EXPANDING INFRASTRUCTURE : THE ITS OPTION

Darryll Thomas
Manager: Traffic Management
Durban Metropolitan Council
P O Box 680, Durban 4000

ABSTRACT

The dramatic emphasis placed on social upliftment in the post-apartheid era in South Africa has, in effect, contributed to the enormous pressure inflicted on the road network. On the one hand the redistribution of wealth has led to an increase in car ownership and movement of traffic while strict financial policies have curtailed new road projects. Population distribution will be based on income rather than race but, despite the fact that AIDS is expected to greatly reduce the future population figures that were predicted in the past, the impact on our transport infrastructure will be significant.

The traditional demand driven approach to transport coupled with the philosophy of "building our way out of trouble" is failing. The redirection of funding to social spheres and the spiralling costs of developing and maintaining the road network dictates that other alternatives, able to maximise the potential of our existing infrastructure, should be given a high priority. **Intelligent Transport Systems (ITS)** are one such alternative.

This paper introduces the concept of **ITS** and highlights the proven cost effectiveness of **ITS** solutions for developing countries such as South Africa, where the improvement in the efficiency of existing transport infrastructure through management measures is targeted as opposed to the traditional course of expanding infrastructure.

1. INTRODUCTION

Apartheid had an enormous effect on commuting throughout the country. The wide disparity in the life chances and lifestyles of white and black populations, representing 1st and 3rd world conditions respectively, has resulted in:

- low and middle income outlying areas with a high dependance on expensive long-distance public transport.
- high income outlying areas with private transport which contributes to congestion within the city
- suburbs on the fringes of the city with rapidly increasing car ownership

A legacy of the past racial segregation of South Africa's population is a mismatch between workers and employment which is reflected in high levels of commuting between home and work, especially for the poor. In this respect, 43% of the population in the Durban Metro Area live north of the Umgeni River and less than 10% of employment opportunities are found in this region. Just over half of these commuter trips are made by a public transport system which is inefficient, largely due to low thresholds resulting from low densities around core areas and outward sprawl that makes it difficult to provide affordable effective commuter transport systems.

The popularity of rail and bus transport is on the decline (peak period overcrowding, poor off-peak service, intimidation by minibus taxi operators) but the minibus taxi industry has grown rapidly over the past 10 years and about half of all South Africans using public transport use minibus taxis.

Social change is occurring at a more rapid pace than ever before and for the first time black people have the opportunity to live, work and recreate in the city centre. The dramatic emphasis placed on social upliftment in the post-apartheid era has, in effect, contributed to the enormous pressure inflicted on the road network. On the one hand the redistribution of wealth has led to an increase in car ownership and movement of traffic while strict financial policies have curtailed new road projects.

National Transport Policy has identified that transport plays a significant role in the social and economic development of South Africa. Public transport, traffic safety, traffic management and maintenance of infrastructure, have therefore been targeted as key areas in the development of an effective transport system aimed at improving mobility for all sectors of the community. However, in spite of this focus, measures of transport service are following a downward trend since, in general, the metropolitan areas in South Africa are in transition and budget priorities dictate the diversion of funds towards social arenas such as housing, education and health. Consequently the roads authorities now have to look at methods of improving the efficiency and effectiveness of service delivery in order to meet the challenges posed by a lack of resources and funding.

The resulting effect is that transport infrastructure is having to be developed and maintained with significantly less funds than were previously available, despite significant increases in travel demand. Measures of transport performance highlight the increasing distress on our transport systems.

The responsibility for extracting the maximum efficiency from the existing road traffic infrastructure rests squarely on the shoulders of the Metropolitan Councils and national transport authorities SANRAL and NDOT. In a developing country such as South Africa the proven cost effectiveness of **ITS** solutions, where the improvement in the efficiency of existing transport infrastructure through management measures is targeted as opposed to the traditional course of expanding infrastructure, is the primary justification for new **ITS** projects.

2. INTELLIGENT TRANSPORT SYSTEMS (ITS)

2.1 What is ITS ?

ITS refers to Intelligent Transport Systems that apply computer technology to improve the operation of transport systems therefore increasing:

- safety
- efficiency
- productivity
- energy savings
- environmental quality

and reducing the need for infrastructure expansion such as construction of new freeways and bridges and widening of existing roads.

ITS simply addresses the need to monitor / react to traffic conditions and to relay traffic related information from the street to the motoring public or traffic authorities using various modes, including**:**

- Variable message signs on freeways
- Radio reports
- Advanced mobile information systems, such as in-vehicle monitors
- Automatic toll collection or electronic fare payment
- CCTV security surveillance and vehicle identification

ITS therefore incorporates the entire transportation system from, road network, public and private transport, traffic authorities (Police, Traffic Engineers etc), emergency and security services to private enterprise (advertising and travel industry).The benefits of utilizing **ITS** solutions, to enhance the productivity of existing and new transport systems are recognized worldwide so the global trend is to include **ITS** components as an integral part of new transport projects.

The cost effectiveness of **ITS** solutions, where the improvement in the efficiency of existing transport infrastructure through management measures is targeted as opposed to the traditional course of expanding infrastructure, has also been proven in many situations. However, **ITS** is not a solution for all our transport problems and **ITS** solutions should be applied selectively, after due consideration.

2.2 Proven effectiveness of ITS projects

The international trend of increasing deployment of **ITS** related projects has resulted in a growing multi-billion dollar worldwide industry. The basic principles of **ITS** are not new, only the emerging applications and the way in which they are being marketed. An indication of the likely benefits of implementing **ITS** in a freeway management role can be obtained by reviewing international experiences. Table 1 quantifies the measured benefits of implementing freeway management systems in the USA.

Table 1 : Benefit / Cost

ITS project	B/C	comment
Incident detection	3.8	repaying investment in a year
Intersection signal control	34	repaying investment in a few months
Area Traffic Control	7.6	extending existing technology to adjacent towns
Parking management	1.7	even for stand alone applications
Emergency vehicles priority	0	no cost saving but faster response time (golden hour) meant fewer people requiring major treatment
Weigh in Motion	1.8	time saving for heavy vehicles due to less maintenance

The implementation of **ITS** applications to obtain capacity, safety, environmental and financial benefits can be cost-effective, in particular circumstances, when compared with traditional methods of “building” capacity. Using average benefits described in Table 2 (below) a simple comparison, to illustrate the relative scale of benefits, ones sees that an additional 15% increase in freeway capacity utilizing **ITS** management measures may cost in the order of R0,5 million per kilometer, while a 33%

increase in freeway capacity [assuming the expansion from three to four lanes per direction] may cost in excess of R5 million per kilometer. The benefit to cost ratios, for the softer **ITS** solutions, are significantly greater. The purpose of this statement is to show that alternative solutions to building capacity are feasible, in broad terms, when applied in the appropriate context.

Studies in the USA showed the life cycle cost of a new road to be 35% less by including **ITS**, compared to building roads without **ITS**. Benefit / cost ratios of selected **ITS** applications in a number of countries have been reported to be in the order of 2 to 8, with the higher figures relating to urban scenarios. A UK study in 1996 concluded with the benefit / cost figures shown in Table 2 :

Table 2: Freeway Management System benefits

Travel Time	Decreased by 13% - 48%
Travel Speed	Increased by 16% - 62%
Freeway Capacity	Increased by 8% - 25%
Total Accidents	Decreased by 24% - 50%
Fuel Consumption	Decreased fuel used in congestion by 41%
Pollution (Detroit Study)	Decreased CO^2 emissions by 122,000 tons annually Decreased HC emissions by 1,400 tons annually Decreased NO^2 emissions by 1,200 tons annually

3. ITS PROJECTS

3.1 Background of ITS Deployment in South Africa

ITS has evolved extensively over the past 15 years or so, particularly in the field of UTC (Urban Traffic Control) systems. In some parts of the world, monitoring road conditions through CCTV, responding to events by changing variable speed and message signs or even updating motorists via in-vehicle monitors have become just a subset of management functions undertaken in today's UTC systems. We have certainly come a long way with **ITS** - even in South Africa, so to put matters into perspective let's just reflect on the past for a second.

It is understood that the world's first "traffic" signal was installed in 1868 in Westminister but this technology took a while to reach our shores and it was 1929 before the first South African traffic signal was installed in Johannesburg. Various systems were introduced to provide limited linking of adjacent traffic signals but in 1962 Durban installed an STC electro-mechanical operated linked system which was considered at the time to be in advance of most systems available internationally, controlling approximately 50 signals in the city centre. In the early 1970's South Africa's first computer controlled UTC systems were installed in Durban and Cape Town, by Plessey SA and Siemens, respectively. It is estimated that there are about 6500 operational traffic signals in South Africa at present, about 2500 of which are connected to modern central computer systems. The remaining signals are either isolated or co-ordinated via some form of local linking, either wireless or cable linked.

3.2 Road Capacity Building Projects

3.2.1 UTC Systems

A typical UTC system provides direct control of the signalized intersection from a central computer. The road-side controller holds most of the safety critical functions, like minimum stage lengths and intergreen parameters, while the central computer manages the stage timings, plan changes, and auxiliary monitoring functions.

An UTC system offers additional flexibility in that the instation computer provides immediate and direct control of signal timings. New signal timing plans don't have to be down loaded to the road ride controllers but can be developed directly on the central computer and initiated at short notice. This offers significant speed advantages when developing timing plans to deal with special or unplanned events. These systems generally offer full monitoring facilities along with traffic flow enhancing facilities like Traffic Responsive Plan Selection [TRPS], where the system selects sets of signal timing plans on the basis of traffic demand.

Communication with the central computer is almost always wire based due to the quick message turn around required for this kind of system. Reliability of the communications network is particularly important for UTC system. However, modern UTC systems usually have robust fallback plans [driven by the roadside controller] in the event of a loss of communications between the roadside controller and the central computer.

Examples of this type of system can be found in Johannesburg, Port Elizabeth, Durban and the Cape Metropolitan Area.

3.2.2 Split Cycle & Offset Optimisation Technique (SCOOT)

In the 1980's and early 1990's Durban, Port Elizabeth and the Cape Metropolitan Area installed modern adaptive control systems. Of the two [major] commercially available systems, SCATS and SCOOT, all three cities selected SCOOT based systems.

Unlike Traffic Responsive Plan Selection (TRPS) based systems where macroscopic timing changes occur according to traffic trends, the SCOOT based systems offer microscopic real time adjustments to signal timing parameters according to actual traffic demands, generally in advance of the traffic platoons arriving at the stop line. This means that timings are adjusted to suit arriving traffic patterns. The SCOOT kernel [or engine] requires an UTC platform to operate. The SCOOT kernel monitors traffic patterns, determines optimal traffic signal timings, and instructs the UTC system to display the optimal timings on the roadside.

3.2.3 Electronic Toll Collection (ETC)

Road pricing schemes were originally introduced to finance the building and operation of new motor way schemes. However, traffic authorities now see these schemes as a means to combat increasing traffic congestion by hoping to influence travel behavior, reduce car use and invest the resulting revenue in improving public transport systems and other infrastructure.

Traditional congestion pricing takes the form of peak congestion charges imposed on users of heavily trafficked roads, intended to deter motorists from entering congested areas or using congested roads and to encourage them to either change to off-peak travel or other modes of travel. In the near future the charging of drivers for driving into(or parking in) the CBD or using sections of the freeway network will become commonplace.

South Africa's toll road system is an effective form of road pricing that has been developed over the past 15 years and controls about 15% of the national road network. Toll financing has made it possible to maintain existing roads to the required standard and provide new road facilities that would otherwise have been unaffordable.

Successful concessionaires are awarded their toll projects on a build-operate-transfer basis and using this financial model the national toll network will soon cover 2,100 km. The huge volume of traffic experienced on most national freeways makes the introduction of traditional stop & pay toll facilities on existing roads impractical. For example, the Ben Schoeman Highway between Pretoria and Johannesburg would have to be widened from the present 6 lanes to 40 lanes to stop the 150,000 vehicles daily for payment.

The **ITS** solution is to introduce non-stop electronic toll collection (ETC) as the toll payment method. ETC systems are installed at many toll plazas, enabling drivers to pay tolls automatically on a no-cash basis without stopping at toll stations. Simple ETC systems, which replace conventional toll plazas with an electronic tag (transponder), are now commonplace around the world.

These systems may have :

- a simple tag, which registers each time the vehicle passes a toll plaza and results in all invoice being prepared for the cost of the transaction, or
- stored value tags, which are pre-paid and debited at each pass of the toll plaza.

More advanced systems, which enable transactions to be undertaken at expressway traffic speeds, are in use in Toronto on Highway 407, and the Melbourne city link road in Australia uses a similar system and both have only electronic toll facilities. Vehicles are not constrained between concrete dividers and are allowed to roam freely between lanes on the "electronic" highway. The tags are read when entering the highway and again at the exit so the motorist is charged for the length of the trip. This reduces delays and also improves toll security by reducing fraud and toll avoidance. Open highway ETC requires accuracy at high vehicle speeds and ETC transaction times may be as short as 50 milliseconds, with few or no opportunities for a second attempt.

ITS technology can provide the enforcement techniques (CCTV cameras and infra red sensors), real-time traveler information and guidance (Dynamic Message Signs) and automatic electronic payment mechanism (tags and smartcards) required for any successful and efficient road pricing initiative.

Most modern applications of ETC enable the motorist to use all the toll facilities in a region (or country) with only one toll account and one toll tag in the vehicle, i.e. the need to obtain a different tag and maintain a different toll account for every toll facility is eliminated. Furthermore, numerous **ITS** applications become possible when the communications technology facilitating ETC is introduced (such as electronic licencing, vehicle tracking and freeway incident detection). In order to ensure interoperability and achieve economies of scale in the deployment of ETC, it is imperative that common South African standards be developed for ETC systems and related **ITS** applications.

An ETC subscriber's account number is identified by means of tag attached to the inside of a vehicle's windscreen and read as the vehicle enters the toll lane via an antenna mounted alongside or above the lane. A clearinghouse for ETC transactions is necessary to organise ETC transactions at different toll plazas into single accounts to motorists and to facilitate payment of toll operators for use of **ITS** facilities when payment is made through a tag issued by another toll company.

3.2.4 Electronic Licencing

The prime motivating force behind ITS initiatives in South Africa is currently the interest in electronic toll collection and electronic licencing where many opportunities for public / private partnerships have been identified. Electronic licencing would make it compulsory for every vehicle on the road to display a tag and as such has been shunned in many other countries because of the possible invasion of privacy, but the potential to control licence payment evasion and car theft in South Africa makes this an extremely attractive project. Indications are that there are currently more than 1,000,000 vehicles with unpaid licence fees for the past 3 years.

While not directly related to "expanding infrastructure", this facility highlights the urgent requirement for a standard, as it will most likely be restricted to dedicated short range communications (DSRC) and it is important that a frequency spectrum is allocated which will allow interoperability with other **ITS** deployments such as vehicle tracking and electronic fare collection.

3.3 Safety Improvement Projects

3.3.1 Dynamic Message Signs (DMS)

A trial system will be implemented in Durban with the current upgrade to the UTC system software using a free formatted dynamic (or variable) message sign incorporated on a proposed "WELCOME TO DURBAN" gantry on the Southern Freeway link to the city. Messages will either be typed by staff at the traffic control centre or automatically selected by an incident detection algorithm using induction loops in the road surface.

3.3.2 Closed Circuit TV Systems (CCTV)

Durban developed a CCTV system that was commissioned 25 years ago, in conjunction with the UTC system, to monitor traffic conditions in the CBD using 40 cameras on a coaxial cable network. This CCTV system was recently upgraded with more reliable equipment incorporating the latest available technology, while at the same time providing additional facilities for night viewing, video recording and shared control for the City Police Department.

There are currently 85 cameras on the system and the area of CCTV influence has been expanded to include the beachfront area with the recent installation of 15 strategically positioned, high resolution colour cameras, suitable for day / night crime surveillance. These have proved to be very effective in assisting the Durban City Police to restore reasonable order to the previously crime ravaged Durban beachfront.

There is a project in progress to make selected pictures of the main freeways available to the public over the Internet. The usual pan-and-tilt cameras are supplemented by an extra two fixed cameras which each send a dedicated view of the traffic conditions to the Traffic Control Centre to relay a video picture over the Internet. Another project will use the CCTV system to facilitate tourist support points with a push-button, eye level camera and microphone flush mounted on CCTV poles to provide security or assistance from the City Police Control Centre. A person in distress would only have to press the button to be connected to the officer on duty who could then offer directions or dispatch a patrolman to the scene.

Johannesburg initiated a pilot CCTV system in the late 1990s on their southern freeway network at a cost of in excess of R 4,000,000 and Cape Town has allocated R 100,000,000 to expand the existing crime surveillance CCTV system and include strategically positioned traffic cameras.

3.3.3 Intelligent Road Studs (IRS)

Around one third of all journeys take place at night, but almost half of serious or fatal accidents occur during the hours of darkness.

Since its introduction, the design of the cat's eye has changed very little and, while we all recognise its inherent benefits, its functionality is strictly limited. Cat's eyes are reflective road studs that passively reflect a percentage of vehicle headlights back towards the driver. The level of reflected light is a function of many variables including the efficiency and alignment of the vehicle headlights and the condition of the cat's eye's rubber / ceramic block and glass reflectors.

Reflected light is only available to the driver whose vehicle headlights are being directed towards the stud. The driver's potential visibility of the road layout ahead is limited by the footprint of the headlight beam, generally in the region of 90m. Furthermore, a passive stud system provides no additional benefit to other road users. The performance of passive guidance systems and traditional white lining is also significantly limited in adverse weather conditions such as heavy rain, mist and fog due to the effects of diffraction and mirrored reflections.

During the last few years a considerable amount of development work has been undertaken to address these limitations and after several years of engineering research, the solar-powered Intelligent Road Stud (IRS) was launched in the UK in 1999. IRS combines patented electronics with passive retro reflectivity to provide enhanced functionality, and also provides a significantly increased contribution to night-time road safety.

The IRS employs integral solar panels which capture daytime energy to charge a capacitor. The microprocessor controlled circuitry monitors ambient light levels and activates high intensity LEDs from dusk to dawn. The frequency of the LEDs is maintained at a constant 27Hz. These studs are capable of operating for several days on a single daytime charge and are fully self contained, require no maintenance and incorporate LEDs and reflective material to the approved standard white, red, amber, green and blue colour combinations.

The benefits of IRS can be summarised as follows:

- Reduction in accident risk;
- Increased driver visibility and awareness of potential hazards;
- Avoidance of sudden braking and last-minute vehicle maneuvers;
- Improved delineation - particularly effective in poor weather conditions;
- Alternative to expensive street lighting.

Conventional passive road markings limit the driver's night visibility to 90m (provided the vehicle's headlights are in good condition). At 60mph (80krn/h) this represents a preview time of 3.3 seconds. Drivers traveling at high speed have no fixed datum to allow proper judgement of, say, the radius of a bend or other hazard. An IRS allows the driver up to 900m of visible road layout irrespective of headlight efficiency. At 60mph, this represents a preview time of up to 30 seconds. The studs provide clear reference points at ground level, focused delineation in the driver's direct vision and higher awareness of potential hazards. This improved highway delineation encourages a more controlled driving regime. By increasing driver reaction time, the driver is therefore less likely to have to make sudden changes to the vehicle speed or direction and the avoidance of sudden braking is encouraged.

Intelligent Road Studs are often used to address specific road safety issues, where there is a need to improve the delineation of the road layout or where a street lighting scheme is difficult or expensive. Typically, these applications are at hazardous sections of a highway such as sharp bends, junctions with poor sight distance and traffic calming

As an alternative to street lighting at night, intelligent road studs offer major cost savings and are environmentally much more acceptable since they cause no light pollution.

Under fog conditions vehicle headlights struggle to illuminate the road ahead because of the diffusing effect of fog on vehicle headlights. Intelligent road studs alleviate this problem - once the onboard sensors detect the fog condition and falling visibility, the encapsulated LEDs are activated to emit an intensity of up to four times the brightest passive stud.

IRS can be equipped with proximity sensors with the ability to detect vehicles. In hazardous conditions (such as fog) the IRS will emit flashing amber LED for approximately four seconds after the vehicle has passed the intelligent road stud. This gives the effect of each vehicle leaving a trail that is visible to following vehicles. Additionally, the IRS can detect a vehicle encroaching on the amber trail caused by the first vehicle and activate a flashing red LED warning to the driver to reduce speed and maintain a safer breaking distance from the leading vehicle. In hazardous conditions IRS can provide a clear and critical indication to a driver who is tailgating.

3.3.4 Speed Advisory Systems

It is widely accepted that many accidents result not from vehicles just speeding but from a vehicle being driven at a speed that is not appropriate for the prevailing conditions. Road geometrics are carefully designed to ensure the super elevation, horizontal and vertical curves etc conform to the design speed for that section of road - always greater than the posted speed limit which simply serves as a conservative guide to the motorist. One is not always acutely aware of the speed limit which can change for no immediately obvious reason.

The vehicle is not much help either. It is increasingly difficult to maintain a given low speed, without continually looking at the instrument panel, in cars designed to accelerate smoothly up to 200km/h; particularly now that the driver is so insulated from the elements that much of the sense of speed is lost, especially after periods of high speed driving. It makes sense to provide the driver with a system that keeps his vehicle within the current speed limit thereby avoiding the need to keep looking at the speedometer or for police cars and speed cameras, both of which detract attention from the main driving task. The point being that the speed limit assists the motorist to drive conservatively within the constraints of the design parameters of the road.

Such a speed advisory system would transmit speed restriction data to the vehicle and be aware of the vehicle’s location with respect to the local speed limit. The 3 main components of this process are :

- Traffic authority control center which sets the speed limits
- Communications transferring this information to the driver / vehicle
- Driver / vehicle reaction to this speed limit information

which enable a system to provide 3 types of external vehicle speed control (EVSC) :

- Advice only - speed limit is displayed to driver inside the vehicle and at the roadside
- User set - the driver is shown the current speed limit and can choose whether to activate the automatic speed maintaining system within the vehicle.
- Full system - the system receives the current speed limit information and automatically attempts to ensure that the vehicle does not exceed it.

Two main mechanisms can automatically provide the current speed limit information :

- Electronic beacons at the roadside - cheaper, but would have to be borne by the public sector maybe even as part of the road construction project
- Digital map held inside each vehicle as part of a vehicle navigation system - included in the price of the vehicle

An EVSC system offers more than pure speed control, it also facilitates fine tuning. For example at dangerous bends, at a school entrance, as well as dynamic speed limits to suit current weather or traffic conditions. The tricky element is to ensure that the vehicle complies with the speed limit automatically especially if the objective is to guarantee that it always does so. It is not always possible to slow a vehicle down from any speed to a given speed over a fixed distance without the use of brakes - however there are also occasions when the use of brakes should be avoided. Unfortunately, engine braking alone can take an unacceptably long time to reduce the speed of a vehicle, especially on a descent. Meanwhile, current research concentrates on some form of automatic throttle control that doesn't permit any acceleration by the engine while the vehicle exceeds the speed limit.

Reducing speeds from 40 to 30 km/h has been shown to reduce pedestrian fatalities by 50%.

The implementation of **ITS** for the purpose of reducing crash risk should concentrate on urban and rural roads (rather than freeways) and intelligent speed adaption is shown to have the highest safety potential to reduce injury collisions.

3.3.5 Road Surface Monitoring

The economic constraints of excessive and often prohibitive costs of new construction and maintenance of our road network have forced a shift toward more effective use of available resources and development of a more sophisticated intelligent highway system. The cost of damage caused by overloading to the national road network is in excess of R 650,000,000 a year. Accurate data is required for many reasons including congestion management, incident detection, air pollution monitoring, construction or maintenance planning economic planning etc.

Wireless solar powered sensors buried below the road surface monitor and transmit real-time data on traffic and road conditions including surface temperature, wet / dry condition and chemical index. The system can be programmed to :

- illuminate a static message sign,
- alter the signal timings by implementing a preset timing plan for those conditions or
- activate a variable message sign to display a pre-defined message or
- send notification of hazardous weather conditions via e-mail to appropriate staff
- alert maintenance staff of deterioration in road surface

In regions that experience severe winters this ability to monitor road surface temperature provides warning that the pavement material is approaching freezing point helps to determine whether to apply anti-skid or de-icing material. More efficient use of salt and anti-icing chemicals, only when it is actually required to remove ice. This will also reduce the corrosive attack on the asphalt surface. This frozen surface information can also be automatically relayed over variable message signs to alert motorists of the adverse conditions.

Sensors buried in the road can also analyse vehicle emissions to control pollution.

4. CONCLUSION

4.1 Problems

If we look at the “high road” scenario, using the country’s GEAR (Growth, Employment and Redistribution) macro economic model targets as a guide, we are likely to see significant increases in personal mobility over the next decade. Population distribution will be based on income rather than race but, despite the fact that AIDS is expected to greatly reduce the predicted future population figures, the impact on our transport infrastructure will be significant.

An example of the results of the relation between economic growth and transport demand emerged in Seoul, South Korea, where private automobile ownership increased ten-fold between 1985 and 1997. This occurred in a city that is served by an extensive, efficient and relatively cheap, public transport system. In most South African cities we do not have the luxury of such systems, therefore, the impact of this scenario is likely to be far more severe.

The traditional demand driven approach to transport coupled with the philosophy of “building our way out of trouble” is failing so new and innovative solutions are now. The redirection of funding to social spheres and the spiralling costs of developing and maintaining transport infrastructure dictates that other alternatives should be incorporated into the equation. Maximizing the potential of our existing infrastructure should be given a high priority.

While the concept of **ITS** is not new in South Africa, there is currently no coordinated effort between the various provincial road authorities. This has unfortunately resulted in numerous ad hoc **ITS** projects being implemented with no thought of standardisation or sharing of resources:

- sophisticated UTC systems have been operated in our major cities for well over twenty years
- dynamic message sign systems (DMS)have been utilized on freeways in major metropolitan areas and in tunnel control applications for a number of years.
- closed circuit traffic surveillance systems are operated in the major metropolitan areas.

...... all this on a completely ad-hoc basis without any thought of standards and interoperability. A classic example of how this can go drastically wrong is the different DMS systems on the N1 highway operated by the Midrand and Johannesburg Local Councils - essentially on the same road for a huge volume of traffic - which are now no longer used due to operational problems.

Generally, the main problems associated with existing **ITS** applications are lack of political awareness and funding, particularly for the on-going maintenance and operation of the systems.

4.2 Solutions

ITS doesn’t create new capacity but rather makes more effective use of existing capacity. It encourages travelers and commercial vehicles to travel at more appropriate times along better selected routes using more efficient modes of transport. The use of **ITS** to facilitate driver information, traffic management and enforcement can aid traffic engineers in improving the efficiency of the road network. The bottom line is less frustration, delay, pollution, fewer accidents and most importantly improved road capacity - all because **ITS** enables smarter travel.

With many road networks reaching capacity and little space to build more roads, concerted efforts are being made to get the maximum possible from existing infrastructure. The ever increasing demand for limited road space has required government and road authorities to seek innovative ways to maximise the use of existing infrastructure and more pro-actively manage demand where it is clear that capacity has been reached.

Taken to the extreme, one could conclude that all we need to resolve our existing congestion problems is to implement **ITS** everywhere. Unfortunately using **ITS** is rather like taking vitamins - they are effective up to a certain point and thereafter any more is just a waste of money. **ITS** may give the equivalent of adding an additional lane to an existing freeway but it is not going to double that capacity of a 4-lane freeway or fully remedy a roadway with inherently unsafe geometrics.

The National **ITS** Committee has been given a mandate to co-ordinate **ITS** related projects to ensure interoperability between the various existing and planned applications countrywide, attempt to align **ITS** goals to support national transport policy and encourage private sector involvement. In this regard South African Society for Intelligent Transport Systems (SASITS) has been established, comprising manufacturers, suppliers, implementing agencies and users of **ITS** technology.

Government responsibilities:

- **ITS** Policy interface with National Transport Policy
- Development of a common systems architecture
- Development of Standards
- Pilot projects (of National interest)

Private sector responsibilities:

- Technology (transfer of proven international R&D)
- User cost recovery
- Value added services
- Market identification and development

4.3 Bottom Line

It is important to note that the applicability of innovative **ITS** solutions are rather limited and that basic transport infrastructure requirements still need to be met by building roads and other facilities. However, the possibility of achieving reductions in overall facility costs by incorporating **ITS** as a component of any new project should not be overlooked.

The merits of **ITS** have been proven worldwide and as a developing country South Africa has numerous transport related problems that are ideal candidates for **ITS** solutions. However, it is so vital that the Civil Engineering profession (not just Transportation Engineers) is made aware of the **ITS** technologies available and include this element in the planning and design of road construction projects. Incorporating the necessary **ITS** infrastructure (such as communication cables, incident detection loops, traffic counting sites, CCTV cameras, variable message signs, electronic toll collection gantries and roadside beacons etc) with the actual road construction *reduces* not only the cost of the **ITS** component but also the disruption to traffic (by digging up the roads at a later stage) and the lengthy delay associated with deploying **ITS**.

5. REFERENCES

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CURRICULUM VITAE

Darryll Howard Thomas

EDUCATIONAL QUALIFICATIONS

< **Higher Education**

T	MSc. Engineering (Transportation)	**:** 1993, Natal University
T	Diploma in Datametrics	**:** 1985, U.N.I.S.A.
T	Registered as Pr. Eng.	**:** 1981
T	BSc. Engineering (Civil)	**:** 1975, Natal University.

EMPLOYMENT HISTORY

< **Present Employer :** Durban Unicity Metro Council, Durban. (*January 1976 - present*)

< **Present Position :** Manager **:** Traffic Management Branch, (*September 1988 - present*)

< **Traffic Management Branch responsibilities** *:* *(Staff : 12 Technical / Traffic & 12 Computer)*

T traffic signal design & implementation in Durban Unicity Metro Area

T preparation of standards, specifications & warrants for traffic signals & equipment

T administration & extending traffic engineering aspects of Area Traffic Control System

COMMITTEES

T National ITS Committee

T Advanced Traffic Management Systems (ATMS) Workgroup

T S.A. Road Traffic Signs Manual Workgroup

PROFESSIONAL ORGANISATIONS

T Engineering Council of South Africa (ECSA)

T S A Society for Intelligent Transport Systems (SASITS)