OBSERVATIONS AND CONCLUSIONS

A self-administered household travel survey appears to be satisfactory in eliciting detailed household and personal travel information. Data collected by the Capital District survey will be used by the CDTC central staff and others for several years in updating 1965 travel relationships currently used in travel forecasting and other activities. Combinations of data obtained will also permit analysis of trip-making characteristics of various "life-cycle" groupings of households, and median trip length information by geographic area will be useful in updating traffic simulation models. The technique appears applicable to other metropolitan areas and repeatable in the Capital District for a modest investment of staff and financial resources.

ACKNOWLEDGMENTS

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Application of the Highway Condition Projection Model to Interstate 4-R Repair

DAVID T. HARTGEN

ABSTRACT

Procedures developed by the New York State Department of Transportation to evaluate repair strategies for the Interstate Resurfacing, Restoring, Rehabilitating and Reconstructing (I-4R) Program are described. Two procedures were used: (a) 5-year work programs for projected I-4R expenditures, developed by the department's 11 regional offices and based on a preliminary allocation of funds to substate areas, and (b) regional-level quantification of current and projected pavement repair needs using the highway condition projection model (HCPM). Both methods produced generally similar results. The HCPM was generally able to identify sections in need of repair and the work required. Overall, the HCPM placed pavement needs estimates at $164 million for 5 years; if implemented, these actions would substantially improve the condition of older New York State Interstates. Regional cost estimates for work needed were higher than HCPM estimates because of included nonpavement improvements. The analysis concludes that an overall network view of repairs is useful in balancing more specific project assessments, which are best prepared by experts closest both administratively and geographically to the project.

Numerous studies have documented the existence of significant deterioration in the extensive system of U.S. roads. At the national level estimates of the repair bill for highways and bridges run upward from $100 billion (1). Although evidence from the most recent Highway Performance Monitoring Study (2) suggests that the condition of local and state roads is worse than that of Interstates, most recent attention has focused on the overall condition and carrying capacity of the Interstate system. Failure of an Interstate bridge in Connecticut and associated traffic problems have further increased public and press attention to overall repair requirements. Although the proportion of Interstates in poor condition is lower than that of other systems (3), this proportion has increased rapidly in recent years. Many Interstates were constructed in the 1960s and early 1970s and are now beginning to require significant repair. The Surface Transportation Assistance Act of 1982 provides additional funds for resurfacing, restoring, rehabilitating, and reconstructing Interstates (I-4R), and these funds have been substantially increased over previous allocations. Nevertheless, considerable concern exists as to whether funding for I-4R repairs will be sufficient to maintain the high quality of the existing system, which carries more than 20 percent of the nation's traffic.

Some of the procedures being used by the New York State Department of Transportation (NYSDOT) to evaluate the condition of Interstates and to develop repair strategies that will allow the state to maintain its Interstates in good condition are described. The approach taken in New York is to combine a strongly decentralized project selection process (done largely through the department's 11 regional offices) with an overall assessment of repair needs based on idealized repair strategies developed by a pavement management task force. Estimates of the longer range impact of repair strategies (condition and cost) are then made with the department's highway condition projection model (HCPM). These estimates are then compared with similar estimates developed by the department's regional offices. A further purpose is to evaluate the capability of the HCPM to assist in the development of highway repair programs. Of particular interest is the ability of the model to identify candidate projects needing work, both in the short and long term; to identify what actions should be undertaken at these locations and when; and to estimate the cost of the work.

It is concluded that the use of broad methodologies for network assessment is particularly important in the allocation of funds for the Interstate system and that such methods can also be useful in identifying specific immediate and future repair needs. However, decisions concerning priorities of pavement improvement versus other actions, as well as the specifics of design for particular road repairs, are best left to engineering judgment and analysts closest to the site, both administratively and geographically.

OVERVIEW OF METHOD

Figure 1 shows an overview of the procedure. The process begins with an assessment of total funds

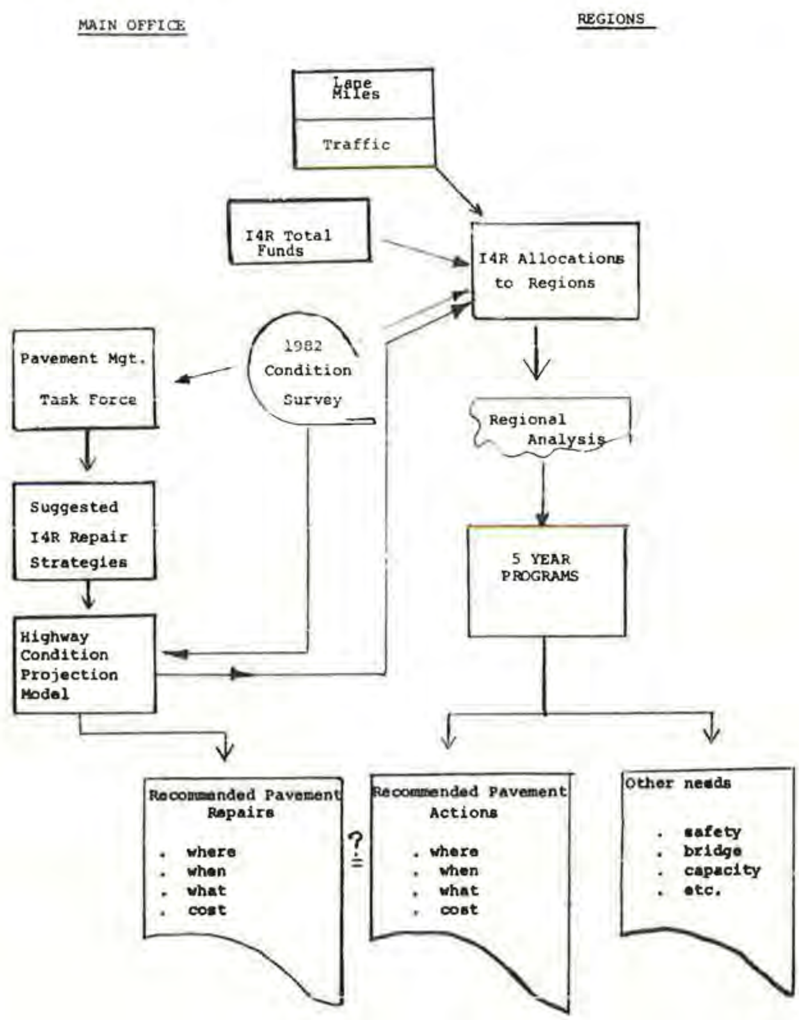

FIGURE 1 Analysis procedure for I-4R study.

available for the 5-year period (Table 1). Total I-4R funds available to New York ($530.5 million) are first reduced by the amount apportioned to the Thruway ($146.1 million). Remaining funds ($384.4 million) are then allocated to the department's 11 regions by the formula:

Allocations to regions = 75% (55% Int. lane-miles + 45% Int. VMT) + 25% (55% Int. bridge $ needs + 45% cost-weighted, pavement $ needs)

TABLE 1 NYS Regional I-4R ALLOCATIONS

Region	Prior Act[a]	Surface Transportation Act of 1982[a]
1 Albany	42.5	62.3
2 Utica-Rome	0.3	0.4
3 Syracuse	36.3	49.8
4 Rochester	18.0	26.5
5 Buffalo	8.9	14.4
6 Elmira	1.2	2.4
7 Watertown	10.9	17.7
8 Poughkeepsie	49.6	70.4
9 Binghamton	11.6	20.3
10 Long Island	–	–
11 New York City	83.3	120.2
NYS Thruway	100.2	146.1
Total	362.8	530.5

[a]In millions of dollars.

The first portion (75 percent) of the allocation is simply the federal formula based on lane-miles and VMT; the second portion (25 percent) adds factors for bridge and pavement needs. Pavement needs are developed from the 5-year estimates described herein weighted to account for different regional unit construction costs. Table 1 shows the allocation of funds to the department's 11 regional offices for the 5-year program.

On the basis of these allocations the regions analyze sections in need of repair and develop regional programs. The development of the program is undertaken largely by regional staffs with general guidance from the department's main office in Albany. Specific sections of highway to be repaired or otherwise improved are identified by the regions on the basis of their perception of various regional needs, including safety concerns, bridge repairs, capacity improvements, and pavement-related actions. Each regional office then submits a set of proposed repair actions for each of its funding categories including I-4R.

To provide a general state-level background to the regional assessments and to assist in the analysis of specific projects, the NYSDOT main office undertakes a separate assessment. This process begins with a current (1982) highway condition survey. This survey, which is an assessment of the condition of all sections of state touring routes (15,687 miles), is undertaken in the early summer of each year. This information, particularly the percentage of Interstates and other facilities in poor condition, was provided to the Department Pavement Management Task Force for analysis.

The goal of the task force was to develop recommended strategies for repair of the Interstate system. New York's Interstate system was largely constructed in the 1960s, although some sections are older. Three kinds of Interstate pavement are presently in place: rigid, flexible, and overlay (Figure 2). Analysis of the condition of these systems and of the recent history of deterioration of the systems showed that, for rigid Interstates, problems

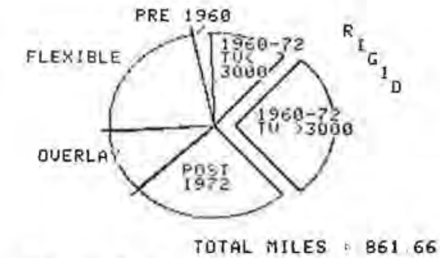

FIGURE 2 Miles of Interstate pavement groups.

with joint faulting are particularly severe for high-truck-volume roads that were built between 1960 and 1972. The reason for this is that load transfer devices between the concrete slabs have rusted through and failed, facilitating rocking movement. Some sections of Interstate, particularly I-84 north of New York City, are extensively faulted particularly in the driving (right-hand) lane where the highest percentage of trucking moves. Although other sections of highway exhibit various kinds of distress signals, the problems associated with faulting are believed to be the most severe on the current Interstate system.

Based on this analysis, the Pavement Management Task Force developed six groups of Interstates presented in Table 2 and Figure 2. For each group of Interstates, specific problems were carefully identified through detailed discussions with the task force and with regional and resident engineers.

TABLE 2 Pavement Groups

Pavement Group	Problems	Interstate Miles[a] (000s)
Rigid, pre-1960	Spalling, rutting Cracking Roughness	24.63
Rigid, 1960-1972, high truck volume (> 3,000)	Faulting > 1/4 in. Spalling Cracking	231.37
Rigid, 1960-1972, low truck volume	Faulting (less) Slight spalling	104.95
Rigid, post-1972	Slight spalling Surface and joints	209.12
Flexible	Cracking and rutting Some potholes	196.46
Overlay	Transverse joint reflection Edge spalling Rutting	95.13
Total		861.66

[a]Excludes Thruway.

Based on these analyses the task force then developed a set of recommended generalized repair strategies focusing on the maintenance of the rigid surface in as good shape as possible for as long as possible. Emphasis was on joint repair and protection of substructure, and the use of overlays for flexible and overlaid pavements as well as for rigid pavements with extensive surface deterioration but adequate base condition. The estimated costs of these repair actions and the resulting improvement in the overall condition of the pavement are given in Table 3.

These strategies, one for each pavement group, were then translated into input for the HCPM. This model, developed by the New York State Department of Transportation, projects the condition of each section of highway into the future using deterioration

TABLE 3 HCPM Input, I-4R Tests

HIGHWAY CONDITION PROJECTION MODEL

NYS DEPARTMENT OF TRANSPORTATION
TRANSPORTATION STATISTICS AND ANALYSIS SECTION

TEST DESCRIPTION: 1982 S-17 INTER BITUM? OVERLAY AT 12 YRS/COLD MILL AT 30? VOL = 0

PARAMETER INPUT DESCRIPTION

NUMBER OF YEARS PROJECTED	25			
REPORT TYPE REQUESTED	ALL SUMMARIES REQUESTED			
CURRENT YEAR INPUT	1982			
INFLATION RATES	10.9%	8.7%	7.6%	7.4%
INTEREST RATES	12.9%	14.9%	13.7%	12.0%

DETERIORATION RATES

RIGID		OVERLAY		BITUMINOUS	
SURFACE	BASE	SURFACE	BASE	SURFACE	BASE
.21	.21	.40	.35	.32	.32

DESCRIPTION OF REPAIR ACTIONS ******************

ACTION NUMBER	DESCRIPTION	IMPROVEMENT IN SURFACE	IMPROVEMENT IN BASE	COST TO REPAIR MIL $/2LA MILE	PERCENT OF COST CAPITALIZED	ECONOMIC SERVICE LIFE	ENDING PVMT TYPE
1	MED. RECONST-PCC	7.0	7.0	1.000	100	25	RIGID
4	RECON RESURF PCC-OV	6.0	6.0	.500	80	20	OVERLAY
5	ML OVERLAY PCC -> OV	4.5	4.5	.200	80	15	OVERLAY
6	CM RESURFACE PCC-OV-OV	3.0	3.0	.120	80	07	OVERLAY
7	GRIND OR. LA/RESEAL PCC	0.4	2.5	.070	80	05	RIGID
8	PATCH SPL/RESEAL-PCC	0.5	1.0	.016	80	05	RIGID
13	MED. RECONST-BITUM	7.0	7.0	1.000	100	25	BITUM.
15	ML OVERLAY PCC-OV POST 72	4.5	3.0	.200	80	12	OVERLAY
16	CM RESURF-AC-AC-AC	2.0	2.0	.120	80	07	BITUM
17	GRIND OR. LA/PATCH SPL/RESEAL	0.8	2.5	.100	80	07	RIGID
25	ML OVERLAY AC-AC	4.5	3.5	.200	80	10	BITUM

STRATEGY MATRIX (ACTION # AT CONDITION X,X) ******************

rates supplied by the user. The model then applies a recommended repair strategy to the section and keeps track of information on necessary repair costs by year, pavement type, federal-aid class, and region. The model is extremely flexible and capable of analyzing a wide variety of repair strategies. It is further discussed elsewhere (4); Figure 3 shows its structure.

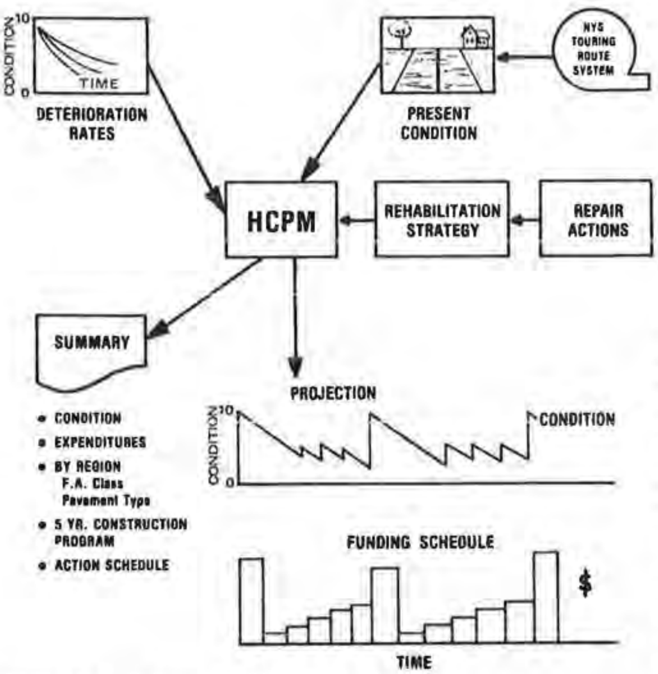

FIGURE 3 Highway condition projection model.

A sample strategy matrix for the actions listed in Table 3 is shown in Figure 4. The numbers within the matrix identify repair actions that would be undertaken when the section deteriorates to the condition shown. For example, a section of pavement in group 1 (rigid pre-1960) would be repaired using a multilayered overlay (action 5) when its condition

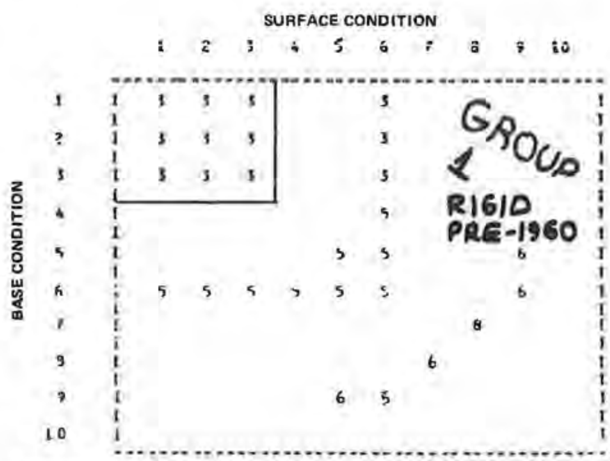

FIGURE 4 Sample study matrix.

had deteriorated to the 6-6 level. The condition scale used to assess highway condition here is one developed by the New York State Department of Transportation using photographs to score roads rapidly in the field. This scale is discussed thoroughly in other reports (5,6). The strategy matrix also shows a box in the upper left-hand corner; this is the minimum condition matrix; that is, the condition level below which roads will be not allowed to deteriorate. This matrix is used in combination with a lane-volume cut-off criterion identifying sections to which the strategy matrix should be applied. In the example discussed here the lane cut-off criterion was set at zero; thus the strategy matrix would be applied as shown to all highway sections in the group.

To account for different deterioration rates for various kinds of pavements and for the effect of traffic on deterioration, the model was supplied with deterioration rates given in Table 4. These deterioration rates were developed by analyzing the deterioration of existing sections of New York State highways.

The output of the HCPM is an estimate of overall condition of each group of pavements, necessary repair needs by region, federal-aid class, and type,

TABLE 4 Deterioration Rates[a]

Pavement Group	Rigid		Flexible		Overlay	
	S	B	S	B	S	B
1	.21	.21	.35	.35	.32	.32
2	.30	.30	.45	.35	.32	.32
3	.20	.20	.35	.30	.32	.32
4	.21	.21	.40	.35	.32	.32
5	.21	.21	.40	.35	.32	.32
6	.21	.21	.40	.35	.32	.32

Note: S = surface and B = base.
[a]Points per year; ten-point scale.

for each year of the projection. Examples of these outputs are available elsewhere (4).

GENERAL RESULTS FROM HCPM

In the remainder of this paper the results of the HCPM forecast are summarized and compared with the proposed strategic actions developed by the regional offices. Table 5 gives the effect of the strategies on the overall condition of and necessary repair costs for the Interstate system. First-year costs are estimated at approximately $55.9 million, resulting in a significant improvement in the overall condition of all groups of Interstates except the newest rigid Interstates constructed after 1972 (group 4). Estimated 5-year pavement-only investment requirements, (that is, funding estimates corresponding to the 5-year program submitted by the regional offices) total $163.9 million and if implemented would result in an improvement in the average condition of the system. However, older sections of Interstates would be markedly improved under this strategy sequence, and newer sections of Interstates, not needing extensive repairs in the next 5 years, would continue to deteriorate and thus the total average would be only slightly higher than the 1982 condition. On balance, therefore, the model suggests that about $164 million over 5 years would be sufficient to maintain the overall condition of the Interstate system at its present level but that this funding would have to be concentrated, particularly on the rigid 1960 to 1972 high-truck-volume category and on flexible pavements (Figure 5). Over the 10-year horizon the distribution of financing would shift slightly away from group 1 (because these routes would be worked on the first 5 years) and increase for the rigid 1960 to 1972 heavy-truck-volume facilities (Figure 6).

The distribution of funds by action type is given in Table 6. The focus of the 5-year program (44 percent) is on multilayered overlays to be added on top of the existing poor concrete pavements. Coldmilling and resurfacing of asphalt concrete pavements account for another 22 percent of the work. Joint repair (actions 7, 8, and 17) account for approximately 5 percent of the work. Because the Interstate system is in relatively good condition, only 4 percent of funding is necessary for major reconstruction resurfacing.

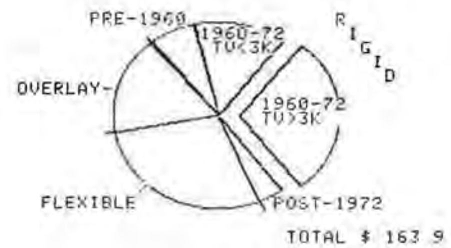

FIGURE 5 Five-year funding by pavement group.

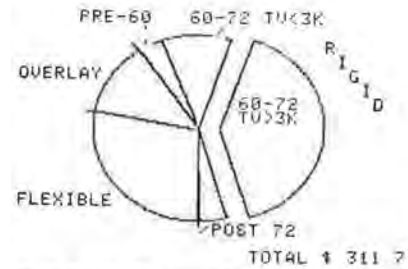

FIGURE 6 Ten-year funding by pavement group.

TABLE 6 Distribution of I-4R Repairs by Type: 5-Year Program

Action No.	Description	Percentage of Miles	Percentage of Funds
3	Med. reconst. PCC	—	—
4	Reconst./resurf. PCC-OV	1.0	4.0
13	Med. reconst.–bitum.	—	—
5	ML overlay PCC-OV	27.0	43.9
15	ML overlay PCC-OV post 1972	1.3	1.2
16	CM resurf. ACC-AC-AC	28.0	21.9
25	ML overlay AC AC	6.2	8.0
6	CM resurf. PCC-OV-OV	16.3	15.8
7	Grind DL/reseal PCC	7.2	3.4
8	Patch spl./reseal PCC	13.0	1.8
17	Grind DL/patch SP/reseal	—	—
Total		100.0	100.0

Note: Dashes = not applicable.

TABLE 5 Effect of Strategies on Condition and Repair Costs for Interstate System

Group No.	Description	1982 Condition			1-Year Effect			5-Year Effect			10-Year Effect		
		Miles	S	B	$	S	B	$	S	B	$	S	B
1	Rigid, pre-1960	24.63	6.1	6.2	5.1	[7.9]	[8.0]	11.6	[8.7]	[8.7]	11.6	[6.9]	[6.9]
2	Rigid, 1960-1972, HTV[a]	231.37	6.9	6.8	16.8	[7.1]	[7.2]	47.5	6.9	[7.2]	124.2	[7.9]	[8.6]
3	Rigid, 1960-1972, LTV[b]	104.95	7.0	6.4	9.1	[7.4]	[7.3]	23.7	[7.7]	[7.9]	34.0	[7.3]	[7.6]
4	Rigid, post-1972	209.12	8.6	8.4	2.1	8.5	8.3	6.8	7.9	7.9	13.9	7.3	7.6
5	Flexible	196.46	7.7	7.8	12.7	[7.9]	[8.1]	46.2	[8.3]	[8.3]	88.5	[8.7]	[8.7]
6	Overlay, 1982	95.13	7.4	7.3	10.1	[7.8]	[7.8]	28.1	[8.2]	[8.3]	39.5	7.5	[7.9]
Total (average)		861.66	(7.5)	(7.4)	55.9	[(7.8)]	[(7.9)]	163.9	[(7.7)]	[(7.8)]	311.7	[(8.0)]	[(8.1)]

Note: Tests based on strategies in 1/20/82 PMTF memorandum; S = surface; B = base. [ ] = improved condition.
[a]HTV = high truck value (>3000).
[b]LTV = low truck value (<3000).

REGIONAL ANALYSIS

The comparison of regional results was undertaken as follows. Careful reviews were made of the 5-year work programs submitted by each of the regional offices. From these work programs, all sections identified for Interstate 4R work were extracted and reviewed for work involving pavements. These sections were then compared with specific sections identified by the HCPM. Comparisons were made of

1. Specific locations,
2. Time frame of the period when work is necessary,
3. Nature of specified work, and
4. Estimated costs.

Table 7 provides a complete summary of each of the sections identified for repairs by HCPM and by regional analysis. The comparison by region is described next.

Overall, the best agreement between the analysis recommended by the model and that by the regions is for regions 7 (Northern Adirondack) and 8 (Poughkeepsie). In these cases both the regional analysis and the model identify largely the same sections of Interstate and in general estimate the same nature of work required by these sections. In these two regions estimated costs from the regional analyses tend to be slightly lower than the cost estimated by the HCPM (the reverse is usually the case). Sections not included in the regional analysis but included in the model tend to need work fairly late in the program. This may indicate that it is unreasonable to expect the regional analysis to identify sections that have not yet deteriorated extensively.

Less agreement is apparent in the comparisons for regions 1 (Albany), 3 (Syracuse), 5 (Buffalo), and 9 (Binghamton). In these cases the model identifies a larger number of sections requiring work, particularly toward the end of the 5-year program. In region 1, for example, both the regional analysis and the model identify similar sections, particularly rigid sections, for the short term. However, the regional analysis does not identify flexible and overlay pavements projected to deteriorate within the 5-year time frame. The patterning is similar for region 5 (although the results here are quite good) and for regions 3 and 9. In general, cost estimates from the regional analysis appear to be somewhat higher than those estimated by the model. This is because the regional estimates include additional work deemed to be necessary as part of the rehabilitation of the section, whereas the model makes cost estimates based only on the pavement work.

Greater disagreement is apparent in the comparisons of region 2 (Utica-Rome) and region 6 (the Southern Tier) although a very small number of sections are involved in each case. In both of these cases the model identifies work likely to be needed within the 5-year time frame, but the regional analysis does not include expenditures for this effort. In the case of region 2 the section of I-790 in Utica is presently in poor condition; in region 6, I-390 in the town of Avoca is presently in good shape and has not deteriorated.

For region 4 (Rochester) and region 11 (New York City), priorities for capacity, safety, and bridge funding account for the large discrepancies between the two analyses. In both cases the regional assessment focused on increases in capacity, safety work, and bridge repairs. In region 4 work is proposed for increases in capacity and a resurfacing effort associated with the Can-of-Worms (a large interchange southeast of the city) even though other sections of I-490 through the city of Rochester are identified by the model for needed repairs. In New York City the needs far outstrip the funding program. Although the model identifies a large number of sections of Interstate that are in need of repair and generally in poor condition, only a few of these are programmed; analysis of the region 11 program shows that the funds are going into bridge repair and safety work that is believed to be critical.

In general, the model seems to operate best in identifying pavements presently in poor shape and in specifying the nature of the work required. The mileage identified for action is generally larger from the model than from the regional analyses. This is because the model includes sections that are not yet in poor shape but are projected to deteriorate within the 5-year program. The regional analysis focuses on sections that are currently in poor shape, and less attention is paid to sections projected to be in that condition within the 5-year time horizon.

CONCLUSIONS AND DISCUSSION

This example suggests that a combination of decentralized decision making for specific projects and an overall network assessment is useful for program assessment. In NYSDOT experience, the highway condition projection model was found to generally be capable of identifying sections in need of repair both in the short term and over the horizon of the program. The model was found to be generally accurate in identifying the nature of the work required; however, it was less able to specify the precise costs of actions because regional costs vary and because elements of work in addition to pavement repair are often included in regional programs.

A particularly important conclusion is that the model looks ahead to the end of the time frame. Most of the regions focused on the current time and paid less attention to longer term efforts that may be needed. Regional accounts therefore often contain fewer, but more expensive, jobs.

The results also point to important concerns that should be kept in mind in using aggregate network tools for regional assessments. Perhaps the most important distinction is that the program is rightly based on a number of factors in addition to pavement condition. The regional assessments include such factors as safety, bridge work, capacity, and congestion needs as well as subregional geographic allocations. These factors, in practice, mean that there will be differences between the results of allocations based on any tool like the HCPM (even a complex one) and assessments based on regional views. The position of NYSDOT is that both assessments are valuable. The department is largely a decentralized operation in which the regional offices are responsible for the development of these programs; the availability of a highway condition projection model does not obviate the need for such assessment at the local level nor does it take away the responsibility for such assessment. It is unlikely that tools such as the HCPM will ever replace regional judgment because the development and operation of such tools in a centralized fashion presumes the existence of allocation rules that place a prespecified weighting on different factors. It is the view of NYSDOT that such weighting is best left to the judgment of those department experts who are closest administratively and geographically to the problems.

The model was found to be useful in structuring the overall size of the program and in placing local

TABLE 7 Comparison of I-4R Program, HCPM Versus Regional Analysis

					HCPM ANALYSIS			REGIONAL ANALYSIS		
Map Location	Pvt. Type	Description	Approx. Length	82 Cond.	When	What	Cost	When	What	Cost
REGION 1										
A I-87	R	From I-90 to 1/2 Mi. S of Mohawk	7.9	6/5	82	Overlay	4.7	-	-	-
B I-87	R	1/2 M. N of Exit 9 to Exit 13	10.2	6/6	84	2.5" Overlay	6.5	84	4" Overlay	$11.0
C I-87	R	Exit 16 to 1/2 Mi. S of 17	3.5	5/5	82	2.5" Overlay	2.6	84	4" Overlay	$ 5.0
D I-890	R	3/4 Mi. from Sch. to Sch. city line	3.0	6/6	84	2.5" Overlay	.9	84	4" Overlay	$ 4.0
E I-87	F	1/4 Mi. N of 14 to Exit 15	2.0	6/6	85	2.5" Overlay	.9	-	-	-
F I-87	F	2 Mi. N of 17 to Hudson River	.5	6/6	85	"	.2	-	-	-
G I-87	F	Hudson River to Exit 19	4.0	6/6	85	"	2.8	-	-	-
N I-90	F	Exit 10 - 12, Rens. Co.	6.5	7/7	84	"	1.3	84	Overlay	$ 4.0
H I-90	O	Fuller Rd. - 1/2 Mi. W of Exit 3	.25	8/8	85	Patch Reseal	.007	-	-	-
I I-90	O	Albany City Line-Rt. 32	1.5	8/8	85	"	.070	-	-	-
J I-87	O	Essex Co.(all)	25	7/8	85	Cold Mill resurface	$ 13	-	-	-
K I-87	O	Alb. Co. 1/2 Mi S of Mok.	.5	7/8	85	"	.25	-	-	-
L I-87	O	Mohawk River Exit 9	4.25	8/7	84	Cold Mill resurface	2.0	-	-	-
M I-87	F	Exit 24 Essex Co. Line	14	8/7	84	"	3.6	-	-	-
REGION 2										
A I-790	R	Utica Rt. 5A - Thruway	1.0	5/5	82	Overlay	.3	-	-	-
REGION 3										
A I 81-690	O	81-690 interchange	2.5	8/8	-	-	-		R&P	8.0
B I 81	O	Tully (Exit 14) Exit 16	6.0	6/6	85	Overlay	1.8	84	R&P	7.5
C I 81	R	Exit 12 - Tully (Exit 14)	12	6/6	85	Overlay	2.3	84	R&P	9.0
D I 81	R	Thruway - Rt. 481	4	77	85	Overlay	2.0	85	R&P	1.6
E I 81	R	Exit 32 - 33	7	87	85	Joint work reseal	.5	-	-	-
F I 81	F	Exit 33 - 35	7	86	85	Cold Mill resurface	1.5	-	-	-
G I 81	O	Exit 16A - Rt. 175	2	87	84	Cold Mill resurface	1.2	-	-	-
REGION 4										
A I 490	R	Monroe Co. Line 1/2 M.W. of Rt. 36	4.4	67	84	Overlay	1.7	-	-	-
B I 490	R	Rt. 259 - Rt. 204	4.9	65	82	Overlay	2.0	-	-	-
C I 490	R	1/2 M. W. of Rt. 33 - I-390 Int.	3.1	67	84	Overlay	1.6	-	-	-
D I 490	R/B	Clinton Ave. - Winton Rd.	2.8	66	82	Overlay	2.1	84	resurface	3.2
E I 490	R	Can-of-worms - Rt. 96	7.3	77	85	Overlay	3.0	-	-	-
F I 490	F	Rt. 96 - Thruway x 45	.4	76	84	Overlay	.1	-	-	-
G I 390	O	various,Rochester, Gates	2.6	77	85	Overlay	.9	-	-	-
H I 590	O	1 Mi. S of Rt. 31 - I 490	3.0	66	84	Overlay	.6	82	(add lane cow) Resurf.	6.7

TABLE 7 (continued)

Map Location	Pvt. Type	Description	Approx. Length	82 Cond.	HCPM ANALYSIS When	HCPM ANALYSIS What	HCPM ANALYSIS Cost	REGIONAL ANALYSIS When	REGIONAL ANALYSIS What	REGIONAL ANALYSIS Cost
REGION 5										
A I 190	R	I 90-N. Grand Isl. Bridge	21.5	32 to 66	83	Recont Overlay	19.7	83	Recon Repave	$22.0
B I 290	R	I 190 - I 90	9	65	83	Overlay	4.3	83	"	2.1
C I 190	R	N Grand Isl. Brdg.-Lewiston	7	66	84-85	Overlay	2.7	-	-	-
REGION 6										
I 390	R	Avoca T L - Steuben Co. Line	21	98	87	Joint Reseal	NA	-	-	-
REGION 7										
A I 87	F	Essex Co. Line - Salmon R. Rd.	10.3	67	85	Overlay }	9.8	84	Overlay	2.9
I 87	F	Salmon River Rd. 3 M. N.of 456	14.3	77	85	Overlay }		-	-	-
B I 87	F	Miner Farm Rd. - Canadian Border	7.6	67	85	Overlay	2.7	84	"	1.9
D I 81	F	Jefferson Co. Line-Adams/Hounsfeld Line	16.9	67	84	Overlay	6.7	84	"	4.6
E I 81	F	Exit 48-5.72 Mi. N.	5.7	67	84	Overlay	2.3	84	"	1.3
F I 81	F	Rt. 411 - Rt. 12	9.3	77	84	Overlay	2.3	-	-	-
REGION 8										
A I 84	R	Penn. Line - Conn. Line	72	76	23 locations, 37 Mis	Grind DL, reseal	$6.1	138 lane miles	Joint Repair	$ 4.1
B I 287	R	Thruway - NE Thruway	11	66	13 locations, 7.1 Mi	Overlay	$3.3	Safety bridge reconditioning		NA
C I 587	R	Kingston	1.2	66	84	Overlay .6 Mi	.2	-	-	-
D I 684	R	I287 - I84	28	66 87	85	Grind DL, reseal 5.8 Mi.	2.1	84	Joint Repair	$ .6
E I 84	R	Rt. 311 - Ludingtonville	3.6	88	-	-	-	84	Joint Repair	$ .5
REGION 9										
A I 81	R	Rt. 17 - Rt. 7 Overcrossing	4.3	65	82	Overlay	2.2	84	R&P	$ 8.0
B I 81	R	Binghamton - Broome Co. Line	23	76	82	Overlay	4.2	82	Overlay (5 Mi. only)	$ 3.6
C I 88	R	Begn I 88 - Chenango Br.	4.2	65	82	Overlay	1.1	-	-	-
D I 88	F	Colesville	2.9	87	83	Cold Mill Resurface	.2	-	-	-
E I 88	F	Afton-Bainbridge	6.5	77	83	Overlay	2.4	-	-	-
F I 88	R	Sidney - Rt. 357	7.2	87	84	Repair Joints	.3	-	-	-
G I 88	R	Otsego-Del. Co. line CR-47	12.7	88	85	Reseal joints	.6	-	-	-
REGION 10 - Not analysed (no interstate)										
REGION 11										
A I 95	R	Cross Bronx. Ex: Bronx R. Pk - I-295	3.5	66	84	Overlay	NA	-	-	-
B I 278	R	Staten Is. Ex: West Shore Ex - Richmond Rd.	4.6	56	84	Overlay				
C I 278	R	Brooklyn Qu Ex: 65th St. - Newton Creek	9.1	66 to 44	84	Overlay & Reconst.	NA			
I 278	R	BQE: Queens Bv - Grand Cent. Parkway	1.4	55	84	Overlay		84	Recon	15.7
D I 278	R	Buchner Exp. Randalls Isl - Hutchinson R. Pk.	4.1	66	84	Overlay				

TABLE 7 (continued)

E	I 295	R	Clearview Exp. 35th - 73rd	2.0	66	84	"
F	I 295	R	Cross Bronx Ex.: Bruckner Connection	.5	66	"	"
G	I 495	R	LIE: Kissena Blvd. NYC Line	5.7	55 76	84	Overlay, Grind reseal
H, J	I 678	R	Van Wyck: Nassau Ex. - Interboro Pkwy.	5.6	65 - 76	84	Overlay grind, reseal
K	I 895	R	Sheridan Ex: Bruckner Cross Bronx	1.1	66	84	Overlay
L	I 87	0	Maj. Deegan 3rd Ave. - NYC line	7.2	76	84	Cold Mill Resurface
M	I 95	0	Cross-Bronx: GWB - Bronx R. Pkwy.	4.4	77	85	Cold Mill Resurface
N	I 278	0	Bruckner:Bronx R.- White Pl. Rd.	1.3	66	83	"
P	I 278	0	BQE: Newton Crk. Queens Bvld	1.9	54 - 77	83	Cold Mill Resurface/Overlay

concerns in state perspective. The model was reasonably accurate in identifying major sections in need of repair and in forecasting future repairs. In this sense, therefore, it provides a balanced assessment of overall allocation strategies.

Given this role, what is the best strategy for using such a tool? In our judgment its best operation would be in the hands of regional analysts. Armed with such a procedure, regional analysts could themselves evaluate the long-term funding implications of locally developed repair strategies. This information could then be balanced with other needs for capacity, bridges, and so forth to develop a balanced program at the regional level. The department is presently working to decentralize the highway condition projection model so that it will be available in an on-line fashion to the regions in conjunction with their own highway condition files and other information. In this way strong pavement management principles tempered by sound local judgment and local concerns beyond the strict engineering of pavements can be combined in a successful management program.

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