# AN INTERPRETIVE STUDY OF FACTORS RELATED TO TRANSPORTATION COSTS IN THE SCHOOL DIVISIONS OF MANITOBA

A Thesis

Presented to

the Faculty of Graduate Studies and Research

The University of Manitoba

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

by

Aron Sawatzky

August 1968

## ABSTRACT

The purpose of this study was to determine the suitability of a selected set of factors as a measure of pupil transportation cost in school divisions in Manitoba. It was also necessary to give supplementary consideration to a comparison of contract with board-operated bus systems, and to study the general quality of the services being provided, relative to the operating cost of school transportation.

### SOURCES OF DATA

The data for this study were obtained from (1) government reports, documents and records, (2) school division and district records, (3) questionnaires, (4) interviews, and (5) letters. The 1967 operational data were used rather than those of other years because of the changes that took place previously and the more limited scope of pupil transportation in the preceding period.

### PROCEDURE

The following procedure was used.

1. Six density measures of pupil transportation operating costs were developed.
2. A weighting procedure was applied to such data as: the number of buses used, the bus mileage, the number of centralized schools, and the number of pupils transported daily.
3. The 1967 operational data were used to calculate the numerical values of the six selected factors.
4. The values of the six factors were treated by a step-wise multiple regression analysis to determine their relationship to the costs of pupil transportation.
5. A multiple regression equation was developed from the results of the statistical analysis.

6. The cost formula was appraised in terms of applicability to each school division included in the study.

7. "Contract" buses were compared with "board-operated" vehicles, respecting both costs and services.

8. The general quality of school transportation services was examined relative to the costs involved and the nature of services in various parts of Canada and the United States.

## RESULTS

The four best predictors or measures of student transportation costs were found to be: (1) pupil-average distance; (2) the number of transported pupils per square mile of organized territory; (3) the assessed valuation per transported pupil, and (4) the bus mileage per square mile of organized area. The application of the cost equation based on these 4 factors showed that 12 out of the 10 divisions included in this part of the study would experience tax increases or decreases well below one mill while only 4 divisions would require increases ranging from 1.71 to 4.21 mills. The formula was found to be comparatively simple to apply yet sufficiently comprehensive in its measurement of influences upon costs to account for 85% of the variance between calculated and actual costs of pupil transportation in the 20 divisions.

The application of the cost formula indicated a need for investigation on the local level respecting such matters as management, economy and efficiency. This was substantiated by the fact that in 12 out of the 20 divisions the costs derived by means of the equation were below actual costs. It was further supported by the comparison of "contract" with "public-owned" buses, which revealed that despite an inferior quality of service the "contract" vehicles were significantly more expensive than "division-owned" systems.

The fact that the general quality of school transportation services was found to be inferior to that provided in many other areas, once again emphasized the need for efficient management as suggested by the application of the cost formula. It was revealed that the quality of service could be greatly improved even without extensive financial expenditure.

Both the cost of pupil transportation and the general quality of the services provided require continuous re-evaluation if the investments in school transportation are to serve the purpose of ensuring safety and maximizing the educational opportunities provided by the schools.

## ACKNOWLEDGMENTS

The writer wishes to express his appreciation to all who have contributed their time and energy in the progress and support of this investigation.

Particular appreciation is expressed to Mr. F. A. Owens, Supervisor of Transportation for the Department of Education, to Mr. A. Anderson, Executive Secretary of the Manitoba Association of School Trustees, and to the many secretary-treasurers of the school divisions and districts, for their effort and cooperation in providing the necessary data for the study.

The writer is also appreciative of the valuable suggestions and criticisms he received from his faculty advisor, Professor Carl Bjarnason, and the faculty committee during the course of this study.

TABLE OF CONTENTS

CHAPTER PAGE

SUPPLEMENT--PART I



SUPPLEMENT--PART II

LIST OF TABLES

# CHAPTER I

## THE PROBLEM, RELATED STUDIES AND METHOD OF PROCEDURE

Every school day in 1965 over 20,000 buses, bombardiers, and station wagons transported more than one million children in excess of 2.5 million miles to Canada's public schools. (Roberts, April, 1966, p. 34)[21] During 1967 in Manitoba more than 2300 vehicles operated daily to convey over 45,000 students to elementary and seconday schools. (Department of Education, Manitoba, 1967)[5] As the school centralization program advances, transportation assumes increasing significance in the education system of the province. It is important, therefore, that school transportation should be given careful study to ensure economy, efficiency and safety in the education of youth.

### Statement of Purpose

The purpose of this study is to determine the suitability of a selected set of factors as a measure of pupil transportation costs in school divisions, consistent with an adequate standard of transportation service in Manitoba. The criteria used must be relatively independent of local board policy if the derived measurement formula is to be universally applicable. It will also be necessary to give supplementary consideration to a comparison of contract with board-operated bus systems, and to study the nature of the services being provided, relative to the cost of pupil transportation.

### Transportation and the Principle of "Equalization"

The grants for transportation at the time of this study were

based upon the government's "estimate" of need, with the "hope" that the cost of service in most areas would be adequately covered without additional local taxation. According to the Manitoba Royal Commission on Local Government Organization and Finance [13] (April, 1964, p. 112) these grants are inadequate because they produce equalization only among those areas which have a comparable unit-cost of transportation. In view of the discrepancies between divisions in the per pupil cost of transportation, considerable variation exists in the local mill-rate required to provide a satisfactory service. This points out the need for some technique to determine transportation costs. Such a measuring device should be adaptable to different conditions, and should permit a comparison of the cost in one division with that in another.

The principle of "equalization" has been widely accepted in the United States and Canada as the basis of a foundation educational program. Essentially this involves the establishment and acceptance of a foundation or minimal program which all local authorities will be able to offer. Localities are required to contribute to a central fund according to an established formula, with the provincial government contributing an amount equal to the difference between the cost of the foundation program as calculated, and the amount obtained from a uniform rate of local taxation.

During the 1920's the Educational Finance Inquiry Commission of New York outlined the basic elements of an equalization program. (Strayer and Haig, 1923, p. 173)[22] The plan called for the establishment of school systems which would give every child in each locality an equal opportunity within feasible limits. The necessary

funds were to be raised by local and/or state taxation on the basis of an equalized tax burden calculated on the ability-to-pay principle. To insure effective use of public funds and equality of educational opportunity the commission recommended close supervision and control of the schools or their direct administration by the state department of education.

Johns and Morphet (1960, pp. 350)[11] have argued that any plan to equalize educational opportunities and costs must include pupil transportation in a foundation program, particularly in rural areas where centralization creates distances which make walking or independent transportation impractical. This poses a problem respecting the determination of transportation costs. Should they be calculated on a basis different from that used in determining other costs such as instruction, or should they be reckoned on a single measure of need to be used for all aspects of the foundation plan? Some studies, such as those by Mort, (1933)[16] support the use of a single measure for calculating all aspects of educational need. But unless carefully devised, such a single unit could needlessly retard centralization because allowances might not be enough to cover pupil transportation costs. On the other hand, such a unit might unduly accelerate the centralization process or even lead to over-centralization.

Studies generally confirm that transportation costs are different from instructional costs in that the latter are more closely related to teachers, pupils and number of classrooms, whereas the former depend upon such factors as pupil distance from school, pupil distribution within the district or division, the type of school

organization being utilized, road conditions, and topography of the area. These observations support the view that transportation costs must be determined on the basis of a complex rather than a simple measure, and independent of criteria used to arrive at instructional needs.

An accurate technique for the computation of pupil transportation costs cannot be disassociated from the element of administrative control. The simplest way might be to establish a "provincially" operated and controlled transportation system, eliminating all local jurisdiction over costs. This may appear to be undemocratic and tend to deaden local interest and initiative. It may be possible, on the other hand, to accept locally incurred expenditures without question and reimburse school authorities out of the foundation program fund. Such a plan would tend to reward inefficient and uneconomical practices. Still another procedure might utilize standardized schedules of costs computed on the basis of factors largely beyond the control of local school authorities. The variables most frequently used under such a plan are related to distance, area, density and population distribution. They can be used to evolve cost equations which are universally applicable. Such a plan would provide a maximum of education opportunity, encourage the development and exercise of local leadership, and demand a senseof responsibility in the provision of transportation services.

The last of the alternatives discussed above has been employed in Alberta. When transportation costs were first accepted as a part of the foundation plan in 1961 the pupil transportation

costs were calculated on the basis of a formula which used a modified "dwelling-to-school" distance factor. (Order-in-Council, 1961)[19] As this approach entailed extensive data respecting the place of pupil residence, it was modified in 1962. (Order-in-Council, 1962)[20] The new plan was based on a "density of population" factor; density being determined by dividing the number of acres in a district by the number of pupils who live beyond $1\frac{1}{2}$ miles from school. The number of acres per pupil was determined for each division or district. These were classified into 36 density groups after the following manner:

| Density Group Number | Number of Acres per Transported Pupil | Cost per Transported Pupil |
|---|---|---|
| 1 | 1-40 | 95.00 |
| 2 | 41-80 | 96.00 |
| 36 | 1401-1440 | 206.00 |

On the basis of the correlations between the number of acres per transported pupil and the per pupil transportation costs of the previous year for each of the 36 groups, an equation was devised for the computation of pupil transportation need. As indicated in the table above, the costs that were derived by the application of the formula to each density classification, ranged from $95.00 to $206.00 per transported pupil. To determine the transportation grant to a division the number of pupils in need of conveyance was multiplied by the amount per pupil applicable in the particular density group under which the division was classified.

Both 1961 and 1962 plans employed in Alberta indicate attempts to include pupil transportation costs in the foundation program. Both treated transportation as separate from instructional or other costs, and based the computations on some form of density factor rather than merely on actual expenditures.

In Manitoba, apparently no attempt has been made to calculate transportation costs according to any specified measurement formula. None of the regulations pertaining to pupil transportation, passed in either 1958 or 1967 nor the amendments of 1960 and 1966, set forth any plan for the measurement of need in order to provide equalization of grants, and thus guarantee an adequate standard of transportation services. (Manitoba Regulation, 58:67)[12] It is evident from this that some attempt must be made to determine a suitable set of factors to measure the needs and therefore the costs of pupil transportation, and to relate these costs to the services provided.

## Related Studies and Formulae

The basic principles to be used for the treatment of the pupil transportation data have been derived from a number of related studies and practices. These reveal a strong trend toward the use of some density measures in determining pupil transportation costs as part of a foundation program. Computations generally have been based upon such factors as the number of pupils needing transportation; the area served; the distance traversed; the school organization; the topography; and the conditions of roads.

Mort, (1933)[16] in his New Jersey study employed three factors in determining pupil transportation need. These were the size of buses;

the distance travelled by the vehicles; and the number of students conveyed. He gave his strongest support to the use of the density of school population factors.

Burns, (1938)[2] in his research, followed the correlational techniques employed by Mort. He first found the relationship of the "density of total population" to the "percentage of pupils transported" and found a close correlation between the population density figure and transportation costs. Next he determined the relationship between the "density of school population" and pupil transportation costs, and concluded, on the basis of the close correlation, that the state government could thus effectively predict pupil transportation need.

Noble, (1940)[18] after investigating pupil transportation costs in Alabama, Oklahoma and Ohio, concluded that authorities in all three states made use of regression equations in which some density factor(s) constituted the basis for the computation. In Alabama the pupil transportation needs were equated to a multiple of the average daily per pupil transportation cost as determined for the counties with a specified population density and the aggregate attendance of all transported students. Oklahoma (Noble, p. 172)[18] authorities adopted the amount of transportation grant per day as the product of the average number of pupils conveyed daily and the amount per pupil per day as specified in a cost schedule. The Ohio plan (Noble, p. 175)[18] employed a regression equation for each district, using the number of pupils conveyed and the number of transported pupils per square mile as the principal factors. The cost figures thus derived were adjusted in terms of some cost accounting factors such as the salaries of bus

drivers, depreciation, storage of vehicles, interest on capital cost liabilities and the purchase prices of vehicles.

In his studies on pupil transportation, Johns (1928)[9] agreed to some extent with the Ohio plan as outlined by Noble. Johns reasoned that all factors such as road conditions, types of roads, transportation distance, contract prices and even the cost of living were either negatively or positively related with the density of population. Thus population density could be regarded as a summation of the effects of the various factors on cost of pupil transportation, and could be used as an independent criteria for predicting such costs. Johns, therefore, evolved an equation which used the percentage of average daily attendance per square mile. Lambert, however, criticized the formula on the ground that inequities would result, expecially when applied to unevenly populated areas. Johns (1949)[10] later argued for state-aid based upon computations giving equitable and objective consideration to criteria beyond the control of local school boards.

McLure conducted a study in Illinois with the purpose of developing a measure of pupil transportation need. (Cornell and McLure, 1949, pp. 152-153)[3] He developed formulae based on a density measure of pupils per square mile and broken into segments. In the equation $X_1 = 0.7700 - 0.0567X_2$, the symbol $X_1$ was taken to represent the (estimated) per pupil transportation cost in dollars and $X_2$ to represent the number of rural pupils per square mile. In summary his formula took the following forms:-

1. For counties with an average of 6 or fewer rural pupils per square mile: $X_1 = 0.7700 - 0.0567X_2$

2. For counties with an average of more than 6 rural pupils per square mile but not more than 11: $X_1 = 0.5850 - 0.0262X_2$

3. For counties with an average of more than 11 rural pupils per square mile but not more than 22: $X_1 = 0.4100 - 0.0100X_2$

4. For counties with an average of more than 22 rural pupils per square mile: $X_1 = 0.3000 - 0.0050X_2$.

An analysis by the Illinois Education Association, (1956)[8] subsequent to McLure's study indicated that pupil transportation costs are primarily related to such factors as the size of the districts, the sparsity of population, and the total number of pupils to be transported. The investigators reported that as the number of pupils per square mile increased, the corresponding cost per pupil for transportation continued to drop until a rather stable figure was reached at a population density of four or five pupils per square mile. (p. 55)[8]

A study similar to that of McLure was undertaken in Michigan by Medlyn (1954)[15] who sought to determine the average cost of pupil transportation and to identify some controllable and uncontrollable factors which influence pupil transportation costs. His analysis led to several conclusions. The four major transportation cost components appeared to be gasoline, vehicle depreciation, drivers' salaries, and mechanics' salaries. The variation in annual per pupil cost from district to district was $18.00 to $156.00 and the variation in actual cost per pupil per mile was 0.18 to 0.99. The factors which tend to cause this difference in cost from one district to another were:

1. The relationship between the number of children per bus route and the cost per pupil;

2. the pupil capacity of vehicles and the cost per pupil;