Dollar Needs to Preserve and Restore U.S. Roads

For almost two decades after the passage of the Federal-Aid Highway Act of 1956, the U.S. highway program benefited from a stable set of goals and finances. During the past several years, however, there have been growing indications of an impending crisis: expenditures needed to preserve the existing highway network are increasing, both because the highways are aging (1) and because of the impact of inflation on the cost of highway improvements (2). At the same time, increased automobile fuel economy, decreased rates of growth in per-capita travel, and tax exemptions for alcohol-gasoline blends are expected to limit future highway user revenues (3). In light of these factors, the National Transportation Policy Study Commission (4) concluded in 1979 that "forecast revenues from highway user charges will be insufficient to maintain current levels of service on the nation's roads."

With this prediction in mind, the General Motors Research Laboratories (GMR) recently undertook a study that examined the existing stock of U.S. highways. The purpose of this research was to measure highway maintenance and restoration needs that must be met by local, state, and federal highway programs. This study focused on several specific questions: (a) How much money is needed to preserve pavement conditions on the major U.S. highway systems? (b) What are the implications of current expenditure levels for future highway conditions? and (c) How much will it cost in future years to restore the nation's highways to their current levels?

Overview of Analysis

The estimates of "needed" expenditures presented in a GMR report (5) were based on some of the same data as earlier studies by the U.S. Department of Transportation (DOT) (6, 7). However, this study differed from those earlier efforts because it (a) focused on a single aspect of highway performance—pavement condition, (b) used both 1975 and 1980 conditions as standards against which to evaluate needed expenditures, (c) estimated pavement deterioration rates on a system-by-system basis, (d) provided estimates of future road conditions that help evaluate the probable impact of current expenditure levels, and (e) considered the impact of inflation on expenditures.

For the purpose of this study, "needed" expenditures were defined as those required either (a) to preserve the existing pavement conditions on a particular highway system or (b) to restore the pavement conditions on a particular highway system to those that existed at a previous point in time.

The study used a mathematical model of the pavement deterioration and improvement processes as a Markov chain to estimate current and future highway

conditions and to determine the expenditures required to preserve and restore the major U.S. highway systems (Interstates, arterials, and collectors). The model viewed pavement conditions on a highway system at the end of each year as a function of (a) pavement conditions at the end of the previous year, (b) the miles of highway improved during the year, and (c) the rate at which pavements on the highway system deteriorate. The model used data on 1969 and 1975 highway pavement conditions and 1970-1975 highway improvements to determine the deterioration rates for each system. These deterioration rates were then used with estimates of current and future improvement rates to project current and future highway conditions. The deterioration rates and condition projections then provided a basis for estimating the expenditures required to preserve and restore the three highway systems.

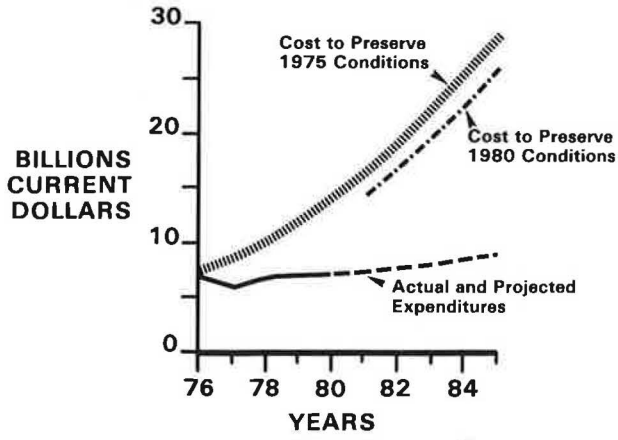

Figure 1. Capital expenditures needed to preserve pavement conditions on the existing U.S. Interstate, arterial, and collector highway systems exceed actual and projected expenditures through 1985.

Summary of Results

At the end of 1975, approximately 100 000 miles of Interstate, arterial, and collector highways had poor pavement conditions—as measured by the Present Serviceability Rating (PSR)—and were in need of resurfacing or reconstruction, (the PSR index is used extensively in the United States to measure road conditions and is based on subjective measurements of pavement conditions by trained observers). The GMR analysis indicated that approximately 26 000 miles of U.S. highways should have been resurfaced or reconstructed each year since 1975 to have kept pace with deterioration. The annual cost of improving this mileage has increased rapidly, from $7.9 billion in 1976 to $14.1 billion in current 1980 dollars.

On average, GMR research (2) has indicated that highway improvement costs increase over one-and-a-half times as fast as general U.S. wholesale prices. Thus, if the general inflation rate would average 10 percent annually, highway costs will increase at an average 15 percent annual rate. As a result, the cost of these required improvements may increase to as much as $28.9 billion by 1985.

Actual improvement expenditures on the Interstates, arterials, and collectors have not met these needed levels. The estimated $6.6 billion spent in 1976 was sufficient to finance 84 percent of the needed improvements. However, 1980 expenditures of $7.1 billion represented just over half of the level required. Based on currently legislated funding levels and the projection of historical growth rates for highway improvement expenditures, actual expenditures are projected to increase to $8.1 billion in 1985. These expected expenditures would represent 30 percent of the funds needed to resurface and reconstruct the 26 000 miles that need to be improved each year to preserve 1975 conditions. (See Figure 1.)

In order to preserve the highway systems at their reduced 1980 levels, 23 000 miles must be resurfaced or reconstructed each year from 1981 through 1985. These required improvements will cost $14.5 billion in 1981, compared with the projected improvement expenditures of $7.5 billion.

As a result of this gap between needed and actual improvement expenditures, GMR analysis identified significant declines in pavement conditions on each of the major highway systems. In 1975, approximately 1500 Interstate miles, or four percent of the system, were in poor condition and required resurfacing or reconstruction. By the end of 1980, an estimated 2800 miles were in poor condition. If current expenditure trends continue, as many as 5300 miles may be in poor condition by 1985. On the arterials, the portion in poor condition has increased from 7 percent to 10 percent. This translates into a 9000-mile increase in the number of arterials requiring extensive repair. Similar increases in the per-

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PERCENT OF MILES IN POOR CONDITION

	1975	1980	1985
INTERSTATES	4	7	14
ARTERIALS	7	10	18
COLLECTORS	10	12	17

Figure 2. As a result of the shortfall in highway resurfacing and reconstruction expenditures, pavement conditions have declined significantly on each of the major U.S. highway systems. The continuation of current expenditure levels will lead to further declines by 1985.

centage of miles in poor condition have occured on the collector highway system. (See Figure 2.)

As a result of these declines in pavement conditions, GMR analysis indicated that considerable expenditures would now be required to restore these systems to their 1975 levels. During the period 1976-1980, need estimates indicate that $53.6 billion should have been spent on the improvement of existing highways. Actually, $33.5 billion was spent, for an estimated shortfall of $20.1 billion. If the actual expenditures had kept pace with the needs during the period, $16.3 billion would be needed in 1981 to preserve the 1975 conditions. However, because these need levels were not met, it would now cost $40.1 billion in 1981 just to restore these systems to their 1975 levels. If current expenditure trends are continued until 1985, the cost to restore these systems to their 1975 levels will grow to nearly $120 billion. (See Figure 3.)

Unfortunately, current expenditure levels are not sufficient to preserve 1980 conditions. If projected expenditure levels are continued through 1985, it will cost $74 billion to restore these systems to the conditions they were in at the end of 1980.

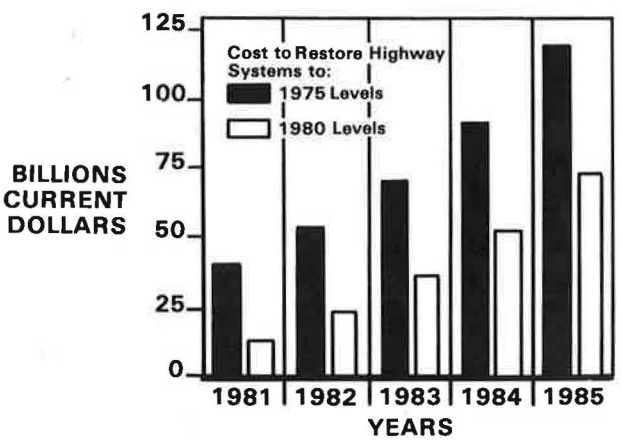

Figure 3. If projected resurfacing and reconstruction expenditures are not increased, it will cost almost $120 billion by 1985 to restore the Interstate, arterial, and collector highway systems to their 1975 conditions and $74 billion to restore them to their 1980 conditions.

Discussion

The shortfall between actual and needed improvement expenditures has been greatest (as a percentage) on the Interstate highway system. During 1978 to 1980, the actual expenditures for capital improvements such as resurfacing and reconstruction have been only 29 percent to 34 percent of those needed to preserve the 1975 pavement conditions. Despite the Interstate resurfacing, restoration, and rehabilitation increases authorized by the Federal-Aid Highway Act of 1978, the projected capital improvement expenditures for 1981 are less than half of the level required just to preserve the current (1980) conditions. Because the shortfall has been greatest on this system, the declines in pavement condition have been more rapid than those on the other systems.

While the shortfall, when viewed in percentage terms, has been greatest on the Interstate system, the amount of the shortfall in actual dollars is relatively small. In order to preserve the current (1980) conditions on the Interstate highways, the projected 1981 improvement expenditures would have to be increased by approximately $480 million (current 1981 dollars). This would represent just a 6.4 percent increase in the projected 1981 capital improvement expenditures on major U.S. highways and only a 3 percent increase in the roughly $15.5 billion that all governments are expected to spend in 1981 on highway capital investments (including new construction).

Although the shortfall on the arterial highway system represents a smaller percentage of actual expenditures, it is much larger in dollar terms. An estimated $5.6 billion will be spent on capital improvements on this system in 1981, compared with a needed level of $10.2 billion to preserve the current (1980) conditions. In order to finance the needed capital improvements, total capital improvement expenditures on major U.S. highways would have to be increased almost 61 percent.

An estimated $1.5 billion will be spent on capital improvements on the collector highway system in 1981, compared with a needed level of $3.3 billion to preserve the current (1980) conditions. In order to finance the needed improvements on the collectors, the total capital improvement expenditures on major U.S. highways would have to be increased by 25 percent.

In order to preserve the current conditions on all three major systems, 1981 capital improvement expenditures must be increased from a projected $7.5 billion to $14.5 billion (current 1981 dollars). This increase, however, is slightly less than the amount expected to be spent on the construction of new roads during 1981.

The results of the GMR analysis indicate that the major U.S. highway systems will continue to deteriorate unless current expenditure trends are altered. Possible policy options might include increasing the revenue available for highway improvement, readjusting the distribution of funds between improvement and new construction, changing maintenance and traffic characteristics to reduce the rate of pavement deterioration, and attempt-

ing to slow the rate of inflation. Although this study does not indicate which set of policy options should be adopted, it does indicate that prompt action is required in order to preserve the nation's investment in its major highway systems.

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