be integrated into a comprehensive system before the implementation of new complex highway safety programs. Without reliable and valid baseline data created by all the agents who are potential users and contributors to the system, accurate measures of success will be, at best, difficult.

In New York State the Office of Alcohol and Highway Safety in the Department of Motor Vehicles is attempting to develop a complete data system in two general ways. First, OAHS is building on the foundation of the original traffic records system put into place years ago by integrating in consistent ways data from other agencies. Second, OAHS is requiring that each county coordinator submit detailed and accurate reports on all appropriate county-level alcohol and highway safety activity. In this way OAHS is using the best data available, either from the state or local systems, to carry out a comprehensive evaluation of the STOP-DWI program.

OAHS believes that the total data acquisition model (Figure 3) will provide the most complete and accurate picture of alcohol highway safety activity in New York State. Although this is not yet an ideal system, it is believed that the evaluation model and the data-acquisition procedures put into place will provide the best possible basis for the program assessment that must be provided to the Governor and the Legislature on March 31, 1985.

REFERENCE

1. Highway Safety Program Manual, Traffic Records. Volume 10. NHTSA, U.S. Department of Transportation, March 1975.

Meeting the Challenge of Traffic Information Systems in the 1980s

MARK H. LARRATT-SMITH

ABSTRACT

The Transportation Regulation Program of the Ontario Ministry of Transportation and Communications (MTC) uses five distinct, but interdependent, information systems: the Driver Licensing and Control System, the Vehicle Registration System, the Motor Carrier Performance and Enforcement System, the Traffic Accident Information System, and the program's internal Management Information System. The Vehicle Registration System has recently been revised in response to pressure from the public, police, and courts. To avoid future massive catch-up projects dictated by client dissatisfaction and as a response to growing external demands and pressures placed on MTC's information systems, several initiatives have been adopted, including (a) establishment of a Systems Improvement Office that oversees system maintenance and improvement, (b) development of priorities for system activities, and (c) career training to familiarize all managers in MTC with the operation of information systems.

The term traffic information systems is frequently defined in narrow terms to refer simply to data files that contain information concerning traffic volumes or accident information. As in so many other areas of government activity, the growth of information technology and the demands on the management of information systems that flow from it have inevitably rendered this narrow view of traffic information systems obsolete.

By using the perspective of an organization with a range of responsibilities that includes all highway users in the province of Ontario, it is proposed that, for purposes of this paper, the term traffic information systems be redefined to include all user-related data (excepting only that which is primarily related to the infrastructure of the highway system) as a prelude to discussing the challenge of the management of such systems in the years ahead.

Within the Transportation Regulation Program of the Ontario Ministry of Transportation and Communications (MTC), five distinct information systems have been identified: the Driver Licensing and Control System, the Vehicle Registration System, the Motor Carrier Performance and Enforcement System, the Traffic Accident Information System, and the program's internal Management Information System.

The Driver Licensing and Control System encompasses the entire process of gathering, storing, and retrieving information about Ontario's 5 million licensed drivers, including the control and suspension components related to convictions, demerit points, medical impairments, and nonpayment of fines.

The Vehicle Registration System includes all aspects of the collection, storage, and retrieval of information concerning the 5.2 million vehicles registered in the province of Ontario, including associated taxation collection and audit components, police interfaces, mechanical fitness requirements, and certification of valid insurance.

Although many of its elements have existed in manual form for many years, the Motor Carrier Performance and Enforcement System has only recently been defined as a coherent and distinct system that

is still in the process of being elaborated. In concept, it contains data related to all operators of commercial motor vehicles who use Ontario's highways. In the future this system will include the classification of carrier, information on vehicles operated, and a wide range of reported infractions from safety violations through labor law, weight and dimension, registration, and operating authority convictions.

As in many other jurisdictions, the Traffic Accident Information System has existed in Ontario for many years, but it is suspected that the MTC is by no means unique in its relatively unsophisticated manner of using this system, which is, after all, the fundamental base on which all highway safety programming must rest. In Ontario considerable effort has been directed to the development of usable information related to infrastructure safety (with significant safety results), but little has been done to develop a sophisticated method of using accident data to direct safety programs that are aimed at the driver and the vehicle. This omission is particularly significant in that current research indicates that more than 80 percent of all accidents are attributable to driver error.

The program's internal Management Information System is also in a state of considerable change. The pressures that will be elaborated on in this paper have resulted in the expansion of traditional personnel and financial short-range budgeting and control information into a long-range planning and control system encompassing not only input information but also information on products produced, services rendered, and results achieved.

As will be apparent from even this brief description of the five general systems that are included in the broad definition of traffic information systems, there is considerable interdependence among all five. The driver system incorporates accident-related data; the carrier system is being built on commercial vehicle registration data and in the future it will increasingly need to incorporate relevant driver information; and the Management Information System monitors all of the resource inputs and product outputs relating to the other four systems.

With this broad definition of traffic information systems, it is evident that the management challenge is a formidable one. This challenge is examined by first looking at the external environment that affects the traffic information systems. Next a specific case, which involves the recent redesign of the entire Vehicle Registration System in Ontario, is discussed as an example of the issues raised and the lessons learned from attempting to manage change in a large system under many of these external pressures. Finally, a review of some specific initiatives that Ontario has under way for the future as a result of the lessons learned is presented. This information is presented, so far as possible, in a generalized fashion in order that it may be of maximum assistance to other jurisdictions facing similar challenges.

EXTERNAL ENVIRONMENT

There are many external demands and pressures placed on government transportation departments to maintain accurate and effective information systems. These demands and pressures increase with the growing sophistication of data systems. One example of the growth in sophistication of data systems in Ontario is evident in the recent decision by MTC to manage the denial of license renewals for nonpayment of motor-vehicle-related fines. Although MTC had previously acted as an enforcement agency for the courts on driver licensing issues, it has only recently begun to do the same for vehicle licensing.

Another example of the growing complexity of data systems in Ontario is the increasing diversity of accident statistics related to types of vehicles. With the advent of new definitions in heavy truck and other vehicle categories, maintenance and analysis of accident statistics become more complex, and even more important for policy-related purposes.

In addition to the growing complexity of the content of systems, departments of transportation must also contend with the changing technologies of data systems. The growth of data records and systems encompasses new information technologies such as microprocessors and distributed processing, all of which are in a constant state of flux. Managers of systems must therefore continually revise systems technologies as well as systems content to keep pace with information flows.

Another environmental challenge to any traffic information system involves financial constraints that create pressures to find more efficient means of maintaining systems. The heavy pressures for greater organizational efficiency tend to feed the automation pressures, because the obvious, if at times superficial, attraction of automated technology is the perception that it will save organizations money and personnel. Too often this is not the case, and in exchange for a saving in clerical staff an organization finds that it has been burdened with a fragile system that is expensive to maintain and whose shortcomings are extremely evident to the public.

Another factor that is closely related to financial constraints is the increasing pressure on public agencies to justify the money that they are given. This pressure for increased accountability for decreasing funds is pushing public agencies heavily in the direction of program effectiveness evaluation, so that their activities can be either justified or eliminated.

The term "program evaluation" finds expression in various ways in different jurisdictions, with "value for money auditing" being one particular term currently in use in Ontario. Value for money auditing provides for the evaluation of all government programs against their ultimate public benefit. Any such system is bound to include a high degree of subjectivity, but the exercise does stimulate a useful emphasis on the development and tracking of appropriate numeric indicators whose linkages to dollars spent, however soft, do tend to focus the debate on issues of public benefit. In this respect the subject of highway safety presents a fascinating challenge. Accident causation is an enormously complex subject, but focusing on linking programs to real-world results in terms of accident reduction has the potential of being a useful device in a field where the choice of programming initiatives has frequently been totally unrelated to any real analysis of potential benefit.

A final external pressure that affects the management of traffic information systems is the issue of fundamental rights. In Canada a Charter of Rights, which is somewhat analogous to the American Bill of Rights, has recently been adopted. In this respect Canada is just now starting to face issues that have been of concern to Americans for nearly 200 years. Although the timing may be a little different in this one respect, it is believed that the pressures associated with the adoption of the Canadian Charter of Rights and also with the extension of human rights legislation in Canada are similar to those that exist in the United States. The right to access information currently maintained by a public agency can create substantial costs and administra-

tive complexities. In addition, freedom of information initiatives raise questions as to whether or under what conditions information should even be collected in the first place. In turn, these questions place additional pressure on justifying government programs that require the data collection, in terms of their impact and effectiveness from a broad public benefit point of view. The debate risks becoming circular when agencies resort to collecting additional information to prove the effectiveness of the programs that required the information that initially came under scrutiny.

Also within the context of rights and privileges, the issue of freedom of information poses an additional constraint on systems management. Newly imposed rules for public access to information in many jurisdictions place government in the position of having to maintain tightened confidentiality on many items, whereas making freely available information that in the past has never been released. This greatly increases the complexity of the management task related to the collection, segregation, retrieval, and production of information.

ONTARIO VEHICLE REGISTRATION SYSTEMS PROJECT

Turning from a general outline of the external factors that pose a challenge for the management of traffic information systems, a recent Ontario experience is presented that illustrates some of the practical difficulties involved when dealing with some of the broad environmental challenges previously discussed.

The Vehicle Registration Systems Project (VRSP) was formally completed on March 31, 1983, although certain details of implementation have carried on since that date. It has involved development of a new plate-to-owner system of license renewal; a staggered renewal of passenger and light commercial vehicles by owner birth date or system generated date; a complete on-line system to more than 300 private agents across Ontario; a revised fee structure, which is fee to plate with a flat fee; a turnaround document that is mailed to vehicle owners in advance of their renewal date; and the capability to deny registration renewal of the offending or replacement plate for nonpayment of parking violations. The project itself cost approximately $11.8 million and involved the complete rebuilding of the previous vehicle registration system. It has been the largest systems project ever undertaken by the Ontario government and the biggest motor-vehicle-related project in North America in recent years.

MTC became involved in VRSP in order to replace a poorly operating automated batch registration system. The inaccuracies and especially the delays in recording transfers on this system caused a high degree of frustration for the police community and the courts. In the case of the police, the system did not meet the requirement that a license plate should provide an accurate pointer to the owner of a vehicle. This pointer is a major investigative tool for all police work, not just for highway-traffic-related law enforcement. At the same time the court system wanted an increased requirement for an accurate identification system that could permit denial of registration for nonpayment of parking fines by vehicle owners as an alternative to the expensive and unpopular process of executing summons and ultimately putting recalcitrant offenders in jail. Although not a primary motivator in undertaking the project, the unhappiness of the general public over long annual lineups for registration renewal was also a factor in the planning of the project.

What is significant about this description of the genesis of VRSP is that, in effect, MTC had lost control of the system. It was the users and their unhappiness with the system that became the generating force for change rather than the organization's own initiative, including its determination of what it could feasibly handle without major disruptions. In retrospect, this loss of control before initiation of the project had extremely important effects on the costs and complexity of the project itself. It has also led to a strong determination by MTC that, through anticipatory planning and attention to user needs, the Ministry will ensure that it never again enters into a massive catch-up project where client dissatisfaction leads to dictated solutions.

Another important and related aspect of this project was that the external pressures involved were related entirely to service improvement. The simplistic notion that automation saves money became a factor in many people's mind, particularly in the central agency responsible for budget control. This not only meant a continual need to explain what indeed the program was about, but it caused difficulties for everyone when severe financial constraints within the Ontario government coincided with the final implementation of the system, which was then fully committed and which involved expensive new services (many of which were impossible to cost-out in advance).

VRSP was implemented over a period of 4 years and involved approximately 40,000 person-days. On the whole it has been a successful program, in that it was implemented on schedule with relatively little negative impact or adverse reaction from the public. It is, however, a qualified success because the system is still not fully in place in terms of some behind-the-scenes adjustments that are still being made. In addition, the cost estimates have grown significantly from the beginning of the project, and they are well above the expectations of the agencies involved.

A number of the lessons learned from VRSP are useful in a discussion of the challenges facing managers of traffic records in the 1980s. The first lesson that emerged from this particular project was the notion that an information system of this type must clearly identify its users and their needs. It must do this on a regular and ongoing basis. It must also set priorities for those needs and clearly articulate what can and cannot be achieved within identified time and dollar constraints. Finally, the information system must force clients, particularly other government agencies, to participate fully in a justification of the public benefits of their wish lists.

Another rather important lesson that MTC has realized from the VRSP experience is the need to build total systems expertise into any organization that is managing traffic records. As automation becomes an important part of information systems, organizations appear to progress through a number of identifiable evolutionary stages. Typically, this evolution starts with a fascination with the hardware itself. Once the computers have been installed, preoccupation gradually shifts to the programming task. At this stage the software experts become in effect the "high priests" of the system. A third stage has become apparent recently with the trend toward so-called user friendliness, which has diminished the need for highly specialized systems programmers within organizations. This stage has expanded the focus to broad-based systems analysts who can deal with issues relating to the overall management of systems and particularly with the people components that are, after all, the most complex and difficult to manage. The final stage of this evolution is to regard the entire operational management

team as part of an organization's systems expertise, so that there is not a gulf placed between those who run the system and those who alter it.

At the outset of VRSP, MTC had not progressed much beyond the second or programmer preoccupation stage. It was discovered that the organization had a dirth of broad systems expertise and that it tended to underestimate both the capability of the operational people to do systems work and their indispensability in keeping the previous system running while the new one was being built. As a consequence, the Ministry became more dependent on highly specialized consultants than would have been desirable. Although consultants are essential to any large-scale systems project because of their ability to provide a pool of highly specialized talent on an ongoing basis, they need to be contained within a strong and tightly controlled organizational matrix to ensure that their talents are appropriately directed and that the results of their work are appropriately transferred to operational staff.

Another important lesson arising from VRSP involves the need for a much clearer understanding of the critical role that the selection and management of a systems project methodology plays in the success of a project. For VRSP, the Ontario government used an existing technology entitled Spectrum. Although the methodology provided many benefits to the project, in the end it proved inadequate. It tended to focus unduly on the production of detailed information rather than placing emphasis on critical decision-making points.

In addition, Spectrum proved to be linear in concept, whereas recent developments in systems technology, as well as the pressure of meeting imposed deadlines, led MTC to adopt an iterative or interactive approach to project tasks. In effect, because of the delay of certain key policy decisions, much of the detailed design, programming, and testing took place virtually simultaneously. One of the specific conclusions that emerged from this project, therefore, was that for any large systems project, time should be taken to devise a custom methodology, or at the very least, to carefully and thoroughly adapt an existing methodology to the requirements of the project.

ONTARIO'S RESPONSES TO ENVIRONMENT AND EXPERIENCE

Given the Ministry's experience with VRSP and its assessment of the environmental challenges facing it in the latter 1980s, MTC has devised a number of initiatives to deal with the future management of information systems.

One such initiative has been the formation of a Systems Improvement Office. This group, which is distinct from the government service organizations that supply computer time and programming support, reports to the senior operational management responsible for operating all of the systems that have been described in this paper. Its mandate is the maintenance and improvement of these systems under the direction of operational managers. The office currently has a complement strength of 31 positions.

There are two aspects of the creation of this group that should be emphasized: funding and control. With respect to funding, there is an interesting parallel to the issue of preserving highway infrastructure. As in many other jurisdictions, highway engineers at MTC have developed a relatively sophisticated approach to highway maintenance based on the fundamental concept that, to build a road, sufficient funds must be allocated, not just to prevent its physical deterioration but also to make operational improvements that will maximize longevity before there is a requirement for massive and costly reconstruction. This same philosophy applies to traffic information systems. Especially with the advent of real-time on-line systems, such as the new VRSP, it has become imperative to put aside, on a continuing basis, a significant portion of the cost of the development of such a system for its maintenance and improvement. Within the $65 million budget of the Transportation Regulation Program, MTC is allocating $3.6 million (as a minimum base level of funding) to the Systems Improvement Office to provide all of the services related to systems maintenance and improvement that are required by operational managers.

The second point of emphasis with regard to this new office is the issue of control. The first principle here is that the Systems Improvement Office operates on a zero-based budget. In fact, the $3.6 million budgeted for it is allocated among the operational managers responsible for each of the five systems that were identified at the beginning of this paper. To allocate this funding on a realistic basis, MTC has developed a relatively sophisticated method of setting priorities for the needs of the individual systems. For a number of years now, MTC has had a functioning cyclical strategic planning process. One major component of this process is the development of an annual long-range plan with a 5-year horizon. In order to set priorities for systems, MTC has added an additional component to the long-range plan for each of the five systems. These systems long-range plans are developed after the general direction of the program has been well-enough established that they can identify the implications of trends and changes of direction. The systems plans are developed by the Systems Improvement Office under the supervision of a committee composed of the key operational managers and internal users of each system. Once these plans have been developed, they are integrated into a series of priorities by the overall program and the available funds are allocated to each user area to purchase systems support. The user committees are also responsible for generally directing the work of the Systems Improvement Office in undertaking developmental activities that flow from this plan.

A brief summary of current program priorities and attendant systems activities will help illustrate the way in which this approach is used. For the driver system, emphasis has been placed on increasing the sophistication of the driver improvement programs. This means that there will be a high priority placed on improving MTC's capability of tracking problem drivers in order to develop selective treatment strategies that will affect motivation and performance. Improved tracking will also generate effectiveness information for use in justifying either the retention or the alteration of programs that have a high degree of public sensitivity.

Also for the driver system, the introduction of a photo driver's license in Ontario is under serious consideration. This innovation will obviously have significant systems implications. In preparation for such an initiative, MTC has been concentrating its efforts on necessary preparatory improvements to the existing system and on extensive evaluation of user requirements and system alternatives.

The priorities that currently exist for vehicle systems center around the final implementation and maintenance of the new system that has just been put in place. As mentioned previously, MTC is also extremely conscious of the need to stay ahead of demand in this field, so that attention is being given to identifying other areas of potential client demand.

For the Motor Carrier Performance and Enforcement

System there appears to be an enormous potential demand for new information to be collected, maintained, and retrieved in innovative ways. The development of a Commercial Vehicle Operators Registration System, which would identify the operators of all trucks on Ontario highways, irrespective of ownership, lease arrangements, and so forth, has been recommended by groups studying both truck safety and economic regulatory reform. Systems activity in this field is focused at the conceptual stage in anticipation of a major effort.

Extensive plans for the accident information system are currently being developed by MTC. As previously mentioned, MTC has in the past collected a great deal of information concerning accidents without using it to its fullest. The priority with regard to using accident statistics no longer lies with the traffic engineering function, but instead is used for the driver system where improved accident analysis can, it is hoped, identify and justify opportunities for new programming.

Another high priority with regard to the accident information system is in the development of a service capability for the evaluation of safety programming. With funds as scarce as they are currently, both in government and in the private sector, there is obviously a need to provide all those interested in highway safety with better support in assessing whether existing or proposed safety initiatives are effective. As the custodians of the accident system, MTC sees an obligation to assist everyone--from local community groups to industry to enforcement agencies--with data and interpretative help in focusing their efforts. Obviously, MTC's ability to help will be constrained by its own resource limitations, but it is anticipated that even a small start may show tangible results.

The current direction of activity in the Management Information System also relates to concerns about effectiveness. It is commonplace to say that the difference between business and government is that only the former has a bottom line. One consequence of this has been that, over the years, it has been both more difficult and less critical to define the products of government than to identify those of a corporation whose survival depends on their profitability. For years governments have tended to manage their affairs on the basis of inputs rather than on the basis of outputs. One of the beneficial results of the recent constraints on government funding at all levels has been to force changes to this particular form of management. These changes go under a variety of names in different jurisdictions, but the net result has been to focus on the planning and control of government programs against specified outputs as well as against resource inputs. Within MTC there is a project under way that anticipates fully automating the operational planning and control of all the resources and outputs of the Transportation Regulation Program. Although this particular internal management system may not be strictly speaking a traffic information system, it is essential to the management of the traffic information systems previously mentioned.

Thus far the discussion of MTC's response to both the environment and its experience has focused on two areas: the creation of a Systems Improvement Office and the development of a capability for setting priorities for systems activities in the five identified areas.

A compliment to these initiatives is the undertaking of a long-term commitment to the development of systems literacy for all operational managers. The first steps in meeting this commitment involve undertaking the development of a training plan to provide greater familiarization to existing managers and a commitment within the context of a comprehensive human resources plan to ensure that managers who progress through the Ministry's ranks receive direct exposure to systems project work as part of their career assignments.

CONCLUSIONS

In conclusion, there are some key messages that Ontario can relay to other jurisdictions in the business of traffic information systems management. The first of these messages is that organizations should broaden their horizons when examining traffic records systems. These systems are so large and so pervasive that they can no longer be managed simply as specialized data bases that focus on specific functions. To attain maximum benefit from systems, uses should be articulated and should have set priorities as part of a total government approach to problem solving. In addition, operational control and systems literacy are key components of systems management and must receive attention not just in short-term organizational solutions but in an integrated longer-term approach to human resource development. Finally, it is crucial that systems are developed with the ultimate user in mind, so that the community at large may obtain maximum benefit from systems that are developed and maintained at public expense.

On the whole, MTC has had some significant success in managing and upgrading its traffic information systems. Through consultation with other jurisdictions and the development of new systems ventures, MTC hopes to meet the challenges that lie ahead within this volatile field.