XYZ Biotech Case Study:
Reducing Cost and Improving Uptime for Air Handler System

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CHALLENGE:

- **XYZ Biotech operates a small 24x7 manufacturing facility which includes four Air Handlers Units (AHU's) to regulate temperature, airflow and humidity control.**
- **Monitoring on the AHU's are performed manually, and XYZ currently employs a time-based preventative maintenance strategy.**
- **XYZ Biotech would like to change their strategy to automated monitoring with condition based maintenance, which they believe will improve uptime, reduce consumables usage, lower safety incidents, and free up skilled labor for other tasks.**
- **However, the cost to retrofit the AHU's for condition based monitoring is cost prohibitive at a total cost of about $220,000 (monitoring system for 44 points).**

SOLUTION:

- **XYZ Biotech installed new automation technology which did not incur any disruption to ongoing processes and required minimal installation cost. The solution, a non-invasive wireless sensor which "clips-on" to existing gauges and/or transducers, costs 70% less than using traditional transducers (total cost of $66,000).**

RESULTS:

- **XYZ Biotech estimates annual savings to be in the range of $58,000 which correlates to an investment payback time of approximately fourteen months.**

Challenge

XYZ Biotech is a startup biotech firm that operates a small 24x7 manufacturing facility. With limited funds and resources, it is critical that the company maximizes their uptime. One of the most critical systems for the facility is the air handler system, which consists of four air handler units (AHU's) to serve 16 manufacturing process rooms. Any unplanned downtime in the AHU's resulted in both process and quality impact, which cost the facility additional resources to address.

XYZ discovered that a significant amount of resources in the Facilities group was dedicated to air handler maintenance. This included performing maintenance rounds, performing preventative maintenance activities, and responding to air handler related issues in the manufacturing facility. With so much time spent maintaining the air handlers, maintenance personnel were stretched too thin and found it difficult keep up with other issues in the facility.

XYZ Biotech had the following maintenance strategy for their air handler systems:

- Maintenance rounds are performed on a shift basis. This includes recording differential pressure data from 28 differential pressure gauges, and recording room temperatures for the 16 process rooms. One technician spends 1.5 hours per shift performing rounds.

- Preventative maintenance procedures are performed on a monthly basis. These procedures involve recording differential pressures across the inline filters at the air handlers. The filters are replaced if differential pressures exceed acceptance criteria, or on an annual basis.

Another problem that XYZ was encountering was an overall safety concern for their personnel working on air handlers. The mechanical space in the facility was difficult to work in, since there was quite a bit of equipment contained in a small space. There had been reports of personnel tripping over ducts or pipes, or hitting their head on overhead equipment. Maintenance personnel had to be quite nimble in order to reach some of the air handlers.

Improving Air Handler Maintenance Strategy

Similar to most facilities, XYZ Biotech utilizes a time-based strategy for air handler maintenance. Monitoring is primarily a manual operation and maintenance activities tend to be very labor intensive. Time-based maintenance requires personnel to inspect air handlers more frequently. In addition, the data collected during maintenance activities only provides a single snapshot of air handler operation. Maintenance personnel are not able to look at historical trends of operation and indications of potential problems.

The primary issue with time-based maintenance is the inability to determine air handler performance due to a lack of data for analysis. This lack of data leads to limitations in failure prevention and response, as well as higher maintenance costs to reduce the risk air handler failures.

If air handler monitoring was more automated, air handler maintenance strategies could be improved from a time-based strategy to a condition-based strategy. The key parameters to monitor in order to implement a condition-based maintenance strategy are temperatures in the areas served, differential pressure across inline filters at the air handlers, and differential pressure across the areas served.

Monitoring the differential pressure across inline filters provides the data required to ensure that the air handler is providing the appropriate quality of air to the areas served. Monitoring the differential pressure across the areas served provides the data required to ensure that the air change rates and air flow patterns are appropriate for the areas served. Monitoring the temperature in the areas served provides the data required to ensure that appropriate temperature control is achieved at the air handlers.

Data Availability With data collected automatically on a shorter time interval, graphics could be easily developed to show operational trends, which would help in identifying potential problems.

Failure Detection and Prevention With the ability to identify potential problems, issues could be resolved without significantly impacting operations. Potential problems could be addressed around production schedules. Preventative maintenance activities could be scheduled around production activities, increasing the flexibility of the organization. Any failure in the air handler system would be immediately detected with automatic monitoring. The delay in failure detection could be reduced from as long as a quarter (the period between PM activities) to as short as the data collection rate.

Lower Operating Costs

- *Savings on Rounds.* Differential pressure data across areas automatically collected reduces the need for manpower to perform rounds on a shift basis.

- *Savings on PM Activities.* Differential pressure data across inline filters automatically collected reduces the need for monthly or quarterly preventative maintenance activities to manually collect the same data. In addition, inline filters would be changed when the acceptance criteria for operation has been reached or exceeded, as opposed to when limits are within a tolerance as observed during maintenance activities or on a time elapsed interval.

- *Savings on unplanned downtime.* The ability to observe potential problems and address them before it becomes a failure reduces the potential for unplanned downtime. The cost associated with an unplanned downtime are difficult to quantify, but could be as severe as product loss, which results in a revenue loss in the millions of dollars. The ability to minimize the risk of occurrence is invaluable.

Evaluation of Traditional Automation Solutions

XYZ Biotech considered replacing their differential pressure gauges and temperature sensors with transducers, and wiring them to their building automation system. However, this alternative was cost prohibitive.

While the transducers were not expensive, the associated costs were high. I/O panels had to be installed to connect the transducers to the building automation system. Each transducer had to be wired to the I/O panel, which also meant installing conduit. Documentation and drawings had to be updated. There was also a potential that the existing building automation system was substandard and major modifications would have to be made to bring the system up to par.

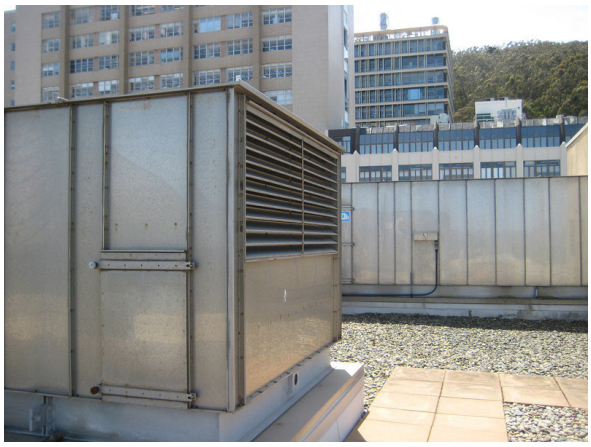
All these factors brought the total cost of installation per point up to $5000. As a result, XYZ Biotech chose not to implement this solution.

The Cypress Solution

With the Cypress solution local differential pressure gauges remain in place, but wireless gauge readers are installed over the gauges. These readers non-invasively “clip” onto the front of the gauges, are battery operated, and contain the wireless transmitter within the reader. A receiver can be located in a central location, with signal boosters strategically placed as required. The receiver has a stand-alone web interface monitoring software, and pre-set alarms may be programmed to alert technicians of excursions. As an alternative, the data could be integrated with an existing building automation system.

This alternative is more cost effective overall because there is no wiring cost associated, and integration costs are included in the installation of the wireless reader. XYZ Biotech chose this solution because the installed cost was $1500 per point, which was 30% of the cost of the traditional automation solution. In addition, the total cost of ownership per point for the Cypress solution was 40% of the total cost of the traditional automation solution.

Figure 1 – Rooftop Air Handler Units at XYZ Biotech



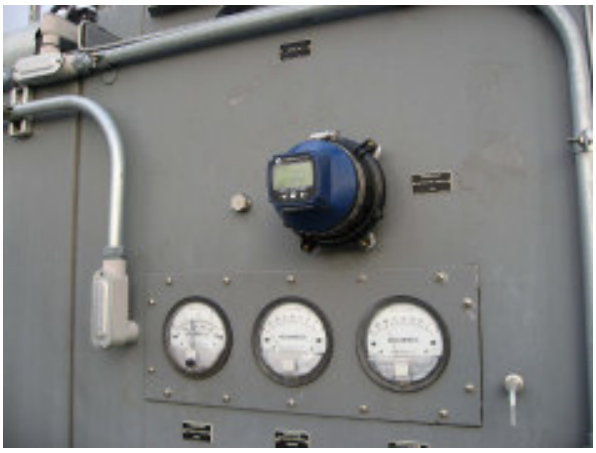


Figure 2 - Comparison of Installed Cost per Point for Traditional Automation Solution vs. Cypress Solution

	Traditional Wired Solution	Cypress Wireless Solution
Capital Cost		
Instrument Cost	$ 1,000	$ 1,200
Conduit/Wiring/Installation Labor	$ 2,500	$ 300
Automation Integration	$ 1,000	$ 0 (included)
Engineering Drawings	$ 500	$ 0
Total Cost, per point	$ 5,000	$ 1,500
Annual Maintenance Cost		
Calibration	$ 100	$ 125
Instrument Replacement (10% failure rate)	$ 100	$ 0 (included)
Annual Maintenance Cost, per Point	$ 200	$ 125
Total Cost of Ownership, per point, 10 years	**$ 7,000**	**$ 2,750**

Benefits

XYZ Biotech installed a total of 44 wireless gauge readers and wireless transducer readers to monitor their air handlers and associated process rooms. Each point required approximately 15 minutes to install and all of it was completed without any equipment downtime.

XYZ Biotech was immediately able to see data trends and was able to change the scope of their maintenance rounds and frequency of preventative maintenance activities.

The safety concerns were immediately addressed when the frequency of maintenance activities was reduced. Maintenance personnel were still able to observe air handler operation without having to maneuver through the mechanical space.

XYZ Biotech was also able to reduce the number of filters consumed on an annual basis. This reduced the waste stream and allowed the company to be more "green."

The initial investment cost was $66,000. The Cypress solution allowed XYZ Biotech to reduce the frequency of their maintenance activities. This allowed XYZ Biotech to reduce their maintenance cost by over $57,950 annually, which translated to a payback period of under 14 months. Additional benefits such as reduced safety incidents, improved uptime, and better troubleshooting were not included in the payback calculation, but are believed to be tangible additional benefits.

Figure 3 – Reduction in Maintenance Cost with Automated Monitoring

	With Manual Monitoring		With Automated Monitoring		Savings
Rounds	90 min/shift 3 shift/day, 365 day/yr $50/hr 1643 man-hr/yr	$82,150	30 min/shift 3 shift/day, 365 day/yr $50/hr 548 man-hr/yr	$27,400	67%
Preventative Maintenance	1 hr/AHU, 4 AHU Performed monthly $50/hr 48 man-hr/yr	$2,400	1 hr/AHU, 4 AHU Performed annually $50/hr 4 man-hr/yr	$200	92%
Filter Replacement	1 set prefilters 1 set final filters Replaced annually 4 AHU $250/filter set, avg.	$2,000	1 set prefilters 1 set final filters Replaced bi-annually 4 AHU $250/filter set, avg.	$1,000	50%
Total Cost	$86,550		$28,600		67%
Annual Cost Savings = $57,950					