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GENERAL ECONOMICS UNDERLYING THE HIGHWAY

By Thomas H. MacDonald
Chief of the U.S.Bureau of Public Roads

The highway is a thing of service - particularly individual service. It comes intimately into human life in its ordinary phases and activities. This is an unchanging aspect and individual service functioning of the highway holds true in whatever country it may be located. Highway transport has a very definite place in the general transportation scheme and in this country we now recognize it as an essential element, and have found in its development a satisfactory and increasing relief from the lack of transportation of the kind for which the need has long existed, and which could not be supplied until the perfecting of the motor vehicle.

Civilization has produced three types of transportation for ordinary usage- rail, water and highway. Each has definite supremacy. Each has its limitations,and it is a mistake to attempt to substitute one form where another is better fitted, to duplicate if satisfactory transportation of another form is already available, or to allow competition to destroy or prevent efficient service.

Influence of Water Transportation on New England

Thinking back to the earlier history of the United States water transportation allowed the first white settlers to reach the country. Water transportation had such a profound influence in the settlement of the New England states that today it is

asserted that 70 percent of the population live within fifty miles of the seaboard, and a major part of the industrial activity is contained in the same area. The influence of the early wagon routes and the early canals into the interior is today very apparent, and it was by water and by overland wagon trail that the great agricultural district of the Mississippi Valley, and the Pacific Coast were pioneered.

But neither the highway nor the water route could ever have made possible the commercial entity of the United States. The railroads reduced the distance between the Pacific and Atlantic coasts as measured not by miles but by time, until the great major districts of the United States were brought close, commercially and politically. Yet even the railroads and the waterways could not multiply themselves into the almost infinite number of relatively small services needed by the individual and the community. Thus, the agricultural districts depended upon the horse-drawn vehicle and highway, and the city upon the horse-drawn vehicle and the electric cars where there was a sufficient use to justify their operation.

Will Soon Have Registration of 20,000,000

When the motor vehicle first made its appearance, the radius of activity of the individual was determined

largely by the horse-drawn vehicle, the electric car and the railroad. Each of these forms had reached its possible development in the degree of service it could render to the individual. Each was capable of expansion and extension in quantity, but the quality of service was defined. When the motor vehicle first became a practical utility, it was regarded naturally as a substitute for the horse-drawn vehicle. As the numbers grew and the vehicle was perfected, some claims were made that it would displace the railroad as the railroad displaced the waterway. This latter view fortunately was not given very serious attention. The major experience with the motor vehicle in the United States has taken place in the past ten years. In that time the number of motor vehicles in service has increased from about one million to fifteen million at the end of 1923. The increase alone in numbers in 1923 was greater than the total number registered ten years ago. It is confidently predicted that the registration figures will reach twenty millions within a short time. He would be a foolish man to predict what numbers the total registration will reach, but it is plainly apparent that a majority of our whole population is now quite directly interested in the motor vehicle, and the proportion is greater in the less congested districts and particularly in the agricultural areas.

There are certain classical questions to which no satisfactory answer has been found. For example, whether the egg or the chicken came first, will probably always remain unanswered. There is no such uncertainty about the development of highway transport in the United States. Theoretically highway transport is the combination of the motor vehicle, and the highway improved to the degree necessary to carry the motor vehicle with economy. Practically, the motor vehicle came first, and it came in such large numbers that it outstripped any possible new construction program of adequate highways. There is no mistake in this thought. The motor vehicle was the forerunner of improved highways in this country. It has brought to a large part of our population a direct interest in the construction and maintenance of adequate highways in every section of the country. Further it contributed last year to the State, Federal and local governments in gasoline taxes, excise taxes, personal property taxes, registration fees and allied taxes more than $480,000,000, an amount equal to 45 per cent of the total expenditure for road construction and maintenance.

Based on the complete road census made by the Bureau of 19.1 of all highway expenditures (I am assuming approx-

imately the same conditions in 1923) about 38 per cent of the total expenditures came from bond issues and about 44½ per cent came from general property taxes. The remainder came from Federal aid.

How Highway Funds Are Raised

The whole of the revenue from the motor vehicle has not been applied directly to the road program for any year. For the past three years the total national expenditure has been approximately one billion dollars. The expenditure for 1921, on a per capita basis, was financed as follows:

Bonds	4.10 per capita
Federal aid	.75 per capita
General property and other taxes	4.82 per capita
Motor vehicle revenues	1.16 per capita
Total	10.83 per capita

A considerable percentage of the bonds are financed from the income from the motor vehicle, and the Federal Government has received in excise taxes on the motor vehicle and accessories more than double the amount that has been paid out in Federal aid.

The current expense from general property and other taxes, amounting to $4.82 per capita, it will be noted, is only a trifle more than one cent per day to the individual. This includes not only current expenditures for roads, but payments made for interest and principal of bonds previously issued. While the road program is large, its opponents will

have to seek elsewhere to find the explanation for high taxes.

This is further borne out by the fact that in 1922 the Census Bureau reports that the public revenues of the country amounted to $4,224,000,000.

Taking from this the revenues collected from the motor vehicle in license fees and gasoline taxes allocated direct for road purposes, the total amounts to $38.80 per capita.

Of this amount $4.82 per capita was collected for highway purposes. Therefore 12.4 per cent of all taxes, other than those accruing from the motor vehicle and used directly for road purposes, was collected for highway purposes.

While the average per capita tax amounted to $4.82, there was a large variation between the different sections of the country.

In the thickly populated New England group of states, 7.2 per cent of the taxes were for highway purposes, and in the mountain group which includes the most thinly populated section, 16.8 per cent of the total tax income was used for highway purposes.

Growth of Gasoline Tax

In 1921 only a small number of the states had a gasoline tax, so the revenue from this source was much smaller than it is at present, but the revenue from gas taxes and regis-

tration fees used directly for road purposes amounted to an average of $11.80 per car. This item also showed considerable variation between the different sections of the country. In the New England states the highest average of $16.40 was reached, and in the Pacific States the lowest of $8.30.

The ratio of the income from the motor fees and gasoline taxes used directly for road purposes was 10.6 per cent of the total highway income. These figures are for 1921 and since then the income from the motor vehicle has been very largely increased by higher registration fees, and by the wider imposition of the gas tax. Thus the actual income from all sources from the motor vehicle, it is believed is correctly placed at the figure previously given of more than $450,000,000 or an amount equal to about 45 per cent of the highway income. While the motor vehicle has brought with it the necessity for a large outlay for road purposes, it is producing revenues equal to a very considerable percentage of the annual expenditures. In addition to the direct income, there is a large indirect income from increased property values and the tremendous valuation of the establishments devoted to the business of highway transport and its allied activities.

Up to and including 1921, for highways, a bonded in-

debtedness of $1,222,000,000 has been accumulated. This amounts to approximately 14 per cent of the total indebtedness for all purposes, exclusive of the national debt. If the national debt is included, the percentage is reduced to about 4 per cent.

These figures portray the side of highway transport that is the most difficult. For highway transportation, the public furnishes the roadways, and the individual the rolling stock. Public funds which come from taxation are ever the cause of more or less resistance and criticism from the public itself. The adjustment of the cost between general taxation and special taxes upon the motor vehicle, including the gasoline tax, is one of the very difficult problems which is not yet adjusted with any considerable uniformity between the states. It must be remembered in this connection that whatever tax is placed against the motor vehicle is a tax upon transportation. In so far as the non - business use of the motor vehicle is taxed, this cost may not be further distributed, but that portion of the tax which goes against the business uses of the highway, whether by persons or commodities, must be finally distributed back to the producer or consumer.

A survey made by the Bureau of Public Roads in Con-

necticut shows that the transportation of commodities over the highways of that state amounted to 150,000,000 ton miles in 1932, and this movement amounted to only about 15 per cent of the total movement, the balance being made up of passenger vehicles, 35 per cent of which was for business purposes and 65 per cent for non - business purposes.

97% of Cincinnati Milk Hauled by Truck

A recent study of the transportation of milk into a number of the larger cities shows that in Cincinnati about 97 percent, in Indianapolis 91 per cent, in Milwaukee 88 per cent, and in Detroit 81 per cent of the total supply comes in over the highways. In Baltimore the percentage has increased from about 6 per cent in 1915 to about 40 per cent at the present time coming in over the highways. Taxes levied against the motor truck must of necessity be distributed to the products which are transported over the highways.

It is not to be doubted that highway transport, as is true of any type of efficient transportation properly developed, changes potential wealth to real wealth. Because of the great flexibility of the combination of motor vehicle and highway in the country, whether intensively developed or in the pioneer stages, highway transport may be satisfactorily secured within the resources available.

The experience of the years has pointed out that highway transport has as many phases as do the communities in different parts of the nation. Highway traffic is found to reflect faithfully the life and activities of the community. Where the large population centers are relatively close, the commodity traffic is made up largely of manufactured goods and the raw and finished materials of industry. In the Connecticut survey - a typical industrial district - the manufactured products furnished 73 per cent of the total tonnage. In the agricultural districts the proportions are reversed, and the transportation of agricultural products becomes the dominant traffic.

One of the very important and growing uses of the highway is reflected in the transportation of milk and other fresh food products from the nearby areas into the population centers.

Highway Systems

No formula has yet been devised that alone will assure the development of highways that will best serve a people. The highway is a thing of service and the service demanded, present and potential, must be studied, intelligently and scientifically, and highways provided that will keep the whole cost of highway transport at the lowest possible figure.

Certain general principles are applicable. Perhaps the most important is this. The highway improvement program must be planned to give maximum service to the largest number of people with the minimum possible mileage.

The second is this. The improvement program must be planned to meet nation- wide and state - wide as well as local needs. This is reached by a division or classification of the highways into systems.

It is a difficult task indeed to focus the energies of a community or of a larger body politic upon a definite system of highways of limited mileage and hold to the task until complete. It is almost if not quite impossible unless each unit of government assumes a share in the administrative and financial burdens.

Highway Administration

Third - For each unit of government participating in the highway program, there must be an administrative head and an engineering organization with authority and funds. The selection of competent personnel, their freedom from the changing winds of partisan politics and their continuance in the work, while, and if, rendering efficient service, will largely determine the character and cost of the improvements undertaken.

Close co-operation between the highway administrative organizations of the different governmental divisions is essential.

In this country, the planning and adoption of the Federal aid system of highways embracing 170,000 miles and covering the great area of the nation, is truly a triumph of co-operation between the States themselves and between the States and the Federal Government. And the States have had on the whole fine help from the county organizations.

Selection of Highway Types

Perhaps the fourth important principle is that the most durable roadway is not the most economical to use for a national improvement program. This may not be orthodox theory but it is a real truth nevertheless. True economy must concern the whole of a people and further must cover the total cost of highway transport. The limitations of time, finance, labor, materials interpose obstacles that restrict the possible annual construction of the most durable paved roadways to a relatively small mileage compared with the total demands for roadways improved to the degree of reasonable utility. Our railways taught us first the practical usefulness of progressive or stage construction; our highways as a whole demand this plan. This country varies from pioneer to highly developed districts, from desert to swamp, mountain to great prairies, so, all types of roadways are used. It has been well demonstrated that one of the great needs is for a long mileage of the lower cost roads and it has also been demonstrated that these lower cost

roads can be built up to wider stronger types when traffic demands and the funds are available. Since 1918, more than 33,000 miles of Federal Aid highways have been completed and about 50 per cent are surfaced with sand - clay and gravel. Some of these will in the future be paved but meanwhile traffic is being carried with greater economy than if the same funds had been used for the more durable type of construction. It will be evident we are attempting to secure both mileage of low cost roadways and continuous construction of the more durable roadways - each where economy dictates.

Highway Maintenance

Fifth. No matter what the construction, economy and satisfactory service can only be obtained through continuous highly organized maintenance. The splendid maintenance of the State and Federal Aid Systems by the State Highway Departments has been a major factor in the widespread and successful development of the highway transport.

Earning Capacity

These principles apply particularly to the administrative and engineering features of a highway improvement program, yet they do not carry the justification of such a national program. The justification is the earning capacity of improved highways. Research has made available definite information which takes the

earning capacity of the improved highway out of the realm of conjecture. It is made real.

First Example:- Tractive resistance of ordinary farm wagon with load - comparison during spring, wet weather.

	Tractive Resistance
Heavy soils, unimproved	400-530 lbs. per ton
Gravel surface, compacted	110-150 lbs. per ton

The same power would move four times the load on the gravel surface.

Same - dry weather condition.

Heavy soils, unimproved	186-215 lbs. per ton
Gravel, well compacted	50- 75 lbs. per ton

The same power would move three times the load on the gravel surface.

Second Example:- Rolling resistance - motor truck, solid tires, 10 m. p. h.

	Tractive Resistance
Earth roads, well maintained	55 lbs. per ton
Gravel roads, well maintained	45 lbs. per ton
Paved roads, well maintained	35 lbs. per ton

Note how the motor vehicle and the improved highway have lowered the tractive power required to move tonnage.

Third Example:- Vehicle operating costs on various types of improved roads. (Cost in cents per ton-mile.)

Type of Surface	Type and Speed of Vehicle: Solid tire trucks, speed 10 mi. per hr.	Pneumatic tire trucks, speed 16 mi. per hr.	Automobiles, 26 to 35 mi. per hr.
Average Portland cement concrete and asphalt filled brick	8.00	8.3	10.00
Best Portland cement and asphalt filled brick	7.75	7.70	9.3
Best gravel, yearly average	8.5	8.8	10.9
Ordinary gravel, yearly average	9.0	9.40	11.8
Waterbound macadam, well maintained	8.7	8.95	11.1
Bituminous macadam, well maintained	8.5	8.80	10.6
Average sheet asphalt yearly average temperature	8.10	8.3	10.00
Average asphaltic concrete yearly average temperature	8.00	8.3	10.00
Best earth, well packed by traffic, yearly average	9.0	9.40	11.70
Ordinary earth with light traffic, yearly average	9.5	9.95	12.6

A 5-ton truck operating an average of 50 miles daily, making 250 ton - miles per day, for 300 days would be 75,000 ton - miles per year. On the basis of the cost figures I have given, you will note that the difference of 1½ cents per ton - mile between an ordinary earth road and a good paved road would be $1,125 per year. Between the same earth road and an ordinary gravel road the saving on the operation of the truck would be $375 per year.