A New Tool for Planning and Managing Road Disruptions – The City of Toronto "ROADMAP" System

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ABSTRACT

Managing road disruptions is becoming an increasingly complex task in many urban areas. Road closures are planned and implemented for road improvements, road repairs, and special events such as sporting vents and parades. These activities are often managed independently by different organizations, or levels of government.

Coordinating these various types of road closures is a significant challenge. A lack of coordination can often significantly disrupt road users, create unnecessary traffic congestion, and also embarrass the agencies involved.

The City of Toronto partnered with Transport Canada to create a system to address these problems. The City of Toronto has now successfully implemented a user-friendly, coordinated system to plan and manage congestion created by road disruptions. The key to the system is "ROADMAP", a web-based software application consisting of a GIS-based Graphical User Interface, and a sophisticated database. ROADMAP is a planning and tracking tool that allows users to identify potential road closure conflicts, and opportunities to link activities early in the planning process, and also manage track the disruptions on a daily basis. The system provides an inventory of a wide variety of road disruption activities in various stages of development; Planned, Approved, Active and Complete. The system is also used to disseminate road closure reports to emergency services, local media outlets and other agencies.

This paper will describe how the ROADMAP system was designed to meet the needs of the City of Toronto traffic engineers, how successful it has been during the construction season, and "lessons-learned" for future improvements.

1. INTRODUCTION

Arterial and expressway road systems serve a vital role in the economic prosperity of municipalities, and therefore the tracking of any roadway disruptions is critical. Roadways serve to move private vehicles, transit vehicles, commercial vehicles, emergency vehicles, cyclists and pedestrians. The road rights-of-way are also the location of utilities used to service homes and businesses. The utilities include hydro, water, wastewater, gas and telecommunications.

Many municipalities have implemented computerized maintenance management systems. These systems are large-scale databases used to manage maintenance activities on municipal infrastructure. The two primary roles are to receive and manage service requests, and to plan and schedule routine maintenance activities. In some municipalities the scope of the tracking systems extends to tracking activities performed by other public and private agencies within the road right-of-way. However, these systems don't track and manage the impact of the disruptions. The City of Toronto recognized this as a major gap in their traffic management systems.

The City of Toronto is responsible for managing thousands of road disruption events on an annual basis. These events include major road reconstruction and other capital work, utility work, maintenance and emergencies. The road rights-of-way are also in demand for special events. These events include: parades, races (e.g. motorized, cycling and running) and street parties (e.g. Taste of the Danforth, Jazz Festival). The road network must also deal with surges of traffic generated by major sporting and entertainment events (e.g. hockey games, concerts).

Transportation Services is expected to know exactly when and where these events are occurring so that they can be managed effectively. The Department had previously attempted to implement a road disruption management system, but encountered some significant hurdles:

1. *The business process.* There is a question of when a road restriction decision / approval is made centrally within the department versus when it is made at the District level. In considering this, it is important to balance important versus minor decisions.

2. *The process for scheduling internal activities* (projects planned and performed by City of Toronto Works & Emergency Services Department) versus external activities. The internal activities don't require the Project Manager to complete a permit process. Therefore, a tangible approval process does not exist, and this needs to be addressed.

3. *The location definition structure.* It is difficult to cope with parades and other activities that may include a long stretch of roadway and/or multiple roadways.

To deal with these issues, the City of Toronto teamed with Transport Canada and IBI Group to develop a computer application that would address the City of Toronto needs, but also could be beneficial to other transportation agencies. The application was given the name "ROADMAP".

ROADMAP was envisioned to be a computer application that facilitates:

- efficient planning and scheduling of activities that disrupt the normal operation of roads, sidewalks, and/or pathways;

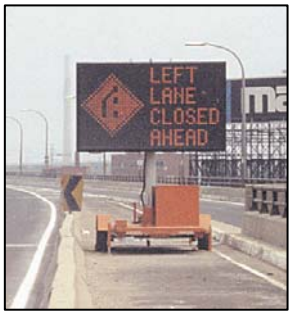
- monitoring and updating the disruption status of these activities;

- access to information about the location, schedule, and severity of the disruptions caused by these activities.

Conversely, ROADMAP was not intended to provide project management or work order management functions. In fact, the primary objectives of the ROADMAP initiative were as follows:

Minimize Delay

The most important goal of the ROADMAP is to minimize the delay and motorist frustration that results from partial and full closures of roads, lanes and sidewalks. Delay benefits generally form a large proportion of the overall benefits realized by ITS initiatives. Delay benefits realized by motorists include non-recurring delay reductions due to the reduced effect of these closures, and a potential reduction in delay due to a reduced number of congestion-related collisions.



Long-term road closure activity (usually related to construction activity) results in recurring delay. Short-term road closure activity (commonly related to utility work, special events, etc.) results in non-recurring delay. So long as these events are scheduled, reductions in recurring and non-recurring delay may be realized through motorist advisory and traffic control initiatives. By advising travelers in advance of problematic routes, we can facilitate informed trip planning, and encourage modified departure time and modal decisions, thereby minimizing delay caused by the lane closures. Furthermore, enhancements to the signal control strategies would allow vehicle throughput to be optimized in light of the temporarily adjusted flow characteristics of the roadway. ROADMAP would ensure that the scheduled events would be brought to the attention of those staff members who need to act upon the information in advance of the event.

Non-scheduled lane reductions can only be acted upon if they are detected in some fashion. The City of Toronto employs the RESCU system to provide CCTV monitoring of the major road network (i.e. Don Valley Parkway, Lake Shore Boulevard, and the Gardiner Expressway). In addition, the City uses road patrol units to scan road conditions. Each of these detection sources is a potential input to the ROADMAP system to improve its base of information on road activity.

Reduce Fuel Consumption and Vehicle Emissions

Reduction in fuel consumption and vehicle emissions is another important benefit which arises from reduced idling time, increased average operating speeds during congestion, and reduced unnecessary acceleration and deceleration cycles. Fuel consumption and related vehicle emissions are a direct function of overall delay. Thus, delay reductions realized by the ROADMAP system will be directly reflected to the motorist by fuel savings, and to Greater Toronto Area residents by the reduction of pollution emissions.

Driver Frustration

Another important benefit is the reduction in driver frustration. Improved knowledge of road conditions, and the perception that the motorist has

more control over the length of his or her trip, contribute to a more pleasant driving experience.

Interagency Coordination

The ROADMAP would allow the transfer of important traffic related information to other agencies, particularly the City of Toronto's immediate neighbours, thereby promoting interagency coordination. A long term goal would be to expand the coverage of the ROADMAP system, leading to a shared operation of the system, thereby allowing all participating partners access to road closure information within the whole of the Greater Toronto Area.

2. ESTABLISHING BUSINESS PROCESSES

The first step in the project was to establish the business processes that would be supported by the software application. A Working Group comprised of City Toronto, Utility, Ontario Ministry of Transportation and TTC representatives was established to guide the project.

The IBI Group team met with the key stakeholders involved in the road disruption data collection, conflict resolution, and data dissemination processes, to ensure that all concerns are addressed in advance of the system design activities. This established the scope of information needed to be collected and disseminated, and established how the ROADMAP system performance would be measured.

Interviews were held with stakeholders. The stakeholders represented all levels of the organization, including road patrollers, construction project managers, road operations dispatchers, senior management, and outside customers such as other transportation agencies, and utility companies.

The purpose of the interviews was to establish:

- The scope of road disruptions to be included. The criteria will include the magnitude of the disruption, and the frequency of the type of disruption.
- The current method by which information on the road disruption is conveyed to decision-makers.
- The reliability of the information provided.
- The current methods used to resolve potential conflicts, and suggestions of how this process could be improved.
- The current methods used to disseminate information on road disruptions, and the clients for this information.
- Suggestions on how this process could be improved.
- The level of receptiveness to ITS solutions.
- Suggested methods to measure the performance of a new system.

This task was successful in identifying the business processes to be supported by the ROADMAP system. However, substantial effort was required in order to put business processes in place so that the City of Toronto could be ready to support the software application once built. Utility companies were concerned that the City would be adding additional steps to the already cumbersome and lengthy permitting process, as opposed to developing a system to improve the process. In addition, the various agencies that do work within the City of Toronto right-of-way all had different processes in place to plan and conduct their work, and the software application had to be flexible enough to accommodate these differences and manage future changes to business processes.

Through this process, there were three key components to the successful implementation of ROADMAP:

- **Importance –** The City of Toronto WES staff must believe that use of ROADMAP to manage activities causing road disruptions is an important task for their department;

- **Ease of Use –** The ROADMAP system must make the current job tasks of the stakeholders easier to perform. Therefore, the interaction with the ROADMAP system must be simple and straightforward to use, so that staff are motivated to populate the system, and use it for decision-making; and,

- **Mandatory –** If the importance of the system, and the ease of use of the system do not provide sufficient motivation, the ROADMAP system must also be set up so that participation is not considered to be optional.

There was a greater recognition that managing road disruption activities is an important task. However, despite good intentions, it was concluded that stakeholders may need to be motivated to meet their obligations because a task is mandatory, or out of concern for consequences, as opposed to out of "goodwill".

Four high-level project objectives were identified for the ROADMAP project as follows:

Comprehensive Inventory of Road Disruption Activities: ROADMAP was intended to be a comprehensive inventory of road disruption activities regardless of the source. Examples of road disruption types include major and minor special events, major road reconstruction, regular maintenance activities, utility work, TTC work, MTO work etc. etc. Many of these activities are not directly within the control of Toronto Transportation Services. However, Toronto Transportation is responsible for managing all of these activities from a road occupancy point of view. The success of ROADMAP would be largely dependent on Toronto Transportation's ability to obtain accurate and timely information from all users of the right-of-way.

Road Disruption Tracking Capabilities: Road disruption activities can range from a temporary closure of a single lane for an hour or less up to a long term full road closure for full reconstruction. Roadmap allows users to track these road disruption activities through various stages as follows: i) Pre-planning, ii) Planning, iii) Design, iv) Budget Approval, v) Work In Progress, vi) Complete. Roadmap can tell users what work is happening today and can also tell users what is planned to take place tomorrow, next week, next month or next year.

Eliminate or Minimize Road Disruption Conflicts: One of ROADMAP's primary objectives is to eliminate road disruption conflicts. For example, a parade and road re-construction on the same route or parallel routes –or- two different utility companies digging up the same section or road for utility work days or months after road reconstruction is undertaken. ROADMAP's success will be measured by our ability to avoid conflicts.

Improved Access to Road Disruption Information: ROADMAP has a significant component dedicated to information dissemination. By making timely and accurate road occupancy information available to the public, road users can make informed route selection and travel mode choices.

3. ROADMAP CONCEPT

ROADMAP is a map-based application that essentially serves as a roadway disruption reservation system. ROADMAP is designed to PLAN, APPROVE, and MONITOR activities that disrupt the normal operation of the road right-of-way.

PREMISE

An activity proceeds through two high level components: the planning of an activity (the "Planning Component"), and the monitoring of the status of active activities (the "Operations Component"). The premise for dealing with each of these two components is described below:

Planning Component

Activity owners are to use the ROADMAP system to check on the activities scheduled for a desired date, geographical location, or a combination of the two. If the activity owner determines that a significant amount of disruption activities (as established through policies and practices) have already been scheduled, it is expected that the activity owner will re-schedule the activity, unless it is an emergency. Conversely, if an emergency road disruption is identified, then the City of Toronto should be able to identify which activities would be in conflict, and contact the activity owners to arrange, if feasible, for a postponement of their activities until the emergency road disruption is completed.

Operations Component

Once the Activity has commenced, it is tracked through different phases. A designated person (as established through policies and practices) is responsible for reporting when there has been a change to the activity phase, and when the entire activity has been completed.

ROADMAP IN USE

For the initial implementation, it was proposed that the ability to enter and modify data in the ROADMAP system would be limited to a small group of trained ROADMAP Operators. Other stakeholders would receive "read only" access to the system. Once a level of comfort is reached, then other stakeholders ("users") would be given access to the system.

The ROADMAP system was designed recognizing that City of Toronto staff perform a variety of tasks to plan and track disruption activities.

The tasks performed can be summarized as follows:

Task 1: Planning for the following year

The City of Toronto staff, begin with entering the Capital Works Program for all of the stakeholders, the major Special Events calendar, into a database. Each disruption activity is then reviewed individually to identify and resolve potential conflicts with other planned activities. Any links between disruption activities (i.e. disruption activities that would benefit from occurring at the same time) would also be identified.

Task 2: Tracking of planned disruption activities

The proposed disruption activities proceed through funding approval, design, and tendering. As this occurs, details on the timing and nature of the disruption are more clearly defined. Whenever the timing or location of a disruption activity is changed or refined the disruption activity will be re-checked for potential conflicts or links.

In many cases, there are short-term and/or urgent disruption activities that must be planned and implemented in a short timeframe. In these cases, the Project Manager, in consultation with the Work Zone Co-ordinator (where applicable) is expected to check if the proposed disruption activity would conflict with another major disruption activity.

Task 3: Tracking of active disruption activities

City staff are notified when the project has commenced, if significant changes to the disruption occur throughout the duration of the project, and when the project has been completed.

CONFLICT RESOLUTION

The ROADMAP system stores very detailed information regarding disruption activities that will create traffic disruptions. The tasks described in the previous section describe how the information is used for planning purposes. Part of the planning process involves using the ROADMAP data to ensure that the amount of disruptions are distributed across the city and through time to minimize the inconvenience to all users of the roadway. ROADMAP provides tools to the operator to plan road disruptions in an efficient manner. This means that they are also able to combine, or “link” disruption activities that may benefit from occurring simultaneously, because this approach may reduce the impact of the traffic disruption, and possibly even save money.

ROADMAP helps to identify and resolve traffic disruption conflicts by allowing the operator to view the disruption plan information graphically on a map and in tabular view. The map has the capability to show traffic disruption plans for any range of dates, different map zoom levels and displaying various layers of information. The tabular view of the information will list traffic disruptions with similar criteria by date period and location. The operator needs to use his/her knowledge of traffic planning to interpret the data shown on the maps and lists.

INFORMATION DISSEMINATION

Another purpose of ROADMAP is to produce the information in a report format that is currently distributed to subscribers regarding traffic disruptions. There are two categories of subscribers: internal (management reports) and external ("customers").

The following reports are available for management purposes:

Activity Summary Report – this report provides a one-page summary of all of the critical information for an activity including the most current version of the phasing plan.

Activity Status Report – this report shows the status of activities with respect to the required milestones (eg. Capital Works Budget Approval etc).

Activity Listing Reports – this report provides a listing of activities that meet the criteria (filters) and sort values set by the operator.

Potential Conflict/Link Report – this report provides a summary for an activity of all of the activities that are linked or in potential conflict with the activity in question.

Conflict Resolution Needed Report – conflict resolution should be done every time there is a date or location change made to a phasing plan.

The following reports are available to external subscribers:

Information for The Road Information Line (telephone-based traveller information line);

Unscheduled/Unplanned Traffic events – disseminated immediately as required;

Daily Notices to Motorists (short term events); and

Weekly Restriction Report (long term projects).

4. ROADMAP – THE SYSTEM

What does it consist of?

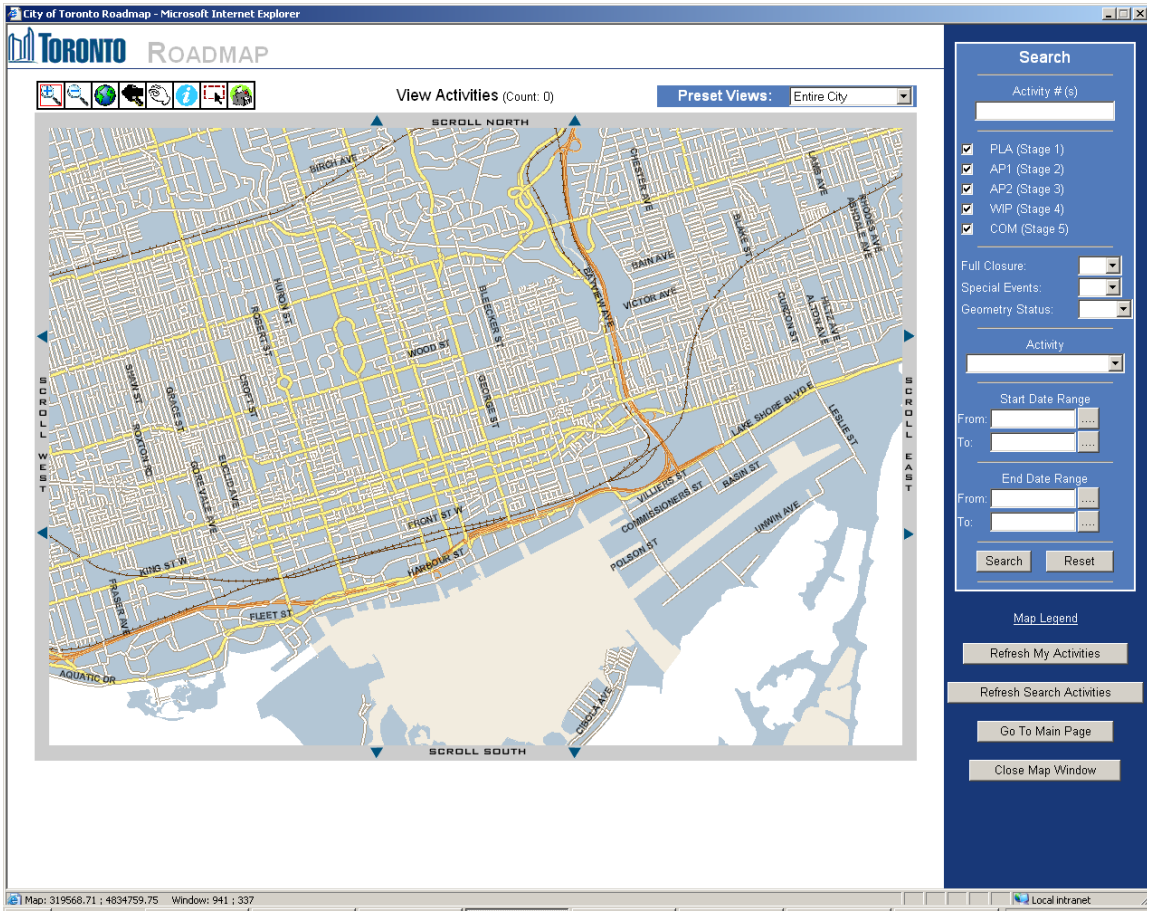
ROADMAP is basically a database with a Graphical User Interface. Its basic components are:

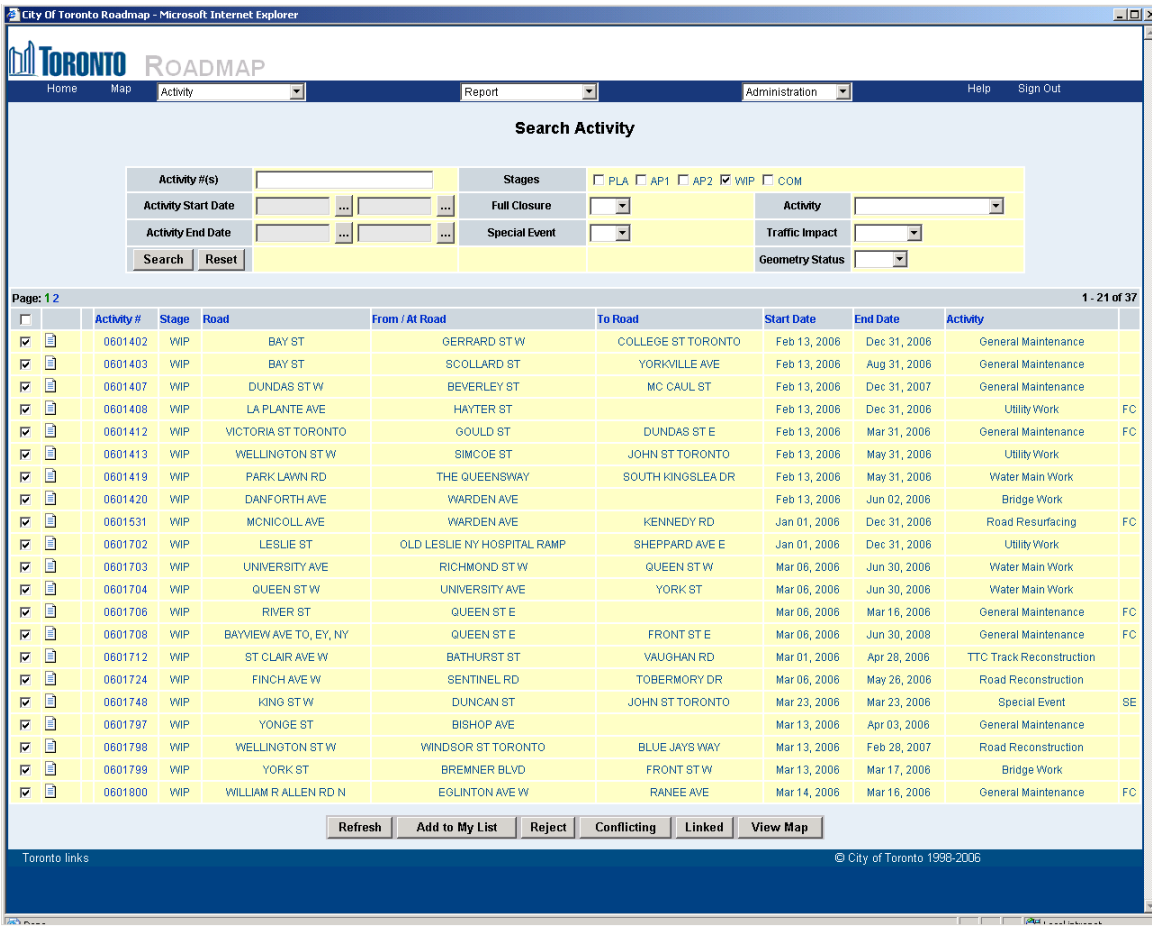
- User Application Security (currently LDAP)
- Database (currently Oracle)
- Web Application Server (currently IBM WAS 6.0)
- Mapping Tool (currently ESRI MapObject 2.1) and

- Reports Engine (currently Crystal Report Server).

How do you use ROADMAP?

In order to operate ROADMAP, you need a web browser. It's currently designed for Internet Explorer 6.0. Operation of ROADMAP involves the use of the Graphical User Interface, and the Forms. Ideally, a person using ROADMAP will have 2 screens, one to display the map, and one to display a Form.





ROADMAP has a number of features which can be used to tailor its use for an individual user, including:

- A default preset view for the map;
- A “My Activities” list to only track activities relevant to the user; and
- A subscription system for receiving information on road disruptions, by email or by fax.

5. RESULTS AND LESSONS LEARNED

The ROADMAP system better fulfills several operational mandates for the City of Toronto. Specifically, ROADMAP provides:

- A comprehensive inventory of road disruption activities within the right-of-way;
- The ability for users to identify road disruptions that are in conflict with one another (same place/same time –or- same time/parallel roadways) before they happen; and

- An information dissemination tool to provide timely and accurate road occupancy information to stakeholders.

Prior to ROADMAP there was no tool available that could provide this functionality.

What Was Achieved?

Funded by the City of Toronto and Transport Canada, the ROADMAP project resulted in the development of a specialized software application that allows users to track and manage road disruptions with the right-of-way. To our knowledge, ROADMAP is the only system of its kind.

Specifically, the ROADMAP system:

Provides a comprehensive inventory of road disruption activities within the right-of-way;

Allows users to track and manage road disruptions of a specific type or within a specific area;

Assists users to identify potential road disruption conflicts before they happen.

Provides better accessibility to road disruption information to stakeholders.

Measures of Success

In concept, ROADMAP would have turned the often chaotic process of scheduling and managing road-work and events into a few mouse clicks and maps. The reality is that the large number of activities and the varying amount of planning done by some activity owners results in day-to-day juggling of priorities and last minute scrambling to avoid embarrassing conflicts.

ROADMAP is a good first step to try to tackle this huge problem. However, until the City of Toronto staff can find ways to effectively police the right-of-way to remove un-authorized occupancy the problem will continue. The City of Toronto needs to force activity owners to plan their work. The term “emergency work” is often used to justify their lack of planning.

The four specific project objectives are discussed below:

(a) *Comprehensive Inventory of Road Disruption Activities;* During the evaluation stage of the ROADMAP project, approximately 3000 road disruption activities were entered into the system. Efforts to obtain road disruption information from all users of the right-of-way are ongoing. The practice of issuing blanket permits to some contractors and agencies has made this difficult. City staff estimate that we are receiving approximately 95% of road occupancy events that have a significant impact. Shorter term road occupancy events or events on minor roadways are not always captured.

(b) Road Disruption Tracking Capabilities; ROADMAP is able to track road disruptions through various stages from pre-planning to project completion. It is often difficult to get status updates on specific activities from some agencies. For short term or emergency type road closures it is often difficult to determine if and when the work is complete. In order to obtain this level of detail a significant effort is required on-street to visit various work sites to obtain status *information.*

(c) Eliminate or Minimize Road Disruption Conflicts; This is an on-going effort. As City staff increase the number of events entered into the system the opportunities to identify conflicts improves. Many of these conflicts are still identified much too late in the project planning process. It is difficult and expensive to reschedule work after contracts have been awarded.

City of Toronto staff continue to work with IBI Group to make enhancements to the system.

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