence A. Robinson, Jr., "U.S. Presses SST Climatic Impact Study," Aviation Week and Space Technology, XCVII, No. 22, p. 50. International participation in CIAP is extensive and currently involves England, France, Japan, and Belgium. It is anticipated that U.S.S.R., Australia and India may join the program.

⁸Ibid.

⁹Fisher, What You Can Do About Pollution Now, pp. 256-257.

FIGURE 3.1

THE MAJOR STEPS AND TIMING OF THE CIAP PROJECT



Source: Clarence A. Robinson, Jr., "U.S. Presses SST Climatic Impact Study," Aviation Week and Space Technology, XCVII, No. 22, p. 50.

If a systems approach can be implemented which considers the interactions between social, economic, and technological subsystems and the human environment, Halaby's prediction will likely come true. Starting with the facts produced by the CIAP studies, the United States has a much better chance of producing an aircraft with low engine noise and low sonic boom in the next decade. An advanced supersonic transport with airline economics may be a reality in the future. Mr. Charles C. Tillinghast, chief executive officer of Trans World Airlines, suggests that:¹⁰

The United States ought to take a serious look at whether it is possible to build a super-sonic aircraft of the second generation which will be desirable both economically and environmentally.

The recognition of the human environment as an important variable in the air transportation industry's decision making process is significant. The future of aviation rests upon man's ability to understand his complex environment. The Climatic Impact Assessment Program is a positive step in this direction.

3.2 Noise and Airport Location

The problem of noise, and its effect on the human environment, is no more evident than in the immediate surroundings of an airport. Beinhaker and Elek see the problem in

¹⁰Richard Cramer, "The Airlines Speak," Environmental Quality, IV, No. 2 (1973), p. 24.

terms of a cost-benefit analysis. They state:¹¹

In terms of the airport environment there are both benefits and adverse effects that have to be taken into account. Whereas a well designed terminal building represents a positive addition to the attractions of a region, the airfield and the noise caused by the aircraft have a negative effect which must be minimized through such means as a proper location of the airport and appropriate land management around the airport.

The physiological and psychological effects of noise are a subject in themselves. Prominent physicians and psychiatrists have blamed excessive noise for such things as paranoidal delusions, psychoses, hallucinations, suicidal and homicidal impulses,¹² irreversible changes in the autonomic nervous system, permanent loss of hearing and even an upset sex life.¹³ Coupled with chronic respiratory diseases (notably bronchitis and emphysema) which have been traced to air pollution,¹⁴ the impact of jet aircraft on area residents is indeed a serious problem.

3.2.1 Reducing the Exposure to Noise

Earlier in my thesis I referred to noise-suppression

¹¹P. Beinhaker and A. Elek, "Methods for Evaluating Transportation Investment, Montreal Airport Study--Ste. Scholastique," in Changing Times and Keeping Up (Oxford, Indiana: The Richard B. Cross Company, 1971), Proceedings of the 12th Annual Meeting of The Transportation Research Forum, p. 57.

¹²Barbara J. Culliton, "Noise Threatens Man," in Pollution Papers, ed. by George E. Frakes and Curtis B. Solberg (New York: Meredith Corporation, 1971), O. 101.

¹³Donald Bruce, "Noise Pollution," B.C. Motorist, Jan.-Feb., 1973, p. 31.

¹⁴See for example, Daniel Briehl, "Air Pollution," America, May 17, 1969, pp. 84-91, and Ehrlich and Ehrlich, Issues in Human Ecology, p. 118.

work by the airlines and aircraft engine manufacturers to reduce ground level noise exposure. Reducing noise at this source is only part of the answer. The other part is reducing people's exposure to noise. "There are four ways of doing this--curtailment of flight operations, noise abatement procedures, better insulation of homes and buildings near aircraft departure and arrival routes, and compatible land use."¹⁵ Curtailment of flight operations, especially between 10 p.m. and 7 a.m., has been a favorite tool of municipalities in close proximity to airports; however, it reduces the effectiveness of the air transportation system.

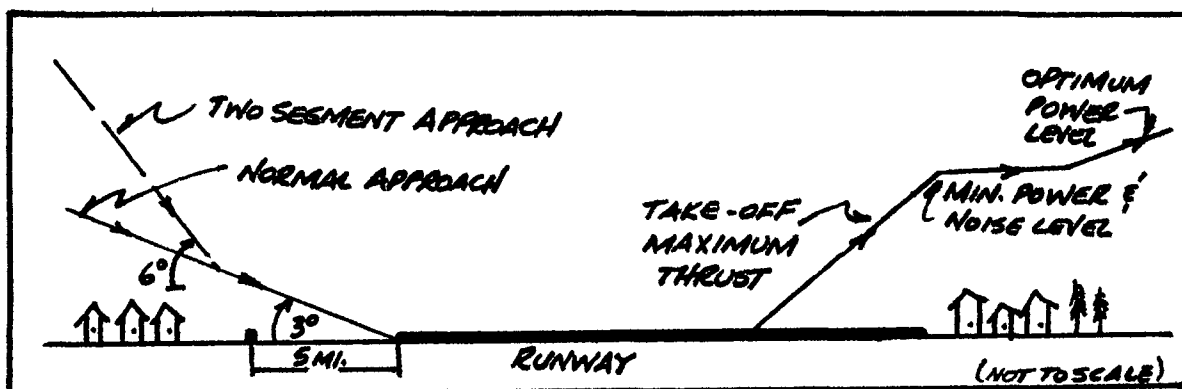
Noise abatement procedures include reduced thrust after initial take-off and two-segment approaches. Figure 3.2 illustrates a profile of these operating procedures. The two-segment approach is basically a sharper angle approach (6°) beyond a navigational radio beacon some 5 miles from the end of the runway, and then a 3° approach (normal) from the 5 mile point to the runway.¹⁶ The safety risk factor decision is critical and one of the present drawbacks of the scheme. The Canadian Air Pilots Publication makes the following proclamation with regard to Noise Abatement Procedures in general:¹⁷

¹⁵Tipton, "Aviation's Three Environments," p. 24. See also Edward Wells, "Aircraft Design, Goals and Problems," in Air Transportation--A Forward Look, ed. by Karl M. Ruppenthal (Palo Alto, California: Graduate School of Business, 1970), p. 85.

¹⁶George Spater, American Airlines, in Cramer, "The Airlines Speak," p. 20.

¹⁷Canadian Air Pilots Publication, "Noise Abatement Procedures, p. L-4.

FIGURE 3.2
FLIGHT PROFILE FOR NOISE ABATEMENT



Source: John Hansen and Robert Stüssi, "Noise and the Urban Environment," an Occasional Student Paper, the Center for Transportation Studies, University of British Columbia, Vancouver, B.C., 1972 (revised).

Caution: Notwithstanding the following procedures or any instructions relating thereto issued by Air Traffic Control, decisions affecting the safe operation of the aircraft shall remain the Captain's responsibility.

Within this framework the ultimate safety risk factor decision rests with the Captain of the aircraft and the future of the two-segment approach rests in his hands. There is, in fact, some argument at present between the U.S. Pilots Association and the Federal Aviation Administration as to which entry level is safe and which is not.¹⁸

The second item to note in Figure 3.2 is the reduced thrust after initial take-off. This maneuver has been used to a great extent in North America¹⁹ and to a greater extent in Europe. There are two issues involved (1) the safety risk

¹⁸Cramer, "The Airlines Speak," p. 20.

¹⁹A take-off procedure has been developed by the Federal Aviation Agency for minimizing aircraft noise in populated areas. Referred to as a standardized noise abatement

factor and (2) how consistent noise level operation is with economic fuel usage. The safety issue is the more critical item. Yannacone and Frangella state this opinion:²⁰

It is criminal that pilots of commercial air carriers, with loads of more than one hundred passengers, are required to reduce power during the critical moments of takeoff as a noise abatement procedure.

I would certainly agree with these authors, the place for testing new procedures is not commercial aviation, and until tests prove conclusively that these procedures are 100% safe they have no place in everyday service.

Better insulation of homes and buildings near aircraft departure and arrival routes has been recommended in various countries. Along these lines a new "staggered-stud" interior wall construction technique is being used in the United States.²¹ In Great Britain, the general attitude is that the

profile, it requires jet aircraft operators to follow these procedures after lift off:

- (1) accelerate to V₂ plus 10 to 20 knots with takeoff flap and takeoff thrust;
- (2) at no sooner than 400 feet, initiate flap retraction schedule and accelerate while maintaining positive climb gradient, achieve minimum maneuvering speed and clean configuration by 1500 feet;
- (3) stabilize with minimum maneuvering speed and target EPR;
- (4) at 4,000 feet, resume en route climb schedule.

Such a procedure is being used at Washington National Airport in cooperation with the FAA, Airline Pilots Association, and the Air Transport Association. Noise levels on the ground are thereby reduced by 8.8 PNdB below those under existing airport procedures elsewhere. As reported by Bragdon, Noise Pollution, The Unquiet Crisis, p. 181.

²⁰Yannacone, Jr., and Frangella, "Environmental Concern --The Law and Aviation," p. 128.

²¹Berland, The Fight for Quiet, p. 205.

householder can either install soundproofing or move. The following legislation was proposed by the Minister of Aviation and enacted by the House of Commons on March 10, 1965:²²

Grants of 50 percent, subject to a maximum of £100, of the cost of soundproofing up to 3 rooms will be made available to householders in a defined area round Heathrow for work carried out with prior approval and to an approved design. The work must be completed by 31st December, 1970, when the scheme will come to an end.

At Paris Airport, as mentioned earlier, an airport tax on passengers is being used to finance soundproofing. Within single-family residential structures, Bishop has found that aircraft noise is reduced by 12 to 30 decibels.²³

Compatible land use is the most promising method of reducing human noise exposure. A basic recognition that unregulated urban growth and jet noise do not mix²⁴ is mandatory for the airport planner. In the past most people have assumed that science will come to their rescue and develop a quiet, non-polluting jet engine.²⁵ Residents have settled around airports

²²Ralph Turvey, "Side Effects of Resource Use," in Environmental Quality in a Growing Economy, ed. by Henry Jarrett (Baltimore, Md.: John Hopkins Press for Resources for the Future, Inc., 1966), p. 50.

²³Bragdon, The Unquiet Crisis, p. 148.

²⁴William R. Sims and Angelo J. Cerchione, "In Search of an Aviation Master Plan," in Master Planning the Aviation Environment, ed. by Angelo J. Cerchione, V.E. Rothe and J. Vercellino (Tucson, Arizona: University of Arizona Press, 1970), p. 114.

²⁵"The Alleviation of Jet Aircraft Noise near Airports," U.S. Office of Science and Technology, March 1966, quoted by Bernard A. Schriever and William A. Seifert, Air Transportation 1975 and Beyond: A Systems Approach, Report of the Transportation Workshop (Cambridge, Mass.: MIT Press, 1968), p. 4.

with little regard for the dangers associated with living in these areas. In the United States some researchers have gone as far as to suggest that a conspiracy exists between the Federal Aviation Administration and the Federal Housing Administration to permit the construction of residential dwelling units in the principal noise zones around major U.S. airports, "at the request of, and certainly for the principal benefit of, major lending institutions and real estate speculators."²⁶ Perhaps a more credible explanation for the propensity to live close to airports is the convenience provided to people working at the airport or using air travel to some extent. To explain the pattern of population growth around airports one need only look at a new plant or industry built in a remote or semi-remote rural area. Early photographs of many industrial sites show small industrial communities which have "built up" around the employment center and which are now in the center of major cities. The population density in Hamilton, Montreal East, Pittsburg, Pa., Manchester, England, and other industrial areas bears this out. The large housing projects near Malton Airport in Toronto, Vancouver International Airport and Chicago O'Hare²⁷ International Airport illustrate the same phenomena.

²⁶Yannacone, Jr., and Frangella, "Environmental Concern --The Law and Aviation," p. 128.

²⁷Charles Tillinghast (TWA) states that 90% of the citizens living under approach paths moved there, "after the airport was established and chose for reasons sufficient unto themselves to live under those conditions." He cites Kennedy Airport where houses are still being built under the approach

The early attempts at compatible land use near airports were based on good planning but poor technical knowledge of the properties of sound. Dulles International Airport is an excellent example of this:²⁸

Dulles International Airport serving Washington, D.C., was designed with its neighbors in mind. The airport itself is isolated from the surrounding territory by land extending a mile and a half beyond the runway limits. Furthermore, it is set off by a grove of trees extending 1,000 feet in from the airport boundary and by 1.5 million new seedlings that were added to the existing timber belt to form a sound barrier 1,000 feet wide all around Dulles' perimeter.

In spite of all these precautions, which required considerable funds, a 100 dB noise level still penetrates a mile beyond the airport limits.

In contrast to the Dulles International Airport, the new Montreal International Airport will occupy 18,500 acres (30 square miles) total developed area plus a total of 70,000 acres of peripheral land. In terms of Dulles' boundary "a mile and a half beyond the runway limits," the distance from the end of main runway 24LC to the North-East boundary will be 8.5 miles (and 6.5 miles for future runway 24RC) and from main runway 11L to the West-North-West boundary will be 7.5 miles (and

path and O'Hare, "which ten years ago was out in the country" and now has "rows and rows and rows of new houses built within the last five or ten years, ... right under the approach path." Quoted in Cramer, "The Airlines Speak," p. 23

²⁸Culliton, "Noise Threatens Man," p. 104, originally published in Science News, October 15, 1966. See also U.S. Department of Housing and Urban Development, Airport Environs: Land Use Controls--Environmental Planning Paper (Washington, D.C.: Government Printing Office, May, 1970), p. 6, in which they state, "What is generally misunderstood is the scale of the noise-affected area. It is not uncommon for communities eight miles away from the airport to experience some effects."

9.5 miles from future runway 11R).²⁹

A major ecological study (EZAİM) is being undertaken by a group of scientists from five Quebec universities to determine the natural ecological balance and predict what is likely to be the balance after the new Montreal International Airport is built.³⁰ This type of work is required not only for new airports but also for additions to existing airports and even increased use of existing facilities. Pioneer studies such as the EZAİM ecological study are necessary to achieve compatible land use patterns. The continued support of the Ministry of Transport and the National Research Council on projects directly concerned with air transportation and the human environment is vital to the future of Canadian aviation. Beinhaker and Elek inform us that:³¹

The decision to build a new airport for Montreal was consistent with the objective of the Ministry of Transport to make transport facilities support broad social and economic goals in addition to serving the needs of transportation.

Pierre Levasseur adds his comments:³²

²⁹Transport Canada, "Site Plan of New Montreal International Airport" BANAIM-S1-JAN.72 in Information Dossier 2nd Edition, New Montreal International Airport Project, Information Service, Montreal, Quebec.

³⁰"Ecology of the Montreal International Airport Area (EZAİM)" in Information Dossier 2nd Edition, New Montreal International Airport Project, Information Service, Montreal, Quebec.

³¹Beinhaker and Elek, "Montreal Airport Study--Ste. Scholastique," p. 59.

³²Levasseur, "Aviation and the Human Environment," p. 3.

We believe it (the new Montreal Airport) to be an outstanding example of the effort that must be made to integrate the airport with the metropolitan socio-economic environment. The goal is to protect the airport's prime function and its environment.

The systems analysis approach reflected in Beinhaker and Elek's statement and Levasseur's emphasis on integrating the airport with the human environment indicate a true understanding of the challenge of the environmental era.

Earlier in this thesis I made the statement that a revised governmental structure with increased emphasis on national and international decision-making was necessary to deal effectively with air pollution. The problems of air pollution have been compounded by overlapping federal, provincial and municipal jurisdictions. Noise pollution near airports has traditionally been a federal matter although there has been an increasing amount of municipal action. Municipal dissatisfaction has resulted from the fact that problems associated with noise have not been effectively handled in the past.³³ An increase in communication between municipal and

³³"Airport Goof Disclosed," Vancouver Sun, January 16, 1973, pp. 1-3. In response to repeated questioning in the House of Commons, the Parliamentary Secretary to the Minister of Transport finally admitted on January 16, 1973 that no special environmental impact study has been carried out with respect to the proposed expansion of Vancouver International Airport. In Calgary recent editorial comment in the Calgary newspapers reveals considerable dissatisfaction with the run-down condition of Calgary Airport, which has long passed its efficient passenger handling capacity. Edmonton International Airport, on the other hand, is considered by many to be a "white elephant" with a very low passenger volume relative to its passenger handling capacity. My point here is not to be critical of the Department of Transport but rather to point out an area in which improved communication and coordination would assist in preparing for the complexities of the air transportation industry now and in the future.

federal levels is required for effective planning, even to the extent of formal lines of communication and structural change.³⁴

If Canada hopes to solve the problems associated with airport noise it must adopt a systems analysis approach. Policy formulation and implementation must be on the national and international level with the central planning function resisting the temptation of promoting highly visible and environmentally sophisticated projects at the expense of neglecting less politically expedient projects. A true macro approach to noise abatement near airports calls for an increase in responsiveness to the demands of all Canadian airport communities and an end to regional disparity.

3.2.2. The Expropriation Act of Canada

In Canada, the major airports are owned and operated by the Federal Government. The Crown sets the regulations, respecting air navigation, in the airspace of Canada, including those for landings and take-offs at airports. The Crown also sets apart the airways, flightways and runways, and the regula-

³⁴The United States Airport and Airway Development Act of 1970, for example, requires greater citizen and local government participation in airport location and expansion projects prior to Federal funding. At a minimum, public hearings must be held to consider the "economic, social and environmental effects of the airport location and its consistency with the goals and objectives of such urban planning as has been carried out by the community." When a proposed new airport does not serve a metropolitan area, the Department of Transportation must consider the views of affected communities around the site prior to granting approval.

tions governing them.³⁵ The area in which the Federal Government has not been actively involved, until quite recently, is direct ownership of the land surrounding its major airports. This is understandable since only within the last few years has there been any major concern over the impact of noise on populated areas. Certain areas near airports and in the vicinity of aircraft operations are inherently dangerous. In the case of military airfields this area includes an area seven and one-half miles along the longitudinal axis of an active runway, and one and three-quarters miles on each side of that active runway.³⁶ Similarly for commercial aviation restrictions on land use can be based on psychological and medical grounds. As Yannacone and Frangella state, "No one should be permitted to add his disease syndrome to the community burden by building a home in a patently unsuitable location."³⁷ It is a "common sense" approach that no residential housing or high-density human activities should be permitted in these zones of maximum hazard, and yet they are.

If an airport exists and a homeowner moves into a dangerous zone one could come to two alternative conclusions:

1. The homeowner living directly under a flight path is not entitled to compensation in the event of expropriation (other than for the book value of his property)

³⁵Clean Air and Water News, III, No. 45, p. 5.

³⁶Yannacone, Jr., and Frangella, "Environmental Concern --The Law and Aviation," p. 126.

³⁷Ibid., p. 127.

because he knew that it was an area of maximum ground hazard from aircraft operations when he moved there.

2. The homeowner is entitled to full compensation in the event of expropriation because full responsibility for suitable zoning and prior planning for future modifications to the airport must be accepted by the Federal Government.

If the airport moves into an area where homes are already present, then the burden of relocating the homeowner out of the zone of maximum hazard must be borne by the Federal Government.

In the first case a situation wherein both parties are partly to blame, the individual homeowner for lack of judgment and the Federal Government for lack of planning, a legislative vehicle was necessary to rectify the past shortcomings and to deal with the problems of the future, including airport expansion and new construction. This vehicle would also have to incorporate the second case wherein the homeowner was clearly entitled to full compensation. The Expropriation Act of Canada, which came into force on June 11, 1970 was Canada's answer to this dilemma. Set up as a model enactment and piloted through the House of Commons by the Hon. John Turner, then Minister of Justice, this act is a vast improvement over its harsh and antiquated predecessor.³⁸ The following steps outline the expropriation procedure and timing:³⁹

³⁸A Committee of Concerned Citizens, "Save Your Environment," Vancouver, B.C., February 5, 1973, p. 2.

³⁹Canadian Air Transportation Administration, Pacific Region.

1. Minister of Transport announces site and a Notice of Intention to Expropriate the proposed site is registered in the local Land Registry office.
2. Titles are then searched so that all persons with an interest in the land concerned can be properly identified and notified by registered letter.
3. The Notice of Intention to Expropriate is then published in the Canada Gazette and local area newspapers. During the ensuing 30 days, any objections to the intended expropriation are made in writing to the Minister of Public Works who records them.
4. The Attorney General of Canada then appoints Hearing Officers who conduct public hearings in the following 30-60 days for the purpose of recording objections. (This period may be extended by the Attorney General of Canada).
5. The Hearing Officers report to the Minister of Public Works who considers their reports. After due consideration the Minister of Public Works confirms expropriation and the Notice of Confirmation to Expropriate is registered. This process takes 30-60 days.
6. The Minister of Public Works makes an offer to each person with an interest in land. Notices requiring possession are subsequently served.
7. Possession of the site is obtained and work may commence. Arrangements are entered into with owners to lease back their property whenever possible. Steps 6 and 7 take about 90 days.

In addition to these expropriation procedures a modification was provided for residents on Sea Island, near the proposed new runway for Vancouver International Airport. This

was the "home for a home" plan which is described as follows:⁴⁰

Rather than assess on property values that might have declined due to the airport's expansion plans, settlement was made with a view to what it would cost to relocate at an equivalent standard in a similar community.

After the acceptance of settlement, any expropriated owner has one year in which to make further claims for compensation if dissatisfied (he must show cause for further compensation, of course).

The Expropriation Act, as it presently stands, does not recognize any difference between a homeowner who lived in the area to be expropriated before the airport was constructed or moved into the area following construction. This particular Act, therefore, does not prevent housing development in areas surrounding existing airports but deals only with current problems. The major fault with the Expropriation Act, from a long-term environmental planning point-of-view, is that the settlements made under the Act encourage people to remain in the expropriated area through lease back arrangements. This seems to be contrary to the health and welfare of the former property owners. One of the major difficulties is deciding upon the extent of expropriation. Studies such as the one underway at Ste. Scholastique should provide some guidance. This problem is humorously portrayed in Figure 3.3.

⁴⁰Ibid. In the case of the Vancouver International Airport, 70% of the land expropriated was by willing sales, accounting for 55% of the total acquisition cost of \$7.25 million.

FIGURE 3.3
EXPROPRIATION FOR AIRPORT EXPANSION



Source: Len Norris, The Vancouver Sun, February 1, 1973, p. 4.

The technical problems of airport expansion and land expropriation are similar in many ways to problems in other areas of transportation. The problems of rapid transit, free-ways, and super-ports similarly reflect a basic need to

consider individual rights and freedoms and to lessen the impact of technological change.

3.3 Design Problems and the Future

One of the most pressing concerns in planning for aviation's future is that technological advance may not be rapid enough to prevent a serious upset in the human environment. In this section I will look at the state of present technology in a few selected areas and attempt to predict any meaningful changes in the next few years.

3.3.1 STOL/VTOL Noise and Air Pollution

Short take-off and landing (STOL) and vertical take-off and landing (VTOL) aircraft have been tested extensively and could provide an ideal transportation mode for the North-East corridor, the Toronto-Montreal area and other densely populated regions if some design problems can be overcome. Much of the difficulty has been in coming up with an engine design which would produce a lower noise level.

Kryter⁴¹ provides a guideline for what would be acceptable for STOL/VTOL aircraft in an urban region:

<u>Noise Level</u>	<u>Comment</u>
80 PNdB (~ 67 dBA) ⁴²	Of no concern
90 PNdB (~ 78 dBA)	Acceptable
100 PNdB (~ 88 dBA)	Barely acceptable
110 PNdB (~ 99 dBA)	Unacceptable

⁴¹K.D. Kryter, "Psychological Reactions to Aircraft Noise," Science, CLI (March 18, 1966), 1346-1355.

⁴²The relationship between A-weighted sound levels and perceived noise levels for 53 different community noise spectra was fit by a least-squares technique to obtain the

Another researcher, Kurt Hohenemser,⁴³ agrees with Kryter, stating, "Unless the STOL/VTOL noise levels can be kept below 90 PNdB, it is doubtful that residential communities will accept STOL/VTOL." A 1970 survey commissioned by the City of New York revealed that its citizens suffered regular exposure to noise levels in excess of 85 decibels (A) and that this threatened the well-being of the individual and the community.⁴⁴ Beranek⁴⁵ puts this figure in perspective by describing the normal noise environment in which we spend most of our lives as in the range of 30 to 90 dB(A) with a noisy office at 75 dB(A) and street-level noise in an urban area at 80 dB(A). Berland⁴⁶ conducted a survey in 1971 by recording city noise

equation $PNdB = 1.02 (dBA) + 11.5$ by Roy Donley, "Community Noise Regulation," Sound and Vibration, February, 1969, p. 19.

⁴³Kurt H. Hohenemser, "Aircraft in the Balance," Environment, XIII, No. 10 (1971), 48.

⁴⁴"Towards a Quieter City: The Report of the Mayor's Task Force on Noise Control," (New York, 1970), in Environmental Management, A Constitutional Study (Ottawa: Information Canada, 1971), p. 93.

⁴⁵L.L. Beranek, "General Aircraft Noise," in Noise as a Public Health Hazard, ed. by W.D. Ward and J.E. Fricke (Washington, D.C.: American Speech and Hearing Association, 1969), pp. 256-259.

⁴⁶Berland, The Fight for Quiet, p. 147. Berland states that our world is getting noisier by an average of one decibel a year and that we have until 1979 to stem the tide of noise or we will be at the threshold of 85 dBA, which can mark permanent hearing loss. See also Ken Giebert, "Transportation and the Environment," Seaports and the Shipping World, July, 1972, p. 42.

levels and came up with a 21-day average of 73.45 dB(A), which in terms of Kryter's scale is acceptable but in terms of peak values may have been damaging. The conclusions for the STOL/VTOL might be: (1) The aircraft must meet a standard of less than 78 dB(A), and by the time of actual implementation of service the background level may have approached this level, and (2) based on the New York City survey further investigation may reveal the need for reduction of the allowable STOL/VTOL noise level even more.

The rate of progress toward a quiet engine for STOL/VTOL has been somewhat slower than for conventional aircraft.⁴⁷ In the next five years I would predict that either: (1) political pressure in prospective use areas will have built up to such an extent as to force the imposition of unrealistic noise regulations on the STOL/VTOL aircraft making it economically infeasible, (2) zoning bylaws will prohibit its use in critical convenience areas thus severely limiting its marketability, or (3) a technological break-through will make it a valuable addition to the overall air transportation system.

Compounding the STOL/VTOL problem is the question of acceptable air pollution levels. Hohenemser states:⁴⁸

If STOL/VTOL craft could be operated without the extensive idling and taxiing periods of the conventional aircraft, air pollution from CO and hydrocarbons could be reduced to a fraction of its present amount. Never-

⁴⁷John N. Cole and Robert T. England, Evaluation of Noise Problems Anticipated with Future VTOL Aircraft, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, AMRL-TR-66-245, May 1967.

⁴⁸Hohenemser, "Aircraft in the Balance," p. 47.

theless, it may be necessary to add anti-pollution devices to the aircraft turbo-engines to alleviate air pollution.

The most significant problem area here is not the available technology but the impact of additional cost on the overall economic viability of the project. The difficulty of choosing among specific noise abatement measures will stem from the rigors of quantifying the social and economic costs of aircraft noise and attempting to "second guess" future legislation.

3.3.2 Commercial Jet Aircraft (Sub-sonic)

3.3.2.1 Aircraft Smoke Reduction

The U.S. aircraft industry is cutting smoke pollution (i.e. particulates) under a voluntary agreement entered into with the Department of Health, Education and Welfare (HEW) in 1970 (HEW administered the air pollution control program at that time) and with the Department of Transportation to retrofit the widely used JT8D jet engines with smoke reduction devices. As of March 31, 1972, 78 percent of the total (i.e. 2625) engines from Boeing 727's, 737's and Douglas DC-9 aircraft had been retrofitted.⁴⁹ The schedule set up in 1970 called for the program to be substantially completed by the end of 1972.

Retrofit involves installing new combustors (commonly called "burner cans") for more efficient burning of fuel in the engines. All JT8D engines since February 1970 have been

⁴⁹Council on Environmental Quality, Environmental Quality--1972 (Washington, D.C.: U.S. Government Printing Office, 1972), p. 212.

equipped with smokeless combustors. In this case it is apparent that technology developed rapidly enough to prevent serious environmental deterioration.

3.3.2.2 Aircraft Noise Reduction

In a M.O.T. Transportation Management Course conducted last summer, Braithwaite et al. summarized the present situation vis-à-vis aircraft noise reduction in conventional jet aircraft. Their comments were:⁵⁰

Current narrow-body jet aircraft (i.e. 707, 727, 737, DC8 and DC9, comprising 90% of large commercial aircraft flying in the free world) vent approximately 1.4 pounds/second of air through by-pass for every pound of air passing through the combustion stream. This compares with a ratio of 2.2 to 1 on the new noise certificated engines. The earlier engines could be converted to the same level of quietness by increasing the fan diameter by roughly 6 inches. NASA hopes to test a converted engine by 1975-76 (with retrofit kits available by 1976-77). Hence, complete retrofit of narrow-body jets possibly could be achieved by 1980. However, the cost may be in the order of \$2 million per aircraft or a world fleet conversion of \$2.7 billion. James Kramer, head of the NASA Refan Project, considers that this cost would have to be spread over a large section of mankind and not just the airlines and passengers. Alternate plans include an acoustic lining in the engine nacelles which may be cheaper but less quiet. The last alternative is merely to wait for the earlier jet aircraft to phase out.

Quieter engines for commercial jets are a present day reality but the ultimate in sound reduction is still unknown. George A. Spater, chairman of the board and chief executive officer of American Airlines makes the following comment about progress in this field as of February, 1973:⁵¹

⁵⁰Braithwaite, et al., Transportation Pollution, p. 14.

⁵¹Cramer, "The Airlines Speak," Environmental Quality, IV, No. 2 (1973), p. 20.

One of the areas that offers a good deal of improvement is the work being done by General Electric under the NASA "Quiet Engine" program. They are quite optimistic that more research in this area will produce considerably quieter engines. But that is something for the future.

One might expect some noise reduction as an added benefit from the installation of new combustors to combat air pollution but unfortunately this is not the case.⁵²

The future of subsonic aircraft noise reduction in the long run is clear: quieter engines will be developed. In the short run, the degree to which airlines are forced into spending money for a complete retrofit of their narrow-body jet fleets will be based on such variables as: (1) the willingness of governments to finance retrofit programs, (2) the speed at which a retrofit kit will be made available (presently estimated as 1976-77) and most importantly (3) the degree of public pressure. If public pressure is great enough, as it was with pure foods and automobile safety, the required money will be raised; however, if public pressure is not too great the conversion will likely be completed through a gradual phase-out of noisy aircraft over the next five to ten years.

3.3.3 Supersonic Jet Aircraft

3.3.3.1 The Sonic Boom

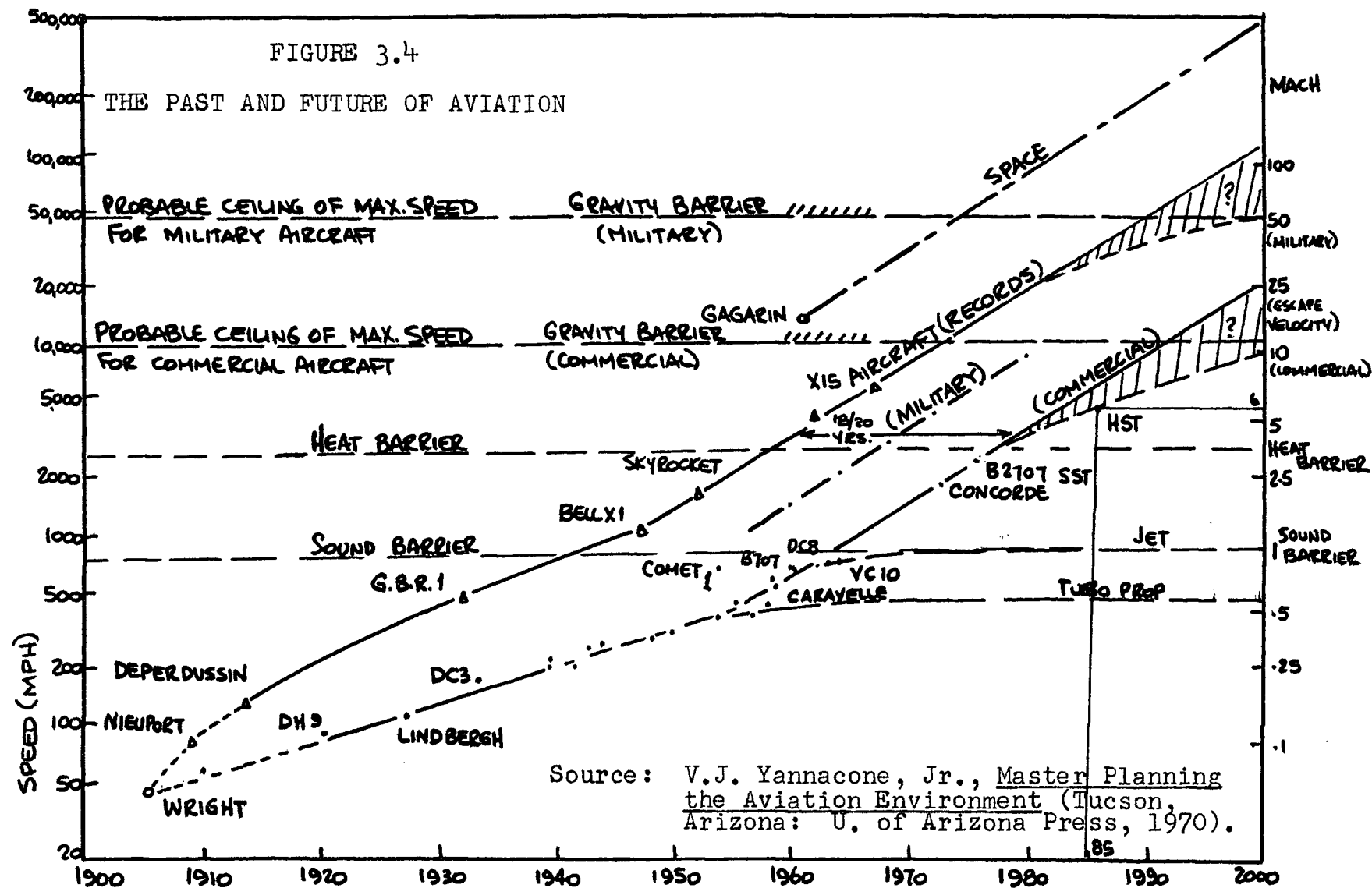
The design problems associated with the sonic boom and inadvertent climate modification are the most difficult to

⁵²U.S. Secretary of Health, Education and Welfare Report to the United States Senate, "Nature and Control of Aircraft Engine Exhaust Emissions," Sec. C--Interactions Between Pollution and Control and Noise Abatement.

solve because they deal with naturally occurring phenomena-- "the laws of nature." In a sense these are "uncontrollable", universal constants such as the sound barrier, the heat barrier and the gravity barrier which pose ceilings on the maximum speed at which commercial aircraft can fly. Figure 3.4 illustrates these barriers to technological advance. Through the space program several "spin-offs" have greatly benefited commercial aviation. Advances in metals (stronger, lighter, more resistant to heat and less subject to fatigue), instrumentation, and navigation, to mention a few. These "spin-offs" have had a great impact on global air travel.

The area in which man has failed is in his attempt to apply "space age technology", designed to solve the problems of outer-space (an open system), to the earth macro-system (an interactive, closed system). In outer space, the limitations are physical barriers, not human barriers. Inner space imposes additional limitations on good design--limitations based on a sound understanding of the human environment.

The technical solution to supersonic travel based on physical limitations has been achieved--the Concorde and TU-144 are flying today. The technical solution to supersonic travel based on physical and human limitations is still on the horizon.



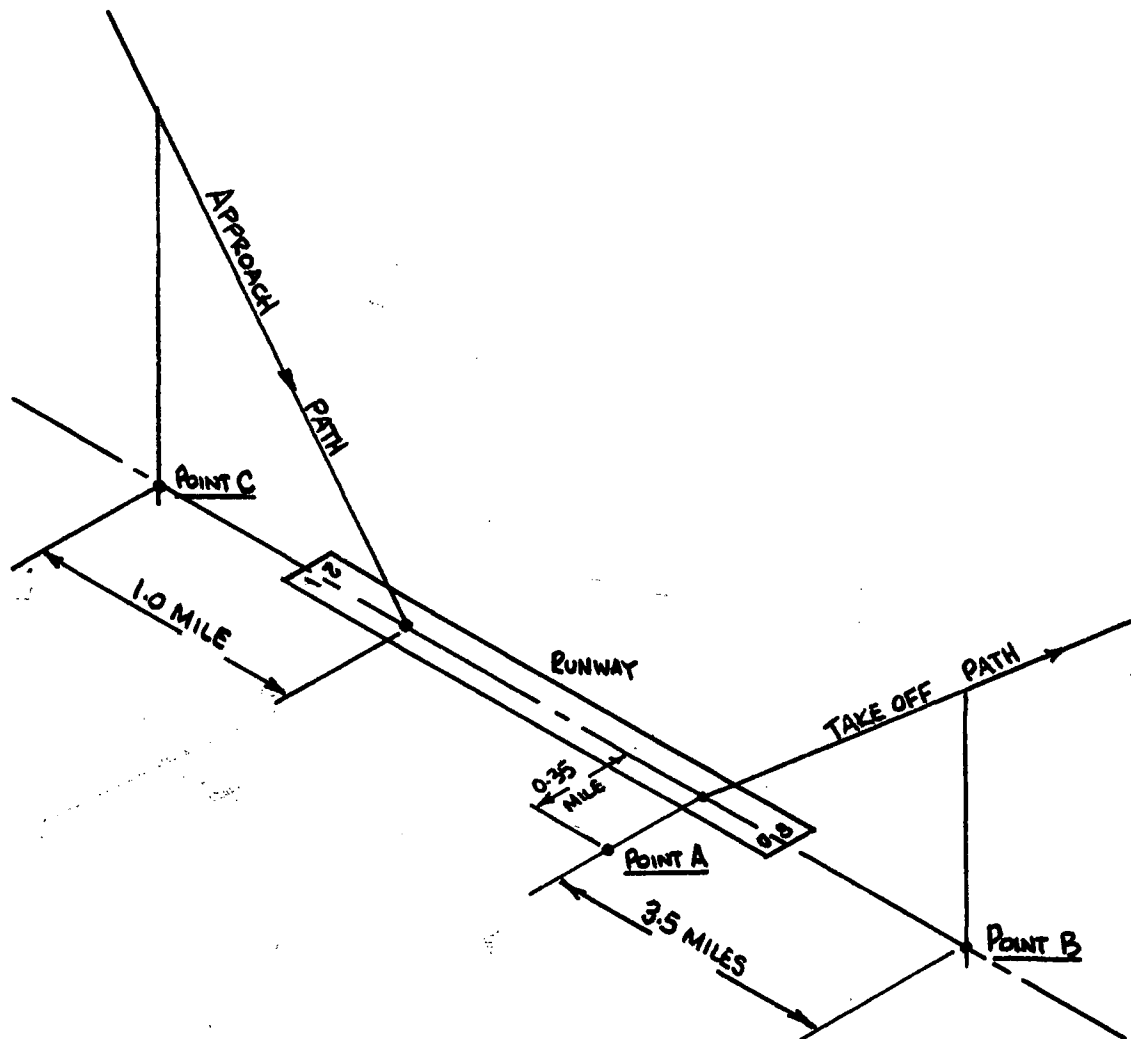
3.3.3.2 Ground Level Noise

Air pollution from SST aircraft does not pose a serious technical problem as a result of improved engine design. Ground level noise, on the other hand, may be a serious limitation for supersonic flight. The most comprehensive measurement for noise level to date is the U.S. Federal Aviation Administration scheme. The maximum noise levels for subsonic transport and turbo-powered airplanes depends upon aircraft weight, number of engines, and point of measurement with a maximum allowable noise level ranging from 93 EPNdB to 108 EPNdB.⁵³ Aircraft not meeting these standards do not receive the government flight certificate necessary to enter service. Measurements occur at three stages of flight; these are measured at three locations which are shown in Figure 3.5. They are:

- Point A. Lateral or Side-line noise - after liftoff, at the point, on a line parallel to and 0.25 nautical miles from the extended centerline of the runway, where the noise is greatest, except that, for airplanes powered by more than three turbojet engines, this distance must be 0.35 nautical miles.
- Point B. Take-off noise - during take-off, 3.5 nautical miles from the start of the take-off roll on the extended centerline of the runway.
- Point C. Approach noise - on approach, at a point 1 nautical mile from the threshold on the extended centerline.

⁵³Effective Perceived Noise Level in Decibels (EPNdB) is the value of PNdB adjusted for both the presence of discrete frequencies and time history.

FIGURE 3.5
AIRPORT NOISE LEVEL MEASUREMENT LOCATIONS



Early estimates suggested that the SST would produce noise levels of up to 124 EPNdB.⁵⁴ In April 1970, the British Aircraft Corporation officially estimated the noise of the Concorde SST at 117.5 EPNdB lateral, 116 EPNdB take-off, and

⁵⁴Horace Sutton, "Is the SST Really Necessary?" Saturday Review, August 15, 1970, p. 15.

116.2 EPNdB approach.⁵⁵ After considerable design effort these figures were reduced to 111, 114, and 115 to 116, respectively, for the production version of the Concorde.⁵⁶ The difference between the present FAA maximum of 108 EPNdB and the most promising SST noise level to date, 115 EPNdB, is still 7 decibels on a logarithmic scale, which means a 40% reduction in noise is still required.

The solution to decreasing the SST noise level is not clear. It is certain that any reduction in the already small payload would not be economically feasible. Engine technology appears to be the answer, but it will take time.

3.4 Fuel Consumption and Air Pollution Trends

Air Canada started advertising Lockheed L 1011 service across Canada on March 15, 1973 and Boeing 747s are commonplace today. Fuel consumption rates for these airplanes, and the McDonnell-Douglas DC-10, will be 30 to 40 percent greater than those for current transport aircraft.⁵⁷ Pollutant emissions are not, however, expected to increase proportionately.

Carbon monoxide, organic emissions, and particulates will be

⁵⁵British Aircraft Corp. Report No. 03-22-28, reprinted in part in U.S. Congress, Senate Hearings, Committee on Appropriations, Civil Supersonic Aircraft Development (SST), 92nd Congress, 1st Session, March 10, 11, 1971.

⁵⁶New York Times, February 24, 1971 and Interavia, September 1971 cited by William A. Shurcliff, SST Handbook for 1972 (Cambridge, Mass.: Citizens League Against the Sonic Boom, 1971), p. 8.5.

⁵⁷Air Transportation Association and Aerospace Industries Assn., "Summary Status Report on Aircraft Engine Exhaust Emissions," Sept. 1968, cited by K.M. Ruppenthal, Problems of Aircraft Noise and Exhaust, Faculty of Commerce, University of British Columbia, Vancouver, B.C., 1972.

reduced, and oxides of nitrogen will increase. As mentioned earlier, oxides of nitrogen are not presently covered by air emission standards under the Clean Air Act, but this is likely to change in the near future.

Fuel consumption in the future is quite difficult to predict. In a survey of Canadian fuel consumption trends, E.R. Mitchell⁵⁸ projects a "continued strong growth rate of 6.5% per annum" in overall fuel consumption to 1980 with only a 4.0 to 4.2% per annum rate of increase of aircraft gasoline and jet fuel. Braithwaite, et al.⁵⁹ are much more optimistic stating:

With respect to commercial aviation, it has been estimated that jet fuel consumption will continue to double every five to six years.

There are so many unknowns that predictions today are poor indicators of the future. Reasons for uncertainty include the following:

1. At the present rate of use, the total known reserves of coal, natural gas and oil in Western Canada could supply our needs for 300 years. Uncertainty lies in the following areas:
 - a. The rate of increase in known reserves in Western Canada, the MacKenzie Delta, the Arctic Islands, the east coast of Newfoundland and Labrador, and Canadian holdings in the North Sea, Australia, and other foreign areas.
 - b. The future rate of use and the future distribution of the crude oil barrel. At present a small per-

⁵⁸E.R. Mitchell, Fuel Consumption and Air Pollution Trends in Canada 1965-1980 (Ottawa: Information Canada, 1972), pp. iii, 16.

⁵⁹Braithwaite, et al., Transportation Pollution, pp. 23-24.

centage of the crude oil barrel goes to jet fuel with a large amount to heating oil. Redistribution through oil refining and natural gas processing may change the proportion of usable fuel for commercial aircraft.

2. Developments such as the Athabaska tar sands and the coal gas projects may promote the use of different types of fuel. Nuclear and matter energy will definitely have an impact on both fuel consumption and air pollution trends.
3. National and international oil policies and the actions of such groups as O.P.E.C. affect the cost structure of airlines (15% of total operating expense is fuel) and may determine consumption trends in the future.
4. The degree of environmental concern over air pollution as evidenced by legislation and/or litigation will be a factor once alternatives to fossil fuels are developed for commercial aircraft.

Air pollution, until quite recently, has followed the pattern of fuel consumption. What went into an engine as a fuel contaminant came out as a pollutant, and was added to by unburned hydrocarbons (due to engine inefficiency). Recently the demands to reduce air pollution have not only increased the efforts to design a more efficient engine but also have increased the efforts in refining cleaner burning fuels. The pressure exerted on the oil industry, by the military, to produce low contaminant JP-6 jet fuel has resulted in close cooperation between oil refiners and the American Petroleum Institute. Through contaminant removal at the source and modern processing techniques the future looks bright for in-

creased fuel consumption and decreased air pollution.

3.5 Summary

From December 17, 1903 when the Wright Brothers finally got their airplane into the air at Kitty Hawk, North Carolina, technology has been synonymous with advance in air transportation. Today the human environment offers new challenge to the ingenuity of aircraft designers, airline executives, pilots, and members of the scientific community.

The U.S. Government's Climatic Impact Assessment Program is the type of response to this challenge that is required for the formulation of meaningful and sensible legislation for the future. The Expropriation Act of Canada indicates a legislative attempt to implement policy concerning the effect of noise on land owners and residents living near airports. This attempt, much debated in Canada, represents progress by recognizing the present state of technology and relating it to the human environment.

The technical considerations involved in the reduction of the harmful effects of noise and air pollution from aircraft challenge the most competent designer. The uncertainties of the future, as illustrated by a wide disparity in fuel consumption projections, and the vast number of interacting design variables provide the aviation industry with its greatest technical challenge since 1903.

CHAPTER IV

THE EXISTING LEGISLATION: ECONOMIC PROBLEMS AND IMPACT

4.1 Environmental Economics

Economics is concerned with the rational allocation of scarce resources among alternative uses to achieve maximum utility. Economics provides a formal basis for decision-making in private and public affairs.¹ These two qualities of economics indicate the importance of an economic approach to air transportation and the human environment. In the first place, there is definite proof that air and water, sometimes referred to as environmental goods, are becoming increasingly scarce, especially in urban industrial areas.² In the second place, a formal basis for decision-making in private and public affairs vis-à-vis environmental expenditure has been lacking in the past. In the past, economic theory has tended to separate private (utility = profit) and public (utility = social benefit) decisions. In reality this separation may be difficult to achieve. Some of the problems associated with this challenge to economic thinking are discussed in this chapter.

¹Roger E. Levien, "The Economic Side of Systems," (one lecture in a series on Macro Systems, Analysis and Synthesis of Complex Systems, presented at the University of California Extension, San Francisco, California, Fall, 1968), p. 1.

²J.R. Lave, J.B. Lave and E.P. Seskin, Migration and Urban Change (Pittsburg, Pa.: Carnegie Mellon U., 1972), p.12.

Branscomb outlines two situations which are commonplace in today's world. These illustrate some of the concepts and difficulties of environmental economics. The first situation is:³

The individual wants good transportation and a clean environment. But when the benefit (clean air) only follows from everyone assuming the cost (a more expensive car), a collective market decision or a social decision is required. The individual's market behavior will not justify any manufacturer's effort to make a more expensive non-polluting car.

The individual decision is not consistent with his wants and he looks to others to provide a clean environment. Under the present system man has no choice on an individual level, ... "but to breathe the air around him--polluted or not."⁴ J.W. MacNeill expands upon this point by stating:⁵

An important characteristic shared by many "environmental goods" is their non-marketability. They simply do not lend themselves to production or packaging or to allocation by price. Clean air, clean water and a quiet neighborhood, for example, are open to the enjoyment of anyone; no one can be excluded from their benefits. The corollary of this is that it is rarely in a single individual's private interest to supply these goods; they normally must be supplied by the people as a whole through the public sector. With few exceptions, this is true of the whole range of "environmental quality goods", they are "public goods".

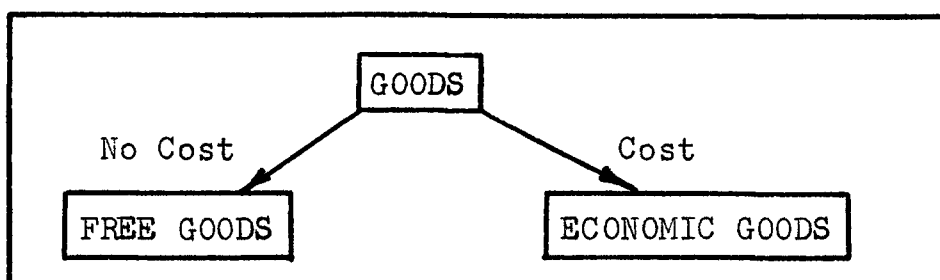
Before environmental goods were considered by economists there was a distinction made between "free goods" and "economic goods". Figure 4.1 below illustrates this distinction:

³Lewis M. Branscomb, "Taming Technology," Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin--Green Bay, 1972), p. 131.

⁴MacNeill, Environmental Management, A Constitutional Study, p. 149.

⁵Ibid., p. 16

FIGURE 4.1
FREE GOODS AND ECONOMIC GOODS



Source: Thomas Crocker and A.J. Rogers, Environmental Economics (Hinsdale, Illinois: Dryden Press Inc., 1971).

In the past, water and air have been treated as if they were free goods. Termed "noneconomic" goods,⁶ they were not considered scarce relative to the need for them and of no particular concern to economists. The use of water by industries and householders was based on payment for the services connected with supplying the water rather than paying for the water itself.⁷ Similarly, a diver would be charged for air compression costs for filling his air cylinder with pure air. This type of economic thinking, still prevalent to a great extent today, was based on the ancient legal notion that the ambient

⁶James M. Murray, "Toward an Environmentally Oriented System of Social Accounts," in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin--Green Bay, 1972), p. 14.

⁷H.J. Kolshus, "Common Property Resources and the Invisible Hand" in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin--Green Bay, 1972), p. 135.

air is "res nullius", the property of no one.⁸

Today the various components of a quality environment--open spaces, attractive neighborhoods, clean air and water, quiet--are beginning to be regarded not only as public goods, but also as "amenity rights", rights to be recognized in law and guarded and protected as jealously as many other fundamental rights.⁹

Branscomb's second example involves another commonplace situation in today's world. He states:¹⁰

The chemical manufacturer is in the same boat. If he makes a unilateral effort to take care of the problem of wastes in the public interest, he has no protection from his less civic-minded competition. Thus, uniform standards are required.

Figure 4.2 illustrates the chemical manufacturer's dilemma. Clean air and water are public goods and hence reflect social costs. Under the present system there is no way in which the chemical manufacturer can bear the costs of destroying these public goods in an equitable manner. Although there is a definite movement toward traditional property law and the standard legal principle, "sic utere tuo ut alienum non laedas" --use your own property in such a manner as not to injure that

⁸Joseph L. Sax, "Legal Strategies Applicable to Environmental Quality Management Decisions," in Environmental Quality Analysis, ed. by Allen V. Kneese and Blair T. Bower (Baltimore, Md.: The John Hopkins Press, 1972), O. 339.

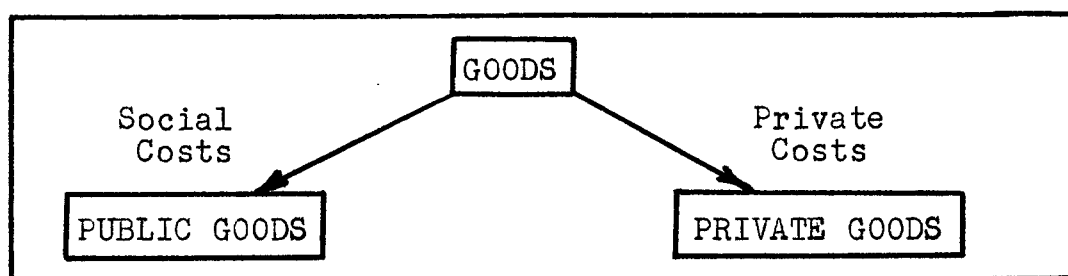
⁹MacNeill, Environmental Management, A Constitutional Study, p. 17.

¹⁰Lewis M. Branscomb, "Taming Technology," p. 131.

of another¹¹the problem is by no means solved.

FIGURE 4.2

PUBLIC GOODS AND PRIVATE GOODS



Two specific items are worth mentioning as essential for an understanding of environmental goods in the existing or in a new economic framework; these are the concepts of resource scarcity and the externalities of environmental pollution.

4.1.1 Resource Scarcity

The assumption that water and air are scarce relative to the need for them is rapidly becoming true, especially in urban industrial areas.¹² Heggie¹³ considers items such as travel time, noise, smoke, effluent, unpleasant working conditions, pain and suffering, and accidental death as elements of a "quality-of-life resource". He points out that, "the scarcity of some parts of this resource--rivers, air and countryside-- only become apparent when a large part of it has

¹¹Sax, "Legal Strategies Applicable to Environmental Quality Management Decisions," p. 339.

¹²Lave, Lave, and Seskin, Migration and Urban Change, p. 12.

¹³Ian G. Heggie, Transport Engineering Economics (Maidenhead, Berkshire, England: McGraw Hill Book Co., (UK) Ltd., 1972), p. 8.

already been consumed."¹⁴ One of the realizations of recent thinking is that man has been consuming a scarce resource for quite some time without paying for it in any way or preserving it for the future. As mentioned in Chapter I, modern day man is realizing that his "... apparent dominion over the environment is but a licence from nature with a fee yet to be paid."¹⁵ Kolshus describes the results of ignoring the scarce resource quality of environmental goods and predicts future costs:¹⁶

The benefactor of industrial pollution is in the short run the consumer who enjoys what economists call a consumers' surplus--he is getting more than he pays for, a gap between total utility and total market value. In the long run the situation is difficult. ... The cost of cleaning up the environment as an after thought is likely to prove considerably more expensive than had it been included in all facets of production.

The greatest challenge is how to reflect resource scarcity of non-monetary inputs in the market place. For example, one might argue that the increased cost of an aircraft engine might sway an airlines decision to expand their fleet. The environmentalist would say, "if that is the case don't expand the fleet." The industry spokesman might see it in a different light and feel that "expansion is necessary for the

¹⁴Ibid., pp. 7-8, Heggie asserts that his "quality-of life resource" has characteristics of the other scarce resources (land, labour, and capital), since, "it can be improved; it must be maintained; it is exhaustible (even clean air can be exhausted); and it has scarcity value."

¹⁵Yannacone, Jr., and Frangella, "Environmental Concern --The Law and Aviation," p. 368.

¹⁶Kolshus, "Common Property Resources and the Invisible Hand," p. 136.

country's balance-of-payments and industrial growth." Without legislative guidance the dual interests of the human environment and the aviation industry cannot be simultaneously met. The tendency to put off investment on pollution abatement equipment is based on the realities of the market place and the time value of money, not on a lack of understanding by private enterprise. Environmental goods are scarce goods and structural economic change is required to reflect this in the market place. Unless the competitive market explicitly recognizes common property resources, or the government recognizes these scarce resources and drafts legislation to control their use, there is no way in which environmental quality can become a true variable in the business decision-making process. In the case of public investment the government must add the "quality of life" to the other scarce resources, land, labor, and capital, in its evaluation procedure.¹⁷

4.1.2 Externalities

From the nature of the air transportation industry and the environment it is clear that (in the economist's terminology) we are concerned with "side-use effects", "spillovers", "external diseconomies" or more commonly "externalities". These are relationships other than those between buyer and seller. The activity of one economic unit generates "real"

¹⁷Heggie, Transport Engineering Economics, p. 8.

effects that are external to it.¹⁸ In the case of air transportation the behavior and equipment of the airlines result in losses to others who are involuntarily exposed to them, but the airlines cannot fully take account of these losses in choosing their behavior and equipment. Those who are involuntarily exposed have no direct remedy or "feedback", apart from a limited ability to avoid places that they find to be noxious.¹⁹ Aircraft noise, for example, is a unidirectional case in which there is some scope for both the creator of the adverse external effect and the sufferer from it to adjust the scale and the nature of their activity. Airlines can, "reduce the number of night take-offs, modify engines to reduce noise and alter the speed and angle of ascent--all at a cost."²⁰ The householders around the airport, on the other hand, "can install soundproofing or move",²¹ but these strategies serve only to lessen the impact of externalities and do not negate their existence.

The control of externalities is difficult and a number of attempts have been made to "internalize" these externali-

¹⁸Allen V. Kneese and O.C. Herfindahl, "Tools for Analysing Some Environmental Problems" in Quality of the Environment: An Economic Approach to Some Problems in Using Land, Water and Air (Washington, D.C.: Resources for the Future, 1965), pp. 14-15.

¹⁹Reynolds, The Urban Transport Problem in Canada, p. 83.

²⁰Turvey, "Side Effects of Resource Use," pp. 47-50.

²¹Ibid.

ties (i.e. bring them within the decision maker's control) through various instruments of fiscal policy such as taxes and fines. Unfortunately pollution externalities can only be internalized at considerable cost, thus reducing profit.²² The private goal of maximizing profit is not consistent with the public goal of maximizing good health. Tinney and Parkes summarize this state of affairs by stating, "Even though we desire a readjustment and reallocation of resources to achieve a better environment, the normal market mechanism is unable to respond."²³ In the next section we will look at some attempts to revise the market system to make it more responsive to environmental demands.

4.2 The Environmental Market System

"Technological external diseconomies are not freakish anomalies in the processes of production and consumption but an inherent and normal part of them," claim Ayres and Kneese.²⁴ The complexity of environmental goods and their externalities are nowhere better shown than by the sonic boom and inadvertent climate modification. These phenomena defy the price system.

²²Richard J. Hickey, "Air Pollution," in Environment--Resources, Pollution, and Safety, ed. by William Murdoch (Stamford, Conn.: Sinauer Associates, Inc., 1971), p. 209.

²³Tinney and Parkes, "Enhancing the Quality of the Environment," p. 15.

²⁴R.U. Ayres and Allen V. Kneese, "Production, Consumption, and Externalities," American Economic Review, LIX, No. 3 (June 1969), p. 287.

In an attempt to move from the confines of the simple cause-effect relationship underlying the present market system several researchers have suggested alternative schemes leading to an environmental market system. Much of the difficulty with the existing economic framework is inherent in the simplifying assumptions introduced in economic theory. Some of the difficulties of estimating the value of pollution abatement are identified by Lester Lave. He suggests:²⁵

Constructing a benefit analysis for pollution abatement consists of finding out what consumers would pay (as a schedule) if there were no problems with knowledge, psychological realization, income distribution, decision-making for others, myopia (and other problems with decisions over time), and public goods. That is, we want to know what consumers would pay for abatement if the economic world were optional except for air pollution (and that only marginally incorrect).

From the point-of-view of the aviation industry, the inability of the present economic system to explicitly place a value on pollution abatement is described by Baxter:²⁶

At the present time all economic incentives to mitigate the effects of noise rest on the neighboring landowner. The aviation industry has no economic incentives to lessen noise impacts. Of course, it does have political incentives to lessen noise, and it has not been so short-sighted as to ignore them. But political pressures, unlike economic criteria, don't tell the industry how much expense it would be appropriate to incur.

Some have been highly critical of these shortcomings of the present economic system. Perhaps the most accurate appraisal

²⁵Lester B. Lave, "Air Pollution Damage: Some Difficulties in Estimating the Value of Abatement" in Environmental Quality Analysis, ed. by Allen V. Kneese and Blair T. Bower (Baltimore, Md.: The Johns Hopkins Press, 1972), p. 213.

²⁶Baxter, "Noise: Legal and Economic Implications," in Air Transportation--A Forward Look, ed. by Karl M. Ruppenthal (Stanford, California: Stanford University, 1970), p. 106.

is that of Auld. He states quite concisely,²⁷ "The free-enterprise, market economy has not operated to ration the resources of air and water and this has led to their misuse and destruction."

Blaming two institutions, the competitive market and our present definition of property rights, does not solve the problem of future pollution or suggest ways of reducing present environmental decay. Several avenues of improvement have been suggested and are discussed below.

4.2.1 Command Economy or Extended Market System

Replacing the market economy with a command economy is presently not practical, and "highly undesirable to the majority of this country."²⁸ The main difficulty with a command economy is that it is not politically acceptable to the citizens of our country. Certainly the advantages are great, with central planning and control of pollution expenditures a great deal could be accomplished. The main drawback is that extensive central control would undermine the existence of the free enterprise system.

An extended market system infers a system in which scarce resources (including free goods as common property resources, such as air and water) would command a price in the

²⁷D.A.L. Auld, "An Economic Analysis of Environmental Pollution," in Economic Thinking and Pollution Problems (Toronto, Ont.: University of Toronto Press, 1972), p. 3.

²⁸Kolshus, "Common Property Resources and the Invisible Hand," p. 135.

market place. Gordon²⁹ has shown the wastefulness of common property arrangements as has Hardin in his treatise entitled, "The Tragedy of the Commons."³⁰ The prohibitive cost of policing individual property rights in air is forcefully brought home by Crocker and Rogers in their book entitled Environmental Economics. They introduce the concept of emission rights and ambient air standards. They say that this "... scheme recognizes the trade-off to be had between continuous optimizing of costs and of damages and the reduction of uncertainty."³¹ Their conclusion is that a choice between centralized control (command economy) and the free market system is not the decision to be made. They suggest:³²

In summary, the basic question in environmental quality control is not of an either/or nature-- a choice between complete centralized control and complete individual control. ... It is a question of the mix between private and central decision-making powers.

4.2.2 Public Policy and Environmental Control

Extending public policy into the area of environmental control is an extremely difficult task. Attempts to date have had limited success, however, they have led to a better appre-

²⁹H.S. Gordon, "The Economics of a Common-Property Resource: The Fishery," Journal of Political Economy, LXII (April 1954), pp. 124-142.

³⁰Garrett Hardin, "The Tragedy of the Commons," Science, CLXII (1968), 1243-1248.

³¹Thomas D. Crocker and A.J. Rogers III, Environmental Economics (Hinsdale, Ill.: The Dryden Press, Inc., 1971), p. 138.

³²Ibid., p. 145.

ciation of the problem, the first step towards its solution. Kneese,³³ Mills,³⁴ and others have classified public policy vis-à-vis environmental control into three main areas: direct regulation, payments by the government to assist in reducing pollution, and effluent charges. These categories are described below:

- (1) Direct regulation - this includes licences, permits, compulsory standards, zoning, registration, and equity litigation.
- (2) Payments - this includes direct payments or subsidies and reductions in collections that would otherwise be made.
- (3) Effluent charges - this includes schedules of charges, or fees for the discharge of different amounts of specified pollutants or levels of noise and excise or other taxes on specific sources of pollution.

It is easy to state the principle by which the socially desirable amount of pollution abatement should be determined:³⁵

Any given pollution level should be reached by the least costly combination of means available: the level of pollution should be achieved at which the cost of a further reduction would exceed the benefits.

A review of the three main areas of public policy identified above will show that this is considerably more difficult in practice than in theory.

³³D.A.L. Auld, Economic Thinking and Pollution Problems (Toronto, Ont.: University of Toronto Press, 1972), p. 70.

³⁴Ibid., p. 67, based on Edwin Mills, The Economics of Air Pollution (New York: W.W. Norton, 1966).

³⁵Auld, Economic Thinking and Pollution Problems, p. 69.

The use of direct regulation is recognition by the governing body that the market mechanism is not a workable system for environmental control. This attitude is expressed by Christian de Laet, Director of the Canadian Council of Resource Ministers, who states,³⁶ "No man can arrogate to himself the right to alter the common environment. Such acts must be subject to public regulation and control." Edwin Mills, on the other hand, is critical of this attitude of giving up the free market system. He feels that,³⁷ "Most people ... think entirely in terms of direct regulation--permits, registration, licences, enforcement of standards, and so on", and suggests, "that this is rather like abandoning a car because it has a flat tire." Most critics feel that direct regulation is too rigid and inflexible and hence is unable to respond to a dynamic environment.

Payments include subsidization of particular control devices, forgiveness of local property taxes on pollution-control equipment, accelerated depreciation on control equipment, payments for decreases in the discharge of pollutants, and tax credits for investment in control equipment. This type of social policy has been used in Canada to a certain extent to help business finance pollution equipment. The major drawback is that it tends to attack the effects of pollution rather than the causes. For example, it encourages the con-

³⁶de Laet, "The Pollution Problem," p. 127.

³⁷Mills, The Economics of Air Pollution.

struction of equipment to treat effluent rather than encouraging means of reducing the amount and concentration of the effluent discharged.³⁸ This type of policy would promote burner cans for jet aircraft rather than a modified original design or cleaner burning turbo fuel. It appears that a direct payment to firms for decreasing the discharge of pollutants would be a better long-range approach to pollution abatement.

Effluent charges on specific sources of pollution have one great advantage over other tools of public policy, this is that they are self-enforcing. The greater the amount of effluent, the greater the cost to the producer and the greater the economic pressure to reduce the absolute quantity discharged. Kneese and Bower³⁹ see "effluent charges or taxes as the most effective and efficient" elements of public policy "from a domestic economy point of view." The main difficulty remains in the implementation of such policy. Joseph Sax describes the

³⁸Yannacone, Cohen, and Davison feel that "pollution control should no longer be viewed as an out-of-profit item for industrial corporations, rather it must be recognized as a cost of production. Therefore, a corporation might be given the option to treat expenditures for noise pollution abatement as a business expense in order to receive an immediate tax write-off without having to depreciate such expenditures over several years." Unfortunately this does not improve the situation mentioned. See Yannacone, Cohen, and Davison, Environmental Rights, and Remedies, Vol. II, Ch. xi, p. 441.

³⁹Allen V. Kneese and Blair T. Bower, Managing Water Quality: Economics, Technology, Institutions (Baltimore, Md.: Johns Hopkins Press, 1969), Ch. 5, 6.

most crucial issue, asserting that:⁴⁰

While it may be true that certain resources--like clean air and water--are not priced effectively by ordinary market transactions, or while it may be true that we have tended too long to treat them as free goods (which may be to say the same thing), I think it is also true that simply to impose a price on them by fiat (as by enacting effluent charge laws) will by no means necessarily make a substantial difference in result. If those who administer effluent tax laws are too compliant, nothing much is likely to change, except our theory.

Although they are "essential elements in a more systematic and coherent program of environmental quality management",⁴¹ isolated and ad hoc taxes and other restrictions are not the sole determinants of such a program.

One of the basic assumptions underlying the concept of effluent charges or "user pays" charges is that the benefit gained by the user of the facility, or the benefit gained by the private enterprise, outweighs the benefit gained by society in general. This type of thinking has been applied, for instance, in the new Montreal International Airport study:⁴²

The objective of making the major airports self-supporting is consistent with the objective of making the passengers who use the facilities pay, directly or indirectly, for the facility instead of the taxpayers.

Similarly, in rapid transit some attempts have been made to make the system bear all the costs associated with its operation. In most cases these attempts have failed. There is a

⁴⁰Sax, "Legal Strategies Applicable to Environmental Quality Management Decisions," pp. 337-338.

⁴¹Ayres and Kneese, "Production, Consumption, and Externalities," p. 287.

⁴²Beinhaker and Elek, "Montreal Airport Study--Ste. Scholastique," p. 57.

definite lack of agreement on whether "user pay" charges are just. For example, Baxter states:⁴³

It's popular in some economic circles to say that noise is a cost of aviation and aviation should bear all that cost. I don't think that's sound.

The lack of agreement as to which area of public policy (direct regulation, payments, or effluent charges) is the best for environmental issues cannot be resolved because there is no one policy which will satisfy all situations. Ralph Turvey suggests that:⁴⁴

Administrators should consider alternatives to direct regulation, economists should not exaggerate the applicability of tax devices, and both should remember that, in a democratic country, questions of fairness require legal or political decisions.

I agree with this approach because it recognizes the importance of looking at public policy in environmental control from a macro-system point of view. The recognition of interacting cause-effect relationships gives the first guidance in what the magnitude of effluent charges or taxes should be in order to "induce behavior that would lead to acceptable levels of pollution."⁴⁵ Some of the novel approaches outlined below recognize the need for obtaining a fit between public environmental policy and the realities of private costs.

A Canadian economist, J.H. Dales, suggests the formation of pollution authorities in regional air and water-sheds.

⁴³Baxter, "Noise: Legal and Economic Implications," p. 105.

⁴⁴Turvey, "Side Effects of Resource Use," p. 60.

⁴⁵R.G. Ridker, Economic Costs of Air Pollution (New York: Frederick Praeger, 1967), Ch. 1.

These authorities would determine the maximum level of pollution that a region would tolerate, and then market pollution rights, certificates allowing a certain amount of pollution. The market would determine the price of these certificates which would be traded as stocks and bonds. Industry would have the choice of developing abatement remedies or purchasing pollution rights. Special interest groups like conservation groups might purchase rights and destroy them, thus lowering the amount of pollution in that area.⁴⁶ This integration of the market system and the ecosystem is based on a minimum amount of government interference⁴⁷ after the tolerable level of pollution for any particular region has been determined. Other suggestions see the government playing more of a role in the balance between regulation and free market control consistent with their perception of the best social policy. Presently these suggestions are unsophisticated and open to attack but they represent a new approach to the problems of environmental control, an approach that is vital to our country's future.

4.3 Economic Costs and Incentives re: Pollution

In this section I will briefly outline some of the economic costs of pollution in Canada and look at the incentives for the reduction of pollution. In a 1971 study, Hedlin

⁴⁶J.H. Dales, Pollution, Property and Prices (Toronto, Ont.: University of Toronto Press, 1968).

⁴⁷Sonja Sinclair, "The New Economics of Pollution," Canadian Business, November, 1971, p. 37.

Menzies and Associates estimated the annual costs of pollution control under current policies in Canada during the next fifteen years. This survey estimated a total annual cost of \$935 million divided into 45.2% water pollution, 31.6% air pollution, and 23.2% solid waste disposal.⁴⁸ Table VI below illustrates the breakdown for air pollution:

TABLE VI
ESTIMATED ANNUAL COSTS OF POLLUTION CONTROL--AIR

	Capital	Operating	Total	Percentage of Total
	(Annual Cost in \$millions)			
Automobile emission control	130	15	145	49.1
SO ₂ removal from stack gases	40	30	70	23.8
Industrial control equipment	50	17	67	22.7
Jet engine exhaust controls	9	4	13	14.4
	<u>229</u>	<u>66</u>	<u>295</u>	<u>100.0</u>

Source: From a study by Hedlin Menzies and Associates Ltd. in Sonja Sinclair, "The New Economics of Pollution," Canadian Business, November, 1971, p. 32.

Mitchell reports that by applying technically feasible abatement measures in 1975, about 6.9 million net tons of harmful pollution can be avoided in 1980. To accomplish this significant feat, it is roughly estimated that a capital expenditure of \$1.6 billion will be needed by 1980 plus

⁴⁸Ibid., p. 32, Values calculated from a study by Hedlin Menzies and Associates Ltd., p. 32.

\$300 million per year for automobile pollution control devices starting in 1975.⁴⁹ Relating this to the Hedlin Menzies and Associates forecast an expenditure of just over twice the annual capital expenditure (\$696 million) and twice the annual automobile emission control expenditure (\$145 million) would allow us to decrease the 1980 pollution burden by 33%.⁵⁰

Lester Lave gives some indication of how a decrease in pollution of this magnitude would affect Canadians. He states:⁵¹

As best I can tell, abating pollution by 50 percent throughout the nation would add three to five years to the life expectancy of a child born in 1970. Another way of stating the effect is to estimate that a 50 percent abatement would lower the economic cost of all ill health by just under 5 percent. ... Recent "miracles of medical care" have had a much smaller impact on the nation's health. For example, eradicating polio by vaccine is much less important than the 5 percent reduction that would be gained by abating pollution.

In the case of decreasing 1980 pollution by 33% we would be looking at a 3.3% decrease in the economic cost of all ill health. In Canada in 1965 hospital costs for respiratory illness amounted to \$123 million and wages lost \$1.5 billion.⁵² Statistics show without doubt that the incidence of such diseases is greater in polluted urban centers than in rural areas and with increased urbanization, the incidence of such disease has increased in the last 20 years. Based on the

⁴⁹Mitchell, Fuel Consumption and Air Pollution Trends in Canada 1965-1980, p. iii.

⁵⁰Ibid.

⁵¹Lave, "Air Pollution Damage," pp. 240-241.

⁵²Braithwaite, et al., Transportation Pollution, p. 8.

figures given above, one might conclude that pollution abatement is a good public investment.⁵³

Noise pollution costs are high. The estimate to modify the world's commercial jet fleet anticipated by 1980 is an investment of \$860 million to \$2.7 billion.⁵⁴ Considering Canada's 3.7% share of the world market this would be roughly \$32 to \$100 million or two to seven times the present \$13 million annual cost of air pollution control for jet engines (of which very little goes to noise abatement equipment). The incentives to reduce noise would have to be somewhat greater than those to reduce air pollution in terms of economics.

In view of the economic costs of pollution and the possibility of a significant public benefit by spending money now to clean up the environment, there appears to be sufficient incentive for government action to achieve this end. Weighed against alternative uses of funds it is unlikely that, even in economic terms, the government will have better investment opportunities for the public. The question remains whether or not federal intervention into the public sector is warranted.

⁵³Minister of the Environment for Canada, Mr. Jack Davis, states that the external costs (costs which must now be internalized by better environmental control) are not large for most industries ranging from 0.5 to 3.0 percent of gross income and averaging about 1 percent for most manufacturers. This estimate is based on present standards rather than a major attack on pollution funded by the government. Cost data from Environment Canada, Canada and the Human Environment (Ottawa: Information Canada, 1972), p. 31.

⁵⁴U.S. Council on Environmental Quality, Environmental Quality--1972, p. 274.

A U.S. Senate Committee report gives some guidance here. It reads:⁵⁵

In dealing with matters of transportation regulation and promotion, government actions at all levels are taken with the justification of broad public interest. This, in fact, is the only legal basis for the extent of Federal intervention in private enterprise.

In the case of increased governmental spending on pollution abatement facilities, the broad public interest is served and federal intervention is justified.

4.4 Environmental Quality and International Trade

In Chapter II, Section 7, I spoke briefly about international agreements on noise levels and air pollution standards. In this section I will extend my international considerations of the air transportation industry to look at the impact of environmental quality on international trade. Air transportation not only contributes to the flow of good between countries but also transports entrepreneurs, government trade commissioners, and representatives of every nation to meet face-to-face over matters of international importance. The manner in which environmental quality is handled on an international scale will have a profound impact on the air transportation industry.

Recognizing that environmental measures can have important economic implications, the Organization for Economic Cooperation and Development (OECD)--composed of Japan, Australia, and the industrial-

⁵⁵U.S. Congress, Senate, National Transportation Policy, Preliminary Draft of a Report for the Committee on Interstate and Foreign Commerce (Washington, D.C.: U.S. Government Printing Office, 1961), p. 32.

ized nations of Western Europe and North America--asked the Environment Committee that it formed in 1970 to suggest ways to minimize the impacts of environmental protection measures on international trade. Based on committee recommendations, the OECD Council at its ministerial meeting in May 1972 adopted a set of guiding principles on the international economic aspects of environmental policies.⁵⁶

The OECD guidelines, referred to above, espouse the "polluter pays" principle, which states that "the cost of pollution controls should be reflected in the costs of making products the use or production of which causes pollution."⁵⁷ Under the "polluter pays" principle some portion of the environmental protection cost is ultimately borne by the consumer of the product as reflected in the selling price. The OECD guidelines include another important principle--"that governments should frame their environmental protection measures in a way that avoids creating nontariff barriers to trade."⁵⁸ The spirit of the OECD guidelines are reflected by d'Arge and Kneese, who assert:⁵⁹

We hope that international negotiation and the harmonizing of environmental control programs can proceed unhindered by unjustified unilateral decisions for protection of domestic industries which will result in inefficiencies in production that are international in scope.

⁵⁶U.S. Council on Environmental Quality, Environmental Quality--1972, p. 80.

⁵⁷Ibid., p. 81.

⁵⁸Ibid.

⁵⁹Ralph C. d'Arge and Allen V. Kneese, "Environmental Quality and International Trade," in World Eco-Crisis ed. by David A. Kay and Eugene Skolnikoff (Madison, Wisc.: University of Wisconsin Press, 1972), pp. 293-294.

The OECD guidelines were optimistic; however, the reality of the situation was demonstrated when the United Nations Conference on the Human Environment adopted a recommendation calling for compensation by the developed countries to the less-developed countries for trade damages stemming from environmental factors.⁶⁰ The coolness of developing countries toward U.N. involvement with the environment⁶¹ is not without reason. Brazil's position, as described by Dr. Hugh Keenleyside, is that, "the developed countries want to climb the ladder of success and pull it up after them," reflecting the general attitude that, "you've had your development, now you want to keep us from doing the same."⁶²

The greatest international concern is that environmental policies of national governments will not be the same. This fear is particularly well-founded when one considers that, "Pollution or defacement of a physical landscape can only be measured against a human preference,"⁶³ and that agreement on

⁶⁰David A. Kay and Eugene B. Skolnikoff, "International Institutions and the Environmental Crisis: A Look Ahead" in World Eco-Crisis ed. by D.A. Kay and E. Skolnikoff (Madison, Wisc.: University of Wisconsin Press, 1972), pp. 305-314.

⁶¹The United States voted against this proposal, pointing out that many forces affect export earnings and that to single out any of these, such as environmental actions, for compensatory treatment is wrong in principle and would create a disincentive for environmental improvement.

⁶²Hugh Keenleyside, "The Stockholm Conference on the Environment: An Assessment."

⁶³Gilbert F. White, "Formation and Role of Public Attitudes," in Environmental Quality in a Growing Economy ed. by Henry Jarrett (Baltimore, Md.: Johns Hopkins Press, 1966), p. 105.

human preference, even on a national scale, is extremely difficult to achieve. The consequences of unequal national treatment of environmental quality are reflected in the fear described by d'Arge and Kneese:⁶⁴

One fear is that cost increases which home industries may have to sustain because of environmental controls will adversely affect both the industry's and the state's international trade position, the level of real national income, and long-term comparative advantage. This fear becomes particularly acute when it is suggested that one trading country move to curb environmental degradation without coordinate action by others or when it is thought that other countries will subsidize the environmental controls instituted by industry while the country in question will not subsidize but perhaps even charge or tax them for any environmental disruptions.

A series of retaliatory trade actions could be triggered by three mechanisms. First, firms subject to strict environmental standards may be put at a competitive disadvantage with foreign competitors that are not, and seek to equalize this by imposing trade barriers on non-environmental goods.⁶⁵ Second, nontariff barriers, such as frontier charges and export subsidies, may be established by nations with high environmental standards to equalize environmental costs with trade competitors. Finally, those nations with high environmental standards may discriminate against nations producing "environmentally inferior goods".

A difficulty directly caused by an international

⁶⁴d'Arge and Kneese, "Environmental Quality and International Trade," pp. 257-258.

⁶⁵U.S. Council on Environmental Quality, Environmental Quality--1972, p. 92.

emphasis on environmental quality develops out of the "environmentally inferior good" concept. For a number of years the United States has been sending mono-degradable detergent to underdeveloped countries and producing bio-degradable detergent for domestic use. Similarly Canada exports high-sulphur coking coal to Japan. This flow of eventual pollutants between nations has been the by-product of demand for low price goods in the international market. It also reflects the former attitude, on an international scale, that clean air and fresh water were "free goods". Another example of a potential upset of international trade patterns is the situation facing the exporters of lead and sulphur (including Canada). Already our prairies are being stockpiled with sulphur as the price declines even further (1971 \approx \$23/ton, 1972 \approx \$8/ton). As lead is phased out of gasolines and paints and as sulphur is recovered from industry, the worldwide demand for these materials will decline,⁶⁶ affecting the international balance of trade.

A third area in which environmental quality considerations may affect international trade flows is in the determination of the location of production facilities. One of the major components in location decisions is the cost of transportation. As John Munro points out:⁶⁷

Within the involved evaluation of the cost and revenue characteristics of alternative locations, transport

⁶⁶Ibid., p. 93.

⁶⁷John M. Munro, Trade Liberalization and Transportation in International Trade (Toronto, Ont.: University of Toronto Press, 1969), pp. 5-6.

costs are a key consideration. They influence the delivered cost of raw materials and fuel, and they affect the market attributes of different locations. Relatively high transport costs mean expensive production and restricted markets and, unless offset by some major locational advantage, can act as an absolute barrier to the establishment of economic activity at a certain location or in a certain region. Changes in transportation costs can have similar effects on firms already established at given locations.

From the point-of-view of the international firm contemplating investment in a particular country, the environmental controls imposed by different countries is going to enter into his decision. The low cost operation of Liberian and Greek tramp steamers may be upset by environmental controls which, reflected in crude prices, may alter the international flow of oil and the location of refining facilities. On a lesser scale, unequal national consideration of the SST may affect the location of business abroad.

In the 1970s, the United Nations will, in its non-political work, be concerned with "quality of life" issues as well as Gross National Product--and with problems of developed as well as less developed countries.⁶⁸ Environmental issues may come to exercise a growing influence on international economic relations.⁶⁹ The problems are not unlike the problems faced on the national level and the need for an inte-

⁶⁸Gardner, "The Role of the U.N. in Environmental Problems," p. 69.

⁶⁹A report submitted by a panel of experts convened by the Secretary-General of the U.N. Conference on the Human Environment, Founex, Switzerland, "Development and Environment" in Environment Law Review--1972 ed. by H. Floyd Sherrod, Jr. (Albany, N.Y.: Sage Hill Publishers Inc., 1972), p. 698.

grated approach which is receptive to the demands of the human environment is even more apparent.

4.5 Summary

Before summarizing this chapter I would like to record the conclusions of Allen V. Kneese with regard to economic studies of environmental quality. His contribution to this area has without doubt been of major impact. He offers three conclusions:⁷⁰

1. Optimum rules, standards, or other techniques for controlling environmental quality must result from analysis of values, contrary to the usual approach which is still narrowly focused on physical effects and objectives. Research in the economics values associated with environmental management has made significant progress along some lines, but has barely begun to shed light on many difficult problems.
2. Even carefully determined value-based rules and regulations governing individual, industrial, and local government decisions often cannot achieve optimal environmental quality management; more direct and explicit collective acting on a regional scale is often indicated.
3. We are ill-equipped institutionally to implement those management systems and procedures which economic and engineering analysis suggests; and appropriate research on how to design suitable institutional and organizational arrangements has hardly begun.

A study of Air Transportation and the Human Environment would not be complete without some mention of the relatively new field of environmental economics. New problems demand new approaches, and, although simplifying assumptions must be made,

⁷⁰Allen V. Kneese, "Research Goals and Progress Toward Them" in Environmental Quality in a Growing Economy, ed. by Henry Jarrett (Baltimore, Md.: Johns Hopkins Press, 1966), p. 87.

important variables cannot be ignored. Recently, new thinking has been directed toward environmental goods, goods such as air and water that have always been with us but have not been recognized in an economic sense. With this new approach some attempts have been made to incorporate the human environment into an economic frame-of-reference. These attempts have not all been successful; however, they have provided a beginning for a more coherent environmental quality management system.

The problems of the human environment are complex and the solutions are not easily determined. On a national level much can be accomplished by increased governmental expenditure to realize the benefits of a healthy population. On an international scale, an understanding of the impact of environmental controls on world trade patterns is vital to both multinational corporation decision makers and government representatives.

CHAPTER V

THE EXISTING LEGISLATION: SOCIAL PROBLEMS AND IMPACT

Aviation has had a major impact on the social patterns of man. From a modest beginning in passenger and mail service in the 1920s to the large-scale international passenger and air cargo service of today, the air transportation industry has influenced human settlement patterns, the adoption of parts of one culture by another, and the spread of various ideologies throughout the world. Aviation has also promoted a general widening of individual perception from a regional to a global scale.

In the first seventy years of this century man ruled the air. In the last few years it appears as if the air is ruling man. The damaging effects of air and noise pollution are causing a revolution in man's attitudes toward transportation.

In 1970, Halaby stated,¹ "The race between technology and sociology is on, and that is where the action is." In the light of recent developments it is less of a "race" between technology and sociology and more of a challenge for technology to accommodate social demands and priorities.

¹N.E. Halaby, "Introduction to the Symposium" in Air Transportation--A Forward Look, ed. by K.M. Ruppenthal (Stanford, Calif.: Stanford University, 1970).

5.1 Noise and Human Tolerance

I have long held the opinion that the amount of noise which anyone can bear undisturbed stands in inverse proportion to his mental capacity, and may therefore be regarded as a pretty fair measure of it.... Noise is a torture to all intellectual people.

So wrote Schopenhauer² in 1844, long before the first airplane ever flew. The physiological, psychological and behavioral effects of noise, as mentioned earlier in this thesis, are items of major impact on the air transportation industry. The community's concern is being brought more and more urgently to the attention of government officials. U.S. General William F. McKee, while he was FAA director, said,³"Noise means irritated citizens whose growing protests are blocking needed airport expansion even when such money is available." Former U.S. Assistant Secretary of Transportation, Cecil M. Mackey went further, saying that the citizen's insistence on less degradation of his environment, "is the single most outstanding characteristic of society."⁴

What are the facts about noise and human tolerance?
How much noise can we stand? Ehrlich and Ehrlich give the

²Arthur Schopenhauer, "On Noise" in The World as Will and Idea (H. Haldane and J. Kemp, trans., 1844), cited by V.J. Yannacone, Jr., B.S. Cohen, and S.G. Davison, Environmental Rights and Remedies (Rochester, New York: The Lawyers Co-operative Publishing Co., 1972), p. 374.

³Evert Clark, "Noise Called Bar to New Airports," New York Times, October 5, 1967.

⁴Ibid.

following guidelines:⁵

Permanent loss of hearing follows chronic exposure to high noise levels. Noise levels as low as 50-55 decibels may delay or interfere with sleep and result in a feeling of fatigue on awakening. Recently there has been growing evidence that noise in the 90-decibel range may cause irreversible changes in the autonomic nervous system.

In terms of common, everyday noise levels these levels can be related to the following scale:⁶

35 decibels	-	classroom
55 decibels	-	restaurant
60 decibels	-	sports arena (use of telephone difficult)
80 decibels	-	use of telephone virtually impossible
90 decibels	-	tolerated only in short periods
100 decibels	-	acute discomfort
130 decibels	-	jet revving engines at take-off (maximum allowable for humans)

These are facts based on human tolerances not on human preferences. They are absolute quantities based on the biological limitations of man. The social problems are inherent in the interpretation of these limitations. How close to approach the limits of discomfort varies with individual, group or employer preference and is based on human judgment rather than fact.

In this section I have dealt specifically with noise pollution. There are human tolerances to other forms of pollution, such as air pollution, and the conclusions reached would apply equally well. In the following sections a more general approach will be used in discussing the social problems of the human environment.

⁵Ehrlich and Ehrlich, Issues in Human Ecology, p. 140.

⁶These levels are based on information given in the proposed U.S. Noise Control Act of 1966 as quoted by Culliton, "Noise Threatens Man," p. 101.

5.2 Perspectives and Pressure Groups

The social problems associated with the human environment involve a hierarchy of needs. Individual needs for a specific level of environmental cleanliness contribute to group needs, group needs help to form national or cultural needs, and national needs form global requirements. As one progresses up such a hierarchy there is increasing pressure on the higher levels to satisfy conflicting needs of the various levels below. This social pressure is the motivating force for change.

Social pressure associated with individual and group concern over environmental issues has been strongest from so-called "pressure groups". The theory behind this attempt to influence social policy is described by Towler and Nonken:⁷

If a sense of social responsibility can be developed within those who control the major sources of pollution, and if pressure groups can be formed and maintained to watch them, we may see some balance. The environmental problem is one of values in conflict.

The assumption made by Towler and Nonken is that those who control the major sources of pollution have different values than those who suffer its effects. Edward Carlson, president of United Airlines, takes exception to this assumption by stating:⁸

I guess one of the things that bothers me with those that are environmentalists, and the environment thing, is that they are not the only ones interested in environmental problems. I happen to be, I think, a pretty good citizen of this country, and I'm interested in the environment. But I am also interested in it as

⁷John Towler and Harold Nonken, "Education for Survival," Environmental Quality, February 1973, p. 38.

⁸Cramer, "The Airlines Speak," p. 21.

the principle officer of this company. So anything we can do in the total field of environmental programs we are going to endorse.

The conflict of corporate responsibilities faced by such men as Carlson is described by Learned, et al.⁹ Learned suggests that the business decision-maker must formulate and implement strategy capable of balancing economic opportunity, corporate resources, personal and organizational aspirations, and the legitimate interests of other segments in society. A code of professional business conduct, such as that outlined by Austin, may call on the executive to place, "the interests of society before his own and his company's interests".¹⁰ Inherent in this code is an assumption of diverse, competing goals. The main difference, as I see it, is that the "pressure group" has one goal--the preservation and enhancement of the environment--whereas the business decision-maker has many.

5.3 Response to Social Pressures

The social problems associated with the human environment have become political issues at the national level. An example of social pressure causing political action is provided by Howes. She states:¹¹

⁹Edmund P. Learned, et al., Business Policy, Text and Cases, revised edition, (Homewood, Illinois: Richard D. Irwin Inc., 1969), pp. 485-493.

¹⁰Robert W. Austin, "Code of Conduct for Executives," Harvard Business Review, September-October 1961, p. 53.

¹¹Helen C. Howes, "Pollution: Careful Plans and Firm Action," Canadian Business, April 1971, p. 30.

The Swedes' insistence on healthful, attractive environment and safe recreation facilities has forced aspiring politicians to make anti-pollution measures and conservation important planks in their platforms. Valfrid Paulson states in Scandinavian Times, "When our new laws were under debate, political parties tried to outdo each other in devotion to the cause." Today Sweden leads the Western world in this field.

In the airlines industry, Scandinavian Airlines and their Swedish subsidiary, Linjeflyg, are giving the matter serious study,¹² consistent with this national movement.

In Canada, the response of society to environmental degradation has been directed toward each level of government. On the local level, citizens' groups have exerted pressure on industry and government in such well publicized events as the "Arrow" incident and West Coast oil spills, air pollution damage in the Windsor/Detroit area, environmental arsenic at Yellowknife, lung cancer in Newfoundland fluorspar miners, and community intrusion due to jet aircraft noise in several of Canada's major population centers. On the regional level, social pressure has been instrumental in the Canada-United States Agreement on Great Lakes Water Quality, the Saint John River Basin Agreement, a marine reserve for the Strait of Georgia, and the preservation of the Canadian North. On the national level, social pressure has resulted in political action and has contributed to the formation of the Department of the Environment, the Clean Air Act, studies on mercury and phosphates, and motor vehicle emission standards. Federal government intervention causing the eventual cancellation of Imperial Oil's Lake Louise Village development was the result

¹²Ibid., p. 36.

of social pressures from conservationists.

International response to the social problems of the human environment has been formal and informal, sometimes based on rational argument and sometimes on emotional appeal. Agreement on international environmental policy has been slow due to a lack of knowledge and disparate national goals. The needs of the developed nations vis-à-vis environmental quality are not the needs of the developing nations, due to differing priorities.

Although agreement on specific policy has been slow, the principles of the United Nations Conference on the Human Environment reflect an international social demand for the preservation of our ecosystem. Principle 5 reads as follows:¹³

The non-renewable resources of the earth must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that the benefits from such employment are shared by all mankind.

Environmentally oriented groups such as the Friends of the Earth, the Greenpeace Foundation, the Environmental Forum, the Sierra Club and the Family of Man, are appealing to mankind on an international scale and, through wide media coverage, are getting their message to decision-makers at all levels.

The co-alignment of society's needs and goals with the needs and goals of business is essential for survival. Pressure groups, concerned citizens, and civic-minded individuals perform a necessary function by providing feedback to govern-

¹³U.S. Committee on Foreign Relations, "Report to the Senate on the United Nations Conference on the Human Environment," p. 16.

ment and industry, and by assisting in the formation of national and international social policy.

5.4 Environmental Education

The need for instituting a nation-wide environmental education program at the elementary school level is vital to Canada's future. If we hope to understand and protect the complex human environment, we must learn the facts about it. This is forcefully brought out by John H. Shaffer with respect to aircraft noise. He states:¹⁴

In the long run, the solution to the noise problem will probably be partly technical, partly procedural, and partly environmental---... In noise, as in so many of aviation's problems, greater public understanding is not only necessary, but may actually be half the solution we're seeking.

Our educational system has failed to provide public understanding and a sound basis for evaluating environmental issues. Present and future leaders need factual information to make rational decisions.¹⁵ On an international scale, Caldwell comments on this problem:¹⁶

¹⁴John H. Shaffer, "Aviation's Hour for Action" in Air Transportation--A Forward Look, ed. by K.M. Ruppenthal (Stanford, Calif.: Stanford University, 1970), p. 195

¹⁵Canada has taken some steps in this direction, as evidenced by a two-week course to acquaint industry and government leaders with the social, economic, and technical aspects of northern development. This course is jointly sponsored by industry and the Government of the Northwest Territories.

¹⁶Lynton K. Caldwell, "An Ecological Approach to International Development: Problems of Policy and Administration" in The Careless Technology-Ecology and International Development, ed. by M. Taghi Farvar and John P. Milton (New York, N.Y.: Doubleday and Co. Inc., 1972), pp. 927-928, 941.

The pressure of people upon resources and living space is necessitating new attitudes and behavior patterns in the interest of human civilization and survival. The inculcation of these attitudes and behaviors will require new instruments of international education and new interpretations of the rights of nations. A body of doctrine is slowly emerging that could form a basis for international environmental policy and administration. The formulation of this policy and the establishment of feasible and effective institutions to administer it is one of the major tasks of national and international politics in our time. ... But the machinery of international negotiations moves slowly, and measures now in gestation may not be born in time to prevent ecological crises in one or more areas of the earth.

Decisions based on insufficient information are high risk decisions. Environmental education emphasizing factual material is the answer to reducing risk and uncertainty in a complex world. The probability of national and international agreement on environmental issues is much higher if individual beliefs and attitudes are formed early in life and are based on complete information.

5.5 Summary

The most complex, difficult, and time-consuming problems in the human environment are social problems. Just as with technical and economic problems there is a need for a more integrated macro-system approach to social problem-solving. Environmentalists make demands based on their narrow perception of human needs and wants, often depicting industry as dispassionate and unconcerned with public welfare. Industry, on the other hand, tries to make rational judgments on social matters with insufficient information. Individuals fail to include the effects of transportation on the national economy

and world trade in their decision-making framework.

These incomplete views are often thought of as conflicting values rather than contributing values in an overall environmental management program. Social demands for a cleaner, quieter atmosphere cannot go unanswered and a reassessment of priorities is essential.

Much of the difficulty manifested in diverse social attitudes can be attributed to a lack of knowledge about our environment. A nationwide or even worldwide program of environmental education would provide important factual information, enhance the possibility of communication between segments of society, and promote a de-polarization of beliefs and attitudes. The eventual goal, an integrated global environmental management system, will take time to achieve, but an increase in environmental awareness can be achieved today.

CHAPTER VI

THE ROLE OF BUSINESS

An understanding of the problems of the human environment as new input to the decision-making process of both government and business is required for survival in the future. A government that is not receptive to change, as perceived by the electorate, is unlikely to remain in power. A business that is not receptive to change, as perceived by the market, is unlikely to survive in a competitive environment.

A limited amount of change is possible through "organizational slack" within the organization, however some structural change will be required to fit the organization (be it private enterprise or government) and its capabilities, to the task environment. The final product of such structural change is an efficient operating system with low uncertainty--an organization attuned to the environment in which it functions.

6.1 Pollution, a New Dimension for Business

Just what effects will legitimate concern for pollution have on business operations and what is business doing to combat it? Oil spills, waste gases and effluents, noise, all have created a new dimension for business--the need to consider in advance whether any of its activities will contribute

to pollution.¹ Duncan McLeod describes this new dimension as follows:²

A year ago it was doubtful if complaints by conservationists about a new business project would have been deemed of sufficient importance to merit serious mention by newspapers. But in the past few months newspapers throughout the western world have devoted increased space to conservationists. Eminent scientists have joined them in questioning publicly the wisdom of a variety of such business projects as transporting Alaskan oil through the Arctic Ocean by supertankers; building the supersonic airliner; and manufacturing no-deposit, non-returnable bottles.

It is interesting to note, for example, that the press coverage of the United Nations Conference on the Human Environment was greater than that of the 1972 Olympic Games in Munich.³

In general, business is more visible in its pollution than other institutions and thus more vulnerable to public criticism. It is easier to see the black or yellow smoke coming from a factory smokestack or a jet engine than the wastes from thousands of home oil furnaces which actually may be polluting the air to a greater extent. The small spills, fires, and exhaust streams similarly go unnoticed but contribute a major amount to the total pollution of the environment. It took a great amount of scientific research to identify automobile exhaust (aided by photo-chemical action from sunlight) as the primary source of Los Angeles' smog. Once identified, a major publicity campaign was necessary to convince people that

¹Duncan McLeod, "Pollution: Its New Dimensions for Business," Canadian Business, March 1971, p. 33.

²Ibid.

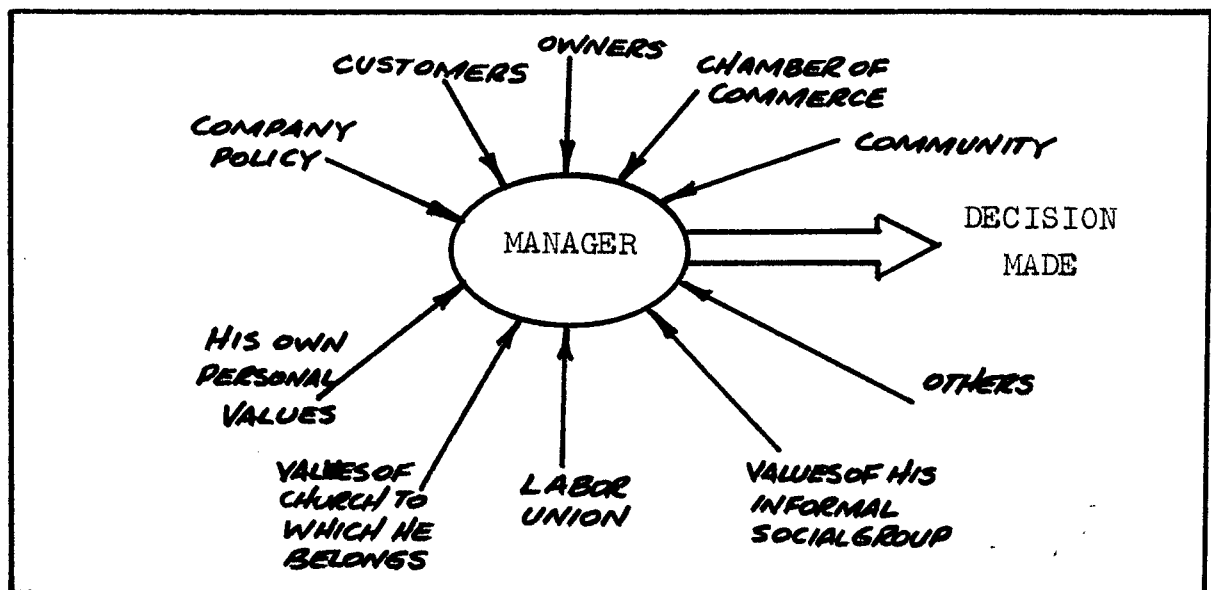
³Keenleyside, "The Stockholm Conference on the Environment: An Assessment."

the extremely visible factories and refineries were not the major causes of smog. By 1969, with normal regulation, combined industrial-residential-commercial sources caused only ten percent of air pollution in Los Angeles County; the remaining ninety percent came from motor vehicles.⁴

The various pressures on the business managers are increased with the added dimension of pollution; Figure 6.1 diagrammatically illustrates this point.

FIGURE 6.1

PRESSURES ON A MANAGER CONCERNING AN AIR POLLUTION PROBLEM



Source: Keith Davis and Robert L. Blomstrom, Business, Society, and Environment: Social Power and Social Response (New York, N.Y.: McGraw-Hill Inc., 1971), p. 77.

Besides dealing with groups having diverse goals and attitudes (such as labor unions, customers, members of the community, and

⁴Louis J. Fuller, "As I See It," Forbes, December 15, 1969, p. 55.

stockholders), the manager must balance conflicting values in the decision-making process. Walton identifies some of these occasionally conflicting values:⁵

1. Technical - based on physical facts, science and logic
2. Economic - based on market values determined by supply and demand
3. Social - based on group and institutional needs
4. Psychological - based on personal needs of individuals
5. Political - based on general welfare needs of the state
6. Aesthetic - based on beauty
7. Ethical - based on what is right
8. Spiritual - based on what God revealed

Historically, the first two value systems, technical and economic, have dominated business decision-making and the political value system has dominated governmental decisions. Today's business and governmental decisions must recognize all of these value systems. Learned et al. state that,⁶ "... a business firm, as an organic entity meaningfully related to its environment, must be adaptive to demands for responsible behavior as for economic service." Acting responsibly thus becomes one of the shared goals of the corporation. The answer to pollution, a new dimension for business, is corporate responsibility.

⁵Clarence C. Walton, Ethos and the Executives: Value in Managerial Decision Making (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1969), p. 24. Edward Spranger similarly classes all individuals as falling into one or another of: (1) Theoretical, (2) Economic, (3) Aesthetic, (4) Social, (5) Political or (6) Religious value orientations. See Learned et al., Business Policy, Text and Cases, p. 324.

⁶Learned et al., Business Policy, Text and Cases, p. 487.

6.2 Technical Role--The Importance of Input

Corporate responsibility in a technical sense must include active participation in the formation of realistic, attainable environmental standards. The role of business in the fight against noise and air pollution in the air industry is to provide input into an overall reasonable scheme of environmental management. Industry participation in joint programs with the government (such as the CIAP and REFAN projects) in such areas as engine testing, safety, and flight procedures, is vital if controls and regulations are to be effective and accepted.

The operating airlines have the most experience and expertise necessary to assess the long run technical capabilities of their fleets. Together with the aircraft manufacturers they can supply the best estimate of the impact of specific technical modifications and changes in operating procedures on the air industry. The formulation of standards should reflect this input and the responsible corporation should be willing to supply it.

6.3 Economic Role--The Profit Motive

Peter Drucker emphasizes that the first duty of the corporation is to survive and that profit, not philanthropy, is the test of performance. He stresses that social responsibilities could never justify actions contrary to the corporation's best interests, although he does concede that a corporation, "should be so organized as to fulfill automati-

cally its social obligations in the very act of seeking its own best self-interest."⁷ Inherent in this socio-economic approach is the underlying assumption that elements of the human environment can be incorporated into the market system in an effective manner. Mr. Ronald Ritchie, vice-president and director of Imperial Oil, looks to a change in the rules of the market place to get "different results from the economic process" and "desired new behavior from business enterprises."⁸ This type of change is required to make business and public interests coincide. Ritchie also outlines business enterprise's major demand on government—political decisions which modify the forces of the market place in such a way as to promote socially desirable environmental quality. He states:⁹

If we mean that merely to meet consumer demands as cheaply as possible is no longer enough, but that it must be done without the use of child labour, we need to say so in specific terms and make it apply generally (as we have done for many decades). If we wish to add to that in today's world, the air and the water and the soil must be kept to certain levels of purity or beauty or safety for human health, then we must not only establish the standards but we must devise rules, incentives, and penalties which allow all of those concerned, which indeed force them, to behave in ways, both as producers and as consumers, that are consistent with these goals. We cannot be content simply with pointing accusing fingers, passing moral judgments, and urging good behaviour without defining how it shall be known what good behaviour is.

⁷Peter F. Drucker, The Practice of Management quoted in Morrell Heald, The Social Responsibilities of Business (Cleveland, Ohio: The Press of Case Western Reserve University, 1970), p. 283.

⁸Ronald S. Ritchie, "The Corporation in the World-To-Be" (Industrial Relations Management Association paper, Harrison Hot Springs, B.C., February 19, 1971), p. 10.

⁹Ibid., p. 11

Businessmen feel that the real key to bringing corporate resources to bear in social problems is the profit motive.¹⁰ Few, if any, corporations can afford to channel large portions of their resources toward solving social and economic problems without being paid for their involvement.

6.4 Social Role--Social Responsibility and Business

In comparison with the classical economic theory model of perfect competition and a free market, business organizations are frequently very powerful and operate in a mixed economy. The degree to which these corporations are socially "responsible" depends upon the definition of social responsibility. Davis and Blomstrom define social responsibility to be, "... a person's obligation to evaluate in the decision-making process the effects of both his personal and institutional decisions and actions on the whole social system."¹¹ They clarify this further in terms of interests as follows:¹²

Businessmen apply social responsibility when they consider the needs and interests of others who may be affected by business actions. In so doing, they look beyond their own personal interests and also beyond their firm's narrow economic and technical interests.

Although social responsibility recognizes the needs of other groups and individuals it does not imply internalization of

¹⁰Keith Davis and Robert L. Blomstrom, Business, Society, and Environment: Social Power and Social Response (New York, N.Y.: McGraw-Hill Inc., 1971), p. 178.

¹¹Ibid., p. 85.

¹²Ibid., p. 86.

these needs. For example, Richard Eells states:¹³

The social responsibilities of a corporation do not demand responses to all public expectations. The public may demand too much. Its desires may be transitory ... The social responsibilities of a corporation, therefore, cannot be defined in terms of merely passive adaptation to the public demands on business.

An example of this from the air transportation industry is the demand that airlines immediately install retrofit kits to lessen noise levels. This may be worth considering by the airlines, but is definitely not a criterion of corporate social responsibility. The true test of social responsibility is whether issues of public interest are considered at the time a decision is made. Careful consideration of key issues rather than adoption of an inflexible point-of-view should be the social role of business.

6.5 Social Role--Voluntary Action

Hundreds of millions of dollars are being spent annually in North America as voluntary business action to prevent and eliminate pollution. Business is starting to internalize environmental costs and recognize pollution control as one more cost of doing business in a particular environment. The term "voluntary" is a little misleading because, "it can be argued quite properly that ... business is responding to countervailing pressures".¹⁴ The interesting facet of voluntary action is that it is based on the corporation's own perception of social responsibility. The late John F. Kennedy expressed the

¹³Richard Eells, The Corporation and the Arts (New York, N.Y.: The MacMillan Company, 1967), p. 175.

¹⁴Ibid., p.343.

view that, "In the last analysis, high ethical standards can be achieved only through voluntary effort."¹⁵ From one point-of-view much of business action is voluntary. Even when regulations exist there can be a considerable difference between the spirit of the law and the letter of the law. An improvement of the market system to reflect social reality would not preclude voluntary action, it would only reconfirm its purpose.

6.6 Competition and Regulation

Air transportation provides a unique mix of competition and regulation. Transportation is a public utility.¹⁶ It does have a public purpose and does serve the general public. The results of this public responsibility and accountability is seen in policy formation within the industry. John Allen, Jr. suggests that:¹⁷

Objective, explicit policy standards are especially appropriate in those areas in which the public is immediately affected. This is especially true in those great industries affected with a public interest. Of the industries, transportation is perhaps the largest. Transportation is regulated today, in fact very strictly, in the name of public interest... Because the industry is so closely connected with the public interest, industry policy-making may be considered in much the same way as in public policy.

¹⁵John F. Kennedy, "A Statement on Business Ethics and a Call to Action" (Statement at a meeting of the Business Ethics Advisory Council, January 16, 1962), U.S. Department of Commerce, 1963, p. 9.

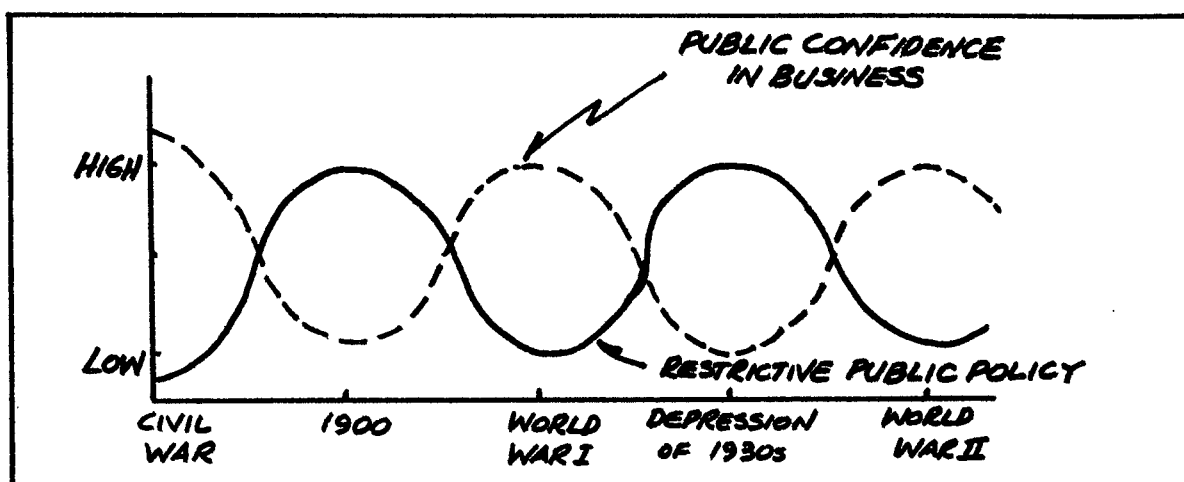
¹⁶A.P. Heiner, "The Transport Revolution and Regulation," in Revolution in Transportation, ed. by K.M. Ruppenthal (Stanford, Calif.: Stanford University, 1960), p. 115.

¹⁷John J. Allen, Jr., "Transportation Planning in the Decade Ahead," in Challenge to Transportation, ed. by K.M. Ruppenthal (Stanford, Calif.: Stanford University, 1961), p. 2.

Ruppenthal notes that, "From the very beginnings of commercial aviation, the federal government has played an important role,"¹⁸ but also that, "... the fact of the matter is that almost all government regulation has come about because the industry has asked for regulation."¹⁹ The historical balance between restrictive public policy and public confidence in business is shown in Figure 6.2:

FIGURE 6.2

HISTORICAL RELATIONSHIP BETWEEN PUBLIC CONFIDENCE IN BUSINESS
AND GOVERNMENT RESTRICTIONS ON BUSINESS



Source: K. Davis and R.L. Blomstrom, Business, Society, and Environment: Social Power and Social Response (New York, N.Y.: McGraw-Hill Inc., 1971), p. 173.

In air transportation specifically, Richmond sees this balance as somewhat less predictable. He states:²⁰

¹⁸Karl M. Ruppenthal, Air Line Management (Stanford, Calif.: Stanford University, 1967), p. 6.

¹⁹Ibid., p. 82

²⁰Samuel B. Richmond, Regulation and Competition in Air Transportation (New York, N.Y.: Columbia University Press, 1961), pp. 256-257.

The optimum blend of competition and regulation is a dynamic quantity. Its movement through the transition from reciprocating engine to jet to supersonic equipment as well as to short and vertical take-off equipment with its repercussions on alternative modes of surface travel cannot be predicted. However it is hoped that the Civil Aeronautics Board ... will as a general policy and whenever feasible, act to preserve and strengthen rather than weaken competition in the air transportation industry.

Self-regulation has taken place through the International Air Transportation Association (IATA) which, "... is concerned with governmental policies that affect aviation and with many economic matters that affect the health of the industry.²¹ The most distinctive work of IATA is as follows:²²

1. Interline agreements: standardisation of forms, procedures, landing agreements, and other factors, making possible the quick and easy exchange of traffic between airlines.
2. The negotiation of international tariffs and rates.
3. The provision of a clearing house for the settlement of airlines' accounts with each other.

The International Civil Aviation Organization (ICAO), on the other hand, is an arm of the various national governments and establishes international standards of navigation, etc. The role of IATA vis-à-vis social responsibility will become important if environmental quality is internalized into the costs of operating an airline or if the market is improved to reflect environmental goods as scarce resources. The role of ICAO is presently an active one in establishing international policy on air transportation and the human environment.

²¹Ruppenthal, Air Line Management, p. 19.

²²W.S. Barry, Airline Management (London: George Allen and Unwin Ltd., 1965), p. 77.

Through self-regulation the airlines can have a considerable input into the formation of international standards rather than adjusting to rules established by groups functioning outside the industry.

One normally thinks of competition and regulation as being mutually exclusive, with each serving a separate purpose in society. Samuel Richmond disagrees, in the case of air transportation, providing insight into the difficulty of defining a unique role of business. He states:²³

It is clear that both competition and direct regulation can, in the appropriate circumstances, be substituted one for the other, as mechanisms for seeking to serve the public good in the economic phases of the air transportation industry.

Whether or not competition and direct regulation are equally effective in dealing with the non-economic problems of the human environment depends, to a great extent, on the relative ability of industry and government to perceive the needs and values of the public. The pressure of the human environment will likely alter the optimum balance between direct regulation and competition; however, the basic goals of business and government will remain the same.

6.7 Summary

The role of the airlines in the existing legislative framework is narrowly defined. In the past much of the air industry decision-making has been dominated by only technical and economic considerations. In order to meet the challenge

²³Richmond, Regulations and Competition in Air Transportation, p. 256.

of the human environment, the airlines have had to expand and redefine their role to accommodate public duties in addition to providing efficient transportation service. These public duties include cooperation with the government in technical areas to provide industry input to the formulation of standards and realistic legislation.

With the impact of pollution and concern over the human environment, a new dimension for business has been added. In the past, government regulation and intervention has been either at the request of industry or restricted to ensuring that the air transportation needs of the general public were adequately served. Presently, business is demanding political decisions which will modify the forces of the market place to make it reflect other social demands.

The balance between competition and regulation in air transportation has also been effected by environmental issues and will likely vary as a function of government and business ability to perceive social needs and expectations.

The emphasis on increased corporate social responsibility has been met with voluntary action by many; however, the profit motive remains the underlying incentive for business. The existing market and legislative structures must be revised to reflect this fact. Recognition of the social needs and goals of society through a revised structure will permit the co-alignment of business and government purpose necessary to deal with the human environment.

CHAPTER VII

THE ROLE OF GOVERNMENT

7.1 Environmental Control and Levels of Government

There appears to be a general feeling among the business community that, "the proper role of government is rule maker and referee, and that it should not, at the same time, attempt also to be a player".¹ According to Peter Drucker, the proper role of government is to formulate social objectives so that they can become opportunities for other institutions to serve society. The chairman of the board of one company commented,³ "Government must lead. But it cannot be the sole problem solver. Its role is to define problems, articulate desired results, organize, directly and indirectly, the whole potential of the society, in a coordinated effort to remake the society and save it from destroying itself." This general feeling toward the role of government is not without merit, but it does neglect the fact that government must be a player if it is to represent the public sector in a responsible manner. If the government assumes a passive role, in which political expedi-

¹Keith Davis and Robert L. Blomstrom, Business, Society, and Environment: Social Power and Social Response (New York, N.Y.: McGraw-Hill Inc., 1971), P. 177.

²Peter F. Drucker, The Age of Discontinuity: Guidelines to Our Changing Society (New York, N.Y.: Harper and Row Inc., 1968), pp. 225, 242.

³Irwin Miller, "Business Has a War to Win," Harvard Business Review, March-April 1969, p. 8.

ency outweighs sound environmental quality management, the public is not well served.⁴ Stanley Stein outlines the present role of government as follows:⁵

In more recent years, there has been a mounting wave of public concern for both the ecological and aesthetic impacts of man's activities on his environment. Governments have responded by assuming an array of postures. ... But even where government activity does exist, it is often fragmented and uncoordinated, reflecting the absence of a comprehensive approach to environmental quality management.

The reason for this fragmented approach is the governmental structure, as mentioned earlier in this thesis. Stein reviews this major barrier to a united and effective governmental role. He states:⁶

The general list of powers of the BNA Act makes clear the intention that local matters should be dealt with locally while national matters are dealt with nationally. However, the net result is the absence of comprehensive jurisdiction at either level of government over all aspects of environmental management.

There are several roles that government could adopt if these constitutional constraints were removed. At one extreme, considerations of environmental quality might be left entirely to private enterprise. At the other extreme, governmental intervention would approach central planning or licensing of virtually all activities. Stein suggests that,⁷ "The final

⁴Political expediency is demonstrated on the provincial level when authorities prefer to encourage technological innovation rather than risk offending industrial polluters through prosecution, if the latter is more socially desirable.

⁵Stanley B. Stein, "Environmental Control and Different Levels of Governments," Canadian Business Administration, 14(1), Spring 1971, p. 129.

⁶Ibid., p. 142.

⁷Ibid., p. 133.

range of government programs for environmental management requires varying degrees of direct government influence on the activities of private enterprise and individuals." With varying degrees of three levels of direct government influence this would prove rather difficult; however, Dupré suggests a "problem shed" concept of governmental jurisdiction which would be more direct.

The "problem shed" concept, one of a number of suggestions based on ecological or geographical zones, would redefine the role of government in terms of physical rather than political boundaries. In this concept public goods are only considered appropriately allocated or "packaged" if "... the boundaries of the unit of government providing that good are such that the externalities of the good are internalized to the public served."⁸ According to this new framework, air pollution control, for example, could be provided with full effectiveness only by a government agency whose territorial jurisdiction coincided with the area required to internalize the benefits of that control.⁹ This type of restructuring would eliminate cross-jurisdictional difficulties and contribute to a more responsive governmental role.

The problems of the aviation industry are closely related to governmental structure and degree of regulation.

⁸J.S. Dupré, "Intergovernmental Relations and the Metropolitan Area" in Politics and Government in Urban Canada, ed. by L.D. Feldman and M.D. Goldrick (Toronto, Ont.: Methuen Publications, 1969), pp. 183-184.

⁹Ibid.

Oscar Bakke has said that probably the most difficult problem the aviation industry faces in the next decade is the structure of government in a federal/state/local sense.¹⁰ Cerchione et al. state that,¹¹ "Aviation, more than any other form of transportation, has the clearest opportunity to eliminate completely its environmental problems, but only if it deals with its shortcomings forthrightly." The major problem for the air transportation industry is that its shortcomings may be inherent in the role of government rather than present within its own organizational boundaries.

7.2 Technical Role--Planning

The role of government in a technical sense involves planning. Enactment of legislation to remove jurisdictional problems would assist in the establishment of regional planning groups. Implementation of policy will require technical knowledge.¹² Figure 7.1 shows some of the existing interrelationships between planning and design processes and air pollution problems. Additional elements of an overall management program, not shown in Figure 7.1, include air quality monitoring,

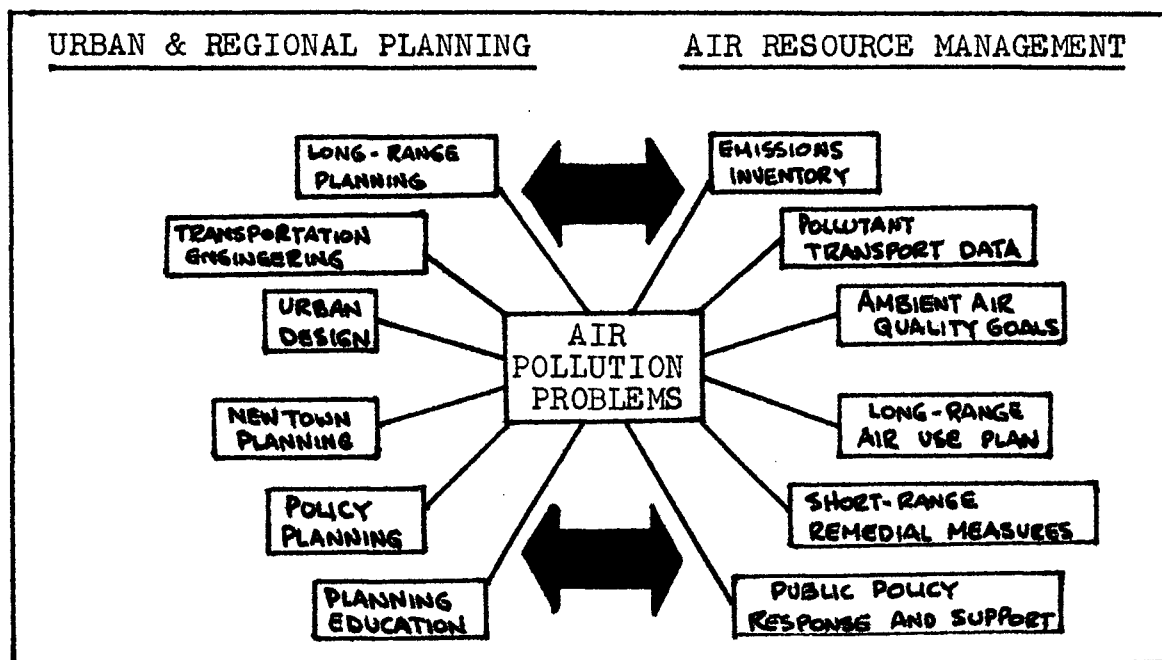
¹⁰Francis Keppel, "Human Resources and the Transportation Industry" in Master Planning the Aviation Environment, ed. by A.J. Cerchione, V.E. Rothe and J. Vercellino (Tucson, Arizona: University of Arizona Press, 1970), p. 20.

¹¹Angelo J. Cerchione, Victor E. Rothe and James Vercellino, editors, Master Planning the Aviation Environment (Tucson, Arizona: University of Arizona Press, 1970), p. iii.

¹²Edward Wells, "Aircraft Design, Goals and Problems," in Air Transportation--A Forward Look, ed. by K.M. Ruppenthal (Stanford, Calif.: Stanford University, 1970), p. 114.

FIGURE 7.1

FOCUSING URBAN/REGIONAL PLANNING AND AIR RESOURCE MANAGEMENT
ON AIR POLLUTION PROBLEMS



Source: Edwin W. Hauser, Leonard B. West, Jr., and A. Richard Schleicher, "Fundamental Air Pollution Consideration for Urban and Transportation Planners," Traffic Quarterly, January 1972, p. 77.

estimates of future conditions, information and education programs, and technical field services. This type of overall planning and management role for government can be equally well applied to noise pollution problems. Hauser, West, and Schleicher stress the importance of an "outline of current technology in air resource management"¹³ as the basis for discussion of air pollution problems. The type of approach to planning and management illustrated in Figure 7.1 is typical

¹³Edwin W. Hauser, Leonard B. West, Jr., and A. Richard Schleicher, "Fundamental Air Pollution Considerations for Urban and Transportation Planners," Traffic Quarterly, January 1972, p. 77.

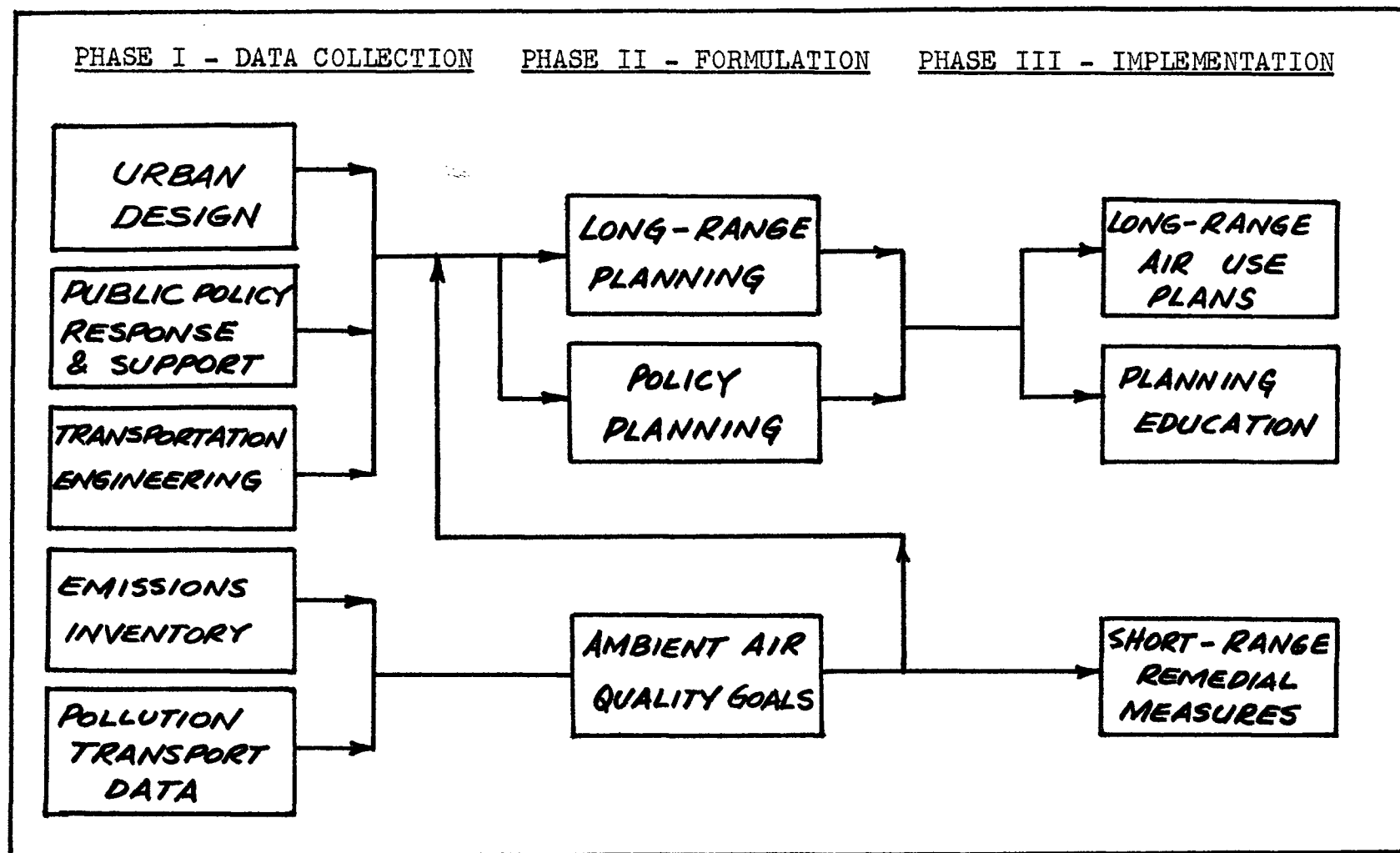
of the various urban and regional planning districts in Canada (e.g. the Greater Vancouver Regional District) and the air resource management of the Department of the Environment. Whereas this approach has the benefits of "local knowledge" it suffers from jurisdictional difficulties and poor communication. The economies of scale of a more integrated approach are apparent in airport planning, for example, where the knowledge gained in one area can be used in another. Figure 7.2 rearranges the components of Figure 7.1 to present a more integrated approach to air pollution problems. The technical role of government, particularly in the data collection phase, underlies the successful formulation and implementation of environmental policy.

Specific recommendations on the technical role of the Canadian government with respect to environmental quality and the air industry would include the following:

1. Through research grants and liaison with industry establish a sound technical basis for a Noise Control Act of 1973 and air pollution standards for new types of air transportation.
2. Increase involvement with the community to determine the technical feasibility of STOL/VTOL aircraft, as part of a long-range evaluation program.
3. Participate actively in areas such as compatible land use near airports, two-segment landing and reduced thrust take-off procedures for aircraft, and application of state-of-the-art technology for noise and air pollution abatement associated with jet engines.

FIGURE 7.2

AN INTEGRATED APPROACH TO AIR POLLUTION PROBLEMS



4. Continue efforts along the lines of EZAIM (Ecology of the new Montreal International Airport area) to gather technical input to long-range planning.
5. Increased involvement internationally in data collection and studies of long-term environmental effects of air traffic to insure that international standards reflect environmental reality rather than political power.
6. The institution of a nationwide environmental education program based on technical facts.

7.3 Economic Role--Internalizing Externalities

The most important contribution the government could make to sound environmental quality management would be the establishment of governmental policy directed toward an environmentally sophisticated, responsive market system that would simultaneously, and by definition, serve the diverse needs and goals of business and society. The accomplishment of such a goal would require compensating government action, "to internalize the costs of environmental deterioration."¹⁴ In Chapter VI Mr. Ronald Ritchie of Imperial Oil stressed the importance of "rules, incentives, and penalties" which will force producers and consumers to behave in ways that are consistent with environmental goals.¹⁵ These rules and incentives need not imply a command economy approach; in fact they can be applied

¹⁴Irving K. Fox, "Policy Problems in the Field of Water Resources" in Water Research, ed. by A.V. Kneese and Stephen C. Smith (Baltimore, Md.: Johns Hopkins Press, 1966), p. 280.

¹⁵Ronald S. Ritchie, "The Corporation in the World-To-Be" (Industrial Relations Management Association paper, Harrison Hot Springs, B.C., February 19, 1971), p. 11.

to the existing market system. By recognizing the failings of the market system vis-à-vis environmental goods, and working towards a solution based on internal change, the government can exert pressure to upgrade the system rather than abandoning it. Policies such as the issuance of pollution rights or other pricing schemes for environmental factors¹⁶ are not without their problems, but they do indicate a direction for government action. Leonard Waverman reviews government's role as follows:¹⁷

The federal and provincial governments have introduced a multitude of fiscal policies--fines, subsidies, loans and tax incentives--to induce firms and individuals to limit their pollution. Economists consider such instruments to be both less effective and more costly than a system of prices for environmental factors. The federal government, appearing to heed economists' advice, incorporated into the Canada Water Act an effluent charge system--which was loudly condemned by provincial governments and many civic anti-pollution groups as a scheme of "licences to pollute".

In this regard, "licences to pollute" remain, whether explicitly recognized through an effluent charge system or tacitly recognized by allowing business and industry to operate equip-

¹⁶Much academic literature has discussed the benefits of instituting a pricing scheme for the environmental factors. See for example J.H. Dales, Pollution, Property and Prices (Toronto, Ont.: University of Toronto Press, 1968); A.V. Kneese and B.T. Bower, Managing Water Quality: Economics, Technology, Institutions (Baltimore, Md.: Johns Hopkins Press, 1968); and L. Waverman, "Pollution: A Problem in Economics" in Canadian Economic Problems and Policies, ed. by L.H. Officer and L.B. Smith (Toronto, Ont.: McGraw-Hill of Canada Ltd., 1970).

¹⁷Leonard Waverman, "Fiscal Instruments and Pollution: An Evaluation of Canadian Legislation," Canadian Tax Journal, Vol. XVIII, No. 6, November-December 1970, p. 505.

ment that contributes to pollution. The establishment of realistic effluent charges has two major advantages over tax incentives.¹⁸ They are direct and they are a positive step toward internalizing externalities.

7.4 Economic Role--Degree of Regulation

In Chapter VI the subject of regulation was discussed from the point-of-view of business. A balance between regulation and competition was stressed as the best way of dealing with the human environment. A realistic view of the process of governmental control in the public interest is given by Bernstein, who states:¹⁹

The public interest is served best when regulation is conceived as a vital element in the comprehensive relationship between government and economy. It is served worst when regulation is treated as a phenomenon which is separable from the context of society and therefore unrelated to general notions about the proper relations between government and economic life.

The attitude toward regulation, as Bernstein points out, reflects the degree to which it is accepted and the degree to which it is effective.

¹⁸The limitations of tax schemes are discussed by a number of economists. See for example: F.T. Dolbear, Jr., "On the Theory of Optimum Externalities," American Economic Review, Vol. LVII, No. 1, March 1967, pp. 90-103; and Paul R. McDaniel and Alan S. Kaplinsky, "The Use of the Federal Income Tax System to Combat Air and Water Pollution: A Case Study in Tax Expenditures," in Environmental Affairs--1971 (Brighton, Mass.: Boston College Law School, 1971), p. 29. The benefits of a national pollution tax are discussed by Norman F. Ramsey, "We Need a Pollution Tax!," Science and Public Affairs, Vol. XXVI, No. 4, April 1970, pp. 3-5.

¹⁹Marver H. Bernstein, Regulating Business by Independent Commission (Princeton, N.J.: Princeton University Press, 1966), p. 281.

Some indication of the role of government vis-à-vis degree of regulation is provided by a Fortune magazine survey conducted in 1970.²⁰ In this survey 270 chief executives of companies listed in Fortune's top 500 U.S. companies were interviewed on various aspects of the environment problem as it affected them as business leaders. The answers to the question, "Would you like to see federal government step up its regulatory activities, maintain them at present levels or cut them back?", were 57% for "step up", 29% for "maintain", and 8% for "cut back". In the transportation sector there was a greater percentage in favor of "cut back" due to present regulation;²¹ however, the survey is interesting as a guide. In Canada, one would estimate that the general trend would be quite similar, and that airline companies would seek regulation to provide consistent standards concerning allowable air and noise pollution levels.

7.5 Social Role--Planning and Education

In Chapter II, I referred to Yannacone's "fundamental statements of fact", which were:²²

²⁰R.S. Diamond, "The Environment--What Business Thinks About Its," Fortune, 1970, pp. 55-60.

²¹M. Ways, "The Environment--How to Think About the Environment," Fortune, 1970, p. 211.

²²Victor J. Yannacone, Jr., "Aviation and the Law" in Master Planning the Aviation Environment (Tucson, Arizona: University of Arizona Press, 1970).

The air traveler is entitled--as a matter of absolute right--to the safest possible flight which the state-of-the-art in modern aviation technology is capable of providing.

The homeowner and the man on the street are entitled to protection from the hazards of aircraft operations.

One of government's roles is to meet the conflicting needs of society. In the case cited above, Yannacone suggests an "ecologically sophisticated, socially relevant, politically feasible, legally supportable airport zoning law."²³ The comprehensive plan is the essence of zoning. As soon as one thinks of zoning, one naturally thinks of the social needs of the people living, or to be living, in a particular area. Unlike most pollution abatement policies such as taxation and effluent charges, zoning is specific to location. A general overall view is not acceptable; consideration of specific areas, situations, and people is necessary as input to noise zoning laws.

Although zoning is not the complete answer to airport planning it does point out the role of government as a planner. One of the most recent examples of poor planning was the federal handling of the proposed runway expansion at Vancouver International Airport. Mr. Alex Fisher, expropriation officer at the Sea Island hearings under the federal Expropriation Act summarized the complaints voiced by the objectors who attended the hearing. They included:²⁴

²³Ibid.

²⁴Bill Bachop, "The Government hasn't done its homework: Why Ottawa has shunned airport hearing," The Vancouver Sun, February 15, 1973, p. 6.

1. The government's failure to appear at the hearing.
2. A lack of communication. Nothing of consequence was supplied by the government as to its plans until three days before the hearings began.
3. Failure of the government to present long-term plans or studies relating to the physical, sociological or environmental effects of the expansion.
4. Piece-meal acquisition of property and a failure to maintain acquired properties, leading to a breakdown of community values.

There appears to be justification for all of these objections. On the other hand, the federal government's planning efforts at Ste. Scholastique have been excellent. It appears that a social role for government is to give equal and responsible treatment to all projects under its jurisdiction.

Finally, one of the most important social roles for government is in the field of environmental education. Although some sectors of industry have provided television programs and other mass media exposure to the problems of the environmental planning, a more integrated approach is required. As mentioned earlier, present and future leaders in government and industry need environmental facts to make decisions. Society, in general, needs these facts to understand the reasons why certain policies are adopted. Education underlies the entire problem of understanding the human environment and is the most critical factor in planning for the future.

7.6 Summary

A structural reworking of the legislative framework in Canada is long overdue. Due in part to the limitations of jurisdiction imposed by the outdated British North America Act, the role of government in the problems of the human environment has been extremely weak. In addition to structural change, the role of government could be vastly improved through an overall environmental management program. A structure based on physical rather than political boundaries is suggested, with technical involvement in areas of research, community planning, environmental education and international environmental programs.

The new role of government should also include a systematic plan for internalizing externalities associated with noise and air pollution, and an emphasis on ecologically sophisticated zoning near airports.

Environmental education is the key to the future and the government must dominate this field. The task of meeting the demands of the human environment necessitates strong public policy and increased public responsibilities of government.

CHAPTER VIII

CONCLUSIONS

8.1 Linkages, Feedback, and the Human Environment

The relationship between air transportation and the human environment can best be described as a complex system. Thomas W. Thompson et al. suggest that, "The basic cause of the environmental problems facing society today is a lack of appreciation and understanding of the linkages existing between the physical and the social environments."¹ In their excellent article, "Biophysical Environment and Human Behavior: Linkages and Feedback Systems", they show a progression from an "unrestrained market" model (Figure 8.1), to an "agency control" model (Figure 8.2), to an "economics versus environment" model (Figure 8.3), and finally to an "integrated" model (Figure 8.4).² In terms of progress we are somewhere between the "agency control" model (with great power in the hands of regulatory agencies) and the "economics versus environment" model (which entails balancing the value of economic activity against environmental quality). Thompson et al. indicate the

¹Thomas W. Thompson, Allen E. Bedrosian, James E. Berry, and James W. Kolka, "Biophysical Environment and Human Behavior: Linkages and Feedback Systems," in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin, 1972), pp. 53-54.

²Ibid., pp. 53-57.

FIGURE 8.1
THE "UNRESTRAINED MARKET" APPROACH

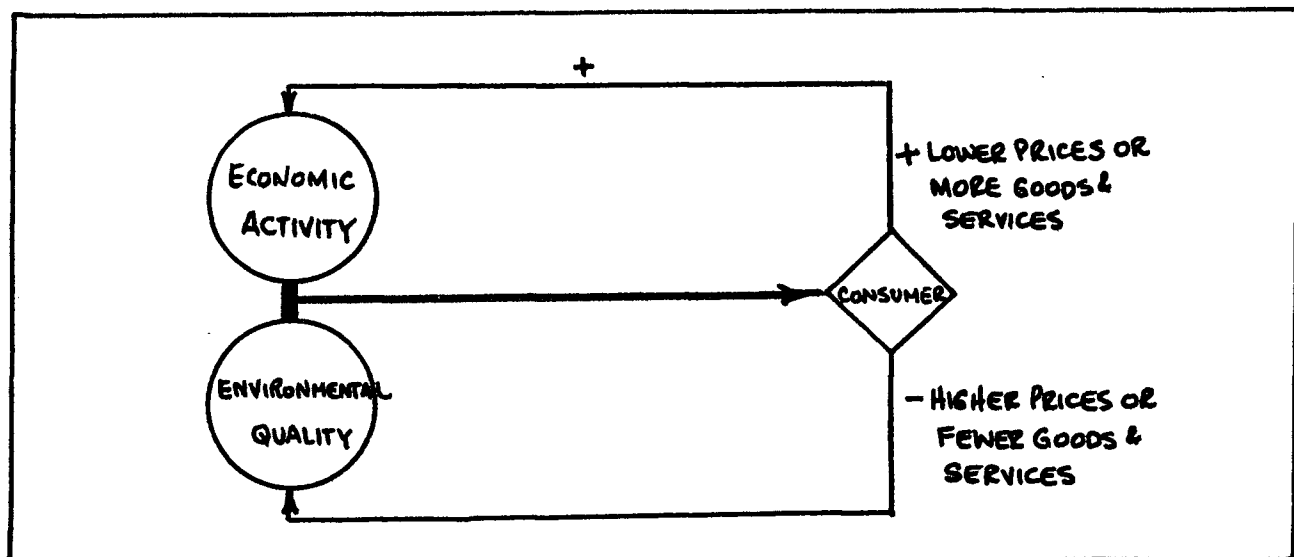
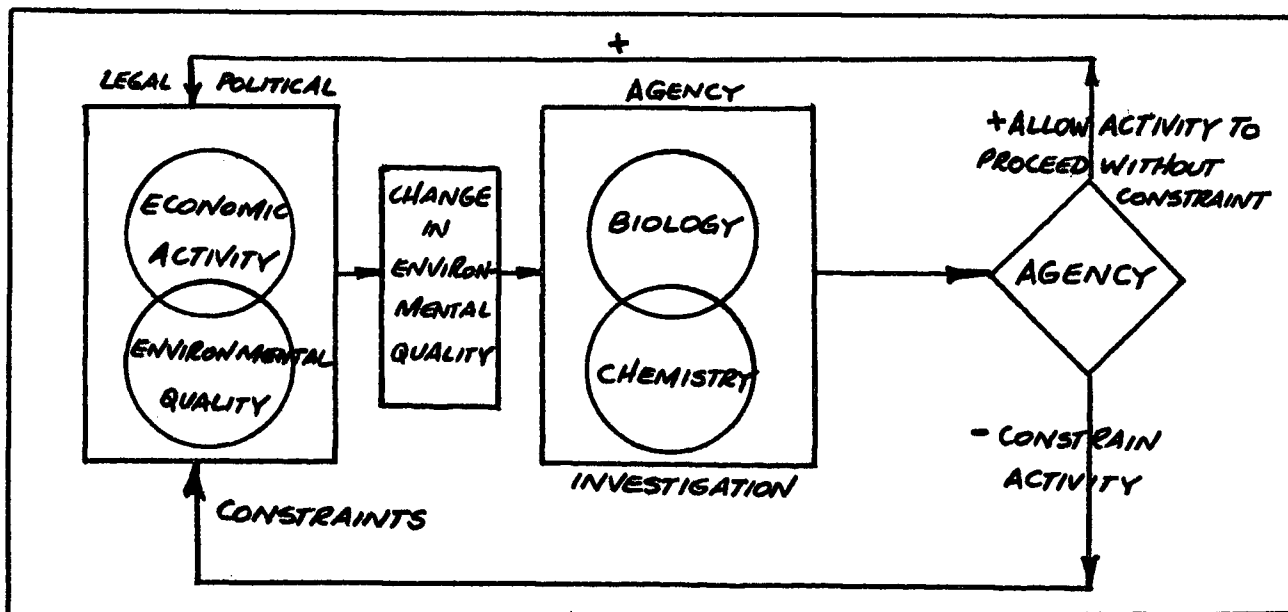


FIGURE 8.2
THE "AGENCY CONTROL" APPROACH



Source: T.W. Thompson, A.E. Bedrosian, J.E. Berry and J.W. Kolka, "Biophysical Environment and Human Behavior: Linkages and Feedback Systems," in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin, 1972), pp. 54, 55.

FIGURE 8.3

THE "ECONOMICS VERSUS ENVIRONMENT" APPROACH

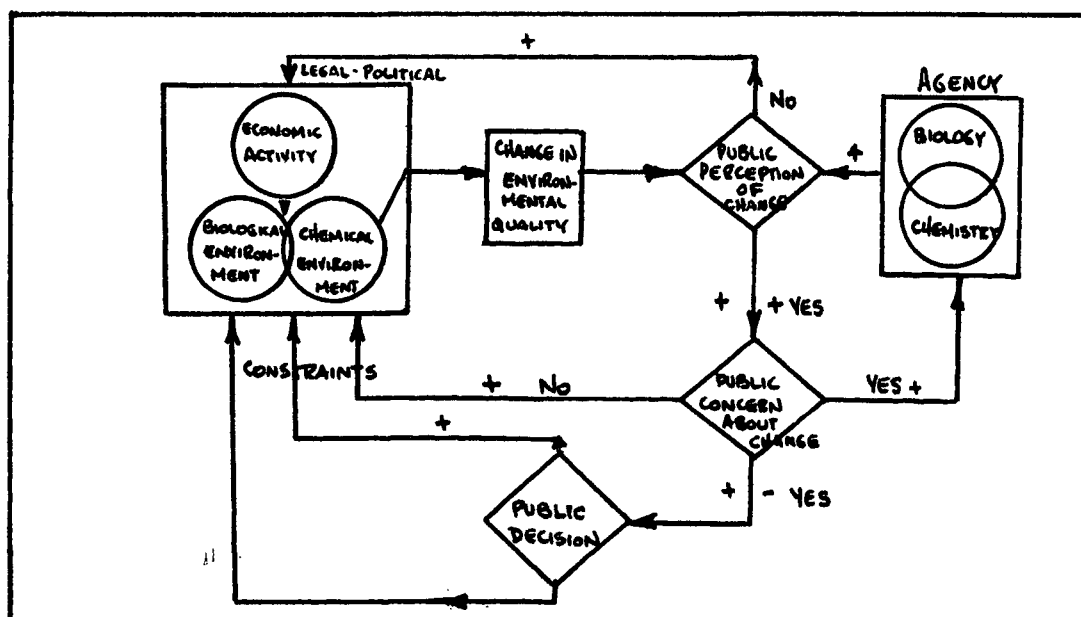
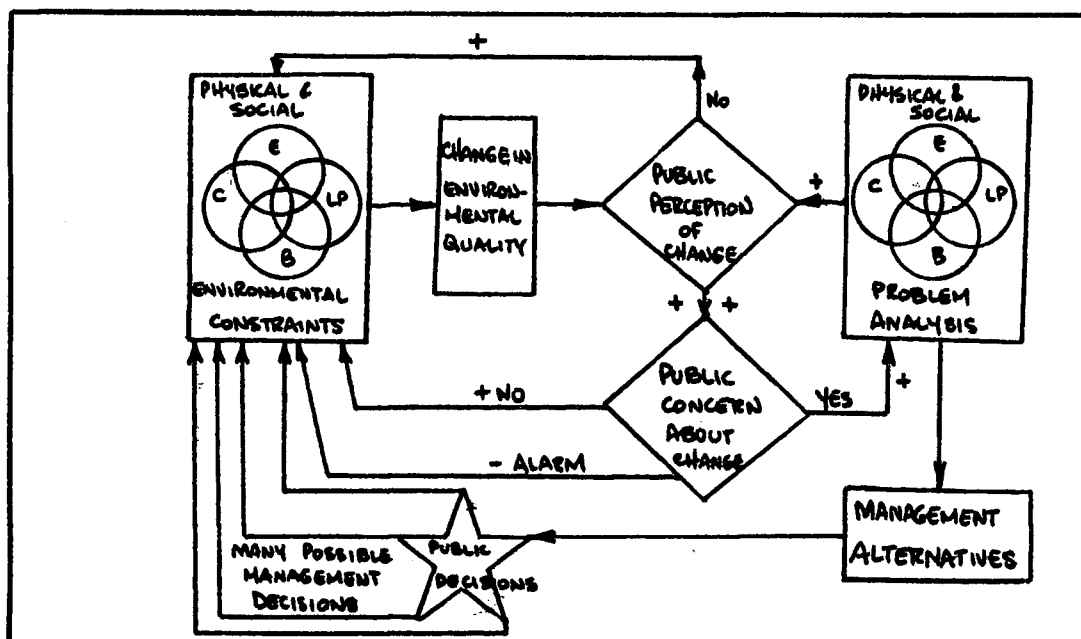


FIGURE 8.4

AN "INTEGRATED" APPROACH



Source: T.W. Thompson, A.E. Bedrosian, J.E. Berry and J.W. Kolka, "Biophysical Environment and Human Behavior: Linkages and Feedback Systems," in Environmental Quality and Social Responsibility, ed. by R.S. Khare, J.W. Kolka, and C.A. Pollis (Green Bay, Wisc.: University of Wisconsin, 1972), pp. 56, 57.

major drawbacks of the "economics versus environment" approach as follows:³

1. The model ... puts economic well-being against environmental quality. The model fails to recognize that negative linkages exist between long-range economic health and deteriorating environmental quality.
2. It fails to internalize many crucial economic disservices and external costs which tend to appear after the elapse of time, or at locations remote from the origin of the environmental insult.
3. The model ... regards political and legal factors as rigid constraints rather than integral, highly mutable parts of a unified system, itself regulated by environmental constraints.
4. The model views the decision as being a yes-no type ... By failing to take into account the infinite variety of management alternatives that exist respecting the use of a given resource, the model, while it allows society to react to situations, fails to provide the tools necessary for planning the future.

The proposal which Thompson et al. make, shown in Figure 8.4, is a model which recognizes that, "relationships ... can and do exist between the natural environment, economic activity and legal/political forces." The "integrated" model differs from the other models shown in Figures 8.1, 8.2, and 8.3 in the following respects:⁴

1. Legal and political forces are integral parts of a total system.
2. The model insists that economic externalities and disservices can be measured and that environmental degradation can be defined in concrete terms rather than on the vague basis of aesthetics.

³Ibid., p. 56.

⁴Ibid.

3. By integrating the efforts of economics, legal/political and bio-physical/chemical investigators, the model produces a variety of management alternatives rather than a single yes-no decision.

The interactions shown in Thompson et al.'s "integrated" model are complex and even more variables are likely to be added in the future; however, their conclusion is sound. They conclude that,⁵ "Without a model which considers the relationships and feedback loops ... defined, it will be impossible to ask the questions necessary to the formulation of meaningful management strategies based on sound and complete predictive information."

In Chapter I, I outlined a conceptual framework for analysis and stressed the importance of a "macro" or social system approach to air transportation and the human environment. In some areas we have progressed toward this goal, and have incorporated some of the feedback loops suggested by Thompson et al. into our approach to environmental management and planning. In other areas we are unquestionably slow. The solution to the problem of accommodating the human environment in our decision-making process, either business or government, is the ability to move away from the narrow institutional framework and question basic premises rather than accepting them as limitations or controls.

8.2 Recommendations for Future Action

The following recommendations are intended as guidelines for future industry and government action. They summarize the major points made in this thesis:

⁵Ibid.

1. A social system approach, which recognizes interactions and feedback in the social, economic, and political environment, is required for an understanding of air transportation and the human environment.
2. A revised and effective legal structure consistent with the state of technology in 1973. This would include:
 - (a) A 1973 Noise Control Act.
 - (b) Revision of the British North America Act.
 - (c) Structural changes in environmental jurisdiction based on ecological, rather than political, boundaries.
 - (d) The Federal Government "carrying the ball" on environmental issues.
3. Increased efforts on an international level concerning environmental quality, including a leading role in international pollution legislation.
4. Government/industry cooperation in the formation of reasonable standards and in technical programs.
5. Increased research grants for environmental studies on compatible land use, inner space technology, and environmental monitoring.
6. Increased governmental spending on pollution abatement to realize the benefits of better national health.
7. A revised market system which would internalize pollution costs and recognize environmental goods as scarce resources.
8. A program of environmental education at the elementary school level to increase environmental awareness and understanding.
9. Structural change to fit the organization and its capabilities to the task environment. Specific recognition of the human environment as a variable in decision-making.

10. Broader public duties for industry. Cooperation with government in the formation of non-technical standards and legislation.
11. A federally coordinated environmental management program that fits its structure to the task, is responsive to the human environment, and is responsible to society.

8.3 Closing Remarks

The answer as to whether or not air transportation and the human environment can co-exist in the future is based on man's ingenuity and ability to adapt. Resolution of the environmental issues of the sonic boom and inadvertent climate modification, in particular, must precede large-scale commercial SST traffic. The level of technology exhibited in man's conquest of the Moon indicates that properly channeled effort, within a closed system rather than an open system, could solve air transportation's technical problems. The social problems, which involve integration of the needs of various groups into a common direction, are the most difficult but are not insurmountable. The economic problems can be solved provided that the market system can be adapted to reflect the true value of environmental goods.

The air transportation industry can be compatible with the limitations of the human environment; however, only through considerable efforts by business, industry, and the public. The problem is similar to other social problems such as training disadvantaged workers, assisting community economic development projects, and solving issues of poverty

and racial inequality. These are not easy problems to solve; they are all people problems, but they do have solutions.

The future of Air Transportation and the Human Environment is in your hands - "TUUM EST".

BIBLIOGRAPHY

A. Books

- Air Transport Association of America. Economics of Air Transport: An Overview. Washington, D.C.: Air Transport Association of America, 1971.
- _____. Major U.S. Airlines, Economic Review and Financial Outlook 1969-1973. Washington, D.C.: Air Transport Association of America, 1969.
- Auld, D.A.L. Economic Thinking and Pollution Problems. Toronto Ontario: University of Toronto Press, 1972.
- Baron, Robert Alex. The Tyranny of Noise. New York, N.Y.: St. Martins Press and the MacMillan Company, 1970.
- Barry, W.S. Airline Management. London: George Allen and Unwin, Ltd., 1965.
- Berland, Theodore. The Fight for Quiet. Englewood Cliffs, N.J. Prentice-Hall, Inc., 1971.
- Bernstein, Marver H. Regulating Business by Independent Commission. Princeton, New Jersey: Princeton University Press, 1966.
- Bragdon, Clifford R. Noise Pollution, the Unquiet Crisis. Philadelphia: University of Pennsylvania Press, 1971.
- Cerchione, Angelo J.; Rothe, V.E.; and Vercellino, J. Master Planning the Aviation Environment. Tucson, Arizona: U. of Arizona Press, 1970.
- Cole, John N., and England, Robert T. Evaluation of Noise Problems Anticipated with Future VTOL Aircraft. Wright-Patterson Air Force Base, Ohio: Aerospace Medical Research Laboratories, 1967.
- Crocker, Thomas D., and Rogers, A.J. III. Environmental Economics. Hinsdale, Illinois: The Dryden Press, Inc., 1971.
- Dales, J.H. Pollution, Property and Prices. Toronto, Ontario: U. of Toronto Press, 1968.
- Davis, Keith, and Blomstrom, Robert L. Business, Society and Environment: Social Power and Social Response. New York: McGraw-Hill, Inc., 1971.

- Davis, R.E.G. Airlines of the United States Since 1914. London: Putnam and Company, Ltd., 1972.
- Day, John A.; Fost, Frederic F.; and Rose, Peter. Dimensions of the Environmental Crisis. New York: John Wiley and Sons, Inc., 1971.
- Drucker, Peter F. The Age of Discontinuity: Guidelines to Our Changing Society. New York: Harper and Row, Inc., 1968.
- Eells, Richard. The Corporation and the Arts. New York: The MacMillan Company, 1967.
- Ehrlich, Paul R., and Ehrlich, Anne H. Population, Resources, Environment: Issues in Human Ecology. San Francisco: W.H. Freeman and Company, 1970.
- Fisher, John. What You Can Do About Pollution Now. Don Mills, Ontario: Longman Canada Ltd., 1971.
- Heald, Morrell. The Social Responsibilities of Business. Cleveland, Ohio: The Press of Case Western Reserve University, 1970.
- Heggie, Ian G. Transport Engineering Economics. Maidenhead, Berkshire, England: McGraw-Hill Book Co. (U.K.), Ltd., 1972.
- Kneese, Allen V., and Bower, Blair T. Managing Water Quality: Economics, Technology, Institutions. Baltimore, Maryland: Johns Hopkins Press, 1969.
- Lave, Judith R.; Lave, Lester B.; and Seskin, Eugene P. Migration and Urban Change. Pittsburg, Pennsylvania. Carnegie Mellon University, 1972.
- Learned, Edmund P.; Christensen, C. Roland; Andrews, Kenneth R.; and Guth, William D. Business Policy, Text and Cases. Revised Edition. Homewood, Illinois: Richard D. Irwin, Inc., 1969.
- Mills, Edwin. The Economics of Air Pollution. New York: W.W. Norton, 1966.
- Morgan, Frank. Pollution, Canada's Critical Challenge. Toronto, Ontario: The Ryerson Press and MacLean-Hunter Ltd., 1970.
- Munro, John M. Trade Liberalization and Transportation in International Trade. Toronto, Ontario: U. of Toronto Press, 1969.
- Pegrum, Dudley F. Transportation Economics and Public Policy. Homewood, Illinois: Richard D. Irwin Inc., 1963.

- Reynolds, D.J. The Urban Transport Problem in Canada: Urban Canada - Problems and Prospects. Ottawa: Central Mortgage and Housing Corporation, 1971.
- Richmond, Samuel B. Regulation and Competition in Air Transportation. New York: Columbia University Press, 1961.
- Ridker, R.G. Economic Costs of Air Pollution. New York: Frederick Praeger, 1967.
- Ruppenthal, Karl M. Air Line Management. Stanford, California: Stanford University, 1967.
- Schafer, R. Murray. The Book of Noise. Vancouver, British Columbia: Price Printing, Ltd., 1970.
- Shurcliff, William A. SST Handbook for 1972. Cambridge, Massachusetts: Citizens League Against the Sonic Boom, 1971.
- S.L.E.P. Man's Impact on the Global Environment, Report of the Study of Critical Environment Problems. Cambridge, Massachusetts: M.I.T. Press, 1970.
- S.M.I.C. Inadvertent Climate Modification. Report of the Study of Man's Impact on Climate. Cambridge, Massachusetts: M.I.T. Press, 1971.
- Straszheim, Mahlon R. The International Airline Industry. Washington, D.C.: The Brookings Institution, 1969.
- Thompson, James D. Organizations in Action. New York: McGraw-Hill, Inc., 1967.
- Walton, Clarence C. Ethos and the Executives: Value in Managerial Decision Making. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1969.
- Wilson, Thomas W., Jr. International Environmental Action, A Global Survey. Cambridge, Mass.: Dunellen, University Press of Cambridge, Mass., 1971.
- Yannacone, Victor J.; Cohen, Bernard S.; and Davison, Steven G. Environmental Rights and Remedies. Rochester, New York: The Lawyers Co-operative Publishing Co., 1972.

B. Articles

- Allen, John J., Jr. "Transportation Planning in the Decade Ahead." Challenge to Transportation. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1961.

- Baxter, William. "Noise: Legal and Economic Implications." Air Transportation--A Forward Look. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1970.
- Beinhaker, P. and Elek, A. "Methods for Evaluating Transportation Investment, Montreal Airport Study--Ste. Scholastique." Changing Times and Keeping Up. Oxford, Indiana: The Richard B. Cross Company, 1971.
- Beranek, L.L. "General Aircraft Noise." Noise as a Public Health Hazard. Edited by W.D. Ward and J.E. Fricke. Washington, D.C.: American Speech and Hearing Association, 1969.
- Bouladon, Gabriel. "A Technological Forecast." Aviation's Role in Future Transportation. Munich: International Air Transport Association, 1968.
- Boyd, Alan S. "The Situation in North America." Aviation's Role in Future Transportation. Munich: International Air Transport Association, 1968.
- Branscomb, Lewis M. "Taming Technology." Environmental Quality and Social Responsibility. Edited by R.S. Khare, J.W. Kolka and C.A. Pollis. Green Bay, Wisc.: U. of Wisconsin--Green Bay, 1972.
- Caldwell, Lynton K. "An Ecological Approach to International Development: Problems of Policy and Administration." The Careless Technology--Ecology and International Development. Edited by M. Taghi Farvar and John P. Milton. New York: Doubleday and Co. Inc., 1972.
- Culliton, Barbara J. "Noise Threatens Man." Pollution Papers. Edited by George E. Frakes and Curtis B. Solberg. New York: Meredith Corporation, 1971.
- Cummings, L.T., and Mastomatteo, E. "Legislation and Administration for Noise Control, The Provincial Role." A Conference on Noise in the Environment. Toronto, Ontario: The Conservation Council of Ontario, 1971.
- d'Arge, Ralph C. and Kneese, Allen V. "Environmental Quality and International Trade." World Eco-Crisis. Edited by David A. Kay and Eugene B. Skolnikoff. Madison, Wisc.: U. of Wisconsin Press, 1972.
- de Laet, Christian. "The Pollution Problem." Economic Thinking and Pollution Problems. Edited by D.A.L. Auld. Toronto, Ont.: U. of Toronto Press, 1972.

- Dupré, J.S. "Intergovernmental Relations and the Metropolitan Area." Politics and Government in Urban Canada. Edited by L.D. Feldman and M.D. Goldrick. Toronto, Ontario: Methuen Publications, 1969.
- Fox, Irving K. "Policy Problems in the Field of Water Resources." Water Research. Edited by A.V. Kneese and S.C. Smith. Baltimore, Maryland: Johns Hopkins Press, 1966.
- Franken, Peter A. "A Panel Discussion--Approaches to Noise Control." A Conference on Noise in the Environment. Toronto, Ont.: The Conservation Council of Ontario, 1971.
- Gardner, Richard N. "The Role of the U.N. in Environmental Problems." World Eco-Crisis, International Organizations in Response. Edited by David A. Kay and Eugene B. Skolnikoff. Madison, Wisconsin: The University of Wisconsin Press, 1972.
- Hambling, D. "Legislation and Administration for Noise Control, the Municipal Role." A Conference on Noise in the Environment. Toronto, Ont.: The Conservation Council of Ontario, 1971.
- Halaby, N.E. "Introduction to the Symposium." Air Transportation--A Forward Look. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1970.
- Heiner, A.P. "The Transport Revolution and Regulation." Revolution in Transportation. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1960.
- Helmer, Olaf. Social Technology. New York: Basic Books, 1966.
- Hickey, Richard, Jr. "Air Pollution." Environment--Resources, Pollution and Safety. Edited by William Murdoch. Stamford, Connecticut: Sinauer Associates, Inc., 1971.
- Johnson, Brian. "The United Nations' Institutional Response to Stockholm: A Case Study in the International Politics of Institutional Change." World Eco-Crisis, International Organizations in Response. Edited by David A. Kay and Eugene B. Skolnikoff. Madison, Wisconsin: The University of Wisconsin Press, 1972.
- Kay, David A. and Skolnikoff, Eugene B. "International Institutions and the Environmental Crisis: A Look Ahead." World Eco-Crisis, International Organizations in Response. Madison, Wisconsin: The University of Wisconsin Press, 1972.

- Keppel, Francis. "Human Resources and the Transportation Industry." Master Planning the Aviation Environment. Tucson, Arizona: U. of Arizona Press, 1970.
- Kneese, Allen V. "Research Goals and Progress Toward Them." Environmental Quality in a Growing Economy. Edited by Henry Jarrett. Baltimore, Maryland: Johns Hopkins Press, 1966.
- _____, and Herfindahl, O.C. "Tools for Analysing Some Environmental Problems." Quality of the Environment: An Economic Approach to Some Problems in Using Land, Water and Air. Washington, D.C.: Resources for the Future, 1965.
- Kolshus, Halvor J. "Common Property Resources and the Invisible Hand." Environmental Quality and Social Responsibility. Edited by R.S. Khare, J.W. Kolka, and C.A. Pollis. Green Bay, Wisc.: U. of Wisconsin--Green Bay, 1972.
- Kramon, James M. "Noise Control: Traditional Remedies and a Proposal for Federal Action." Environment Law Review--1971. Albany, New York: Sage Hill Publishers, Inc., 1971.
- Lave, Lester B. "Air Pollution Damage: Some Difficulties in Estimating the Value of Abatement." Environmental Quality Analysis. Edited by Allen V. Kneese and Blair T. Bower. Baltimore, Maryland: Johns Hopkins Press, 1972.
- McDaniel, Paul R. and Kaplinsky, Alan S. "The Use of the Federal Income Tax System to Combat Air and Water Pollution: A Case Study in Tax Expenditures." Environmental Affairs--1971. Brighton, Mass.: Boston College Law School, 1971.
- MacDonald, Gordon J.F. "Pollution, Weather and Climate." Environment--Resources, Pollution and Safety. Edited by William W. Murdoch. Stamford, Conn.: Sinauer Associates, Inc., 1971.
- MacNeill, J.W. "Legislation and Administration for Noise Control, The Federal Role." A Conference on Noise in the Environment. Toronto, Ont.: The Conservation Council of Ontario, 1971.
- Mander, H.W. "The Quality of British Transport." Transpo '69, The Environmental Aspects of Transportation. London: Imperial College, Society of Environmental Engineers, 1969.

- Meadows, Dennis L. and Randers, Jorgen. "Adding a Time Dimension to Environmental Policy." World Eco-Crisis, International Organizations in Response. Edited by David A. Kay and Eugene B. Skolnikoff. Madison, Wisconsin: The University of Wisconsin Press, 1972.
- Meyer, Michael B. "Air and Noise Pollution Surrounding Airports: East Haven v. Eastern Airlines, Inc." Environmental Affairs--1972. Brighton, Mass.: Boston College Law School, 1972.
- Murray, James M. "Toward an Environmentally Oriented System of Social Accounts." Environmental Quality and Social Responsibility. Edited by R.S. Khare, J. W. Kolka, and C.A. Pollis. Green Bay, Wisc.: U. of Wisconsin--Greene Bay, 1972.
- Muskie, Edmund S. "Torts, Transportation, and Pollution: Do the Old Shoes Still Fit?" Environment Law Review--1971. Albany, New York: Sage Hill Publishers, Inc., 1971.
- Ozorio de Almeida, Miguel A. "The Confrontation Between Problems of Development and Environment." Environment and Development. New York: Carnegie Endowment for International Peace, 1972.
- Pearson, John Y. "Toward a Constitutionally Protected Environment." Environment Law Review--1971. Albany, New York: Sage Hill Publishers, Inc., 1971.
- Ruppenthal, Karl M. "Some Socioeconomic Considerations." Air Transportation--A Forward Look. Stanford, California: Stanford University, 1970.
- Sax, Joseph L. "Legal Strategies Applicable to Environmental Quality Management Decisions." Environmental Quality Analysis. Edited by Allen V. Kneese and Blair T. Bower. Baltimore, Md.: Johns Hopkins Press, 1972.
- Shaffer, John H. "Aviation's Hour for Action." Air Transportation--A Forward Look. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1970.
- Sims, William R. and Cerchione, Angelo J. "In Search of an Aviation Master Plan." Master Planning the Aviation Environment. Edited by Angelo J. Cerchione, Victor E. Rothe and James Vercellino. Tucson, Arizona: U. of Arizona Press, 1970.
- Thompson, Thomas W.; Bedrosian, Allen E.; Berry, James E.; and Kolka, James W. "Biophysical Environment and Human Behavior: Linkages and Feedback Systems." Environmental Quality and Social Responsibility. Edited by R.S. Khare, J.W. Kolka and C.A. Pollis. Green Bay, Wisc.: U. of Wisconsin, 1972.

- Tipton, Stuart G. "Aviation's Three Environments." Master Planning the Aviation Environment. Edited by Angelo J. Cerchione, Victor E. Rothe and James Vercellino. Tucson, Arizona: U. of Arizona Press, 1970.
- Turvey, Ralph. "Side Effects of Resource Use." Environmental Quality in a Growing Economy. Edited by Henry Jarrett. Baltimore, Md.: Johns Hopkins Press, 1966.
- Waverman, Leonard. "Pollution: A Problem in Economics." Canadian Economic Problems and Policies. Edited by L.H. Officer and L.B. Smith. Toronto, Ont.: McGraw-Hill of Canada Ltd., 1970.
- Wells, Edward. "Aircraft Design, Goals and Problems." Air Transportation--A Forward Look. Edited by Karl M. Ruppenthal. Stanford, California: Stanford University, 1970.
- White, Gilbert F. "Formation and Role of Public Attitudes." Environmental Quality in a Growing Economy. Edited by Henry Jarrett. Baltimore, Md.: Johns Hopkins Press, 1966.
- Yannacone, Victor J., Jr. "Aviation and the Law." Master Planning the Aviation Environment. Edited by Angelo J. Cerchione, Victor E. Rothe and James Vercellino. Tucson, Arizona: U. of Arizona Press, 1970.
- Yannacone, Victor J., Jr. "Environment and the Law." Environment--Resources, Pollution and Safety. Edited by William W. Murdoch. Stamford, Conn.: Sinauer Associates, Inc., 1971.
- Yannacone, Victor J., Jr., and Frangella, Patrick. "Environmental Concern--The Law and Aviation." Master Planning the Aviation Environment. Edited by Angelo J. Cerchione, Victor E. Rothe, and James Vercellino. Tucson, Arizona: U. of Arizona Press, 1970.

C. Government Publications

- Braithwaite, E.; Clarke, J.Y.; Gunderson, J.R.; and Hornsby, J. Transportation Pollution. Sydney, N.S.: Canadian Coast Guard College, 1972.
Prepared as part of a Ministry of Transport, Transportation Management Course, Queens University, July-August, 1972.
- Canada. Clean Air Act, 1971. 19-20 Elizabeth 2, Chapter 47, Section 20(2). Ottawa: Queen's Printer, 1971.

Canadian Air Pilots Publication. Noise Abatement Procedures, Vancouver International Airport, Vancouver, B.C. Ottawa: Department of Energy, Mines and Resources, 1971.

Canadian Air Transportation Administration, Pacific Region. Vancouver International Airport Proposed Expansion, Public Information Kit. Vancouver, B.C.: Transport Canada, 1973.

Canadian Council of Resource Ministers. A Digest of Environmental Pollution Legislation in Canada, Air and Soil. Montreal, P.Q.: Canadian Council of Resource Ministers, 1970.

Department of the Environment. Canada and the Human Environment. Ottawa: Information Canada, 1972.

———. Environment and the Law, A Summary of Environmental Jurisdictions and Recent Federal Anti-Pollution Legislation in Canada. Ottawa: Information Canada, 1972.

———. Environment Canada, Its Organization and Objectives. Ottawa: Information Canada, 1971.

Information Service, Information Dossier, 2nd Edition, New Montreal Airport Project. Montreal, P.Q.: Transport Canada, 1972.

Kennedy, John F. "A Statement on Business Ethics and a Call to Action." Washington, D.C.: U.S. Department of Commerce, 1963.

Statement at a meeting of the Business Ethics Advisory Council, January 16, 1962.

MacNeill, J.W. Environmental Management. Ottawa: Information Canada, 1971.

A Constitutional Study prepared for the Government of Canada.

Ministry of Transport, Civil Aviation Branch. 1971 Flight Information Manual. Ottawa: Information Canada, 1971.

Mitchell, E.R. Fuel Consumption and Air Pollution Trends in Canada 1965-1980. Ottawa: Information Canada, 1972.

Nixon, Richard. "The President's Message to Congress, August, 1972." Environmental Quality--1972, Third Annual Report of the Council of the Environmental Quality. Washington, D.C.: U.S. Government Printing Office, 1972.

Revised Statutes of Canada, 1970, Chapter xiv (2nd Supplement). Government Organization Act, 1971, Part I. Ottawa: Queen's Printer, 1971.

United States Congress, Committee on Appropriations. Senate Hearings, Civil Supersonic Aircraft Development (SST). 92nd Congress, 1st Session, 1971. Washington, D.C.: U.S. Government Printing Office, 1971.

_____, Senate, Committee on Foreign Relations, Report on the United Nations Conference on the Human Environment. 92nd Congress, 2nd Session, 1972. Washington, D.C.: U.S. Government Printing Office, 1972.

_____, Senate. National Transportation Policy, Preliminary Draft of a Report for the Committee on Interstate and Foreign Commerce. Washington, D.C.: U.S. Government Printing Office, 1961.

United States Council on Environmental Quality. Environmental Quality--1972. Washington, D.C.: U.S. Government Printing Office, 1972.

United States Department of Health, Education and Welfare. Report of the Secretary to the U.S. Congress on the Nature and Control of Aircraft Engine Exhaust Emissions. Washington, D.C.: U.S. Government Printing Office, 1969.

United States Department of Housing and Urban Development. Airport Environs: Land Use Control--Environmental Planning Paper. Washington, D.C.: U.S. Government Printing Office, 1970.

United States Office of Science and Technology. "The Alleviation of Jet Aircraft Noise near Airports." Air Transportation 1975 and Beyond: A Systems Approach, Report of the Transportation Workshop. Cambridge, Mass.: M.I.T. Press, 1968.

D. Journals

Ayres, R.U. and Kneese, A.V. "Production, Consumption, and Externalities." American Economic Review, LIX, No. 3 (June 1969), 282-297.

Brecher, Joseph J. "Environmental Litigation: Strengths and Weaknesses." Environmental Affairs, I, No. 3 (1971), 575.

Clean Air and Water News, III, No. 45 (November 12, 1971), 687.

- Dolbear, F.T., Jr. "On the Theory of Optimum Externality." American Economic Review, LVII (March 1967), 90-103.
- George, R.E.; Nevitt, J.S.; and Verssen, J.A. "Jet Aircraft Operations: Impact on the Air Environment." Journal of the Air Pollution Control Association, XXII, No. 7 (July 1972), 507-515.
- Gordon, H.S. "The Economics of a Common-Property Resources: The Fishery." Journal of Political Economy, LXII (April 1954), 124-142.
- Hardin, Garrett. "The Tragedy of the Commons." Science, CLXII (1968), 1243-1248.
- Helmer, Olaf and Rescher, Nicholas. "On the Epistemology of the Inexact Sciences." Management Science, VI (1959).
- Hohenemser, Kurt H. "Aircraft in the Balance." Environment, XIII, No. 10 (1971), 48.
- Juergensmeyer. "Control of Air Pollution Through the Assertion of Private Rights." Duke Law Journal, (1967).
- Kryter, K.D. "Psychological Reactions to Aircraft Noise." Science, CLI (March 18, 1966), 1346-1355.
- Ramsey, Norman F. "We Need a Pollution Tax." Science and Public Affairs, XXVI (April 1970), 3-5.
- Robinson, Clarence A., Jr. "U.S. Presses SST Climatic Impact Study." Aviation Week and Space Technology, XCVII, No. 22 (November 27, 1972), 50-51.
- Rosevear, A.B. "Noise in the Vicinity of Airports and Sonic Boom." Chitty's Law Journal, January 1969), 3-7.
- Roth. "Sonic Boom: A Definition and Some Legal Implications." Journal of Air Law and Commerce, XXV (1958).
- Sawyer, R.F. "Reducing Jet Pollution Before It Becomes Serious." Astronautics and Aeronautics, VIII, No. 4 (1970), 62-67.
- Stein, Stanley S. "Environmental Control and Different Levels of Governments." Canadian Public Administration, XIV, No. 2 (Spring 1971), 129-144.
- Tinney, E. Roy and Parkes, J.G. Michael. "Enhancing the Quality of the Environment: Current Federal Legislation and Programs." Habitat, VIII, No. 5 & 6 (1970), 14-24.

Waverman, Leonard. "Fiscal Instruments and Pollution: An Evaluation of Canadian Legislation." Canadian Tax Journal, XVIII (1970), 505-513.

E. Magazines

Austin, Robert W. "Code of Conduct for Executives." Harvard Business Review, September-October, 1961, pp. 53-61.

Briehl, Daniel. "Air Pollution." America, May 17, 1969, pp. 84-91.

Bruce, Donald. "Noise Pollution." B.C. Motorist, January-February, 1973, p. 31.

Cramer, Richard. "The Airlines Speak." Environmental Quality, February, 1973, pp. 19-26, 73.

Diamond, R.S. "The Environment--What Business Thinks About Its." Fortune, 1970, pp. 55-64.

Donley, Roy. "Community Noise Regulation." Sound and Vibration, February, 1969.

Fuller, Louis. "As I See It." Forbes, December 15, 1969.

Giebert, Ken. "Transportation and the Environment." Seaports and the Shipping World, July, 1972, pp. 42-49.

Hauser, Edwin W.; West, Leonard B., Jr.; and Schleicher, A. Richard. "The Fundamental Air Pollution Considerations for Urban and Transportation Planners." Traffic Quarterly, January, 1972, pp. 71-84.

Howes, Helen C. "Pollution: Careful Plans and Firm Action." Canadian Business, April, 1971, pp. 30-36, 55.

Levasseur, Pierre J. "Aviation and the Human Environment, Land-Use Planning Protects Airport and Community." ICAO Bulletin, April, 1972.

McLeod, Duncan. "Pollution: Its New Dimensions for Business." Canadian Business, March, 1971, pp. 32-36.

Miller, Irwin. "Business Has a War to Win." Harvard Business Review, March-April, 1969, p. 8.

Sinclair, Sonja. "The New Economics of Pollution." Canadian Business, November, 1971.

Sutton, Horace. "Is the SST Really Necessary?" Saturday Review, August 15, 1970.

Towler, John and Nonken, Harold. "Education for Survival." Environmental Quality, February, 1973, pp. 36-38, 74.

Ways, M. "The Environment--How to Think About the Environment." Fortune, 1970, pp. 195-220.

F. Newspapers

Bachop, Bill. "Noise No Problem, Airport Foes Told." Vancouver Sun, February 13, 1973.

_____. "The Government Hasn't Done Its Homework: Why Ottawa Has Shunned Airport Hearing." Vancouver Sun, February 15, 1973.

Bird, David. "Rickles Asks Noise Limits to Ban Jets from City." New York Times, December 30, 1970.

Clark, Evert. "Noise Called Bar to New Airports." New York Times, October 5, 1967.

Committee of Concerned Citizens. "Save Your Environment." Vancouver, B.C., February 5, 1973 (Mimeographed).

Fainsworth, Clyde H. "Conference on Sonic Boom Told Noise Can't Be Designed Away." New York Times, February 4, 1970.

Farnsworth, "O.E.C.D. Will Set Pollution Limits." New York Times, February 19, 1970.

Lindsey, Robert. "FAA Acts to Cut Noise of Jetliners." New York Times, November 13, 1969.

Vancouver Sun. "Airport Goof Disclosed." January 16, 1973.

_____. "Clean Air Bill Challenged as Anti-Pollution Weapon." February 20, 1971.

_____. "Surrey Blames Public, Few Anti-Noise Laws Found." March 6, 1973.

G. Lectures and Papers

- Beare, John B. "Investment Policies and Economic Stabilization Policies: A Case Study of Transport."
Paper presented at the University of Toronto, York University Joint Program in Transportation, Toronto, 1969.
- Diamant, E.S. "Earth Transportation Macro Systems."
One lecture in a series on Macro Systems, Analysis and Synthesis of Complex Systems, presented at the University of California Extension, San Francisco, California, Fall 1968.
- Hansen, John and Stüssi, Robert. "Noise and the Urban Environment."
An Occasional Student Paper. The Center for Transportation Studies, University of British Columbia, Vancouver, B.C., 1972.
- Keenleyside, Hugh. "The Stockholm Conference on the Environment: An Assessment."
One in a series of Westwater lectures presented at the University of British Columbia, Vancouver, B.C., January 26, 1973.
- Levien, Roger E. "The Economic Side of Systems."
One lecture in a series on Macro Systems, Analysis and Synthesis of Complex Systems, presented at the University of California Extension, San Francisco, California, Fall 1968.
- Ritchie, Ronald S. "The Corporation in the World-To-Be."
Paper presented to the Industrial Relations Management Association, Harrison Hot Springs, B.C., February 19, 1971.
- Ruppenthal, Karl M. "Problems of Aircraft Noise and Exhaust."
Faculty of Commerce and Business Administration, University of British Columbia, Vancouver, B.C., 1972 (Mimeographed).