2. LITERATURE REVIEW

2.1 Introduction to Intelligent Transportation Systems

Intelligent transport systems (ITS) are advanced applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.

Intelligent transportation systems include the application of advanced information processing (computers), communication and electronics (sensing and control) technologies and management strategies – in an integrated manner – providing traveler information to increase the safety and efficiency performance of ground transportation systems for passengers and freight both in urban and rural areas. ITS also provide useful, real-time information to system operators[1].

ITS technologies are changing the way in which we build, design, manage and operate our transportation system. The application of these leading-edge technologies are proving to be an effective means for making existing transportation systems safer, more productive, more reliable and environmentally friendly without having to physically alter the current infrastructure. ITS have the potential to increase the capacity of existing infrastructure at a fraction of the cost of constructing new facilities. Further, ITS make it possible to implement a number of government regulations and processes more economically. ITS technologies cannot solve all the ground transportation problems, however, coupled with demand management techniques and some degree of infrastructure expansion, they provide a practical and effective alternative to the traditional way of doing business.

Through their ability to bring together the road user, the vehicle and the infrastructure in one integrated system, ITS enables these elements to exchange information for better management and use of available resources.

ITS applications contribute to improving safety, mobility and service levels, reducing energy and environmental impacts, and enhancing productivity. The potential benefits generated from their implementation are considerable, including time savings, vehicle operating cost reductions, more reliable transportation, safer highways, avoided
transportation infrastructure costs, reduced emissions and more pleasant driving experience.

2.2 Application of Intelligent Transport Systems

ITS was first evolved in Northern America and now it is divided into 7 “Service Bundles” comprising 30 distinct “user services” or ITS products[1].

i. Travel and Transportation Management:
The services provided under this heading collect and process real-time information about the ground transportation system and use this both for providing commands to traffic control devices, and for disseminating intelligence regarding infrastructure and other conditions within the system to the traveler. They may take their inputs from detectors or CCTV cameras which indicate such things as the presence of vehicles, their speeds, headways, and other parameters that permit a determination of how efficiently traffic is moving. Real-time data collection and surveillance are primary characteristics of the services provided in this bundle.

ii. Travel Demand Management:
This bundle of services is intended to support policies and strategies that are aimed at reducing vehicle demand by developing and encouraging modes of travel other than the single occupancy vehicle.

iii. Public Transportation Operations:
These services are intended to help improve both the service and efficiency of public transit companies. By providing improved information to public transit users both at the pre-trip planning stage and during the trip itself, they can help to improve the reliability and attractiveness of public transit as a travel mode.

iv. Electronic Payment:
Electronic payment will help to promote intermodal travel by providing a common electronic payment medium for a wide variety of transportation services including tolls, transit fares, and parking.
v. Commercial Vehicle Operations (CVO):
The purpose of the CVO bundle of services is to improve the safety and efficiency of commercial vehicle operations. They offer these benefits through two distinct mechanisms; improvements in fleet management tools and techniques for the carriers themselves; and improved and more efficient regulatory enforcement techniques for government agencies to the fleet management and dispatch functions which are critical to the effective management of resources.

vi. Emergency Management:
Emergency services such as police, fire and specialized rescue operations can use the services under this bundle to improve both response time and management of resources under their control. The primary characteristics of the applications in this bundle include knowledge of vehicle location, communications, and response.

vii. Advanced Vehicle Control and Safety Systems:
The common goal of these services is to improve vehicle safety. In the short-term, all of the services (except the automated highway application) depend on autonomous in-vehicle technologies to do their jobs.

2.3 Benefits of Intelligent Transport Systems
The potential benefits of ITS applications are considerable for all concerned including users and providers of services, the public sectors and the public at large. There are benefits, for instance, for users in congested urban areas as well as those in rural communities. The key benefits of ITS technologies are improved safety of the transportation system, reduced congestion and improved mobility, enhanced economic productivity, reduced travel time and government, traveler and operator costs, improved energy efficiency and reduced impacts on the environment.

2.4 Traffic Incident Management
This is also an ITS application, falling under the category of Travel and Transportation.

2.4.1 Definition of an Incident: Any non recurring event that causes a reduction of roadway capacity such as traffic crashes, disabled vehicles, spilled cargo or brush fire. Planned activities such as road construction etc are also considered as incidents.
Incident Management is a term describing the activities of an organization to identify, analyze and correct hazards to prevent a future re-occurrence.

The **Traffic Incident Management** may be defined as a systematic, planned and coordinated effort to detect, respond to and remove traffic incidents and restore traffic capacity as safely and quickly as possible. This involves the applications of institutional, mechanical and technical resources, including Intelligent Transport Systems and offers a number of measurable benefits.

### 2.4.2 What is Traffic Incident Management

Traffic incident management is the process of coordinating the resources of a number of different partner agencies and private sector companies to detect, respond to, and clear traffic incidents as quickly as possible to reduce the impacts of incidents on safety and congestion, while protecting the safety of on-scene responders and the traveling public.

From this it is clear that the traffic incident management does not mean merely the **provision** of information to the road users, but it includes various **connected events for its completion** such as:

1. Assist in incident detection
2. Protect/ secure the incident scene.
3. Evacuation of vehicles
4. Suppress fire.
5. Hazardous materials handling
6. Safety measures to avoid secondary crashes.
7. Directing / or diverting of traffic
8. Organizing emergency treatment, first aid to the affected people or sending them for the treatment depending on the situation.- connected with medical facility service providers
9. Law enforcement; conduct investigations
10. Clearance of the incident site.
11. Protecting properties of victims etc[2][3].

From this it is clear that the traffic incident management is a process, to be coordinated with several other relevant agencies. So the incident management should be in a well
organized manner in order to implement efficiently and successfully. The following agencies or institutions are mostly connected to this.

1. Police
2. Emergency Medical services
3. Towing and recovery agencies
4. Transportation agencies
5. Media
6. Insurance agencies
7. Fire or agencies dealing with hazardous materials

As there are more than one institutions involved, a centralized coordinating, controlling and monitoring system is necessary.

2.4.3 Benefits of the Traffic Incident Management[3]

The traffic incident management can greatly contribute to reduce congestion, delay due to congestion, secondary collisions, fuel consumption, loss of toll revenue and improve response and clearance times and thereby air quality and responder safety are improved. As a whole, country’s transportation system efficiency and the nation’s economic standards are increased.

The greatest benefits of an effective incident management program are achieved through the reduction of incident duration. Reducing the duration of an incident is fostered by:

1. Reducing the time to detect incidents
2. Initiating an expedient and appropriate response
3. Clearing the incident as quickly as possible

Substantial reductions in response and clearance of incidents can be achieved through the implementation of policies and procedures that are understood and agreed upon by each player in the incident management process.

Benefits resulting from an effective incident management program can be characterized as both quantitative and qualitative.

2.4.3.1 Quantitative Benefits

No consistent standard has been identified that can be uniformly applied to evaluate the quantifiable benefits of an effective incident management program.
But, quantifiable benefits generally associated with an effective incident management program include:

i. Increased survival rates of crash victims
ii. Reduced delay
iii. Improved response time
iv. Improved air quality
v. Reduced occurrence of secondary incidents
vi. Improved safety of responders, crash victims and other motorists

2.4.3.2 Qualitative Benefits
Just as with quantifiable benefits, no consistent standard has been identified that can be uniformly applied to evaluate the qualitative benefits of an effective incident management program. Qualitative benefits generally associated with an effective incident management program include:

i. Improved public perception of agency operations
ii. Reduced driver frustration
iii. Improved quality of life
iv. Improved coordination and cooperation of response agencies.

2.4.4 Five measurable objectives of incident management
1. Reducing the time for incident detection and verification
2. Reducing response time (the time for response personnel and equipment to arrive at the scene)
3. Exercising proper and safe on-scene management of personnel and equipment, while keeping as many lanes open to traffic as possible
4. Reducing clearance time (the time required for the incident to be removed from the roadway)
5. Providing timely, accurate information to the public that enables them to make informed choices.

2.4.5 Traffic Incident Management is a Team Effort

Incident response involves response from multiple responders from a variety of organizations each with a specific role and responsibility at an incident scene. For traffic
incident management to be effective it is important that all of these agencies work collaboratively.

2.4.6 Types of Incidents

In order to understand the impacts of incidents and to see the ways to minimize it, an understanding of types of incidents is necessary. Types of incidents could be categorized as follows, based on type, severity and duration[3].

1. Vehicle disablements
2. Accidents
3. Other incidents (Rallies, repairs etc.)

Each of this could be further categorized as On Shoulder or Blocking Lane.

2.5 Incident Management Activities[3]

Incident management entails an identifiable series of activities, which may be carried out by personnel from a variety of response agencies and organizations. These activities are not necessarily performed sequentially. For instance, motorist information is continually updated and typically disseminated throughout the duration of the incident while other incident management functions, such as clearance take place. In any case, the incident management process can be characterized as a set of activities that fall into the following seven categories.

1. **Detection**: Incident detection is the process by which an incident is brought to the attention of the agency or agencies responsible for maintaining traffic flow and safe operations on the facility. Methods commonly used to detect and verify incidents include: by calls from motorists, CCTV, Police patrols, Aerial surveillance, from Traffic Reporting Services etc are some modes providing information.

2. **Verification**: Incident verification entails confirming that an incident has occurred, determining its exact location, and obtaining as many relevant details about the incident as possible. Verification includes gathering enough information to dispatch the proper initial response. Incident verification is usually completed with the arrival of the first responders on the scene. Methods of incident verification include the following: Arrival of first responder to the scene, CCTV images, combining information from multiple cellular calls.
3. **Motorist Information**: Motorist information involves activating various means of disseminating incident-related information to affected motorists. Media used to disseminate motorist information include the following:

1. Commercial radio broadcasts
2. Highway advisory radio (HAR)
3. Variable message signs (VMS)
4. Telephone information systems
5. In-vehicle or personal data assistant information or route guidance systems
6. Commercial and public television traffic reports
7. Internet/on-line services

Motorist information needs to be disseminated as soon as possible, and beyond the time it takes to clear an incident. In fact, it should be disseminated until traffic flow is returned to normal conditions.

4. **Response**: Incident response includes dispatching the appropriate personnel and equipment, and activating the appropriate communication links and motorist information media as soon as there is reasonable certainty that an incident is present. Response requires preparedness by each responding agency or service provider. This is fostered through training and planning, both as individual, and collectively with other response agencies. Effective response mainly involves preparedness by a number of agencies.

5. **Site Management**: It is the process of effectively coordinating and managing on-scene resources. Ensuring the safety of response personnel, incident victims, and other motorists is the foremost objective of incident site management. Site management encompasses the following activities: Process of effectively coordinating and managing on-scene resources. This can be achieved by

1. Accurately assessing incidents
2. Properly establishing priorities
3. Notifying and coordinating with appropriate agencies and organizations.

6. **Traffic Management**: Traffic management involves the application of traffic control measures in areas affected by an incident. Traffic management in the context of an incident may include:

1. Establishing point traffic control on-scene.
2. Managing the roadway space (opening and closing lanes, blocking only
the portion of the incident scene that is needed for safety, staging and parking emergency vehicles and equipment to minimize impact on traffic flow)

3. Deploying appropriate personnel to assist in traffic management (e.g., state police, local police, and service patrols).

4. Actively managing traffic control devices (including ramp meters, lane control signs, and traffic signals) in affected areas, and

5. Designating, developing, and operating alternate routes.

7. **Clearance:** Incident clearance is the process of removing wreckage, debris, or any other element that disrupts the normal flow of traffic, or forces lane closures, and restoring the roadway capacity to its pre-incident condition. At times, this may also include temporary or permanent repair to the infrastructure.

### 2.6 Roles and Responsibilities

The incident management activities described above require the skills and expertise of a diverse disciplines and agencies. To develop an effective incident management program, it is important to understand the roles that various agencies play in incident management. When this system is introduced first, there will be conflicts, if these the roles of agencies are not defined clearly[3].

#### 2.6.1 Law Enforcement

Typical incident management roles and responsibilities assumed by law enforcement include:

i. Assist in incident detection

ii. Secure the incident scene

iii. Assist disabled motorists

iv. Provide emergency medical aid until help arrives

v. Direct traffic

vi. Conduct accident investigations

vii. Serve as incident commander

viii. Safeguard personal property

ix. Supervise scene clearance
2.6.2. Fire and Rescue

Incident management roles and responsibilities typically assumed by fire departments include:

i. Protect the incident scene
ii. Provide traffic control until police or relevant authority’s arrival
iii. Provide emergency medical care
iv. Fire suppression
v. Crash victim rescue from wrecked vehicles
vi. Rescue crash victims from contaminated environments
vii. Arrange transportation for the injured
viii. Serve as incident commander
ix. Assist in incident clearance

2.6.3. Emergency Medical Services (EMS)

The primary responsibilities of EMS are the triage, treatment and transport of crash victims. In many areas, private companies provide these services to local jurisdictions under contract. Typical incident management roles and responsibilities assumed by EMS include:

i. Provide advanced emergency medical care
ii. Determine of destination and transportation requirements for the injured
iii. Coordinate evacuation with fire, police and ambulance or airlift
iv. Serve as incident commander for medical emergencies
v. Determine approximate cause of injuries for the trauma center
vi. Remove medical waste from incident scene

Emergency Medical Services (EMS) have evolved as primary caregivers to individuals needing medical care in emergencies. As with police, EMS has a defined set of priorities. They focus on providing patient care, crash victim rescue, and ensuring the safety of their personnel. A primary concern of EMS operators is liability. Even if a vehicle has little or no damage, when an occupant complains of possible injury, EMS policy may dictate that emergency medical responders stabilize or immobilize the patient and carefully remove the crash victim from the vehicle. Consequently, this can take a significant amount of time. Clarifying the exact circumstances under which this policy is in force may lead to
reduction in clearance times, which will lead to increased impacts on traffic. As such, these more comprehensive measures are only used when absolutely necessary.

2.6.4. Transportation Agencies

Transportation agencies are typically responsible for the overall planning and implementation of incident management programs. Typically, these agencies are also involved in the development, implementation, and operation of the traffic operations center (TOC), as well as the management of service patrols. Typical operational responsibilities assumed by transportation agencies and their service patrols include:

i. Assist in incident detection and verification
ii. Initiate traffic management strategies on incident impacted facilities
iii. Protect the incident scene
iv. Initiate emergency medical assistance until help arrives
v. Provide traffic control
vi. Assist motorists with disabled vehicles
vii. Provide motorist information
viii. Determine incident clearance and roadway repair needs
ix. Establish and operate alternate routes
x. Coordinate clearance and repair resources
xi. Serve as incident commander for clearance and repair functions
xii. Repair transportation infrastructure

2.6.5 Towing and Recovery Service Providers

Towing and recovery service providers are responsible for the safe and efficient removal of wrecked or disabled vehicles, and debris from the incident scene. Their typical responsibilities include:

i. Remove vehicles from incident scene
ii. Protect victims’ property and vehicles
iii. Remove debris from the roadway
iv. Provide transportation for uninjured vehicle occupants
v. Serve as incident commander for recovery operations

Towing and recovery companies that respond to highway incidents are indispensable components of all incident management programs. Even programs that include service
patrols with relocation capability depend on towing and recovery service providers. Challenges facing this industry are unique because they are not public agencies. As such, they must remain profitable to retain a skilled work force and to stay in business.

2.6.6 Media
The typical roles and responsibilities of the media as they relate to incident management activities include:

i. Report traffic incidents
ii. Broadcast information on delays
iii. Provide alternate route information
iv. Update incident status frequently
v. Provide video or photography services

2.6.7 Information Service Providers (ISPs)
Information service providers are usually commercial entities that provide traffic information updates to both motorists and the media. These service providers operate in many metropolitan areas nationally. Information is typically disseminated by ISPs via:

i. Broadcast radio
   ii. Broadcast television
   iii. Telephone systems
   iv. Cable television traffic alerts
   v. E-mail services
   vi. Pager services, or
   vii. Internet web-sites

2.6.8 Coroners and Medical Examiners
By law coroners or medical examiners are responsible for investigating deaths that result from anything other than natural causes. As such, they play an important role in investigating fatal accidents that occur on roadways.

2.6.9 Hazardous Materials
Hazardous materials contractors are hired by emergency or transportation authorities to clean up and dispose of toxic or hazardous materials.
2.7 Organizing, Planning and Designing an Incident Management Program

2.7.1 Steps in Developing an Incident Management Program[3]

Even in areas without formal incident management programs, agencies perform some type of incident response. That is, someone responds to incidents that occur. Thus, the goal of an incident management system is not to create a response, but rather to create a more effective response for all responding agencies.

2.7.2 Stakeholder Identification

A critical step in developing a successful incident management program is to identify the relevant stakeholders and to build from this group’s critical coalitions and institutional frameworks that will support, protect, and fund the program. This groundwork should be laid at the beginning of the planning. Identification of stakeholders should be inclusive of:

a. Each agency that are responsible for incident management functions (e.g., Dept of Transportation, Fire, State and local police, Department of Natural Resources);

b. Other departments or individuals within the typical response agencies (e.g., within Department of Transportation, it is usually important to involve both maintenance and traffic operations, at a minimum);

c. Other stakeholders who are affected by, or contribute to, traffic operations (e.g., media, towing and recovery, major employers, user groups, interested elected officials and other policy makers).

2.7.3 The Kick-Off Meeting

Identifying as many agencies, officials, and representatives as possible and arranging for them to attend a kick-off meeting to introduce the concept and benefits of incident management is a vital first step in incident management program development. The list of attendees to a kick-off meeting may include, but are not limited to, representatives from the following organizations, in the context of Colombo Municipal area:

i. Traffic section of the Police Department

ii. Colombo Municipal Council

iii. Urban Development Authority as Metropolitan Planning Organization

iv. Road Development Authority

v. Ministry of Health Services
vi. Ministry of Justice  


viii. Media Agencies  

In addition to securing broad stakeholder participation from the relevant agencies and jurisdictions, it is also important to ensure that an adequate amount and the appropriate type of public outreach are pursued. Public outreach serves two primary functions:  

(1) To make the general public aware of the value of incident management, leading to generalized public support; and  

(2) To help the public better understand how their actions, such as moving drivable vehicles out of traffic, and providing good information in reporting incidents, can support effective incident management.  

2.7.4 The Basic 8 Step Incident Management Program Development Process[3]  

Once the Incident Management Task Force has been established, the group can address program development in earnest. The following steps are to be considered.  

(1) Define the problem: A clear understanding of the severity, impacts and locations of incident is required.  

(2) Set goals and objectives: The following are common incident management program goals and objectives.  

<table>
<thead>
<tr>
<th>GOALS</th>
<th>OBJECTIVES</th>
</tr>
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<tbody>
<tr>
<td>• Reduce secondary incidents</td>
<td>• Decrease detection times</td>
</tr>
<tr>
<td>• Increase safety for responders</td>
<td>• Improve response times</td>
</tr>
<tr>
<td>• Increase and improve use of alternate routes</td>
<td>• Increase motorist information</td>
</tr>
<tr>
<td>• Reduce liability for response Agencies</td>
<td>• Improve clearance procedures</td>
</tr>
<tr>
<td></td>
<td>• Decrease number of lanes closed</td>
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<tr>
<td></td>
<td>• Decrease road and lane closure times</td>
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</table>
(3) **Select alternatives:** A wide range of incident management techniques are currently in use. The Incident Management Task Force’s choice of strategies and techniques will depend on the nature, causes, and scale of the problems identified.

(4) **Evaluate Alternatives:** The structure and formality of the evaluation process used to assess the costs and benefits of the alternatives will depend on the complexity and coordination needs of each agency or Incident Management Task Force. In any case, the evaluation process and criteria should be rooted in the goals and the objectives established in an earlier step in the program development process.

(5) **Funding:** A critical step in developing the alternatives is to assess their likely costs, as well as funding sources. Added costs due to the incident management program may include infrastructure improvements (e.g., ITS infrastructure, such as CCTV, dynamic message signs, and computer-aided dispatch); additional labour hours and staff development; and additional materials and equipment, including specially outfitted incident response.

(6) **Implement alternatives:** Among the most sensitive alternatives that may be implemented are alternate routes. Ideally, alternate route planning is a systematic process that involves determining where and how much traffic should be diverted whenever an incident occurs, on any section of transportation network, at any time of the day. In most areas, alternative route contingency plans are developed for various severity levels, for various times of day, for points throughout the system.

(7) **Re-evaluate alternatives:** Incident management program development is an ongoing process, one that must take into account changes in the local operational, technological, political, and funding environment. Effective program evaluation and the subsequent revaluation of alternatives to refocus or refine an existing system require the routine collection of appropriate data. Regular data collection, which occurs in the course of regular program operations, allows program managers to assess the effectiveness of their efforts, to identify areas for improvement, to demonstrate the benefits provided by the program, and to support requests for additional resources.
Among the types of data that have proven useful in evaluating incident management programs include:

i. Time required to detect incidents
ii. Time required to reach the incident site
iii. Time required to clear the incident
iv. Delay caused by the incidents
v. Incident management program costs
vi. Costs recovered from “at-fault” drivers to clear the scene

Holding “debriefings” following major incidents, which are attended by all responders, and in which both positive and negative aspects of the response are reviewed, is another key element of successful incident management programs.

(8) Refine the System

To continuously improve incident management program, effective feedback at two levels must be established and maintained. Each level is equally important, although in quite different ways. First, it is critical that clear lines of communication are maintained with upper management at participating agencies and jurisdictions. Second, it is important that field-level personnel and their supervisors provide ongoing feedback regarding the effectiveness of specific techniques, tools, and approaches. If communications and coordination are fostered continuously and genuinely at each of these levels, the system would be successful.

2.7.5 Elements of Successful Incident Management Programs

2.7.5.1 People

They are well trained and deliver actual incident management services in the field and in conjunction with their colleagues in traffic operations centers.

2.7.5.2 Infrastructure and Operational Strategies

Intelligent Transportation Systems (ITS) – The application of advanced sensor, computer, electronics and communication technologies – provide a complementary means to maximize the efficiency and safety of transportation infrastructure.

a. Detection and Verification: The following are used for this:
   Inductive Loop Detectors
   Magnetometer Detection
Microwave Radar Detection
Infrared Detection
Ultrasonic Detection
Video-Image Processing
Closed Circuit Television (CCTV)
Vehicle Probes
Automatic Vehicle Identification
Automatic Vehicle Location
Signpost based positioning systems
Ground-based radio navigation.
Global Positioning Systems

b. Motorist Information

Motorist information includes the dissemination of incident-related information to motorists who are

1. at the scene of the incident,
2. approaching the scene of the incident, and
3. not yet departed from work, home, or another location.

Motorist information should be provided as early in the incident management process as possible and should continue until the incident has been cleared and the traffic backup has dissipated. Motorist information supports incident response and clearance in the following ways by:

i. Reducing traffic demand at and approaching the scene
ii. Reducing secondary incidents
iii. Improving responder safety on scene
iv. Reducing erratic behaviour due to motorist frustration

Specific ITS technologies that can be used to disseminate motorist information can be divided into two primary categories, en-route and pre-trip. Motorist receives en-route information while they are traveling. Pre-trip traveler information is received in non-travel settings, such as home, office, or shopping areas and is provided to assist travelers in making travel decisions.
Roadside devices that are commonly deployed to disseminate information to motorists are described below.


![Variable Message Signs](image_url)

Figure 2-1: A variable sign board

b. Highway Advisory Radio (HAR)- HAR information is communicated to drivers via AM radio receivers in their vehicles.

c. Automated Highway Advisory Radio (AHAR)- AHAR systems emit a special electronic signal upstream of a HAR message. This system allows the HAR message to interrupt regular transmission of a specially designed radio/compact disc player within the vehicle.

d. Wireless Phone “Hotlines”

e. Commercial Radio; Kiosks: Television; Pagers.

f. Internet- Gives real time updates.

c. Traffic Control

Traffic Signal Timing Adjustments may be applied to incident response and clearance are done in a way to resolve the traffic problems.

d. Response: Technologies that support enhanced emergency management are Computer-Aided Dispatch (CAD). They,

1. Assist dispatchers in tracking the status of field units and in assigning units to respond to an incident based on the urgency of the call, the field unit’s proximity, and available equipment.
2. Provide police and fire personnel with access to multiple databases containing information on issues such as the haz-mat locations, national crime databases, and data from department of licensing and motor vehicles.

e. Traffic Operation Centre (TOC) [3]

Traffic Operations Centers (TOCs) serve as the hub or nerve center of Intelligent Transportation Systems and traffic control systems, at which information about the transportation system is collected, processed, and collated. The traffic information collected for, analyzed by, and disseminated from Traffic Operation Centers is key to effective incident management. Quick identification and verification of incidents makes it possible to respond rapidly with the proper equipment and personnel. It also allows motorists to receive information early enough to change their routing, which can reduce delay and the risk of secondary collisions. Traffic Operation Centers can further manage traffic by altering signal timing; activating dynamic message signs and Highway Advisory Radio (HAR); dispatching Department Of Transportation support, such as service patrols and maintenance vehicles; and notifying affected jurisdictions.

The following are common goals and objectives of Traffic Operation Centers:

1. To foster wide dissemination of real-time traffic information
2. To improve traveler safety and travel times
3. To enhance coordination between response and transportation agencies
4. To maximize the capacity of the highway transportation system
5. To reduce congestion through advanced communications and control technologies
6. To collect and store data essential for the evaluation of incident management and traffic management programs and strategies.

The traffic operations center serves as the focal point for communications and coordination among multiple agencies for incident management. They support detection and verification, response, site management, traffic management, clearance and motorist information. The Traffic Operation Centers, by virtue of this comprehensive role can be the primary data collection point for traffic incident data to improve operations and support funding requests.

Although an integral part of incident management, detection is not a primary function of the Traffic Operation Centre.
Verification involves confirming that an incident has occurred, identifying its exact location and the direction of travel, and other details necessary to determine the appropriate response. Many Traffic Operation Centers are able to verify incidents with video monitoring systems. This is important because even minor incidents can have a serious effect on traffic flows when roadways are at or near capacity. Quick verification and response can mitigate incident impacts significantly.

Incident response is not generally a primary Traffic Operations Centre function unless that Traffic Operation Center is part of a jointly operated center collocated with police and/or service patrol dispatch. Jointly operated centers do have the advantage of being able to coordinate response faster and more effectively because of the continuous working relationships and information sharing that characterizes their operations. They can also coordinate to prevent the dispatch of unnecessary personnel or equipment. Traffic Operation Centers that are linked to the police and/or fire Computer-Aided Dispatch (CAD) systems have proven very effective.

The role of the Traffic Operations Center in site management is usually one of safety and support. Keeping motorists informed, using traffic management programs to reduce traffic queues, and apprising responders of the best access routes to the incident, achieve this. Many Traffic Operation Centers routinely track the locations of maintenance equipment, such as dump trucks and sweepers. This too facilitates timely and appropriate site management. Managing the traffic queue also entails watching for secondary collisions. Monitoring for blocking disabled vehicles and sending assistance to them can also support site management and reduce overall incident duration. If closures or alternate routes are required, Traffic Operation Centers can play a role in identifying the optimal route, informing affected responders (and the media) and altering traffic signal and ramp meter controls in order to keep the alternate route plan functioning smoothly. Clearance entails more than getting disabled vehicles and debris off the roadway. It also means using Traffic Operation Centers capabilities to clear the queue as quickly as possible once the roadway is clear. It can also mean assisting with actual cleanup and clearance. Operators in a Traffic Operation Centers can evaluate an incident and send the appropriate equipment for clearance prior to its request.
The center can also control Variable Message Signs throughout the state when district offices are closed. They can also disseminate information through the Internet, kiosks, special telephone lines, and pagers. Although any single method may only reach a small number of motorists, cumulative effects can be substantial.

The Traffic Operations Centers can also be used to document the use of Department of Transportation equipment and personnel, which is essential in seeking response cost reimbursement from at-fault motorists or their insurance companies in major incidents. Recovery of damages can help fund the incident management programs.

**Traffic Operations Centre (TOC) Management Issues**
Department of Transportation agencies attempting to get Computer Aided Dispatch (CAD) data from the police for incident management purposes often face obstacles. Police agencies have a high level of security and maintain confidentiality of records for all investigations, wanted checks, and criminal records. As such, law enforcement agencies may be reluctant to release even minimal information to other agencies for fear that it will compromise their system’s integrity.

Voice communications are another concern. The ability of different agencies to communicate by radio is typically very limited. Some agencies will not allow anyone from another agency to access their radio frequency; still others will not take on additional responsibilities, such as dispatching service patrols, because they lack sufficient staffing and because such tasks would interfere with their primary mission.

Another institutional issue relates to responders from various agencies who do not perceive the potential value of a Traffic Operation Centers. Such agency staff may be accustomed to solving problems in their own way, without involving the Department of Transportation (DOT), except in rare cases (e.g., those that require DOT equipment, substantial traffic control, or infrastructure repair).

**f. Service Patrols** - Service patrols have been cited as a very effective element of incident management programs. They can be extremely effective in reducing incident detection time, as well as the overall duration of the incident. It should have sufficient members.
2.9 Identifying suitability of agencies proposed to be involved with Traffic Incident Management within the Municipal limits.

In order to carry out the functions under the framework, it was required to identify the stakeholders. For this purpose, the institutions currently involved with the similar functions were identified and their suitability and capability were analyzed.

2.9.1 Traffic Division of the Police Department[4].

Main Functions
1. Enforce Traffic Laws, prevent violations of traffic regulations and prosecution of offenders
2. Investigate into accidents.
3. Control traffic on highways.
4. Provide pilot duties for VIPP.
5. Assist the public in various social events and functions where motor traffic is involved.

Functions of the Traffic Headquarters
A Superintendent attached to Traffic Police headquarters and is supervised by Deputy Inspector General (Traffic Administration and Road safety).

a). Functions will include the following:-

i. To keep the Island’s accident statistics; to coordinate with RDA and other stake holders (Department of Registration of Motor vehicles, Ministry of Highways, Ministry of Transport, National Road Safety Secretariat) in order to identify Black Spot areas and to attend to Road infrastructure defects and to make preventive action.
   ii. To direct accident preventive action;
   iii. To organize Road Safety work on an Island-wide scale;
   iv. To act as Adviser and Consultant in all traffic matters;
   v. To train Police Officers engaged on traffic work and accident investigation;
vi. To supervise the Police Traffic schools and the Training School;

vii. To advise in the organization of traffic schemes on special occasions and state functions.

viii. To investigate any special traffic problems with a view to suggesting remedial action;

ix. To advise (in consultation with AG’s Department) in all legal difficulties connected with traffic work; and to handle suggestions to improve the Traffic and also to expedite in obtaining instructions in filing indictment and plaint in all fatal accidents and serious accidents.

x. To examine the working of Divisional/District Traffic/Traffic Branches, with a view to bringing about co-ordination and uniformity in the methods of handling traffic problems throughout the Island.

xi. To organize and conduct lectures Island wide for schools Public & Private organizations with a trained team of lectures.

xii. To provide motorcades / escorts / pilots and also to supervise and co-ordinate the motorcade functions for ceremonial escort.

xiii. To co-ordinate with Ministries of Highways, Transport, Commissioner General of Motor Traffic, National Road Safety Secretariat and other stakeholders with regard to Traffic Administration & Road Safety.

xiv. To conduct Senior & Junior Traffic Management Courses, Refresher Courses for Officers in Traffic Branches.

xv. To supervise driving schools at Police college and at traffic head quarters.

xvi. To conduct Traffic Impact Assessments on new developments on the requests made by UDA and other local authorities.

xvii. To supervise Expressway projects and to train, educate officers and members of the public and all road users and to administer and supervise highway patrol and control centers.

xviii. To have close liaison with Commissioner General of Motor Traffic and also supervision of the Registration of Motor Vehicles (RMV) Police post and administration in providing information with regards to registered owners of vehicle, Driving license, stolen vehicles Suspension and cancellation of license, entering of demerit points etc.

xix. Probe into public complaints regarding accidents and injustice caused to public on orders of IG Police Senior DIG Traffic.
2.9.2 CCTV Division of the Police[4].
These CCTV cameras were installed purely for the security purpose at the beginning, with the current situation, these can be used for various other purposes including traffic and transportation efficiently.

Vision of CCTV Division
Hi-Tech approach with surveillance cameras (24X7) to enhance capacity of Police service.

Mission
Co-ordination with all security authorities to update them with on-line findings at it zero time for quick response.

Figure No: 2-2 Control Room at Olcott Mawatha
(Source:http\www. police.lk)

Figure No:2-3 Fixed CCTV Cameras
(Source:http\www.police.lk)
At present 105 numbers of closed circuit TV cameras (CCTV) installed at main intersections in the Colombo city. A Control Room with 28 LCD screens has been constructed at Police CCTV Division, Olcott Mawatha, Colombo-11, with a number of trained officers.

Moreover, the unit is capable of storing images for several days. These surveillance cameras are used for the City traffic management that has a daily average of over 200,000 vehicles into the City of Colombo.

This division has been connected with Police Central Communication Network. This makes more convenient for the purpose of using it for incident management.

b). The role and responsibilities of the CCTV Division
3. Aiding in Public Security Safety—to propagate the Colombo city as the safest and secure place.
4. Aiding in Crime Detection, prevention & Inquiries
5. To provide integrated support to help ensure an effective and immediate Police response in any emergency situations.
6. Prevent and reduce crime.
7. Reduce public fear of crime.
8. Promote public awareness on how to enhance their personal safety.
10. To provide strong policing measures against theft and vandalism of public and government assets & possessions.
11. Disaster Management to participate in community safety and security among the police and other agencies.
12. Providing Training pertaining to CCTV technological system.
13. Providing consultation services on CCTV systems and Technologies.
14. The moving images could help to identify the cause of accident and make any modification to the road and junction, in order to prevent or minimize it.
c). Information Technology Division of the Police Department.

Vision - To enhance the capacity of Policing through Information Technology.

Mission - To automate the Police functions through electronic data processing to meet the growing demand of Police requirement.

Objectives

The main objective of the Police Information Technology Division is to provide Information Technology facilities to the Police Departmental functions as a support service. This setup is headed by a Deputy Inspector General of Police and a total cadre is around 70 men working round the clock. Their functions:

i. Planning the computerization of the important administrative and operational functions,

ii. Inspections of the computer systems available in the various divisions/units,

iii. Sending instructions and circulars

iv. Training on the operation and application of Information Technology

v. Carrying out feasibility studies in view of computerization of functional divisions as well as territorial divisions of Police

vi. Maintenance of a Wide area Network and Local area Network to communicate from Divisions with Police Headquarters and vice versa.


Incident Alert System via Bulk SMS Facility for Police Department :-

The solution interface provided by Sri Lanka Telecom can cater to the various groups such as Inspector General of Police, Deputy Inspector General of Police and cater to 100 users at a time. When there are an important incidents or administrative matter, those will be communicated to the above officers within seconds to their mobile telephones. This facility is very much useful to send messages instantly to many places.
Police Stations Available within the Municipal Area

1. Kollupitiya  2. Bambalapitiya  
3. Wellawatte    4. Kirulapone  
7. Dematagoda   8. Grandpass  
11. Foreshore   12. Fort  
15. Maradana    16. Mattakkuliya  
17. Armour Street  18. Kompanna Veediya  

There are sufficient numbers of Police Stations at close proximity and each station has a traffic division.

From the above study it is clear that the traffic police is currently involved with several functions related to traffic incident framework and having capability and strength to undertake the framework. In addition to that the proposed Traffic Operations Center and CCTV camera systems are also owned and operated by them. As such, they should be designated as stakeholders and their contribution is necessary.

2.9.3 The Road Development Authority (RDA) – Maintenance & Management

Division of the RDA is responsible for the maintenance of roads and coordination with other authorities. Under this division, there are divisional, district and provincial offices. In addition, labour depots also available with necessary labour, machinery and materials to carryout maintenance and repairs of roads. But within the Colombo Municipal limits, the Municipal Council is responsible for the maintenance of majority of the roads.

Even though the roads belonging to RDA within the Municipal limits are maintained by Municipal Council, RDA is involved with the planning, construction and maintenance of some roads and outside the limits fully involved with above functions, it is designated as stakeholder and its contribution identified.
2.9.4 Colombo Municipal Council (CMC)

The Colombo Municipal Council area has been divided into 6 administrative divisions. Under each division there is an Engineering Section with a works division. Under the supervision of a District Engineer, required facilities have been provided for each division[5].

Responsibilities of District Engineer

i. Construction & Periodic Maintenance of Road network within the District area.

ii. Issuing road cutting permits.


v. Implementation of Special Programs and the Programs of Central Government entrusted.

vi. Administration of district office.

vii. Removing and preventing unauthorized construction within the District.

2.9.4.1 Traffic Section of the Colombo Municipal Council

The Traffic and Road Safety Division of the CMC is responsible for efficient management of road network and road furniture, facilitating the road safety and minimizing traffic floor in the city. Involves with

1. Road and intersection Design
2. Traffic studies, counting and traffic signal design, Installation and maintenance
3. Lane Marking
4. Identifying safe locations for Pedestrian Crossings and marking.
5. Road furniture design, installation & maintenance
6. Road safety education
7. Street light design, installation and maintenance of a Part of the city
8. Designing of Road side parking, tendering and management
9. Private sector participation projects for traffic infrastructure implementation.
10. Preparation of project proposals for infrastructure development within the city for funding agencies.

In addition to this, a Structural Design Division and an Architectural Section are also available.

From this it is clear that the Municipal Council consists a well established organization and having the capability to undertake any responsibilities related to incident management.

Since the Municipal Council is responsible for the city planning, city roads planning and improvement, repairs and maintenance of roads, traffic signal designs and installing, its current functions included many of the framework requirements. As such its contributions is required to the framework and is identified as a stakeholder.

2.9.4.2 Fire Service Department of the Colombo Municipal Council

Fire service departments are available with the Colombo Municipal Council at Darley Road, Grandpass, Roxy Garden and Hettihawatte. Occurrence of fire is rare but the fire brigade has to be maintained ready throughout.

Since maintaining a separate fire and rescue team will be costly, services of this department could be obtained whenever necessary by designating it as a stakeholder.

2.9.5 Emergency Medical Providers

At present, after an accident, medical services are provided at the government hospitals and are maintained at satisfactory level. But there are no separate arrangements available for treating the accident victims, who need urgent treatment.

Once the message is sent to ambulance by a responsible authority (at present it is the Police), services are provided at the hospitals, subject to availability. First aid is not provided generally. Some improvements to the existing arrangements required in order to provide quick arrival to the scene and first aid for the victims. The following government hospitals are available in and around the Colombo Municipal area.

1. The National Hospital
2. Kalubowila Hospital
3. Eye Hospital
4. Lady Ridgeway Hospital
5. Castle Hospital.

Since provision of emergency medical treatments has been identified as a requirement of the traffic incident framework, services of all these government hospitals required and their contribution towards the framework required. On behalf all these hospitals, the Department of Health Services should be taken as a stakeholder.