



## Performance indicators for the road sector

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**Abstract.** Seeing the trend for public accountability of road administrations and noting the many reform efforts undertaken in transport sectors around the world, the OECD established a Scientific Expert Group on *Performance Indicators for the Road Sector* in 1996 to provide its member countries a framework for assessing road administrations' performance.<sup>1</sup> The results of the Expert Group's work is presented in this paper.

Fifteen indispensable, forty primary, and thirty-five secondary indicators are proposed to portray the road sector from different perspectives. They are designed to be changed in response to human needs and technological development and supplemented by country specific indicators. In keeping with this approach and in support of one of the maxims of the Expert Group that 'useful performance indicators are those which are used', an application in the form of a Field Test is now in progress by an OECD task force.

The Performance Indicators proposed are grounded in a mental model adopted by the Expert Group. This model is *management by results* model, and is useful as a theoretical tool in the many highly fluid contexts in which restructuring is moving forward. In the model, the products and services are judged by standards or criteria; outcomes – derivatives of products and services through user interface – are judged relative to objectives and user satisfaction. The achievement of objectives, however, is not proposed as the only or even primary basis of evaluation. The situation is more abstract and complex. Therefore, the various uses of Performance Indicators – including the opportunities to assist road administrations in becoming learning organizations – are given much emphasis in the paper. The views and conclusions in the paper are those of the author and should not be attributed to the World Bank or its affiliated organizations.

### 1. Introduction

The role of the Road administration is increasingly seen as contributing to the quality of life, the quality of the environment and to the economic performance of both public and private sectors worldwide. The road administration is not alone as an institution under reform and change as countries' economies and societies develop. Restructuring in many other institutions – private and public – is occurring across the globe, resulting in a call for increasing accountability among institutions. A larger perceived role for road administrations, and the general trend for accountability have broadened the scope of self-evaluation road administrations apply to their performance beyond the historical demands to deliver services to the public at minimum cost.

Many road administrations and researchers have already developed performance indicators to evaluate the results of road administrations (Hartgen 1993; Sikow & Talvitie 1997; Talvitie & Sikow 1992). These works have had a positive influence and fueled interest in measuring road administrations' performance, and improved data and their acquisition on which the performance evaluation relies. In most road administrations the applied performance indicators in use often are 'ad hoc' and difficult to translate across different management environments. Consequently, in 1995 the OECD initiated international cooperation to develop performance indicators to assist road administrations to be responsive to decision-makers and to users. A short list of performance indicators was seen useful for evaluating most important aspects of the road program and for helping identify the interventions with the most leverage. An OECD Scientific Expert Group on *Performance Indicators for the Road Sector* as part of its *Road Transport Research Programme* was established to provide a comprehensive framework for broad self-evaluation for assessing road administrations' performance (OECD 1997).

Initially, OECD gave the Expert Group four objectives. The first was to survey the member countries' practices in road sector performance assessment. The second was to develop a parsimonious set of performance indicators which could serve many uses and which is consistent with the broad mission of a modern road administration. The third was to suggest a process or a procedure for testing and refining the indicators to meet the needs prevailing in different countries and take reasonable account of the available data resources and analytical procedures. And the fourth was to provide a basis for tracking important trends for establishing benchmarks and to make intra-country or inter-country comparisons. These objectives were allowed to evolve during the course of the work.

At the outset of its work, it was acknowledged that focusing only on roads would ignore important transport modes. But, limiting the scope to the road sector was practical: it made it possible to assemble a group of experienced practitioners to discuss and propose performance indicators for their sector. To attempt the same for the entire transport sector would have been over-ambitious. The Expert Group also recognized the importance of developing meaningful indicators appropriate for application from country to country. Even though inter-country comparisons were considered to be of lesser importance, it was accepted that such comparisons would be made in any case. There was consensus that any measures developed should be sensitive to differences between countries and provide opportunities for learning from the experiences of others.

Comprehensiveness, then, was an aim of the Expert Group's work. However, countries are different in many ways and the performance indicators proposed by the Expert Group and presented in this report, are those which have general

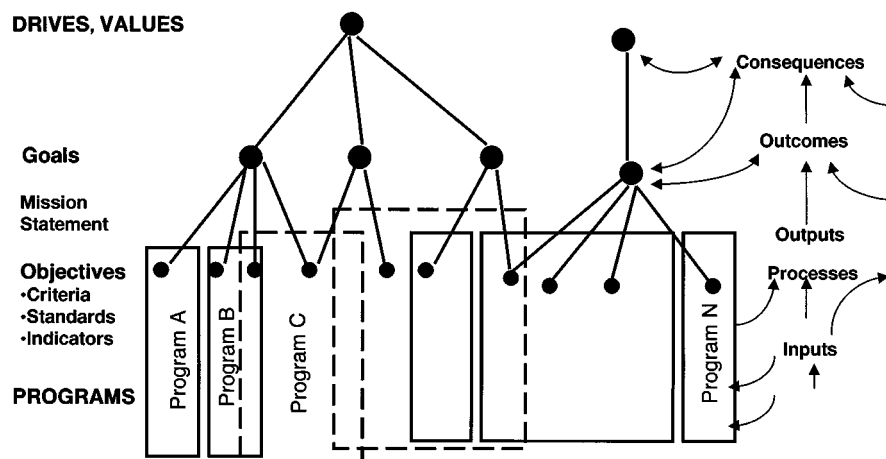
applicability. They can – and they must – be supplemented by country specific indicators when appropriate and they can – and they must – be changed in response to human needs and technological development.

## 2. Approach and definitions

In order to maximize applicability. The Expert Group strove to approach the question of performance indicators holistically. Its approach emerged from a desire to help answer three questions: ‘*Is the road administration doing the right things*’, ‘*Is the road administration doing things right*’, ‘*What things done by others significantly affect the road sector.*’

The modern world of road management is a complex everything-depends-on-everything universe. Clearly delineating the components that make up in this complex universe – while avoiding the rigidity and inflexibility that would defeat the purpose of establishing meaningful performance indicators – was crucial. A first step to finding its way through this maze was defining terms.

*Drives* are the irreducible, unobservable bases of human motivation. *Values*, are changing and changeable drive derivatives. A *goal* is a general statement of an end state, a desired direction of change, or an ideal function of a transport system. An *objective* is a concrete, measurable course or milestone toward a goal; *standard* or *performance target* is an objective which cannot be traded-off against other objectives or actions to achieve an objective. (*Road*) *programs* seek to connect objectives to actions, the road program.



Source: OECD (1997). Adapted from Thomas and Schofer (1970).

Figure 1. Definitions: drives, goals, objectives and programs.

*Inputs* are resources used to satisfy the (road administration's) operational needs to produce outputs. *Outputs* describe the outflows of products and services delivered (quantity and quality of roads maintained or built, studies made, etc.). There are two kinds of outputs, those, which are intended, and *concomitant outputs*, the by-products of the actions undertaken. For example, pollutant is a concomitant output of travel. *Processes* describe how inputs are transformed into outputs. *Outcomes* describe the systemic, user- or employer-conditioned results of all (road administration's) activities. *Externality or consequence* describes a class of societal outcomes and impacts on persons or things outside the transport system.

Broadly speaking, three perspectives were identified for the road sector performance: *government* (including 'stakeholders' who voice their concerns through the 'government'), *road administration* (the organization traditionally responsible for 'system performance'), and *user/customer* (the users and operators of transport services, and the community).

These definitions form the core concepts for the taxonomy of the Performance Indicators. They are used as organizing concepts to 'unbundle' many interrelated factors, creating some separability in the otherwise everything-depends-on-everything universe of the transport sector. In so doing they help define a divisible and incomplete set of performance indicators which is useful to road administration managers and affected interest groups.

The organizing concepts reflect the view that the road administration collects data, undertakes analyses and makes the day-to-day decisions. But, *government officials (elected and selected) and the public do have direct input into decision-making processes. They are ultimately responsible that the data collected and analyses undertaken reflect their concerns and affect project selection and actions performed.*

### 3. Aim of the paper

The paper is mainly intended to serve the management of a road administration. It aspires to be sensitive to overall political, economic and social circumstances in different countries. It addresses three central questions.

- First, what is the appropriate framework, the mental model, for the performance indicators for a road administration – one that is conceptual but can still be adapted and quantified to suit each country's unique needs?
- Second, what are the most important indicators to assess the performance of the road sector but which also allow creative approaches to be developed, and what are the associated requirements for data and analytical procedures?
- And finally how should the performance indicators be applied so that the

process of evaluation would contribute to the creation of a learning organization? This issue evolved during the work of the OECD Scientific Expert Group to be the most important, even more important than the performance indicators themselves.

To address this last question a field test was proposed to assess the use of a select number of performance indicators in practice. This field test is now ongoing. Suffice it to say here that the Expert Group proposed that testing in the field be an integral part of developing and learning to use performance indicators across the road transport sector.

#### **4. Current practice**

Most OECD countries measure road system performance in one way or another. The measurements are derived as a by-product from their current data systems rather than from a 'mental model' of the road administration's products and services and their interface with road users. However, such a model would provide a theoretical grounding, a before-the-fact platform for thinking rather than a conceptual framework imposed after-the-fact, to rationally organize data. Its importance to the effort to create comprehensive yet flexible performance indicators, cannot be overemphasized.

The use of mental models is beginning to be seen in the field, as road administrations are in the process of formalizing performance measurement, the most ambitious steps being taken in Australia (1997). Both achievements of objectives by the management and performance of the road system are measured: for planning and budgeting, for benchmarking performance targets, for evaluating service delivery, and for tailoring road system to match customer preferences.

The following gives a brief summary of the general categories of indicators currently in use in the OECD countries. They are classified according to the dimensions adopted by the OECD Expert Group; the governmental point of view predominates the measures.

*Accessibility and mobility.* For the most part accessibility and mobility are dealt with implicitly using the extent of road networks, classification and their level-of-service in terms of travel speeds. In sparsely settled countries regional distribution of roads and road budgets are issues that are monitored closely; some countries have standardized the level of service to be provided by road class. Travel cost is not used, excepting in benefit-cost calculations. Road pricing and – surprisingly – congestion are rarely regarded as affecting accessibility or mobility.

*Traffic safety.* Traffic safety is a significant issue in most OECD countries. High level organizations ensure visibility and funding for traffic safety concerns. Road administrations have comprehensive accident recording systems by type, location, road and traffic conditions, and site and driver specific factors. The Scandinavian countries have shown consistent success in converting the organizational and data support for reducing accidents.

*Environment.* All OECD countries have standards for water, noise and atmospheric pollution. There is an increasing interest in landscape and visual considerations. Vehicle inspection and maintenance systems were effective in all the participating countries. Recently, some countries and States have conducted surveys to ascertain public opinion regarding noise and air pollution, quality of service areas, and other important issues to road users.

*Equity and community.* Regional distribution of roads is of major concern in OECD countries with low population density. Excepting the handicapped access restrictions, no specific laws or regulations regarding mobility or distribution of roads were reported. There are wide-ranging consultations of the community in the context of major projects in most countries.

*Road program development.* All OECD countries undertake long term planning, using planning systems of variable complexity and sophistication. Autonomy in program development follows the institutional hierarchy. Decision makers at relevant political levels approve the plans. This process is highly country specific. With regard to distribution of the budget to different road administration objectives, there is no common or transparent system linked to performance. User views are rarely solicited in a methodical way in program development.

*Road program delivery.* Most OECD countries have an indicator related to the completion of the long-term plans. All countries have an indicator on the road administration's efficiency to delivery its products and, to a lesser extent, its services. Numerous 'ad hoc' measures are used. There seems to be a general movement, especially in Europe, toward exposing the road administration's direct labor force to competition.

*Road program performance.* The value of road assets is calculated in most OECD countries. The trend in asset value is monitored in some countries, mainly as input in the budgeting process. All countries have indicators describing the condition of the road surface and of the bridges. Trends are monitored regularly through road and bridge inspection and management systems. Road user views are rarely solicited.

*Summary of current practice.* This brief summary of current practice on performance indicators, shows that over the years, road administrations have evolved extensive data collection systems, some measure of citizen participation processes, sophisticated analytical tools, and classification procedures for measuring their own performance and that of the road system from their point of view. Road administrations have in-depth knowledge of the outputs of the road transport system – among them, road capacity, traffic volumes, travel speeds and level-of-service, maintenance and accidents. Road administrations similarly have at their disposal data regarding a road system's inputs: labor, materials, and machine hours and their costs since they are detailed in accounting systems.

In short, road administrations are proficient in dealing with the road system outputs as seen by them. But the road administration perspective is only one viable perspective from which to evaluate road system performance. There are at least two others – the government and the user-customer – as well as additional criteria, on which to base evaluation.

The Expert Group, which benefited from its members' direct knowledge of road administrations' processes, found that there was a continuum from 'bottom-up' technical practices to 'top down' management for results-based management, but that there was a link missing in the continuum. This link would incorporate the views of the different market segments in a significant way and had been under conscious and unconscious development for some time. The present work is an expression of that working-through process which had its origins in the late sixties as shown next by the brief literature review which is a prelude to the Expert Group's adopted conceptual model. Without over-examining the matter at length now, what follows demonstrates that a conceptual model is a necessary prerequisite for developing performance indicators and, which is even more important, using them.

## **5. The conceptual model**

In a practice that goes at least as far back as the Chicago Area Transportation Study (CATS 1957, 1962), road administrations seek the lowest costs to the public. They maintain extensive data systems to document and monitor their activities. The data and processes are an integral part of accounting systems to keep track of operations, maintenance and construction in various circumstances. Taken together, these data form the foundation of eventual outcome models: the vehicle operating speeds and costs in various traffic and terrain conditions, and for accident risk and its reduction. To mitigate against adverse concomitant outputs, whose significance was recognized early on, standards were adopted for design of roads, vehicles and driver testing.

These separate data items were gradually incorporated under unified concepts of road system planning and road management systems. Data collection procedures supporting the evaluation of output-efficiency were decentralized and highway engineering, 'bottom-up' approaches began to dominate both the measurement of the output and its 'optimization'. In short, road administrations had become, and still are, efficient in providing the road system outputs as seen by them. And again, while this perspective is a valuable and viable one, it is just that – only one.

The increasing comprehensiveness of transport planning led to the formulation of goal-directed transport planning models and quite sophisticated evaluation frameworks for self-adaptive systems. Early examples include those of Thomas and Schofer (NCHRP 1970) and by Morlok (1970). More recently, these trends have been incorporated in comprehensive road management systems which have become a commonplace in road administrations for managing roads (Watanatada et al. 1987; OECD 1994; Talvitie 1995). In an important work in the late 60's Thomas and Schofer describe a comprehensive model for the transport system and lay the conceptual foundation for the cost-effectiveness framework for evaluating transport plans. This model is a self-adapting transport system.

In this system, evolving goals and objectives reflect human values and needs. These are expressed and made tangible in the form of desired outcomes and consequences which are achieved through inputs (e.g. materials, money), processes (e.g. maintenance work, data collection) and outputs (e.g. passable roads, bridges). These, and unexpected outcomes as well, are tracked and evaluated using data collected by the road administration and feedback from the road users and community.

The Model's central idea is to move the focus of planning from the alleviation of current symptoms to creation of future results. This incorporates evaluation of the goals and objectives themselves in a feedback loop. Evaluation results are characterized both in terms of the quality and quantity of the outputs (e.g. condition of the road system) and in terms of user satisfaction with outcomes. As a *management-by-results model*, it provides a concrete framework for self-evaluation.

The Model illustrates how the road administration carries out activities using resources allocated to it. Products and services – outputs and concomitant outputs – are judged in relation to pre-determined standards and criteria. Outcomes, derivatives of products and services through user interface, are judged relative to requirements for the objectives that the road users and the community desire.

This Model was modified slightly to be the mental model for performance indicators. In Figure 2, the top two lines simply lay out the terminology employed and present the idea that objectives and goals have a dynamic



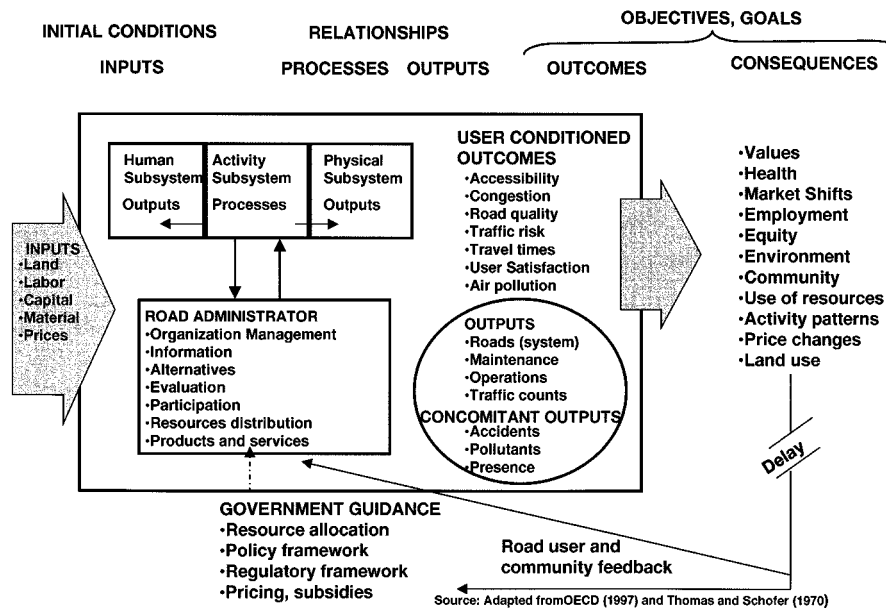


Figure 2. Road transport system.

relationship with the initial conditions from which the system evolves forward. The transport system has three sub-systems: the human, the physical and the activity subsystems. The human subsystem contains individuals and groups and their interrelationships. The physical subsystem is defined as ‘what would remain if all persons were evacuated, leaving their possessions behind?’ (Thomas & Schofer, 96, p. 14). It thus contains both man-made elements, such as roads, as well as natural elements such as wetlands. The activity subsystem is an interface between the physical subsystem and the human subsystem and contains the daily activities of persons such as trips. Road administration is a part of all the subsystems, but for purposes of the model it is identified separately because it engages in activities to produce outputs which modify the road system and also produce concomitant outputs, such as air pollutants.

Governmental policy guidance comes from outside the system because it is assumed that the road administration is, or should be, an autonomous organization with a clear mission. To fulfill this mission the road administration is organized to achieve objectives – user-conditioned outcomes – by complex processes. These processes are used to: manage an organization, gather information, develop alternatives, evaluate programs and engage the public for doing so, allocate resources to deliver products and services, outputs, to the road users. The outcomes are, thus, output derivatives. According to this model, the processes, the outputs and the user conditioned outcomes – such as acces-

sibility, congestion, road quality, traffic risk, user satisfaction, and air pollution – are all internal to the road transport system. Note that air pollutants and accidents are classified as concomitant outputs. Air pollution and traffic risk are user-conditioned outcomes derived from the amount of air pollutants emitted, or the number of accidents, and depend on drive habits, travel patterns, vehicle type and other behavioral choices.

The system can be called self-adaptive because the goals and objectives are partial responses to evaluation of outputs, processes, outcomes, consequences and community feedback. In turn, road administration management and political guidance are both based on this evaluation and feedback and on an understanding, albeit partial, of the relationships between inputs (initial conditions, and constraints), processes, outputs, and objectives.

The model can also be called *management-by-results* because it clarifies the output and outcome criteria. Governmental appropriation (either through the budget or a designated income source, such as the road fund), policy and regulatory framework, and pricing, subsidies and performance indicators are among the most important instruments used to direct the road sector administration. Control is maintained by establishing the (political) goals and allocation of funds. The results are characterized both in terms of the quality of the outputs (e.g. condition of the road system) and in terms of user satisfaction with outcomes.

The introduction of objectives and goals into transport planning, and the recognition of consequences in the provision of roads is not new. These activities in fact predate the CATS study and the groundbreaking studies of the 1960's by a good measure. The earliest objective of road improvements was to 'pull the farmers out of the mud', both a social and economic objective. The outcome of the early effort was a reduction in transport costs and an improvement in shipment reliability, which propagated into lower costs of goods and services to consumers and increased mobility and better accessibility for all people. Traffic accidents, as a concomitant output, was also felt and acknowledged early on in the history of transport planning. But air pollution and consequent environmental consequences appeared much later as constituent elements in road plans. The outputs, outcomes and consequences show, progressively, the extended time horizon adopted long ago for transport planning and for the evaluation of road improvement schemes.

The fundamental importance of outcomes and consequences in the road sector – that is, improvement in productivity; the appearance and quality of the man-made environment; impacts on health, mobility, equity, markets and community; and changes in land use, resource use and values – are now being recognized with renewed awareness. Improving quality of life and of the environment, and enhancing the performance of both public and private sectors truly constitute the fundamental roles of transportation.

The trend for scrutiny and accountability, and the need for stronger justification for investment has rendered the traditional output-related measures and evaluation of the road programs inadequate. Public administrations are faced with measuring and publicizing their plans and performance. The historical demands on efficiency to deliver services to the public at minimum cost are still valid. But the output measures respond to this need only partially. Road administrations are evaluated also in terms of outcomes and a range of consequences of their activities to meet the objectives and goals set by a (political) oversight body. These bodies occasionally even prescribe internal objectives, for example in terms of employment.

*Why not a single bottom-line measure?*

It was noted earlier that the traditional framework for the measurement of outputs was linked to the perspective which road administrations use to evaluate performance. The significant research and development work undertaken within that framework enabled the collapse of the many output measures into a single measurable objective (OECD 1994). However, once the notion of outcomes and consequences is accepted as valid for the evaluation of road administrations' plans, programs, and activities, expanded perspectives of performance appeared to be required. Performance has to be looked at also from other points of view than only the road administration.

An important 'box' containing 'the people' is normally omitted from the graphs describing the transport planning and implementation processes. The omission is especially ironic, since from the very beginning, when 'the farmers were being pulled out of the mud', citizen participation has been an important part of the process. In the late sixties, when citizen participation became a regular feature in the planning and implementation stages it became clear that differing values and viewpoints had to be reconciled with road plans and programs. It also became evident that values associated with differing viewpoints were not stable and that over the life cycle of the plans and the roads, people and businesses changed physically. Their needs and expectations also underwent a change. This led to periodic reassessment of road plans and programs. Continuous evaluation and 'disjointed incrementalism' (Braybrooke & Lindblom 1963; Manheim 1967) became the 'buzzwords' of road and transport professionals. The inescapable conclusion derived from these years of experience is that performance indicators must serve an open road planning and implementation process.

Because of this increased public openness, many road administrations have undertaken comprehensive performance measurement albeit in a fragmented and 'ad hoc' manner. There were, however, perfectly good reasons for road administrations to take a low-key approach with performance measurement.

Road administrations operate in a complex political environment, and also themselves are complex organizations with multidimensional outputs whose quantity and quality is difficult to measure. Measurement of outcomes and attribution of causes to transport actions is often impossible. The large number of governmental entities, jurisdictions, private and non-governmental organizations present in planning processes often leads to multiple interpretations of the same indicator. At the very least, it requires tolerating conflicting views not adequately captured by any one indicator. Performance indicators were not seen as helpful in such complex environment. Until recently, the relative insulation of the road administrations from public scrutiny only hardened this view.

The road administration organization, and management and funding methods, may also have suffered of neglect simply because addressing these broad multidimensional concerns by the road administration management was not politically expedient. In fact, it was discouraged. There also was uneasiness about performance measurement because it can have undesirable effects if used for finger-pointing rather than for the purpose intended: a comprehensive evaluation and measurement of the effectiveness, efficiency and satisfaction with the road administration and road sector policies. Though no unequivocal prescription can be mandated on how performance indicators should be used, the manner in which they are applied is important.

In spite of legitimate apprehensions, development of performance indicators is a positive undertaking. It can be plausibly argued that in the same way that the road management systems enabled the operationalization of a coherent least cost framework for rehabilitation and maintenance (OECD 1994), the search for performance indicators is an attempt to integrate the *least cost principle* comprehensively over the road sector. This means including in the indicators investment and demand-side measures – and not only the effects of supply-side actions for rehabilitation and maintenance – and the effects of institutional arrangements. The use of the plural form for performance indicators is a recognition that a composite performance index may be useful on occasion but insufficient; this only formalizes the contemporary, even if disjointed, practice.

## 6. Taxonomy and suggested performance indicators

‘There is only one issue but it is huge’ was the Expert Group’s conclusion when discussing the complexities and interrelationships of the road sector issues and their indicators. This and two other maxims – one, that ‘a useful indicator is one which is used’ and the other, by Michael Porter (1985), that ‘what is measured gets done’ – became beacons for the Expert Group’s work.

*There is only one issue but it is huge.* The list of interrelated, irreducible factors that are part of the highway profession's work is endless. There would seem to be only one issue, but it is huge. Without a way to make this indivisible world divisible, analysis would be paralyzed. The suggested measures make an indivisible world seem divisible. But the measures must not be used as if the world is divisible.

*Useful indicators are the ones that are used.* The Expert Group seeks to suggest useful performance indicators, but recognized that the true test comes from practice. For this reason, field-testing is proposed for learning how to utilize performance indicators, for measuring them, for establishing benchmarks and so on.

*What gets measured gets done.* This assertion can be interpreted in two ways. The positive one holds that when the right things are measured in the right way, good decisions can be made. The negative interpretation suggests that when either the thing being measured or the measure used is ill-defined, the wrong thing gets done. Either way, measurement of performance will have profound effects on road management.

After considering several alternatives to classify performance indicators, the Expert Group concluded that performance indicators serve an important function in all aspects and phases of road system evaluation and decision-making. It also became clear that the various viewpoints or perspectives from which an objective was viewed was critical. Travel time, one of the proposed performance indicators, is illustrative of this:

From the Government viewpoint and for resource allocation, travel time may be of minor interest; it is sufficient to express it in terms of level-of-service categories or extent of congestion. For road administration, on the other hand, travel time and its variability and the extent and location of congestion are important information for planning, programme development, and for traffic management. For users, the expected trip time, information on current traffic conditions, and degree of satisfaction with travel time and user service are important.

After extensive discussion, in which the mental model was operationalized, it was decided to opt for a classification of performance indicators which recognizes the fundamental roles of transportation as being represented by important groups of objectives: *mobility, accessibility, safety, environment, equity, community and economic development*, and equate them with the strategic system level (planning). The dynamic, goal-seeking transportation

system and its continuous evolution are represented by the three remaining major activities of the road administration: *programme development*, *service delivery*, and *system operation*. The perspectives of government (including stakeholders), road administration, and the user/community are maintained for all categories of indicators.

### *Operationalizing the mental model*

The mental model had to be operationalized to be applicable to performance indicators. This operationalized model is presented in Figure 3.

In the figure, the *Rolling Multiyear Plan*, the road program cycle is divided into four phases corresponding to the above conceptual model: the development of system objectives and long range planning, road programme development, service delivery, and system operation and monitoring (road program performance). This rolling multiyear program is motored by the *drives and goals* of individuals and groups. Fuel is also supplied by *short term and long term consequences*, which stimulate drives and keep the program rolling. Additional forces are provided by the Government policy guidance and other outside system inputs.

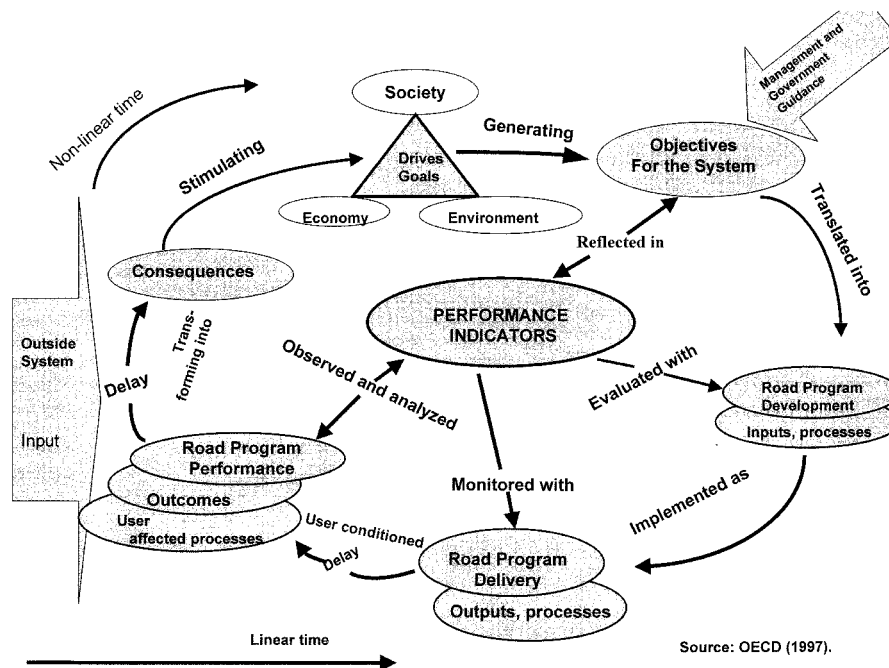


Figure 3. Rolling multiyear program.

Performance Indicators play a central role in this cycle, an observing eye in the center as shown in Figure 3. The road program cycle originates from individual and societal drives and goals. They generate objectives that, augmented by policy guidance from the government and the appropriate political entities and the civil society, are *reflected in performance indicators* for the road system. These objectives are translated, again with policy guidance, into an (annual) road program whose key inputs and processes are *evaluated with performance indicators*. The delivery of the road programs outputs and processes are *monitored with the assistance of performance indicators*. Finally, the outcomes of the road program, the program performance, are *analyzed with the help of performance indicators*. These outcomes co-evolve with influences from outside the road transport system and are observed with unspecified time lags and lead to complex societal consequences. These consequences in turn stimulate new goals and start a new cycle.

One thought in Figure 3 deserves attention. Figure 3 incorporates both linear and ‘non-linear’ time. The annual road programs follow linear time in consequent sequence. Year after year, the rolling plan moves horizontally. However, user-affected outcomes, which follow from the interface of the human subsystem and the products and services delivered road administration, and other significant actors, are experienced with delay. The length of this delay is predictable only to some degree. Different outcomes have different delays. The consequences are almost totally unpredictable and are observed with unknown time lags. These unpredictable elements drive the rolling plan according to their own timetable, hence the label ‘non-linear time’.

This road program cycle rests, on the platform of road administration management which is responsible for the road program utilizing the means available to it: learning, information gathering, development of new options, public participation, evaluation, interaction with the market, and allocating resources to these activities.

## 7. Suggested Performance Indicators (PI)

The suggested PIs are shown Table 1.

The indispensable indicators are underlined in boldface; the primary indicators are shown in bold and the *secondary indicators in italic* typeface. There are fifteen indispensable indicators (4/8/3 – Government/Road Administration/Road User), forty primary indicators (10/20/10) and thirty-five secondary indicators (15/10/10). For the most part, the variables can be unambiguously defined and measured. The details for all indicators are in the full OECD report (1997). That document should be consulted because Table 1 (as well as Table 2) is only a summary.

Table 1. Taxonomy and performance indicators

Perspective/dimension	Government (Ministry)	Road administration	Road user
<b>Accessibility mobility</b> (Many of these measures apply to Community and Equity dimensions)	<ul style="list-style-type: none"> <li>• <b>HCM Level of Service (percent): A, B, C, D, F</b></li> <li>• <i>By functional class</i></li> <li>• <u><b>Average road user cost (car and truck)</b></u></li> <li>• <i>Composite access index</i></li> <li>• <i>Total transport cost/GNP</i></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Expenditures for maintenance and operation/veh-km</b></li> <li>• <i>ditto by functional class</i></li> <li>• <b>Travel time and its variability</b></li> <li>• <i>Quality of information to road users (from audit)</i></li> </ul>	<ul style="list-style-type: none"> <li>• <u><b>Level of satisfaction regarding travel time, its reliability and quality of road user information</b></u></li> <li>• <i>Hours of congestion delay</i></li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>• <u><b>Accident risk: fatalities and injuries and/or fatal and/or injury accidents per veh-km</b></u></li> <li>• <b>Existence of National traffic safety program</b></li> <li>• <b>Percentage of accidents involving drunken driver</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Method to assess the safety programs</b></li> <li>• <b>Percentage of traffic flow speeding (weighted)</b></li> <li>• <i>Percent of roads not meeting min design standards</i></li> <li>• <i>Exposure of pedestrians and cyclists to vehicle traffic</i></li> </ul>	<ul style="list-style-type: none"> <li>• <u><b>Unprotected road user risk</b></u></li> <li>• <i>Time from alert to treatment (medivac)</i></li> <li>• <i>Share of pop that considers traffic accidents as a public health problem</i></li> </ul>
<b>Environment</b>	<ul style="list-style-type: none"> <li>• <b>Existence of air quality standards</b></li> <li>• <i>Cumulative land area taken by roads (%)</i></li> <li>• <i>New land area taken for roadway use</i></li> <li>• <i>Insp/maint prog'm for veh emissions</i></li> </ul>	<ul style="list-style-type: none"> <li>• <u><b>Environment policy or program (y/n)</b></u></li> <li>• <b>Use of de-icing agents</b></li> <li>• <b>Emissions per capita for CO<sub>2</sub>, NO<sub>x</sub>, VOC, PM</b></li> <li>• <i>Pollutant concentrations in road run-off</i></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Percent of pop exposed to noise levels &gt; 65 db</b></li> <li>• <i>Percent of pop exposed to emission levels violating air quality standards</i></li> </ul>
<b>Equity</b>	<ul style="list-style-type: none"> <li>• <i>Regional distbn of roads</i></li> <li>• <i>Laws for mobility limited, (y/n)</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Surplus (deficit) of road expenditures relative to road user charges collected by region</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Travel cost, travel time by user group</i></li> <li>• <i>Accident risk by user group</i></li> </ul>



Community	<ul style="list-style-type: none"> <li>Processes for public participation and to reconsider prior decisions</li> </ul>	<ul style="list-style-type: none"> <li><u>Processes in place for market research and customer feedback (y/n)</u></li> </ul>	<ul style="list-style-type: none"> <li>Satisfaction with the number and types of feedback mechanisms</li> </ul>
Program development	<ul style="list-style-type: none"> <li><u>Long-term progms for construction, maintenance, and operations (y/n)</u></li> <li>B-C analysis of the adopted road program</li> <li>Projected level congestion</li> </ul>	<ul style="list-style-type: none"> <li><u>Management systems for distribution of all the resources (y/n)</u></li> <li>B-C analysis of the (proposed) road program</li> <li><u>Quality Management Audit program (y/n)</u></li> </ul>	<ul style="list-style-type: none"> <li>Satisfaction with the road program development process</li> </ul>
Program delivery	<ul style="list-style-type: none"> <li>Sufficiency of maintenance funding</li> <li>Degree of completion of the long-term road program</li> </ul>	<ul style="list-style-type: none"> <li><u>Forecast road costs vs. the actual</u></li> <li>Cost of operation/lane-km</li> <li><u>Overhead percent</u></li> <li>% construction materials recycled</li> <li>No. of staff/lanekm</li> <li>Percent of work by direct labor</li> </ul>	<ul style="list-style-type: none"> <li>Satisfaction with the road program delivery</li> <li>Adm costs and user delay costs associated with maintenance</li> </ul>
Program performance	<ul style="list-style-type: none"> <li><u>Value of assets</u></li> <li>Ex-post values of Benefit-Cost analyses</li> <li>Trends in road budget by program</li> <li>Return on assets</li> <li>Road exps/GNP</li> </ul>	<ul style="list-style-type: none"> <li><u>Roughness</u> (by road class)</li> <li><u>Bearing capacity</u> (by road class)</li> <li>% Load posted bridges</li> <li><u>% Defective bridge deck area</u></li> <li>Congested roads – km</li> <li><u>Incidence of truck overloading</u></li> <li>Management system for road furniture</li> </ul>	<ul style="list-style-type: none"> <li><u>Surface condition and satisfaction with road condition</u></li> <li>Rest areas/100 km</li> <li>% of Main roads lighted</li> <li>Quality of winter maintenance</li> <li>User info system (y/n)</li> </ul>

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Table 2. Country profile and present provision of roads

Context	Indicator	Significance
<b>Demography</b>	<ul style="list-style-type: none"> <li>Population (urban/rural) and population growth per annum</li> </ul>	<ul style="list-style-type: none"> <li>Population and area of the country are descriptive measures to 'size' the other indicators.</li> </ul>
<b>Territory</b>	<ul style="list-style-type: none"> <li>Area of the country</li> </ul>	
<b>Economy</b>	<ul style="list-style-type: none"> <li>GNP or GDP (/capita)</li> <li>GNP or GDP growth per annum</li> </ul>	<ul style="list-style-type: none"> <li>A significant determinant, travel demand grows at the rate of GNP</li> </ul>
<b>Vehicle fleet</b>	<ul style="list-style-type: none"> <li>Cars/buses/trucks/other</li> <li>Growth in vehicle fleet/annum</li> <li>Percent vehicles without emission control</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle stock is important travel demand factor</li> <li>Describes the extent of the potential environmental problem</li> </ul>
<b>User charges</b>	<ul style="list-style-type: none"> <li>Variable user charges (e.g. fuel levy)</li> <li>Fixed charges (e.g. vehicle levy)</li> <li>Congestion charges (e.g. tolls)</li> </ul>	<ul style="list-style-type: none"> <li>Variable user charges/depreciation is an indicator for cost recovery</li> <li>Fixed and congestion charges can be compared with constr budget</li> </ul>
<b>Funding</b>	<ul style="list-style-type: none"> <li>Road adm budget by program (constr, maint, operations)</li> </ul>	<ul style="list-style-type: none"> <li>Funding compared to user charges is an indicator of cost recovery</li> </ul>
<b>Depreciation</b>	<ul style="list-style-type: none"> <li>Annual depreciation of assets</li> </ul>	<ul style="list-style-type: none"> <li>For comparing trends in maint funding and depreciation (or value of assets)</li> </ul>
<b>Road network</b>	<ul style="list-style-type: none"> <li>Kms of Road by functional class (arterial, collector, local)</li> <li>Engineering structures (km) (bridges, tunnels, ferries)</li> <li>Kms of Road by Adm Class (federal, state, municipal, other)</li> </ul>	<ul style="list-style-type: none"> <li>Network size is an important descriptor of the road system</li> <li>Structures are expensive and also describe risk</li> <li>Administrative levels indicate complexity of organization</li> </ul>
<b>Value of road assets</b>	<ul style="list-style-type: none"> <li>Replacement value of assets, by functional class or type of structure;</li> </ul>	<ul style="list-style-type: none"> <li>Indicates in money terms the values of different elements of the network</li> </ul>
<b>Accessibility</b>	<ul style="list-style-type: none"> <li>Road km/ sq km</li> <li>Lane km/ capita</li> <li>Lane km/ GDP</li> </ul>	<ul style="list-style-type: none"> <li>Accessibility to land</li> <li>Accessibility to activities</li> <li>Road network 'burden'</li> </ul>
<b>Usage of roads</b>	<ul style="list-style-type: none"> <li>Vehicle and ton kilometers of travel (VKT) and (TKT) by functional class</li> <li>Traffic volumes by functional class (weighted by road link length)</li> </ul>	<ul style="list-style-type: none"> <li>Measure of travel demand; past 5-year trend desirable</li> <li>Measure of demand and congestion</li> </ul>
<b>Usage of other modes</b>	<ul style="list-style-type: none"> <li>Mode splits for passenger and freight travel (all the road modes)</li> </ul>	<ul style="list-style-type: none"> <li>Extent of provision and s competition by mode</li> </ul>
<b>Congestion</b>	<ul style="list-style-type: none"> <li>VKT weighted road-kms with Volume/Capacity &gt; 1</li> </ul>	<ul style="list-style-type: none"> <li>Extent of congestion in the road network</li> </ul>

Many of the PIs rely on reasoned assessment of the current situation in the road sector in a country or State. There is, of course, an ever-present danger that simple or even complex measures regress to a 'good is good' assessment. Such measures have no intellectual or practical leverage. The aim in selecting the suggested PIs has been to choose ones, which are easy to understand, stimulate reflection and comprehensive inquiry, or have leverage. This comprehensive inquiry in itself is a most potent means for change. There has been no aim to achieve a uniform level of either complexity or comprehensiveness.

Two examples are illustrative. One recommended PI for traffic safety is a *method to assess results of safety programs*. This PI is 'yes' or 'no' and simply indicates whether or not a method exists in a road administration. But the response goes beyond one word. Before the concise answer can be given, an inquiry into the existence of the traffic accident data base, the quality of the data, and the analysis interface with numerous other kinds of data must be reviewed. This is clearly a complex and comprehensive task. Thus, behind the short answer for this measure is a complicated story and much work. Making it more complex is that the tasks and subtasks will differ both in quantity as well as kind from country to country. The accident data bases and analysis methods and their sophistication and quality vary from country to country. An international comparison of the data bases, analysis methods and indicator values is possible. If such comparison done, it may influence the practice and quality of data or analysis with regard to traffic safety. This would be an example of learning from others and a desired concomitant outcome of the indicators.

Another suggested PI for traffic safety is the *(weighted) percentage of vehicles speeding*. This measure is narrow and well-defined. It was chosen because of its strong correlation with traffic accidents and their severity. It too is subject to quality differences: the percentage of speeding traffic may be inaccurately surveyed. In order to address the pervasive quality issues relevant to many indicators, another PI is proposed: the existence of *quality management audit* in a road administration.

It is clear from these examples that the suggested performance indicators build a picture of the whole piece by piece. They focus on matters with great complexity or those with high leverage, and include measures, which attempt to integrate the pieces, comprehensive or narrow, into a whole.

There is one more aim. This aim is to encourage progressive communication for continued improvement and sequential learning and adjustment. The performance indicators facilitate that through market surveys and dialogue with affected interests, and through international cooperation and exchange of ideas. Comparisons of PIs within a country or State are most useful because many uncontrollable but important factors remain the same or there exists a tacit

and in some cases quantifiable basis to know these factors. Building and following the trends in a consistent set of indicators is a useful management aid and invaluable information to the public.

The ‘inherited’ network and social and economic circumstances form the backdrop for performance indicators. These circumstances change. Given the changing context, this backdrop must be attached to the performance indicators. An important part of the road administration’s mission is a periodic assessments of the goals and objectives. An historical record of the performance indicators is, therefore, essential. This, and the backdrop, is provided by the description of the initial conditions. The initial conditions also reflect the performance of the past road programs and supplement the road sector performance indicators. The suggested initial condition variables are shown in Table 2.

## **8. Use of performance indicators**

It is a solid piece of experiential knowledge that a well-defined set of goals and objectives is part and parcel of most successful projects. It is much less clear however, that the existence of well-defined goals and objectives is the cause or even antecedent to success. Thus, the use of performance indicators should not consist solely of helping to evaluate the degree to which goals and objectives have been achieved. The situation is more abstract for several reasons.

First, goals and objectives are often defined in isolation and not necessarily by those responsible for the specific projects or programs; or, they are designed to achieve broad-based goals with unmeasurable objectives. At best, there may have been a wished-for relationship between the goals and objectives. At worst, what may result is a clear disconnect between the goals and objectives, or between the objectives and the road programs. Second, even with ill-defined goals and objectives, good management of a well-defined project or program can make – and has made – a meaningful contribution toward desired end states. Third, there even are extreme examples in which a good management has salvaged a ‘bad’ project (or program) to serve worthwhile ends. Fourth, because of the fluidity of values or the emergence of new important goals, or changed priorities among the existing ones, summative evaluation has not always found it useful to address the issue of whether the goals and objectives were attained. Indeed, it is possible that unsuccessful projects are, in retrospect, seen by an external observer to have served valuable objectives, though not necessarily those established for the project. And finally, there can be situations in which there are no goals or objectives, merely issues or problems to be addressed and learned from.

The Performance Indicators are intended to serve in all five above circumstances: development of alternative courses of action or means to achieve desired goals or avoid unintended ones; evaluation of the degree of achievement of goals and objectives; assessment of the efficiency and effectiveness of alternatives and of the road administration; as a guide for both program and project management; and development or a periodic re-evaluation of goals and objectives. There is an implicit sixth circumstance: road administrations are – or can be – learning organizations. Performance indicators can serve a useful role as a cornerstone on which structured learning experiences can be built. A paragraph for each of the six uses follows.

*Development of alternative courses of actions and performance targets.* The development of alternative courses of action is and should be a serial and adaptive process. Numerous performance indicators and criteria are used. These may change with time and place. The following kinds of monitorable targets have been proposed: a given reduction in the number of injury accidents over a time period; a given reduction in air pollution over a time period; a reduction in congestion in terms of vehicle kilometers of travel experiencing congestion; an improvement in level-of-service or road condition; level of operations cost of roads; arrest of the decline in the value of road assets, and so forth. Studying the feasibility of these targets requires the existence of data and management systems and analytical procedures. The existence of such systems is included as a performance indicator.

*Evaluation of the achievement of goals and objectives.* The achievement of a target must be evaluated comprehensively. For example, if the objective concerns maintenance funding, among questions to be analyzed are: were the maintenance funds used efficiently and directed to right actions?; did weather affect the outputs or outcomes observed?; are the users satisfied with the product or service?; has productivity improved?, etc. Evaluation of the achievement of the objectives is thus anchored to much deeper considerations than just comparing targets and outputs or outcomes.

*Development or periodic re-evaluation of goals and objectives.* The development of goals and objectives is an important and time-consuming task. Normally goals and objectives are servant to an array of conflicting political and professional agendas and conflicts with ensuing programs are inevitable. These conflicts or disconnects of another sort having to do with ‘time’ must be captured by re-evaluation of goals and objectives. This is because the decision to build a road, which is opened today, was likely made ten years ago under what may have been different circumstances; or, because a policy made years ago may have served a different set of objectives; or, because

the function and the population served by a road may have changed. Clearly, in such circumstances it is not appropriate to evaluate the project or policy relative to their original goals. When ‘disconnect’ occurs or is impending, the need to re-evaluate or develop new goals arises. This requires an open-ended and serial process of *progressive communication* in which performance indicators can serve as a common yardstick.

*Assessment of the efficiency and effectiveness of the road administration.* Although comparing road administrations with each other or against past trends is only one use of performance indicators, it may be met with resistance. If the performance indicators are derived for several countries, States or regions for a number of years, they of course can – and should – be used to make comparisons either between these entities or as a trend within. The large differences, which inevitably will exist between entities, raise the question: why? It is worth stressing that the most relevant comparison is the trend within the country, State, or region; the most important finding is the magnitude of change in response to an intervention; and, the most important outcome of performance review is learning.

*Organization and management of road administrations.* The most important basis for claiming that performance indicators are useful to the management of road administrations are the road administration managers’ opinions. The opinion of these managers was expressed directly as members of the Expert Group and indirectly through their representation in the Expert Group. To ensure that management is aware and up-to-date on how well the customers are served, the proposed performance indicators make extensive use of customer surveys and market research techniques. Studies show that reorganizing road administration can significantly reduce costs because economies of scale and scope affect the delivery of products and services. Therefore, performance indicators should also be interpreted with a view toward organization structure and periodic studies commissioned to investigate the issue (Talvitie & Sikow 1994, Talvitie 1997).

*Aid to a learning organization.* Evidence collected over centuries points out that people do not change their behavior or make decisions on the basis of ‘rational evidence’ if that evidence is incompatible with their wishes, beliefs or experience, and not framed according to their thoughts about causes and effects. That is, change is grounded on emotional experiences. For highway professionals the problem of a learning organization is apparent: under what circumstances interventions, both material and immaterial, will have good consequences; what kind of planning processes facilitate emotional communications and changes in behavior or decision patterns; and so forth.

An issue, perhaps the most fundamental one, is how an organization can commit itself to try new approaches for developing, recommending, and implementing new plans or policies when they may require a substantial departure from extant practice. This view for the usage of the performance indicators goes conceptually beyond the identification of the inputs, processes, outputs, outcomes and consequences associated with a project (or program) in order to achieve objectives and goals. Even though it is true that, objectively speaking, these five items are the ones that can be partially measured, their evaluation is dependent on values that are largely unmeasurable. Furthermore, as implied by the strong influence attributed above to management, the application technique associated with the use of the performance indicators is crucially important to processes, outputs, outcomes and consequences. The task here is to relate the performance indicators to everyday experiences of highway professionals and road users.

*The need for flexibility and specificity in the use of performance indicators*

The question raised in the beginning of this section about the attribution of cause has broad implications for management by results and for the content and use of performance indicators. For the road sector, which is the concern here, it is important that the performance indicators are broad enough to capture the essential concerns of the government, the administration, the users and the community. A scope this large and flexible allows the road administration to respond to the issues in an appropriate manner, taking note of the wide ramifications an action or program may entail. The OECD Group arrived at the recommended performance indicators after much discussion and after considering the existing ones used by the OECD member countries and the kinds of decisions in which a road administration is involved; and after reviewing the complicated, country-specific institutional processes present in decision-making. They were chosen because they reflected as well as accommodated the complexity of the situations encountered and provide the flexibility desired. To ensure that management is keenly aware and up-to-date on how well the 'customers', the road users and shippers of goods, are served, the proposed performance indicators make extensive use of customer surveys and market research techniques to complement the road administration and the government views, traditionally more accessible to the management.

## **9. Conclusions**

The conclusion of the Expert Group was that the performance indicators chosen after reflective discussions over a period of time do give a broad-based picture

of the road sector from several different perspectives. In addition, it concluded that:

- the road user views should be solicited and incorporated into policies, plans, programs and service delivery and that more should be done on that score than presently;
- the road administration professionals want the public to know what they know;
- more can and should be known about the issues with regard to equity, community, and economic development;
- performance indicators should serve a learning institution and encourage the institution to learn;
- the end-product of the work was unexpected: there is much less emphasis on numbers – though there are critically important numbers – and much more on qualitative reflection on what purposes the road program is serving and whether these purposes reflect the views of the public;
- the fifteen ‘indispensable’ indicators should be subject to a field test by an International Task Force.

There was much confidence that the OECD countries’ road administrations can deliver performance, or they can cause it to be delivered – once it is known what should be delivered. And there is consensus that this information should be gained and used. That probably is the major contribution of the indicators: they will tell the story of what objectives are being served and why and at what costs.

#### *International task force*

An OECD Task Force, consisting of representatives of the OECD member countries’ road administrations, has been convened to put together, refine, use and discuss experiences in quantifying, qualifying and using the ‘indispensable’ performance indicators. This was seen to be the best way to pilot a new product and the emerging management philosophy, and answer the several questions that cannot be addressed in the abstract. A broad-based international co-operation also increases the reliability and trustworthiness of the results. The objectives of the now ongoing field-test are:

- *Learning*. Organizational learning was considered by the OECD Scientific Expert Group to be the most important purpose for the use of performance indicators.
- *Establishment of benchmarks and observation of trends*. The purpose initially is to establish procedures for tracking trends to establish country specific benchmarks.



- *Inquiry into reasons for not achieving set objectives or targets.* Inquiries into the causes of cost overruns of road projects, or for decreases or increases in traffic accidents, or comparisons of a market survey of road user opinions relative to the policies and practices of road administration, and so forth.
- *Definitions and measurement of indicators.* Many of the indicators are not yet precisely defined or several definitions are possible. The Task Force should experiment and evaluate alternative definitions and measurements.
- *Data collection.* The Task Force should investigate and experiment with alternative methods regarding the adequacy, accuracy, expense, and measurement techniques of current data systems and evaluate these experiences.
- *Analytical procedures.* Most indicators or their application requires analytical procedures. The Task Force should attempt to identify if the available analytical procedures are sufficient and what kind of new procedures or skills are needed.

There may be other, unexpected issues that need to be addressed in the context of putting together or applying the performance indicators.

## Note

1. The countries and organizations participating in the Expert Group were: Australia, Austria, Belgium, Denmark, Finland, France, Greece, Italy, Japan, The Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States, AASHTO, PIARC, and World Bank. The author chaired the Expert Group.

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