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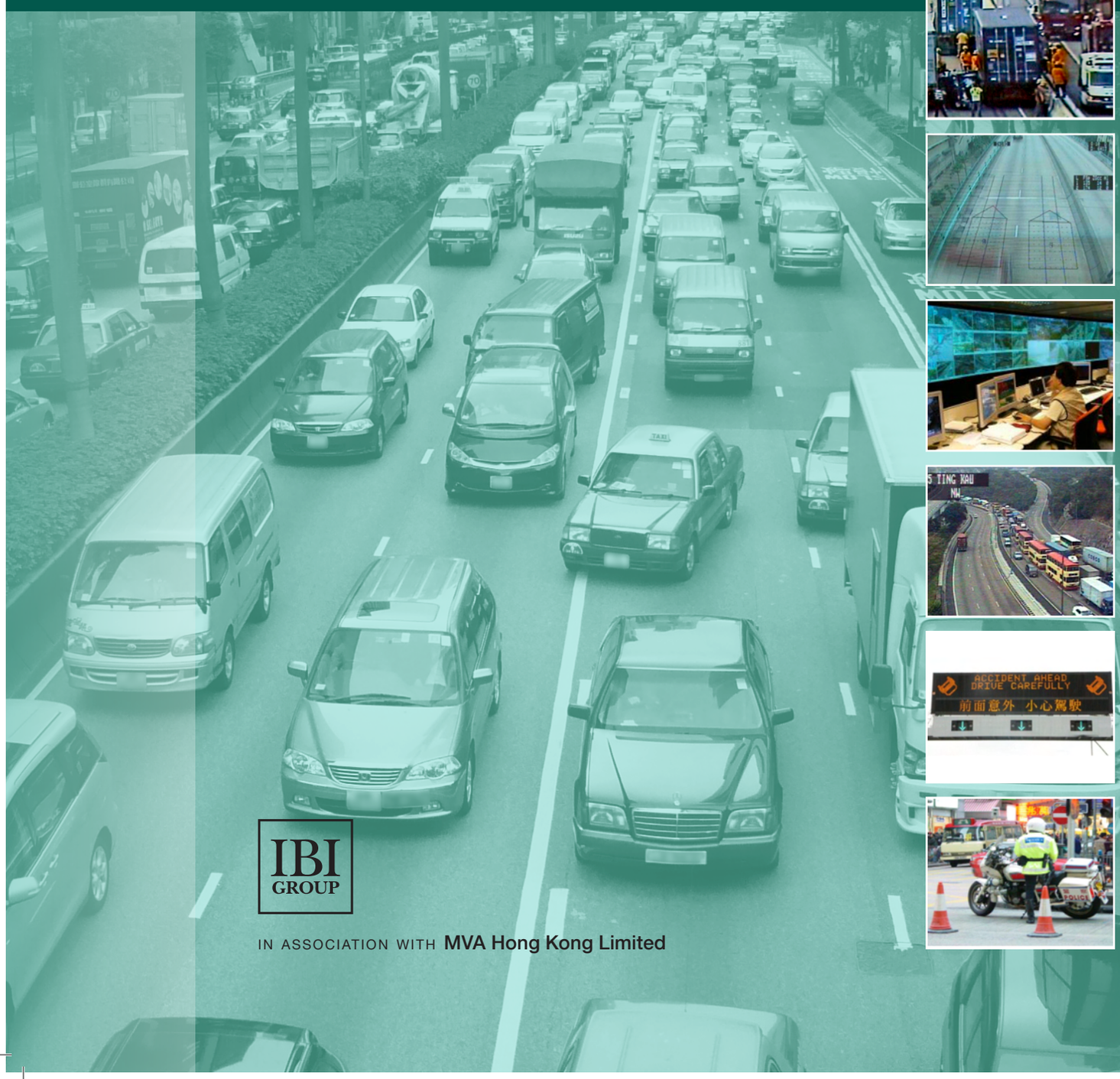
Transport Department

Feasibility Study on Deploying Advanced Technologies in Incident Management

Executive Summary

FEBRUARY 2010



IBI GROUP

IN ASSOCIATION WITH **MVA Hong Kong Limited**

EXECUTIVE SUMMARY

Background

(1) The month of May 2005 was marked by heavy rain, active thunderstorms and severe squalls. On the 9th of May, severe gusts with speeds reaching 135 kilometres per hour resulted in more than 250 emergency incidents relating to traffic in different parts of Hong Kong in the period from 12:00 to 24:00.

(2) In a five minute period between 12:37 and 12:42, three major incidents arising from fallen trees and scaffolding occurred on three main roads in western, central and eastern Kowloon at Argyle Street, Waterloo Road and Prince Edward Road East respectively. Each of these are key corridors in Kowloon, and resulted in abnormally serious congestion, which also impacted on traffic in the Cross Harbour and Lion Rock Tunnels, and even extended to the Wan Chai district on Hong Kong Island.

(3) The Government's mechanisms for the handling of emergency traffic and transport incidents generated great public attention and, subsequently, the then Secretary for the Environment, Transport and Works appointed a Task Force to review and improve emergency transport coordination.

(4) The Task Force was tasked to review and make recommendations on:

(a) crisis management mechanism;

(b) internal coordination to expedite immediate remedial works;

(c) congestion relief measures; and

(d) dissemination of information to the public.

with a view to facilitating better handling of similar unforeseen emergency situations with substantial traffic impact in the future.

(5) The Task Force Report on Emergency Transport Coordination was published in June 2005, containing a total of 56 recommendations for various aspects of emergency transport coordination. In response to the Task Force's recommendations, the Transport Department (TD) addressed the majority of the areas of concern. There are, however, 12 medium- to long-term recommendations which required more detailed consideration.

(6) A Business Process Re-engineering (BPR) study carried out by the Government's Efficiency Unit recommended a number of improvement opportunities for the incident management and information dissemination processes, with the support of a computerised traffic and incident management system and the deployment of advanced technologies.

(7) Various key recommendations put forward by the Task Force and pointed out in the BPR study focused on the need to deploy advanced technologies to collect, display, share and disseminate real-time traffic and transport information for incident management. Hence, this Feasibility Study (the Study) was commissioned to examine the use of advanced technologies to enhance TD's incident management capabilities.

(8) The main objectives of the Study, in brief, are to:

(a) investigate the feasibility of harnessing advanced technologies;

(b) develop a schematic design of an Integrated Solution;

(c) confirm the technical feasibility of the suggested Integrated Solution and recommend suitable technology options; and

(d) justify the implementation by a cost-benefit analysis.

Study Structure

(9) The Study is carried out sequentially in the following five stages:

(a) review of technologies used for incident management in overseas cities and countries;

(b) review of technologies currently used in Hong Kong for incident management, and traffic control and surveillance;

(c) identification and analysis of requirements for incident management in Hong Kong and improvement measures with the use of technologies;

(d) development of an Incident Management Strategy for an Integrated Solution; and

(e) development of the associated implementation plan and programme.

What is an Incident?

(10) In the Hong Kong context, an incident refers to a range of events impacting on the normal operation of the road and transport network. Such events are broadly classified into:

(a) unplanned events, such as accidents, safety hazards, congestion and adverse weather, which impact on the capacity of the road network and public transport operations and facilities; and

(b) planned events, such as roadworks, procession and opening of major public transport facilities.

(11) The recommendations in the Study should be capable of equally addressing the traffic and transport impacts of all incidents in the strategic and urban arterial road network.

Incident Management Timeline

(12) Equally important is understanding the typical incident management timeline and the steps and processes associated with an incident or event. The major steps for incident management along with the timeline are as follows:

(a) detection;

(b) confirmation;

(c) analysis;

(d) response;

(e) clearance; and

(f) recovery.

Current Situation in Hong Kong

(13) Traffic forecasts for Hong Kong indicate that, even with new major roads and railways under construction and planning, all existing major roads will experience a growth in overall traffic volume. As a result, traffic conditions during incidents will worsen.

(14) Whilst there are existing traffic and transport management systems in place throughout Hong Kong, these systems are typically not intended for comprehensive incident management – there is little detection infrastructure, and systems are standalone and not coordinated/linked.

(15) In May 2000, TD established the Emergency Transport Coordination Centre (ETCC) to coordinate emergency traffic and transport incidents and minimise the impact, delay and inconvenience caused by incidents to the public on a 24-hour basis throughout the year.

(16) Whilst the ETCC provides an effective and efficient response to all traffic and transport incidents, the majority of the processes are still manual in nature. A number of enhancements are suggested in the Study, primarily by means of computerized systems to facilitate greater automation of incident handling processes and better coordination of multiple concurrent incidents.

Advanced Technologies

(17) A global review of the latest technologies utilised for incident management is undertaken, with these being assessed under a set of criteria including data type, accuracy and reliability, ease of implementation, capital and maintenance costs, applicability to different parts of the road network, and suitability for use in the Hong Kong environment.

(18) Technologies suitable for data collection, data analysis, data display, information sharing and dissemination, and enhancement of the Control Centre, are consolidated into an Integrated Solution. A computerised Traffic and Incident Management System (TIMS) with relevant rules and cases for incident management is recommended.

(19) The potential use of dynamic traffic models for contingency planning and incident handling is also considered. Although some models are promising, it is found that they are not mature enough for simulating complicated traffic conditions and developing real-time contingency plans for handling incidents with a sound level of confidence. It is therefore recommended that the development of these tools be further monitored for future investigation.

(20) The dissemination of real-time traffic information by Radio Data System – Traffic Message Channel (RDS-TMC), Vehicle Information and Communication System (VICS) and Highways Advisory Radio (HAR) are considered feasible. However, their applications are constrained by the unavailability of a territory-wide FM frequency in Hong Kong for the operation of such systems. The launch of Digital Audio Broadcast under consultation may free up some frequencies and hence open up an opportunity for disseminating real-time traffic information by radio or digital broadcast.

Incident Management Strategy

(21) The recommended measures are formulated within the framework of an Incident Management Strategy.

(22) The Strategy, building on the investigation and analysis work undertaken, and in recognition of the limitations with the existing arrangement, sets out the key elements – vision, mission and strategic objectives – which will be delivered through a series of goals and associated measures.

(23) The vision provides the very high level desired outcome for incident management. This vision is **"managing incidents to keep Hong Kong moving"**.

(24) The mission builds on this, providing a statement which defines the vision for incident management, and forms the policy objective. This mission is **"deploying feasible incident management strategy and advanced traffic and incident management system for effective and efficient management of incidents to minimise traffic impact and inconvenience to travellers on the Hong Kong transport network"**.

(25) The third component of the Strategy is the strategic objectives, which are:

(a) safety;

(b) efficiency;

(c) management; and

(d) communication.

(26) Delivering these objectives will be through a series of goals and associated measures. The goals are:

Goal 1: Better Detection of Incidents

Goal 2: Better Analysis of Incidents and Impact

Goal 3: Better Response, Management and Clearance of Incidents

Goal 4: Better Real-Time Traffic and Transport Information Dissemination

Goal 5: Improved Operating Arrangements

Goal 6: Education of Road Users and Public on Traffic and Transport Incidents

Goal 7: Closer Collaboration with Private Sector

Goal 8: Continuing Enhancement of the Incident Management Strategy

The Integrated Solution

(27) Built on the Incident Management Strategy, a series of recommendations are developed around the "Integrated Solution" concept, where a holistic approach is taken in recognition of the relationship between the measures, ensuring that these are progressing together.

(28) The Integrated Solution comprises a wide range of technologies and measures which will deliver the desired enhancements with four core components at its heart. Whilst these measures can be progressed separately, this will introduce a fragmented approach, and the Integrated Solution recognises the need to progress the core components in a coordinated manner to effectively deliver enhanced incident management, with ensuing demonstrable benefits.

(29) The core components of the Integrated Solution are:

(a) **Traffic and Incident Management System** which will process and analyse data, assist operation, communicate with other stakeholders, provide a common platform for data fusion, integrate systems and facilitate information exchange with other systems;

(b) **incident management field infrastructure** which will comprise monitoring and detection technologies to collect comprehensive real-time data, and electronic message signs to disseminate real-time information to travellers on-road;

(c) **information services** which will consist of a wide range of services to provide real-time information to drivers and passengers through means convenient to them and to facilitate immediate dissemination of information in the event of an incident; and

(d) **enhancements to the control centre** which will include both physical and non-physical improvement measures to the ETCC for the accommodation of the above core components of the Integrated Solution and thereby higher capability of incident management.

Traffic and Incident Management System (TIMS)

(30) Building on the existing ETCC system, the TIMS is the cornerstone of the Integrated Solution, with the system providing the ETCC with the ability to manage traffic and transport incidents in a more effective and efficient manner, such as earlier detection of incidents and quicker information dissemination through automatic means.

(31) The following key requirements for the TIMS are established:

(a) collect and process data from multiple sources in an automated manner to provide higher quality and more useful information for better understanding of traffic conditions;

(b) assist in detecting incidents through closer collaboration with stakeholders (e.g. Hong Kong Police Force, public transport operators and tunnel/bridge operators, etc) and the use of algorithms and available real-time data;

(c) assist in confirming incidents with automatic identification of relevant closed-circuit television (CCTV) cameras and information sharing with stakeholders;

(d) provide tools to allow quick and comprehensive analysis of incidents and their impact;

(e) establish a central computerized incident database to facilitate reporting, incident review and contingency planning;

(f) enable the widest and prompt dissemination of real-time traffic information both externally to the public, media and value-added service providers, and internally to stakeholders such as Government departments, public transport operators and TD management;

(g) assist in managing incidents through improved communication with existing systems and field infrastructure; and

(h) most importantly, enable efficient handling of multiple concurrent incidents and managing of the transport network on a regional basis and in a co-ordinated manner.

(32) The architecture of the TIMS should be reliable, scalable and future-proofed, such that any advances in technology can be suitably harnessed at any point during implementation.

(33) The implementation of the TIMS will also see some other key aspects being progressed, notably the development of Intelligent Transport Systems (ITS) Standards/ Architecture which will provide general framework for planning, defining and seamlessly integrating ITS technologies, and the development of information exchange standards which will facilitate the exchange of information between different systems.

(34) In the long term, TIMS should be capable of implementing incident response measures, particularly on the Strategic Road Network (SRN), through Centre-to-Centre (C2C) interfaces or system integration with existing and planned systems such as Traffic Control & Surveillance Systems (TCSS) to allow comprehensive network-wide incident management.

(35) To capture the benefits from using proven technologies and contain the project risks, the TIMS will be developed in two phases. The TIMS Phase 1 will have the core functionality, such as central database for incident and real-time data, data fusion, automatic incident detection, incident logging, automatic selection of CCTV images for incident confirmation, impact analysis and information dissemination. The scope of the Phase 1 development will further be expanded with more channels and avenues for the supply of data. The TIMS Phase 2 will have more complex functionality, such as dynamic traffic modelling and direct control over TCSS, at a longer time.

(36) While the TIMS and associated developments will allow TD to undertake enhanced incident management through the integration of all resources including stakeholders' input, existing systems and field infrastructure, the deployment of experienced staff in control room is essential for making sound judgements in handling incidents.

Incident Management (IM) Field Infrastructure

(37) The provision of IM field infrastructure is the most expensive component of the Integrated Solution, covering detection and surveillance infrastructure, appropriate electronic signage, communications, and all associated civil and structural engineering elements.

(38) The overall objective is to have complete detection, surveillance and control on all strategic and urban arterial routes in Hong Kong, achieved through implementing a range of technologies, as well as harnessing data from existing and planned systems.

(39) The strategy for the provision of IM field infrastructure is split into two areas – SRN and non-SRN – reflecting the different nature of these areas. The former, mainly comprising expressways, has more uniform traffic flow and more space for field equipment installations, while the latter has more varying traffic flow because of signal junctions, stopped vehicles, loading and unloading activities, and more space constraints because of buildings and overhanging structures.

(40) For SRN sections, it is suggested to have in place a more comprehensive management regime, wherever possible, to provide quicker detection and greater control during incidents and events. This will require:

(a) deployment of additional detectors, which are preferably fixed type technologies for higher accuracy and quicker implementation, to facilitate automatic detection of incidents; and

(b) deployment of network management facilities, such as variable speed limit and lane control, to allow greater regulation of traffic flow, minimise the incident impact and mitigate against subsequent incidents occurring.

(41) The implementation should take account of any existing infrastructure in place, from which traffic data and traffic control ability will be obtained through C2C interfaces with the TIMS.

(42) For non-SRN sections, it is suggested to provide detection coverage in two steps.

(43) The first step will be to make use of existing systems and infrastructure which can provide real-time data to the TIMS. This includes the Journey Time Indication System which covers some key routes in Hong Kong Island and Kowloon, and the Area Traffic Control (ATC) and CCTV systems which potentially provide useful data.

(44) The second step will implement new monitoring and detection measures in the following two phases:

(a) The first phase concentrates on key traffic-sensitive routes and cross border routes, with the deployment of fixed infrastructure. It is envisaged that fixed type technologies, such as video, microwave or bluetooth identification, would be appropriate for these routes; and

(b) The second phase looks at utilising more advanced technology solutions, such as cell phone or global positioning system to provide comprehensive coverage on urban and arterial routes on a network-wide basis. These technologies are favoured over fixed type technologies because fixed infrastructure may not be practical in urban environment due to space constraint whereas these advanced technology solutions can be applied under urban environment and can cover a wider network. However, the use of probe vehicle type technologies should take account of the penetration rate of probes, environmental factors (e.g. urban canyon effect) and public concern on potential privacy impact, and a trial will be conducted to prove the viability.

(45) It is worthy of noting that a combination of various detection technologies, instead of a particular type, should be used to cater for different traffic flow characteristics and environmental conditions in different areas and take the advantage of complementary effect arising from the use of different technologies.

Information Services

(46) The third core component of the Integrated Solution is information services. It is imperative that accurate and prompt dissemination of real-time information is provided to users of all road and transport networks. The real-time information to be disseminated shall include traffic conditions, public transport arrangements and incident information etc.

(47) The implementation of other components will support the introduction of an extensive range of information services, building on the existing services provided by TD. With the increasing availability of real-time data across the network, information services with larger geographic coverage and more functions/features could be provided.

(48) The strategy for providing information services is that real-time data will be provided to users wherever they may be – on-road, at transport interchanges, at home, at work, etc – via a range of means which is convenient to them.

(49) These means are grouped into a range of categories, including:

(a) information dissemination: on-road

(i) fixed infrastructure, with electronic message signs (EMS) located along key routes. The provision of appropriate sized EMS at key locations in the non-SRN sections should also be considered; and

(ii) in-vehicle services, such as RDS-TMC, VICS and HAR. These would be provided by the private sector, with the support of TD on provision of real-time traffic information from the TIMS.

(b) information dissemination: public

(i) web-based services, such as enhancing TD's existing Road Traffic Information Service and introduction of new functionality;

(ii) mobile device services, where key information would be made available in formats accessible via mobile devices;

(iii) alert services, such as Really Simple Syndication (RSS) feeds and e-mail/Short Message Service (SMS), providing incident or traffic alerts as well as upcoming planned event information. These can act as additional means of disseminating Special Traffic News;

(iv) Interactive Voice Response (IVR) traveller information service, allowing users to obtain real-time traffic and transport information by phone;

(v) traveller information kiosks located at key locations, such as transport interchanges, airports, and shopping malls, providing access to the web-based services, which could be configured to provide information relevant to that location; and

(vi) electronic information display boards, providing basic incident information at key transport terminals, interchanges and stations. Existing display boards can be utilised through C2C interfaces between the TIMS and the systems controlling these boards.

(c) information dissemination: key stakeholders

(i) ePress Release System, which would replace the existing manual based approach, ensuring quicker and automated dissemination of real-time information;

(ii) web portals for TD senior management and key stakeholders, in which detailed data, particularly real-time data, and additional functionality relevant to the incident management process would be provided; and

(iii) management reports to TD senior management and other key stakeholders for decision making and review purpose, these being generated automatically and replacing the current manual production process.

Enhancements to the Control Centre

(50) The fourth key component of the Integrated Solution relates to enhancements to the Control Centre (i.e. ETCC) to accommodate the changes arising from the implementation of the measures recommended in the above for the Integrated Solution.

(51) Opportunities for enhancements to the Control Centre are identified in the following areas:

(a) operational and organisational changes; and

(b) physical changes to the ETCC.

(52) Operational and organisational changes may take place to cater for the new operating philosophy arising from the introduction of the TIMS, which will automate many of the existing incident handling processes at ETCC. Operating practices will be adapted gradually and carefully to reflect such automation.

(53) Changes to the ETCC environment are also required to accommodate the TIMS and further enhance operations. These will be implemented in two stages:

(a) Stage 1 – re-design of the current ETCC shall be undertaken in parallel with the initial implementation of the TIMS; and

(b) Stage 2 – construction of a new state-of-the-art Transport Management & Information Centre (TMIC) in conjunction with the future relocation of TD offices from Wan Chai.

(54) Co-location of traffic signal systems (e.g. ATC centres), open highway control systems (e.g. TCSS) and emergency traffic and transport management functions such as ETCC is expected to have benefits for incident management. International experience has shown that such an approach improves efficiencies during incidents through improved communication between different stakeholders, thus increasing the speed and quality of decisions. This further enables rapid, effective and flexible management across all transport modes and better response to incidents.

(55) With all of TD's major incident management facilities under one roof, it is envisaged that the TMIC will be the hub of traffic and transport incident management in Hong Kong.

Other Measures in the Integrated Solution

(56) In addition to the four core components of the Integrated Solution, there are also other elements which can be progressed in parallel, including:

(a) review on incident management process – this is necessary to facilitate the introduction of the TIMS and other measures, and ensure that appropriate focus is given within different stakeholder organisations to improving the incident management process;

(b) education measures – these increase awareness of incidents and their impact, and what travellers should do during or if involved in incidents. The aim of this is to reduce the impact of incidents and assist Government agencies in improving the efficiency with which they handle incidents;

(c) new technologies, trials, further investigation and research - a programme of tasks is recommended to validate technologies not yet deployed in Hong Kong, develop standards for key measures (e.g. standards for data exchange) and investigate into the new technologies under development around the world; and

(d) co-operation with government departments, public transport operators, Mainland traffic authorities and private sector – it is recommended to facilitate exchange of real-time traffic and incident information to improve the incident response coordination.

Implementation Strategy and Plan

(57) The recommended measures are grouped in packages, thus delivering geographic expansion or functional enhancement in a co-ordinated and pragmatic manner. The package approach also gives TD the flexibility to reschedule the implementation of particular measures to cope with any change in the completion dates of other items or for other reasons, such as budgetary or resource constraints.

(58) Furthermore, as technologies continue to develop, the package approach allows for such advances to be harnessed during the implementation stage. This also means that the technologies can be utilised as soon as they are in place, rather than waiting until the end of the implementation programme.

(59) The TIMS will be developed in two phases, with core functionality introduced in Phase 1, and more complex functionality launched at a future time in Phase 2. Between these phases there will be expansion of geographic coverage and minor functional enhancements in parallel with the implementation of IM field infrastructure which shall be taken forward to prepare for reaping the full benefit of TIMS.

(60) IM field infrastructure should be included in future major roadworks projects, including new and improvement works.

(61) New and enhanced information services should be delivered together with the TIMS which will be the central hub of real-time traffic and transport information as well as incident information.

(62) Overall, the Integrated Solution approach presents the lowest risk approach for progressing such a wide range of measures within the overall implementation framework with the degree of flexibility necessary to adapt to any changes in circumstances.

Procurement Approach

(63) Delivery of all measures is envisaged to be led by TD, with support from other Government departments and private consultants.

(64) Funding for the implementation will be sourced having regard to the implementation plan, in accordance with the Government's funding procedures.

(65) IM field infrastructure will also be included in the requirements for major roadworks projects, both of new infrastructure and improvement nature.

(66) A further possible option in taking forward certain recommendations on introducing more advanced or value-added services (e.g. dynamic car navigation) is partnership/co-operation with the private sector. Technical issues associated with this approach may be resolved through discussion and negotiation.

Cost-Benefit Analysis

(67) There will be many benefits arising from the implementation of the Integrated Solution. The benefits include operational enhancements as well as the time savings to the road users from reduced incident durations and more available real-time information.

(68) The implementation of the TIMS Phase 1 and the Integrated Solution will reduce the duration of incidents by 10 and 18 minutes respectively. The respective ten-year benefit-cost ratios will be 2.0 and 1.3.

The Way Forward

(69) It is recommended to implement the Integrated Solution in a coordinated manner, ensuring that the maximum benefits to the incident management process can be delivered.

(70) In order to realize the early benefits of the Integrated Solution, short-term measures (including minor improvements on ETCC's information dissemination and trials on detection technologies) and TIMS Phase 1 should be implemented as soon as possible with a view to completing in or before 2012 and 2015 respectively. It is also important to carry out the enhancements to the ETCC and deliver new information services to match with the development of the TIMS.

(71) If TIMS is the "brain", IM field infrastructure will be the "eyes and limbs" for incident management. IM field infrastructure should be implemented progressively with a priority on traffic and transport sensitive routes, particularly those with high traffic volume to capacity ratios and accident rates.

(72) Before the full implementation, it is suggested to conduct field trials to evaluate the effectiveness of various state-of-the-art vehicle detection technologies such as high definition radar, cell phone positioning and bluetooth identification in the Hong Kong environment.

(73) In addition, the development of dynamic traffic model as a decision tool for incident management and the possible launch of Digital Audio Broadcast in Hong Kong should be closely monitored with a view to introducing them in incident management.

(74) With the implementation of the Integrated Solution, the Government will not only attain millions of economic savings annually, but also become more capable of meeting the increasing public demand for effective and efficient incident management.