ROAD NETWORK OPERATIONS

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TC 1.4 MANAGEMENT OF NETWORK OPERATIONS

INTRODUCTORY REPORT

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EXECUTIVE SUMMARY

Network Operations is about the safe, efficient and reliable operation of our roads and highways. Roads authorities have long-standing responsibilities for building and maintaining the infrastructure and for managing the asset, but they are now acquiring new responsibilities. Present-day network operations are increasingly a matter of strategic importance, vital to the health of the local, regional and national economy. Highways need to be fully integrated with local transport networks, ports, ferry terminals, airports, railways stations and other long-distance modes. Strategies for traffic management, expressway operations, demand management and enforcement of traffic laws are urgently needed with congestion management and reduced incident response times high on the agenda.

The overall theme for the Technical Committee on Network Operations (TC1.4) has been integrated network operations in the widest sense. This means integrating road network operations between different road authorities and agencies in the city and region, locally and long-distance, including international frontiers, for the benefit of all road users.

Road network operations are set to benefit from a variety of technical developments, some of which will become widely available in the very near future:

- more accurate and cost effective data collection
- systems for improving the efficiency of the network or making better use of it. These could include speed management, access control, lane control
- data warehousing and intelligent systems for using static and real time data to predict the build up of congestion, journey times etc
- co-operative systems, infrastructure and vehicles working together to improve safety and management
- intelligent vehicles working together to improve safety
- improved integration between road operators, police and emergency services
- provision of driver information in vehicle and presented when required
- development of new infrastructure-vehicle services such as car parking management/booking, traveller information/entertainment, tourist information/ attractions
- integrated road and public transport traveller information
- enforcement and security systems aimed at reducing the level of illegal driving and dangerous or defective vehicles

The Technical Session at Congress will include presentations on how network operations are developing in different parts of the world. Reference will be made to case studies and guidance from the committee, which will complement the authoritative Intelligent Transport Systems Handbook from PIARC, now in its second edition (PIARC 2005). The session will be structured around the three main themes for the committee's work:

- "New ideas for network operations"
- "Information management and the public interest"
- "Appropriate use of ITS for Integrated Transport Systems"

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1. NETWORK-WIDE OPERATIONS

1.1. Background

Historically road authorities have responded to increasing demand by adding capacity, building new roads or expanding the existing ones. With the high costs and constraints of building conventional infrastructure, maximizing the effectiveness of existing systems, including capitalizing on new technologies such as intelligent transport systems (ITS) has become, for many authorities, a new focus.

Given demographic trends and the growing demand for improved system performance, road authorities are changing the way they plan and operate their transport systems and are focusing more intensely on road network operations.

More importantly, the transportation world has become increasingly user driven. Users/customers are concerned with mobility, journey reliability and accessibility. Operating the network is thus about optimizing the overall performance of the network and satisfying as many user needs as possible.

Road network operations can be defined as all traffic management and user support activities intended to permit, improve, or facilitate the use of an existing network, whatever its conditions of use.

Network operations therefore embrace operation of the road network in the widest sense, including the integration of activities:

- Across geographical boundaries between road operators and road administrations
- Allowing all travellers, transport managers and shippers the optimised use of all modes of transport
- Facilitating inter-modal transfer and smooth access to transport interchange points and terminals for passengers and freight.

This approach also supports policies relating to safe, sustainable, efficient and environmentally friendly transport, providing for the mobility needs of the user while decreasing negative environmental impacts whenever possible. More and more, transportation professionals and officials will be called upon to implement strategies that support sustainability providing the basic access needs of individuals and societies in balance with human and ecosystem health and, with equity within and between generations.

1.2. Scope and Objectives

Network operations concern all activities directly related to the concept of service to the user of a road network (personal transport, commercial vehicle operators and drivers, freight transporters, and public transport operators). It differs from:

- *improvement* of the infrastructure, which consists in equipping it and adjusting its geometric and physical characteristics;
- *maintenance* of the infrastructure, designed to ensure the preservation, quality of use and renewal of road assets;
- *traffic policing powers* that concern general or local rules of road use, whether permanent or temporary.

The network operations focus is also consistent with the mission of developing sustainable transport, providing for the mobility needs of the user while avoiding critical negative environmental impacts.

The objectives of the network operator therefore include:

- Improving safety on the road network;
- Optimising traffic flow on arterial and freeway networks;
- Reducing congestion within and between cities;
- Co-ordinating agency traffic/transit operations;
- Managing incidents, reducing delays and adverse effects of incidents, weather, roadwork, special events, emergencies and disaster situations;
- Effectively managing maintenance and construction work to minimise the impact on safety and congestion;
- Informing travellers with timely and accurate information;
- Improving the interfaces between modes of transport for passengers and freight;
- Eliminating bottlenecks due to inadequate road geometry;
- Providing reliable and convenient public transport services.

2. NETWORK OPERATIONS IN PRACTICE

2.1. Organisation of Network Operations

Network operations is characterised by the involvement of many partners in the delivery of services. Different organisations are involved depending on the network hierarchy (expressways, highways, urban roadways, etc), transport mode (roadways, public transport, railways, etc) or the type of service (safety, information, etc). Effective road network operations require functional, organisational, and inter-jurisdictional coordination, cooperation, integration and interoperability within a geographic region.

The logical outcome of the shared responsibility for network operations is the need to establish partnerships. In their organisational, financial and legal aspects, partnerships are often beset with particularly challenging issues. Some of the reasons institutional issues arise are included in Table 1 below.

Table 1 - Summary of potential causes of institutional issues

Reason	Explanation	Comments
Concern with Autonomy	Coordination implies a loss of individual organisation autonomy	
Different missions	Different organisations have different missions	The missions may be complementary but: each organisation brings a different mindset to the table which may cause institutional difficulties
Differences in Resources	Budgets vary by jurisdiction and organisation which may lead to differences in the capability of partners to perform equally	
Technology	Different organisations adopt different technological approaches which lead to difficulties in making technical system interface properly	
Information	The operations mission depends on Information	Sharing of information is a very sensitive issue. Also integrating information may present technical difficulties.

2.2. Network Operations Planning

Structured planning for operation of the network is essential in ensuring that the delivery of road user services and operations activities are consistent and integrated with broader transport policy objectives and performance requirements. It is necessary to analyse the particular needs, operational constraints and priorities of each party involved. A clear division of roles and responsibilities among various partners is essential, be they from the public or private sectors.

Network operations planning therefore involves proactive collaboration with key partners and engagement with stakeholders and the community to identify innovative solutions to optimise the safety, efficiency and reliability of the existing road network. The goal is an integrated and sustainable transport system. The focus should be on the “outside-in” view (road user), to understand the perspective of the road user in the planning and delivery of road network operations that support the road user, rather than the more traditional “inside-out” view of the road operator.

Effective planning for network operations will assist in achieving more effective operation of the road network, more effective infrastructure investment decisions, and potentially reduce or defer the need for major capital investment. General design procedures include the following:

Information gathering

- Identify the geographical limits of the network to be covered,
- Identify the organisational boundaries and interfaces in the road hierarchy including the toll roads, bridge and tunnel operators and any major traffic generators of strategic importance (e.g. entertainment and sport complexes, ports, airports)
- Identify the key partners involved in operating this network: the road authorities and operators of transport facilities directly involved, traffic police and other enforcement agencies.

Understand the requirements

- Identify underlying operational and environmental problems for roads and traffic on the network.
- In consultation with key partners, define operational objectives from both the network operator's and the road user's perspective, including performance criteria.
- Specify the functions and performance levels that are required (technical, organisational, operational)

Plan the delivery

- Identify the roles and responsibilities to be assigned to each key partner
- Select operational equipment and services that are needed
- Identify the information strategy to best achieve network operations goals
- Select technologies based on cost-effective delivery of the functional requirements
- Determine funding resources for capital expenditure and on-going operational and maintenance needs
- Negotiate operational agreements and funding arrangements with the key partners
- Implement network operations, with regular reviews for improvement and updating

2.3. Components and Major Functions

The following components are identified as major functions of network operations:

- Operations centre
- Network monitoring
- Maintaining road serviceability and safety
- Traffic control
- Travel aid and user information
- Demand management

Operations Centre

Functions to be performed at the operations centre include monitoring traffic and traffic environmental conditions, incident detection, centralised data processing, support of operator's decision-making processes, communication with relevant agencies and service media, and implementation and evaluation of operations strategies

In order to support these functions, the control centre needs to house computer hardware and software corresponding to these functions. The major functions of the computer system are to receive and transmit data to/from the field, to process data regarding traffic flow and incident characteristics, to receive operator's commands, to control graphic displays and to store and create historical data, and last but not the least to exchange information with external bodies (media, information service providers,) including neighbouring traffic operations centres and operation centres for other modes of transports. In particular, software algorithms play significant roles in detecting incidents and identifying severity of incidents, supporting operations decision-making, and selecting and/or prioritising traffic operations/control strategies.

Network monitoring

Network monitoring performs a key function in gathering prevailing road network information and providing support for other network operation missions. Quick response to incidents based on the monitored information enables road network operators to take appropriate actions to minimise the negative effects of incidents. The resulting impacts of these operations activities are again monitored and evaluated to take further actions. A closed loop of information involving monitoring, decision-making and evaluation of resulting impacts is thus maintained.

Maintaining road serviceability and safety

Incidents such as crashes and vehicles breakdowns as well as impassable/unsafe road conditions are estimated to cause up to 60% of annual roadway congestion. The traffic congestion that results from these incidents can lead to additional crashes and cause delayed response to emergency situations. According to one case study, for every minute an incident remains on the roadway, it causes an additional 5 minutes of delay after the incident is cleared. Below is a synoptic table of the major findings on this topic (PIARC 2003)

Table 2 - Synopsis for maintaining roads serviceability and safety

	Objectives	Equipment	Tools	Effectiveness	Lessons learned
Maintenance, Rehabilitation, Upgrading	To improve road conditions to better accommodate the traffic	Roadworks machinery – and manual labour; the standard equipments of construction	-Planning and scheduling tools	-better roads	-requires careful planning -requires good prior notice -signs and safety essential
Lane Control	To ensure that the vehicles observe their lanes in order to avoid accidents	-magnetic rails, etc -sensors on the vehicles		-better lane observance	-requires equipment on the vehicle side, which may make it difficult to implement in some economies
Automatic Braking	Automatically control the throttle to control speed, based on various conditions (distance with other cars, speed limit of the area)	-Throttle control -GPS -DSRC (Dedicated Short Range Communication)	-Video processing -detection algorithm -traffic simulation algorithm	-better understanding and response for conditions -better decision making -promote better co-ordination between parties -Accumulation of data	-Some detectors require accurate installation -balance between purpose, data volume and communication bandwidth -planning and co-ordination about the use and the collection method is essential -beware of privacy issues
Road Condition Warning	To warn the user about road conditions such as icy roads and incidents	-CCTV, inductive loops and other sensors, variable message signs	-information processing	-reduce accidents, better tool for action	Theft of the equipment can be a major problem
Control Centre	To observe and respond to various incidents and events	-various	-various	-better response	-effective but requires coordination between parties

Traffic control

Traffic Control in this context is referred to as innovative systems that make use of up-to-date communication and real-time software technologies to improve traffic flow. Although they could be considered as contributing to traffic control operation, systems that make use of in-vehicle equipment have not been addressed, except those equipment used for receiving traffic information (Radio, RDS-TMC receivers,) (see sect. 3.1 below)

Travel aid and user information

The common objective of all traveller information services is to provide high quality, real-time, detailed information on transportation system operational conditions, including weather, so that individual travellers and drivers can make informed decisions regarding whether to make a trip, when to make it, what mode to take, and what route to take. Traveller information should be available both before a traveller begins a trip, as well as while the trips are underway, so that adjustments can be made to reflect changing operational conditions.

Demand management

Road network operations are directed towards maintaining optimal conditions on the road network in relation to supply and demand. *Supply* is based on a hierarchy of service levels that determines the methods, organisational structures and resources needed to support strategies for road network operations, maintenance and incident response. *Demand* reflects the needs of the various customers and stakeholders (road network operators and users) and their operational objectives. Demand Management is increasingly being undertaken in city-regions that suffer from severe traffic congestion

2.4. Application of ITS to Network Operations

Intelligent Transport Systems – ITS - is a generic term for the integrated application of communications, control and information processing technologies to the transportation system. The use of ITS makes it possible either to devise new strategies for network operations or to improve existing strategies. ITS has been steadily evolving with accelerating acceptance by road authorities over the past decade. These tools can assist in demand management and make it possible to influence the distribution of users between the various networks in order to improve traffic flow and achieve greater efficiency for the benefit of all.

A detailed discussion on the full spectrum of ITS considerations can be found in PIARC's ITS Handbook (see Bibliography). The ITS Handbook covers all aspects of ITS from benefits of their implementation, to how to get started, as well as institutional issues and special considerations for countries in transition.

Advanced Traffic Control: Traffic control is a major role for the network operator. Advanced systems make use of up-to-date communication and real-time software technologies to enhance safety and improve traffic flow. Solutions include ramp metering, speed control, tidal flow systems, adaptive signal control, collective and individual route guidance and freight access control.

Ramp metering is a popular form of traffic control in the United States. It is used far less in Europe and Japan. Ramp metering systems have proven to be effective in avoiding flow breakdown on congested freeways. The following figures are based on results obtained in the United States:

Effectiveness of Ramp Metering in United States

Optimising the motorway capacity	Range 17% to 25%
Increasing speeds	Range 16% to 62%
Reducing accidents	all accidents : range 24 % to 50 % ; injury accidents : 71 %,
Reducing air pollution	15 % (CO and HC emissions).

(Source: PIARC Road Network Operations Handbook, 2003)

Speed control systems are more common in Europe than in the US or Japan and the major benefit relates to improved safety. Displayed speeds (generally mandatory) are aimed at reducing the range of individual speeds in non-congested situations and protecting the end of queues when congestion appears. The benefits of speed adaptation systems include: smoother flowing of traffic, yielding increased capacity, thus resulting in a postponed disruption time, and reduced number of accidents, especially rear-end accidents. These benefits are obtained through an effective reduction of observed speeds but also through an increase in driver attention.

In some systems (for example, on M25 motorway around London), the variable speed limit display is coupled with an automated enforcement system (involving video cameras recording licence plate numbers), which issues citations to motorists exceeding the posted speed limit by a predetermined threshold. Evaluations show:

- a decrease of accidents of 24% (MCSS : Motorway Control and Signalling System in the Netherlands) to 28 % (M25 in U.K.) and 35 % (Aichelberg in Germany);
- an increase of capacity of 2% (MCSS) to 5% (A4 motorway near Strasbourg, using advised speeds);
- smoother traffic flows (less accelerating, less braking)- which has a positive impact on pollution;
- and, all together, a rather limited increase of average travel times (M25);

The observance of speed limits by drivers is a consequence of many legal, social and cultural factors. Automatic enforcement, when it is supported at political level, can result in a significant reduction of speeding and casualties: the number of deaths on French roads decreased by 24 % on French roads during the three year program to deploy 1500 automatic radar speed detectors.

Active Traffic Management is an approach that is being adopted in the UK for heavily trafficked and congested expressways and motorways. It requires an integrated operation across all the different agencies directly involved, to improve the level of service offered to the road user. The agencies work together to develop the necessary operational procedures. The following methods are in use:

- Monitoring in real-time to determine current and forecast traffic conditions on the network, with heavy instrumentation, TV surveillance and comprehensive data collection.
- Traffic management and control which is adapted in real-time to changing traffic conditions, both automatically and through interventions at the operations centre.
- Variable speed and lane control using overhead electronic signs and lane indicators.
- Mandatory variable speed limits which respond to current flow conditions.
- Speed enforcement tied to variable speed signs and speed enforcement cameras.
- Hard shoulder running at peak times to gain an additional lane of traffic.
- Incident detection and rapid-response rescue services.
- Driver information such as point-to-point journey times, incident Information, through Variable Message Signs (VMS), highway advisory radio, and other traffic information.

Inter-modal and Intra-modal Integration ITS can deliver integration benefits by improving inter-modal and intra-modal integration. An example is the Sydney Transport Strategy which brought about a significant improvement in highways performance. The strategy was roads based but included HOV lanes, significant bus and coach improvements, plus information enhancements and ticketing innovations on ferries and trains.

Demand management: Regimes such as access control (ramp metering primarily), and dynamic lane use, such as High-Occupancy Toll (HOT) lanes can be applied to expressways and inter-urban roads. The advent of ETC has made it easier for network operators to implement different rates (tolls and other charges) for different periods and thus implement "value pricing". The next evolution of vehicle access control will see the increased use of these ETC systems following the example of charging trucks (Heavy Goods Vehicles) in Germany and the congestion charge schemes that have been evaluated for Stockholm and which operate in central London.

3. INFORMATION MANAGEMENT IN NETWORK OPERATIONS

3.1. Traffic and Travel Information Services

Information services are complementary to the traffic control functions of network operations. They aim to provide high quality, real-time, detailed information on transportation system operational conditions, including weather, so that people can make informed decisions regarding whether to make a trip, when to make it, what mode to take, and what route to take. Typical information that can be made available includes:

- Traffic conditions
- Weather and road conditions
- Incident and emergency management information
- Work-zone information
- Route planning and navigation
- Alternative route information
- Real time transit information, real time traffic information
- Parking location and availability
- Local area and tourist information - hotels, restaurants, shopping facilities

Real-time information is becoming increasingly available for all categories of road users. Such information enables users to change trip plans in real time based on the various conditions and disturbances on the road network. The same information allows road network operators to offer better service and to minimise certain safety-related risks.

There have been few comprehensive evaluations that attempt to numerically quantify the benefits of providing traveller information to road users. However, users of traveller information services generally agree that availability of high quality, real-time traveller information saves time for users, helps them to avoid congested locations and incidents, and reduces uncertainty and stress associated with travel.

Some of the most significant ITS impacts on inter- and intra-modal transfer have been from information systems. Real time information systems on buses, trains and metro routes and networks can be equivalent to “a 3 minute time saving per trip”. Increasingly, real time information is available off-system, for example the real time bus information by telephone and WAP in Gwynedd (Wales UK). ITS also provide integrated information for different networks. Examples include the 511 National Travel System providing a single point of contact for all travel in the USA and the Transport Direct service which is being developed in the UK.

3.2. The Supply Chain for Traffic and Travel Information Services

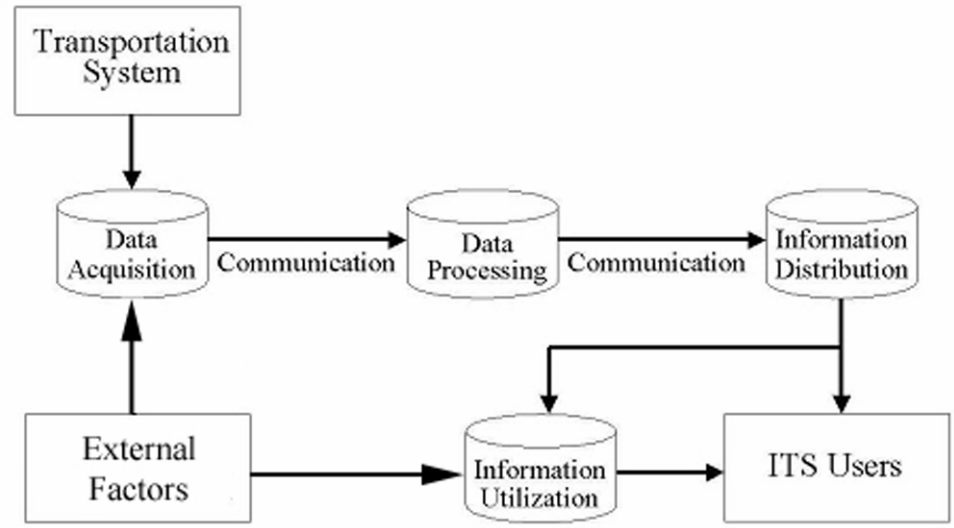

Figure 1 - Information Supply Chain

The concept of an information chain is not new to those who have managed comprehensive traffic systems. What are relatively new, however, are the technologies and system concepts for:

- information exchange and decision coordination involving multiple centres (such as between traffic and transit management centres for intermodal transportation services)
- information acquisition and integration between the vehicle and the road infrastructure for such functions as dynamic route guidance (route guidance taking into account the current traffic situation)
- information exchange with new private-sector organisations (e.g. for information service providers to distribute traffic information through cellular phones or the Internet)
- information exchange with non-transport organisations (e.g. in electronic payment systems involving financial institutions, and in border crossings involving customs and immigration agencies)

Floating Car Data

The probe vehicle or “Floating Car Data” (FCD) method provides a cost-effective alternative, or a supplement to more conventional methods of monitoring traffic. Increasing numbers of vehicle fleets – such as delivery vans, taxis and hire cars - are now equipped with vehicle positioning systems linked to satellite navigation. By agreement with the owners traffic data are derived from a sample of widely dispersed vehicles, which transmit their speed, position and direction of travel to a central database. In this way they 'float' with the traffic and provide a proxy of current road traffic conditions. Experience of obtaining real-time traffic and travel data in this way is rapidly growing, often involving a private operator in partnership with the public authority.

Information Distribution

Distribution of traffic and travel information is achieved in a number of ways.

- Commercial broadcast media, including radio, cable television, commercial television, and teletext services are still the most common methods of dissemination.
- Internet websites are widespread. Some systems offer subscribers the option of receiving alerts by pager, e-mail, or other electronic methods regarding major incidents or conditions on specific routes.
- Telephone dial-up services: In the United States, a nationwide three digit telephone number, 511, has been designated for traveller information services,
- Roadside electronic Variable Message Signs (VMS) can display fairly detailed information on location and extent of congestion, travel times, alternate routes, and downstream weather conditions (e.g. wind, precipitation, snow).
- Highway Advisory Radio is being used in several case study locations, although its use appears to be declining in some countries with the popularity of RDS-TMC applications, which are now widespread in Europe.
- Pre-trip traveller information is available kiosks located in hotels, motorway service areas, shopping centres and other public places (e.g. shopping malls)
- En route information provided through in-vehicle navigation systems is growing in use.
- Pre-trip and en-route information provided through messaging (personal digital assistant, cellular phone, pager) subscription services is being applied in several locations
- Real-time public transportation information is being successfully disseminated at transit stops

In-vehicle systems

The VICS system in Japan, which enjoys a high market penetration of in-vehicle navigation systems, is the most extensive application of this type studied. Dissemination of detailed en-route information is accomplished through transmission from beacons or FM sub carrier broadcasts to the in-vehicle device. Other countries are deploying this technology and also expanding the distribution by Internet of video images from CCTV traffic cameras.

4. FUTURE DEVELOPMENTS

4.1. Intelligent Vehicles

Vehicles will increasingly be interconnected, or connected to the road infrastructure via communications technologies to improve the transport efficiency of people and freight and to mitigate and avoid crashes. A key enabler is Vehicle Safety Communications (VSC), whose technical, standards, legal and economic challenges are being successfully addressed by a range of Government and Industry players. The VSC set of technologies support other road safety initiatives, focusing on crash- and congestion-avoidance and prevention.

Vehicle on-board systems need up-to-date information about the driving environment, including road conditions and geometry, weather, traffic hazards, work zones, etc. The Automotive Industry is also applying these developments for improved and Customer- and Vehicle-Relationship management. Marketplace success requires the development and standardization of wireless technologies and protocols. CALM standards (Continuous Air Interface for Long and Medium range) are being developed by ISO TC204/ WG 16. CALM provides vehicle communications interfaces across multiple protocols, allowing vehicles to stay connected irrespective of their location.

European efforts are centred on the e-Safety Forum, with the goal to cut fatalities 50% by 2010. For example, the Car2Car Consortium is preparing open standards for communications for driver assistance and crash avoidance. The PReVENT initiative tests a range of Advanced Driver Assistance System (ADAS) concepts, whilst the Cooperative Vehicle-Infrastructure researches Vehicle to Infrastructure (V2I) linkages. The SafeSpot program extends drivers' awareness of the road ahead.

In the USA, Vehicle Infrastructure Integration (VII) seeks to equip vehicles with a communications device to exchange data with a nationwide, instrumented roadway. Intersection Collision Avoidance applies Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications to enhance driver decision-making.

In Japan, the Advanced Safety Vehicle program uses vehicle-vehicle communications to prevent intersection collisions. Advanced Cruise-Assist Research Association (AHSRA) vehicles are equipped with V2I and V2V communications to provide safety warnings and reduce crashes, including rear-end and at intersections.

4.2. Other Trends

Road network operations are set to benefit from a variety of other technical developments, some of which will become widely available in the very near future. In summary these are:

- more accurate and cost effective data collection
- systems for improving the efficiency of the network or making better use of it. These could include speed management, access control, lane control
- data warehousing and intelligent systems for using static and real time data to predict the build up of congestion, journey times etc
- co-operative systems, infrastructure and vehicles working together to improve safety and management
- intelligent vehicles working together to improve safety

- improved integration between road operators, police and emergency services
- provision of driver information in vehicle and presented when required
- development of new infrastructure-vehicle services such as car parking management/booking, traveller information/entertainment, tourist information/ attractions
- integrated road and public transport traveller information
- enforcement and security systems aimed at reducing the level of illegal driving and dangerous or defective vehicles

4.3. Evaluation of Performance

In future, it will become increasingly critical to implement processes that enable an assessment of how effective road network operations are in meeting the needs of road users. Performance assessment methods must be both reliable and credible and must serve as a means of changing how things are done. It will be advantageous to establish specific performance indicators as well as structured and quantified quality plans.

Some of the major reasons for adopting performance measures include:

- Accountability: performance measurement provides a means of determining whether resources are being allocated to the priority needs;
- Efficiency: performance measurement focuses actions and resources on organisational outputs and the process of delivery;
- Effectiveness: performance measurement provides a link between ultimate outcomes of policy decisions and the more immediate actions of transportation agencies. It provides a means to evaluate how well we are achieving our goals;
- Communications: performance measurement provides better information to customers and stakeholders on progress being made toward desired goals and objectives;
- Progress: performance measurement allows periodic refinement of programs and service delivery.

Performance management will become an ongoing activity for most road network operators. The use of performance measurement information will help set agreed-upon performance goals, allocate and prioritise resources, inform road network operators to either confirm or change current policy or program directions to meet those goals, and finally, report on the success of meeting the goals set.

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DRAFT CONCLUSIONS

Network Operations Policy and Practice

There is a continuing need to develop the policy and practice of Network Operations as it evolves, incorporating Intelligent Transport Systems where appropriate. Increasingly the need is to integrate road network operations across regional and international boundaries. PIARC needs to find active committee members or expert advisers who can assist with first-hand knowledge of network operations in developing countries and countries with economies in transition. In addition, greater contact with the public or private sector stakeholders in network operations – especially those that use as well the Road Network (Public Transport and Freight Haulage companies), or are highly depending on it for completing the offered intermodal chain (Railroad, inland waterways or ferry terminals) is needed in PIARC, e.g. by including them as co-opted expert advisers or invited on an ad hoc basis to help TC members on specific agenda topics.

Specifically, Technical Committee TC1.4 sees the need to develop good practice in the following areas as a real challenge:

- Managing the operational, jurisdictional and other administrative interfaces
- Inter-modal operations at international airports, ferry terminals and ports
- Management of cross-border road-freight and transit traffic
- Novel approaches to Network Operations
- Interface of network operations with other major stakeholders: commercial vehicle fleet operators, servicing of local markets, city transport, just-in-time deliveries, etc
- Accommodating the increased need for maintenance of the road infrastructure
- Bringing capital investment and asset management of the network together with network operations
- Strategic planning and modelling for network operations purposes
- Good practice on peak-spreading and demand management
- Role of ITS and new technologies in network operations
- Exchange of information between road authorities, police and emergency services
- Security of network operations
- Opportunities for co-operative vehicle-highway systems

Benefits and Evaluation in Network Operations

Roads authorities are required to justify their budgets for network operations against a background of growing traffic demands and increased public and stakeholder expectations. This is in the context of increasingly scarce public funding. Established evaluation and assessment methods need examining from a network operations perspective. The issues differ from those involved in justifying capital investment in roads infrastructure, but similar methodologies and benefits/costs values can be applied. The committee recommend that PIARC continues to work on the assessment methods collaboration with the International group working on ITS Benefits, Evaluation and Costs (IBEC). The methods include:

- Methodology for ante- and post-evaluation of new methods of network operations (ITS tools and systems)
- Effective inter-agency working: partnerships and contracts between the roads authorities and other stakeholders in network operations
- Risk assessment in network operations, including inter-agency working, corridor management, operating frameworks and contingency plans
- Evaluation of the impact of personal and in-vehicle telematics, information and communications devices on network operations
- Cost-effective procurement of ITS projects and systems

Outreach and Education

The combination of C16/TC1.4 deliverables from this and previous cycles now provide PIARC with a rich resource for outreach and education for students and young transportation professionals through workshops, seminars and training sessions. The current committee, TC1.4 recommends that outreach and training in network operations is built in to the next PIARC Strategic Plan in order to maximise the benefit of PIARC committee work that has been done over the past decade.

Finally, the recommendations made by the previous PIARC committee on Network Operations, C16, remain on the table and are endorsed by TC1.4:

A. For policy leaders

A major transition needs to occur from a public works mentality to a mobility service mentality. A transition of this magnitude will require leadership and constituency building from governmental and private sector organizations. Policy leaders must provide this leadership.

- Network Operations need to be defined and institutionalized in agencies' policies, in their processes and in their programs. This will have a significant impact on budgets and human resources.
- The new focus will require a customer performance point of view rather then just a facilities performance point of view.
- Establishment of performance measures for multiple modes and for interdependent agencies will be required. This action necessitates inter-agency collaboration and cooperation.
- Policies for road user charging open up new strategies for demand and mobility management. Road user charging also brings new opportunities for funding transportation facilities.
- There is an urgent need to foster partnerships between the roads authorities, the automotive industry and other key players to exploit new technologies for the benefit of sustainable mobility in the field of in-vehicle systems (ADAS, co-operative systems).

B. For transportation professionals

Transportation professionals will be the ones implementing the policies, operating the systems and actually measuring the performance. Therefore, the organisations' plans, programs and staffing will need to reflect network operations concepts.

- A continuous learning and training process will be required as the transition takes place from the traditional emphasis on public works towards new service-driven network operations.
- Professionals will need to develop and maintain awareness and knowledge of the new tools and technologies such as ITS.
- New technologies bring opportunities to achieve better network efficiency, and to enhance road safety. Therefore roads authorities will need to work in partnership with the automotive and other industries to realise the potential of vehicle to infrastructure communications.
- Mechanisms to establish measurable customer expectations and to actually measure customer satisfaction will have to be developed and refined.
- Education and training institutions will be required to modify transportation curricula to include network operations concepts, practices, tools and techniques.
- There is an urgent and continuing need for network operators to participate in research and development activities (including demonstration applications).

C. For international organizations

There is a need to give more prominence to the concept of network operations.

- Information sharing on network operations concepts, best practices, benefits and funding sources should become a high priority.
- Introducing network operations modules into international roads and transportation conferences would be valuable in spreading the experiences of many countries.
- Publication of handbooks in several languages and in different media, including the Internet, could facilitate a better understanding of the concepts and the potential benefits of network operations.
- Workshops and routine publications should carry experiences, best practices and identify locations where successful network operations actions are underway.
- International organizations can encourage international study visits, which are of great assistance for the transfer of know-how.