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BMS revolution!

How building management systems have become a vital tool for technicians

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BMS REVOLUTION!

HVAC&R technicians are increasingly interacting with building management systems (BMS), particularly in the commercial building sector. **Sean McGowan** reports on how being equipped with the right knowledge can help you make the most of these interactions.

Before the introduction of digital control of buildings in the late 1970s and 1980s, pneumatic or electric control was commonplace, operating on a standalone basis.

Most of these systems are now a thing of the past. Instead, modern building management systems (BMS) have been installed to provide control and oversight of internal environmental conditions including heating, cooling and lighting.

BMSs are also known as building management and controls systems (BMCS), building automation systems (BAS) and building automation and control systems (BACS). They typically consist of several digital controllers that communicate via a network infrastructure to a system server and operator workstation.

These controllers are digital – and increasingly wireless. They operate with embedded software specific to HVAC control known as direct digital control (DDC).

BMS architecture typically features three to four levels: field, system, management and enterprise.

The field level refers to application-specific controllers such as terminal devices including fan coil units (FCUs), and variable air volume (VAV) boxes and control peripherals such as sensors, valves and dampers. The system level, also known as the automation level, is associated with controllers that serve the main plant such as air handling units (AHUs), chillers and boilers.

The management level comprises the BMS server and the operator workstation (dashboard). It allows for the management and monitoring of the control system from a single point. A fourth level – enterprise – can sit above the other three levels to provide data analytics including asset management.

Very simple systems that serve some buildings may only require two-level architecture, or DDC.

DIRECT DIGITAL CONTROL

Residing upon the BMS network, DDCs share information with the system and perform their primary function of controlling mechanical equipment such as fans, pumps, valves and dampers.

There are typically two types of DDCs: fixed function or freely programmable.

Fixed-function controllers are traditionally associated with field terminal devices such as FCUs and VAV boxes, which have limited fixed input and output channels.

Freely programmable controllers offer greater flexibility to program a control strategy specific to a function.

All DDC controllers have the ability to communicate on a network. Field-level controllers communicate on a simple network infrastructure physically connected together in a "daisy chain".

System-level controllers have multiple levels of communication, including one for the field-level network and another for the system-level network. They provide faster speeds to cater for the large amounts of data being transferred.

TALKING MY LANGUAGE

Traditionally, BMS communication has been conducted via serial networks and ethernet networks utilising protocols such as Modbus, BACnet, LON and N2.

The former two have, and continue to be, the most commonly used protocols in building automation. BACnet is often used at the heart of the BMS, with Modbus used in the devices being integrated to a system.

"Many years ago, the transition from proprietary systems to BACnet open protocol was a big step in the right direction for the industry," says Jason Duncan, Affil.AIRAH, regional sales manager for Reliable Controls.

"Back in the days of proprietary systems, and even back in the early 2000s, we could only access BAS systems by attending site and physically going to the BAS computer in the building. But with improved processing power of PCs (and everything generally), coupled with improved network infrastructures, those days are gone."

Today, BMS manufacturers offer broader communication protocol capability within their products. This includes server-based software with a browser user interface (BUI) to access the BMS from anywhere, at any time.

"As the world transitions to IoT (internet of things) and big data, the industry – like all other technology-based industries – is currently in a transition from the information and data silos that buildings were," says Duncan, "to information and data sources that can be mined, analysed, optimised and operated by multiple sources."

Other significant changes to BMS technology in recent years include improvements to speed, reliability and data storage capacity and efficiency.

There has also been a dramatic increase in the extent of integration to other building systems.

Where system integration is conducted, even more IT-based languages are in use. These include APIs (application programming interface), JavaScript, and multiple data formats including XML and JSON.

THE STATE OF BMS

While ASHRAE guidelines state that the average life expectancy of a BMS is 15 years, the state of operating systems in buildings varies greatly.

"Some sites have brand new systems, and others are surviving on legacy systems that are more than 20 years old," says Jeremy Cooke, managing director at Logical Building Automation.

He says the extent to which a system's age impacts on operation depends largely on the system's backward compatibility.

"For systems that have large technology changes that result in hardware becoming obsolete with the latest software, these are the most at risk of impacting operations," he says. "The systems are not able to utilise the latest enhancements that software or drivers may offer."

Ageing BMS systems – or more pointedly, systems that are not continuously optimised and upgraded – often result in less efficient buildings. Energy savings are not maximised. Additionally, equipment connected to ageing BMSs can have decreased life expectancy, an increase in replacements and integration costs, and are less likely to maintain optimal comfort conditions.

LEVELS OF ENGAGEMENT

In the early days of BMS, there were few opportunities for HVAC technicians, or any other trade that didn't work for the product manufacturer, to connect to a BMS system. Mainly this was because such systems were proprietary and closed-source.

"When I joined the BMS industry, I remember needing to have a client application software running on a laptop and plugging into a controller with some kind of ethernet-to-serial converter," Cooke says.

This has since evolved from being able to use a web browser with no pre-loaded software and connecting onto an IP network, to now being able to use mobile devices over wireless networks.

TRAIN HOW YOU PLAY

Logical Building Automation managing director **Jeremy Cooke** is an advocate for continuing professional development.

How can you gain confidence with BMSs?

The best way for HVAC technicians to work more confidently on BMSs is to have training, and seek more of it.

If you are working with or around a BMS system that you're not familiar with, speak to your supervisor about arranging some training for you from the BMS contractor.

The BMS system really is intended to be a tool for all stakeholders to use at various levels so as to get the most value out of it for the building, and ultimately, the occupants and owners.

What kinds of projects can technicians expect to work on?

Logical has been involved in the design, implementation and tuning/maintenance of BMS systems for over 20 years for clients in sectors including universities, data centres, hospitals, premium-grade office towers and energy-monitoring systems. The company applies technology to achieve customer goals such as sustainability initiatives, space utilisation, occupant comfort (IEQ), and energy-saving initiatives like Green Star and NABERS. ■

WHAT CAN GO WRONG?

Reliable Controls regional sales manager **Jason Duncan, Affil.AIRAH**, outlines some of the main things to look for, or be aware of, when interacting with a building's BMS.

Is what you are seeing on the screen really happening?

It's very easy to get caught in a mode where you see things happening on a screen and assume that that is what is actually happening in the field. But it's just a computer – it might not be a reality. So, get off the chair and get out into the field to check what's really going on, then compare it to what's being put forward by the BAS.

When should be manual override be implemented?

The entire operation is meant to be automated. So, if something has to be over-ridden and put into manual operation, then that's a problem. Use a manual override as a short-term solution only, and find a way to get the system back to full automation as soon as possible.

How can manufacturers empower stakeholders?

Unlike some of the traditional BAS manufacturers, we believe all the building stakeholders should be empowered with the knowledge and resources to understand and operate their systems. With all open protocol products, as well as being simple, flexible and sustainable, we empower stakeholders with choice by distributing products through an authorised dealer network. ■

Connections can even be made without directly accessing a BMS system, via the cloud.

And while there are still plenty of proprietary BMS vendors, the number of closed systems is diminishing.

So why engage with the BMS? What's in it for HVAC technicians?

According to Cooke, technicians can obtain a lot of information from the BMS about the performance of HVAC equipment and plant, and the building's operation more generally.

For instance, they can access real-time information about the network and health of DCCs. They can also use tools such as alarms, trends and analytics to identify areas of concern as part of a broader data-driven maintenance regime.

"For mechanical or electrical technicians, they can work closely with the BMS contractor to set up or train up on some of the features of the BMS system that would allow them to identify poor performing equipment to investigate as part of their maintenance," Cooke says.

This is often done is by comparing HVAC performance either against design parameters measured over time, or against the same equipment operating in different locations. Should vast differences or anomalies be identified, then these can be investigated in the field.

"These differences, anomalies or thresholds can also be pre-programmed as part of a fault detection diagnostics approach," Cooke says. "The BMS system will detect this in real time as soon as these events occur, or predict when these will occur in the future."

A NEW MODEL

Duncan says the old model of maintenance via a roster where most of the equipment checked is functioning fine (and didn't really need to be checked) is rapidly disappearing.

In its place, data-driven maintenance is becoming the new and preferred model for many HVAC and building services contractors.

"Data-driven maintenance is the way of the future," says Duncan. "And the BAS is the collector of and simultaneously the window to that data."

He says using features such as integrated fault detection and diagnostics (IFDD) from within the BAS can highlight poor performing equipment and suggest intuitive action to improve performance.

> Data-driven maintenance is the way for the future.

"This is a way to use technology to optimise a technician's time onsite," he says, "by sending them straight to the poorest performing equipment for rectification."

For this reason, Duncan says data-driven maintenance is a win-win.

"The building stakeholders get a more efficient building that costs them less to run and has less impact on the environment," he says. "At the same time the service providers get to work on more interesting projects, and overall get more work because the BAS is constantly providing optimisation opportunities in the building."

Duncan says collaboration and engagement from everyone involved in the operation of a building is critical to successful optimisation. The BMS is no exception.

"You need to ask yourself these questions," he says. "Am I engaged with and do I have the support of someone who will help me if things go wrong? What BMS product is being used in the building? Where can I get training and support to learn about this product before diving in?"

THE INQUISITIVE MIND

The common goal of all stakeholders managing and maintaining a building should be to make the building better. And the best way of achieving that is for everyone to work together while learning from each other.

"Arrange your maintenance day onsite to coincide with that of the BAS technician," Duncan advises. "I come from an HVAC trade background, and I remember when I first made the transition to BAS, I thought it was all very easy. But once I started digging in, I realised there is an endless world of technology behind the screen that takes a journey of continuous learning to understand and keep up with.

"So, start slow, connect with the right people and keep asking questions." ■

REMOTE ACCESS

Network communications can be extended beyond the boundary of the physical BMS via an internet connection to allow for remote monitoring and control functionality.

Web-based systems behave like a website and serve pages of information that can be accessed by a standard web browser, while non-web-based systems use proprietary software to provide remote access. ■

RESPECT THE TECH

Despite the advances in technology, and opportunities that BMS systems afford, they can be a minefield for HVAC technicians who are under-trained or ill prepared to work with them.

So, what do you need to be aware of before plugging in?

"It begins with respecting the local BMS contractor and the intrinsic knowledge they have of the system," says Jeremy Cooke from Logical Building Automation.

"Work closely with the BMS contractor and building manager to establish processes that may involve the ability to temporarily disable alarms while working on equipment. Or take equipment out of sequence that need servicing – via the BMS and not the local isolator – to avoid unnecessary nuisance alarms."

Technicians should also recognise that there are many connected parts to a BMS, and much time and effort goes into the configuration and programming of these systems.

"There are sometimes misperceptions out there that BMS systems are 'plug and play' or simply an interchangeable commodity," says Cooke. "But these systems are only becoming more complex and crossing further over into the IT and software-development world." ■

TOP 10 THINGS TO KNOW ABOUT A BMS

1. Respect that a whole lot of thought, time and effort has gone into the BMS in the project phase. What you determine that the system is doing from a quick screenshot may not necessarily be the whole picture.
2. Understand what "open protocol" actually means and what role BACnet plays in that. It is an important step to understanding a BMS.
3. Read the functional description for the BMS, and be aware of any pre-conceived ideas on how things should operate.
4. Everything is easy once you know it. Make the effort to get to know your BMS provider and learn some of the key fundamentals of the BMS so that everything you do on a daily basis will become a lot easier.
5. A BMS is not a mysterious black box – but it can be incredibly technical and fidgety.
6. The BMS should be your first point of call, and is your best tool for fault finding and optimisation of HVAC equipment.
7. BMS fault finding needs a methodical approach – and patience.
8. The BMS technology will never take your job. But if you learn how to use it to your advantage it will make your job easier, the building will perform better, and you will get some of the credit for it.
9. The BMS industry is ever-evolving and exciting to be in.
10. A BMS product that can be purchased and installed by more than one provider is critical to ensuring ongoing quality service. ■