CHAPTER FIVE

SUMMARIES OF EXISTING PRACTICES

PURPOSE

This chapter summarizes the results of current, formal engineering practices used by surveyed organizations in planning and evaluating traffic signal systems. The chapter concludes by identifying those traffic signal systems engineering topic areas lacking information on systems engineering processes. In addition, areas requiring future research and/or improved documentation are highlighted.

SUMMARY OF EXISTING METHODOLOGIES

Table 29 compares the use of engineering practices employed by cities and states with available systems engineering techniques. Items in the table denoted by asterisks indicate areas where methodologies are not documented in a way that can be easily located or used by practitioners.

The use of existing formal methodologies by practitioners is affected by the following:

- Lack of knowledge by practitioners of the existence of the methodologies.
- Lack of a user-friendly format.
- Strong design requirement needed to be compatible with existing systems or equipment.
- Organizational practices that discourage the use of system design methodologies such as (1) use of standard specifications or engineering practices in the

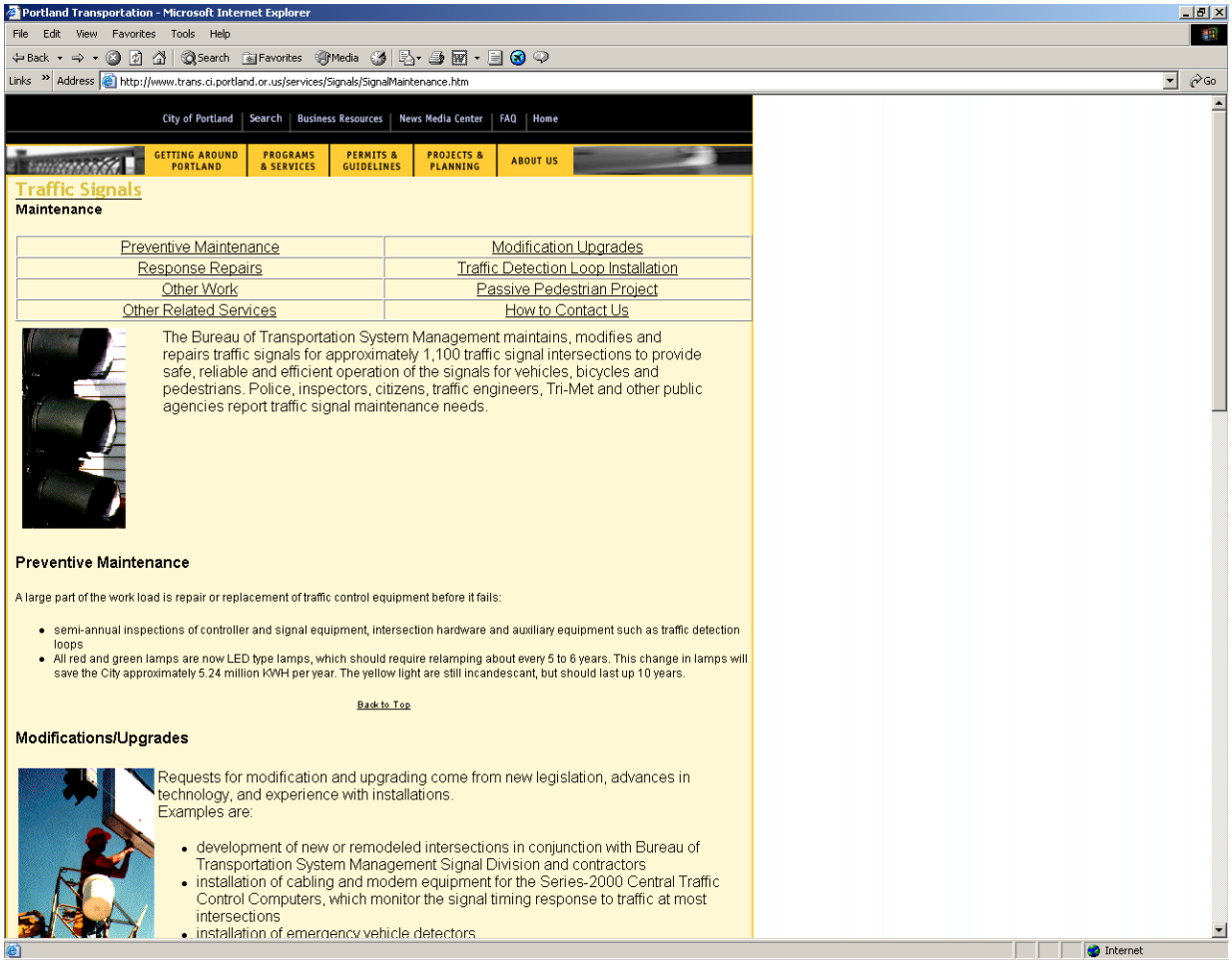

FIGURE 25 City of Portland (Oregon) Office of Transportation website describes current traffic signal maintenance practices. (*Courtesy*: City of Portland Office of Transportation.)

TABLE 29
SUMMARIES OF ENGINEERING PRACTICES EMPLOYED BY STATES AND CITIES WITH AVAILABLE TECHNIQUES

Topic	Currently Available Formal Methodologies	Use of Formal Techniques in Practice	Comments
Checklist of Traffic Signal Systems Engineering Requirements	Yes (e.g., structured analysis)	No	This document contains an initial checklist. The checklist may require additions or modifications.
Goal and Problem Definition	Yes	≈50%	
Project Management Approach	Yes	Infrequently	Some agencies use a formal scoping process.
Alternatives Evaluation	Yes	≈47%	
Project Evaluation	Yes	≈32% of states and 60% of cities	
Traffic Signal System Engineering			
Need for traffic signals	Yes	Nearly 100%	References MUTCD warrants and recommendations.
Signal timing	Yes	Mostly	Computer programs are widely used to develop timing plans.
Need for coordination of signals	Yes	≈42%	
Coordinated traffic control systems	No methodology description available for selection of system capability level.	Sometimes	Computer simulation is sometimes used as a design tool. Utility or Delphi approaches are sometimes incorporated in system planning. There exists a significant absence of available information.* Research is required to develop methodology.*
	Some information on system detector placement available but not widely distributed.	Sometimes	Recommend upgrading the presentation documentation and distribution of information.*
	Some information on Level 3-traffic responsive implementation available, but not widely distributed	Level 3 traffic-responsive operation is relatively infrequently employed, although Level 3 capable systems are widely used. Systematic techniques for establishing parameters are rarely used	Recommend upgrading the presentation, documentation, and distribution of information on Level 3 implementation.*
Communication System Engineering			
Selection of communication systems type	Yes, but requires update	≈28%	Often use methodologies other than formal methodologies. The integration of protocols such as NTCIP is a key issue. Recommend updating existing methodology to incorporate new technologies.*
Communication system design	Yes	Usually performed by design specialists	Detailed design guidance is often in other than traffic system literature.
Field Equipment Selection	Yes	≈35%	Generally used methodologies consist of evaluation of standard national specifications. Most agencies use these specifications and selection is made formally or informally.
Local Intersection Control			
Selection of local actuation strategy	Yes	Infrequently	Most agencies surveyed provide full or semi-actuation as design policy. Therefore, guidance is required as to when to employ the appropriate mode. Available guidance should be upgraded and represented in this way.*

TABLE 29 (*Continued*)

Topic	Currently Available Formal Methodologies	Use of Formal Techniques in Practice	Comments
Location and configuration of vehicle detectors for local actuation	Yes	Frequently	
Railroad and emergency vehicle preemption	Yes	Frequently	
Transit signal priority	Some information available	Information not available until recently	Effective design of transit signal priority is a technically complex issue. Insufficient information exists on when priority should be used, strategy selection, and design implementation.*
System Procurement	Yes	≈70%	Approach is often determined by agency policy and regulations.
Operations and Logistics			
Operations	In specific areas (e.g., signal timing)	Sometimes	Level of staffing and hours of staffed operation usually determined by experience and budget availability.
Maintenance	Yes	Most states and some cities	Many organizations have formal procedures for preventive maintenance and standards for field response requirements.
Training	Yes	Frequently used	Many organizations require and/or support maintenance training. Training for operations and operations support is often obtained from industry or by means of professional level courses.

Notes: MUTCD = *Manual on Uniform Traffic Control Devices*; NTCIP = National Transportation Communications for ITS Protocol.
* Indicates deficiencies in existing methodologies or their documentation.

selection of systems and equipment, (2) selection of signals for coordination, or (3) employment of local actuation.

- Lack of resources for operation and maintenance that may dictate the use of relatively simple and easy to maintain traffic systems and equipment. Figure 25 shows the city of Portland (Oregon) Office of Transportation "preventive maintenance" strategy.
- Designs constrained by specifications and practices developed for statewide use by the main office; although most state DOTs develop traffic system designs within the administrative region or division offices. Thus, the system designer is not fully free to establish the system design.

The traffic systems engineering processes discussed in chapter three focus on system design for a particular project in a particular location with goals established for that specific project. On the other hand, city and county traffic departments and state DOTs have, over time, developed specifications and design, operational, and maintenance practices that are perceived to best suit their needs as an organization, and to best satisfy their constituencies and stakeholders on an overall basis. Thus, it may not always be feasible or desirable to employ project-oriented systems engineering processes. It is, however, useful to close the gaps in providing information on systems engineering processes for these practitioners who are able to make use of it.

The following section summarizes those areas identified in Table 29 that require additional research or improved documentation.

- Checklist of traffic signal system engineering requirements—An example of a requirement set is provided in this document. it is subject to expansion or modification.
- Selection of system level (type of control strategy)—Current research does not provide the basis for a systematic selection. Research is needed.
- Placement of system detectors for Level 3 systems (centralized control, two-level distributed, closed loop)—The presentation of existing information should be made more accessible and user friendly to practitioners.
- Establishment of system parameters for traffic responsive operation for Level 3 systems (conventional strategies)—The documentation of methodologies for providing the database for traffic-responsive operation should be upgraded and made more widely available. The development of the database for Level 2 systems (time of day) is well understood by most traffic engineers. Most of the systems in use today are capable of operating at Level 3. For traffic-responsive operations, these systems generally employ either the First Generation Urban Traffic Control System control algorithm or a cycle, split, and offset selection algorithm based on detector threshold values. Most Level 3 capable systems currently operate

at Level 2. Although guidance exists for the development of Level 3 databases, it is not widely available and may not be easily used by traffic engineers. Documentation and its distribution should be improved.

- Communication systems—Existing methodologies for architecture and technology selection should be updated to reflect current technology and National Transportation Communications for ITS Protocol requirements.
- Selection of fully actuated and semi-actuated control strategies for field controllers—The existing documentation on the conditions for implementation and periods of use should be upgraded and made more widely available.
- Transit signal priority engineering—Additional guidance for selection of priority strategy, algorithm, priority locations, zones for priority request, and design implementation alternatives should be provided.