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Teaching Pneumatics Controls with New Tricks: Case Study on Existing Buildings Getting Intelligent Solutions*

Consolato Gattuso, Leo O'Loughlinm, and *Harry Sim*

ABSTRACT

Intelligent buildings promise the ability to significantly improve energy efficiency and reduce operational costs by constantly monitoring and optimizing millions of data points from equipment and sensors. However, only newer buildings with modern automation systems can take full advantage of this. Older buildings that employ pneumatic and analog control technologies, typically constructed before 1999, must undergo very costly and disruptive upgrades to enable them to be smart.

In recent years, innovative non-invasive technologies were introduced that significantly reduce the cost to retrofit an existing building compared to conventional direct digital controls (DDC) upgrade. This article describes the project at 311 South Wacker Drive, a 65 story hi-rise acquired by Zeller Realty in early 2014. This 1.4 million sq-ft Class A office tower in Chicago was upgraded to an intelligent building at 70% lower cost than using DDC, achieving a 1.7-year payback.

INTRODUCTION

"Intelligent buildings," "internet of things," "cloud solutions"…. these concepts generate a lot of discussion in the buildings community. For facility operators, they promise the ability to remotely monitor and manage buildings to improve energy efficiency and reduce operational costs. This technology can gather millions of data points from individual pieces of equipment across a building portfolio and analyze them in real-time using complex algorithms. When the system identifies an anomaly, it can often diagnose the cause and make adjustments to correct the problem (Figure 1). Cost savings are realized via reduced energy

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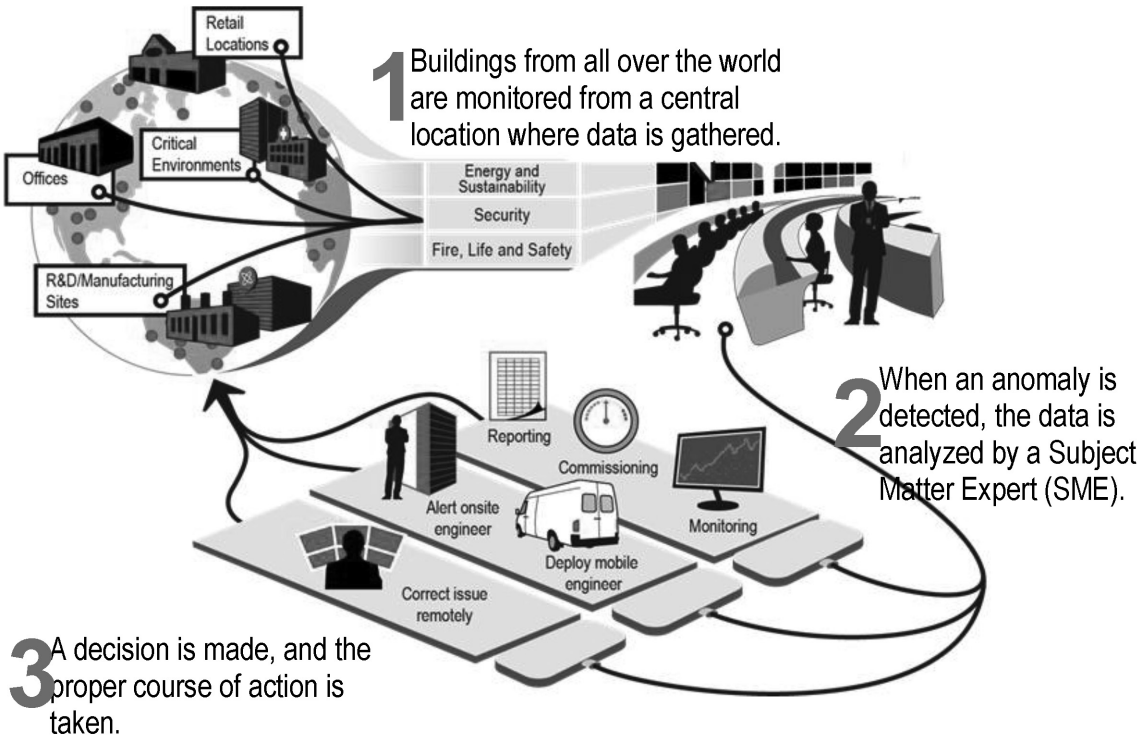


Figure 1. Intelligent Building Platform

costs, lower maintenance costs, and longer operational life for equipment. An intelligent building would typically cost 10% less to operate than a conventional building.

CHALLENGES FOR EXISTING BUILDINGS

However, only newer buildings already equipped with networked sensors and automation systems can take full advantage of intelligent building software and algorithms. Older buildings (constructed before 1995 generally) are frequently considered to not be good candidates because they employ pneumatic and analog technologies that provide little or no data visibility. More than half of all existing non-residential buildings fall in this latter category, including some of the most prestigious buildings in the country.

The 65-story tower at 311 S. Wacker Drive in Chicago is one such example (Figure 2). It is located by the Chicago River and boasts an impressive two-level, 50-foot-tall glass-ceilinged "winter garden" with palm trees and a fountain. Built in 1990, its building automation system was upgraded in 2000. Yet, virtually all of the tenant space still relies on pneumatic thermostats with no remote monitoring or control. If a space is too hot or too cold, a tenant must alert the facilities staff. The building cannot implement energy savings strategies such as night and weekend setbacks, optimal start/stop, auto-demand response, duct static pressure control etc.

NON-INVASIVE LOWER COST SOLUTION

Immediately after acquiring the building, Zeller considered upgrading to a direct digital control (DDC) system, but found that would incur unacceptable cost and also significant disruption to tenants, involving cutting open ceilings and walls. After evaluating different technologies, Zeller decided to implement a novel non-invasive retrofit technology called the wireless pneumatic thermostat (WPT). The WPT can be implemented in a fraction of the time and cost of conventional DDC, but provides essentially the same functionality (Figure 3).

950 WPTs were installed in approximately 6 weeks (compared with many months required for DDC) and were fully integrated with the JLL



Figure 2. 311 South Wacker Building

IntelliCommand cloud-based intelligent building platform to provide remote visibility and control to 1.5 million sq ft of tenant space—for the first time since the building was constructed.

The combined WPT and intelligent building software was then programmed to implement advanced energy savings and optimization strategies including occupancy-based setpoint control, "deadband" setpoint control, fan duct static pressure control, optimal start/stop, supply temperature resets, and monitoring based commissioning (Figure 4). The system also provides advanced dashboards and analytics to improve the effectiveness of the building staff (Figure 5).

In the first six months after the retrofit was completed, the building has already seen a reduction in HVAC energy use by 25%. Based on the savings the project qualified for rebates from Commonwealth Edison for 50% of the total cost, resulting in a payback period of 1.7 years. The $400,000 rebate was the largest ever energy savings award given to a commercial building by Commonwealth Edison.

The 311 South Wacker project is an excellent example of how cost-effective intelligent building technologies can unlock the energy savings potential inherent in the huge existing building stock.

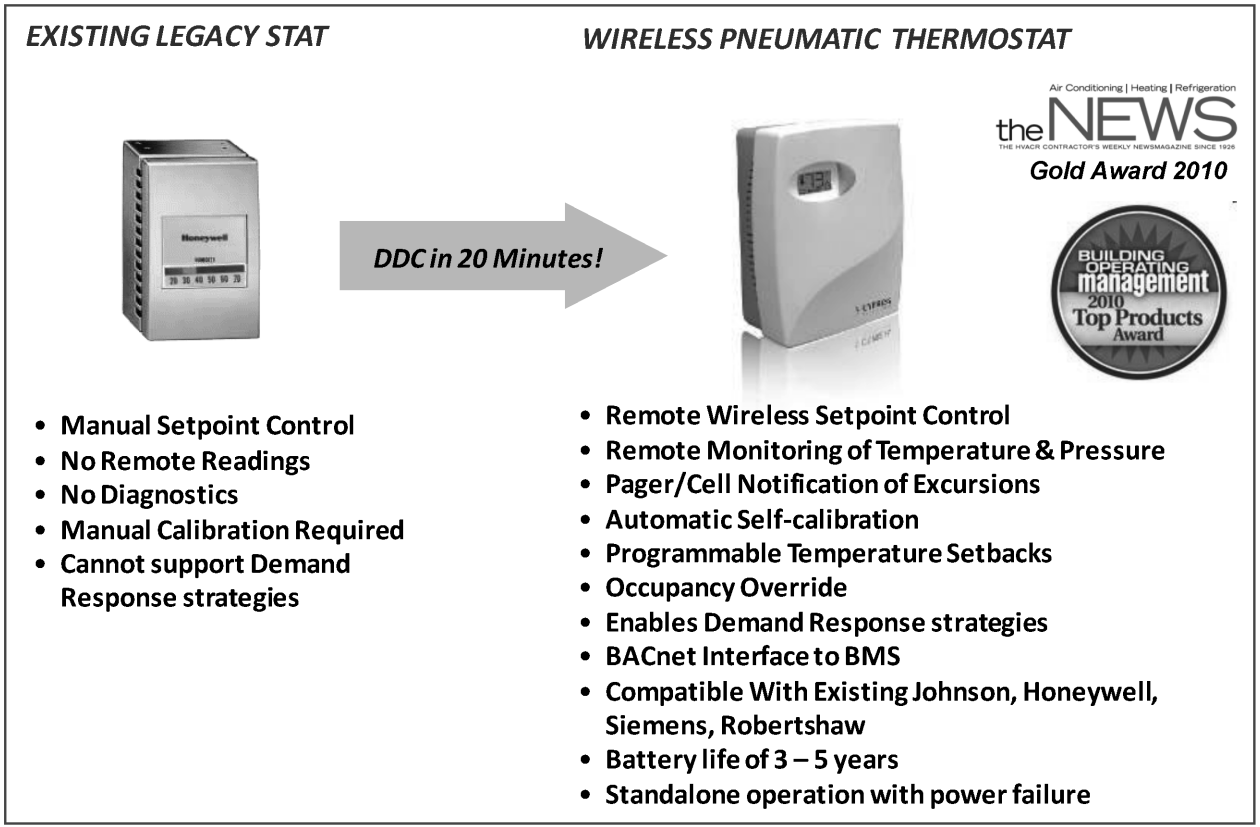


Figure 3. Wireless Pneumatic Thermostat Non-Invasive Retrofit

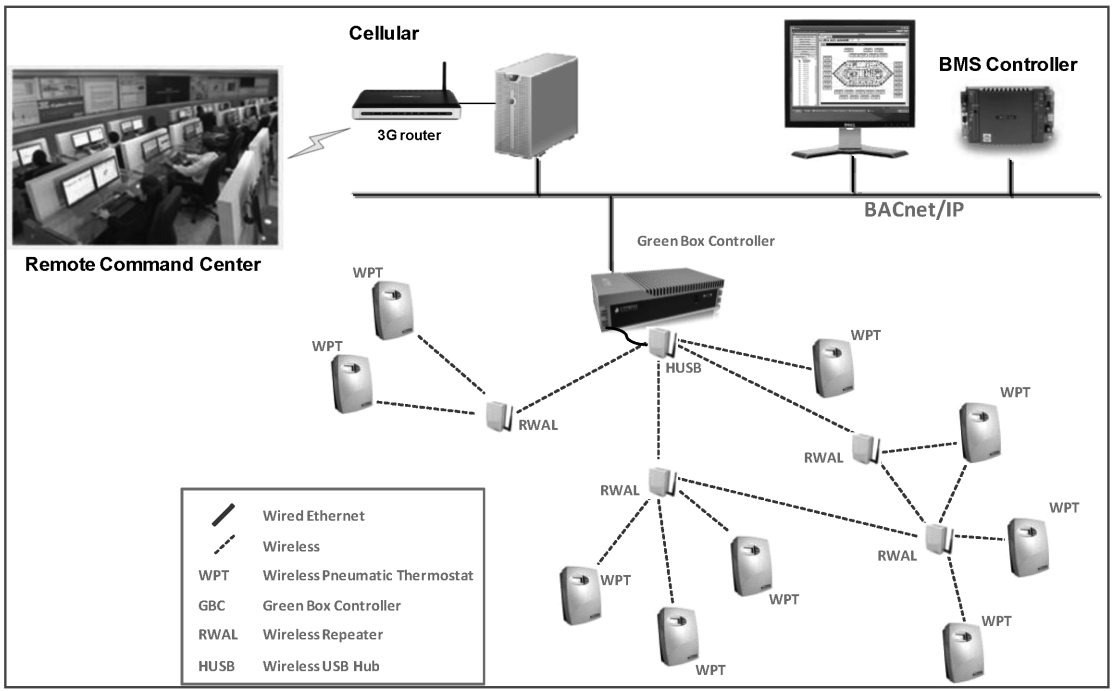


Figure 4. Intelligent Building Platform with Wireless Pneumatic Thermostats

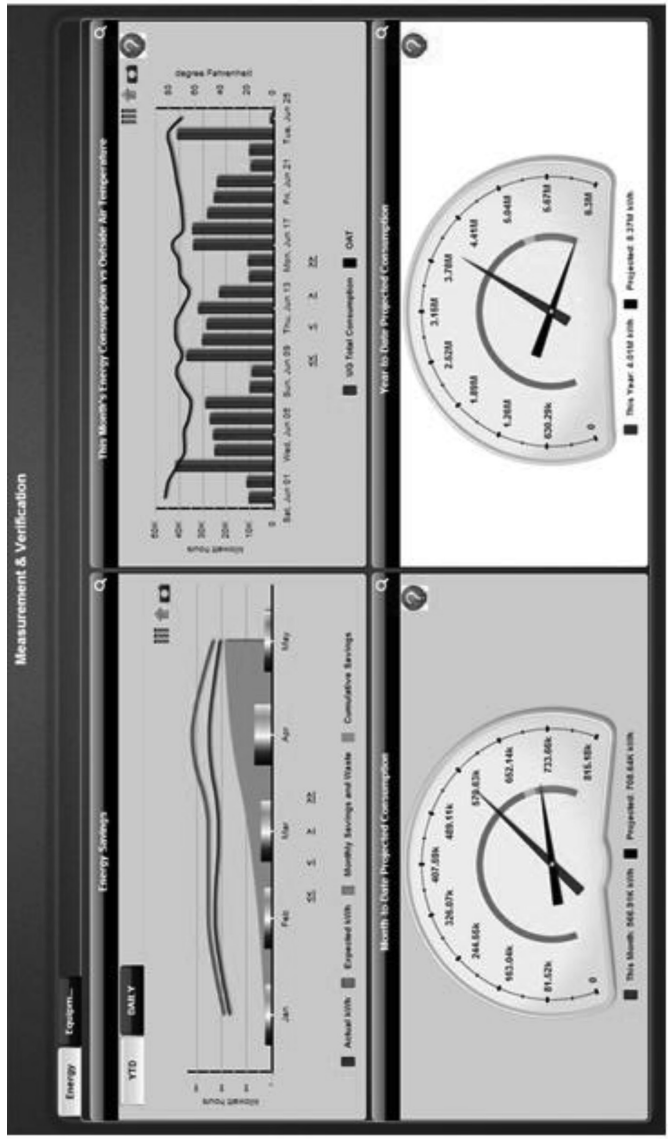


Figure 5. Remote Dashboards for Full Building / Portfolio Visibility

CONCLUSION

Even existing buildings with legacy pneumatic and manual technologies can be retrofitted to become an "intelligent building" at a reasonable cost with payback periods as short as 1.7 years.

Further Background and References

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Harry Sim is the CEO of Cypress Envirosystems, a company that focuses on improving energy efficiency in existing facilities. Harry believes in the need for non-invasive and fast payback solutions to retrofit existing buildings. He has been involved in all phases of developing products and applications for energy efficiency for existing buildings and industrial plants. Prior to Cypress Envirosystems, Harry was a Vice-President at Honeywell Automation and Control Solutions, working in the Building Automation, Industrial Automation, and Wireless and Sensors businesses. Prior to Honeywell, Harry was a Payload Director at NASA's Mission Control Center in Houston for Space Shuttle mission STS-40. He has lived and worked in the US, Canada, Europe and

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