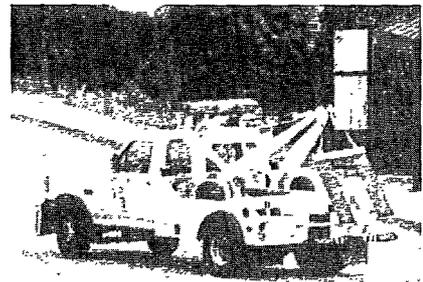


Incident Management Systems: A Step-by-Step Approach

This chapter presents some simple guides to help develop new incident management systems and to “flesh out” specific incident management measures that are being considered for implementation within an existing system.

Because these two processes involve different types of questions and actions, this chapter is divided into two parts. The first half discusses the steps that an agency should consider when it is initially designing an incident management process and the questions it must answer to successfully perform those steps. The second half provides questions designed to ensure that an agency fully understands the implications of specific incident management measures. The answers to these questions should help determine how response techniques will function within a given management system, and they are appropriate for agencies that want to refine or improve an existing incident management system.

Both parts of this chapter assume that the user is familiar with the general subjects covered in the previous sections of this guide.



DESIGNING A NEW INCIDENT MANAGEMENT SYSTEM

As indicated above, this chapter presents brief guidelines on how to design and implement an incident management system. Because developing such a system requires considerable interagency cooperation and coordination, performing the tasks described below may take anywhere from several months to several years, depending upon the urgency of the incident problem, and agencies’ ability and desire to allocate resources to alleviate that problem.

Because of the potentially long time frame, a series of tables lists the actions to be taken and questions that an agency should answer order to develop and implement a successful incident management process.

The material presented below follows the same organization as the second and third chapters of Section I. The reader is referred to those chapters for additional information.

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Jurisdiction

Questions presented in this area are intended to ensure that all of the appropriate agencies have been included in the incident management system and that their roles and interactions have been adequately considered. The questions below will help ensure that the information necessary to adequately identify and resolve the jurisdictional problems that accompany a multi-agency incident management system can be answered.

What jurisdictions should/will be involved in the incident management process?

Agency Perspectives and Responsibilities

Once the agencies that should/will be involved in the project have been identified, it is necessary to consider how each of these agencies views incident management, what their roles are, and how they interact with each other.



What actions does each agency currently perform?

What are each of those agency's responsibilities?

Do those responsibilities conflict with respect to incident response or clearance? (Is it possible that they might result in some type of conflict? If so what is that conflict?)

Should the duties or capabilities of one or more agencies be expanded? Why?

How would that expansion be viewed by the other participating agencies?

Site Management

After an understanding of the participating agencies has been gained, it is important to understand how those agencies' personnel should interact at an incident site.

When more than one agency responds to an incident site, which agency should control that site?
Does this change with the type of incident?

Does one agency need to change its perspective to work within the incident response system?

Interagency Field Communications

When multiple agencies respond to an incident site, it is necessary for the responding personnel to be able to communicate quickly and reliably for the response to be well directed. When an incident management system is set up, it is important to determine how this interagency field communication will take place.

How will staff from different agencies perform the following communications tasks:

- contacting and requesting that a specific agency respond to an incident,
 - contacting field personnel from a different agency from a field location, and
 - performing on-site (out of their respective vehicles) communication?
-

Administrative Coordination Among Agencies

In addition to the needs for real-time communication among personnel in the field, agencies need to communicate at the administrative and managerial levels to keep the incident management process functioning smoothly.

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How will the coordination among agencies be monitored, maintained, and revised as needed? (Set up a structure to do this, for example, have monthly meetings between mid-level management involved with the incident management process.)

Usually, at least one person must be dedicated to incident management and must spend a significant portion of his/her time performing administrative coordination among agencies. Who is that person? What are his/her authority and specific responsibilities?

Legal Ramifications

Legislative statutes often restrict or constrain the development of incident management techniques. Before the broad structure of an incident management process has been designed, and before specific incident management strategies have been selected, the limitations imposed by existing laws and regulations must be understood.

What are the legal limits to the incident response roles a specific agency's personnel can perform?

What are the legal restrictions to the methods that can be used to clear an accident or other traffic blockage?

What is the financial liability of agencies, agency personnel and the public with respect to incidents and specific incident management options?

Which agency's personnel are allowed to handle hazardous material?

Do regulations exist for governing who may close a road and for how long that road may remain closed?

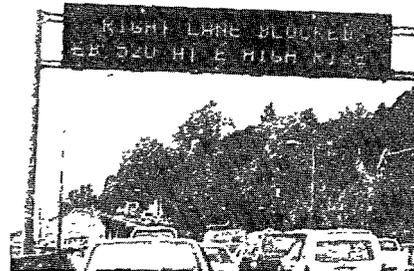
What are the laws governing the financial responsibility of persons involved in accidents? (Does a state have the right to charge a motorist for the time and equipment required to respond to an incident?)

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What are the laws governing the actions public agencies may take as part of their incident management actions? Do these laws change the financial responsibility of persons involved in the incident?

Forming Consensus

The agencies participating in an incident management process must agree on the steps to be taken by all agencies. Cooperation beyond this first level of agreement can significantly benefit the operation of the system by reducing the total cost of the system and by smoothing and speeding the response process.



What actions can/should the respective agencies take independently and under what conditions should they take them? (For example, under what conditions must a facility be closed, and under what conditions may a facility be kept open or partially open?)

Is it possible to develop some type of inter-jurisdictional agreement, training or new legislation to eliminate legal or other restrictions to desirable incident management actions? (For example, can highway personnel be trained to handle hazardous waste or assist emergency crews?)

Can specific “deals” be made between agencies to promote the incident management process? (For example, “We’ll buy you an extra 10 radio sets for incident response communications, if you will let the interagency incident response teams use your on-site communications radio frequency when responding to incidents.”)

What are the geographic areas of operation and the manner in which response is handled within those boundaries during specific times of day or at specific types of incidents?

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Political Sensitivity

Political and public impact is also important for incident management systems. When a system is created, the need for political support and the need to address public perceptions of traffic congestion must be considered. These issues apply to both the selection of management measures and the need to justify the operation of the system.

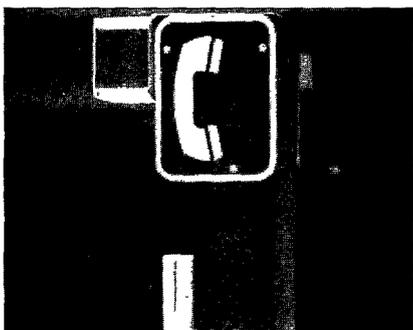
What political stimuli should the incident management process address?

How does the proposed management action address those stimuli?

What are the political consequences or potential ramifications of the proposed management action?

In what manner can credit be obtained by the participating agencies if the management process is successful?

How will the success and/or failure of response measures be determined?



Geographic Constraints

Resources requirements and administrative burdens are directly impacted by the size of the geographic area covered by an incident management system. It is important to carefully consider just what the bounds of the incident management system will be, and how those boundaries will impact the operation and administration of the response process.

What are the geographic boundaries of the incident management system? (Provide a map where possible.)

Are there internal divisions within the proposed geographic area (e.g., a “north” response zone and a “south” response zone)?

If so, how does the location of an incident affect the operational procedures used to respond to that location?

Do different agencies respond in different geographic areas? If so, describe where these boundaries are and which agencies respond within each boundary.

Are different sets of response guidelines needed for different geographic areas within the basic incident management system (urban versus rural areas)?

Are different sets of administrative oversight committees (both internal to an agency and among multiple agencies) needed for different geographic stratifications of the incident management area?

What will the incident management process be outside of the “covered” incident management system?

Can personnel from one geographic area assist with an incident in another geographic area? If so, which personnel can cross boundaries and under what conditions can they be called in (on both a regular and emergency basis)?

When should the police or highway authority in a neighboring geographic area be notified of an incident, and who should make that notification?

What additional actions can be taken if the congestion caused by an accident crosses a political boundary?

§ Available Resources

Determining the resources that are already available for use in incident management can dramatically decrease the cost of implementing an incident management system by limiting the need to purchase additional equipment or hire new staff. It also helps determine the easiest, most cost effective management strategies (i.e., the strategies for which equipment and staff already exist). An inventory of available resources also helps identify shortcomings that need to be addressed as part of developing a comprehensive management process.

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Equipment, Staffing and Funding

The first part of this effort is to identify the resources available for incident response, both within the lead agency and within other cooperating agencies.

What resources exist within the incident management system's geographic boundaries that can be used as part of the incident management system?

Can those resources be used on short notice to respond to incidents?

Do finances limit the size of the area the incident management system can cover?

If so, what are the options for reducing the size of the area covered or reducing the cost of the incident management process so that it can cover a larger area? What are the mechanisms for prioritizing different geographic areas within the basic management system?

Resource Sharing Agreements

Where resources exist within one agency but are needed by another agency, interagency agreements can be developed to share those resources. These resource sharing arrangements can result in financial advantages to both cooperating agencies.

Are sufficient resources readily available to one participating agency but not others?

Can the agency with available funding subsidize the incident management activities of other agencies?

If not, can one agency supply resources to another agency or take over specific duties as part of an incident management agreement?

If one agency can "borrow" equipment or staff, does a mechanism exist to provide access to those resources (i.e., can the incident response team

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from the highway department call the city and borrow its crane)?

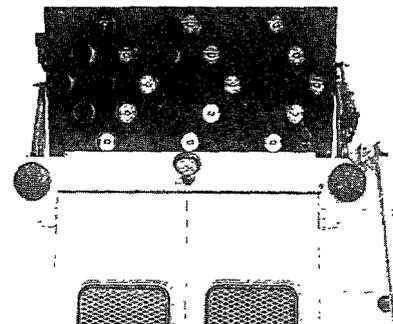
Can procedures be developed or identified to bring the appropriate resources to bear on incidents within the desired time period (i.e., if the highway department has money for incident management, is there a mechanism it can use to reimburse the city for the use of the city's crane)?

When resource sharing makes sense, can an agreement between agencies be designed to clarify the resources to be shared? The agreement should include the following:

- the conditions under which specific equipment or personnel should be called to an incident site,
- how that equipment or personnel should be requested,
- who will operate the shared equipment,
- whether payments will be made for the use of that equipment, how those payments will be made, and what the size of those payments will be, and
- any statements required to shift the legal liability for using the shared equipment to the appropriate operating agency.

Operational Procedures

Once the specific incident management measures have been selected for implementation (or even for detailed analysis), it is important to determine how the operation of those techniques will impact the participating agencies. The operational procedures selected should reflect previous decisions regarding how agencies and jurisdictions will interact and what and how equipment will be used.



How can all agencies involved in the incident process ensure that they are using the same set of incident management procedures?

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How is equipment called to an incident site?

Under what conditions should specific equipment be called to an incident site?

What records will be kept concerning the incident management process (cost, benefits, the number of incidents responded to, the time involved in those responses, the reductions to travel time delay)?

Field Communications

Perhaps the most critical of the operational issues is how incident management staff will communicate with both staff of the same organization and staff of different organizations.

What communication channels are needed to make the management process work for

- call out,
- arrival on the scene, and
- communications on site?

Does the above communications scheme account for the needed interagency communication? If not, how will these communications take place?

If additional communications equipment is needed, how will these purchases be funded?

Legal Ramifications And Operational Decisions

When the incident management procedures are developed, it is important that the selected management techniques do not conflict with existing laws or regulations. This is especially true for union rules and other labor usage regulations.

Are there legal considerations for the operation of selected management techniques (e.g., who is allowed to handle hazardous material, and is the selected response technique safe for the employees that will be implementing it)?

Is more legal clarification needed to allow proper operation of the system? For example, what constitutes hazardous material? How is hazardous material disposed of after it has been collected at an incident site? Are particular steps required by law when someone first reaches an incident that contains (or might contain) hazardous material?

What legal requirements must be met in the response to specific types of incidents, and do those required legal steps change how the candidate management process should take place? (For example, most states have different procedural requirements for fatal accidents than for non-fatal accidents, but many also have different requirements for serious injury accidents versus “non-serious injury” accidents.)

For incidents involving hazardous material, the following issues need to be resolved:

- Who is allowed to handle hazardous material?
- What constitutes hazardous material?
- How is hazardous material disposed of after it has been collected at an incident site?
- Are particular steps required when someone first reaches an incident that contains (or might contain) hazardous material?

Do regulations exist for governing who may close a road and for how long that road may remain closed?

What are the laws governing the financial responsibility of persons involved in accidents?

What are the laws governing the actions public agencies may take as part of their incident management actions? Do these laws change the financial responsibility of persons involved in the incident?

When should the scene and/or approach to the scene be photographed?

 **Training**

Another item that must be resolved to develop an incident management system is the need to train the personnel who will make the system work. Training is the key to making the operational procedures function smoothly. At the administrative level, it is important to determine what information must be given, who that information should be given to, and how often those training sessions should take place.

What training is needed to implement the selected management measures? (At a minimum training should include general operational procedures such as how to set up traffic control, communications procedures to be followed, where to get additional help and/or resources when at an incident site, what each staff person's role is at an incident site, what the perspectives and job functions are for staff from participating agencies, and what the command structure is at an incident site under various conditions.)

Which agencies/jurisdictions should be included in the training performed as part of implementing the incident management system?

When will that training be offered, and will field personnel be allowed to work on incident management before they have had special incident management training?

Is training required for personnel outside of your agency?
If so, how will that training be accomplished?

Who will teach the training sessions and what materials will be used to do the teaching?

How does the available training discuss the perspectives other agencies will have and the tasks they will perform during the incident management process?

□ Administration

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Because incident management staff and equipment requirements often cross division boundaries within an organization, the need for communication, cooperation and consensus within an agency is almost as great as that between agencies. Many of the same topics discussed above should be re-examined to address differences in mission, perspective, and priority among divisions within an agency. In addition, topics such as those below must be reviewed.

General Administrative Coordination

How will the individuals involved in incident management measures fit into the existing organizational structure of the agency? The more self contained these resources are, the less difficult will be the administrative burden of the incident management process. The more diffused these resources are, the more difficult the administrative tasks will be.

Are the personnel and equipment that will participate in the incident management system directed by the same portion of the organization that will direct the system? (That is, if the Operations division is in charge of incident management, are the responding field staff from the Operations division or the Maintenance division?)

Is responding to incidents a “normal” part of that portion of the agency’s routine duties, or is the response technique “borrowing” workers and equipment from other job functions?

If the resources are being “borrowed,” how will that borrowing impact the performance of that staff’s regular duties?

Is there a cost transfer from one division to the other in return for the use of those persons and equipment? How will that transfer work?

How are the rewards/penalties for the proper/improper use of those personnel/equipment designed so that the appropriate use of those resources is encouraged? (What are the rewards/penalties?)

What mechanism has been set up to resolve conflicts over the use (or the priority of use) of personnel and equipment?

Is there a need to expand the duties or Capabilities of the agency division that will perform the selected incident management alternatives?

How would that expansion be viewed by the other divisions within the agency?

Internal Agency Perspectives

The degree of conflict within an agency that will result from the use of personnel and equipment from different divisions for incident management will depend on the perspective those divisions have of incident management. Where incident management contributes directly to the perceived goals of that part of the agency, support for incident management will be strong. When incident management does not contribute directly to the those perceived goals, support will be less strong. Opposition will occur when resources are taken from a division of an agency for incident management and little benefit returns to that division:

What are the responsibilities of the different divisions that are impacted by the need for resources for incident management?

Do those responsibilities conflict with respect to incident response actions or clearance? (Is it possible that they may result in some type of conflict? If so what is that conflict?)

Do the duties or capabilities of the agency divisions performing incident management need to be expended?

How would that expansion be viewed by the other divisions within the agency?

In what manner can credit for a "job well done" be given to divisions that cooperate with incident management (e.g., that provide equipment or staff), especially when incident management is not their major impetus? (In other words, what types of "carrots" can be used to encourage cooperation with incident management?)

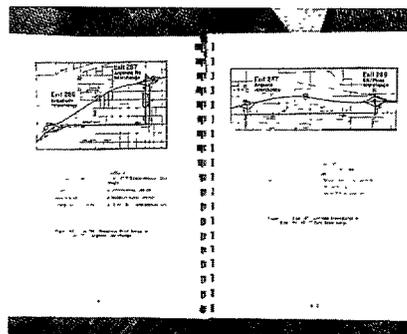
DEVELOPING SPECIFIC INCIDENT MANAGEMENT MEASURES

Incident Management Systems: A Step-by-Step Approach

The next section is a step-by-step process for developing alternative incident management measures for consideration in an existing incident management system. This process provides a consistent manner with which to “flesh out” the basic incident techniques described in Section II. Answering the questions below will allow the implementing agency to systematically consider all of the major issues that impact a specific incident management technique.

This information can be used either to help differentiate among alternative management measures or to simply provide a better understanding of the complexities of operating a specific management measure. As in the previous half of this chapter, the material presented below follows the same organization as the second and third chapters in Section I. These earlier chapters should be referenced as necessary.

Because each incident management system is different and each possible technique is unique as it is applied to each urban area, it is impossible to design a single series of questions that are both sufficiently detailed and relevant for all uses. Therefore, the question sets below are on the side of completeness. Portions of the following question series that do not apply to the technique being examined should be disregarded.



To develop a complete alternative for evaluation, follow the steps outlined below:

- Identify the problem to be solved.
- Select one or more alternatives from the techniques listed in Section II that improve the condition or relieve the problem area.
- Answer the applicable questions listed below for each alternative selected from Section II to determine the pros and cons for each alternative.
- Evaluate the alternatives that have been selected for study.

These last two steps can be performed in reverse order if the evaluation process does not need to consider the detailed workings of the incident management technique's implementation (i.e., if the evaluation is between two very disparate alternatives, rather than two related alternatives).

Jurisdiction

To determine the jurisdictional impacts of the proposed alternative, consider the following questions.

What agency(s) will perform the incident management alternative action under consideration?

Will two or more agencies need to interact to undertake this alternative?

If more than one agency is involved, how will this interaction work (which tasks will be performed by which agency, and which agency will manage the site? Will site management be the same under all conditions?)

Have all of the participating agencies been contacted to gather their input in the development of this measure? If so, what are their comments, needs, and/or concerns?

Can some portion of this management action be taken independently by one agency, and if so, under what conditions?

Is it necessary to develop some type of inter-jurisdictional agreement, training, or new legislation to eliminate legal or other restrictions to this incident management alternative?

Do jurisdictional disputes exist between agencies in the response areas that might restrict potential management measures (e.g., "We won't trespass to incidents over that border because they won't contribute to our costs.")?

Agency Perspectives and Responsibilities

Different agencies and jurisdictions may view an alternative from decidedly different outlooks. Consequently, what may be the perfect alternative to one agency may be a disaster to another. Before an alternative has been selected, it is important that the agency considers how each agency and jurisdiction within the geographic boundaries of the management system will view the application of each particular incident management approach.

Is it possible that this technique will conflict with the goals, objectives or operations of some other agency (e.g., a “fast clearance technique” may warrant objections because it creates an unsafe working environment for some other responding agency’s workers)?

If so, can these issues be resolved through minor changes in operating procedures?

Do these issues mean that the objecting agency has strong feelings against implementation of this technique? Should these objections cause this alternative to be withdrawn from consideration or significantly revised to reduce this negative impact?

Similarly, do impacted agencies strongly favor this alternative and thus should it be given additional consideration because of these other impacts?

Interagency Field Communications

If more than one agency is involved in performing an incident management technique, then the ways that communication will take place between staff from those agencies should be established.

How will staff from the different participating agencies perform the following communications tasks:

- contact and request that staff and/or equipment from the other agency respond to an incident,
 - contact field personnel from a different agency from a field location, and
 - perform on site (in or out of their respective vehicles) communication?
-

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Administrative Coordination Among Agencies

In addition to the needs for real-time communication among personnel in the field, participating agencies need to communicate at the administrative and managerial levels to keep any incident management process functioning smoothly. In many cases, this same managerial communication is necessary among agencies, even when staff from one of those agencies is not directly involved with the incident management process. (That management technique may create problems for another agency that need to be resolved.) Therefore the following must be understood.

Does the proposed management measure require interagency coordination at the administrative level (e.g., for shared funding, shared equipment, or interaction among agency personnel)?

If so, list the persons who should perform that coordination and explain how that coordination will take place (e.g., a bi-monthly meeting among the administrative managers for each agency, or through multi-agency corridor management teams).

If not, how will coordination among agencies be monitored, maintained and revised as needed?



Legal Ramifications

Legislative statutes often restrict or constrain the incident management techniques that can be applied by an agency. Laws and regulations may also place an agency in an untenable financial position if it implements a particular management action. Thus, before a specific incident management option has been implemented, the legal consequences and/or limitations of that action must be understood.

Does legislation exist that specifically allows the agencies identified above to perform, or prevents them from performing, the selected tasks? (For example, is the highway agency legally allowed to handle spilled hazardous material?)

If barriers to implementation exist, can legislation be enacted to remove those limitations?

Can another agency perform the desired management actions without those legal limitations if it were given assistance (See Resource Sharing in Section I, “Major Issues in Selecting Incident Management Alternatives”)?

If the legal relationship between an agency and a response technique is not clear, obtain the state Attorney General’s opinion on the matter.

Does the proposed response technique change the financial liability of agencies, agency personnel, or the public? If so, list those changes. (Again, if these changes are uncertain, obtain the Attorney General’s opinion on the matter.)

Forming Consensus

Agencies impacted by an incident management measure must be involved in the process that results in the implementation of that technique. A consensus among the agencies involved with (or impacted by) incident management will help ensure that the technique selected is supported once it has been implemented.

How do other agencies that are impacted by your agency’s incident management process react to this proposal? Is it something they will support or oppose?

If there are objections to the proposed incident management technique, list those objections and potential ways to alleviate them,

Political Sensitivity

When the impact of a proposed incident management technique is considered, the ways in which those actions will be viewed by the public and by elected officials should also be examined. Support from these sectors is essential for continued support (both financial and political) of an incident management system. To help determine how a proposed management technique will be viewed politically, the following questions should be answered.

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Are there political stimuli (e.g., traffic congestion at a specific location or a bridge that is deemed to be “unsafe”) that need to be addressed by the incident management process?

How does the proposed management alternative action address those stimuli?

Are there other political consequences or potential ramifications of the proposed alternative?

In what manner can credit be obtained by the participating agencies if the response process is successful?

How will the success and/or failure of the incident management measure be determined?

Will there be a noticeable change in traffic performance as a result of the proposed incident management process, or will the management process be visible to the public (“your tax dollars at work”)?

Geographic Constraints

Resource requirements and administrative burdens for a specific incident management technique are directly impacted by the size of the geographic area that will be covered. An agency must carefully consider the bounds within which the proposed management technique will be applied and how those boundaries will impact the operation and administration of the management process.

What are the geographic bounds to the proposed incident management technique?

Are there geographic divisions within the proposed coverage area (e.g., a “north” management zone and a “south” management zone)?

If so, how does the location of an incident affect the operational procedures used to respond to that location?

Is the management technique applied differently in some geographic areas? If so, describe how the technique applies to each of the covered areas.

Can personnel from one geographic area assist with incident management in another geographic area? If so, which personnel can cross boundaries and under what conditions can they be called in?

Under what conditions can the personnel or equipment from one jurisdiction be used in another jurisdiction (both on an emergency basis and on a regular basis)?

Are different sets of administrative oversight committees needed for different geographic stratifications of the incident management? If so, list the persons/organizations that should be included on each of these committees.

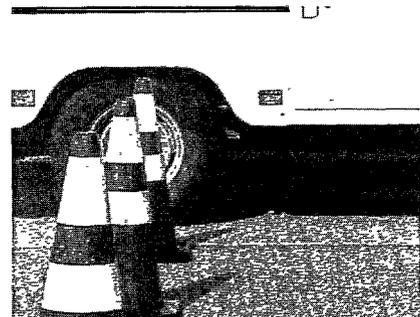
What jurisdictions should be included in the administrative information and training aspects of the incident management system?

What resources exist within the geographic areas that can be used as part of the incident management system?

What will the incident management process be outside of the “covered” incident management area?

§ Available Resources

Determining the resources that are already available for use in incident management can decrease the cost of implementing incident response by limiting the need to purchase additional equipment or hire new staff. It can also help resolve questions about which management strategies should be pursued first (e.g., those strategies for which equipment and staff already exist) and which will take more time and money to implement. Performing an inventory of available resources can also identify shortcomings that need to be addressed as part of the incident management development.



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Equipment, Staffing and Funding

The first part of this effort is to identify the resources available for incident management, both within the lead agency and within other cooperating agencies.

What resources are required by the desired incident management technique?

Will these resources be needed or used on a 24-hour a day basis or only during particular time periods such as the peak commute hours?

Are these resources readily available to the agencies that will perform this technique?

Can those resources be used on short notice to respond to incidents?

If either of the above are not true, can one agency fund the participation of another agency?

What agency(s) are willing to fund or perform this incident management action or equipment purchase?

Are special communications equipment needed (e.g., for interagency radio links) to implement this effort? If so, how will this equipment be purchased?

Resource Sharing Agreements

Where resources exist within one agency but are needed by another agency, interagency agreements can be developed to share those resources. These resource sharing arrangements can result in financial advantages to both cooperating agencies.

Is it necessary for one agency to fund (or partially fund) the participation of another agency?

Do sufficient (cash) funds exist to pay for the use of another agency's resources?

Can specific “deals” be made between agencies to promote the incident management process and/or spread the cost of the system? If so what are they?

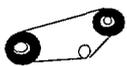
Does a mechanism exist to provide access to those resources (i.e., can the incident management team from the highway agency call the city and borrow its crane)? If so, describe that mechanism.

Are there legal ramifications from sharing equipment, staffing, or funding? If so, what are those ramifications, and how might they be mitigated?

Can procedures be developed or identified to apply the appropriate resources to incidents within the desired time period (i.e., if the highway agency has money for incident response, is there a mechanism to reimburse the city for the use of that crane)?

If resource sharing makes sense, agreements should be drawn up between agencies to clarify the resources to be shared (list the information to be included). The agreements should include the following:

- the conditions under which specific equipment or personnel should be called to an incident site (list any equipment that can be called and the conditions under which it should be requested),
 - how that equipment is requested,
 - who operates the equipment,
 - whether the use of that equipment must be paid for, and
 - if so, the procedures for making those payments.
-



Operational Procedures

It is important to determine how the operation of the selected techniques will impact the participating agencies. The operational procedures selected should reflect the decisions regarding how agencies and jurisdictions will interact, and what and how equipment will be used.

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What are the procedures for operating the proposed incident management measure?

Under what conditions should specific equipment be called to an incident site?

How is equipment called to in incident site?

Who operates the equipment?

Who pays for the use of that equipment?

Are there special procedures for making those payments?

Should special record keeping be done to monitor the use of incident management equipment?

Field Communications

Perhaps the most critical of the operational issues is how incident management staff will communicate with staff of the same organization and staff of different organizations.

What communications channels are needed to make the candidate management measure work for

- call out,
- arrival on the scene, and
- communications on site?

Is more than one agency involved in the candidate response effort? If so, does the above communications scheme account for the needed interagency communication? If not, how will these communications take place?

If additional communications equipment is needed, how will these purchases be funded?

Legal Ramifications To Operational Decisions

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When the incident management procedures are developed, it is important to make sure that the selected management techniques do not conflict with existing laws or regulations. This is especially true for union rules and other labor usage regulations.

Are there legal considerations for the operation of the selected management technique (e.g., who is allowed to handle hazardous material)?

Is additional legal clarification needed to allow proper operation of the system? For example, what constitutes hazardous material? How is hazardous material disposed of after it has been collected at an incident site? Are particular steps required by law when someone first reaches an incident that contains (or might contain) hazardous material?

Are there legal requirements that must be met in the response to specific types of incidents, and do those required legal steps change how the candidate management process should take place? (For example, most states have different procedural requirements for fatal accidents than for non-fatal accidents, but many also have different requirements for serious injury accidents versus "non-serious injury" accidents.)

Training

Another item that must be investigated before an incident management program is implemented is the need to train the personnel who will make the operational procedures developed function smoothly.

What training is needed to implement this incident management measure?

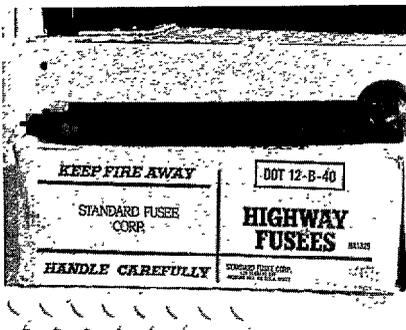
When will that training be offered, and who will teach the training session?

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Is training required for personnel outside of the agency?
If so, how will that training be accomplished?

How are the following issues covered by the training that will be employed as part of implementing the candidate incident management measure:

- what tasks will other agencies be performing,
 - what perspectives on incident management do those agencies have,
 - where can field personnel get additional assistance when responding to an incident (for example, additional equipment, additional traffic control, hazardous waste crews),
 - what are the communications procedures that will be used,
 - what decisions should field staff make for themselves and which should be made by other personnel,
 - who should field staff take directions from when at an incident site, and
 - how does the new procedure fit within the rest of the incident management system?
-



Administration

Because incident management staff and equipment needs often cross division boundaries within an organization, the need for communication, cooperation, and consensus within an agency is almost as great as that among agencies. Many of the same topics discussed above should be re-examined to address differences in mission, perspective, and priority among divisions within an agency. In addition, topics such as those below must be reviewed.

General Administrative Coordination

The way in which the individuals involved in the selected incident management measure will fit into the existing organizational structure of the agency should be reviewed. The more self contained the

needed resources are the less difficult will be the administrative burden of the incident management measure. The more diffused these resources are, the more difficult the administrative tasks will be.

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Are the response technique's equipment and personnel coming from the same portion of the organization?

Is responding to incidents a "normal" part of that department's routine duties, or is the response technique "borrowing" workers and equipment from other job functions?

If the resources are being "borrowed," how will that borrowing impact the performance of that staff's regular duties?

Is there a cost transfer for the use of those persons and equipment? How will that transfer work?

How are the rewards/penalties for the proper/improper use of those personnel/equipment designed so that the appropriate use of those resources is encouraged? (What are the rewards/penalties?)

What mechanism has been set up to resolve conflicts over the use (or the priority of use) of personnel?

Is there a need to expand the duties or capabilities of the agency divisions that will perform the selected incident management alternative?

How will that expansion be viewed by the other divisions within the agency?

Quantifying Incident Management Benefits

Although many factors are considered in incident management alternative evaluation (see Table 1.7), few have the publicity impact of being able to say that a specific incident management program has reduced the average duration of incidents by x minutes and this has saved commuters y hours of travel time. Unfortunately, arriving at statistically accurate values of x and y is an exceedingly difficult task. For example, in determining the reduction in incident duration resulting from a specific alternative, it is important to control for all naturally varying, non-alternative related factors (e.g., seasonal variations in traffic flow, weather conditions, the presence of special events, traffic growth, changes in operational procedures). Determination of the travel time savings resulting from reductions in incident duration requires extensive monitoring of queues and travel times or, alternatively, the use of a fairly sophisticated traffic simulation model. In both cases, arriving at precise values is not easy but is often considered worthwhile in accomplishing the following:



- demonstrating the effectiveness of an incident management alternative,
- isolating weaknesses in incident management programs, and
- measuring potential traffic impact benefits.

The following two sections outline some of the specifics of quantifying incident management benefits.

EVALUATING INCIDENT DURATION

Incident duration is typically defined as the time between incident (accident or vehicle disablement) occurrence and roadway clearance. In most metropolitan areas, such data are available from two sources: (1) accident reports and (2) state patrol or local patrol dispatch reports. The types of data typically available in these reports are presented in Tables 3.1 and 3.2 for accident report and dispatch logs, respectively. To evaluate incident duration and check for consistency in

Table 3.1 Information Typically Available from Accident Reports

Year	Year of accident
Month	Month of accident
Day	Day of Accident
Day of Week	Indicator for day of week Monday to Sunday
Hour	Hour accident report started
Minute	Minute accident report started
Sign Route	State route highway designation number
SR Milepost	State route mile post
Accident Sev	Accident severity index; property only, injury accident, or fatality
N. Injured	Number of persons injured in the accident
N. Fatal	Number of persons killed in the accident
Light	Indicator for illumination level at accident site: daylight, dawn, dusk, dark (with and without street lights, and other)
Collision Type	Code for various possible collision types including pedestrian/vehicle, vehicle/vehicle, parked vehicle and others kinds
Object Struck	Kind of object struck, if any (e.g., light standard)
M. Sev.Inj.	The most severe injury caused by the accident (no injury, fatal, disabling non-disabling, possible, unknown)
N. Veh.	Number of vehicles involved in the accident
P.Dam.\$	Property Damage measured in dollars
R. Char.	Roadway character - grades and curves
L. Char.	Location character - codes for various intersections, under and over passes and other facilities
R. Sur.	Road surface character: not stated, dry, wet, snow, ice, other
Weather	Weather at the accident site:clear/cloudy, rain, snow, fog, or other
Res. Prox.	Residence proximity of involved drivers: within 15 miles, elsewhere in state, or out of state
Sobriety	Sobriety of the drivers in the accident: 7 codes for had been drinking — ability impaired to had not been drinking
A. Sev.	Alcohol severity: drunkest driver involved in accident
Con.Circ	24 codes indicating different possible RCW violations or indicating no violation
D.V.Act	Driver Vehicle Action: codes indicating evasive or non evasive actions taken by the involved drivers
Veh. typ.	Vehicle type: vehicle type code
Age	Age for each of the involved drivers
Haz. Mat.	Kind of hazardous material involved, if any
Fuel	Fuel Spill (yes/no)
Fire	Fire Resulted (yes/no)

Table 3.2 Information Typically Available from Dispatch Logs

Year	Year of accident
Date	Month and day of the accident
DOW	Day of week: Monday to Sunday
TOD	Time of day: one of eight 3 hour time slots
Rcvd	Dispatcher received call for assistance
Enroute	Time Trooper was en route to accident scene
Atscene	Time Trooper arrived at the accident scene
Roadcl	Time road was cleared, if it had been blocked
Troopcl	Time Trooper cleared the scene of the accident
Tow	Number of tow trucks called to accident site
Amb	Number of ambulances called to the accident site
Other	Number of other emergency vehicles called to the accident site (e.g., Fire Department)
Exp	Indicates that accident occurred on the express lanes
Loc. c	Location Code: code for the cross streets on I-5 and SR 520 within our study area
Dir	Direction of travel
Lane	Lanes(s) involved
N.Veh	Number of vehicles involved
N.L.Block	Number of lanes blocked
Inj	Number of injuries
Ftl	Fatality accident (yes/no)
T/B	Truck or bus involved in the accident

Quantifying Incident Management Benefits

data, it is desirable to match accident reports with corresponding dispatch logs to obtain a more complete description of each incident.

As mentioned earlier, to evaluate the effectiveness of an incident management alternative, it is important to control for naturally varying factors. A simple comparison of before and after duration data can easily produce erroneous or counter-intuitive results. Proper evaluation necessitates the use of multivariate statistical procedures that explicitly account for the effects of all factors that influence changes in incident duration, not just the incident alternative being studied. An example of such a multivariate statistical procedure is the hazard function approach recently used to study incident duration in Seattle (Jones, Janssen, and Mannering (1991)). This study found that incident duration was influenced by a variety of factors such as the following:

- Seasonal Effects seasonal variations in traffic and weather.
- Daily Variations variations by time of day (i.e., day versus night, rush hours versus non-rush hours) and day of week (i.e., weekday versus weekend).
- Special Events major sporting events such as college football games.
- Driver and Vehicle Characteristics driver age, driver intoxication, whether or not trucks or buses were involved, and the number of vehicles.
- Accident Severity Measures the number of lanes blocked, the number of injuries, and property damage.

A summary of the effect of these factors on incident duration is presented in Table 3.3.

On the basis of the multivariate statistical analysis of incident duration conducted by Jones, Janssen, and Mannering, the following conclusions were drawn regarding incident management in Seattle as it existed between 1987 and 1989:

- The fact that incidents occurring during special events and rush hours had smaller durations indicated very good incident management during these periods, and such incident management should be extended to other time periods, providing funding exists.
- Trooper response to accidents involving drunk drivers is exceptional (resulting in reduced incident duration) and such efforts should be extended to all accidents.

Table 3.3 Typical Factors Influencing Incident Duration

Factors Increasing Incident Duration	Factors Decreasing Incident Duration
. Winter months	• Rush hours*
• Night conditions	• Special events*
• Weekends	• Accidents involving drunk drivers*
• Accidents involving older drivers	
• Accidents involving trucks or buses	
• Accidents involving iniuries	
• Accidents resulting in high property damage	
• Accidents blocking a high percentage of lanes	

*These factors were found to decrease incident duration because of the increased level of incident management available during rush hours and special events and the massive trooper response to accidents involving intoxicated drivers.

- During the 1987-89 time frame, Seattle-area incident management procedures demonstrated difficulty in clearing large accidents. This was evidenced by the disproportionate effect that accident severity had on increasing incident duration. It was recommended that Seattle improve its response to large incidents by providing additional personnel training and improving the access of necessary incident-clearing equipment to the scene.

The Jones, Janssen, Mannering multivariate statistical analysis was conducted over a single cross-sectional period. While single period data can reveal weaknesses in existing incident management practice, multi-period or continuously collected data are needed to quantify the before-and-after effects that a specific incident management alternative has on incident duration. The multivariate procedures demonstrated in the Jones, Janssen, Mannering article are ideally suited to such a before-and-after study and can be used to precisely quantify the effectiveness

Quantifying Incident Management Benefits

of the alternative, even in the presence of naturally varying factors such as traffic, weather, and so on. The procedure is to simply estimate before-and-after multivariate statistical models of incident duration and conduct a likelihood ratio test (which is chi-squared distributed) to test for the time-stability or model parameters (see Ben-Akiva and Lerman (1985)), as well as the magnitude and statistical significance of the reduction in incident duration resulting from the implementation of the incident management alternative. Schematically, this evaluation procedure is presented in Figure 3.1.

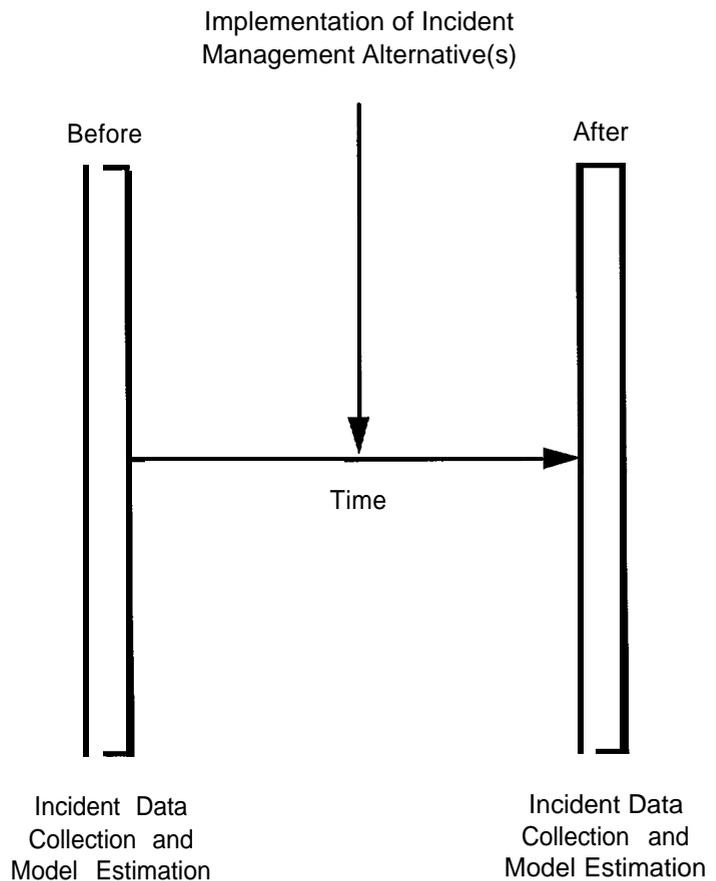


Figure 3.1 Schematic of Before-and-After Incident Duration Model Estimation

EVALUATING TRAFFIC IMPACTS

Quantifying Incident Management Benefits

The traffic measure of the benefit of an incident management alternative is not necessarily the reduction in incident duration time but, instead, the impact that the reduction has on traffic delay, specifically, the number of vehicle or traveler hours saved as a result of implementing the incident management alternative. One would expect the number of hours saved to be dependent on the following factors:

1. the reduction in incident duration attributed to the incident management alternative;
2. the location of the incident on the traffic network (e.g., major freeway, minor collector, etc.);
3. the time of incident occurrence (e.g., during rush hour, off-peak periods, etc.); and
4. the nature and amount of incident related information provided to drivers (so that some route diversion can be undertaken).

Because collection of real-time traffic information relating to route diversion, queue formation and dissipation, and travel speeds (on all routes) is beyond current technical capabilities, the evaluation of traffic impacts, in terms of travel times, is best undertaken using a suitable traffic simulation model.

A wide-range of traffic simulation models could be used to simulate an incident of known duration. A comparison of these models, with respect to key features, is shown in Table 3.4.

From an implementation point-of-view, many of the traffic models presented in Table 3.4 must be modified to evaluate incident-induced traffic impact because they were originally intended for other purposes (e.g., peak hour flows, signal timing, etc.). One model designed specifically for incident evaluation is XXEXQ. The application of this model to the Seattle area is described in Garrison and Mannering (1990). The required inputs for XXEXQ are similar to those required for most standard traffic assignment models. They include the following:

1. a peak-hour trip origin-destination matrix,
2. capacity and speed limits of all highway links on the traffic network,
3. the percentage of drivers assumed to be receiving and responding to traffic information concerning incidents,
4. the physical location of the incident being studied and its effect on roadway capacity, and
5. the duration of the incidents.

Table 3.4 Comparison of Existing Traffic Models

	CORFLO	CORQ CORCON	FREQ	INTRAS	MACK	RFLO	SCOT	TMODEL	XXE	XXEQ	SIMX
Year Designed	Ongoing	late '60s	late '60s	late '70s	late '60s	new	late '60s	mid-'80s	early '80s	late '80s	late '80s
Macroscopic/ Microscopic	macro	macro	macro	micro	macro	macro	macro/ micro	macro	macro	macro	macro
Deterministic/ Stochastic	det/stoch	det	det	stoch	det	det	det	det	det	det	stoch
Simulate/Optimize	sim	sim	opt	sim	sim	sim	sim	sim	sim	sim	sim
Arterial/Freeway	art/frwy	frwy	art/frwy	frwy	frwy	art/frwy	art/frwy	artlfrwy	artlfrwy	art/frwy	art/frwy
Methodology	user eq	min. indiv. trav. costs	user's choice	car fol- lowing theory	fluid flow	fluid flow	fluid flow min. cost	incr/iter	user eq.	sequential user eq.	utility max.
Changes	route	route	route	route	route	route	route	route	route mode	route	route/dep time
inputs											
Turning	yes	yes	no	yes	no	no	yes	no	no	no	no
Signals	yes	no	no	yes	no	no	yes	no	no	no	no
Geometrics (requirement — simple, intermediate, complex)	complex	simple	simple	complex	interm.	interm.	complex	complex	simple	simple	simple
Operation (require ment — simple, intermediate, complex)	complex	interm.	interm.	complex	interm.	complex	complex	interm.	simple	simple	simple
Outputs											
Queues	no	yes	yes	no	yes	implied	yes	yes	implied	yes	yes
Emissions	no	no	yes	Yes	yes	no	yes	no	no	no	no
Bus	yes	no	yes	yes	no	no	no	no	no	no	no

XXEXQ outputs include the following:

1. total vehicle travel time on the network,
2. traffic flows on all highway links,
3. traffic queues on all highway links, and
4. total vehicle miles of travel on the network.

XXEXQ employs a sequential user equilibrium algorithm to simulate incident-induced traffic impacts. Figures 3.2, 3.3, and 3.4 provide some examples of how XXEXQ's output can be presented to gain an understanding of a range of possible incident-related traffic impacts. Figure 3.2 shows the traffic impacts of various assumptions regarding the percentage of drivers receiving and responding to incident traffic information. Figures 3.3 and 3.4 show the impacts of a major freeway incident, of various durations, that causes a 50 percent reduction in roadway capacity. These two figures underscore the non-linear relationship between incident duration and travel time. The reader is referred to Garrison and Mannering (1990) for additional information on simulating the traffic impacts of incidents.

SUMMARY

As the preceding discussion has indicated, quantifying incident management benefits is not an easy task. The quantification of the effectiveness of specific incident management alternatives requires extensive data collection from accident reports, dispatch logs, and possibly other sources, as well as a multivariate statistical analysis of the collected data. This can be an expensive and time consuming task.

The assessment of traffic impacts resulting from incidents is best achieved by means of a traffic simulation model. While gathering the initial input data to run the traffic simulation model is a time consuming task (e.g., determining the origin-destination matrix, coding the highway network), once this initial barrier has been overcome, the model can be applied fairly inexpensively. Still, occasional updates of the data, particularly the origin-destination matrix, are necessary to ensure reasonably accurate traffic impact estimates.

Quantifying Incident Management Benefits

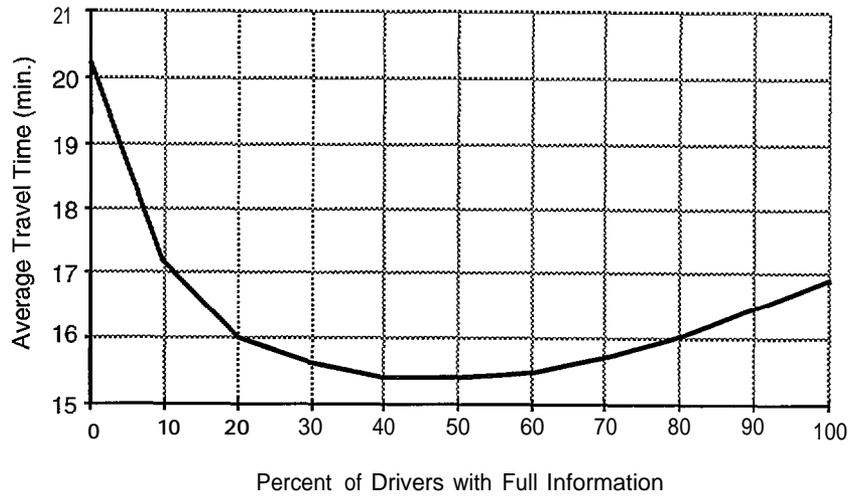


Figure 3.2 The Impact of Driver Information on Average Network Commute Time

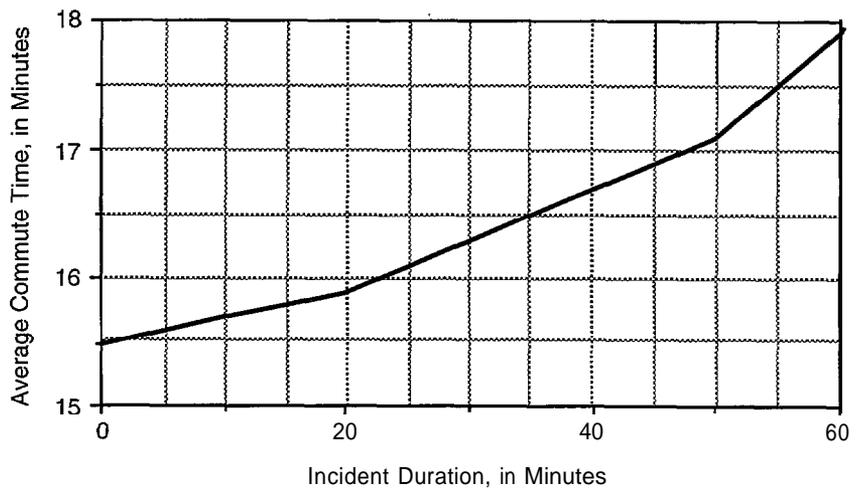


Figure 3.3 The Impact of Incident Duration on Average Network Commute Time

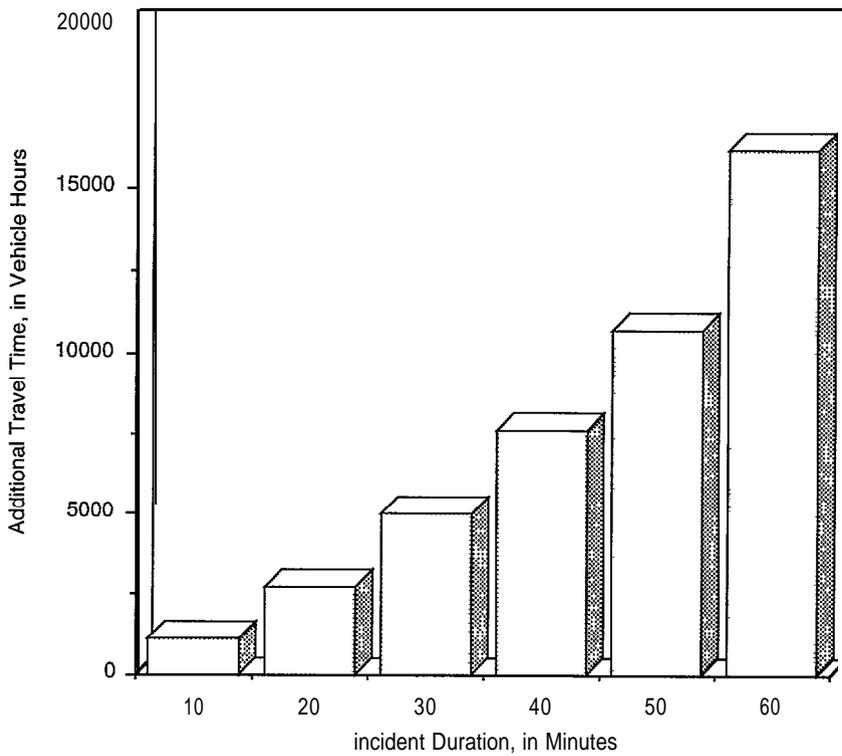


Figure 3.4 Impacts of Incident Duration on Total Network Travel Time

CHAPTER REFERENCES

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