

# DEVELOPMENT OF AN INTELLIGENT TRANSPORT SYSTEMS STRATEGIC PLAN FOR GAUTENG

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## ABSTRACT

Transport is vital to the fabric of the Gauteng province. An efficient transport system is an essential requirement for the healthy working of an urban economy, and for the well being of its citizens. An urban environment whose transport networks are congested, unreliable, and inaccessible risks losing its most important assets – its business and its people – to places where these problems are less evident, thus resulting in urban sprawl.

The Gauteng Government has launched a Congestion Management Strategy aimed at reducing the level of congestion on Gauteng's roads. The Intelligent Transport Systems (ITS) strategic plan is one action that will support this strategy, and give guidance towards technology solutions in congestion management and other applications.

The paper will focus on the process for developing an ITS Strategy i.e. stakeholder identification, inventorizing existing systems, analysis of regional transportation needs, assessment of the potential for ITS as well as a specification for requirements of the ITS strategic plan. The paper will conclude by identifying the key ITS thrusts for the province and suggestions on the way forward.

## 1. INTRODUCTION

The application of technology in the transport environment today is commonplace. In South Africa we are getting used to paying freeway tolls by electronic means, CCTV cameras are being deployed in our major cities and along our major freeways to assist with incident management and travel demand management, smart cards are in the process of being introduced for electronic fare collection in our public transport environment and advanced safety features in the upmarket vehicles of the major vehicle manufacturers are becoming standard. Many other examples can be cited. In the international environment technology applications are at the heart of the London congestion management strategy recently launched, different technologies are used to enable distance charging for heavy vehicles on German national freeways and smart cards are used to enable seamless travel between public transport modes in various Far Eastern countries. These are only a few examples of the role technology plays in our transportation environment.

Transport authorities in Gauteng are faced with a multitude of complex and diverse applications in the Intelligent Transport Systems (ITS) environment such as the ones referred to above.

ITS, by definition, has the ability to integrate products and services, monitor and enforce solutions and ensure the most cost-effective use of scarce funds and resources. With the need to provide multi-modal transportation solutions throughout the Province, it is essential to maintain a clear and holistic understanding of transportation if the potential of ITS is to be fully realized. ITS is so pervasive throughout the transportation environment because the impact and subsequent benefits frequently traverse functional and jurisdictional boundaries.

Although there is comprehensive documentation detailing the transportation needs for the Province these policy statements do not include a comprehensive ITS perspective. The ITS strategic plan therefore attempts to clarify the position of ITS, with specific regard to the transportation needs of Gauteng. In addition, it develops strategic initiatives, via preliminary deployment plans, aimed at resolving key issues identified through contact with the major stakeholders in the area.

## **2. WHAT IS ITS?**

ITS involves the collection, processing, integration and supply of information through the application of computer, control and communications technologies to enable authorities, operators and individual customers to make better informed, more intelligent and more co-ordinated transport decisions.

ITS comprises two types of components:

- Intelligent vehicles – in-vehicle systems to assist drivers and intervene in vehicle control; and
- Intelligent infrastructure – systems that monitor operating conditions and prevent or quickly respond to problems, provide information to travellers and operators, and support intelligent vehicle operations.

The overarching function of ITS is to improve the operations of transport systems and enable seamless integration of transport subsystems which in turn will support the general transport objectives of mobility, safety, reliability, effectiveness, efficiency and environmental quality. In other words, it's about saving time, money and lives and improving the quality of life. Internationally, ITS has become an essential component for road authorities in their efforts to manage limited resources into a future focused on multi-modal transportation.

## **3. WHY ITS?**

The notion of ITS has always been to improve transportation; to increase efficiencies and to assist every functional responsibility of a road authority, from policy-making to law enforcement. ITS is an essential 'transportation management tool' and not an isolated strategy to address individual transportation aspects within the system.

As transportation moves toward a multi-modal and integrated environment, it will be vital for the road authority to manage the system better and coordinate efforts of the numerous and diverse organisations across jurisdictional and functional boundaries. Technologies is already applied in the Transportation environment; there is also wide spread deployment of communications technology, some of which could form the communications backbone of any future ITS system implementation.

The significance of ITS, however, is not in the impact of new technologies – ITS offers the opportunity to integrate the transportation system. The transportation system as a whole includes infrastructure, vehicles, and the people and goods being moved. Each of these elements has experts, organizations, advocates, and sometimes a dedicated government organization or department. Information technology can bind these elements into an integrated system.

If information flows easily and inexpensively via modern technology, the system is more likely to be optimised and to operate as a system. Conversely, if information is unavailable or impeded, it is impossible for the system to operate as it should.

The flow of information is fundamental to the effectiveness of the transportation system of the future. The information-oriented paradigm of transportation, as depicted in the figure below, can help to dissolve the traditional – and increasingly artificial – barriers between transportation and communications. People, goods, and information can be moved from one place to another, and in many cases one can be substituted for another to achieve the ends more efficiently.

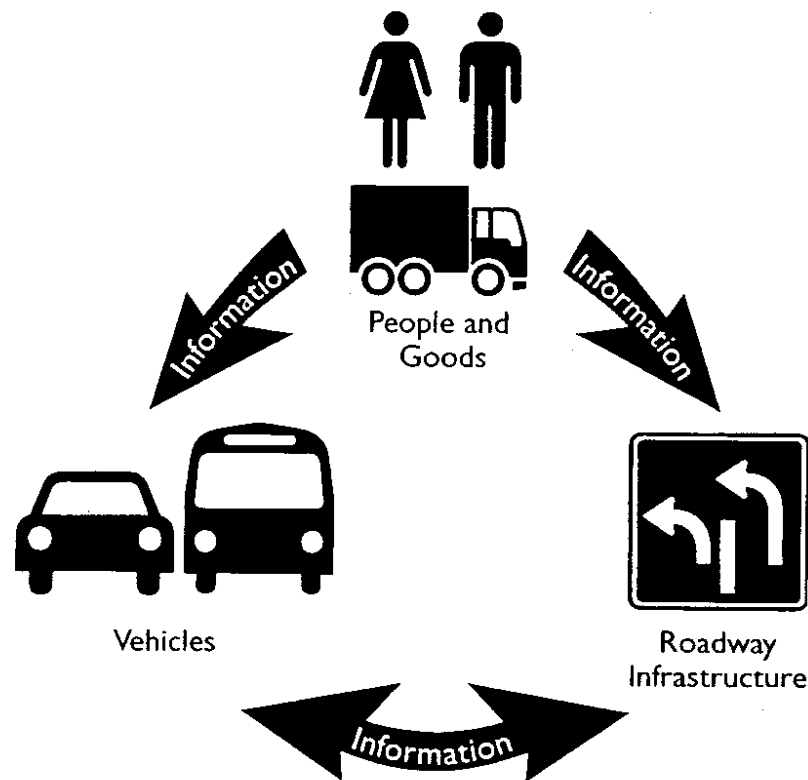


Figure 1. Integrated Transportation System.

In recent years, transportation operations – as opposed to construction and maintenance of infrastructure – have become a primary focus worldwide. ITS deals with the technology-enhanced operations of complex transportation systems. The ITS community has argued that focusing on operations through advanced technology is cost-effective, considering the social, political, and economic barriers to conventional infrastructure particularly in urban areas. ITS can avoid the high upfront costs of conventional infrastructure as well as lower maintenance costs through more modest investments in electronic infrastructure, followed by a focus on effectively operating the infrastructure and the transportation network at large.

The public and private customer look at the transportation system as a whole, and s/he wants to see the whole system operate smoothly. Yet, success for government public works departments is commonly defined as completing projects – whether it is new construction, rehabilitation, or having the infrastructure in a good state of repair; and enforcement departments may be primarily concerned with lowering crime statistics – even within traffic units, the focus may primarily be on enforcement rather than on “smooth operations”. Similarly, emergency services teams are focused on lifesaving, with little attention as to how their actions could also contribute to overall transport system operations.

Public Transport departments are unique in having operations as a core mission, but overall the management and operations of the transport system within the province is fragmented amongst and within the different government institutions and authorities.

A strong argument for a co-operative and joint approach to ITS is the benefits of integration. Integration of ITS means sharing infrastructure, communications links, systems, common standards etc.

Examples of the extra benefits from ITS integration include:

- Better coordination from area-wide strategies: e.g. supervisor type systems could ensure a balanced, coordinated response to traffic problems.
- Lower equipment and operating costs: e.g. a bus operator could use the same data on vehicle locations to help track and manage a fleet, provide real-time at-stop information for passengers, and give buses priority through traffic signals.
- Better communication between organizations: e.g. communication links between regional highway/emergency operators and the city traffic department would allow each organisation to know immediately of incidents on the other's communication network, and choose the appropriate strategy.
- Cooperative marking and communication devices (relying on inexpensive sensors) installed on vehicles and roadway infrastructure could significantly enhance the traffic management and safety benefits.
- Partnerships help cut costs: e.g. new revenue could be gained from a private operator to use data (collected for urban traffic control) to provide a commercial traffic information service to individual subscribers.
- New and more accessible services for users: e.g. a travel information system, which offers a national journey planning service for all public transport modes, via a single telephone enquiry number.

ITS has become an essential management and implementation component for road authorities in their efforts to manage limited resources into a future focused on multi-modal transportation. ITS allows road authorities to achieve more capacity from the system in a faster, safer and more cost-effective manner than is currently possible. When considering the primary focus areas in Gauteng of Transportation Infrastructure, Traffic Management, Public Transport and Freight Movement, ITS is the linkage that effects all these aspects seamlessly and in a most productive and efficient manner.

#### **4. THE TRANSPORTATION FRAMEWORK IN GAUTENG**

It is imperative that any ITS Strategy in Gauteng take due cognisance of the nature and scope of the current transport problem in the province. Any solutions or key thrusts need to be mapped onto the existing situation. In this regard, matters pertaining to policy and legal aspects, organizational aspects and transport plans and initiatives in general, were considered.

In assessing policy and legal matters, various acts and guideline documents were considered. These include the National Land Transport Transition Act (NLTTA), the Gauteng White Paper on Transport Policy, the Provincial Land Transport Framework and various other provincial legislation. Linkages with ITS were identified and ITS application opportunities within the Gauteng PLTF Strategic Actions were listed (see Appendix 1).

The existing organisational framework within implementing agencies was considered.

The Gauteng Department of Public Transport, Roads and Works (Gautrans), plays a co-ordination role at provincial level, and has as its key focus areas Transportation Infrastructure, Traffic Management, Public Transport and Freight Transport. Transportation matters are currently co-ordinated through the Transportation Co-ordinating Committee (TCC), where authorities at different levels of Government have representation.

Current transport plans and initiatives informed the strategy both in direct and indirect ways. Projects such as the high speed rail project linking Johannesburg, Pretoria and the Johannesburg International Airport, the proposed toll scheme for the highway system linking Johannesburg and Pretoria, and various public transport initiatives (such as the taxi recapitalization project) were considered. These projects are both vital and complementary elements of the holistic transport strategy for the Gauteng Province, and relevant aspects ought to be integrated into the ITS strategy.

## **5. THE NEED FOR AN ITS STRATEGY**

It has been shown that many of the problems associated with the transport environment relate to the diversity of transportation and particularly the difficulty of coordinating the numerous agencies within Gauteng. Jurisdictional boundaries can be disparate and responsibilities become difficult to define efficiently without overlap or duplication.

Hence, the need for an ITS strategy arises from the need to manage the provision of transportation within Gauteng. Such a comprehensive undertaking requires that a strategic view be taken before rushing into, potentially, ad-hoc applications or initiatives.

The real benefits of ITS arise out of cooperation and coordination and, hence strategic planning is important for the following reasons:-

- without ITS, there may be a focus on individual facilities or transportation problems by a specific agency, in isolation of other agencies of facilities.
- greater benefits are offered through integration of systems across functional, modal or jurisdictional boundaries.
- economies of scale may be derived from introducing ITS components in a coordinated and efficient manner, avoiding duplication, encouraging competition in the market place and developing business opportunities through private sector partnerships.

The policies previously referred to allude to numerous and diverse issues which involve many role-players and departments within Gautrans. If these issues are to be addressed systematically, then it is the all-encompassing functionality of ITS which can provide such holistic solutions. ITS can extend across geographical and jurisdictional boundaries, facilitating efficiencies or operations, of manpower and resources to effect improvements throughout all aspects of transportation.

In order to provide a reference point for the deployment of ITS, a guiding strategy is essential to offer clarity and direction for the initiatives to follow. For ITS to be truly effective, a strategy is required that encompasses all the stakeholders within the transportation environment.

Hence, a Provincial-wide approach is required that facilitates interaction, debate and, ultimately, a coordinated effort to maximise funds and achieve real improvements for transportation. Such a strategy will need to be monitored and reviewed to remain appropriate, and in this regard, it is also important for the strategy to be sufficiently robust to achieve its stated purpose, without being too inflexible to change when circumstances dictate such a change.

Hence, a Provincial Strategy will:

- Harness the potential of ITS to improve the efficiency of transportation operations across geographic, functional and jurisdictional boundaries.
- Utilise agreed international norms and standards to ensure cost-effective solutions.
- Encourage confidence in the private sector to facilitate private-public partnerships and,
- Develop a local technology industry capable of creating employment opportunities to serve both local and overseas markets.

## **6. ITS ARCHITECTURE**

The advent of ITS rendered the “architecture” concept relevant to the world of transportation. One of the fundamental insights of the pioneers of ITS was the notion that vehicles and infrastructure should function together as a coherent system. Whereas land transport vehicles and infrastructure had traditionally functioned independently of one another, the emergence of technologies such as modern computers, communications, and sensors created the opportunity to link the two elements together. However, an underlying structure would be needed to describe the manner in which this linkage would take place.

This underlying structure, or architecture, would need to address questions such as the following:

- What is the split of “intelligence” between the vehicle and the infrastructure?
- What types of communication links will need to be developed to connect vehicles, infrastructure, and transportation centres?
- What types of information need to be exchanged?
- How can one ensure that a system used in one part of the country/province will also work in other parts of the country/province? Even more basically, how can one ensure that multiple systems within one region of the country/province will be interoperable?
- Which services should these technologies support?
- How might various services interact with one another so that the whole ITS deployment is greater than the sum of its individual service parts?
- Promote national imperatives such as job creation.

ITS are systems where system components are complexly intertwined. An ITS architecture is a framework within which the individual ITS services and functions – such as traffic monitoring, incident detection, and emergency support – can be developed. It clarifies how components of the system affect each other and work as one, and it stipulates functions of the entire system and each subsystem. ITS architecture does not need to assume specific technologies. Instead it allows system developers to assign freely while specifying the system interfaces that will facilitate future benefits, such as interchangeable products, increased competition, reduced risk, and lower costs through standardization. The main strength of an ITS architecture is that it provides the strategic framework through which activities of various players can be integrated. It is important to develop the ITS Strategy with an end goal in mind i.e. an ITS architecture; a thorough understanding of the concept is therefore desirable.

## **7. STRATEGY COMPONENTS**

In developing the overarching strategy, three parallel development lines or thrusts were pursued:

- establish an appropriate policy and legal framework in line with a long-range ITS vision to enable extensive ITS implementation
- create a supporting institutional and financial framework, and
- initiate development of a provincial systems architecture and strategic deployment framework.

Strategies for each thrust are listed hereafter and some key actions are identified or discussed.

## 7.1 Policy and legal framework

### *Strategy 1-1: Create a transportation systems policy framework*

It is important to align and integrate ITS with current policy documents. ITS is seen as a thread bringing components of the provincial land transport framework together.

### *Strategy 1-2: Develop an enabling legal framework*

The current legal framework might not permit all aspects of ITS deployment. These need to be assessed and risks identified.

## 7.2 Supporting Institutional and Financial Framework

### *Strategy 2-1: Develop the means for geographical integration and associated institutional co-ordination at provincial level.*

The co-ordination of ITS should be formalised at provincial level – most likely through a TCC working group.

### *Strategy 2-2: Develop effective mechanisms for internal co-ordination within authorities at different levels of Government*

ITS is not a line function in the typical organisation. Effective internal co-ordination can only be assured by formalising an ITS co-ordination function within the organisation.

### *Strategy 2-3: Create and improve ITS awareness within the province*

ITS is not an end in itself, but it provides the means to an end. The outcomes of ITS need to be conveyed to the politician, official and general user – not necessarily the ITS concept itself.

### *Strategy 2-4: Create a funding and incentives framework tailored to support a long-term ITS implementation*

ITS measures should be incorporated in general infrastructure provision. Funding should be provided either from historical sources, or else be obtained through partnering initiatives where income generated through technology applications should be shared.

## 7.3 Systems Architecture and Deployment Framework

### *Strategy 3-1: Develop an overarching ITS Architecture*

An ITS architecture need to be in place to ensure that the haphazard and ultimately inefficient deployment of technology measures is prevented.

### *Strategy 3-2: Create an enabling environment and guiding framework for regional architecture development.*

ITS plans need to be regionalised and integrated with local Integrated Transport Plans.

### *Strategy 3-3: Promote and initiate ITS deployment through demonstration projects*

For ITS to be successful, it has to be seen to be successful. Identify ITS projects that can be implemented and provide sufficient benefits – such “early winners” will be much to promote further ITS deployment.

## **8. GUIDING PRINCIPLES**

Various guiding principles for the implementation of the strategies were identified and should be considered in the process ahead. They are summarised in Figure 2.

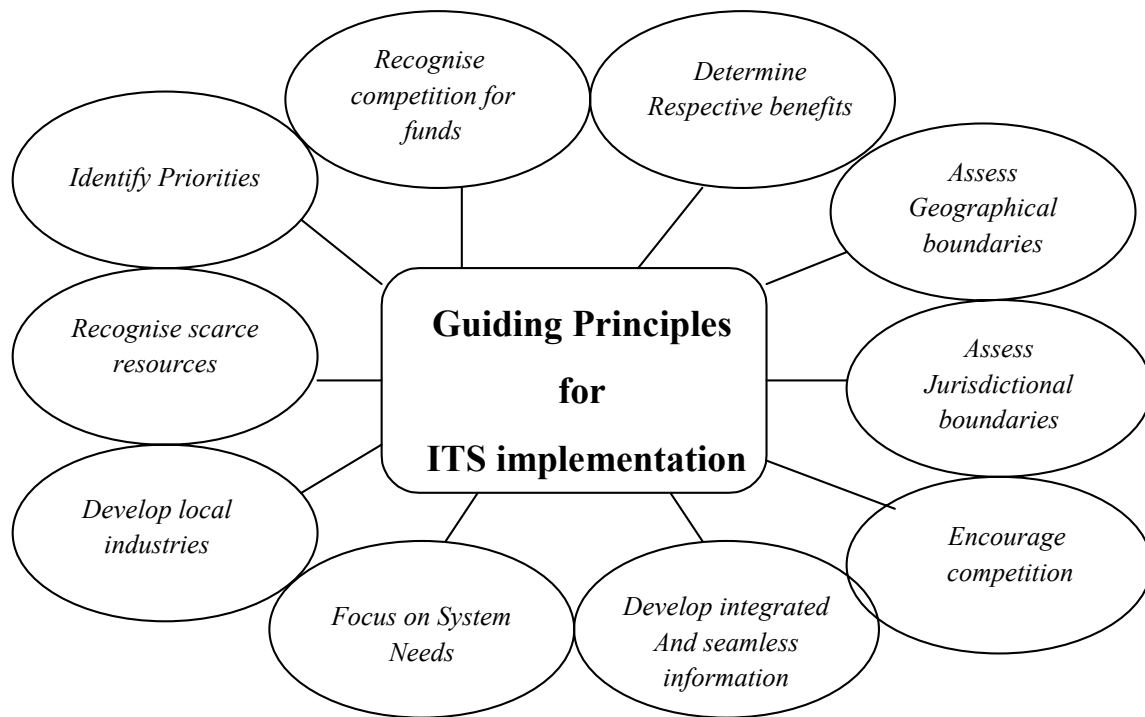


Figure 2. ITS Strategy Guiding Principles.

## 9. CONCLUDING REMARKS

This paper represents the first version of an ITS strategy for Gauteng. It will be developed further and formalised in consultation with various stakeholders. Various priorities and projects for early implementation have been identified, and will be integrated into the ultimate strategy for Gauteng.

The application of Intelligent Transport Systems, by definition, is a complex amalgamation of pragmatic transportation needs, coupled with an extensive array of communication technologies and technical possibilities. The urgency to improve transportation throughout the Province, at all levels and through all modes of operations, are recognised. ITS can be the catalyst to initiate numerous projects and improve co-ordination : it can integrate diverse user needs, co-ordinate multi-modal operations and assist service personnel from all agencies providing a multitude of services in transportation.

This paper sets out a logical sequence leading to the development of a provincial ITS Strategy. Through implementation thereof, the province is well positioned to build on successes elsewhere, while avoiding many of the pitfalls and mistakes made.

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