Transportation Management Centers—Bringing It All Together Through Staff Coordination

BY VINCENT PEARCE

THE TRANSPORTATION MANagement center (TMC) often serves as a focal point for coordination of transportation activity in its geographic area of responsibility. To carry out its functions, the Operations and Maintenance units of its constituent agencies must coordinate effectively around-the-clock. The purpose of this feature is to describe the types of interaction and coordination that are found in North American TMCs and to provide examples of successful practices. The basis for these findings includes detailed examination of operations and maintenance practices at nearly two dozen freeway, signal and transit control centers in the United States and Canada and inputs from two TMC peer meetings.

THE SETTING: A TMC AND ITS SYSTEMS

The TMC depends extensively upon automated systems to accomplish its goals. These systems monitor transportation resources, provide control from the TMC and distribute transportation information. In each of these activities, the efforts of one or more agencies must be coordinated to achieve optimal results.

The TMC's systems can typically be separated into two categories: those found within the TMC and those found outside, often referred to as "field equipment"; for transit management centers there are also vehicle systems. An extensive communications network may connect these resources, possibly containing multiple wireline and wireless technologies. In larger freeway or signal-control centers, field equipment may represent an investment of several hundred million dollars, deployed over as much as 20 years.

As with any transportation infrastructure, the systems require both preventive and response maintenance to be functional when they are needed. Most systems are monitored for operational status, with malfunctions reported to the TMC. Thus, the TMC is able to initiate action to return the systems to acceptable operational condition, or is able to adapt operational procedures to compensate for loss of the services of systems that are currently out of service.

TYPICAL ORGANIZATIONAL RELATIONSHIP OF OPERATIONS AND MAINTENANCE

The interaction between Operations and Maintenance units would be relatively simple if their objectives were identical, if resources were unlimited and if they reported to a single organizational leader. This is seldom the case. In the majority of TMCs studied, most maintenance functions reported to a different organizational lead than did TMC Operations. Internal TMC systems are often the responsibility of a systems staff component of the TMC Operations organization. Thus, a repair effort may require coordinated efforts of all three of these units, along with possibly partner agencies such as the city or county (depending upon the location and type of malfunction) and public utilities.

FORMS OF INTERACTION

As mentioned earlier, Operations and Maintenance units commonly interact to keep the TMC's internal and field systems acceptably operational. This is only one form of interaction between the two, however. A more complete list of common situations requiring interaction includes:

- Identification of devices that have failed or are not performing to specification. A common example of this would be detecting that a ramp meter is not functioning after being knocked down by a vehicle. Typically Operations would receive notice of the knockdown either automatically through the system, or through notification by the public, law enforcement, mobile operations personnel, or possibly even from Maintenance. Operations would then verify the loss of operational status and perhaps investigate the situation with closed-circuit television, if video coverage of the site is available. Operations would then report the situation to Maintenance, who would place this repair request in its activity queue, assigning a priority agreed upon with Operations;
- Diagnosis, repair, testing and bringing those devices back online. The interaction does not stop at the point where Maintenance is informed that a unit needs repair. If the malfunction is not obvious, Maintenance may request that Operations further investigate the failure through various system interactions to most clearly identify what specific problem exists. For example, if signals at an intersection have returned to fixed-time operation, Maintenance may request that the TMC check through the system to determine if the controller has malfunctioned or if communication with the intersection has been lost. The interaction

continues during repair and testing of the failed unit, in much the same way. Once Maintenance has taken repair action, there will likely be two-way interaction to bring the unit back online and to verify that it is performing acceptably;

- Adjusting devices for optimal performance. When monitoring traffic conditions, the TMC has the ability to note where adjustments of field equipment could result in superior performance. Examples would include adjustments of ramp meter or signal timing. In cases where the opportunity for improvement is noted, but where TMC Operations cannot achieve these improvements (most commonly for devices in local control mode), Operations can request that Maintenance make adjustments from the device site that will result in superior performance. This activity includes both devices in steady-state operation and adjustments of device operation for special circumstances such as parades or other special events. In California, Caltrans Maintenance may be requested to alter the timing of specific ramp meters to facilitate egress of traffic from special-event venues;
- Bringing new equipment online. As new devices are installed, the interaction to bring them online and verify their operational status is similar to that for bringing a repaired unit online. This interaction is most commonly initiated from the field, either by Construction or Maintenance units. In this case, TMC Operations would verify that the device has been identified to its central databases, that proper operational parameters are downloaded or are already present in the device, that the device has been recognized properly by and can be addressed by the central control system and that the two are communicating properly; and
- Implementing equipment upgrades. Particularly with reference to equipment within the TMC, upgrades and modifications are common. Many of these devices contain significant software, including operating systems commercial software such as database management systems and custom software. Each of these is subject to ongoing releases through each year. Maintenance would develop a plan for such upgrades, in coordination with Operations. The focus of this plan would be to implement the upgrades with minimal disruption to core operational hours but also to have thorough testing executed by Operations.

BENEFITS OF EFFECTIVE INTERACTION

The benefits to both organizations of an effective interaction are immediate and quite visible. Maintenance is able to efficiently plan the use of its limited resources each day and is able to respond to Operations' priorities as best possible. Information may be available from Operations that allows Maintenance to be considerably more efficient in making repairs, by having taken to the site the proper personnel, documentation, tools, test equipment and replacement parts that are most likely to be needed.

When the two units are interacting effectively, Operations is able to implement interim procedures that allow it to work around failed devices and is able to get priority equipment online sooner. Thus, it is able to implement superior solutions to addressing the agency's transportation management goals. Stress level within the TMC also is reduced, as Operations staff encounter fewer cases where equipment is malfunctioning or offline when it is most needed.

For required, nonemergency actions such as system upgrades, effective coordination will allow Maintenance to minimize overtime costs. Maintenance also is able to work through implementation problems that are spotted by Operations during testing, before the system is fully operational. Operations will benefit by experiencing minimum disruption to core operational periods, by receiving upgrades that provide additional desirable functionality, by having such upgrades delivered after they are operationally stable and by being able to participate in the testing of the upgrades.

METHODS OF INTERACTION

Operations and Maintenance may interact over a variety of communications media. These would commonly include: telephone, fax, pager and two-way radio but also may include interaction electronic mail.

Highly integrated interaction can be found in situations where the maintenance management system used by Maintenance to track maintenance activity and device status is integrated with Operations' computer system. This level of integration potentially provides Operations with information on current and planned Maintenance activity and equipment status and allows Operations to provide device status details that may later be useful to Maintenance. This could include information that does not require Maintenance activity, such as when Operations has to "recycle" a unit off and on to get it to function properly.

EXAMPLES OF EFFECTIVE INTERACTION

In the process of studying TMC activity, several interesting situations were identified that have proven highly successful in their particular circumstances.

Houston TranStar

Texas Department of Transportation (DOT) Operations staff at the Houston TranStar TMC exchange equipment status information electronically with the Texas DOT Maintenance staff and maintenance contractor who work from another location. They have established a spreadsheet that contains equipment status and activity information. This spreadsheet is passed between the two units at least daily. At the time of our study, some TMC systems were still under integration. Because of this, the Operations staff daily verified the operational status of all field equipment and reported findings to Maintenance on the spreadsheet. The spreadsheet also served to inform the incoming a.m. Operations shift of maintenance activity that had occurred during the previous evening shift and of changes in status of any devices.

The spreadsheet also allows Texas DOT to track problem categories and performance of specific devices. This provides feedback into the design and construction

processes with regard to which devices are best suited to supporting their objectives.

Caltrans: Maintenance Dispatch

In the typical Caltrans urban TMC, repair of a malfunction may require coordination of Operations with both TMC Support and District Maintenance units. TMC Support performs maintenance related to software and systems, and Maintenance deals with most other remaining repair requirements. Communications failures also may require involvement of the local carrier or of the telecommunications arm of California state government, who usually have personnel located at the district offices.

Primary contact between TMC Operations and Maintenance occurs through the Maintenance dispatch center. This process works well, since the TMC's operations may cover a region supported by several Maintenance area offices. Thus, the Maintenance dispatch center not only contacts the correct area but also directs the information to the appropriate Maintenance functional unit within that area.

ATSAC

Since the ATSAC system in Los Angeles, Calif., USA, polls all field devices once per second, operational failures (flashing traffic signals, communications failure, etc.) are detected and reported rapidly. The system provides an audible signal (beep) and display flashers to notify an ATSAC operator of a failure. The ATSAC operator typically contacts Maintenance dispatch by telephone or radio within one minute after receipt of the automated notification. The dispatcher informs the Maintenance technicians of the malfunction. The technicians are assigned to specific geographical areas within the city. The priority of response is determined based on the nature and severity of the reported problems.

The maintenance and procurement responsibilities within the ATSAC system are divided based on the technologies applied. The Central Yard or Electronics Development and Repair Laboratory is responsible for maintaining and procuring ATSAC communications backbone and associated electronic technologies, including hardware, equipment and unique devices such as changeable message signs and highway advisory radio units.

There are three regional Maintenance yards, which are separate from the Central Yard. The regional yards provide the manpower and replacement equipment for conventional traffic control units and the equipment and tools necessary to test them. The regional yards also construct some new traffic signals; contractors construct the remaining new traffic signals citywide.

Long Island INFORM

The INFORM program on Long Island has procured the services of a maintenance contractor for several years. INFORM's computer system automatically detects field-device failure and causes the operator map interface to change the color of the device icons to indicate a change in operational status. The system also provides screens that indicate device status and equipment status reports that can be printed. Both automatic and manual logs of equipment status changes are maintained. There is also a signal-failure-management tracking system.

Operations is in two-way radio communication with Maintenance technicians, who report back to operations when repairs are completed, so operations can retry device access/control. All maintenance calls are logged by Operations. Operations also receives summary repair reports from Maintenance roughly weekly.

Operations meets weekly to discuss maintenance issues and meets biweekly with the maintenance contractor. The Maintenance contractor's work is inspected by an independent consultant.

INFORM also has a preventive maintenance program in which field equipment of maintenance contractors is periodically inspected. It also has programs for relamping VMS, balancing signal levels on its coaxial communications cable and changing filters.

CONCLUSION

Effective integration of Maintenance and Operations efforts in transportation management is a mutually beneficial relationship. The rapid movement of information and execution of complimentary support activities moves the transportation management program forward and allows the TMC to carry out its role in achieving the region's transportation objectives.

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