3 MAINTENANCE MODEL

As was discussed in last chapter, ODOT stakeholders often mentioned the lack of a clear set of procedures and guidelines to direct how ITS maintenance activities are performed. Such a set of procedures, which will be referred to as a maintenance model, is intended to describe how problems are reported and verified, who is responsible for tracking the maintenance process, and what roles and responsibilities ODOT staff have throughout the process.

A Technical Memorandum from this project (11) presented four maintenance model concepts. Development of each of these concepts was guided by the following assumptions.

1. Each alternative should build upon the existing ODOT organizational structure.

2. Each alternative should include systematic logging and tracking of maintenance.

3. Additional staff will be available for ITS maintenance, although the maintenance model will be used to help identify how these staff should fit into ODOT's organizational structure.

These concepts were subsequently revised for presentation to ODOT in a series of stakeholder meetings that were conducted in August 1999, and are discussed in greater detail in Appendix C. Based on these stakeholder meetings, the two-tier maintenance model was selected as the preferred alternative. This chapter will describe how repair maintenance activities are processed under this model, the roles and responsibilities for various ODOT staff, and recommendations for further action.

3.1 Description of Process

The philosophy behind the two-tier model, as shown in Figure 3-1, is to classify each ITS device into one of two tiers. One tier would consist of "mainstream devices" – i.e. devices which have become standardized within ODOT and for which repair training is adequate for ODOT to be capable of handling nearly all diagnostic and repair capabilities in-house. This would include devices such as traffic signals, ramp meters, and road and weather information systems (RWIS). In some cases, a device may be mainstream in one region but not in another due to broader deployment experience. For example, closed-circuit television (CCTV) cameras would likely be mainstream in Region 1, but they may not be mainstream yet in some of the rural regions. The second tier would be comprised of what are termed "emerging technologies" – i.e. devices which may be limited or non-standardized in deployment. Emerging technologies would be classified not necessarily as technologically new technologies, but technologies that are relatively new to ODOT. Therefore, this would include new technologies such as travel time estimation and automatic incident detection systems, as well as older but non-standardized technologies such as variable message signs (VMS). Over time, perhaps as long as five to ten years, it is hoped that emerging technologies would become "mainstreamed."

One significant feature of this model is the creation of a regional ITS support coordinator position to be on the front line for ITS maintenance. The support coordinator would be expected

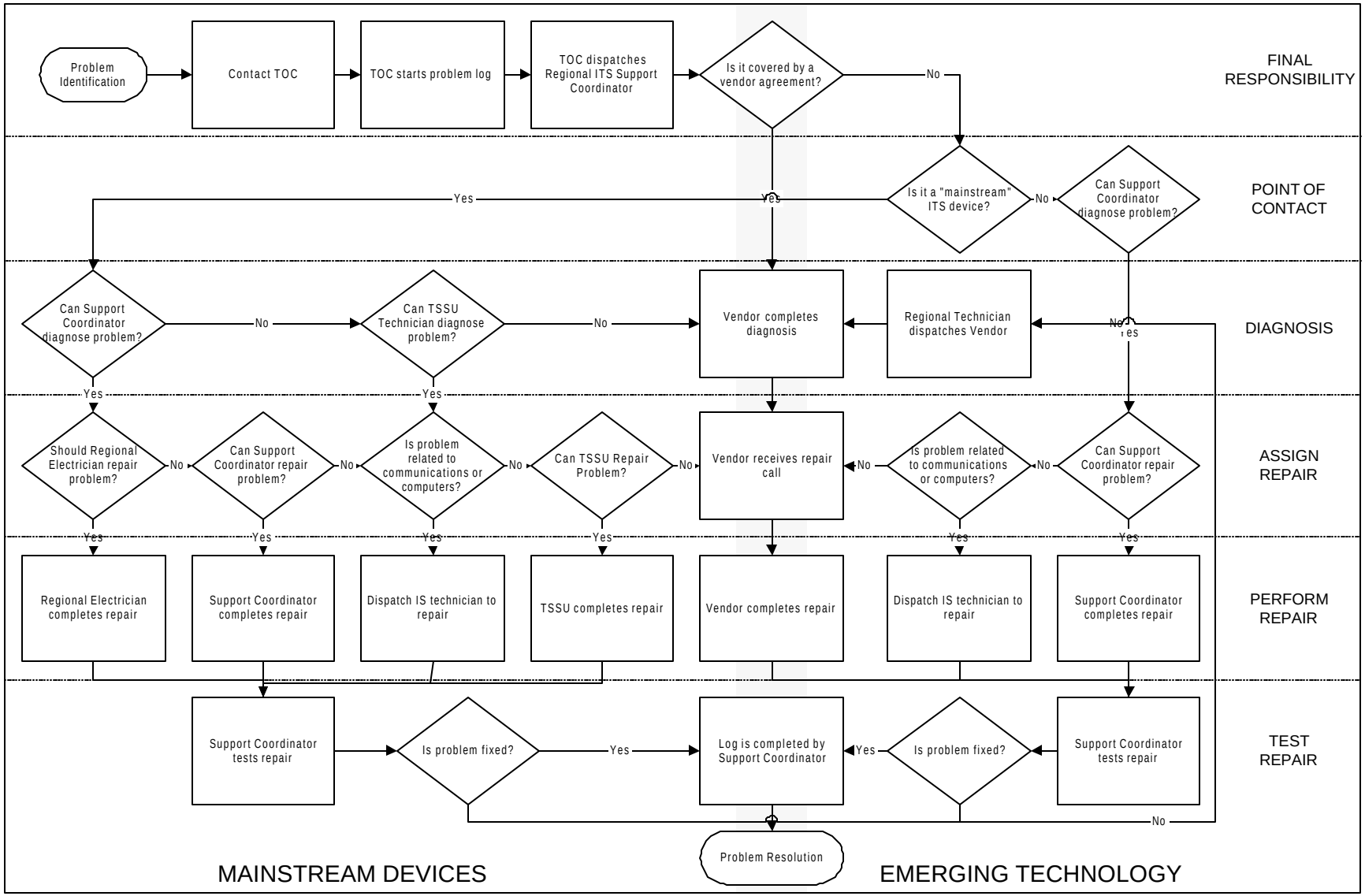

Figure 3-1: Repair Process for Two-Tier Maintenance Model.

to be capable of performing most device diagnostics, some device repairs, post-repair testing and logging. More importantly, however, the support coordinator is expected to be able to identify individuals with the appropriate skills to handle maintenance needs when they occur, and to track the repair until it has been successfully remedied.

The order of the repair process itself differs depending upon which of the two tiers the particular device falls under. For mainstream devices, the process is organized as follows.

- Problem diagnosis. Once a problem is reported, the support coordinator dispatches a regional electrician to diagnose the problem. It is assumed that the electrician will have adequate training to be able to successfully diagnose, if not repair, most ITS problems. If the electrician is unable to diagnose the problem, the electrician will report it to a TSSU technician. If the TSSU technician is unable to diagnose the problem, the TOC is notified and dispatches vendor service to perform a diagnosis.

- Problem repair. Whoever is able to diagnose the problem has significant responsibility in determining how the problem will get resolved. If the electrician diagnoses it and is able to fix it, the repair will be made as soon as possible. If the electrician has diagnosed the problem but is not technically competent to fix the problem, the electrician will contact the next appropriate level of support. If the problem is identified as occurring in the field device, a TSSU technician would be dispatched to complete the repair. For other problems, such as network connections, communications support, and computers for back-end ITS support, an Information Services technician would be assigned. If ODOT staff is unable to repair the problem, the vendor is dispatched.

- Solution testing. After the repair has been completed, the next step is to confirm that the repair has been successful. This requires testing the ITS device to ensure that it is working properly. The regional electrician would be in the field to ensure the device is working properly, although they may need to coordinate with others to perform testing (such as sending test messages to a VMS).

- Logging and tracking. Documentation is needed to track the problem from the beginning of the repair process to repair completion. A paper tracking system may be used, where the paper is handed off from one technician to the other during the process, noting all maintenance tasks performed, until the repair is completed. In the long-term, this system may be supplemented or replaced with a purely computerized system, perhaps using personal digital assistants (PDA) to enter and receive data.

For emerging technologies, the repair process is as follows.

- Problem diagnosis. Once a problem is reported, the support coordinator will make the first effort at diagnosing the problem. If necessary, the regional support coordinator may seek TSSU support to help diagnose the problem. If the regional ITS support coordinator cannot diagnose the problem, the support coordinator would contact the vendor.

- Problem repair. The support coordinator will fix the device to the extent they are capable. In some cases, they may make simple repairs for which a vendor could be called but is unnecessary to do so, such as re-booting a server. It is not expected that the support coordinator will be capable of resolving all ITS problems, but this individual should be able to readily identify who needs to be brought in to fix problems. Information Services would be brought in for communications and computer-related issues outside of the field device, while TSSU would be dispatched for problems at the field device level.

- Solution testing. After the repair is completed, the support coordinator is responsible for verifying that the repair has been successful.

- Logging and tracking. The regional support coordinator is responsible for logging and tracking maintenance activities upon being contacted by the TOC. It is the support coordinator's responsibility to complete the maintenance record, identifying actions taken, individuals contacted, and the corrections made.

3.2 Roles and Responsibilities

Table 3-1 highlights the roles and responsibilities of ODOT staff under the two-tiered model. The TOC is responsible for initiating requests for maintenance, but the problem is then handed off to the support coordinator for resolution. The regional support coordinator would be the single point-of-contact for maintenance, and would have a role in training the regional electricians, but they would also be responsible for handling the maintenance of emerging technologies. The support coordinators will need to be in a continual learning mode in order to stay abreast of current and future ITS deployment technologies. At the district or regional maintenance level, electricians will likewise need to be in a continual learning mode in order to become increasingly familiar with more technologies as they are mainstreamed. Information Services would have maintenance responsibility for ITS components beyond the field device, including back-end computer support and communications linkages between the field devices and the TOC.

3.3 Remaining Issues

Stakeholders agreed that the two-tier model was philosophically preferable, but there was some concern about some of the details. This section highlights the major issues stakeholders raised in connection with the two-tier model. These issues have been, or are in the process of being, addressed as ODOT works on implementing the preferred model alternative. Issues are divided into three broad categories: organizational issues, technological evolution, and staffing and training. Although some preliminary recommendations are provided in some instances, it is beyond the scope of this maintenance plan to fully address these questions.

3.3.1 Organizational Issues

Where does the ITS support coordinator reside? Based on input collected from the stakeholder meetings, it was preferred, if possible, to locate the support coordinators at a regional level in the same building as the TOC. This would improve coordination activities.

ODOT Organizational Unit / Title	Primary Role	Primary Maintenance Responsibilities
TOC	Oversight for ITS maintenance	• Initiates the maintenance process • Initiates the maintenance record
Regional ITS Support Coordinators	First line of ITS maintenance	• Determine if vendor should be first point of contact for a particular repair • Coordinate repair activities • Track entire maintenance process Mainstream Devices • Lead field repair efforts after unsuccessful repair Emerging Technologies • Diagnose most ITS problems • Repair problems to the extent they are capable • Test repairs • Complete repair log
District/Regional Maintenance Staff	First line of ITS maintenance for mainstream devices; no responsibility for emerging technologies	Mainstream Devices • Perform initial diagnosis • Repair problems to the extent they are capable • Test repairs • Complete repair log Emerging Technologies • No ITS maintenance responsibilities
Information Services	Second line of ITS maintenance	• Repair problems related to communications and computers for back-end ITS equipment including network connections to roadside devices
TSSU	Third line of ITS maintenance for mainstream devices; no responsibility for emerging technologies	Mainstream Devices • Diagnose and repair problems beyond capability of regional electricians for roadside devices and sensors Emerging Technologies • No maintenance repair responsibilities
Vendors / Contractors	Last line of ITS maintenance for mainstream devices and emerging technologies	• Fulfill vendor maintenance agreements • Diagnose and repair problems beyond ODOT capabilities

Table 3-1: Maintenance Roles and Responsibilities.

Who does the support coordinator report to? It is envisioned that the support coordinator would report to different individuals for different duties. The support coordinator would report to the regional TOC for billing purposes and for learning of current maintenance issues. It is also envisioned that each support coordinator would report to the recently created ITS standards engineer position in Salem. This would promote information sharing across regions and to allow the support coordinators to cover for each other during vacations or evening and weekend hours.

How does the support coordinator manage maintenance once it goes into other business units, such as Information Services and TSSU? One concern raised by many stakeholders is that the support coordinator would lose some control in problem resolution once they had to hand it off to a different business unit. In some cases, moreover, these business units are not necessarily homogeneous, one-stop entities. If a device is malfunctioning due to what has been identified as an area Information Services is responsible for, there could still be many individuals within Information Services who need to be contacted, depending if it's a hardware, software, server, network, communications or other issue. In order to avoid this, it is recommended that each unit that is involved in ITS maintenance, including Information Services, TSSU and the maintenance districts, identify a single point-of-contact who could shepherd maintenance through that unit. These contact people need to work with each region's support coordinator to develop an understanding of the role of ITS in ODOT's mission and an understanding of which maintenance activities are of highest priority in fulfilling the mission.

Who decides that contract maintenance support needs to be brought in? It is recommended that this decision be made at a local level and that it be coordinated at a statewide level. This may improve the ability to acquire more favorable contractor relationships.

Who manages maintenance support contracts? Maintenance support contracts should similarly be managed at a local level, with a statewide perspective in mind.

3.3.2 Technological Evolution

Who makes the decision about what is mainstream technology versus what is emerging technology? The ITS Technical Working Group likely represents the best forum for appreciating when a technology may be considered mainstream. They have the best statewide perspective within ODOT about the pace of technological innovation with respect to ITS.

Can the evolution decision be made at a local level? Yes; however, this decision ought to be coordinated through the ITS Technical Working Group to promote the coordination of ITS activities throughout the state.

3.3.3 Resources and Training

What is the skill set for the support coordinator? The following are recommended skills that the support coordinator should have.

- Contract administration. The support coordinator will have significant interaction with vendors and contractors, and needs to be able to administer these contracts appropriately.

- First-level diagnostic capabilities. The two-tier model places the support coordinator at the front line for diagnosing emerging technologies. Since emerging technologies are more likely to have self-diagnostic capabilities or rely on solid-state "black box" technology, diagnostics may require less technical skill in the future.

- Some electrical knowledge. If the support coordinator has some electrical knowledge, this may reduce the need for electricians to travel to remote locations to address simple electrical repair needs.

- Some systems/networking knowledge. Similarly, the support coordinator should have some elementary computer knowledge in order to be able to repair simple problems on their own, such as re-booting a server, testing network connectivity, etc.

- Licensing. While licensing may be valuable for repairs involving electrical or communication systems, a licensing requirement would tend to make this skills set practically impossible to fulfill. Therefore, it is recommended that this position not require any special licensing or certification. The support coordinator should learn what types of repairs require licensing or certification to complete, and which ODOT technicians have the appropriate background to do those repairs.

Can people with these skills be recruited and retained? This rhetorical question is a natural outcome of examining the desired skill level for the support coordinator position.

Does an appropriate job classification exist? In the positions approved for the Traffic Management Section, the support coordinator position was designated as Traffic Signal Technician-2 (TS-2). Based on the skill set, it may be necessary to classify the position as a level 5 Information Services technician (IS-5), or perhaps create a new classification.

How do you balance the recently approved additional ITS unit FTEs versus the number of needed support coordinators? The three approved support coordinator positions would not allow there to be one support coordinator for each of the four existing TOCs, or for the fifth planned TOC. There are a few potential solutions to this problem, each of which has some disadvantages.

- Use a contractor. Contract support could provide a fairly immediate method for staffing each of the TOCs with a support coordinator. The principal drawback in using contract support for this position is that the position will be most effective when the support coordinator can establish long-term relationships throughout ODOT to expedite maintenance activities. Furthermore, it would be philosophically preferable to have the support coordinator positions filled by ODOT staff in order to foster a sense of organizational "ownership" of ODOT's ITS infrastructure and to allow it to become integrated into ODOT's mission alongside more traditional maintenance activities.

- Have support coordinators centrally located (in Salem) until a sufficient number of coordinators can be obtained to staff each of the regions. An arrangement like this would encourage the support coordinators to work together as a team. This solution has the disadvantage of preserving a separation between operations and maintenance functions in each of the regions. Once additional positions are obtained, would ODOT be able to keep these individuals in those positions and yet move them to different regions of the state? Moreover, it would become increasingly complicated for the support coordinators to perform first-line diagnostics and basic repairs when they may be several hours distance from malfunctioning devices.

- Allocate the three support coordinators over the entire state. Under this concept, one support coordinator might be responsible for northwest Oregon including Region 1 and northern Region 2, another support coordinator would be responsible for southwest Oregon (Region 3 and the remainder of Region 2), and the third coordinator would be responsible for Regions 4 and 5. This would allow ODOT to implement the two-tier model, with a single point-of-contact, on a statewide level while allowing for room to grow as additional support coordinator positions are obtained. One question with this possible solution is whether the three support coordinators could adequately handle the workloads without suffering professional burnout.

- Postpone implementation of the two-tier model until additional positions are obtained. This solution looks at implementing the two-tier model as an "all-or-nothing" proposition. Due to the time lag that exists between realization of a staffing need and ODOT's ability to procure an FTE, this solution would likely promote inertia and reduce the likelihood of many of ODOT's current ITS maintenance problems being remedied in the near future.

How do you cover 24-hour/7-day operations with one FTE per region? ITS devices may not always malfunction during regular business hours. Accordingly, the support coordinator role needs to be provided in some capacity to match the 24-hour/7-day operational needs of many ITS devices. One potential solution is to have the support coordinators work as a coordinated team, with them rotating to take turns being on-call during evening and weekend hours. This will succeed only if two things occur. First, the TOCs must prioritize when maintenance issues warrant after-hours support. This relates to the regional prioritization of ITS maintenance, which was discussed in the first technical memorandum. Second, the workload of the support coordinators must be manageable enough during business hours that on-call duty will not be perceived as a time-consuming burden. Otherwise, this will increase the difficulty of recruiting qualified people for these positions.

How do you provide training for emerging technologies? It is likely that basic maintenance training would be provided for support coordinators (and perhaps a couple of maintenance staff) upon device deployment[4]. The challenge for ODOT will be to ensure that there is a technology transfer from the few who learn the maintenance procedures initially to the many who will need to know it upon large-scale device deployment.

[4] See Chapter 6 for a more in-depth exploration into training issues.