

ELEVATOR MANAGEMENT SYSTEMS

by Andrew Trapani

Elevator management systems with traffic analysis capabilities are a common component in the modernization of elevator banks. The traffic analysis data provided by these elevator management systems is a valuable tool that can be used to quantify elevator system performance and provide feedback necessary to configure the elevator system for optimal traffic handling.

When the decision is made to modernize a bank of elevators, the building management has a general perception of the elevator passenger traffic handling and the desired elevator system performance. Typically, this perception is based on the observation of building personnel and feedback from passengers. The observations of the building personnel may be subjective and representative of a limited aspect of the system operation. Passenger feedback may only consist of negative reports about the elevator operation. In general, this information will be incomplete and negatively biased. For high profile commercial properties, an elevator consultant may perform a traffic analysis "snapshot" to determine the modernization requirements, but not all consultants will have this information before proceeding with modernization.

Today's microprocessor-based elevator control systems are complex computer systems that have extensive parameter settings designed to provide a wide range of flexibility in the configuration of the elevator system's traffic handling methods. These parameters will be set to a default value based on the control manufacturer's fabrication processes. Each set of stops serviced by an elevator bank has potentially unique passenger behavior, and the default parameter values may not yield the optimal traffic handling. One of the main objectives of modernization of any elevator bank is to implement the best possible traffic-handling operation. Consequently, one of the final tasks in the modernization process is to identify the control system parameters that will yield the best elevator system performance. Without the benefit of traffic analysis data, this task is performed

based on feedback from building management personnel. Figure 1 shows the typical feedback loop that guides the configuration of the elevator control system parameters.

The main drawback of this feedback loop is that it is open and would be very difficult to verify that any adjustments to the control system parameters have achieved the desired change in traffic handling. Modernizations that include an elevator management system can close the feedback loop by providing the building management and elevator technicians with the information necessary to measure the effects of control system parameter adjustments. Figure 2 shows the enhanced feedback loop that guides the configuration of the elevator control system parameters.

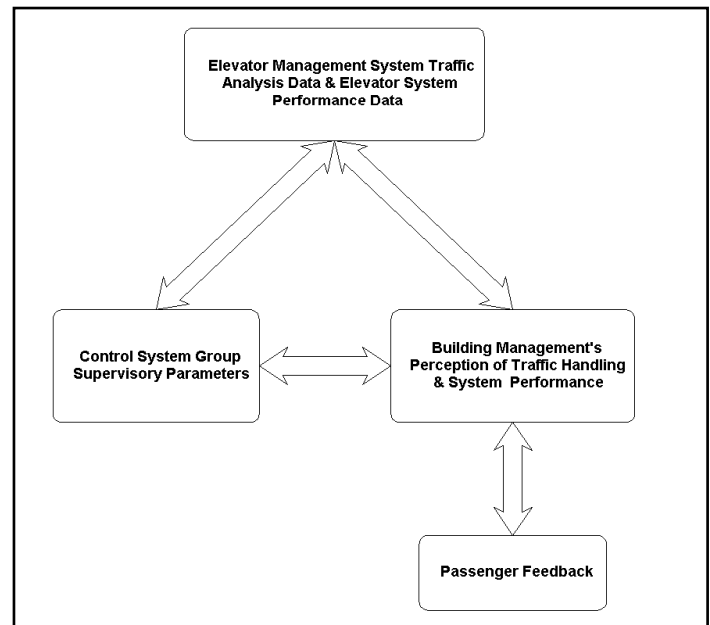


Figure 2: Enhanced feedback loop

Common Traffic Analysis Metrics

Traffic analysis reports may vary based on the type of elevator management system, but many will provide the most common traffic analysis metrics. Some metrics, e.g., number of door cycles, can be used for determining preventative maintenance schedules. Other metrics are strictly concerned with measuring current system performance. The following metrics are particularly important for determining if the elevator system is providing optimal traffic handling:

- ✓ **Hall Demand Response Time:** The amount of time it takes for the elevator system to respond to a demand for service initiated from a hall button. Typically, average response time is shown for each hall demand in the up and down direction as well as a distribution curve for response to all up and/or down demand. Figure 3 shows a sample report of wait time distribution.

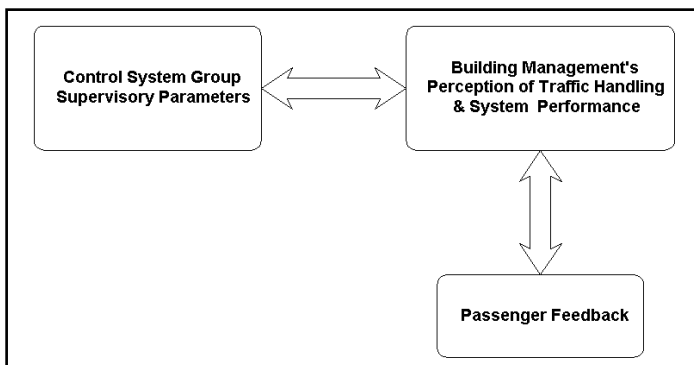


Figure 1: Typical feedback loop

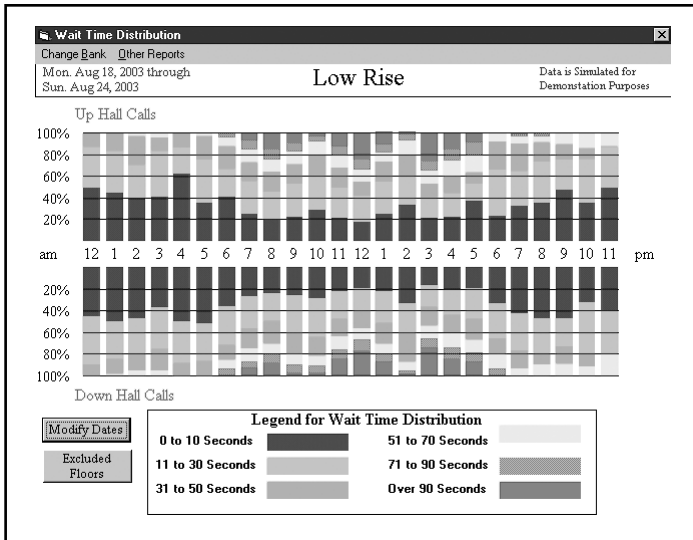


Figure 3: Wait time distribution

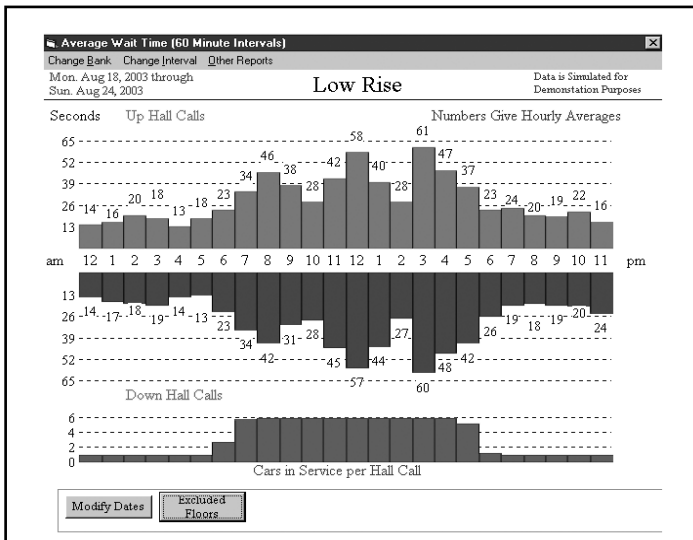


Figure 4: Average wait time distribution

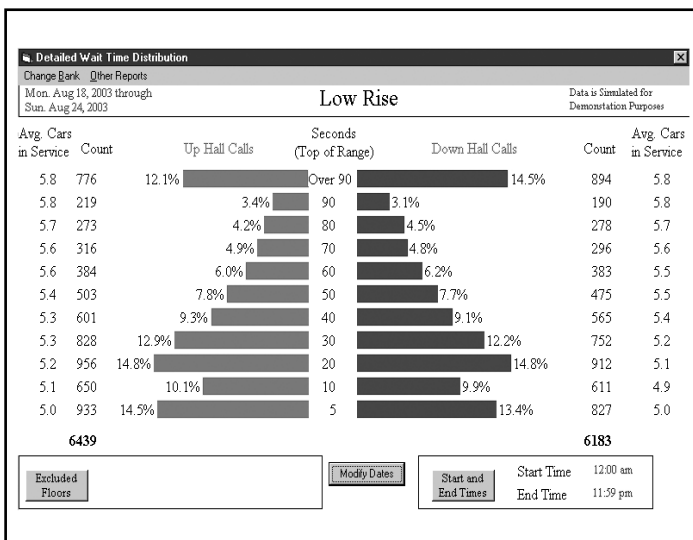


Figure 5: Detailed wait time distribution

✓ Individual Elevator Status/Mode of Operation:

The amount of time that each elevator spent in a particular status or mode of operation including the amount of time that the elevator spent in automatic group operation. Figure 4 shows a sample report comparing average wait time distribution to the number of cars in automatic group operation.

✓ Longest Waiting Times for Hall Demand:

The longest amount of time it takes for the elevator system to respond to a demand for service initiated from a hall button. Figure 6 shows a sample report listing the 10 longest wait times compared to the number of elevators in automatic group operation.

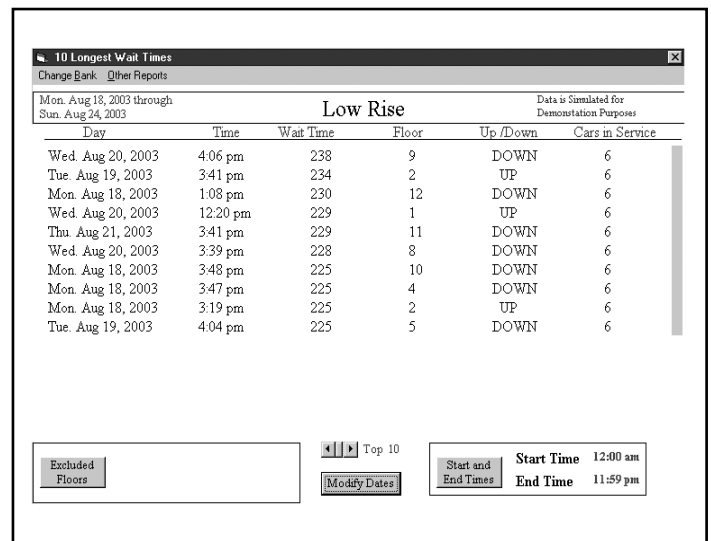


Figure 6: Longest wait times

Maximizing the Number of Elevators in Automatic Group Operation

One of the most important considerations for maintaining optimal traffic handling in a bank of elevators is to maximize the amount of time that each elevator is in the automatic group operation. Elevator load weighing technology has improved significantly in recent years and load-weighing devices play a critical role in achieving optimal traffic handling. Weight dispatching is a feature that will dispatch an elevator from the landing as soon as the elevator is full and cannot accept more passengers. Without weight dispatch, the elevator may wait at the floor for a pre-programmed amount of time, which is a waste of time for a full elevator. Weight dispatching is particularly effective for moving elevators out of the lobby during up-peak traffic patterns. A weight bypass feature prevents a fully loaded elevator from stopping for any hall demand until passengers exiting at their destination floors reduce the load. Weight bypass ensures that an elevator capable of accepting passengers will answer every hall demand.

Elevators that are operating in weight dispatch or weight bypass mode are no longer in automatic group operation. The elevator is unavailable to the group supervisory system until the load has been reduced. Consequently, load weighing devices must be properly calibrated in order to be effective. Load weighing devices that are not configured properly can unnecessarily remove elevators from automatic group operation and have a negative effect on traffic handling. Sometimes building personnel use passenger elevators for maintenance purposes and may take control of an elevator by placing it on independent operation. Elevators on independent operation are removed from group operation and will reduce the traffic handling capacity of the elevator bank. Elevator usage and service reports can be used to measure the amount of time each elevator is removed from automatic group operation. Figure 7 shows the amount of time each elevator was in automatic group operation. Figure 8 shows a historical comparison of elevator usage.

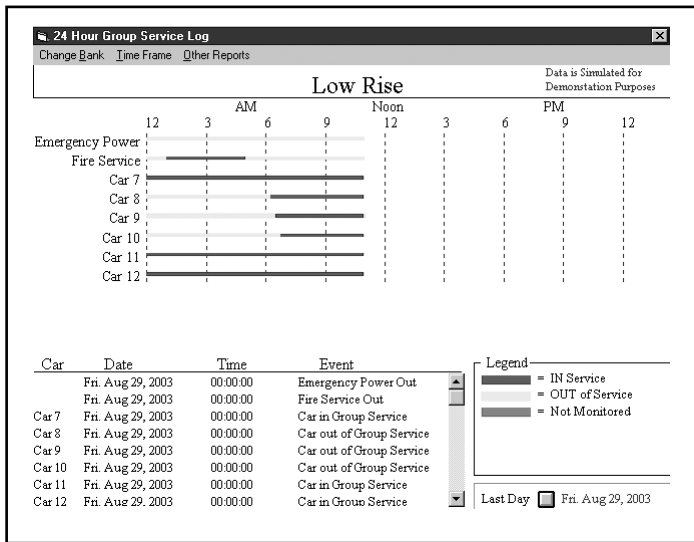


Figure 7: 24-hour group service log

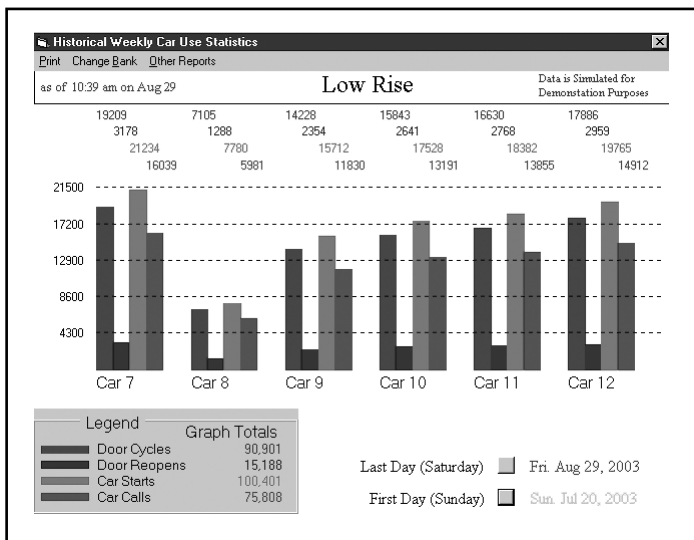


Figure 8: Weekly car use comparisons

Achieving Optimal Traffic Handling

Once all elevators in the bank are running in automatic group operation and the building management system is online, we can proceed with the analysis and adjustment of the control system parameters.

Phase I: Identify the Major Traffic Patterns

The first step is to set the control system parameter values based on the initial feedback of building personnel and/or the elevator consultant. The elevator bank should then run for a minimum time period that allows the system to respond to the normal variations of passenger traffic. The minimum time period may vary depending on the type of building, but a basic guideline is a full week of normal traffic activity. In general, a longer time period is better because it will provide a more complete statistical base of data but this must be weighed against a realistic schedule for the building management and passengers. For the sake of this discussion, we will use a one-week time period. After the initial one-week time period, traffic analysis reports should be run for each day and for the complete period. The traffic analysis reports can then be reviewed to identify the major traffic patterns. The most common major traffic patterns that should be identified first include:

- ✓ Up-Peak Traffic
- ✓ Down-Peak Traffic
- ✓ Off-Peak or Interfloor Traffic

Other important patterns to look for are daily variations. Does each weekday exhibit similar traffic data? Does each weekend day exhibit similar traffic data? The traffic analysis reports will also reveal traffic variations for special function floors such as a cafeteria floor or a parking garage level. Once the initial time period analysis is complete, then the control system parameter values should be set to accommodate the major peak traffic patterns. Be as specific as the control system parameters will allow. If possible, set the start and end times on a daily basis for each of the peak traffic patterns (up, down and interfloor). Review other control system parameter values against the data in the initial traffic analysis reports and make any adjustments.

Phase II: Determine the Source of the Longest Waiting Times

The elevator bank should then run for another minimum time period and at its conclusion run traffic analysis reports for each day and for the complete period. Compare these traffic analysis reports with the initial reports and identify the differences in the elevator system performance. Under similar traffic conditions, the measurable differences in the elevator system performance can be directly related back to the control system parameter adjustments. Examine the longest waiting times report and determine the source of

these long wait times. Do the longest waiting times occur during periods when one or more elevators are removed from automatic group operation? Do long wait times occur during a particular time of day or day of week? Inform building management about the source of the long wait times. Building management will then be better prepared to address passenger feedback. Review the traffic analysis reports and control system parameters with the building management and/or elevator consultant. Based on the review, make any further adjustments to the control system parameters

Phase III and Beyond: Review Traffic Analysis as Part of Normal Maintenance Routine

As before, allow the elevator bank to run again for the minimum time period and examine the traffic reports. Control system parameters can be tweaked with minor adjustments. At this point, the traffic reports can be archived and used as a historical baseline of the elevator system operation. Incorporating the review of traffic analysis reports into the normal maintenance routine will guarantee that future changes in traffic patterns can be addressed proactively.

Lift-Net™ Traffic Analysis Screens courtesy of Integrated Display Systems.

Andrew Trapani is the Information Systems manager at O. Thompson Co.

