The driver can be induced to divert if given timely information needed to make the correct decision.

ACKNOWLEDGMENTS

This paper discusses one phase of a research project entitled A Survey of Motorist Route-Selection Criteria, which was conducted by the Texas Transportation Institute and sponsored by the Federal Highway Administration. The contents of this paper reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented. The contents do not reflect the official views or policies of the Federal Highway Administration. The paper does not constitute a standard, specification, or regulation.

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Publication of this paper sponsored by Committee on Motorist Information Systems.

Motorist-Aid System on a Rural Freeway: The Illinois Experience

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The state of Illinois has installed an experimental motorist-aid telephone system along 221 km (138 miles) of I-80 between Rock Island and Joliet. The system consists of 302 roadside terminals in pairs, one telephone in each direction of travel, at approximately 1.6-km (1-mile) intervals. Before and after studies were conducted to evaluate the effectiveness of the system in terms of system use, response time, convenience, reliability, and costs. The sources for these data were stopped-vehicle surveys, state police assistance-rendered reports, service-unit assistance-rendered reports, a public-opinion survey, and a motorist-aid system-use survey. The major findings were that (a) approximately 24 percent of all I-80 aid candidates are using the motorist-aid system, (b) the average time between incident occurrence and police notification is reduced from 15.5 min in the before period to 12.8 min in the after period and to 9.6 min when the aid telephones were used, and (c) the cost-effectiveness of the system, considering accident reduction and time saved only, is in the 0.6 to 0.7 range for the total investment.

The state of Illinois has installed an experimental motorist-aid telephone system along 221 km (138 miles) of I-80 between I-74 (Rock Island) and Ill-43 (Joliet). The system consists of 302 roadside terminals in pairs, one telephone in each direction of travel, at approximately 1.6-km (1-mile) intervals. The Illinois Department of Transportation (IDOT) owned system is a two-way voice carrier, hard-wire (25 pairs) installation, operated through the state police headquarters near Joliet (police district 5) and Rock Island (police District 7). Toll-free calls from motorists requiring assistance are answered by a police desk sergeant, who either dispatches the necessary services or provides the required information.

The primary goals of the system, as defined in a 1968 feasibility study (1), were

1. To provide aid in an efficient manner to the motorist in need,
2. To minimize the hazard caused by the motorist in distress, and
3. To keep traffic flowing.

The secondary goals, which have varying degrees of importance, were

1. To maximize the service quality,
2. To maximize the extent and quality of upstream warnings of hazards,
3. To maximize the use of existing and planned resources,
4. To minimize the system obsolescence, and
5. To provide for the collection of adequate statistical operative data to analyze and evaluate the performance of the system and ensure legal backup for each incident in case of motorist suit.

SYSTEM EVALUATION

In the evaluation program, the pertinent measures of effectiveness were defined and placed in three categories—system use, response time, and convenience. The evaluation consisted of before and after studies related to the costs of the system and the measures of effectiveness (2, 3).

The measures of effectiveness related to system use were

1. The system-utilization ratio, i.e., the ratio of the number of system activations by aid candidates to the total number of aid candidates;
2. The system-efficiency ratio, i.e., the ratio of the number of successful motorist aids to the total number of aid candidates; and
3. The system-success ratio, i.e., the ratio of the number of successful motorist aids to the number of system-aid activations.

In the before study, an activation was defined as a

stop of an aid candidate on or alongside the road. In the after study, an activation was defined as the attempt of a motorist to convey a need for aid through the communication terminal. An aid candidate was defined as a stopped motorist who needed assistance from one of the services provided by the motorist-aid system (such as the police, medical, fire, mechanical, or information services).

The measures of effectiveness related to the response-time category were detection and need-definition times, the time to scene, the time on scene, and the time to aid center or base.

The measures of effectiveness related to convenience were (a) ability to provide precise need definition, (b) safety (primary and secondary accidents), and (c) the opinions of aid candidates regarding system performance.

The studies and sources of data for the evaluation of the system included (a) stopped-vehicle surveys (which measured system use and response time), (b) state police assistance-rendered reports (which measured response time), (c) service units assistance-rendered reports (which measured response time and system use), (d) I-80 accident reports (which measured response time, system use, and convenience), (e) a public-opinion survey (which measured convenience, system use, and response time), and (f) a motorist-aid system-use survey (which measured system use).

Stopped-Vehicle Surveys

Two before (September 1969 and March 1970) and one after (August 1973) stopped-vehicle surveys were conducted, each for 24 h/d for a week, on a 14.5-km (9-mile) section of I-80. In the two before studies, 857 and 438 vehicles respectively were spotted stopped; in the after study, the number of stopped vehicles observed was 861. The means of the duration of stops were 13.4 and 13.7 min for the before studies and 12.6 min for the after study. However, statistical analysis could not establish a significant difference.

The percentages of stopped drivers that could be considered aid candidates because of their apparent reason for stopping were approximately 12 and 14 for the two before studies and 25 for the after study. The system-use measures of effectiveness for the 36 observed cases of aid-telephone use during the after stopped-vehicle surveys are given below.

Ratio	Value
System utilization	0.17
System success	0.67
System efficiency	0.11

The rate of aid-candidate stops per vehicle kilometer of travel was 1 stop/16 340 vehicle·km (1 stop/8600 vehicle miles). [This rate is significantly higher than the rate of 1 stop/32 000 vehicle·km (1 stop/20 000 vehicle miles) advocated by previous studies.] Because of the small sample (0.5 percent of the total travel), the latter rate was used hereafter.

State Police Assistance-Rendered Reports

In the before study (August 1969 to October 1971), 3040 assist reports were collected (117 assists/month). In the after study (April 1973 to April 1974), 729 assist reports were obtained (61 assists/month). The reduction in the number of reported assists could be attributed to the following effects: the shift from giving directional information by police patrol to giving it through the motorist-aid system, the fading enthusiasm of the police in filling the assist forms, and the reduction in total travel due to the energy shortage.

In district 5, the police patrol was nine officers and nine vehicles during the before study and seven officers and seven vehicles during the after study. In district 7, the patrol level was increased from six officers and six vehicles to nine of each. These changes were made due to organizational changes in the police districts.

The average motorist waiting time for field assists increased from 13.4 min during the before period to 20.5 min in the after period. The average police on-scene time increased from 22.3 min during the before study to 30.2 min during the after study. Both of these increases can be attributed in part to the elimination of most of the short-time field assists, such as information aid, from the after sample.

Part of the after study period fell within the period of the energy shortage and the reduced (20 percent) speed limit (January to April 1974). If the motorist waiting time is adjusted for this speed-limit reduction, the difference between the before and after values for the corresponding patrol levels could have been an increase of nearly 3.5 min.

Service-Unit Assistance-Rendered Reports

In the before study (December 1969 to May 1972), a total of 521 assist forms were received. Three service units (6 percent of the submitting units and 1.2 percent of the contacted units) were responsible for the return of 73.7 percent of them. These service units operated over 41.3 percent of the length of the study section.

In the after study (April 1973 to June 1974), 320 assist forms were returned, of which 82 percent were sent by three service units operating over 37.4 percent of the study section. The averages for the time to scene, time on scene, and time to aid center or base differed significantly in the before and after study, as shown below:

Time	Before (min)	After (min)	Change (%)
To scene	20.9	16.4	21.5
On scene	23.4	17.4	25.6
To aid center or base	27.7	19.0	31.4

The differences in the time to scene and time to aid center or base are quite significant, especially when the effect of the speed-limit reduction is also considered. The time to scene and the time on scene for ambulances and fire units were not significantly different in the before and after studies. The vehicle-service assists reported in the after study involved aid-telephone notification for 70 percent of the sample.

The same two service units accounted for 60 and 70 percent of the reports in the before and after study periods respectively. This prevents analyzing the contribution of the optimal service-coordination capability of the telephone system and suggests that other factors could be responsible for the significant differences in the time to scene and the time to aid center or base.

The significant reduction in the time on scene during the after study could also be related to a reduction in the percentage of assists by service vehicles patrolling the road. Such a decrease could reduce the probability of prolonging the time on scene, if the service vehicle is not fully equipped to handle the disability.

I-80 Accident Analyses

Of the 752 yearly accidents reported in the before study period (August 1969 to May 1972), 71 were of the secondary type, and of the 723 yearly accidents in the after study period (April 1973 to April 1974), 27 were of the secondary type. The reduction in the number of secondary accidents far exceeds the 23 percent (4) expected from the reduced travel and speed during the gasoline shortage and thereafter.

In addition, this apparent reduction more than offsets the 13 accidents involving aid telephone poles. However, because of the small sample sizes, no conclusions as to a statistically significant effect of the motorist-aid system on the reduction in secondary accidents can be made.

In the case of accidents, the motorist-aid system was used to notify the police in 46 percent of the cases. For all I-80 accidents, the aid-telephone system-use measures of effectiveness are given below.

Ratio	Value
System utilization	0.46
System success	1.00
System efficiency	0.46

The average time to notify the police was reduced from 15.5 min in the before study period to 12.8 min (9.6 min when the aid telephone was used, with 72 percent of such calls made by passing motorists) in the after study period and was found to be statistically significant. The effects of the motorist-aid system on the recovery of the ill and of accident victims could not be determined because it was impossible to obtain the necessary data from the various health agencies. However, the reduction in time to notify the police by an average of 2.7 min could only have had positive effects.

Public-Opinion Survey

In the before study (December 1969 to May 1972), approximately 1700 questionnaires were distributed by the police when assisting, but only 231 (15 percent) were returned. In the after study (April 1973 to April 1974), only 88 questionnaires, out of an unknown number distributed, were returned.

In general, the after respondents were aware (93 percent) of the I-80 motorist-aid telephone system and favored (63 percent) its expansion. Nearly half (49 percent) of the respondents had used the system. More than 90 percent of the respondents found the 1.6-km (1-mile) spacing between the aid telephones about right.

After the installation of the system, nearly 89 percent of the respondents were not unduly delayed in being detected, compared to approximately 76 percent before the installation. Nearly 70 percent of the respondents in the before study were not unduly delayed in receiving service, compared to approximately 90 percent in the after study.

Motorist-Aid System Use

There were 17 689 activations registered on the audio tapes from motorist-aid calls between April 1973 and April 1974. This represented nearly 85 percent of the estimated 20 846 system activations during that period.

The activations were classified into five categories: incident-first call (no previous calls), duplicate call [previous call(s) regarding the incident], return call by police (aid arrangement or additional information), maintenance call, and others (bad connections, prank calls, and false calls). Table 1 gives the breakdown of the system activations and shows that 65 percent of the activations were incident related.

The primary reasons for use of the aid telephone and the related types of action by the dispatcher are given in Table 2. The major reasons were vehicle disability (63.3 percent), information (26.5 percent), and accidents (4.0 percent).

Dispatcher actions in cases of disability included sending a service vehicle (60 percent), placing a call to a local contact (18 percent), giving information as to availability of service (12 percent), and sending a police patrol (8 percent). For information calls, information was given directly (84 percent), police were sent to help (15 percent), and the dispatcher made a call elsewhere for information (0.4 percent). For accident calls ambulances were sent (8.1 percent), and police were sent (81.4 percent). For fires, five units were sent (40 percent), and police were sent (47.7 percent).

Further analysis showed that aid-telephone calls are made by the stopped-vehicle occupants (78 percent), passing motorists (15 percent), police patrols (4 percent), and others (3 percent). Of the vehicle occupants who made calls, 81 percent drove to the telephone terminal, 18 percent walked, and 1 percent received a ride to the nearest telephone. In addition, 3.5 percent of all calls were made from telephones located opposite the direction of travel for the reported incident.

Calculations based on a rate of one aid-candidate stop for every 32 000 vehicle·km (20 000 vehicle miles)

Table 1. Recorded and estimated system activations.

System Activation	Recorded	Estimated	Percentage
Incident-first call	8 646	10 191	48.9
Duplicate call	1 985	2 339	11.2
Return call by police	877	1 033	4.9
Maintenance call	2 883	3 397	16.3
Others	3 298	3 886	18.7
Total	17 689	20 846	100.0

Table 2. Reasons for use of aid telephone and related dispatcher actions.

Reason	Percentage of Calls	Dispatcher Actions (percentage of action by category)								
		Gave Information	Sent Police	Sent Fire Unit	Sent Ambulance	Sent Tow Truck	Sent Service Unit	Placed Telephone Call	Other	Total
Vehicle disability	63.3	11.5	8.2	—	—	10.8	49.3	18.0	2.2	100
Fire	0.7	3.1	47.7	40.0	—	1.5	—	3.1	4.6	100
Accident	4.0	1.2	81.4	0.6	8.1	4.1	1.7	0.6	2.3	100
Illness	0.4	26.5	61.8	—	2.9	—	—	5.9	2.9	100
Automobile in ditch	2.7	1.7	59.5	—	0.4	34.2	0.8	2.1	1.3	100
Make telephone call	1.6	4.4	0.7	—	—	—	—	35.3	59.6	100
Information	26.5	83.8	14.7	—	—	—	—	0.4	1.1	100
Other	0.8	2.9	52.2	—	—	1.5	2.9	4.3	36.2	100
Percentage of total calls	100.0	29.8	15.0	0.3	0.3	7.9	31.3	12.2	3.2	100

of travel and nearly 1.45 billion vehicle·km (846 million vehicle miles) of travel during the after study period give an estimate of 42 300 aid candidates stopped along I-80. This gives the following overall system-use measures of effectiveness:

Ratio	Value
System utilization	0.24
System efficiency	0.23
System success	0.98

Communication-System Reliability

Data on failure of the system hardware were collected for the period from mid-April 1973 to mid-April 1974. The 1501 equipment malfunctions were due to circuitry failure (96.4 percent), vandalism (2.1 percent), cable cuts (0.5 percent), and accidents (1.1 percent). A major cause for circuitry failure was lighting, which was later rectified by circuit modification.

The expected number of daily failures was 4.1, with a mean time between failures of approximately 6 h. The probability of system availability at any particular time was 0.93 with 7 percent of the telephone terminals out of order at any particular time.

System Evaluation: Summary

There were several difficulties in conducting a statistically sound evaluation of the motorist-aid system. The foremost was the energy crisis that prevailed during the latter part of the after study period (January 1974 to April 1974). The crisis affected the availability and quality of service on the one hand and the total travel and travel time on the other. No restructure of the study to enable the evaluation of these effects and their impact on the effectiveness of the motorist-aid system was possible. However, an adjustment factor was introduced to reduce these effects.

During the study period, an organizational change took place in districts 5 and 7 of the state police. These changes, however, were not necessarily to reflect the operation of the motorist-aid system, and thus the full impact of the system on the level of police patrolling could not be established.

The data-collection task was very involved and required the cooperation of the motoring public and many public and private agencies. However, the length of the study (5 years) definitely affected the enthusiasm of the participating agencies, as evidenced by the relatively small data samples. In summary, the following values of system-use measures of effectiveness and response times are considered to represent the before and after situations:

Measure of Effectiveness	Before	After
System-utilization ratio	—	0.24
System-efficiency ratio	—	0.23
System-success ratio	—	0.98
Time to detect an incident, min	15.5	12.5
Time to scene, min	20.2	16.6
Time on scene, min	23.1	17.8
Time to aid center or base, min	31.7	25.4

BENEFITS AND COSTS

Determining the overall benefits due to the motorist-aid telephone system involves tangible and intangible benefits of which the relative importance and value are often difficult to determine.

The tangible measures of effectiveness or benefits considered in the analysis included the following: aid-candidate involvement time in an incident, number of secondary accidents, number of accidents involving telephones, level of police patrol, system-utilization ratio, system-efficiency ratio, and public acceptance. The intangible measures of effectiveness included the following: value of the system to Illinois Department of Transportation, value of the system to the state police, value of the system to national and state policies regarding aiding motorists on rural freeways, and quality of the service of assisting agencies.

Table 3 gives the before and after values for the tangible measures of effectiveness. As with any before and after study, the differences in values cannot be precisely attributed to the effects of the system in question. However, in this case, if it were assumed that the changes were fully caused by the aid telephones, and furthermore, that 1 h of time was worth $4.00, then the time saving per incident would be approximately $1.00 for every vehicle occupant. Since 9935 out of 10 102 aid candidates actually received aid, if vehicle occupancy is 1.8, the time saved due to the system is worth nearly $17 883.

There are several estimates of the losses involved with fatal, injury producing, and damage producing accidents. The National Safety Council estimate (1972) is as follows (5):

Accident	Loss ($)
Fatal	82 000
Injury	3 400
Damage	480

If the difference in the number of secondary accidents after adjusting for the energy-crisis factor had been due to the availability of the motorist-aid system, then the yearly saving would have been approximately $140 000 (1972), including the loss due to the accidents involving the aid telephone (3 injuries and 10 damages).

Assigning monetary values to human life and limb can also be approached from the standpoint of the lost individual income in future years and other factors and result in extremely large benefits for even one serious incident. In such cases, any apparent reduction in fatal accidents or injuries can be expanded into substantial monetary benefits.

The yearly costs of highway patrol personnel and vehicle operation were approximately $526 000 in the before study period and approximately $782 000 in the after period. This represents an increased cost of nearly $255 000/year, which the state police attributed to factors other than the telephone system.

To estimate the cost of the motorist-aid telephone system, per aided call, annual system costs were computed based on a system life of 10 years (1973 to 1983), an 8 percent interest rate, and an 8 percent inflation rate. For simplicity in the analysis, it was assumed that all costs involved in the program development and implementation were invested at the initial point in time. The total annual costs for the first 2 years considered the maintenance cost as part of the system implementation phase. For the remaining 8 years of the life of the system, an average maintenance cost based on a 1975 base cost of $140 000 and an 8 percent inflation rate were used. These costs, however, exclude system construction and maintenance supervision. Table 4 presents the system cost analysis.

The cost of the system per aided call, or the subsidy per aided call, could be evaluated with respect to two investment situations: development and installation of the I-80 system or continuing operation of the I-80 system beyond 1976.

Before proceeding with the analysis, it is necessary

to estimate the average number of aided calls per year for the first 2 and for the remaining 8 years of the economic life of the system. A ratio of 7.3 aided calls/million vehicle • km (11.7/million vehicle miles) was found based on 1973 and 1974 data. If it is assumed that the annual increase in traffic will be 4 percent and that the above ratio will remain constant throughout the economic life of the system, the average numbers of aided calls per year for the first 2 and the remaining 8 years are estimated to be 10 000 and 12 500 respectively. If aided calls are further classified into critical calls and noncritical ones, where critical calls are those due to disability, accident, fire, or an automobile in a ditch, then according to Table 2, the critical calls were 71.1 percent of the aided calls. The projected critical calls for the first 2 and the remaining 8 years are then estimated to be 7181 and 8887 respectively.

In the first investment situation, the costs per aided call and per aided critical call during the first 2 years (1973 to 1975) were estimated to be approximately $27 and $37 respectively. For the remaining 8 years, the average costs per aided call and per aided critical call were estimated to be approximately $37 and $52 respectively.

In the second investment situation, the costs per aided call and per aided critical call would be approximately $15 and $21 respectively.

If the differences in the values of the measures of effectiveness (time saved and reduced accidents) are considered to be results of the availability of the system only, subtracting their monetary value (adjusted for inflation) from the annual system cost gives a cost per aided call of approximately $10 for the first 2 years of operation (1973 to 1975). When the average maintenance cost and the ever-increasing monetary value of saved time and reduced accidents are considered, the average benefit-cost ratio during the remaining life of the system should be approximately 2 to 1, and when the total investment and the above benefits are considered, the benefit-cost ratio is in the range of 0.6 to 0.7.

Table 3. Summary of measures of effectiveness.

Measure	Before	After	Change (%)
Aid-candidate involvement time in incident, min			
Ends on scene	58.8	46.9	20
Ends at aid center	90.5	72.3	20
Number of secondary accidents/year	71	27	50[a, b]
Severity of secondary accidents			
Fatal (personal)	2; 1[a]	0	1[a, b]
Injury (personal)	32; 25[a]	4	84[a, b]
Damage	37; 28[a]	23	19[a, b]
Number of accidents involving telephone poles	0	13[c]	13
Level of police patrol (officers and vehicles)			
District 5	9 and 9	7 and 7[d]	22
District 7	6 and 6	9 and 9[d]	50
System-utilization ratio	—	0.24	—
System-efficiency ratio	—	0.23	—
System-success ratio	—	0.98	—

[a] Adjusted for energy shortage and impact of speed-limit reduction.
[b] Sample too small for statistical significance.
[c] Three injury accidents and 10 damage accidents.
[d] Changes in police patrol level due to organizational changes.

Table 4. Estimated costs of motorist-aid system.

Item	Total Cost ($)	Annual Cost ($)
Program development (feasibility study, program administration, evaluation)	240 300	49 766
System implementation (design, purchase, installation, training, and maintenance for first 2 years)	1 055 300	218 552
Total annual cost (first 2 years)	—	268 318
System operations [maintenance (based on 1975)]	—	190 400
Total annual cost (last 8 years)	—	458 718

SUMMARY OF FINDINGS

1. More than 10 000 motorists/year seek aid through the I-80 aid telephone system.
2. Approximately 24 percent of all I-80 aid candidates use the motorist-aid system.
3. Approximately 98 percent of the aid candidates who call successfully receive aid.
4. Approximately 23 percent of the aid candidates on the facility are successfully aided by the motorist-aid system.
5. Approximately 46 percent of the I-80 accidents are reported through the aid telephones, with 72 percent of such calls made by passing motorists.
6. The average time between incident occurrence and police notification was reduced from 15.5 to 12.8 min in the after period and to 9.6 min when the aid telephones were used.
7. The primary reasons for use of the aid telephone were vehicle disability (63.3 percent), information request (26.5 percent), and accident (4.0 percent).
8. The primary dispatcher actions were sending tow trucks or other service units (39.2 percent), providing information (29.8 percent), and sending a police vehicle (15.0 percent).
9. Calls from aid telephones are made by stopped-vehicle occupants (78 percent), passing motorists (15 percent), police patrols (4 percent), and others (3 percent).
10. Of the vehicle occupants making calls, 81 percent drove to the terminal, 18 percent walked, and 1 percent received a ride to the nearest telephone.
11. The telephone system operates at 93 percent reliability, because 7 percent of the telephones are out of service at any particular time.
12. The opinion of a sample of telephone users is favorable and indicates recognition of reduced travel delays when compared with that of a before sample.
13. The after study period showed reduced incident response times of 20 percent and reduced secondary accidents of 50 percent.
14. During the after study period, the system telephone poles were involved in 13 accidents.
15. When the total investment is considered, the motorist-aid system costs per aided call and per aided critical call for the first 2 years of operation are approximately $27 and $37 respectively.
16. When the total investment is considered, the expected costs per aided call and per aided critical call for the remaining system life (8 years) are approximately $37 and $52 respectively.
17. When only the operating costs are considered, the expected costs per aided call and per aided critical call for the remaining 8 years of the economic life of the system are approximately $15 and $21 respectively.
18. Analysis of the effectiveness of the system indicates that if the adjusted reduction in secondary accidents is wholly attributed to the availability of the aid telephone system, then the expected benefit-to-cost ratio for the remaining economic life of the system, considering accident reduction and time saved only, is approximately twice the average maintenance cost or in the 0.6 to 0.7 range for the total investment.

Table 5. I-80 and I-87 motorist-aid systems.

Item	I-80	I-87
Type of system	Two-way communication; buried cable; call-back feature	Two-way communication; buried cable; no call-back feature
Length, km	221	287
Number of telephones	302	712
Avg spacing of telephones, km	1.4	0.8
Number of control consoles	2	5
Total travel, billion vehicle-km	1.36 (1973)	1.15 (1969)
System-use ratio	0.24[a] (1973)	0.71[b] (1968)
Number of accidents	723 (1973)	488 (1968)
System cost, $	1 055 300[c] (1973)	692 234 (1968)
System cost per telephone, $	3494	974
Annual maintenance cost, $	85 000 (1975)	137 500 (year unknown)
Annual maintenance cost per telephone, $	281	193
Maintenance agency	Private contractor	Telephone company
Benefit-cost ratio	0.6 to 0.7[d]	0.10[d]
Cost per aided call, $	31[e]; 30[f]	19[g]

Note: 1 km = 0.62 mile.

[a] Based on one aid-candidate stop/32 000 vehicle-km (1 stop/20 000 vehicle miles).
[b] Based on expanded stopped-vehicle survey.
[c] Includes maintenance cost for 2 years.
[d] Benefits might not be comparable.
[e] Based on 10-year economic life (interest rate 8 percent, inflation rate 8 percent).
[f] Based on 20-year economic life (interest rate 8 percent, inflation rate 8 percent).
[g] Based on 20-year economic life (interest and inflation rates and whether included unknown).

CONCLUSIONS AND RECOMMENDATIONS

At the outset of this project, the need for a cost-effective operation was not a critical issue because of the low probability of achieving such a positive ratio in a rural environment. However, the secondary goals, which involved optimization of certain system functions, included the desire for an optimal allocation of resources.

While the study results indicate favorable trends toward achieving these goals, the use and value of the aid telephone system to the various parties and issues involved—the motoring public, the state police, the Illinois Department of Transportation, and national and state policies on implementing motorist-aid systems on rural freeways—vary in degree and importance.

Definitely, to the motoring public, the use and value of the system are quite high. Aid candidates were able to reduce the time to notify a service agency of their need by nearly 6 min, and the overall average reduction in time involved with an incident was approximately 15 min. This reduced the hazard caused by the motorist in distress as expressed in a reduced number of secondary accidents during the after study period. Also, the system helps to instill a sense of safety and security in the driver who knows that if something happens, help can be reached.

The use of the system to the state police could not be fully evaluated because of the reorganization within the police districts having jurisdiction over the study section. However, they have recently said that, while they did not encourage the original installation of the emergency call service on I-80, it is now very important because the patrols are organized to fit this type of operation, and if the telephones were removed, a far heavier concentration of patrols would be required. This, of course, indicates that the police consider the system as an integral part of the service and use it to their satisfaction.

The major function of the Illinois Department of Transportation, as of any other department of transportation, is to provide for a safe and efficient movement of people and goods. The availability of the motorist-aid system definitely aids in fulfilling this function. In an economy with dwindling financial resources, the investment in services to the motoring public contributing to these resources should be based on statewide priorities. In the case of the I-80 motorist-aid system, where the contribution to the resources is not through its use but through the use of the highway facility itself, the low benefit-cost ratio of the system, ranging between 0.6 and 0.7, is a crucial issue.

Any decision about the future of the system or the installation of a new and similar one should consider, among other things, the following: (a) public relations, (b) the degree of use of the system by the motoring public, (c) traffic safety, (d) reduction of the cost of the system by the reduction of its size, and improvement of its reliability while maintaining an acceptable level of service, and (e) citizens band (CB) radios.

To improve the rating of the system among other systems or projects competing for funds, it is necessary to improve its benefit-cost ratio. This can be done by increasing the benefits, reducing the cost (maintenance), or both.

The study findings indicate that, at most, 24 percent of the aid candidates used the system, and 23 percent of them successfully received aid. According to a suggested guideline (1), the latter percentage indicates a marginally effective system. An increase in public awareness of the motorist-aid system services could increase the use of the system, which would yield higher benefits.

Nearly 83 percent of those who used the system drove to the terminal, which suggests that a greater spacing of terminals could achieve a similar system-use ratio for a smaller system maintenance cost. The spacing could be even greater at the vicinity of interchanges where access to aid is less remote. The effect of greater spacing on the time saved by the motorist should not be drastic if, for instance, the spacing were increased to 3.2 km (2 miles).

As to national and state policies on implementing motorist-aid systems on rural freeways, conclusions about some technical aspects of such a system could be made. The two-way voice communication system with call-back features proves to be very effective and has an advantage over other communication systems, because it enables relay of full information and needs in both directions and return calls to the aid candidate if more information is necessary.

As to the implementation of such a system on similar facilities in Illinois, the issue of the low benefit-cost ratio emerges as a critical one, although some significant intangible factors are involved. However, when the motorist-aid system on I-80 in Illinois is compared with the one on I-87 in New York (6), the I-80 system appears to compare favorably with the one on I-87, even though the installation and maintenance costs per telephone are higher for the Illinois system, and its use is approximately one-third of that in New York. A major factor in considering the implementation of future motorist-aid systems in Illinois should be the ability to bring the installation and maintenance costs to more attractive levels.

Because of the findings of this study and the increased use of CB radios, it is recommended that a feasibility study to incorporate CB radios into a motorist-aid system on I-80 should be conducted. However, to improve the benefit-cost ratio of the existing I-80 motorist-aid system, the following should be undertaken:

1. Develop and implement a public information program to increase the awareness of the motoring public to the motorist-aid system and its service capabilities;
2. Study and improve the system circuitry to increase its reliability and reduce the maintenance costs; and
3. Analyze and implement lower cost maintenance procedures, and make changes in the configuration of the

system to reduce maintenance requirements.

DISCLAIMER

The contents of this paper reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein.

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Publication of this paper sponsored by Committee on Motorist Services.