

# **A Framework for Developing Incident Management Systems: A Summary**

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MANAGEMENT SYSTEMS:**

**A SUMMARY**

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## SUMMARY

The two reports produced by this study (*Framework for Developing Incident Management Systems* and *Development of Incident Management Systems: the Seattle Case Study*) contain a wealth of information relating to current incident management development procedures and those recently applied in the development of the Seattle Incident Management System. The primary intent of both of these reports is to provide a documented list of procedures and experiences that will aid in the development or enhancement of incident management systems in any U.S. metropolitan area.

The *Framework for Developing Incident Management Systems* report is composed of three major topic areas: (1) Systems Development, (2) Management Options, and (3) Process and References. The "Systems Development" section of the report provides an overview of how the systems approach to problem solving can be used to develop an incident management system. Details on the systems approach, as applied to incident management, include defining the problem, setting goals and objectives, developing alternatives, evaluating alternatives, selecting alternatives, implementing alternatives, re-evaluating alternatives, and refining the system. This section of the report provides a substantive basis for incident management system creation and is ideally suited to management personnel.

The "Management Options" section of the report presents details on all known incident management options (45 in all). These incident management options are grouped by those designed to (1) reduce detection and verification time, (2) reduce response time, (3) improve site management, (4) reduce clearance time, and (5) improve motorist information. Each incident management option is discussed in detail, with lists of its advantages and disadvantages, and information on costs, operation, and funding responsibilities.

The final section of the report, "Process and References," begins with a step-by-step approach to incident management systems development. This approach follows the guidelines of the "Systems Development" section of the report but presents the process from a "grass-roots" perspective as opposed to the management-oriented perspective of the systems development section. The final section of the report also includes information on quantifying incident management benefits, a bibliographic incident management reference guide, and a list of contact names, numbers, and addresses.

The second report developed under the project (*Development of Incident Management Systems: the Seattle Case Study*) presents a highly detailed evaluation of Seattle's incident management experience. The report begins with an introduction that discusses the extent of the incident management problem in Seattle. It then describes how the systems approach to problem solving was applied to develop Seattle's incident management system. Next, the report provides detailed observations on how specific incident management options were implemented in Seattle. Finally, it discusses special event conditions and provides recommendations and conclusions.

## CONCLUSIONS AND RECOMMENDATIONS

On the basis of the findings of the report *Framework for Developing Incident Management Systems* the following conclusions can be drawn:

- The systems approach to problem solving is well-suited to the development of incident management systems.
- A wide range of incident management options have been proposed nationwide, and the suitability of any particular option is very much dependent on local conditions.
- Step-by-step procedures for incident management system development should be of great value, regardless of the size of the metropolitan area.

With regard to the Seattle case study report, the development of the Seattle incident management program showed that several types of programs can be vital components of a comprehensive and efficient incident management system. These include the following:

- traffic management teams,
- a traffic operation center,
- dedicated freeway/service patrols,
- interagency communications,
- alternative route plans, and
- media ties

In developing these programs, several issues need to be considered.

- Resources need to be allocated or prioritized according to their impacts.
- The location of permanent facilities is key, both for use of the facility and resulting impacts.
- A range of costs usually exists; it is better to implement on a small scale with the potential to grow than to do nothing.

- **Interagency cooperation at both the field level and upper management level is vital.**
- **Adequate communication, both within agencies at each level and within the various levels of a single agency, is key.**
- **Incident management personnel need to be aware of the economics involved in the urgency of restoring the roadway capacity.**

**Each of these issues had to be addressed in the development of the Seattle area incident management program and need to be addressed in any developing program to ensure a successful and efficient incident management system.**

**In the Seattle area, the success of each of the component programs within the incident management system, as well as the success of the overall system, resulted largely because of a careful study of the problems at hand, well defined goals and objectives, comprehensive development and evaluation of alternatives, accurate selection and implementation of the appropriate alternatives, and a continued re-evaluation and refinement effort. In other words, in the greater Seattle metropolitan area, the use of the systems approach to develop a comprehensive incident management system has met with much success and is recommended for use in urban areas across the nation.**

## **INTRODUCTION AND BACKGROUND**

### **PROJECT MOTIVATION**

Incidents, which include vehicle accidents, disablements, spilled loads, or other random events, typically cause significant traffic delays in U.S. urban areas. According to a recent study of the nation's 37 largest urban areas by the Federal Highway Administration (FHWA), 60 percent of all freeway congestion in urban areas is caused by incidents. The cost to freeway users in 1984 was estimated to be \$5 billion in excess fuel consumption and motorist delay. By 2005, the FHWA estimates that 70 percent of all urban freeway congestion will be caused by incidents, with a user cost of \$35 billion.

Given the magnitude of the above figures, it is clear that incident management systems (specifically designed to mitigate the traffic impacts of incidents) are a critical component of any urban traffic management effort. The importance of an effective incident management system has been recognized in many major metropolitan areas, and management systems have been developed. However, the development of such systems has often been piece-meal because of a relative lack of knowledge about the effectiveness of alternative incident mitigation options and various funding and management limitations. Moreover, the interest of many key metropolitan areas in developing incident management systems has recently been kindled by traffic congestion concerns, and these areas are frantically seeking guidance in developing cost effective management systems.

Because of the growing nationwide interest in incident management, there was a clear need for a comprehensive information source that would provide a structure for developing incident management systems, as well as documentation that would demonstrate the applicability of that structure by means of a case study.

## **RESEARCH OBJECTIVES**

The objectives of this project included the following:

1. to develop a framework that would serve as a guide to agencies wishing to develop an incident management system,
2. to analyze the effectiveness and costs of various incident management options, and
3. to determine appropriate conditions for implementing various incident management strategies and to provide a case study demonstration.

## **RESEARCH APPROACH**

A review of existing literature indicated that the key to successfully fulfilling the objectives of this research study was to develop a framework approach that would maximize accessibility to the material both from managerial and "on-site" perspectives. To achieve this, the framework was structured around a comprehensive systems approach with a "Systems Development" section that is oriented toward managers (i.e., top-down) and a "Process and References" section that presents essentially the same material with a bottom-up emphasis. The framework also includes an extensive section on management options that describes all known incident management alternatives. All players in the incident management theater should find this section readily understandable and accessible.

Finally, to conclude the study, we provide a detailed description of the development of the Seattle area's incident management system (case study). This description follows the comprehensive approach detailed in the framework.

This case study provides the perfect companion to the framework document and, through descriptions of actual experiences, enables readers of the report to resolve any uncertainties that may be lingering regarding incident management system development.

It is strongly believed that this framework-case study research approach is the most effective way of conveying this important material. The presentation of the material in this way is likely to reach the largest possible audience and have the greatest impact.



## PROCEDURES AND DISCUSSION

### INCIDENT MANAGEMENT TASKS

In every urban area, agencies already perform some type of incident management. That is, someone already responds to incidents. Thus, the goal of an incident management system is not to create a response, but rather to create a more effective response from all cooperating agencies. Often, if an agency already has significant responsibilities for incident management, a formal "management system" may actually decrease the resources necessary to react to incidents. It may also allocate resources differently within the organization.

Incident management systems encompass five basic tasks. Even in the absence of a formal incident management process, these five functions take place. However, they take place less effectively and more slowly than if they had been conducted as part of a well planned procedure. These tasks include

- incident detection,
- incident response,
- incident site management,
- incident clearance, and
- motorist information.

These functions often occur simultaneously and in an iterative fashion. That is, the response to the incident may begin with preliminary information about the incident and then change as the incident is understood more clearly. (For example, the initial response to all incidents may be the same: send a police officer. On the basis of the results of that response, the needs identified for various incidents will differ, and any additional response for an incident will be based directly on those needs.) Within each of these five tasks there are numerous options (strategies). For example, Table 1 shows options for incident detection.



## **BASIC CONCERNS**

Inherent within each of the five tasks listed above are a variety of capabilities and problems that should be considered when measures are selected for inclusion in a management system. Each management technique considered, regardless of which task it relates to, involves six concerns (as shown in Figure 1): jurisdictional issues, geographical constraints, available resources, operational procedures, training requirements, and administrative coordination.

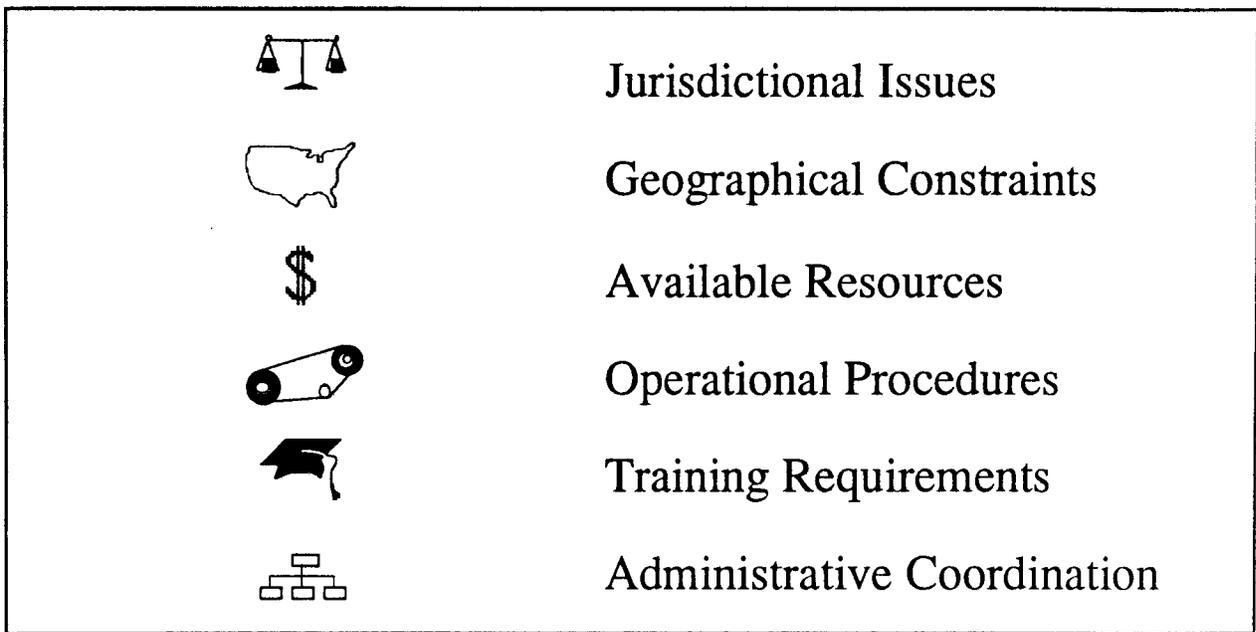
For most management techniques, one or more of these issues is trivial. For example, a management action that requires only one agency's participation does not involve interagency cooperation and thus requires no administrative coordination among agencies or agreements to smooth jurisdictional disputes. However, that same management technique may require extensive staff training or allocation of agency resources. The key to developing a successful incident management process is to identify the actions that both accomplish the most good (i.e., improve the five basic tasks to be accomplished) and have the least negative impact on the areas of concern listed above. Each area and agency that implement an incident management system has different strengths or weaknesses (i.e., some have funding but not staff, others have equipment and staff but poor relationships with other agencies), and thus the importance of any of these issues is case specific.

## **SELECTING INCIDENT MANAGEMENT STRATEGIES**

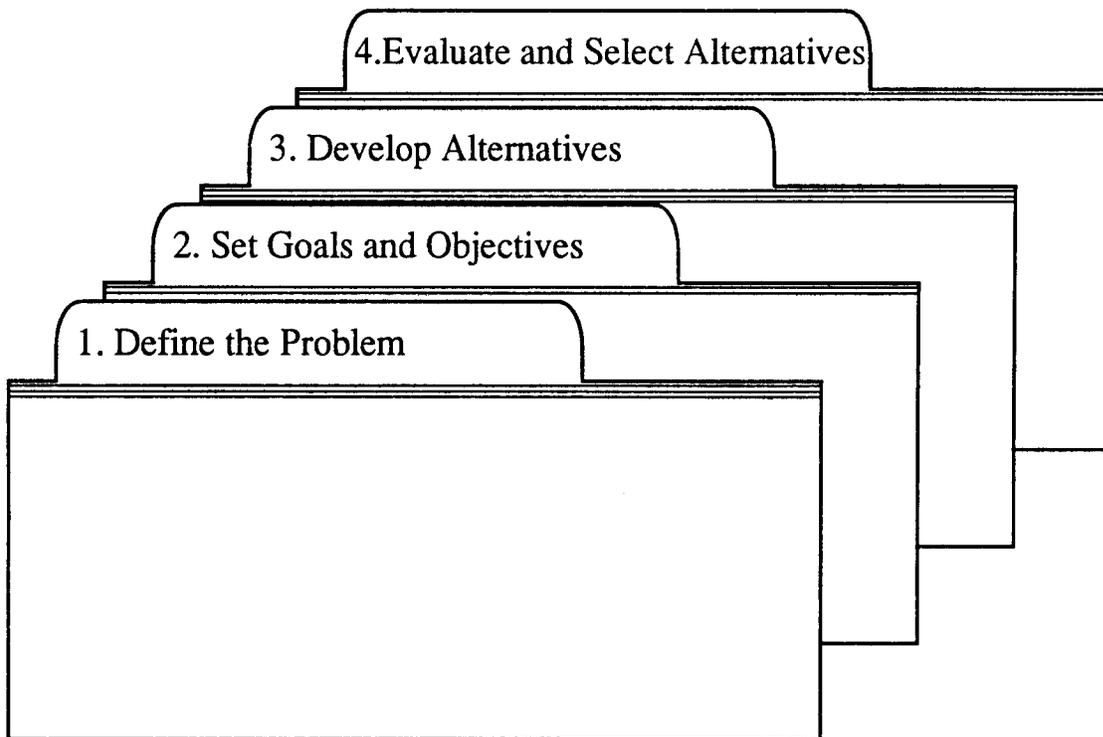
The recommended steps for designing an incident management system are as follows (see Figure 2): define the problem, set goals and objectives, develop alternatives, and evaluate and select from those alternatives. Each of these topics is discussed below.

### **Define the Problem**

The first step in developing a formal incident management process is to understand the problems that are occurring. Once the problems have been understood, the agency can then advance to the tasks of developing and selecting among the alternatives that address



**Figure 1. Six Basic Concerns**



**Figure 2. Steps Involved in Incident Management Strategies**

those problems. It is particularly important to understand the cause(s) of the problems being examined, not just the symptoms that an agency or area might be experiencing. Identification of the true cause(s) of the problems helps set the scope for the incident management process being developed.

### **Set Goals and Objectives**

Another major part of developing a successful incident management process is carefully defining the achievements that should result from that process. It is important to define the goals and objectives for the incident management system, and these goals and objectives should relate directly to the problems identified above. The selected goals and objectives must consider the perspectives of all participating agencies and should be common to those agencies whenever possible. Also important to the process of setting goals and objectives are the public's perception of the incident management system and the need to justify both the initial system and the continuing operation of the system to local public officials and (sometimes) state legislators.

### **Develop Alternatives**

Once the problems and intentions of the incident management system have been established, specific incident management alternatives should be reviewed. The full report, *A Framework for Developing An Incident Management System*, provides more detailed information on each of these techniques.

The techniques selected for further study should respond to the identified problems. They should also reflect the different roles, capabilities, and perspectives of the participating agencies. The alternatives should be judged by their ability to meet the stated goals and objectives, given their costs. In addition, the incident management alternatives selected should include measures that cover all five areas of incident management: incident detection, incident response, incident site management, incident clearance, and motorist information. If all of these needs are not addressed, the management process will not function as well as intended.

## **Evaluate and Select the Alternatives**

Once the list of alternatives for implementation has been developed, they must be evaluated with respect to each other and with respect to available resources. To make these comparisons, evaluation techniques must be selected and evaluation criteria must be developed. This selection process should include the agencies that will be involved in, or affected by, the incident response process.

## **IMPLEMENTATION**

Discussions with many of the agencies currently involved in incident management indicated that development of the "system" takes at least one knowledgeable, dynamic, motivated individual to lead the effort. That is, creation of enough impetus to overcome the natural barriers (turf, the need for funds, or reluctance to release resources) that impede the implementation of incident management systems requires an advocate within the lead agency. The advocate must work within his/her agency and with other agencies to build the administrative support and cooperation required for incident management to be successful.

## **RE-EVALUATION**

As noted earlier in this summary, it is important to re-evaluate the system that has been implemented (the initial evaluation having been undertaken before implementation). Re-evaluation allows the value of the incident management system to be proved or disproved. For example, it is valuable to measure the number of assists a new service patrol has made to indicate how many motorists have benefited from the system. Even better is a determination of how many times the service patrol has identified and cleared an incident that had yet to be reported through some other source, saving both detection and response time, as well as providing service to the individual motorists and general driving public. Furthermore, demonstrating the benefits a new system has achieved provides feedback to the people who supported the effort and will aid in both retaining the system

that is installed and expanding it if such expansion is warranted. Finally, the evaluation of the implemented system shows when and where refinements should be made to the system to further improve its performance.

### **SYSTEM REFINEMENT**

Because traffic conditions and political impressions change, every incident management system needs refinement over time. New incident management measures have to be undertaken. Arrangements between agencies and/or contractors have to be modified. Special needs develop because of new technologies and evolving land use patterns. The need for new or additional incident management techniques can often be determined from an ongoing evaluation process.

As a result of the great potential for change in traffic conditions, an effective incident management system must maintain an effective feedback loop that informs the managers of the system when problems occur, when members of the response teams have ideas to improve the system, and generally when changes of one kind or another are needed.

This feedback mechanism should exist for both the upper management/political levels of participating agencies and for the field crews who apply the incident techniques. The feedback provided through upper management and political channels will ensure that the incident management process continues to address the issues that are important to the political decision makers both inside the agency and within the general political climate.

Feedback from the field personnel should help identify specific operating problems or opportunities. This feedback loop will allow continued improvement in the operation of the system on a day-to-day basis. These improvements may include discarding the systems and procedures that do not work or are unsafe, or facilitating the development and implementation of new ideas that may work better.

The end result is a constantly evolving system that continues to improve the incident management process; continues to adapt to the changing needs of the local area; and continues to meet the needs of the participating agencies, the affected jurisdictions, and the motoring public.

## **APPLICATION AND IMPLEMENTATION**

The procedures summarized in the preceding section and discussed in detail in *Framework for Developing Incident Management Systems* were tested with the realities of Seattle's incident management system. The results illustrated the applicability of the framework and can be found in the project report *Development of Incident Management Systems: the Seattle Case Study*.

### **APPLYING THE SYSTEMS APPROACH**

The systems approach (defining the problem, setting goals and objectives, developing alternatives, evaluating alternatives, selecting alternatives, implementing alternatives, re-evaluating alternatives, and refining the system) was evaluated against the Seattle incident management system. In this evaluation, consideration was given to Seattle's predominate incident type, general traffic impacts, existing system operation, the influence of incident management programs from other U.S. metropolitan areas, and the presence of existing incident management efforts in Seattle.

### **OBSERVING SPECIFIC SEATTLE PROGRAMS**

After the systems approach had been applied, a detailed evaluation of specific incident programs was undertaken. The programs evaluated included accident investigation sites, alternative route planning, equipment storage sites, highway advisory radio, improved interagency radio communication, incident management manual, incident response teams, personnel training programs, surveying equipment, variable message signs, and modifications to account for special event conditions. The evaluation of these programs with the methods described in the report *Framework for Developing Incident Management Systems* clearly demonstrated the applicability and usefulness of these evaluation methods. Such an evaluation can be effectively used to develop new, and enhance existing, incident management systems.