

Figure 4-1. Progressive Point Estimates of MTBF

Based on the fact that the MTBF (or the failure rate) of the various subsystems has not reached a steady state, the frequency of the outages will generally be reduced even without major upgrades to the system. However, this statement is not true when assessing the system's MTTR trends. For the short run, the most urgent need is to improve the maintainability, such as having an adequate and better-trained support staff. A required strategy is to amend all identified weak points in the system and infrastructure, particularly, the single points of failure identified in Section 3. This will improve the overall system availability by:

- Reducing the vulnerability to system-wide failure and consequently increase the uptime.
- Providing automatic switchover to the backup and thus effectively reduce the downtime.

The HEC incident report shows that 6 out of 15 system failures since the system went live involved human or procedural errors, and they account for 78% (32.08 hours / 35.73 hours) of the total unexpected outage downtime. The outage history indicates that, not only did the maintenance staff from Northrop Grumman and HP make mistakes; they also seemed to complicate the problems further resulting in a very slow recovery of the system. Some problems leading to human errors may have been intrinsically difficult. Nevertheless, improvements in the skill level of the maintenance staff may help to increase the MTTR and, thus, improve the availability of the system.

4.3 Workload and Performance Assessment

The MITRE team observed the operations of the CAD system during several on-site visits and interviewed management staff, call takers, and call dispatchers to discuss system performance. During these discussions, concerns were raised about the performance of the system during busy time periods and when upgrades were made to the system. In order to attempt to determine whether the workload of the system impacted system and performance, call volume statistics and

data were gathered. This data identified call volume statistics handled by the various departments for the period of January 2004 to December 2004. A secondary analysis was to try to determine if the demand level pointed out a probable cause for some of the system outages that occurred at HEC.

System performance can be affected by the amount of demand using the system. There are three major types of demands that require system resources and may contribute to component wear out and cause degradation in system performance. These three types are:

- (1) 911 (including 10-digit calls) call volume statistics.
- (2) Call takers and dispatchers use of the CAD systems.
- (3) Police and Fire/EMS units and stations that have to respond to the dispatching assignments and make information queries.

Among those three types of demands, only the call volume statistics has data available for each hour during the assessment period. A more useful demand data will be the staffing level records (how many call takers and dispatchers are connecting to the system at each hour), which corresponds to the second type of demands. A series of charts of call volume data are presented in Appendix D. As an example, Figure 4-2 shows the chart for November 2003 (prior to the acceptance). The purpose of the analysis is to determine whether there is any correlation between call volume and outage occurrences. Each chart covers a one month interval within the assessment period. The call volume value includes all calls for Fire, EMS, and Police events. Each data point is the call volume for the corresponding hour. Each triangle on the chart indicates the start time of one of the seventeen outages since the system went live.

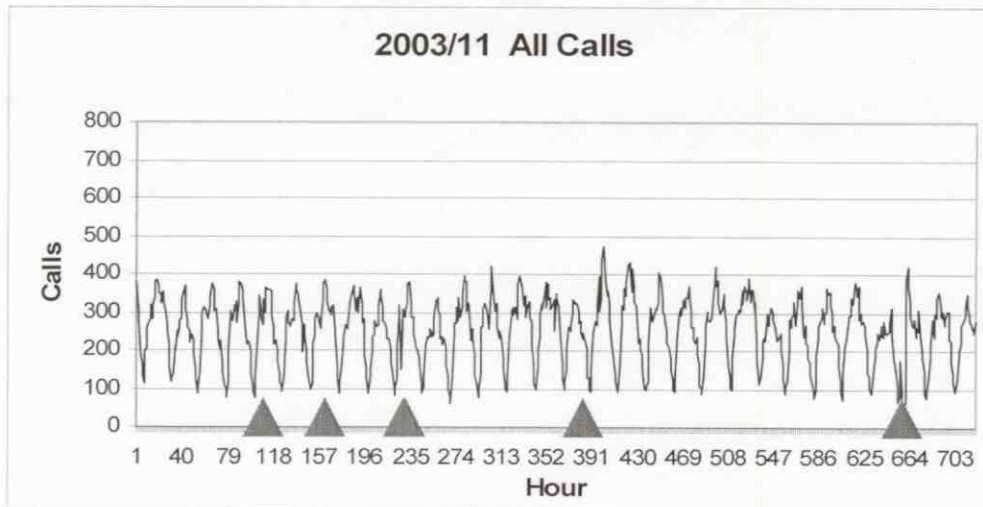


Figure 4-2. Call Volume Statistics and Outages

The analysis of the data from the charts concludes that none of the outages correlate with a spike or surge of the total 911 call volume. Using separated department-wise⁷ call volume data, there is still no evidence of correlation between system outages and the volume of either Police calls or Fire/EMS calls. Although a careful analyst may sometimes look further into the fluctuation and variation of the raw data to extract hidden patterns, observations obtained from the plain call volume data deemed further analyses unnecessary. MITRE concludes that the call volume data by itself, does not show impact on the outages.

The MITRE team attempted to gather performance statistical data at various levels to make a clear determination or root cause analysis of system performance.

Figure 4-3 identifies our approach to the end-to-end performance analysis effort. By taking this approach, the team planned to gather performance data at each layer of the subsystems, and then correlate the data to make an accurate assessment of potential system performance issues.

The HP Systems Insight Manager was not adequate for the performance analysis because it was not completely configured. The team was able to use UNIX level command scripts to gather performance data on the CAD and RMS servers in order to conduct a performance analysis for these two subsystems. Figure 4-4 summarizes CPU utilization for a specific snapshot period.

⁷Individual charts for Police calls and Fire/EMS calls are not included in this report, but they have been inspected and led to the same conclusion.

