Delivering Intelligent Transport Systems
Driving integration and innovation
Transport has a major impact on the quality of life in a city, its environment and the economy. Transport Authorities globally are facing similar strategic challenges around worsening congestion, insufficient transport infrastructure, affordability constraints, increasing emissions and growing customer needs.

To respond to this demanding environment, Transport Authorities can no longer depend solely on the traditional approach of building more infrastructure as this requires significant financial commitment as well as complex regulatory and environmental planning processes to manage (see Figure 1).

Consequently, Transport Authorities across the world are increasingly focussing on the use of demand management with schemes such as road user charging; and information and customer management techniques including enhanced traveller information services. This broader application of Information Technology (IT) provides an opportunity to drive innovation in the provision of transportation systems and services.

The current use of Intelligent Transport Systems (ITS) is often limited by a lack of an integrated and holistic vision. Traditionally, the implementation of ITS projects has been more tactical, focused on single transport modes using stand-alone proprietary systems. As Transport Authorities embark on increasingly complex mixes of IT investment to support the provision of their transport networks, there is a real need and opportunity to align the IT architectural framework with the business strategy and operational model to achieve a greater degree of system, data and service integration.

IBM believes that an integrated common framework uniting some of the key transport sub-systems will offer Transport Authorities the ability to better manage their network and provide integrated services to customers. This framework should make maximum use of open and common standards as well as adopting a Service Oriented Architecture approach, which simplifies future integration and inter-operability between transport systems.

In addition, the implementation of a new strategic transport project such as an Automatic Fare Collection (AFC) system or a Road User Charging (RUC) system allows the opportunity to utilise the new infrastructure as a base for future projects. For example, the Customer Relationship Management (CRM) component of a multi-modal AFC system can form the framework for other transport systems to integrate their customer data. The development of a new transport portal / website that provide trip advisory services and real-time information updates to customers is another example of how a strategic project can stimulate the data integration of other transport systems. These strategic initiatives can kick-start the development of a common framework that leads to improved customer services, reduced operational costs and increased revenues.
Intelligent Transport Systems at a turning point

Over recent years, ITS has played an increasingly important part in providing transport services more effectively. With its growing maturity, IBM believes ITS is approaching the next stage in its development where it will be influenced by:

- Greater integration between systems and modes
- Open and common standards, and a shared framework
- Service Oriented Architecture
- Increased customer services
- Real-time information sharing and responsiveness
- Demonstrable value for money

Transport Maturity Model

Based on extensive research and interviews with leading Transport Authorities globally, IBM has developed a Maturity Model based on the level of system, data and service integration across multiple transport modes. The Model enables authorities to view their business and ITS solutions holistically and capture their vision of where they would like to go to (see Figure 2). A profile of a typical Transport Authority has been mapped for reference.

<table>
<thead>
<tr>
<th>Planning</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
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<tr>
<td></td>
<td>Silo</td>
<td>Single Mode Integrated</td>
<td>Partially Integrated</td>
<td>Multimodal Integrated</td>
<td>Multimodal Optimized</td>
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<tr>
<td></td>
<td>Functional Area Planning (single mode)</td>
<td>Project-based Planning (single mode)</td>
<td>Integrated agency-wide planning (single mode)</td>
<td>Integrated corridor-based multimodal planning</td>
<td>Integrated regional multimodal planning</td>
</tr>
<tr>
<td>Performance</td>
<td>Minimal</td>
<td>Defined metrics by mode</td>
<td>Limited integration across organizational silos</td>
<td>Shared multimodal system-wide metrics</td>
<td>Continuous system-wide performance management</td>
</tr>
<tr>
<td>Measurement</td>
<td>Minimal capability, no customer accounts</td>
<td>Customer accounts managed separately for each system mode</td>
<td>Multi-channel account interaction per mode</td>
<td>Unified customer account across multiple modes</td>
<td>Integrated multimodal incentives to optimize multimodal use</td>
</tr>
<tr>
<td>Customer Relationships</td>
<td>Minimal capability, no customer accounts</td>
<td>Customer accounts managed separately for each system mode</td>
<td>Multi-channel account interaction per mode</td>
<td>Unified customer account across multiple modes</td>
<td>Integrated multimodal incentives to optimize multimodal use</td>
</tr>
<tr>
<td>Data Collection</td>
<td>Limited or Manual Input</td>
<td>Near real-time for major routes</td>
<td>Real-time for major routes using multiple inputs</td>
<td>Real-time coverage for major corridors, all significant modes</td>
<td>System-wide real-time data collection across all modes</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>Networked</td>
<td>Common user interface</td>
<td>2-way system integration</td>
<td>Extended integration</td>
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<tr>
<td>Data Integration</td>
<td>Ad-hoc analysis</td>
<td>Periodic, Systematic analysis</td>
<td>High-level analysis in near real-time</td>
<td>Detailed analysis in real-time</td>
<td>Multimodal analysis in real-time</td>
</tr>
<tr>
<td>Analytics</td>
<td>Manual Cash Collection</td>
<td>Automatic Cash Machines</td>
<td>Electronic Payments</td>
<td>Multimodal integrated fare card</td>
<td>Multimodal, multi-media (fare cards, cell phones, etc)</td>
</tr>
<tr>
<td></td>
<td>Ad-Hoc, Single Mode</td>
<td>Centralized, Single Mode</td>
<td>Automatic, Single Mode</td>
<td>Automated, Multimodal</td>
<td>Multimodal real-time optimized</td>
</tr>
<tr>
<td>Network Ops. Response</td>
<td>Manual detection, response and recovery</td>
<td>Manual detection, coordinated response, recovery</td>
<td>Automatic detection, coordinated response and manual recovery</td>
<td>Automated pre-planned multimodal recovery plans</td>
<td>Dynamic multimodal recovery plans based on real-time data</td>
</tr>
<tr>
<td>Incident Management</td>
<td>Individual static measures</td>
<td>Individual measures, with long-term variability</td>
<td>Coordinated measures with short-term variability</td>
<td>Dynamic pricing</td>
<td>Multimodal dynamic pricing</td>
</tr>
<tr>
<td>Demand Management</td>
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<td>Multi-channel trip planning and account based alert subscription</td>
<td>Location-based, on journey multimodal information</td>
<td>Location based, multimodal proactive re-routing</td>
</tr>
</tbody>
</table>

Figure 2: Multimodal Network Management Maturity Model
IBM's ITS experiences

IBM's experience of developing ITS solutions includes the delivery and operation of the Stockholm Congestion Tax Project, Singapore's Automatic Fare Collection back office systems, the UK Driver and Vehicle Licensing Agency's Electronic Vehicle Licensing system and a leading UK insurance company's usage-based insurance model.

Case Study: Congestion Charging in Stockholm

The Swedish authorities required a system that would automatically tax Swedish registered vehicles entering and leaving the city centre between 06.30 and 18.30, Monday to Friday (excluding national holidays). The target was to reduce congestion by between 10% and 15%.

The biggest challenges during the design and implementation process were the tight time frame, political sensitivity and public scrutiny. The trial was to be followed, in September 2006, by a referendum for Stockholm residents to decide whether to implement the congestion tax permanently. It was crucial that the trial brought tangible, measurable benefits and won over its users.

The trial itself launched on time and ran without interruption through to its end on 31 July 2006. It not only met its objectives – it exceeded them:
- Traffic congestion in Stockholm was reduced by 25%, far above the original target.
- Traffic queuing times fell by up to 50%; Journey times were faster and more predictable.
- Stockholm bus timetables were re-written to take improvements to traffic flow into account.
- Pollution levels in the city fell by between 10% and 15%.
- Confidence in the system was high due to minimal enforcement and administrative errors.

When the trial ended, a majority of Stockholm residents voted in favour in the referendum. This was the first time that the residents of a European city have elected to adopt road charging. As a result, the Swedish parliament decided to introduce the system permanently. Following the parliamentary process and some enhancements, the scheme was relaunched in August 2007.

Case Study: DVLA's Electronic Vehicle Licensing system

The Driver and Vehicle Licensing Agency (DVLA) sought to deliver higher levels of customer service at a lower cost through a new online channel for vehicle licensing. Implemented over 12 months, the innovative project won several awards including the UK e-Government Award for Central e-Government Excellence in 2006.

Its benefits include:
- Reduction in licensing processing time.
- Reduction in cost of vehicle licence renewal.
- Easier compliance for motorists.
- Faster renewals through integration with insurance companies and other government agencies.
Investment in ITS innovations

IBM is investing in several Innovation Programmes that focus on the next generation of ITS solutions: Global Innovation Outlook and InnovationJam. The InnovationJam programme is being used to design and in-market test the next generation of road user charging systems - Innovative Transport Pricing - and to develop advanced information management solutions for end-users and transport operators - Advanced Transport Information Management (see Figure 3).

IBM’s global Innovative Transport Pricing project is focused on the technology roadmap for road user charging from City based schemes through to time, distance and place schemes at a national/state level. It is addressing the operational and technology challenges of scale, privacy, accuracy, interoperability, enforcement, total cost of ownership and critically the migration from individual schemes through to national schemes.

IBM is running several co-invested trials with Transport Authorities globally. An example is the Traffic Prediction Pilot in Singapore (see case study below).

Case Study: Traffic Prediction Pilot in Singapore

Even though Singapore has one of the most advanced traffic management systems in the world, the Land Transport Authority (LTA) is constantly looking for innovative solutions to expand on and improve its range of traffic management tools to keep traffic flowing.

Through IBM’s Global Innovation Outlook programme, the LTA and IBM co-invested in a pilot to predict traffic flows in Singapore’s central business district (CBD). Using historical traffic data and real-time traffic input from the LTA’s i-Transport system, IBM’s Traffic Prediction Tool predicted traffic flows over pre-set durations (10, 15, 30, 45 and 60 minutes). Both speed and volume predictions covering the CBD were above the target accuracy of 85%. In addition, during peak periods where more real-time data was available, the average accuracy of the volume forecasts on the CBD was near or above 90% from 10-minutes all the way to the predictions 60-minutes into the future.

With these predictions, LTA’s traffic controllers will be able to anticipate and better manage the flow of traffic to prevent the build-up of congestion.
IBM Solutions
IBM has a team of over 200 ITS specialists providing the following types of services and solutions to Transport Authorities globally:

- Transportation IT Strategy Consulting
  - Transport Maturity Model
  - Integrated ITS framework
- Road User Charging
  - Project management, scheme implementation and operation
  - Urban and Time Distance Place road charging solutions
  - Total cost of ownership models
- Automatic Fare Collection
  - Project management and implementation
  - Global partners
- Transport Information Management
  - Single and multi-modal
  - Network management and end-user sharing
- Asset Management
  - IBM Maximo Asset Management
  - Management modules in asset, work, service, contract, materials and procurement management

These solutions allow Transport Authorities to optimise their networks leading to improved customer services, reduced operational costs and increased revenues.

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