AN ANALYSIS OF FREIGHT TRANSPORTATION IN THE YUKON ECONOMY

by

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Abstract

Transportation has always been of vital importance in the Yukon because of the small population, the harsh climate, and the remoteness from large markets. It has imported almost all of its industrial and consumer goods, supported by the export of a limited tonnage of high value mineral concentrates. Little growth has occurred in the past fifteen years in the value of mineral production, as it has remained fairly constantly at about $14 million.

At present, though, the Yukon is in a stage of transition as many ore bodies are being brought into production. The effect on the Yukon economy will be substantial, as one estimate sees the dollar value of production increasing more than three-fold by 1975.

The objective of this thesis is to determine the impact of this economic change on the total transport system. It is thus necessary to establish a measurement of the present level of freight services (the year chosen is 1964) and to establish a forecast of freight services for 1975. The measurement and forecast are then used to determine in what way the economic change may influence transport rates and services.

The main sources of information for this paper were the various transportation and mining companies that are engaged in Yukon activities. Considerable use was made of the 1966 Stanford Research Institute study that concerned itself with

the economics of paving the Alaska Highway. While many other sources were also consulted, they were generally of lesser importance.

The growth rate of goods going north into the Yukon is forecast to be a moderate 5% per annum. The growth in the amount of ore concentrates going out of the Yukon should be considerably larger. For every ton moving north into the Yukon in 1964, 1.5 tons of freight moved out of the area, while by 1975 the ratio should increase to 6.5 tons for every northbound ton.

As the present and planned mining developments are principally in the area north and northeast of Whitehorse where the White Pass and Yukon Route has the competitive advantage, most of the direct increase in freight traffic should benefit the White Pass and Yukon Route. Other transport companies should benefit also, but more due to indirect effects of the mining developments on freight traffic.

The increase in the level of freight should make possible a higher utilization of present facilities and lower average costs. It appears that especially for the White Pass and Yukon Route the potential for reductions in freight rates should increase.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

1. Problem and Importance of Paper

The purpose of this paper is to analyze the transportation of freight into and out of the Yukon, as well as to consider the impact of the present large scale mining development boom in the Yukon on the transportation system. This necessarily includes an evaluation of the present freight services and freight volume, a forecast of freight traffic for the 1967 to 1975 period, and an estimation of the type of changes that may result in Yukon freight transportation due to the predicted increase in traffic.

Within the economic region of the Yukon, with its small population, its harsh and unfavourable climate, and its remoteness from large markets, transportation has always been of vital importance. This was especially so in the Yukon's first period of great change, that of the Klondike Gold Rush. Occurring at the turn of the century some seventy years ago, it also brought with it the need to transport into the Yukon vast amounts of food and general supplies. While a ship connection from Skagway, Alaska, just below the southern Yukon border, had already existed for some time with Van-

couver and Seattle about a thousand miles to the south, there had been only a small difficult trail connecting Skagway and the Yukon. It was the gold rush that brought about the construction of a permanent means of transportation from Skagway across the 2900 foot high White Pass to the Plateau that makes up the Yukon.

The 110 mile long White Pass and Yukon Route railroad began regular service in August of 1900, and since then has been the main artery of Yukon transportation.

The second major period of change in the Yukon was World War II, and the building of the first land access to southern Canada: the Alaska Highway. Truck transport increased greatly, while at the same time the first airports were built. New mining interest resulted in the increase of silver, lead and zinc production, the value of which soon bypassed the value of gold production.

The third major period of change in the Yukon economy is taking place at the present time. Thus until the Second World War, production of the precious metals gold and silver was in the order of two million dollars a year. During the post-war period the Yukon mineral output increased to about twelve million dollars. While this level of output has remained up until the present, a reassessment of the Yukon's mineral potential has occurred in recent years. C. J. Brown[1] thus

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1. C. J. Brown, "Yukon Mineral Resources and Transportation," paper presented to the Alaska Centennial Conference, Fairbanks, Alaska, 1967, p. 5.

states that "the results of this reassessment...indicate that Yukon's mineral output should rise to 30 million dollars by 1970 and by 1975 production could exceed 50 million dollars."

To be able to appreciate the impact of this substantially increased level of mining activities on the total transportation system, it is necessary to look at the present system and to analyze how it is presently being utilized. It will then be possible to arrive at general conclusions regarding the impact of increased mineral production on Yukon freight services and the total transportation system.

2. Organization of Remainder of the Thesis

The geographic, demographic and economic characteristics of the Yukon are reviewed in Chapter II, in an attempt to present the uniqueness of the market for transportation services.

Chapter III first looks at problems and examples of freight measurement, and then presents a measurement of Yukon freight services including the volume of actual movement, the cost of transport and the level of service by transportation stream.[2]

Problems and examples of freight forecasting are reviewed in Chapter IV, followed by a presentation of freight forecasting for 1975.

Chapter V discusses the implications of the freight

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2. The three transportation streams are White Pass and Yukon Route Stream, the Trucking Stream, and the Air Stream. The use of the word "stream" is explained in Chapter II.

forecast, including the distribution of freight customers, the effect of the bigger economic base, and the possible effect on the level of competition between the transportation streams.

The summary and conclusions are given in Chapter VI.

3. Procedure and Sources

The procedure followed was to outline general theories of measuring and forecasting transportation services, and then to introduce data obtained from transportation companies operating into the Yukon Territory. While one significant source was the 1966 Stanford Research Institute study on the economic benefits of paving the Alaska Highway, much information was gained from the White Pass and Yukon Route, Canadian Freightways Limited, Canadian Pacific Airlines, and other transportation and mining companies.

4. Limitations and Considerations

One limitation of the paper is that the Yukon is an export economy and substantial changes in market prices may have considerable effects on the forecast volume of exports. Similarly no information is available on possible rate changes for scheduled air freight and for the White Pass and Yukon Route, with the former being a very strong possibility after the introduction of the Boeing 737 jet plane in late 1968.

It would have been desirable to have the Vancouver-Yukon part[3] of the Trucking Stream divided into a) all trucking,

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3. The other principal part is Edmonton (and Calgary) - Yukon.

and b) a combination of Pacific Great Eastern Railway freight from Vancouver to Dawson Creek and trucking from there to the Yukon. This information, though, was not obtainable from the particular companies, and everything is included within the Trucking stream.

A further limitation arising out of the paper is the extent to which the Stanford Research Institute study on the Alaska Highway is usable. Much of their information could only be applied with further substantiation from private companies. Thus the study is concerned with traffic using the full length of the unpaved portion of the Alaska Highway, starting at mile 80 just north of Fort St. John. This means that most of their data about average freight loads per truck are limited in usefulness.

Two other considerations should also be mentioned here. On the one hand, the freight traffic carried by American freight companies travelling from the continental United States straight through to Alaska was not included in the paper. Similarly, the specialized petroleum carriers taking petroleum products from Taylor Field Refinery near Fort St. John to Alaska were not considered. On the other hand, it was felt that the operations at Cassiar, B.C., just south of Watson Lake and the Yukon border, as well as the operations at Tungsten, on the eastern side of the Yukon-Northwest Territories border, were woven in so much with the Yukon economy that the freight activities resulting from their operations should be included with the Yukon freight measurements.

Finally, it should be mentioned that the freight traffic growth rates used in the forecast may not reflect the secondary effects of the mining boom very well, but they are the best figures that are available for this purpose.

CHAPTER II

A YUKON INVENTORY

The Yukon Territory as a region and as an economy is unique in many respects. An analysis of its transportation system and of the modal relationships can thus be best appreciated when based on a description of the physical and economic characteristics of the region.

I. PHYSICAL CHARACTERISTICS

The "Western Highlands," four-fifths of which makes up the Yukon Territory, consists mainly of "an up-thrust, roughly triangular block of ancient, folded mountains amounting to a quarter of a million square miles of peaks, plateaus, glaciers, canyons, tundra plains and broad mountain-guarded river valleys."[1] Its whole southern part is made up of the Yukon Plateau, separated from the northern Peel Plateau and Porcupine Plain by the Ogilvie Mountains.

The Yukon Plateau is bordered on the west by Alaska, and is cut off from the Pacific Ocean by the massive St. Elias Mountains, and from British Columbia to the south by the northern buttresses of the Cassiar and Coastal Ranges.[2]

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1. Farley Mowat, Canada North (Toronto: McClelland and Stewart Ltd., 1967), p. 111.

2. Ibid., p. 112.

The ice sheet that left most of the Canadian North bare and exposed, spared most of the rivers and lands of the Yukon area. Thus while soil and sediments have been swept away in most of Canada's North, they cover the Yukon Plateaus so thickly "that one can fly many hundreds of miles over them and see no rock, not even on the highest hills."[3]

While the plateaus are very fertile, and between "two hundred and fifty thousand and five hundred thousand acres of arable land exist in the Yukon, only a few thousand acres have so far been put to agricultural use."[4] Similarly forests of commercial timber extend much farther north than anywhere else in Canada, although their commercial value is low due to large distance from markets.

One of the reasons for the limited use of the fertile land is the severity and length of the Yukon winter. On the average, snow covers the ground from November to March (TABLE I) and it is normally only from June to August that precipitation falls in the form of rain.[5]

While winter temperatures may fall as low as -75°F, the temperature during an average January night falls to "only" -29°, and rises to -16° during the warmest part of the day.[6] In the short summer the temperature may rise up to 90°.

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3. Ibid., p. 113.

4. Ibid.

5. Kendrew, W.G. and D. Kerr, The Climate of British Columbia and the Yukon Territory (Ottawa, 1955), p. 192.

6. Battelle Memorial Institute, Transportation Requirements for the Growth of Northwest North America (Washington, D.C.: United States Government Printing Office, 1961), p.III-10.

TABLE I

SNOW, AVERAGE DEPTH (INCHES) ON GROUND

Town	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Teslin	8	12	17	18	13	-
Dawson City	5	7	14	6	6	3
Mayo	6	10	17	20	12	-
Watson Lake	6	16	25	30	14	4

Source: Kendrew, W.G. and D. Kerr, The Climate of British Columbia and the Yukon Territory, Ottawa, 1955, p.192.

Length and severity of the Yukon winter as well as the brevity of the summer have been among the main reasons for the limited population in the Yukon. While its area encompasses 205,000 square miles, which is 5.8% of Canada's land mass, its 1961 population of 14,628 (TABLE II) is only .08% of Canada's total population.[7] Thus the population density of

TABLE II

POPULATION OF YUKON TERRITORY
1931-1961

Year	Population
1931	4,230
1941	4,914
1951	9,096
1961	14,628

Source: Canada Yearbook

7. Stanford Research Institute, Improvement Program for the Alaska Highway: An Analysis of Economic Benefits, prepared for the Department of Northern Affairs and National Resources, Government of Canada (Ottawa: Queen's Printer and Controller of Stationery, 1966), p. IV-52.

persons per square mile is .07, while that of Canada as a whole is 5.12.[8] The Yukon population increase during the most recent decade averages out to about 4.9% per annum.[9]

The biggest city in the Yukon, and also the nerve center of transportation activities, is Whitehorse. Its population was 5031 in 1961, almost double the 1951 figure of 2594. The other major communities are Watson Lake, Dawson, and Mayo.

II. ECONOMY OF THE YUKON

Economic development of the Yukon Territory has been faced with considerable handicaps, including "geographic isolation, inaccessibility to important export markets, vulnerability to uncontrollable external factors, and high cost structures."[10] It has centered primarily around the production and export of staple products, especially gold, silver, and other metal concentrates. While mining has been the Yukon's major industry, some contribution to the economy has also been made by forest products and in recent years oil and gas exploration.

It was the Yukon's escape from the glacial ice sheet that made possible the first great influx of population.

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9. Surprisingly enough, the 1966 Census data, as listed by the Dominion Bureau of Statistics 1967 Population booklet, shows the Yukon population as having decreased to 14,382. This is quite unexpected, and not enough is known for evaluating possible implications.

10. Ibid.

About eighty thousand people[11] are estimated to have come from all corners of the earth to search for the elusive gold that over the ages had sunk to the bottom of Yukon rivers and streams. If an ice sheet had moved across the Yukon, as it did over the rest of Canada's north, "the protecting upper layers of sand and gravel would have been stripped away and the placer gold with them."[12]

While the majority of these fortune-seekers did not remain in the Yukon for long, some did decide to make their permanent home there. For many years gold mining was the only major industry and source of income. Not until the post World War II period did the significance of gold mining in the Yukon economy undergo any major change.

During World War II the Alaska Highway was built as an overland link between Alaska and the continental United States. Not only did the highway provide the Yukon with a new industry, tourism, but also made it easier for mining exploration and development to be carried out.

The major mining operation in the Yukon, United Keno Hill Mines Ltd., started its silver-lead-zinc operations in the late forties, and have since then accounted for the bulk of mineral production in the Yukon. During 1963 they accounted for 69% of the total value of Yukon mineral output.[13] TABLE III indicates the total mineral production of the Yukon for the

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11. Mowat, op. cit., p. 114.

12. Ibid., p. 113.

13. Stanford Research Institute, op. cit., IV-56.

TABLE III

TOTAL MINERAL PRODUCTION IN THE YUKON, 1951-1965

Year	Amount ('000,000)	Year	Amount ('000,000)
1951	$9.8	1959	$12.6
1952	11.4	1960	13.3
1953	14.7	1961	12.8
1954	16.6	1962	13.1
1955	14.7	1963	14.4
1956	15.7	1964	15.2
1957	14.1	1965	13.2
1958	12.3		

Source: Department of Mines and Technical Surveys, Canadian Minerals Yearbook, Ottawa: Statistics Section, Mineral Resources Division, Queen's Printer and Controller of Stationery.

last fifteen years.

The importance of mining production as a part of total commodity production in the Yukon can be shown statiscally only through aggregation with the Northwest Territories (TABLE IV). While the totals do not divide equally between the two economic regions, the table still gives a relatively good indication. Thus for the total net value of commodity production for 1963, 76.6% is accounted for by mining.[14]

Among the various metals mined in the Yukon, gold had been the major one until the Second World War. While it is still important, it has in recent years been passed by silver in dollar value of total production. The other major metals mined are lead and zinc (TABLE V).

There are four general mining districts within the Yukon. The Mayo Mining District has been the most productive one since the early fifties due to the presence of United Keno Hill Mines Ltd. While the Whitehorse Mining District and the Dawson Mining District have not been very productive in recent years, the present development work by Anvil Mining Corporation in the Ross River area, by Cassiar Asbestos at Clinton Creek, by New Imperial Mines Ltd. near Whitehorse, and by several smaller mining companies is a strong indicator of rising production in these districts in the near future. The Watson Lake Mining District has little production activity

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14. Dominion Bureau of Statistics, National Accounts and Balance of Payments Division, Industrial Output Section, Survey of Production, 1963 (Ottawa: Queen's Printer and Controller of Stationery, 1963).

TABLE IV

NET VALUE OF COMMODITY PRODUCTION BY INDUSTRIES, YUKON AND NORTHWEST TERRITORIES, 1961-1963

Commodity	1961 '000	1961 %	1962 '000	1962 %	1963 '000	1963 %
Agriculture[a]	-	-	-	-	-	-
Forestry	$ 201	0.7%	$ 570	1.9%	$ 562	1.9%
Fishing	675	2.2	859	2.9	796	2.6
Trapping	1,425	4.7	1,014	3.4	934	3.1
Mining	23,954	78.6	22,201	75.4	22,968	76.6
Electric Power	3,487	11.4	3,614	12.3	3,260	10.9
Manufacturing	738	2.4	1,206	4.1	1,480	4.9
Construction[a]	-	-	-	-	-	-
	$30,479	100%	$29,464	100%	$30,000	100%

Source: Dominion Bureau of Statistics, National Accounts and Balance of Payment Division, Industrial Output Section. Survey of Production, 1963. Ottawa.

[a]Included with British Columbia total, and thus not available.

TABLE V

VALUE OF MINERAL PRODUCTION IN THE YUKON, 1960-1965 ($'000)

Mineral	1960	1961	1962	1963	1964	1965
Silver	$6,417	$6,539	$7,552	$8,451	$7,894	$6,289
Gold	2,652	2,371	2,050	2,084	1,671	2,182
Lead	2,167	1,712	1,616	1,868	2,744	2,637
Zinc	1,789	1,528	1,439	1,515	2,025	2,114
Cadmium	207	228	231	326	428	423
Copper	-	257	134	-	-	-
Coal	97	114	115	124	98	88

Source: Department of Mines and Technical Surveys, Canadian Minerals Yearbook, Ottawa: Statistics Section, Mineral Resources Division, Queen's Printer and Controller of Stationery.

within the Yukon boundaries, even though just south of the B.C.-Yukon border is the Cassiar Asbestos Mine at Cassiar, while the Canada Tungsten operation is just east of the Yukon-Northwest Territories border.

The three other basic industries in the Yukon are forest products, agriculture, and the petroleum industry. While substantial forest resources exist, the production has been limited to local consumption. Thus 1963 production was under $250,000 while, as a comparison, mineral production during the same year was $14.4 million.[15] The situation of supplying only local markets is not likely to change much during the next ten years. Agricultural production similarly is only for local consumption, with total cash income being between $85,000 to $140,000[16] per year.

The petroleum industry, even though no oil or gas has been produced commercially, is making itself felt in the Yukon economy through expenditures on exploration. During 1956 and 1957 expenditures averaged $1 million annually, rose to about $2 million per year through 1961, and increased further to about $3.5 million per year for 1962 and 1963.[17] It is felt though that even if sizeable oil and gas reserves are found in the northern Yukon area, their economic development before 1975 is seriously hampered due to (a) lack of large domestic market; (b) existence of a high-cost structure; and

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15. Stanford Research Institute, op. cit., p. IV-58.

16. Ibid., p. IV-59.

17. Ibid., p. IV-60.

(c) remoteness from potential export markets.[18]

This general review of economic activities in the Yukon Territory may be concluded with a brief look at the labour force. TABLE VI compares the labour force for various divisions of the Yukon with that of British Columbia. Employment in the transportation force is proportionately about 60% higher for the Yukon, while employment in the primary force is about 40% higher. This would substantiate the claim that the Yukon is a resource-based, export-oriented economy. The sales force on the other hand is about 65% less for the Yukon than for B.C., which can to a large extent be explained by the much reduced wholesaling activity in the Yukon, as well as by the direct mining company purchasing from firms outside the Territory.

II. TRANSPORTATION STREAMS OF THE YUKON

A resource-based, export-oriented economy has to be supported by an efficient transportation system, not only because exports have to be transported to their market at such a cost that the product is still able to compete in price, but also to provide reasonably-priced transportation for incoming factory inputs, manufactured goods, food products, and other necessary materials. If the cost to import materials were exorbitant, resulting in an extremely high-cost structure, then the export production of the economy could be priced out of the

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18. Ibid.

TABLE VI

LABOUR FORCE IN THE YUKON
AND IN BRITISH COLUMBIA, 1961

Area	Yukon		B. C.	
	No. of People	% of Total	No. of People	% of Total
Managerial	501	8.0%	57,023	9.9%
Professional & Technical	501	8.0	56,664	9.8
Clerical	626	10.0	73,683	12.7
Sales	161	2.6	42,175	7.3
Service & Recreation	1,153	18.4	78,199	13.6
Transportation & Communic.	661	10.6	37,651	6.5
Primary	722	11.6	46,959	8.1
Craftsmen	1,320	21.1	139,408	24.1
Labourers	341	5.6	28,699	5.0
Not stated	256	4.1	17,187	3.0
	6,242	100%	577,648	100%

Source: The Financial Post, Survey of Markets and Business Year Book, 1967-68, Toronto: Maclean-Hunter Publishing Company Ltd.

international market.[19]

Since the turn of the century the Yukon has been connected to the outside world by the White Pass and Yukon Route, which is made up of rail service for the 110 miles from Whitehorse to tidewater at Skagway, and ship service from there to southern B.C.[20] Up to World War II local transportation consisted mainly of boat service, and at one time as many as sixty-five sternwheelers plyed the waters of the Yukon River between Whitehorse and Dawson City.[21]

The second World War brought with it the building of the Alaska Highway, and not only did the transport of materials within the Yukon turn from shipping to trucking, but also was there a significant increase in the amount of materials trucked overland to the Yukon. At the same time the building of airports fostered the growth of commercial air transport between the Yukon and the rest of Canada.

By the middle fifties the White Pass and Yukon Route had established an integrated transportation system.[22] This considerably increased the efficiency of their system, as hitherto goods leaving the Yukon first had to be put on trucks for shipment to Whitehorse, then transferred to the railroad to

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19. As it is, the present high-cost structure of the Yukon permits some limited secondary manufacturing, although only for local demand.

20. Brown, op. cit., p. 2.

21. Mowat, op. cit., p. 116.

22. Brown, op. cit., p. 4.

go to Skagway, and finally put on the boat to be shipped south. Through integrated facilities the time involved for these intermodal transfers was very much reduced, as now the same container could be put from the ship onto the train and then onto the trucks, and vice versa.

The facilities of the White Pass and Yukon Route were further improved in 1965. Over 8.5 million dollars were spent to upgrade the container concept and to construct a new container ship (the Frank H. Brown), capable of handling up to 6500 short tons of combined freight and petroleum products.[23] The ship has facilities to carry vented, heated, dry and refrigerated container units. While the frequency of sailings is still only every two weeks, the freight capacity and handling facilities have been improved considerably.

The Yukon Territory may at present be considered as being served by three transportation streams:[24]

1. The White Pass and Yukon Route (W.P. and Y.R.) Stream. It entails ship service between Vancouver and Skagway; railway transportation from Skagway to Whitehorse; and truck transport from Whitehorse to other points in the Yukon area and northern B.C. (mainly Cassiar).

2. The Trucking Stream. It entails either truck transport between B.C., Alberta, and Prairie cities and the Yukon or rail transportation from Vancouver or Edmonton to the Dawson Creek area, and truck transport between there and

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23. Ibid.

24. The term "stream" was felt to be the most appropriate one in the context of this paper.

the Yukon. For local shipments in the Yukon, trucking assumes the major responsibility although a small share of goods is carried by air.

3. The Air Stream. It involves scheduled air freight services via Canadian Pacific Airlines (C.P.A.) between Vancouver and the Yukon, and between Edmonton and the Yukon.

The above three transportation streams will be used in the remaining chapters of this paper. While important roles are played by unscheduled aircrafts, chartered helicopters, private small-truck operators (owning one truck, less than 10 tons) they are not significant from the point of view of interprovincial freight transportation and are therefore excluded.

The three transportation streams are an important part of the small, resources-oriented Yukon economy. The population is very small, and almost all consumer and industry products are imported from outside the area, mainly southern British Columbia and Alberta. It will now be desirable to look more closely at the transportation freight services for the Yukon as provided by these three streams.

CHAPTER III

MEASUREMENT OF FREIGHT SERVICES

I. FREIGHT MEASUREMENT IN GENERAL

Importance of Measurement

The importance of freight measurement arises not simply out of a comparison of actual tonnages moving within and between economic regions by different modes (or transportation streams). It is just as important to include with these tonnages a more detailed analysis of the relationship existing between the modal freight services. This analysis includes principally the main types of products that move along different modal routes, the main origin and destination patterns for the different modal routes, the cost of transport for different modes, the types of customers encountered by different modes, and the level of service offered by each mode.

An understanding of these relationships can be of some significance at the governmental level not only in assisting with the possible adjustment of regional transport policy and in the decision-making concerning the extent to which additional transport facilities requiring public expenditure may be needed. It may also be of value in the formation of policy regarding economic development of regions. Finally, this understanding is necessary for the formulation of freight

forecasts and to facilitate the comprehension of forecast implications at the government and at the industry level.

Unit of Measurement

Before looking at specific techniques of freight measurement it is necessary to decide on a unit of freight tonnage measurement. While the choice of available units ranges from tons, carloads, ton-miles, and carload-miles to dollar revenue, the usual choice is ton-miles. The explanation given by Wilson[1] is that transportation firms create "place utility". Thus while they move things from points where their economic value is more, they produce a product which is bound up with weight and distance.

The usage of 'ton-miles' may, on the other hand, result in an underestimation of the contribution of some modes as these may offer more services than others, thereby making their function more valuable. Thus ton-miles would underestimate the contribution of inter-city trucking (in comparison to railway ton-miles) because truck transport normally carries more of the higher valued traffic and usually includes pickup and delivery services.[2]

Dollar revenue might thus be a better estimation of the

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1. George W. Wilson, "On the Output Unit of Transportation," Land Economics (Madison, Wisconsin: University of Wisconsin, Aug. 1959), p. 268.

2. D.W. Carr and Associates, "Truck and Rail Competition in Canada," Royal Commission on Transportation, Vol. II (Ottawa: Queen's Printer and Controller of Stationery, July 1962), p. 7.

contribution that each mode makes to transport. The difficulty that arises is one of obtaining meaningful revenue data, as it is only intercity transport revenue that is desirable for modal comparison, and company records would show revenue from other transport functions as well. Furthermore, it is questionable whether the resulting comparison would be a worthwhile tool for providing usable results. As previously indicated, the unit that is thus used by most transport studies is 'ton-miles'.

For the measurement of tonnage into and out of the Yukon, though, the unit "tons" is used. Part of the reason is the difficulty of finding complete ton-mile data. Also, most of the northbound general freight originates in two areas, Vancouver and Edmonton, which are approximately equidistant to the Yukon. Thus when tonnages are changed to ton-miles, the relationship between the amount of freight originating in Vancouver and Edmonton is still about the same. The unit "tons" then is used to compare the tonnage of freight travelling along the three transportation streams.

Techniques and Examples of Measurement

It is desirable to examine the approach of other studies to the problem of freight measurement before attempting a measurement of freight services for the Yukon area.

For most countries it is possible to base an analysis of freight transportation on governmental data. A problem arises for developing countries that have not established freight data collection, as well as for the case where national data is

available but where a regional area is of prime interest.

An extreme case involving the former is an economic survey of Western Africa[3] which, when faced with the absence of data for the volume of road transport, looked at two very indirect indicators. The first one, the number of vehicles in use in each country, was inadequate in its reflection of road traffic growth because no increase in average load per truck nor intensity of utilization could be seen. This inadequacy was then partially accounted for by statistics of motor fuel imports. For instance, in the period 1952 to 1962 Ghana experienced an increase in gasoline imports from 111.6 to 196.4 thousand metric tons, while its diesel oil imports grew from 105.7 to 244.0 thousand metric tons.[4] While this data did not suffice by itself, it did present some indication of the level of truck transport.

In another area a problem arose when it was found desirable to evaluate the truck usage of the newly built Cochabamba to Santa Cruz Highway in Bolivia. As data were not directly available, field traffic sampling had to be carried out to reach an estimate of truck traffic. Of the several studies made, one reached its estimate by taking a 24 hour count of traffic leaving Santa Cruz.[5] For ten months it found the destination, main type of cargo, and average weight of all

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3. United Nations, Economic Survey of Africa, Vol. I (Ethiopia, 1966).

4. Ibid., p. 64.

5. G.W. Wilson et al, The Impact of Highway Investment on Development (N.W.Washington, D.C.: The Brookings Institution, 1966), p. 33.

vehicles leaving the city. These data were then extrapolated forward to arrive at the number of trucks using the highway for the year, as well as the average weight of these trucks.

Another study of the same highway section reached a considerably larger traffic estimate by basing it on divided highway segments.[6] The study used a daily 10 hour sample to arrive at a daily traffic density for different highway segments, and carried these densities forward to achieve an estimate of yearly truck traffic for the total highway.

The discrepancy between the two estimates arose mainly because the larger one recognized the truck traffic which left Cochabamba but did not travel as far as Santa Cruz. The first study did not do this. Thus the decision made by the first study to stage its traffic count at Santa Cruz rather than at Cochabamba caused its estimate to miss a considerable portion of truck traffic.

The Stanford Research Institute study of the Alaska Highway based its estimate for the most part on data received through interviews with the main trucking firms (of which fortunately there were not very many). These data were then substantiated by a 3 week, 24 hour, traffic sample taken at Watson Lake.[7] Through this sample the remaining small truck traffic was accounted for. This remaining portion actually made up only about 20 percent of all truck vehicle miles travelled on the highway.

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6. Ibid., p. 34.

7. Stanford Research Institute, op. cit., p. A-19.

The techniques for the Bolivian study and the Alaska Highway study were basically the same in that they were both depending on actual traffic counts, even though a shorter time period was used for the latter. The Alaska Highway study was in the advantageous position that the number of trucking firms was relatively small, in contrast to the large number of small operators using the Cochabamba-Santa Cruz Highway. Prime importance was therefore put on information gained directly from transport companies, with traffic count information being used more as a check and for rounding out the picture.

Thus while the technique of measurement is normally an actual count and survey of traffic passing a certain point, there are certain variables that may be adjusted to suit the regional area. These variables include the number of hours per day and the number of weeks in general taken for the field count, the point along the route at which the count is taking place, and the emphasis put on other sources of information.

The danger with a traffic count is that unless the count is continued for the full year, its results are subject to a wide variation of interpretations. This is especially so as little information is available on seasonality of traffic and possible changes in the size of specific commodity flows.

More generally, it may be concluded that a regional case study is much closer to reality in contrast to an aggregation of many regions which arises out of national data. A. Hirschman thus claims that "generalizations involving large

aggregates of the economic system have somehow seemed to be lacking in ready applicability to the specific problems that confront the practical planner."[8] The Yukon can be looked upon as a region where conclusions reached have more practical applicability.

II. CASE STUDY ON THE YUKON

While the above samples have shown some of the variations that occur in actual freight measurements, it will be desirable to use the Yukon Territory as an example of an economy for which only limited useful data is available, and to develop for it a measurement of freight services. This measurement has to a limited extent been based on the recent Stanford Research Institute study of the Alaska Highway. Even though the study used "vehicle-miles" as the basic output unit, much of its data were still applicable. Most of the gaps that still occurred were filled by information gained from transportation company sources. As the Stanford study used 1964 transportation data, the same year will be used for the purpose of this paper for determining tonnage measurements. Other comparisons, such as cost and service comparisons, will be on the basis of 1967 company information.

The freight measurement will first deal with the actual tonnages and the types of products travelling via each transportation stream, and will then consider the cost of transport and the service level existing per transportation stream.

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8. Wilson et al, op. cit., p. 162.

1. Freight Tonnages per Transport Stream

Actual tonnages. The first transportation stream to be considered includes all freight going by truck or by railway to the Dawson Creek area, and from then by truck into the Yukon. The tonnages, by commodity grouping, are shown as going north into the Yukon and going south out of the Yukon. (TABLE VII).

The White Pass and Yukon Route Stream is made up of all freight utilizing the White Pass and Yukon Route ship and rail facilities, with distribution in the Yukon being conducted by trucking. The results are listed in TABLE VIII.

The third transportation stream includes all general freight and mail going by scheduled airline operations into and out of the Yukon (TABLE IX).

Types of products. The different types of products that travel along the first two transportation streams are quite similar with respect to specific commodity groups, although predictably the products travelling by airfreight are of a different type as well as generally of much lesser weight.

The northbound truck commodities include meat and packinghouse products, fresh and frozen produce, miscellaneous manufactured items, building products and cement, and small quantities of beer and lumber.[9] Special carrier trucks transport bulk petroleum and refined petroleum products, house trailers (for commercial, industrial or private use)

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9. Stanford Research Institute, op. cit., p. V-19.

TABLE VII

TRUCKING STREAM: ALL FREIGHT GOING INTO AND OUT OF THE YUKON, BY GENERAL COMMODITY GROUPING, 1964

Into the Yukon:	General Freight	13,900 tons[b]
	Petroleum	11,720 tons
	Household Effects	230 tons
	House Trailers	104 tons
Out of the Yukon:	General Freight	2,000 tons[b]
	Asbestos[a]	10,248 tons
	Household Effects	730 tons

Source: Appendix A, except for asbestos.

[a]Tonnage obtained from Pacific Great Eastern Railway Company.

[b]While these were the best estimates available (calculations in Appendix A), they are still relatively unreliable and should be viewed with caution.

TABLE VIII

WHITE PASS AND YUKON ROUTE STREAM: ALL FREIGHT GOING INTO AND OUT OF THE YUKON, BY GENERAL COMMODITY GROUPING, 1964

Into the Yukon:	General Freight[a]	25,000 tons
	Petroleum prod.	16,500 tons
Out of the Yukon:	General Freight[a]	2,000 tons
	Ore concentrates	31,700 tons
	Asbestos concentrates	56,000 tons

Source: White Pass and Yukon Route, and various other companies.

[a]This does not include freight carried along the Trucking Stream by Loiselle Transport Limited, a subsidiary of the White Pass and Yukon Company.

TABLE IX

AIR STREAM: ALL FREIGHT
GOING INTO AND OUT OF THE YUKON, 1964

Into the Yukon:	General Freight	207 tons
	Air Mail	34 tons
Out of the Yukon:	General Freight	53 tons
	Air Mail	31 tons

Source: Canadian Pacific Airlines
and Post Office estimates.

and household effects. In addition there are culvert and drilling pipe, heavy machinery and oilfield equipment commodities, delivered mainly in the Fort Nelson-Watson Lake area. All the other commodities are delivered to communities all along the highway.

The main southbound truck commodity is asbestos fiber going to the P.G.E. railhead at Fort St. John. Others include used machinery and equipment, empty beer bottles, used pipe, household effects and, to a lesser degree, tourist automobiles.[10]

The northbound White Pass and Yukon Route Stream commodities, as indicated before, are very similar to those in the Trucking Stream, although the proportions are very different. While specific figures are not available, the emphasis is much more on building materials and machinery. The commodity groups in general include perishable and packaged groceries, building materials, liquor, machinery, general merchandise, and petroleum products.[11] The main southbound commodities were of a much different type, though, as ore concentrates and asbestos fiber accounted for 98% of the southbound tonnage.[12]

The commodities travelling along the northward Air Stream were of a generally different nature. Similar to airfreight in other Canadian regions, these commodities were either emergency items, goods of high value, or of a highly

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10. Ibid.

11. White Pass and Yukon Route.

12. Ibid.

perishable nature. Table X lists these commodities, and compares them to the ten largest commodity groups carried on Canadian domestic routes. For the Yukon the five most common items, making up more than 80% of total shipments, are general merchandise, machinery and parts, automobile and truck parts, newspapers and magazines, and films and video tapes.

Looking even further at the sizes of shipments travelling by air freight to the Yukon, TABLE XI compares them to air freight data found by a 1962 British traffic distribution study. Thus for freight shipments to the Yukon, 94% of all the shipments (weighing between 1 and 50 pounds each) accounted for 74% of total weight carried. For the shipments on B.E.A. routes, however, using approximately the same weight range of from 1 pound to 72.5 pounds, 74% of all shipments accounted for only 12% of total weight. Thus British European Airways carried 26% of all their shipments with a weight of more than 72.5 pounds, accounting for 88% of all the freight tonnage transported by the company. Of the freight going into the Yukon, though, only 8% of shipments were over 50 pounds, and this represented only about 10% of total weight carried into the Yukon.

This difference in the size of shipments can be partially explained by the size of the Yukon economy, in that there are fewer customers for the goods shipped by air. Another possible reason is that for shipments under thirty pounds, Air Stream rates are very competitive with rates for the other transportation streams (TABLE XII). Over fifty pounds no rate incentives exist to encourage larger air shipments (unlike inter-

TABLE X

COMPARISON OF AIRFREIGHT COMMODITIES ON BRITISH COLUMBIA-INTO-YUKON ROUTE AND ON DOMESTIC CANADIAN ROUTES

B.C.-Yukon Route		Domestic Canadian Routes	
Commodity	% of total shipments[a]	Commodity	Rank
General Merchandise	22.8%	Machinery parts & equip.	1
Machinery, parts	22.0	Cut flowers	2
Automobile, truck parts	15.3	Electrical products	3
Newspapers, magazines	13.2	Wearing apparel	4
Films, video tapes	8.1	Magazines, books	5
Food parcels	2.3	Auto parts, accessories	6
Flowers	2.1	Aircraft parts	7
Unknown items	6.7	General hardware	8
Miscellaneous	7.5	Advertising, displays	9
	100.0%	Photographic film	10

Source: For B.C.-Yukon Route: Canadian Pacific Airlines. For Domestic Canadian Routes: Morton Stern, "Air Freight takes off," Canadian Business, June 1967, p. 74.

[a]These shipments include all the shipments during four sample weeks in 1967.

TABLE XI

COMPARISON OF WEIGHT DISTRIBUTIONS FOR SHIPMENTS ON BRITISH COLUMBIA-TO-YUKON FLIGHTS AND ON BRITISH EUROPEAN AIRWAYS FLIGHTS

B.C. to Yukon Flights			B.E.A. Flights		
Weight	% of total shipments[a]	% of total weight	Weight[b]	% of total shipments	% of total weight
1-10 lbs.	31%	7%	1-10.9 lbs.	37%	2%
11-20	26	18	11-21.9	12	2
21-50	37	49	22-72.5	24	8
51-100	6	16	72.6-109.9	6	5
101-200	1	3	110-219.9	9	11
201-400	1	7	220-439.9	6	14
			440 & over	6	58

Source: For B.C. to Yukon Flights: Canadian Pacific Airlines. For B.E.A. Flights: D.G. Little, "Air Freighting," The Journal of the Institute of Transport, London: Sept. 1962, p. 373.

[a]Includes all shipments during four sample weeks, 1967.

[b]The B.E.A. weight groupings have been transformed from kilograms to pounds.

Note: The percentages may not add due to rounding.

national routes where incentives do exist), and except for emergency shipments the Air Stream may be far too expensive compared to the other streams. If this were the case, specific rate decreases for larger shipments provide a potential for increasing total freight for Air Stream.

Of the southbound Air Stream commodities, 27% of the shipment packages contained film and video tapes, and furs, while the remaining 73% of packages involved a large number of commodity groupings, each of which consisted of only a small percentage of total shipments.[13] The general freight volume itself was only a quarter of the northbound Air Stream volume.

2. Cost per Transport Stream

Having looked at the type of commodities travelling along the three transportation streams, it will now be desirable to indicate the chief origins of freight volume going into the Yukon. The origin-destination path with the largest traffic, Vancouver to Yukon, can then be conveniently used to outline a cost, or rate, comparison for all three transportation streams into the Yukon.

Approximately 80% of the general freight trucking volume into the Yukon is carried by two firms, Canadian Freightways Ltd. and Loiselle Transport Ltd.[14] While Loiselle has about 40% of its traffic originating in Edmonton and 60% in Dawson Creek, Canadian Freightways has about 30% of its

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13. Canadian Pacific Airlines.

14. Canadian Freightways Ltd.; Loiselle Transport Ltd.

traffic coming from Edmonton and Calgary, 20% from Dawson Creek, and 40% from Vancouver. Even though much of the Dawson Creek freight came up by P.G.E. from Vancouver, it is the 40% coming directly from Vancouver by truck that is of interest for rate comparison.

The scheduled airline freight into the Yukon has about 70% originating in Vancouver (75% of this destined for Whitehorse, 20% for Watson Lake), and almost all of the balance coming from Edmonton (70% of this to Whitehorse, 15% to Watson Lake, and 10% to Dawson).[15]

Vancouver is the southern terminal of the White Pass and Yukon Route Stream, and it is the only origin for freight from the Vancouver area bound for the Yukon.

The rates for general freight travelling along the three transportation streams to the Yukon are compared in TABLE XII. While Canadian Freightways has only one rate for more than 90% of the goods sent to the Yukon, and Canadian Pacific Airlines Company similarly has only one air express and one air freight rate, a problem for comparison does arise due to the many different rates existing on the White Pass and Yukon Route.

The sample rates that are used for the White Pass and Yukon Route Stream therefore are a low (Item 80), a medium (Item 55), and a high level rate (Item 25). More specifically, Item 80 includes machinery. Item 55 exists of packaged groceries such as vegetables, hardy fruits, and household sundries (packaged, dry or in glass), while Item 25 includes a large

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15. Canadian Pacific Airlines.

TABLE XII

COMPARISON OF FREIGHT RATES (IN DOLLARS) FOR THE THREE TRANSPORTATION STREAMS INTO THE YUKON (per C.W.T.[a]), 1967

A. Vancouver to Watson Lake

Minimum Weight (lbs)	White Pass and Yukon Route			Truck	Air	
	Item 80	Item 55	Item 25		Freight[b]	Express
10	5.50	5.50	6.30	7.81	6.60	4.30
50	5.50	5.50	6.30	7.81	11.85	21.50
100	5.50	5.50	6.30	7.81	19.35	43.00
500	4.30	5.10	6.30	7.60	18.50	43.00
1M	3.96	4.51	5.71	7.29	*	*
10M	3.51	4.16	4.96	5.95	*	*
36M	2.95	3.55	4.25	4.00	*	*

B. Vancouver to Whitehorse

10	4.50	4.50	5.50	8.23	6.60	4.90
50	4.50	4.50	5.50	8.23	11.85	24.50
100	4.50	4.50	5.50	8.23	19.35	49.00
500	3.50	4.30	5.50	8.07	18.50	49.00
1M	3.25	3.80	5.00	7.81	*	*
10M	2.75	3.40	4.20	6.38	*	*
36M	2.50	3.10	3.80	5.15	*	*

continued next page

[a]When the minimum weight is less than 100 pounds the given dollar rate is the actual rate for the weight listed.

TABLE XII (cont'd)

COMPARISON OF FREIGHT RATES (IN DOLLARS) FOR THE THREE TRANSPORTATION STREAMS INTO THE YUKON (per C.W.T.[a]), 1967

Minimum Weight (lbs.)	White Pass and Yukon Route			Truck[c]	Air	
	Item 80	Item 55	Item 25		Freight[b]	Express
C. Vancouver to Mayo						
10	5.00	5.80	7.00	10.83	8.35	6.20
50	5.00	5.80	7.00	10.83	15.35	31.00
100	5.00	5.80	7.00	10.83	24.95	62.00
500	5.00	5.80	7.00	10.32	24.10	62.00
1M	4.70	5.25	6.45	10.06	*	*
10M	3.80	4.45	5.25	7.88	*	*
36M	3.30	3.90	4.60	6.65	*	*
D. Vancouver to Dawson City						
10	5.60	6.40	7.60	11.25	9.10	7.20
50	5.60	6.40	7.60	11.25	16.85	36.00
100	5.60	6.40	7.60	11.25	27.75	72.00
500	5.60	6.40	7.60	10.57	26.90	72.00
1M	5.25	5.80	7.00	10.31	*	*
10M	4.25	4.90	5.70	8.13	*	*
36M	3.60	4.20	4.90	6.90	*	*

Source: Published rates of White Pass and Yukon Route; Canadian Freightways Ltd.; and Canadian Pacific Airlines.

[b] In order to have the rates on an equal service basis, the air freight includes a charge for pickup and delivery, a minimum of $1.35, or 50¢ per 100 pounds.

[c] The truck rates to Mayo and Dawson are made up of the Canadian Freightways rate to Whitehorse, plus an additional charge for further shipment by another company.

* A single air shipment of this size is extremely unlikely due to plane limitations. (Note: a company shipment of 2 crates is in the case of air cargo regarded as two shipments.

number of goods ranging from adding machines, carpets, furniture, and refrigerators to sailboats.[16]

The truck rates can be considered price competitive only to the high level rates of the White Pass and Yukon Route. TABLE XII shows that this competitiveness is strongest for the Vancouver to Watson Lake route. Except for the full truckload (36,000 pounds) rate where trucking is less expensive, the truck rate is on the average about 20% higher than the high White Pass and Yukon Route rate. For the Vancouver to Whitehorse route, though, the truck rate is about 50% higher than the high level White Pass and Yukon Route rate. This rate difference of 50% is continued for Vancouver to Dawson and Mayo routes.

The Air Stream rates can be considered price competitive for shipments under 50 pounds. Shipments of 10 pounds or less, sent via Air Stream, are even as cheap as, or cheaper than shipments sent along the two other streams. The Air Stream is thus in an excellent competitive position for small shipments. For larger shipments the price competitiveness of the Air Stream decreases greatly. Depending on the destination and the shipment size, the Air Stream rate may be from 150% to 250% higher than corresponding rates on the other streams.

A concluding comparison can be made, regarding the cost of transport per transportation stream, when relating the revenue of shipping a ton of goods to the actual miles travelled

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16. White Pass and Yukon Route.

(TABLE XIII). These revenue per ton-mile figures show that the truck rate, when considered per ton-mile, is almost the same as the White Pass and Yukon Route rate. This is even though the latter is based on an 850 nautical mile[17] (980 land mile) ocean trip; normally ocean ton-mile costs are considerably lower than truck ton-mile costs.

TABLE XIII

REVENUE PER TON-MILE RANGES FOR THE THREE TRANSPORTATION STREAMS FROM VANCOUVER INTO THE YUKON, 1967

Transport Stream	Origin and Destination	Distance (in miles)	Rate Range	Revenue per ton-mile range
Truck	Van. to W.Lake	1470	$4.00- 7.81	5.4¢-10.6¢
W.P.& Y.R.	Van. to W.Lake	1370	$2.95- 6.30	4.4¢- 9.2¢
Truck	Van. to Whitehorse	1750	$5.15- 8.23	5.9¢- 9.4¢
W.P.& Y.R.	Van. to Whitehorse	1090	$2.50- 5.50	4.6¢-10.1¢
Air	Van. to W.Lake and Whitehorse	900	$18.50-49.00	41.2¢-108.9¢

Source: previous rate tables.

Looking at similar data for the total United States, average revenue per ton-mile of domestic freight for 1964 was 1.3¢ for rail, 6.5¢ for motor carriers, 0.3¢ for inland waterways, and 21.7¢ for domestic trunk airlines.[18] While this is

17. Brown, op. cit., p. 4.

18. M.D. Dawson, "A Technique of Air Cargo Market Research," Papers - Sixth Annual Meeting, Transportation Research Forum (Oxford, Indiana: Richard B. Cross Co., 1965), p. 289.

not a valid comparison, it does to a small extent provide a frame of reference for comparison. This is especially so for southbound ores.

The rates for southbound ore concentrates and asbestos fibers, shipped almost exclusively on the White Pass and Yukon Route, are much lower than northbound general freight rates. Thus the rate from Whitehorse to Vancouver is $17.00 per ton for ore concentrates and $16.00 per ton for asbestos.[19] This comes to about 1.56¢ and 1.47¢ revenue per ton-mile respectively, a fairly low rate when considering the United States ton-mile data above.

3. Service Level per Transport Stream

The distribution strategy that makes firms elect certain transportation streams involves more, though, than just the published cost of transport. A recent survey was conducted by "Traffic Management" magazine in the U.S. "to determine what factors led to the selection of a carrier."[20] They concluded that time in-transit was the most important, followed by on-time performance, shipment tracing and, in fourth place, freight charges.[21] The final measurement and comparison of freight services will therefore be concerned with time in-transit for transport to the Yukon.

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19. White Pass and Yukon Route.

20. C.C. Watson, "Railways' Big Role in Total PD Concept," Canadian Transportation, April 1967, p. 34.

21. Ibid.

The advantages that arise to the user of different transport systems due to shorter time in-transit occur mainly in six categories. These are interest on capital invested in shipments on route; storage warehousing costs; size of inventories needed; obsolescence; flexibility in adapting to changing marketing demands; and, lastly, better service and greater customer satisfaction.[22] The significance of these factors varies, of course, for the various transport users and the different products transported.

The number of days for time in-transit for the three transportation streams from Vancouver into the Yukon is shown in TABLE XIV. In each case in-transit time is shown to have a minimum and a maximum number of days. The minimum is achieved in the most optimum case when, as in the White Pass and Yukon Route example, perishables are delivered to the ship the day before it sails north. Five days later these start arriving in Whitehorse. The maximum time in-transit is arrived at when the day furthest from a departure date is chosen as day 1 with the maximum being the last day when a shipment may arrive at its destination.

The minimum time in-transit for the White Pass and Yukon Route is achieved only with perishables. Normal shipments to Whitehorse take on the average almost twice as long when the shipment is sent to the ship just before departure time, and may at the most take as long as 28 days.

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22. A.D. Groenewege, "A Key to Profits," Canadian Transportation, Sept. 1966, p. 27.

TABLE XIV

TIME IN-TRANSIT FOR THE THREE TRANSPORTATION STREAMS FROM VANCOUVER TO YUKON POINTS, 1967

Transportation Stream	Time In-Transit	Destination		
		Whitehorse	Watson Lake	Mayo
White Pass & Yukon Route:	Minimum (days)	5	7	8
	Maximum (days)	29	28	29
Trucking:	Minimum (days)	5	5	6
	Maximum (days)	9	15	12
Air:	Minimum (days)	1	1	1
	Maximum (days)[a]	2	2	2

Source: White Pass and Yukon Route; Canadian Freightways Ltd; Canadian Pacific Airlines.

[a]Maximum days for Air are for summer schedule only.

While the minimum times in-transit in TABLE XIV are about the same for the Trucking and the White Pass and Yukon Route Streams, a very significant difference exists for the maximum times. Thus the White Pass and Yukon Route times in-transit, when compared to the Trucking Stream, may be as much as three times as great to Whitehorse, and twice as great to Watson Lake, Dawson, and Mayo. The Watson Lake maximum is large as only one truck makes the weekly trip from Dawson Creek north to Watson Lake. In the case that the truck is completely full (which is not a common occurrence), a shipment will have to wait until the following week for the next departure.

The time in-transit advantage of the Trucking Stream also becomes apparent in another way. It is thus possible for almost all Trucking Stream shipments to approach the minimum time in-transit. For the White Pass and Yukon Route Stream only perishables can approach this minimum level. It may be said that for general shipments, the White Pass and Yukon Route Stream minimum time in-transit is almost twice that of the Trucking Stream.

The times in-transit for the Air Stream are valid for the "summer season" only, that is from April until September. This period includes the spring breakup and fall freeze-over. At other times of the year, the minimum/maximum times in-transit for Mayo increase to 2/4 days. There is thus a considerable time in-transit improvement for the summer season.

While the Trucking Stream has the competitive edge over the White Pass and Yukon Route Stream for time in-transit, the latter offers better services when temperature controls are an important factor. The White Pass and Yukon Route thus is capable of supplying heated and vented containers, as well as cooler and freezer services. The Trucking Stream can supply refrigerated trailers only if one customer wants to send a truckload of goods. An example of this is when truckloads of meat are sent from Alberta to the Yukon.

The measurement of freight services into the Yukon has thus shown the leading role that the White Pass and Yukon Route has. A prime reason for its dominance seems to be the generally lower rates compared to the White Pass and Yukon Route Stream. The Trucking Stream has a time in-transit advantage although its rates are slightly higher. The Air Stream is by far the fastest means of shipping to the Yukon, and for shipments under 50 pounds it is also very price competitive. For larger shipments the cost of shipping by Air Stream is so much more, though, that very few indeed find it advantageous to ship by air.

CHAPTER IV

I. FREIGHT FORECASTING IN GENERAL

Introduction

Once the freight services of a country have been measured for a one-year period, this measurement can be used as a basis for forecasting freight for some future period. It is normal to take data for a succession of years, and to mathematically project this data forward to arrive at a forecast. Very often though, especially for less developed countries, the lack of data collection makes freight forecasting difficult. This difficulty may even be compounded by characteristics of the economy itself. In other cases few difficulties arise and good forecasts can be achieved from nationally collected data.

For Canada it is possible to arrive at excellent correlations between say air freight revenue (goods) ton-miles, or total intercity transport ton-miles, and the Gross National Product economic indicator. This correlation can then be used to provide a good freight forecast for at least the next five years. In other countries a forecast presents a much larger problem. This is not only due to the insufficiency of data, but also because these countries often have the export side of their economy depend on a few main staple products. World market prices for these products may easily experience un-

predictable changes and thereby cause significant increases or decreases in exports as well as in the level of freight travel.

While these uncertainties do exist, an understanding and forecasting of freight movement, and thus an understanding of the potential deficiencies of the existing transport system, can be of some significance to a country's economy.

Thus forecasts may "detect developing trends in industry, and assist firms in predicting business conditions and potential sales."[1] They may show where new investments are necessary, or where government pressure is deemed desirable to encourage extension or enlargement of the transportation network in a nationally more optimum direction. Forecasts may also give encouragement to possible rate adjustments.

A freight forecast, especially a national one, should always be looked at with caution. While it may in total present a relatively accurate forecast, it may on the other hand hide important internal variations. While estimates of total traffic demand may thus provide a rough measure of future transport requirements, they must be supplemented by studies of the transport system as a whole, along with detailed analyses of planned industrial projects and a consideration of other planned developments.[2]

To arrive at specific physical requirements for transport and to determine financial needs, it is essential to

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1. D. Eldon, "Transportation Statistics," Royal Commission on Transportation Vol. 3 (Ottawa: Queen's Printer and Controller of Stationery, 1962), p. 411.

2. Wilfred Owen, Strategy for Mobility, Transport Research Program, (Washington, D.C.: The Brookings Institution, 1964), p. 52.

depart from total estimates of freight and build these estimates from the ground up. Such a build-up is based on a knowledge of the "existing regional transport plant" and its current utilization, as well as an estimate of the additional transport demands resulting from "regional economic and social goals."[3]

A case in point is Owen's example of India's Second Plan.[4] The provision of sufficient railway facilities was to a large extent based on a forecast of rail freight. While the forecast was quite accurate, shortages still developed because of the uneven distribution of the traffic burden. Overall figures concealed actual conditions of transport supply and demand for specific routes. Failure to determine new plant locations and to estimate important geographic factors in advance meant that traffic flows could not be anticipated. The result was that serious congestion developed in certain parts of the rail system.

Techniques for Forecasting

For the development of a freight forecast itself, several general approaches are available:[5]

(1) a freehand line of trend drawn through the annual data for total freight in ton-miles and extrapolated forward for x number of years;

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3. Ibid.

4. Ibid., p. 66.

5. J.D. Murphy, Airline Passenger Forecasts and Forecasting Methodology (unpublished Master's thesis, The University of British Columbia, Vancouver, 1965).

(2) a least-squares trend line fitted mathematically to past data on total freight in ton-miles, and carried forward;

(3) a correlation of total freight ton-miles with an economic indicator such as gross national product or disposable income connecting future freight increases with rises in the national economy;

(4) marketing surveys;

(5) a determination of factors that cause freight movement to be at a certain level, and assigning weights to these factors.

The first two approaches might provide an adequate forecast for a developed economy (along with minor adjustment due to consideration of the other four approaches). For a developing economy though, due to the lack of data as well as the significance of a few primary industries, a forecast would have to revolve around the fifth approach. Thus a later forecast example will show how even though past figures may be available for a trend projection into the near future, a substantial deviation from these projected figures may result due to the change in magnitude of some determining factors.

"The heart of the forecasting problem then is really three problems: first, to identify the factors which determine the future level of freight; secondly, to develop weights to be assigned to each of the causal factors; and thirdly, to decide upon the most likely future magnitude of the determining factors."[6]

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6. Civil Aeronautics Board, Forecasts of Passenger Traffic of the Domestic Trunk Air Carriers, Domestic Operations Scheduled Service, 1965-75, (Washington, D.C.: Research and Statistics Division, Bureau of Accounts and Statistics, 1965).

Examples of Forecasts

It may be desirable at this stage to look at several sample forecasts, showing an application of the above approaches, after which the Yukon will be used as a case study for freight forecasting in a developing region.

A United Nations study on the Economic development in Colombia[7] also includes an analysis of the 1953 state of the transportation system, as well as a 10 year forecast for passenger and freight traffic. Taking figures from 1925 to 1953, the study uses a logarithmic scale to show the relationship that exists between the gross product generated by freight and the annual quantum of agricultural, industrial and mining production, of building activities, and of imports and exports of goods.

This relationship is then quantified, so that "every 1-per-cent increment in the value (at constant prices) of production, building activities and foreign trade in goods was linked to a 1.7-per-cent increment in the gross product generated by freight".[8] This relationship (designated as an elasticity coefficient "for convenience sake") is then used as a criterion on which growth estimates of gross product of transport can be based. The study also assumes that there will be some lowering of transport costs (due to improvement of transport facilities) and thus arbitrarily sets the ratio,

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7. United Nations, Department of Economic and Social Affairs, Analysis and Projections of Economic Development, III The Economic Development of Colombia (Geneva: United Nations Publications, 1957).

8. Ibid., p. 371

and thus the elasticity coefficient, to be only 1.4. Having already decided, through an anlysis of present and future prospects, on two possible rates of growth for the production, construction and trade industries,[9] the study then combines these figures to arrive at a forecast for the gross product generated in the transport sector (TABLE XV).

TABLE XV

COLOMBIA: PRODUCTIONS OF GROSS PRODUCT GENERATED IN FREIGHT TRANSPORT, 1953-65[10]

	1953	1965 Hypothesis A	1965 Hypothesis B
Rate of Growth of production, construction and trade	--	6.5	4.9
Elasticity-coefficient of transport	1.7	1.4	1.4
Rate of Growth of gross product from transport	--	9.0	7.0
Gross product[a]	336	960	755

[a]Millions of pesos at 1950 prices.

In addition to the total freight correlation and freight forecast the Colombia study also establishes correlations between individual transport modes and economic indicators. More than likely, a forecast per mode is of more value for the formation of government transport policy and for private agencies than a total freight forecast. In some cases,

9. The Study has a more optimistic annual growth rate of 6.5% and a less optimistic one of 4.9%.

10. United Nations, Department of Economic and Social Affairs, op. cit., p. 372.

though, it may be possible that both, correlations and resulting forecasts, are of little value due to concealment of valuable regional data.

The Colombia freight forecast is an excellent example of how a causal relationship can be established between an economic indicator, (in this case production, construction, and trade), and a freight transport indicator (in this case the product generated by freight transport, in peso currency), and how this correlation along with an estimation of the probable growth rate of the economic indicator can be used to establish a freight forecast. A necessary prerequisite was of course the availability of data. The following example uses ton-miles to establish a similar relationship.

A recent unpublished paper on the correlation of economic indicators with revenue (goods) ton-miles for Canadian domestic air freight found an extremely high correlation for various indicators.[11] Thus the correlation factor between the Canadian Gross National Product at 1949 prices and the domestic revenue ton-miles was found to be a high .9865 (TABLE XVI). A similarly good correlation was found between the annual wholesale trade in Canada and domestic revenue (goods) ton-miles. Both correlations suggest of course that increases for economic indicators will to a very high degree be the explanation for

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11. I.L. Proctor, "The Correlation of Economic Indicators with Canadian Domestic Revenue (Goods) Ton-Miles" (unpublished paper, The University of British Columbia, 1967).

TABLE XVI

CORRELATION OF G.N.P. AT CONSTANT (1949 DOLLAR) PRICES WITH CANADIAN DOMESTIC REVENUE (GOODS) TON-MILES

Year	($, in millions)	Revenue Ton-Miles (Millions)
1955	21,920	18.4
1956	23,811	21.1
1957	24,117	23.9
1958	24,397	26.0
1959	25,242	29.2
1960	25,849	31.5
1961	26,515	34.4
1962	28,275	39.1
1963	29,740	42.8
1964	31,663	52.0
1965	33,770	64.3

Correlation factor 4 = .9865

Source: I.L. Proctor, "The Correlation of Economic Indicators with Canadian Domestic Revenue (Goods) Ton-Miles" (unpublished paper, The University of British Columbia, 1967), Appendix, p. 2.

similar percentage increases in air freight ton-miles.[12]

When looking at the total Canadian freight system, and the ton-miles performed per mode, the correlation to the Gross National Product (at 1949 Dollar prices) is also very good. For the set of data shown in TABLE B-I in Appendix B, the correlation was found to be .9726. It should be noted though that while this correlation with the G.N.P. would provide a good basis for a total ton-miles forecast, it is not implied that the total ton-miles forecast arrived at will be used without careful evaluation.

If a value can be established, then a freight forecast for a developed economy can be obtained by using the correlation with economic indicators such as the G.N.P. as a basis. This basis could then be enlarged upon by a graphic trend analysis.

A graph plotting G.N.P. at 1949 Dollar prices against time and total ton-miles against time would show that ton-miles were experiencing larger increases in the last two years. This may be a significant change which is not apparent when looking only at the correlation. The freight forecast therefore should incorporate this new trend as well.

For a developing economy such as the Yukon, a past history approach to forecasting, even if complete data on economic indicators were available, would not be too valuable.

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12. It should be noted here that while the correlation for the 11 years is very high, the increase in ton-miles for 1964 and 1965 is rather large. Thus if the G.N.P. and air ton-miles correlation were used as a basis for an air freight forecast this factor, which may be partially due to lower rates, should be given additional weighting.

A correlation would not present a proper account of the impact of present exploration and development activities.

A company forecast by Canadian Pacific Airlines for air freight into the Yukon substantiates how a historical trend analysis, if used as the only basis for forecasting, can provide a very misleading picture. A trend line fitted to the 1964 to 1957 yearly data would suggest freight increases averaging about 10% per annum for the 1968 to 1972 period. The actual forecast by C.P.A. for 1969 and the following three years predicts yearly increases of 29%.[13] It may therefore be assumed that the forecast incorporates an outside factor which will influence the freight level, but which cannot be found from historical data. Most probably this outside factor is the introduction of Boeing 737 jet planes on British Columbia-Yukon routes, as well as possibly a decrease in certain freight rates. There is also the possibility that this forecast is overly optimistic.

The final forecast example that will be looked at here is the Alaska Highway paving study.[14] One of its objectives is to forecast the amount of traffic that will exist on different sections of the highway in the next twenty years. As the unit of measurement for truck traffic is the number of commercial trucks using only the Alaska Highway itself, the

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13. Canadian Pacific Airline company sources.

14. Stanford Research Institute, Improvement Program for the Alaska Highway, Prepared for the Department of Northern Affairs and National Resources (Ottawa: Queen's Printer and Controller of Stationery, 1966).

results are of limited significance for a forecast of freight in the total Yukon economy.

The study suggests that truck traffic from Southern B.C. and Alberta to Watson Lake and Whitehorse will experience an annual growth rate of 5 per cent.[15] While this represents only changes in yearly truck vehicle-miles, it does at least to some extent suggest what actual tonnage increases may be. The study also expects an annual growth rate of 6% for the section from Whitehorse to Dawson and Mayo, while only 2% growth rates are forecast for traffic between a) Fort St. John and Watson Lake, and b) Watson Lake and Whitehorse.[16]

While the Stanford Research Institute made an estimation, through questionnaires and actual field sampling, of truck traffic for 1964, it arrived at its forecast figures mainly through an evaluation of the effect which various factors might have on the growth of the economy and thus the growth of truck traffic. The Yukon being a resources-oriented economy, the main factor is of course mineral and petroleum exploration and development.

Concluding then, a freight forecast should have two major considerations. First, a general economic indicator such as Gross National Product, along with an indicator of the yearly transport product will, if available, be of variable value as a basis for prediction. Secondly, a detailed surveillance of explorational and developmental changes in resource and secondary industries is necessary, as complement,

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15. Ibid., p. VI-16.

16. Ibid.

to include the impact of planned activities on the transportation industry. While more difficult, it may also be desirable to find out if market price and demand fluctuations for these resources may have much effect on transportation requirements for these industries.[17]

II. CASE STUDY ON THE YUKON

1. Problems and Considerations

There are two basic difficulties that prevent a sophisticated approach to a forecast of freight in the Yukon economy. Not only is there a critical lack of past data for the region. (All economic indicators are published together with those of the Northwest Territories or with British Columbia, and not for the Yukon alone). There are also at present developmental changes occurring that will substantially alter the Yukon's economy. Thus, in a recent paper given at the 1967 Alaska Centennial Conference, Mr. C. J. Brown said that while recent mineral output in the Yukon has been about $12 million, this should rise to about $30 million by 1970, and could exceed $50 million by 1975.[18]

Due to the present surge of development activity, the correlation technique, based on the relation between freight and time, is of little help. One could for example compare the total northbound freight of the White Pass and

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17. For the Yukon, an example of this is tungsten. When the price of tungsten dropped in 1963, Canada Tungsten on the Yukon-Northwest Territories border closed down its operations for part of the year.

18. Brown, ibid., p. 5.

Yukon Railway with the Canadian Gross National Product (TABLE B-II, Appendix B). The correlation coefficient is r = .8368, which seems reasonably good. A graphic representation of this data would suggest that for every 1 per cent increase in the G.N.P., there would be a 2 per cent increase in the tons of freight transported. Assuming that the G.N.P. continues growing at the level of the past 5 years, it should increase from the estimated 1967 level of $37.2 billion (1949 dollars) to $51.6 billion by 1975 (yearly increments of $1.8 billion). This 39% increase in G.N.P.would mean a 78% increase during the same period for northbound freight through the relationship established above. This in turn would mean approximately a 7.5% yearly increase, which is an unrealistically high conclusion not recognizing what has actually occurred in the Yukon in recent years.

It does not account for the fact that there was almost no change in the level of W.P. and Y.R. freight for the four years up to 1965. The level of freight then increased by about 50% by 1967, mainly due to the construction for Cassiar Asbestos at Clinton Creek, for the New Imperial Mine near Whitehorse, for Anvil Mines at Ross River and for several small operations. On the basis of this historical analysis it is not possible to assume that mining operations will continue to keep growing at this high rate.

The technique used to establish a freight forecast will therefore be based not on a correlation with economic indicators, but on a sector analysis. The northbound freight will be based

on the different transportation streams that exist, namely (a) the White Pass and Yukon Route Stream (with ship from Vancouver to Skagway, by railway from Skagway to Whitehorse, and by truck to various points in the Yukon); (b) the Trucking Stream (from various Alberta and British Columbia points (including Dawson Creek, which is the end terminal for the Pacific Great Eastern railway from Vancouver) to the Yukon); and (c) the Air Stream (from Vancouver, Edmonton, and intermediate points via Canadian Pacific Airlines to the Yukon).

For southbound freight, which consists mainly of ore concentrates and other mineral products, the analysis looks mainly at the users of the above streams, that is the presently existing and the planned mining developments in the Yukon area.

To achieve the forecast, the 1964 freight measurement of the previous chapter was updated through mining and transportation company sources to obtain a measurement for the year 1967.[19] The time period used for the forecast is 1967 to 1975.[20] Beyond this point there are just too many uncertainties.

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19. As much of the tonnage information received was of a confidential nature, it was necessary to base the forecast on an index system. The pertinent growth information is still apparent.

20. 1974 is the year that all the presently considered serious mining developments should with some certainty have been brought into the production stage, so that by 1975 a reasonable stability should have returned to the economy.

With respect to annual growth rates, several assumptions were made. The Stanford Research Institute rate of 5% for vehicle-miles growth[21] (which refers to traffic between the Yukon and Canadian regions other than Canadian Alaska Highway communities) was adopted for the growth in general freight truck traffic, both north and southbound.[22] 40% of the northbound truck freight and 36% of the northbound W.P. & Y.R. freight were fuel, oil and gas, and again a 5% annual growth rate was used. The 1967 level of northbound general freight on the W.P. and Y.R. Stream was felt to be very high (as it was about 50% more than in 1964). For that reason the traffic was broken down into that going to Whitehorse, and that going on further to Watson Lake area, Dawson and Mayo area, and New Central Yukon area. Parenthetically, the New Central Yukon area is situated north and northeast of Whitehorse, and is meant to include all those mining developments that are presently being opened up; it includes, among others, Anvil Mines, New Imperial Mines, and Cassiar Asbestos Clinton Creek, but not the established towns of Dawson and Mayo which are in the same area.

The different W.P. and Y.R. freight destinations are looked at separately in determining freight growth rates. A

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21. Stanford Research Institute, op. cit., p. VI-16.

22. While the Stanford study on the one hand does not incorporate the extraordinary mining activities in the late sixties (especially the Anvil Mines development), there was on the other hand the recent decrease in Yukon population. It thus seems that a 5% growth rate is the most realistic one before better economic figures are available.

5% growth rate is assumed for Whitehorse, while the Dawson and Mayo rate is assumed to be a little lower, and the Watson Lake area (including Cassiar, B.C.) should have a low growth rate of about 2%.[22] No rate, however, can be assumed for the growth of the New Central Yukon area. Rather, all developments are considered separately and, mainly through company estimates, an estimate is made for their future general freight volumes.

Finally, the previously mentioned Canadian Pacific Airlines company forecast growth rate of 29% per annum for 1968 to 1972 was adopted for airfreight, while a slightly lower rate of 20% was chosen for the last years up to 1975.

2. The Actual Freight Forecast

TABLE XVII then shows the results for the forecast of freight, including general freight and petroleum products, into and out of the Yukon. While an index comparison is used for northbound and southbound freight, it may be pointed out that the total northbound freight tonnage is roughly twenty-two times as large as the southbound tonnage.

The forecast growth of general freight, averaged over the forecast period, represents approximately a 5% yearly increase for northbound and southbound directions. The most significant tonnage change will of course occur in the shipment of ore concentrates and asbestos fiber out of the Yukon. A large number of mining developments are either presently taking place or are being seriously considered for

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23. Ibid.

TABLE XVII

YUKON: PROJECTION OF FREIGHT[a]
1967-1975

Northbound into Yukon	Percent of Total Tons		Index Value	
	1967	1976	1967	1975
(a) W.P.& Y.R.Stream	68.5%	68.3%	68.5	102.5
(b) Truck Stream[b]	31.1	30.4	31.1	45.6
(c) Air Stream[b]	.4	1.3	.4	1.9
	100.0%	100.0%	100	150
Growth Index	100	150		
Southbound out of Yukon				
(a) W.P. & Y.R. Stream	24.0%	22.3%	24.0	33.7
(b) Truck Stream[b]	73.5	70.1	73.5	105.8
(c) Air Stream[b]	2.5	7.6	2.5	11.5
	100.0%	100.0%	100	151
Growth Index	100	151		

Source: Mining and transportation companies, and previously mentioned assumptions.

[a]Includes northbound fuel oil and gas, and general freight, but excludes mineral concentrates.

[b]Does not include small private truck operators (one truck less than 10 tons), nor unscheduled and private aircraft operations.

the period in question.[24] Through company information and other sources a picture of prospective yearly tonnages was obtained (TABLE XVIII). Parenthetically, effects of the mineral developments on such areas as level of employment and size of the economic base will be looked at in the next chapter.

TABLE XVIII

PROJECTION OF CONCENTRATES LEAVING THE YUKON ALONG EACH TRANSPORT STREAM, 1967-1975

	Percentage of Total Tons		Index Value	
	1967	1975	1967	1975
W.P. and Y.R. Stream	93.5%	98.2%	93.5	604
Truck Stream	7.5%	1.8%	7.5	11
	100.0%	100.0%	100.0	615
Growth Index	100	615		

Source: Various mining company sources.

The total tonnage represents all the concentrates that leave the Yukon, with the main destinations being Japan and Vancouver, B.C. It was assumed that the small tonnage of asbestos going south through Watson Lake would not experience any significant change. The shipment of tungsten from Tungsten in the Northwest Territories, which takes the same route south

24. The companies included were Cassiar Asbestos at Clinton Creek and at Cassiar, United Keno Hill Mines Ltd., New Imperial Mines Ltd., Anvil Mining Corporation, Arctic Mining and Exploration Ltd., Mt. Nansen Mines Ltd., Venus Mines Ltd. Pure Silver, Kerr Addison Mines Ltd., and Vangorda Mines Ltd.

through Watson Lake, was very small in 1967 due to a fire in the company's operations. This is expected to go back to its normal capacity, resulting in tonnages between 5500 and 6000 tons.[25] All other concentrate shipments will travel along the W.P. and Y.R. Stream.

The increase in the growth index represents approximately a 26% yearly increase, although this increase is by no means spread evely over the 8 year period. The biggest increase will be when Anvil Mining Corporation goes into full production somewhere around 1969, as it will have an approximate capacity of 370,000 tons[26] of copper concentrate annually.[27]

A comparison of the tonnage figures inherent in both TABLE XVIII and TABLE XIX shows that in 1967 for every ton shipped into the Yukon, about 1½ tons were shipped out of the Yukon. This ratio shifts significantly so that in 1975 6½ tons are shipped out of the Yukon for every ton being shipped in. It is, understandably, the ratio of a resource-based economy. The increase in mineral exports is largely due to finding of high value copper ore bodies and to the demand for copper concentrates by Japan industries. Until now the minerals exported out of the Yukon were primarily asbestos, silver, gold, lead and zinc, involving relatively low tonnages with fairly high value.

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25. Canada Tungsten Company.

26. Brown, loc. cit.

27. Some of the other major producers are Cassiar Asbestos (Cassiar) - 80,000 tons; Cassiar Asbestos (Clinton Creek) - 60,000 to 80,000 tons; New Imperial Mines - 30,000 tons. Source: Ibid.

Finally, it must be noted that the above forecast is made on the assumption that present demand and supply situations for these resources in the world market do not experience adverse changes. This is always a possibility, and again underlines the difficulty that exists in forecasting freight in a developing economy, especially of course if the economy is very dependent on the export of raw materials.

CHAPTER V

FORECAST IMPLICATIONS

A forecast of freight tonnages moving into and out of a regional area may provide much significant data. Even in a regional forecast, though, valuable information may be hidden through aggregation. Thus it will be worthwhile to look at some more detailed direct and indirect aspects of the Yukon forecast and to consider their possible implications.

1. Size of Economic Base

The planned mining developments in the Yukon will not only result in a large increase in mineral production. They will also greatly increase the labour force in the mining area directly, and in the secondary and service industries indirectly. While it is not possible to give quantitative illustrations, it may be of interest that the prospective employment for Cassiar Asbestos (Clinton Creek), New Imperial Mines, and Anvil Mining Corporation alone is expected to total about 900 people.[1] This is already about one-seventh of the number of people employed in all of the Yukon for 1961. Additionally there should be a greater indirect population increase as a result of activities.

More indirectly, there will be increased demand for

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1. Respective company information.

local forest products and for services provided by local industries and retail operations. It is presently also being considered whether coal deposits near Carmacks should be utilized to provide fuel for the Anvil Mining Corporation operations. Involved are 30,000 tons of coal annually,[2] providing further stimulus to the Yukon economy. If fuel oil is used instead, lesser benefits would result (assuming the cost is about the same for both) as it would be imported from outside the Yukon.

The total effect of the new operations will be that the primary, secondary, and service industries will all experience a considerable boost in size, thereby increasing the size of the Yukon economic base. This, in turn, can enable a better realization of economies of scale in many areas of the economy, such as lower cost of local production through greater volume, and lower cost of transportation through certainty of greater volume.

For the Air Stream, more traffic would support the replacement of piston aircraft by bigger and much more efficient jet planes. This change would not only reduce flying time by half, but would also lower direct operating costs by more than half. The cost, for example,[3] of moving cargo in the piston-powered DC-7 plane is 10.06¢ per available ton-mile while that

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2. Bill Fletcher, "White Pass Sets Record," The Vancouver Sun, April 2, 1968, p. 26.

3. The example is not meant to apply to the Yukon; the figures quoted are for all-cargo planes.

for the DC-8F jet plane is only 3.64¢ per ton-mile.[4]

For the present there does not seem to be enough traffic potential to warrant the use of all-cargo jet planes. While Canadian Pacific Airlines is planning to switch from Douglas DC-6B piston planes to Boeing 737-100 jets, it is being done primarily due to passenger considerations. Cost efficiencies will benefit freight operations as well, though.

2. Geographic Areas of Influence

A more specific aspect of the increase in mining operations involves the areas of the Yukon where the three transportation streams are most influential in terms of percentage of traffic carried.

When considering all the general freight that was shipped to the Yukon during 1964 per transport stream, the Trucking Stream had about 60% of its volume going to the Whitehorse area and 40% going to the Watson Lake area. The W.P. and Y.R. Stream had about 72% of its volume going to Whitehorse, 8% to Watson Lake, and 20% to the Central Yukon[5] area. The Air Stream experienced about 73% of its volume travelling to the Whitehorse area, 18% to the Watson Lake area, and the balance to the Central Yukon area.[6]

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4. Stanley H. Brewer and D.T. Coster, The Nature of Air Cargo Costs (Seattle, Wash.: The University of Washington), 1967, p. vi.

5. This includes all the points north and northeast of Whitehorse, in contrast to the previously mentioned "New Central Yukon area" that excluded Dawson and Mayo.

6. Transportation companies.

By 1967 this distribution pattern had already experienced a considerable change. While the Trucking and Air Stream distributions remained quite stable, a substantial shift occurred for the W.P. and Y.R. Stream. Having experienced a 50% increase in general freight volume during this three year period, it reduced the percentage of shipments to the Whitehorse area to 55% of total general freight, while those to the Watson Lake area stayed at 8%, and those to the Central Yukon area increased to 37%.[7]

For the period until 1975 these volume distributions to the three Yukon area destinations should remain at approximately the same level. The only change should be an even further increase in the amount of W.P. and Y.R. volume going to the Central Yukon area. This should increase to about 40% of its total volume, with the Whitehorse area portion decreasing to about 53% and the Watson Lake area portion to about 7%. The increase in the Central Yukon area shipments underlines the benefit that the W.P. and Y.R. Stream should receive from the mining operations boom.

When considering all the general freight that was shipped to each Yukon area, it is found that for 1967 the Watson Lake area received about one-third of its general freight from the W.P. and Y.R. Stream, and about two-thirds from the Trucking Stream. The Whitehorse area received two-thirds of its general freight from the W.P. and Y.R. Stream, and one-third from the Trucking Stream.[8] The Central Yukon

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7. White Pass and Yukon Route.

8. White Pass and Yukon Route; trucking companies.

area however got almost all of its general freight via the W.P. and Y.R. Stream. These distributions per Yukon area should remain about the same for 1967, although a relatively major change should occur for the Air Stream.

It is the annual 29% increase in air freight that should make itself felt in air stream shipments to Yukon areas. Thus while both the Watson Lake and Whitehorse areas received about .6% of their general freight via air in 1967, this proportion should increase to about 2.5% by 1975.[9] The Central Yukon area receives a large percentage of air shipments via Whitehorse, and a substantial increase in air freight does not seem possible.

The most decisive change in geographic influence concerns the export of ore concentrates. During 1964, with the W.P. and Y.R. Stream transporting 90% of the outbound concentrates, 64% came from the Watson Lake area (actually Cassiar, B.C., which is included in the Watson Lake area) and only 36% came from the Central Yukon area.[10] All of the Trucking Stream concentrates came from the Watson Lake area.

By 1967, with the W.P. and Y.R. Stream carrying 92.5% of the outbound concentrates, even more came from the Watson Lake area. Thus almost 70% came from this area while only 30% came from the Central Yukon area.[11]

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9. Various transport companies.

10. White Pass and Yukon Route; mining and trucking companies.

11. Ibid.

With almost all of the new mining operations occurring north and northeast of Whitehorse in the Central Yukon area, a substantial shift should take place by 1975. While the absolute tonnage level of concentrates should increase about six-fold between 1967 and 1975, the portion carried by the W.P. and Y.R. Stream should increase to about 98.2% of total volume. Of this, about 90% should originate in the Central Yukon area, with the balance coming from the Watson Lake area.[12]

The changes occurring in geographic influence per transport stream then are concentrated mainly on two fronts: the Air Stream should increase its influence in the Whitehorse and Watson Lake areas, while the W.P. and Y.R. Stream should expect the Central Yukon area to play a greatly increased role in its operations. Thus a larger share of W.P. and Y.R. Stream general freight should have their destination in the Central Yukon area, and a significantly large portion of southbound concentrates (98% of which travel on the W.P. and Y.R. Stream) should come from the Central Yukon area.

3. Product Groups per Transport Stream

Another aspect raised by the change in the level of mining operations concerns the volume of each product group that was carried by the three transport streams. Parenthetically, the product groups include only general freight and petroleum products for northbound traffic, and general freight and mineral concentrates for southbound traffic.

The White Pass and Yukon Route Stream in general is

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12. Ibid.

the principal carrier of product groups into and out of the Yukon. TABLE XIX shows its dominant position in every group, except southbound general freight, for 1964 and 1967, and what it should be in 1975. It also shows that between 1964 and 1967 the W.P. and Y.R. Stream improved its position in all groups except southbound general freight.[13] The percentage distribution should remain at about this level for 1975, although the purchase of coal for Anvil Mines from the nearby Carmacks area should decrease somewhat the W.P. and Y.R. fuel percentage.

When considering the total volume of freight transported into the Yukon, petroleum products are increasing less rapidly than general freight products. During 1964, while general freight accounted for 58% (39,580 tons) of total volume, petroleum tonnage was 42% (28,220 tons). By 1967 petroleum accounted for only 38% of total volume, and should decrease to 37%, if not further, by 1975.

A comparison of product group percentages for 1967 and 1975 (TABLE XIX) indicates that there is generally only little variation between the years. This is primarily due to the earlier assumption that freight growth in most areas would be 5% per annum. The same assumption is also reflected in the similarity of growth indexes. Thus the increase in the growth rate at the 5% rate, over an eight-year period, should theo-

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13. To provide an approximate significance level, total southbound general freight for 1975 is about 1% of southbound ore tonnage. Southbound tonnage should be about 6 times northbound tonnage for 1975.

TABLE XIX

YUKON: DISTRIBUTION OF PRODUCT GROUPS AMONG TRANSPORT STREAMS, 1964-1975

Product Groups	Transport Stream	Percentage of Total Tons[a] 1964	1967	1975
Northbound:				
(a) General Freight	W.P.& Y.R.	63.0%	70.0%	70.0%
	Truck	36.5	29.5	28.0
	Air	.5	.5	2.0
		100.0	100.0	100.0
Growth Index		-	100	152
(b) Petroleum	W.P.& Y.R.	58.5%	66.0%	66.0%
	Truck	41.5	34	34
		100.0	100.0	100.0
Growth Index		-	100	147
Southbound:				
(a) General Freight	W.P. & Y.R.	41.0%	24.0%	23.0%
	Truck	57.0	73.5	70.0
	Air	2.0	2.5	7.5
		100.0	100.0	100.0
Growth Index		-	100	154
(b) Ores	W.P. & Y.R.	89.5%	93.5%	98.0%
	Truck	10.5	7.5	2.0
		100.0	100.0	100.0
Growth Index		-	100	615

Source: Previous tables; transportation companies.

[a]To the nearest half percent; may not add due to rounding.

retically be from 100 to 147. The index for all groups except ores actually is very close to the 147 level. The initial impact, though, of the mining operations boom has already occurred in 1967, providing thus a good indication of the impact effect.

Besides the large increase in ore tonnage, one other large change is the Air Stream transport of general freight. The 1975 volume of northbound air freight is thus four times the 1967 level, with the southbound freight increasing almost as much. The absolute level of 2% is still small compared to the other streams, even though the southbound freight percentage of 7.5% is quite large. This growth, in general, seems to be more a realization of potential that has existed for air-freight for some time, rather than a growth which is mainly due to the mining operations boom.

4. Level of Competition

A final consideration of the more detailed aspects of the Yukon forecast involves the general level of competition among the transport streams, with the two focal points being price and service competition.

It has thus been indicated that the W.P. and Y.R. rates for 1967 are lower than the rates on the other two streams, but usually not very much lower. The comparison of revenue per ton-mile (Chapter IV) indicates that the W.P. and Y.R. rates, per ton-mile, are actually about the same as the Trucking Stream rates. While its rates for southbound ores are low, and this is important to keep Yukon export prices

competitive, the rates for northbound general freight seem to be made according to what the traffic will bear. The one consideration is to be less expensive than the Trucking Stream. This consideration seems to provide the main reason why the W.P. and Y.R., in 1967, transported about 85% of all the general freight going from Vancouver to the Yukon.[14]

The ton-mile cost comparison referred to above seems to infer that it should be possible for the W.P. and Y.R. to offer lower general freight rates, especially now that its volume of freight carried has experienced such a substantial increase due to the first impact of the present mining operations boom.[15] Their profits for 1967 were certainly much higher, making the possibility of a rate decrease not unrealistic. Thus, on an 11% higher gross revenue for the White Pass and Yukon Corporation Ltd. for 1967 over 1966, the company increased its net profits from 6.7% of gross revenue to 8.4%.[16]

The Trucking Stream could be more price competitive than the W.P. and Y.R. Stream if carload trailers of about 20 tons were piggybacked from Vancouver to Dawson Creek by train, and trucked from there to the Yukon. While this piggyback service is available now, its rate of $3.44/c.w.t. to Whitehorse is only slightly below the present Trucking Stream rate. Because much lower costs are involved concerning handling and

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14. Transportation companies; previous tables.

15. The W.P. and Y.R. did have an approximate 6% decrease in general freight rates, as well as a lower rate for concentrates, in 1966.

16. Fletcher, ibid.

loading activities, it should be possible to offer piggybacking at a rate of about 5¢ per ton-mile rather than the present 7.5¢ per ton-mile.[17]

The piggyback rate per trailer to Dawson Creek is about $400, which comes to about 2.4¢ per ton-mile. If then a trucking rate of 5¢ per ton-mile is used for the remaining 635 miles to Watson Lake, an overall rate of 3.5¢ per ton-mile, or about $2.60 per c.w.t. would be achieved. This is considerably less than the W.P. and Y.R. Stream rate to Watson Lake, which ranges between $2.95 and $4.25 per c.w.t. for carloads of 36,000 pounds, and much less than the normal Trucking Stream rate of $4.00 per c.w.t. for carloads.[18]

A result not quite as favourable is achieved for Whitehorse itself. With the same conditions as above, an overall rate of 3.8¢ per ton-mile would be achieved for piggyback trucking, or about $3.30 per c.w.t. This does not compare quite as well with the W.P. and Y.R. range of $2.50 to $3.80 per c.w.t., although it is much lower than the normal Trucking rate of $5.15 per c.w.t.[19]

While this theoretical case again suggests that the W.P. and Y.R. freight rates are a little high, the question arises what is of more benefit to the W.P. and Y.R. and to the

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17. The low rate for trucking in TABLE IV was 4.6¢ for loads of 18 tons. The rate of 5¢ per ton-mile is thus only a hypothetical case. The actual rate of the trucking company presently offering this service is 3.44/c.w.t. from Dawson Creek to Whitehorse (920 miles), or 7.5¢ per ton-mile.

18. TABLE XVII.

19. These rates apply only for the Dawson Creek to Whitehorse stretch.

Yukon economy as a whole: to lower rates for northbound freight, or to have the lowest possible rates, where costs are barely covered, for outbound ores. This is of course a complicated situation which cannot be easily answered. The higher profit level, as well as the promise of still more northbound and southbound volume due to the mining operations boom, should make some combination of rate decrease possible.

The Trucking Stream rates appear to have not much potential for further rate decreases. The choice exists of course to utilize the P.G.E. train piggyback service as far as Dawson Creek. If companies can thus manage to consolidate their shipments in Vancouver, a very low transport rate is possible. This normally would not be done by large mining companies such as United Keno Hill, or the New Anvil Mining Corp., as they already have trucks returning empty from Whitehorse to the mine. This utilization of empty backhaul would normally easily offset any benefits that might accrue from piggybacking.

With the upcoming change-over to jet planes, it does appear that there may be a decrease in at least some specific commodity rates for the Air Stream. Until the effect of the Boeing 737 jet plane on the lowering of costs can be assessed, it will be difficult to reach more concrete conclusions. The Air Stream will always be considerably more expensive than the other two streams, with its main advantage of course being its short time in-transit.

As mentioned before, time in-transit is the main

factor to consider when looking at service competition. In this regard, the W.P. and Y.R. Stream will always have one large constraint because its container ship leaves Vancouver only every two weeks. The Trucking Stream offers twice a week delivery to the Yukon, while the Air Stream has everyday flights to the Yukon.

For shipments that can be planned in advance, though, this constraint is not too important. In that case, the W.P. and Y.R. Stream is only 2-4 days slower than the Trucking Stream. The large potential that exists for the Trucking Stream for achieving a low time in-transit from Vancouver to the Yukon, along with a low price competitive rate, is through piggybacking of carload shipments to Dawson Creek. The resulting time in-transit is about half the most optimum W.P. and Y.R. time, which ranges from 9 to 11 days. As the demand for shipments to the Yukon increases, so will the possibility of shipping goods by truck and piggyback.

The major impact of freight volume increases due to the mining development boom on the level of competition between the transport streams should therefore be not so much on time in-transit, but on price competition itself. The potential for price decreases in the W.P. and Y.R. Stream is there already, and should become larger still. The same holds true for the Air Stream, even though the cause is as much the change to jet planes as it is the increase in mining operations.

CHAPTER VI

CONCLUSION

The basic aim of this paper has been to analyze the transportation of freight into and out of the Yukon Territory, and to consider the impact of the present mining development boom on the total transport system.

The Yukon Territory presents a very unique market for transportation services. It is a sparsely populated region, located close to the Arctic Circle and very distant from populated areas of southern Canada, and with a very harsh climate. While it "imports" most manufactured items and food products from southern Canada, its only "exports" are ore and asbestos concentrates. Being so very resource-oriented, the Yukon economy is very dependent on low-cost transportation to bring its goods to outside markets, as well as to bring in the items that it needs.

The actual freight measurement for the Yukon was done for the year 1964, which also conveniently showed the level of freight that existed before the first impact of the present mining boom. It was found that for every ton of freight transported into the Yukon, about 1.5 tons were transported out. Almost all of the southbound tonnage was ore and asbestos, with two mines providing most of these concentrates.

The revenue per ton-mile figure on the White Pass and Yukon Route northbound Stream was found to be quite high, as was the Air Stream figure. The cost of small air freight shipments was low compared to the other streams. The White Pass and Yukon Route Stream has considerably lower rates for southbound concentrates. The Trucking Stream figures for revenue per ton-mile were surprisingly low, as they almost equalled those for the White Pass and Yukon Route Stream.

The 1964 data, as well as information from various companies, were combined to form a 1967 freight measurement. While the actual figures were not used because some company information was confidential, the growth over this three-year period was actually quite normal. The only exception was the White Pass and Yukon Route freight increase of almost 50%. While it might have been expected, it seemed that the two other streams did not make any significant gains from the initial mining boom impact.

The 1967 freight measurement was taken as the base year for a freight forecast up to 1975. Some of the major findings were: (a) most freight groups should experience a 50% increase between 1967 and 1975; (b) For every one ton shipped into the Yukon in 1975, about six tons of concentrates will probably be shipped out; (c) The transport of freight into the Yukon should be about six times as much in 1975 compared to the 1967 volume; (d) The Air Stream growth is more due to the switch to jet planes than to the increase in mining operations; (e) The increase in freight to the Central Yukon area should be very substantial, compared to the moderate

growth in all other areas; and (f) The White Pass and Yukon Route Stream benefits most from the direct demands of the Central Yukon area, although the indirect effects of the mining boom on all parts of the Yukon, as well as the normal steady growth of the Yukon, will also benefit the other transport streams.

Even a regional forecast may still hide some important occurrences, so that it is necessary to consider more detailed forecast implications. Thus the growth of the Central Yukon area for 1967 has been so substantial that the White Pass and Yukon Route Stream not only greatly increased its volume of general freight and fuel tonnage shipped into the Yukon, but it also increased its share of the total tonnage compared to the other transport streams. The same occurred for southbound ores. The Central Yukon area, as a customer of transportation services, played a much bigger role in the White Pass and Yukon Route operations during 1967, and this importance should grow even more by 1975. This is in spite of normal growth of transport demands in other regions of the Yukon.

A rate decrease for the White Pass and Yukon Route Stream and for the Air Stream should be possible, although the former presents a problem of where a rate decrease would be more beneficial to the economy, and thus to the company. Involved in this trade-off situation is the freight moving into the Yukon on the one hand, and the ore concentrates moving out of the Yukon on the other. Rates on the White Pass and Yukon Route Stream are low enough that for 1967, 85% of the

freight going from Vancouver to the Yukon travelled along this stream.

The Trucking Stream, combined with rail piggyback to Dawson Creek, presents a potentially very price competitive transport stream as well as being considerably faster than the White Pass and Yukon Route Stream. The rates that are presently listed for this transport combination do not bear this out though. In addition there would exist the problem that those mining firms that send their products by truck to Whitehorse to be shipped on the White Pass and Yukon Route out of the Yukon, thereby create a backhaul situation on the trucks going back to the mine. This inexpensive backhaul to the mine, for general freight going to the mine, provides further stimulus to use the White Pass and Yukon Route rather than the piggyback and truck combination.

The general conclusion is that the impact of the mining developments has already had a substantial effect on the amount of freight carried in 1967, with most of the direct benefits accruing to the White Pass and Yukon Route transport system, in the form of much higher northbound traffic. The benefits should be even greater with the expected sixfold increase in southbound ore volume by 1975.

The present mining development boom should thus have a very substantial direct impact on the volume of freight shipped on the White Pass and Yukon Route Stream, as well as indirect effects on the other transportation streams. It should on the whole ensure the transportation companies of

larger freight volumes, and thereby provide the means for transport to be priced as low as possible. This low-priced transportation is the safeguard of the competitiveness of Yukon mineral exports, the health of the Yukon economy, and the economic well-being of a population inhabiting such a remote and climatically severe region of Canada.

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Canadian Pacific Airlines

Canadian Freightways Ltd.

Loiselle Transport Limited

White Pass and Yukon Route.

APPENDIX A

ESTIMATION OF NORTHBOUND AND SOUTHBOUND FREIGHT TONNAGES

In estimating the Yukon freight tonnage data from the Stanford Research Institute Alaska Highway study, the following calculations were conducted:

(1) Petroleum.

About 2000 truckloads come from Taylor Field at Fort St. John, and 400 truckloads come from Edmonton.[1] Of this 90% ends up between Fort St. John and Whitehorse (75% to Fort Nelson, 18% to Watson Lake, and 7% to Whitehorse), and the remaining 10% goes to Alaska (82% to Fairbanks, and 18% to Anchorage).[2] The average weight of petroleum per truck is 21.7 tons,[3] which is then used to show the amount of petroleum going to each town (TABLE A-I). The total tonnage to the Yukon itself is 11,720 tons.

(2) Housetrailers

The northbound movement of housetrailers accounted for 51,000 loaded vehicle miles[4] on the unpaved portion of the Alaska Highway past Mile 80. Of this traffic 71% ter-

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1. Stanford Research Institute, op. cit., p. IV-49
2. Ibid., p. V-20.
3. Ibid., p. A-33.
4. Ibid., p. V-20.

TABLE A-I

NORTHBOUND PETROLEUM, 1964[a]

Destination	% of Trucks	Trucks	Tonnage
Ft. Nelson	67.5	1620	35,150
Watson Lake	16.2	388	8,420
Whitehorse	6.3	152	3,300
Fairbanks	8.2	197	4,280
Anchorage	1.8	43	900
	100%	2400	49,050

Source: See foregoing discussion

[a]Does not include petroleum carried by White Pass and Yukon.

minates at Fort Nelson, 8% at Watson Lake, 10% at Whitehorse, and 11% in Alaska.[5] TABLE A-II uses these breakdowns to arrive at the vehicle trips terminating in each town, as well as the associated tonnages. Total tonnage to the Yukon is 104 tons.

TABLE A-II

NORTHBOUND HOUSETRAILERS, 1964

Destination	Loaded Vehicle Miles	Miles per Truck[a]	No. of Trucks	Tonnage[b]
Ft. Nelson	36,200	220	166	1,328
Watson Lake	4,100	554	7	56
Whitehorse	5,100	838	6	48
Alaska	5,600	1,500	4	32

Source: Stanford Research Institute, ibid., p. V-21.

[a]Number of miles past Mile 80 on Alaska Highway.

[b]Average load is 8 tons per truck: source: ibid., p. A-33.

5. Ibid., p. V-20.

(3) Household Effects

Canadian household effects carriers accounted for 71,200 loaded vehicle miles, while only 24% of northbound trips were loaded and 100% of southbound trips were loaded.[6] Thus northbound loaded vehicle miles totalled 13,700. As 82% of total trips terminate at Watson Lake, and 18% at Whitehorse,[7] the total number of trips X can be found from the equation:

$$(.82)(554)X + (.18)(838)X = 13,700.$$

With the number of trips X = 23, 19 terminate at Watson Lake, and 4 at Whitehorse. As the average load per truck is 10 tons, the tonnages then are 190 tons to Watson Lake and 40 tons to Whitehorse.

The southbound loaded vehicle miles total 57,500. As 83% of total trips leave from Whitehorse, and 17% leave from Watson Lake,[8] the total number of trips Y can be found from the equation:

$$(.83)(838)Y + (.17)(554)Y = 57,500.$$

The number of trips Y is found to be 73, of which 61 leave from Whitehorse, and 12 leave from Watson Lake, resulting in tonnages of 610 and 120 tons respectively.

(4) Northbound General Freight

The Canadian northbound general freight total of 1,775,000 loaded vehicle miles is made up of 1,027,000 from

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6. Ibid., p. V-21.

7. Ibid.

8. Ibid.

Edmonton and Calgary, 20% (or 355,000[9]) from the Vancouver area, 4% (or 78,000) from other Prairie points, and 18% (or 320,000[10]) from other Alaska Highway points.[11] TABLE A-III gives the general distribution pattern of trips from Edmonton-Calgary, Vancouver, and the remaining Canadian Prairies:

TABLE A-III

DESTINATION OF NORTHBOUND GENERAL FREIGHT, 1964

Origin	Destination (% of total trips)				
	Fort St. John	Fort Nelson	Watson Lake	White-horse	Alaska
Edmonton-Calgary	6%	6%	33%	44%	11%
Vancouver	8	9	16	51	16
Can.Prairies	-	12	-	41	35

Source: Stanford Research Institute, ibid., p.V-18.

Since Fort Nelson, Watson Lake, Whitehorse and Alaska are 220, 554, 838, and 1445 miles respectively from Mile 80, the total number of trips L, M, and N originating in Edmonton-Calgary,

9. This figure, representing only general freight, conflicts with the statement on page V-14 of the Stanford Research Institute study that 12% of total northbound traffic (2,745,000 loaded vehicle miles) comes from Vancouver (which would be 329,000), as well as with the table on page A-28 showing that total northbound traffic from Vancouver equals 322,000 loaded vehicle miles. It is nevertheless still used for these calculations, because it appears to fit in better with the other data.

10. This figure conflicts with that of 304,000 on page V-19, but again must be used to keep the relation to the other figures on page V-18.

11. Stanford Research Institute, op. cit., p. V-18.

Vancouver, and in the Canadian Prairies respectively can be found by the equations:

$$(.06)(220)L + (.33)(554)L + (.44)(838)L + (.11)(1445)L = 1{,}027{,}000 \quad (3)$$

$$(.09)(220)M + (.16)(554)M + (.51)(838)M + (.16)(1445)M = 355{,}000 \quad (4)$$

$$(.12)(220)N + (.41)(838)N + (.35)(1445)N = 78{,}000 \quad (5)$$

The total number of trips then resulting are L = 1420, M = 464, and N = 89. These totals can then be used to calculate the destinations of northbound general freight by actual vehicle trips (TABLE A-IV).

TABLE A-IV

DESTINATION OF NORTHBOUND GENERAL FREIGHT TRIPS, 1964

Origin	Destination (number of trips)					
	Fort St. John	Fort Nelson	Watson Lake	White-horse	Alaska	Total
Edmonton-Calgary	85	85	469	625	156	1,420
Vancouver	37	42	74	237	74	464
Can.Prairies	11	11	-	36	31	89
Total	133	138	543	898	261	1,973

Source: From previous table and calculations.

The number of loaded vehicles carrying general freight to Whitehorse is thus 898, while those going to Watson Lake number 543. The average content figure of 17.1 tons[12] is not a good average to use for finding tonnages going into

12. Ibid., p. A-33.

the Yukon per truck, especially as these trucks don't deposit all their content at one location. A reasonable estimate thus may be 10 tons per truck for Whitehorse destination, and 9 tons per truck for Watson Lake destination.[13] This would result in about 9000 tons of general freight travelling to Whitehorse, and about 4900 tons travelling to Watson Lake.

It is not clear from the Stanford study whether the figures concerning piggyback trailers carried from Vancouver to Dawson Creek by P.G.E. railway, and from there by Loiselle Transport to the Yukon, are included as having originated in Vancouver or Dawson Creek. The assumption is that the origin is Vancouver. This in general seems to fit the data picture fairly well.

Of the remaining 320,000 loaded vehicle miles of northbound general freight, 30% is for the delivery of mail, while the other 70% is for the delivery of asbestos to Whitehorse, the delivery of White Pass and Yukon Route goods northward, and for local highway deliveries of little significance. The mail tonnage cannot be found (although it is an insignificant part of total freight), while the White Pass and Yukon figures are already included in their flight stream totals.

(5) Southbound General Freight

The total southbound freight results in 844,500

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13. Company and private sources. Due to lack of better information these are the best estimates that can be found.

loaded vehicle miles.[14] While 491,000 of these are accounted for by local White Pass and Yukon Route deliveries as well as Cassiar asbestos deliveries south to Fort St. John, 351,000 loaded vehicle miles[15] is freight traffic to southern Canadian points.[16] As there were 57,500 loaded vehicle miles[17] of southbound household effects, these were subtracted from 351,000 to yield 293,500 loaded vehicle miles of southbound general freight. With 80% general freight originating in Whitehorse and 20% originating in Watson Lake,[18] there are then about 400 loaded vehicles of southbound general freight to Canadian points not on the Alaska Highway.

The average weight content then for southbound Canadian general freight loaded carrier vehicles is 17.6 tons.[19] This average content figure is very high as the average incorporates shipments of asbestos from Cassiar to Fort St. John. While the average content is apparently in the neighbourhood of 4 tons per loaded vehicle, the resulting tonnage will be considered to be about 2000 tons of southbound general freight.[20]

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14. Stanford Research Institute, op. cit., p. A-28.

15. Ibid.

16. Figures on page V-19 state that there were only 100,000 loaded vehicle miles for southbound general freight. They were felt not to be inaccurate, so the data on page A-28 of the study were used.

17. Part (3) of Appendix A.

18. Stanford Research Institute, op. cit., p. V-19.

19. Ibid., p. A.33.

20. Trucking company sources.

APPENDIX B

TABLE B-I

CORRELATION OF G.N.P. AT CONSTANT (1949 DOLLARS) PRICES WITH TOTAL CANADIAN TON-MILES

Year	G.N.P. '000,000	Total Ton-Miles '000,000
1950	17,330	90,800
1953	20,270	114,700
1955	21,650	123,100
1960	25,850	139,800
1961	26,520	151,900
1962	28,280	163,300
1963	29,740	179,000
1964	31,670	200,000

$$r = \frac{n \sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2 \; n\sum y^2 - (\sum y)^2}$$

x = G.N.P.
y = ton-miles
n - 8

$$= .9849$$

Source: G.N.P. 1950, 1953, 1955: Dominion Bureau of Statistics, National Accounts and Income Expenditure, Research Development Division;

G.N.P. 1960-1964: J.L. Proctor, loc.cit.

Ton-miles: Canada Yearbook 1967, p. 215.

TABLE B-II

CORRELATION OF TOTAL NORTHBOUND FREIGHT[a]
(On the White Pass & Yukon Railway) and
G.N.P. AT CONSTANT (1949) DOLLAR) PRICES

Year	Freight[b]	G.N.P. '000,000
1962	100	28,280
1963	91.7	29,740
1964	79.9	31,670
1965	88.2	33,770
1966	117.7	35,400[c]
1967	126.0	37,200[c]

r = .8368

Source: White Pass and Yukon Company

[a]includes general freight, and gas and oil
[b]tons are indexed with base year 1962 = 100
[c]estimates, based on trend for previous 5 years.