PIARC – ST1

ROAD TECHNOLOGY

ROAD QUALITY SERVICE LEVELS AND INNOVATIONS TO MEET USER EXPECTATIONS

Monday 20 October 2003 (1.30 – 5.00 p.m.)

SESSION AGENDA & INTRODUCTORY REPORT

22.31.E

Session Agenda

PART 1: PROCEDURES TO IDENTIFY USERS EXPECTATIONS AND SERVICE QUALITY INDICATORS TO EVALUATE THE LEVEL OF RESPONSE TO THEIR DEMANDS

1. **Session Introduction**

Mr. Antonio J. ALONSO BURGOS (ST1 Coordinator/SPAIN)

2. **Road quality service levels and innovations to meet users expectations**

Mr. Antonio J. ALONSO BURGOS (ST1 Coordinator/SPAIN)

3. **Performance indicators: A management tool for Road Administrations**

Mr. Ivar SCHACKE (Danish Road Directorate, WERD/DENMARK)

4. **Service levels and Responses to user expectations: The French experience**

Mr. Alain LASLAZ (National Reporter, Road Directorate/FRANCE)

5. **Road service quality control in Cuba**

Dr. Eduardo DÍAZ GARCIA (National Reporter, ISPJAE/CUBA)

6. **Quality of service evaluation through users surveys: The experience of Madrid Regional Road Administration**

Mr. Juan J. JARILLO RODRÍGUEZ (Community of Madrid/SPAIN)

7. **Panel discussion and debate on how to identify users demands and how to monitor quality of service**

Panel: PART 1 Speakers

PART 2: TECHNOLOGY TO PROVIDE THE BEST SERVICE TO THE ROAD USERS

1. **ST1 Technical Committees perspective**

   a) **User expectation and optimisation of maintenance strategies based on pavement management systems**

   Mr. Bjarne SCHMIDT (C1 Committee Chairperson/DENMARK)

   b) **Factors to be considered in selecting pavement types and examples of recent advances in pavement techniques**

Mr. Nelson RIOUX (C7/8 Committee Chairperson/CANADA-QUEBEC)

c) Development in slope risk assessment and monitoring

Mr. Giorgio PERONI (C12 Committee Chairperson/ITALY)

2. COST 343 compilation of best practice in pavement maintenance to reduce congestion and to improve road safety

Mr. Oscar GUTIÉRREZ-BOLIVAR (C6 member/SPAIN)

3. Development of pavement technology aimed at conserving and improving roadside living environment

Mr. Akira INOKUMA (National reporter, PWRI/JAPAN)

4. New maintenance procedures and management methods to improve service levels in the Spanish road network

Mr. Angel SÁNCHEZ-VICENTE (National Reporter, Road Directorate/SPAIN)

5. Road work and maintenance on motorway A1: Innovating choises, winning results

Ms. Ghislaine BAILLEMONT (SANEF/FRANCE)

6. Pavement material that improves rutting resistance on heavy loaded areas

Mr. Jesper SUNDAHL (RAMBOLL/DENMARK**)**

7. Panel discussion and debate on how to optimise the quality of service and on the future orientation of ST1

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8. Conclusion

Mr. Antonio J. ALONSO BURGOS (ST1 Coordinator/SPAIN)

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PRESENTATION

Throughout history there have been a great many examples illustrating the fact that a nation's development is intimately linked to that of its infrastructure, and its road infrastructure in particular, as roads constitute an essential element of economic policy because they contribute effectively to economic and social development, improve private sector productivity, increase competition between regions and businesses, create employment, create a backbone structure for territory and have a multiplying effect on the other economic sectors.

Road infrastructure planning has gradually evolved with time. At the beginning, the paramount aim of all road plans was to create a basic network capable of boosting economic activity and providing accessibility to the entire territory. Having achieved this aim, new necessities arose and any nondescript type of infrastructure ceased to be effective. Society now called for an infrastructure with satisfactory 'capacity' capable of providing a 'level of service' adapted to its users.

A fundamental change has occurred in the users of this road infrastructure. They no longer consider roads as products of primary necessity, but a service where quality must be exacted. In other words, safety, comfort and convenience, reliability, etc. These quality demands are not a matter of whims but rather one of transcendental importance to a nation's economy, inasmuch as this road infrastructure makes up a substantial portion of the industrial and economic fabric of a territory. We only have to think of the repercussions there would be if in the space of a single day or even a few hours traffic were halted on a few of the major communication highways in our country.

This is why we need to apply a management system focussed on quality of service in each individual stage of the investment process - planning, programming, design, putting out to tender, construction, operation and maintenance.

1.- INTRODUCTION

In order to be able to make this assessment of service quality and set up action that will redound to the benefit of a higher quality and optimisation of the resources available, we first need to be aware how users perceive upgrading action for a road and the degree of satisfaction this provides for them, in order then to be in a position to combine both the technical quality of a road and its quality of service in reliable indicators.

However, roads do not constitute an end in themselves, but gain weight if they manage to meet the needs of all the direct and indirect users. These users are wide-ranging and sometimes their interests are conflicting, depending on the type of vehicles they drive and the goods they haul, etc.

Users demand that roads permit fluid, comfortable and convenient and safe driving conditions at all times and which do not entail transport oncosts.

These also appear in the environment of contributory roads where it is not a question of direct users but rather ones who irregularly suffer the consequences caused by traffic - high noise levels, atmospheric pollution and lower property value, etc. In all countries there is a growing environmental awareness that is forcing the authorities to carry out relevant measures to minimise the environmental impact caused by road works and operation.

Road Authorities need to meet these requirements by efficiently managing the budgets available which are very often insufficient to achieve all the desirable targets.

For many years now, road professionals have been handling indexes that allowed them to characterise the state of the different elements comprising roads, allowing them to be aware of the quality of building processes, changes in the levels of pavement deterioration and the suitability of new techniques, etc. As from the mid 1990s there has been a rising interest in using traditional indexes plus others that have appeared more recently to define the levels of quality capable of being demanded in roads, linked in many cases to their maintenance through outsourcing to private firms.

Road Authorities need to be aware at all times of the requirements of users and what their demands are for roads at all times. To this end, we must bear in mind that road users are not all the same and as a result their needs are also very divergent.

In order to achieve this level of awareness many countries are carrying out a number of measures that have been specified in the national reports:

- setting up a permanent telephone information service allowing users to be aware in real time of the different incidents occurring in the road network (roadwork, accidents and adverse weather conditions, etc.);
- internet;
- telephone or face-to-face surveys;
- mobile telephones;
- variable message signs on roads for providing information systems;
- the media.

It is most interesting to highlight that by all these means Road Authorities are feeding information to users but that also users can in turn supply information or lodge complaints on aspects they feel are important.

On many occasions, road construction and maintenance professionals are not aware of all the problems that can arise in the vicinity of roads and it is proving most useful to obtain feedback from users, who frequently notice road elements that are not functioning correctly.

The indexes enable the elements comprising roads to be objectively characterised, thereby facilitating their comparison with desirable or optimum average values or with values corresponding to other roads. This is the way investment can be objectively prioritised by road or by element (pavements, signing, slopes, etc.), thereby improving investment efficiency.

In the initial design planning and preparation stage the main problem is to use a 'single indicator' to rank, in a joint and reliable way, both the technical quality of the works to be designed (taken to mean compliance with regulations and specifications) and their quality of service (covering all the factors involved in the management, performance and service provided by the infrastructure). This 'single indicator' should combine the economic assessment traditionally applied to the technical quality of a design, i.e.: costs of construction, maintenance, rehabilitation, functioning, etc., with an assessment that is hard to quantify in monetary terms such as its quality of service (taken to mean driving safety, comfort and convenience, blending into the environment and reliability of journey times, etc.).

In construction, operation and maintenance contracts, in addition to demanding minimum quality standards, beneath which the work carried out cannot be accepted, the possibility should exist for rewarding or penalising the successful bidder as a function of the technical or service-related quality standards achieved in comparison to a pre-determined 'standard' quality. For this we need to select and weight a number of parameters or indicators that will be used for reference purposes at the time of assessing the work carried out. These parameters may be technical (surface evenness, asphalt density), environmental (level of noise, vibrations, pollution, etc.) or service-related (effective maintenance of the serviceability conditions, accident and incident attendance service, etc.).

Some countries have recently begun to set up maintenance contracts linked to values attained by a number of pre-set indexes. As a function of these indexes the contractor receives a monetary bonus or fine comprising a further incentive on top of its permanent contractual obligation to carry out the different maintenance operations with satisfactory levels of quality.

The indexes selected can be very wide-ranging: friction/braking force coefficient, IRI, rutting and accident rate, etc. Single indexes are also used, or a combination of several simple indexes by weighting their values, allowing the overall state of the road to be assessed and fixing a quality level for it.

The indexes are also suitable for rewarding quality execution of works such as laying asphalt macadam. In this case, the contractor would receive a larger or smaller amount of money depending on the IRI values achieved for the pavement wearing course.

We see that some countries have opted for a small number of indexes, allowing them to be obtained easily and systematically, whereas others have decided to select a large number of indexes, thereby obtaining very full information on the different elements comprising their road networks.

We must constantly bear in mind that the different levels of quality must always be correlated with user demands for obtaining safe and comfortable/convenient driving conditions on the roads, which is why it is appropriate to demand that at all times they are capable of providing the minimum standards capable of guaranteeing their aptness.

With a view to lessening the inconvenience roads cause to users as a result of the roadwork carried out for maintenance and upgrading purposes, Road Authorities take different steps to improve traffic fluidity and safety in stretches affected by roadwork.

The measures taken should achieve increased safety for the roadwork, both for motorists and the workforce involved. Road maintenance entails an additional risk for the workforce if we compare it to other public works inasmuch as road traffic is an autonomous element that is difficult to control, dynamic and dependent on the will of motorists.

Authorities carry out different measures to mitigate the inconvenience and dangers caused by roadwork. The most significant are:

- revising roadwork signing regulations;
- using fixed or movable variable message panels allowing motorists to be warned sufficiently in advance about the state of the road and the alternative routes existing;
- specific planning for the types of roadwork that can create the greatest impact on driving conditions;
- carrying out roadwork at night or at weekends in search of times that will affect traffic least;
- police radar speed control;
- using construction methods lessening impacts on traffic;

- announcing roadwork prior to its commencement on the Internet, in the media and on specific radio frequencies, etc.;
- traffic guidance equipment and specific traffic containing systems to improve roadwork safety.

There are occasions when specific indicators can be considered, such as the delays motorists ought to have to put up with as a result of roadwork, in order to define schedules for execution of the works or the level of information motorists should be given.

Other indicators, such as the length or number of lanes to be closed to traffic or the time they will be out of use to traffic can be used to reward or penalise contractors, thereby encouraging them to cut down the inconvenience to be generated, which always translates into longer journey times and consequently higher freight costs.

Road Authorities need to bear in mind at all times the strategic importance of road haulage in the majority of countries and the costs that can be generated as a result of incorrect management of maintenance and upgrading work in their road networks.

The information given to motorists through the media and other ways (Internet, mobile telephones, etc.) redounds to the benefit of better road network operation. Motorists are warned in advance of the points where the existence of incidents can delay journey times, making it easier for them to start off on journeys earlier or choose the alternative routes previously indicated by the Road Authorities.

This also helps motorists to take suitable measures (dropping speeds, increased attention to driving, etc.) designed to cut down the danger existing in and around roadwork, thereby increasing safety for drivers and workforce alike.

With a view to lessening the impact traffic has on the members of the public living alongside roads, new types of pavement dressing are being studied to achieve, amongst others, the following aims:

- lessening noise intensity generated by vehicles;
- lessening the vibrations transmitted to the road environment;
- lowering atmospheric pollution;
- lowering pavement temperatures to lower the overall temperature in cities.

In some countries, specific pavement dressing contracts are awarded to firms tendering environmentally-friendly construction methods that cut down possible negative effects.

In mountainous countries, road construction usually involves substantial earthworks creating very high slopes. These slopes entail a risk associated with these engineering structures inasmuch as in adverse weather conditions, very often linked to torrential downpours, land slides occur that ruin roads and endanger adjacent property. The Road Authorities in these countries study the slopes, establishing soil geotypes with associated risk factors and risk tendency indexes, to the effect that, prior to construction of the road, the soils with the highest associated risk are identified and layouts can be studied that involves smaller number of slopes and the slopes selected can involve lower depths of excavation.

Winter weather conditions have a marked effect on driving conditions, cutting down fluidity and increasing danger to traffic. As a result, for many years Road Authorities have adopted technical measures to guarantee winter serviceability.

It is complicated to set up indexes to rate winter serviceability. Some countries use indexes like the 'number of hours a road has been closed to traffic' or 'the number of hours the use of chains was compulsory', although the effectiveness of these needs to be specifically analysed as winter serviceability is a complex phenomenon that is difficult to break down into individual indexes.

The new technologies have only been introduced bit by bit into winter serviceability - GPS systems on board vehicles and weather stations producing real time reports, etc., redounding to the benefit of the increased efficiency of network management.

2.- STRATEGIC THEME ST1

For this reason the Strategic Session ST1 at the XXIInd World Road Congress, entitled "Road Service Quality Levels and Innovations to meet User Expectations" focuses on maintenance methods for optimising road capacity, functional quality indicators determining the degree of user satisfaction achieved and technical innovations in this field that have been implemented over the past four years.

In view of the 'innovative' slant of this work session in comparison with previous world road congress, I wish to thank the PIARC member countries and the members of the following PIARC Committees:

- C 1 Surface Characteristics
- C 7/8 Pavements and
- C 12 Earthworks, Drainage and Subgrade

for their collaboration in the preparation of Strategic Session ST1 and for the effort that has gone into preparing the papers and reports submitted.

3.- STRUCTURE OF SESSION ST1

This work session is structured in two parts scheduled to last 90 minutes each with a 30-minute break between them. Each part will contain an introduction by the chairman of the session followed by national reports, individual papers and a discussion-cum-debate. The second half will close with a proposal for conclusions.

4.- TOPICS PROPOSED FOR DISCUSSION

As I have just pointed out, the session will end with a discussion-cum-debate in which I would like to encourage all attending to participate knowing that your opinions will enhance the conclusions for this Keynote Session.

Without any intention of excluding topics or of prejudicing the outcome of the presentations that follow on the agenda, I would like to introduce some subjects to set the debate off and for you to be thinking about in order to express your opinion.

The topics I propose are as follows:

- the role of surveys for assessing user opinions concerning the level of service provided by road authorities - the design of these surveys, the types of question they should contain and the statistical analysis of the findings;
- the effects roads have on frontage residents - the importance of the techniques used to cut down noise levels, pollution, vibrations, temperature, etc.
- roads and the environment: reduction of environmental impact; current importance and future development of pavement recycling; use of waste materials; reduction of the number of quarries and waste dumps existing;
- definition of uniform worldwide indexes for assessing the level of service provided by roads and capable of allowing comparisons amongst them with a view to objective fund allocation for repairs and improvements - comments on whether these indexes are suitable or not and on the risks attached to indiscriminate use of them;
- the accountability of road authorities for the service they provide to users: complaints lodged over delays caused by road works or by pavement defects and slope collapse, etc. and the social and economic importance of such complaints.

5.- NATIONAL REPORTS

At a national level, the following PIARC member countries have submitted reports: Austria, Australia, Canada-Quebec, Chad, Czech Republic, Cuba, France, Germany, Hungary, Italy, Japan, Mexico, New Zealand, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

An examination of these reports enabled us to determine two levels of implementation of service standards in road management. In the initial stage, the indicators were very simple and used a numerical system to reflect the factors road users perceived as most directly representing the state of road pavements: friction/braking force coefficient, surface evenness, cracking, subsidence and potholes, etc. Subsequently, the system evolved to include indicators related to bridges, walls, drains, slopes, winter serviceability, tunnels and other road structures perceived by users to be on a second plane and which acquire importance when the state of the pavement is acceptable by the standards of user demands. In a third and more advanced stage, the indicators do not refer to the elements and characteristics of roads but to their interaction with the physical environment surrounding them: noise, vibrations, pollution, ambient temperature, etc. and the services provided for motorists such as rest areas, service areas, etc.

Once the state of roads has been analysed from the technical point of view and the characteristic values for the most common indicators have been defined, the advanced stage of the system involves a situation where it becomes more important for the Road Authorities to learn about user points of view through surveys and by informing motorists of the way to react to specific incidents - roadwork, snow, road serviceability in tunnels, etc. - with a view to mitigating the inconvenience users can suffer. This is being implemented in some countries including France, New Zealand, Canada-Quebec, United Kingdom and Australia.

In order to cut down the inconvenience caused to users in countries such as Germany, Portugal and Quebec, measures have been adopted to increase safety standards in roadwork and minimise impact on traffic. By way of example, Portugal has implemented a management system whereby roadwork is carried out at night on roads with an ADT of over 30,000 vehicles/day.

Geographical characteristics affect the interest shown by individual countries in certain specific aspects of road management. Countries such as Sweden and Hungary have developed a management system for winter serviceability adapted to their particular climate conditions. Switzerland gives special importance to subjects related to slope stability and special geotechnical problems in view of its mountainous relief.

Rumania, the Czech Republic, Hungary and Slovakia have implemented a pavement management system based on more or less routine inspections and on quality indicators.

One evolution in indicator-based pavement management systems, designed to improve the quality of the finished product, is the system adopted by Mexico which grants monetary bonuses or fines to contractors responsible for asphalt spreading as a function of the surface evenness results.

Austria, Italy and Germany have general-condition indexes covering CRT, IRI and rutting, etc. that are given different weighting factors. Austria runs a compaction control system on every piece of compaction equipment.

Spain has developed and implemented across the majority of its State Road Networks multiennial maintenance contracts with private firms under government guidance, termed 'integral maintenance' contracts. This system already incorporates indicators of the state of repair of road elements and indicators of the service provided, as an instrument for monitoring and managing the contract, and where only a few service indicators are linked to payment for the corresponding items. A recent advance in this subject has consisted of a pilot experiment for indicator-related maintenance contracting, understood to be the setting up of fixed-sum bonuses or fines depending on the values achieved for these indicators which are assessed by regular inspections. The national report covers two pilot experiments, begun in 2002, referring to the use of indicator-based maintenance contracts. The first is a concession granted for a shadow toll motorway (whereby Central Administration pays the concessionaire a set rate for the traffic using the motorway) which incorporates a system of incentives and sanctions in accordance with the rating achieved for certain service indicators (accident rate and reduced traffic capacity owing to lane closures). The second case involves contracts for highway sections where different preset amounts are paid for each of the condition- and service-based indicators established so that specific thresholds are achieved and kept up and failure to reach these levels incurs sanctions and deadlines for doing repairs.

As from 2000 the Spanish road authority has implemented extensive internal regulations governing the execution of road works designed to cause the least possible disturbance to users. Works are carried out during off-peak traffic times, during the night in many cases. For other types of work 24-hour daily schedules are set up in three 8-hour shifts with a view to cutting down execution times by a significant extent. Work schedules are also limited around and during public holidays and vacation periods in order not to curb road capacity on days with heavy traffic counts.

Within the field of network operation and maintenance management and with a view to optimising the procedures and performance of the contingents available, Spain is paying special attention to winter serviceability and tunnel operation on account of their vital impact on winter motoring. By way of example, on the question of winter serviceability, protocols and operative plans for action and coordination have been introduced amongst the different bodies accountable and the material and human resources have also been stepped up. The quality of service provided by the equipment teams is measured by the degree to which they meet the predetermined winter serviceability operational plan set up as a function of the means available, the characteristics of the road section involved and the predictable scenarios.

In order to increase the quality of operation and upgrade driving safety conditions through tunnels, operating manuals have been introduced as well as coordination protocols and explanatory leaflets distributed on the attitude motorists should take when confronted with risk situations in very long tunnels, and minimum equipment requirements have been set up in terms of safety measures as a function of the characteristics in each individual tunnel.

Spain has recently implemented specific legislation governing the minimum machinery and equipment recommended for installation in tunnels as a function of the tunnel characteristics involved (length, one- or two-way traffic flow, urban or interurban location and traffic density, etc.).

Before giving the floor to the presentations, allow me to thank all the PIARC members mentioned above for their participation in ST1, even though we have selected the following national reports for presentation on account of time restrictions, in order to introduce and deal with innovative questions and to combine the interests of countries with similar problems or concerns, in addition to our intention to cover the widest possible range of subjects:

- Cuba
- Spain
- France
- Japan

These particular national reports have been chosen for the reasons that follow.

The report from Cuba presents its particular, recently introduced method to determine the level of service quality in a road, and whose chief advantages are cost cutting, precision and simplicity.

Spain's national report covers several aspects that are very much related to the subject of the ST1 session and describes the experiments carried out in relation to road maintenance based on service indicators.

The report presented by France reflects the level of implementation of quality systems for the different elements of roads. These quality systems first began to be introduced in 1993 in respect of pavements and were subsequently developed for structures, tunnels and retaining walls. Soon to be implemented are quality systems for road drainage and equipment and machinery. Parallel to this technical quality system, France has introduced a sophisticated system for user enquiries designed not only to learn the level of user satisfaction existing but also the shortfalls to be eliminated or improvements to be made in the road network.

In this respect it is interesting to see how France has developed a system which on the one hand analyses infrastructure quality levels from a technical and more objective point of view and, on the other, it has developed a quality system for the services provided for road users.

The report presented by Japan is very innovative in this respect inasmuch as it considers different parameters from the ones traditionally analysed to measure the level of service quality provided by a particular pavement. In other words, in addition to surface evenness, rutting, sideways force coefficient, etc., it also considers a series of environmental parameters such as reducing levels of noise, vibrations and pollution, increased temperature in urban areas, etc. and including in the payment terms to contractors a bonus or fine as a function of the environmentally friendly parameters achieved by the roadwork.

The Session will also include a presentation on the COST 343 work depending, which has identified the procedures considered to be best practice for organising pavement maintenance, both at design and network levels. In order to identify these 'ideal' procedures, data have been taken from the different bodies managing road networks in 17 European countries.

6.- INDIVIDUAL PAPERS

The following individual papers have been submitted:

- Ghislaine Baillemont (France)
- Juan José Jarillo-Rodríguez (Spain)
- Jesper Sundahl, Jan Elert Munk & Soren Bunch (Denmark)
- Gordana Petkovic, Oystein Myhre & Jacob Mehus (Norway)
- Pasquale Colonna, Simona d'Amoja, Manuela Maizza & Vittorio Rainieri (Italy)
- Adolfo Güell (Spain)
- Hassan Saline (Chad)
- Jean-François Godard, Didier Rouveix & Frédéric Sagnier (France)
- Gabriele Boscaino, Filippo Giammaria Praticò & Rosolino Vaiana (Italy)
- Jean-Claude Valeux (France)

The papers corresponding to Baillemont, Jarillo and Sundahl et al will be described below.

The paper by Colonna et al (Italy) reports on the studies carried out to achieve a worldwide service index.

The paper by Adolfo Güell describes several repairs made to the A 52 Expressway in Galicia (North-West Spain), carried out on porous asphalt wearing courses.

Hassan Saline (Chad) reports on the recent implementation of maintenance contracts whereby contractors receive a fixed sum per kilometre for routine maintenance work and extraordinary maintenance is paid for separately on a specific job basis.

The paper by Godard et al (France) describes the EVALIS multifunction pavement assessment system capable of surveying the condition of nine parameters - longitudinal section (roughness), transverse section and macrotexture, etc.

Boscaino et al (Italy) report on a set of experiments designed to assess the correlation between the texture levels of different wavelengths and friction or flow measurements.

Petkovic et al (Norway) describe the use of recycled materials and the way they have been adapted to the specific weather conditions prevailing in Norway.

Valeux (France) describes a pavement dressing using an asphalt emulsion in the Caribbean, including the whole process involved in the stages of analysis, drawing up of technical specifications, execution of the work and monitoring of the results.

7.- TOPICS PROPOSED FOR FUTURE DEVELOPMENT

The following topics are proposed for future development:

- selection criteria for the pavement package based on quality of service; new pavement packages designed to cut down user impact during execution of the work and also maintenance tasks over the useful life of the pavements;
- correlation studies between worldwide indexes and the opinion and perception users have of roads and the level of service provided by them; appropriateness of these indexes;
- new indicators to be developed in the future in respect of pavement characteristics and the hazards associated with roads - slope instability and slides, etc.
- new forms of works and maintenance contracts where payment depends on the degree to which impact on traffic is reduced - lower lane occupation, work in off-peak traffic time and efficient provisional diversions, etc.;
- studies correlating road safety, road condition and service levels.

8.- REFLECTIONS

Finally, and before starting to present the papers and national reports, I would like to make a series of reflections.

While the aims and means are clear, better and higher quality service must be provided by applying all the tools at our disposal for this.

We must bear in mind that however much we desire to do so, roadworks and maintenance and operation management are difficult to assess, and even more difficult to appraise because of the existence of a number of constraints and circumstances that are hard to forecast, such as the human factor or weather conditions. This is why we need to get across to those with the ultimate responsibility and to users that road construction and management are not exact sciences, and that in order to be able to provide a good quality service, on top of the help afforded by having a set of advances and 'indicators' available to us that facilitate the task of we professionals, these indicators must be taken with the appropriate caution.

We need to distinguish the technical criteria and parameters from user-side quality service aspects. Users will not appreciate the number of inspections made on a bridge or tunnel, or their complexity or degree of detail, nor the number of snowploughs ready on a road, because these are technical questions that are difficult for users to understand and to rate. What users can and do rate is the service this infrastructure provides them with - safety, comfort and convenience, reliability, etc.

To be successful in providing a better quality of service, we need to rely, inter alia, on the new information and communications technology, which offers possibilities unthinkable before now for improving the way roads are operated, such as rerouting drivers to uncongested or roadwork-free alternative roads, informing users via variable message signs of the speed to drive at as a function of traffic and prevailing weather conditions, etc