Remote Monitoring Of Elevators And Escalators: Managing The Alarms And The Maintenance

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The possibility of remote monitoring of elevators has recently become a reality for many manufacturers of elevators. The primary drawback has been that this monitoring has been designed primarily for newly manufactured equipment only. Reliable and affordable monitoring for multiple manufacturers and vintages is not wide spread. Escalator monitoring is virtually unheard of.

Many transit properties have many types of elevators and escalators. Some authorities have difficulty determining if their equipment is even running or not! Relying on complaints from the public or a station manager can be a frustrating and cumbersome method of managing elevators and escalators whether you outsource your maintenance or perform it in house.

Managing elevators and escalators in the transit industry is becoming more visible to the public eye, and rarely in a positive one at that. Liability, station access and system availability are key issues for any transit manager to wrestle with on a daily basis. Understanding this issue, Gannett Fleming has designed a patent pending solution to address not only the remote monitoring of new and existing elevators and escalators, but how to manage that information as well.

In designing this process, we determined several key management issues to resolve:

KEY ALARM ISSUES

1. Out of service notification: Internal to management and external to a mechanic.
2. How long was the unit out of service?
3. When was the mechanic or contractor notified?
4. When was it returned to service?
5. What was the fault that shut the unit down?
6. What was happening to the unit when the fault occurred?
7. How do I keep reliable records of this information?

Obtaining this information is critical in managing an elevator/escalator department. It is also good information for many other types of equipment as well. This paper will deal with other disciplines later. While this information is valuable, it is only part of the business process to manage the information and issues related to keeping the department up and running to peak efficiency.

PREVENTIVE MAINTENANCE ISSUES

Preventive maintenance is difficult at best in the transit industry. Taking an escalator out of service during rush hour is a major undertaking that is avoided or delayed as much as possible. Overtime is often avoided where possible and planned repairs and maintenance tasks are often deferred unintentionally.

Unfortunately, preventive maintenance can rarely be deferred successfully. Managing this aspect of elevators and escalators poses certain problems:

1. Is the preventive maintenance program designed appropriate for my transit facility?
2. Is the preventive maintenance up to date?
3. How can I verify that the preventive maintenance is being performed?
4. How can I manage my third party contractor's maintenance and inspection efforts?
5. How can I manage my own maintenance and testing efforts?
6. Are my records up to date?
7. Are my records complete and accurate?
8. Are my records being completed in a timely manner?

Another series of questions that must be addressed is related to ensuring that the information you gather is as accurate as possible. There are questions relating to how this information is gathered that are important to consider:

1. How can I reduce human error or mischief in the entering of vital information?
2. How can I reduce subjectivity in the preventive maintenance records and priorities?
3. How can I improve on the performance requirements of the elevator and escalator preventive maintenance?
4. Do I have enough accurate information to understand the true availability of the equipment?

5. How can I respond to the press and upper management when questioned on a specific incident or trend?

These are questions and issues that apply to any operation dealing with mechanical equipment. We have recognized these issues and designed a solution that provides a real tool, in real time that offers a real solution.

THE ENGINEERED SOLUTION

The strategy is to provide information to the manager and the mechanic that is reliable, accurate and easy to use. The first two properties to benefit from this solution are SEPTA and PATCO. Both authorities are replacing a significant number of escalators. As part of that procurement, the VT-MMS (Vertical Transportation Maintenance Management System) has been designed to incorporate as much standard equipment as possible.

The equipment controllers are Allen Bradley SLC 5/03 PLC controls. A key advantage to this selection is that all of the escalator suppliers could supply their standard escalator with this PLC. The Remote Terminal Unit (RTU) and software packages selected are supplied by Rockwell Automation, Inc. Rockwell Automation owns Allen Bradley, making the data flow as simple as possible with all of the connections are from the same company.

It is important to note that Rockwell Automation will sell their products to the contractors. This is intended to keep the bid list open and provide competitive pricing throughout the process. Allen Bradley PLC's are not a requirement, and DeviceNET™ compatible PLC will work as long as the data tables are provided as specified.

DeviceNET™ is an industry standard communication protocol adopted by more than 120 different manufacturers of PLC devices. This protocol was selected for the VT-MMS to facilitate the potential to add other types of devices to the same maintenance management system.

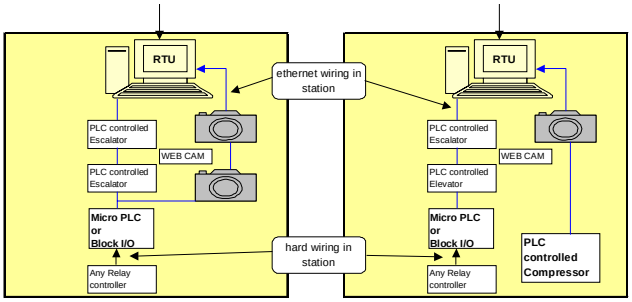

Diagram 1.

The monitoring system is a patent pending business solution called the VT-MMS. It has been designed to:

1. Connect elevators, escalators and other PLC controlled devices to one RTU per station via Ethernet (fiber Ethernet preferred) within the station.
2. The RTU includes a PC which is a "seat" for the CMMS (Computerized Maintenance Mgt. System) and buffers a web cam.
3. Escalators (or other devices if desired) will have a streaming video web cam that can be viewed remotely. When a fault occurs, the web cam captures a two minute loop around the fault and uploads it to a central server. The web cam is locked at the server so no local mischief can turn off the software or camera.
4. The RTU is typically connected via a fiber Ethernet to the authority HQ. A dial up system is possible, but information data flow is limited or slowed dramatically.
5. The RTU's all work remotely on a server which holds alarm software which can view real time data on any escalator or device. This real time data includes; handrail speed, step speed, current draw on the motor, motor temperature, KWhours used, direction of travel, total run time, run time by direction, run time since last fault and video of the escalator at that moment.
6. The alarm software automatically pages, phones, faxes or email up to eight people when a fault occurs.
7. The alarm then automatically writes a corrective work order on the CMMS database system.
8. When the mechanic arrives at the station, he checks in for the work order at the RTU PC, performs the work and closes the work order out online.
9. If the mechanic needs help in fixing the escalator or needs a part, the PC in the RTU is linked to the unit specific O&M manuals, spare parts (with diagrams and photos if available), trouble shooting guides etc . . .
10. When returned to service, the alarm software automatically sends a signal to the CMMS that the unit is back in service. This is to offset any manipulations at the job site regarding how much time was spent on the repair.
11. Many, Many reports are available in the CMMS to help manage internal mechanics or third party contractors. Sample reports include MTBF for the system, line, station, equipment/device, by mechanic or selected component (chain, handrails,

etc. . . .), Manpower reports, spare parts usage and several custom reporting options are available.

CURRENT PROJECTS

There are two transit systems installing this equipment at the time of this publication. This table illustrates the scope and extent of those projects.

Planned VT-MMS Installations	
SEPTA:	**Details**
Cecil B. Moore (1) Snyder Avenue (2)	December, 2001 EARLY 2002
Retrofit first 9 escalators in replacement program	December, 2001
Escalator Modernization Program	15 escalators, 3 new stations
New Escalators	2 new stations
Retrofit recent OEM escalator controllers	3 escalators, 2 new RTU's
Future expansion: Market Street Elevated Franklin Transportation Center Elevators Fire Alarms Compressors Chillers Scavenger tanks	 5 RTU's, 10 escalators, 10 elevators 1 RTU, 5 escalators *No new RTU, software or server is required to add this other equipment when installed in a station with an existing VT-MMS RTU.*
PATCO	
Station Modernization program	9 escalators, 8 stations, first phase turned over in December, 2001.

Table 4.

CONCLUSION

Managing geographically spread out transit systems is difficult at best and often frustrating. It is now possible to connect many pieces of equipment and get real time information at your desk. It is now possible add chillers, fire alarms, compressors, fans or virtually any other piece of important equipment to this one system without purchasing a new backbone of software and hardware.

The station RTU can handle hundreds of inputs, and the CMMS system can be configured to manage many different types of equipment. The key is to understand your current process for preventive maintenance and corrective actions. Improvement of the process will not come from automating it alone. A careful examination of the process itself is critical to break the, "garbage in, garbage out" syndrome.

Up to 70% of owners who purchase a maintenance database system are not fully satisfied with the results. Careful investigation of this problem reveals that the work flow process was never updated along with the database improvements. Now they have much more information, but no adequate process to streamline and process the information. A thoughtful re engineering of your work flow process is essential to gain all the benefits of automating your maintenance management system.

Areas to consider re engineering include:

1. Are the preventive maintenance tasks up to date?
2. How is a mechanic dispatched for a shut down escalator?
3. How are spare parts ordered?
4. How are code required tests scheduled?
5. How are planned repairs scheduled?
6. How does management communicate to the field employees?
7. How is the information collected, and how is it reviewed?
8. How are the custom reports designed?

EXPANDED CAPABILITY

Once installed, this system is capable of other tasks that can streamline and improve operations:

Automatic payroll entries and time card functions

The RTU is where the work orders are opened and then closed out. A time stamp is entered on all work orders and access to other open work orders is possible at the station RTU.

Predictive maintenance

There are a number of reliable engineering companies that have large databases of machine noise, temperature and vibration information that can be designed to trigger predictive maintenance. Predictive maintenance can save costly problems from occurring by alerting management when a problem is about to happen instead of alerting management that it failed. It is important to note that this software is not available for elevators and escalators, but it is for a wide variety of other mechanical equipment typically installed in transit systems.

Web access for third party contractors to CMMS and alarms

Outside contractors can be given the ability to access the RTU remotely to view operations and alarms. The CMMS system can have work orders updated, reviewed and closed out remotely as well.

Inventory management

While spare parts can be viewed online, ordering the parts is possible as well. This typically will require some form of integration of the warehouse and its ordering procedures. Inventory control and automation are a natural extension of automating the work order process.

Remote monitoring is vital and achievable on a wide variety of equipment, not just elevators and escalators. The key to maximizing potential improvements lies in the management of this information. The VT-MMS design solution automates many of these tasks leaving more time for managers to actually manage their property.

As a final note, it is important to understand that Gannett Fleming is not selling a product. The VT-MMS is a solution designed to solve common problems in operating a facility. There are a number of methods to accomplish the goals of the VT-MMS. Each installation is custom engineered and configured as appropriate for each location.

While we reserve our opinions on any particular OEM, we recognize the need for flexibility and the variety of PLC's and CMMS programs that may already be in place. The VT-MMS solution can be accomplished in a multitude of ways. The key concept is flexibility in design while maintaining very strict objectives to accomplish a successful maintenance management system.